Ganesh Thapa · Anjani Kumar · P. K. Joshi
Editors

Agricultural Transformation in Nepal

Trends, Prospects, and Policy Options

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ISBN 978-981-32-9647-3 ISBN 978-981-32-9648-0 (eBook)
https://doi.org/10.1007/978-981-32-9648-0

This Springer imprint is published by the registered company Springer Nature Singapore Pte Ltd.
The registered company address is: 152 Beach Road, #21-01/04 Gateway East, Singapore 189721, Singapore

Foreword

Agriculture is a vital sector of Nepal's economy for the achievement of goals related to food security, employment generation and poverty reduction. However, this sector's performance during the last two and half decades, as measured by the growth in total factor productivity, has lagged behind that of its South Asian neighbours. At the same time, as in other developing countries, the demand for food, particularly high-value food commodities, has increased due to rising incomes, urbanization and diet diversification. As domestic food production has not kept pace with rising food demand, the country has turned into a net importer of food, both staples and high-value commodities.

The decade-long armed conflict and a long political transition that followed had an enormous adverse effect on the agriculture sector in Nepal. The promulgation of new constitution and completion of elections have provided much-needed political stability that is crucial for development. However, the agriculture sector faces a number of challenges, some of which are structural while others are new challenges. Farmers, particularly smallholders, have poor access to technology, inputs and credit. The second challenge is to enhance the participation of smallholders in the production of high-value commodities. They are constrained by high transaction costs, low capacity to bear risk and low access to inputs and information. An emerging challenge is the potential impact of climate change on smallholders, who are the most vulnerable to floods, droughts and other extreme events.

Despite these challenges, several new opportunities have opened up, which can help in boosting agricultural production and productivity sustainably and in ensuring the inclusion of smallholders in the production of high-value agricultural products. As a result of rising demand for high-value commodities, farmers' income enhancement opportunities have grown significantly. Remittance flows to rural areas have increased significantly in recent years due to high level of migration from rural areas to other countries. Available evidence shows a positive impact of remittances on agricultural development and rural livelihoods. However, only a small proportion of remittance flow is currently invested in agriculture and rural development. Therefore, potentials exist to significantly increase the use of this resource for investment in agriculture and other rural enterprises.

Many technological and institutional innovations are now available for agricultural productivity enhancement and to help smallholders benefit from high-value agriculture and adapt to the effects of climate change. These include mechanical technologies, climate-smart agricultural technologies and information and communication technologies.

Although there has been scattered research on the various dimensions of the challenges and opportunities in the agriculture sector, it is generally felt that there is a lack of comprehensive and analytical research, which can provide evidence-based policy directions to the government and other stakeholders to formulate and implement appropriate policies, programmes and projects. This book tries to fill that gap.

This book covers topics related to macro-issues affecting agriculture, agricultural productivity growth, agricultural diversification, trade and marketing and institutions and governance. Some chapters of this book present the findings of research carried out under the Policy Reform Initiative Project for Agricultural Development and Food Security in Nepal, funded by USAID and implemented by IFPRI in collaboration with Nepal's Ministry of Agricultural Development between 2014 and 2019. Some others were sponsored by IFPRI for the purpose of this book, whereas a few chapters were the work of individual research by the authors.

The chapters included in this book try to analyse the important issues and provide answers to questions surrounding new developments and emerging challenges in Nepal's agriculture sector. Based on such analyses, they provide policy options for the government and other stakeholders to formulate and implement new policies, programmes and projects for the development of the sector. I would like to congratulate the editors for their hard work in bringing out this work. I am confident that this book will stimulate discussions among various stakeholders and will contribute to evidence-based policy-making.

November 2019

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Secretary
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Acknowledgements

This book is an outcome of the efforts of several colleagues from National Systems and international organizations, along with various policy-makers. We greatly acknowledge the support of donors that include USAID and IFPRI. This work was also undertaken as part of the CGIAR Research Programme on Policies, Institutions and Markets (PIM). The opinions expressed here belong to the authors and do not necessarily reflect those of USAID, IFPRI or PIM. We would like to thank the government departments and ministries and the academicians from national institutions who provided the intellectual inputs that shaped this book and added value in many ways.

We profusely thank the authors for their excellent contributions and timely compliance with several deadlines. We express our sincere gratitude to Shri Madhab Karkee, who contributed immensely from conceptualization of themes, identification and coordination with the authors. The coverage of different themes on agricultural development in Nepal requires a spectrum of expert knowledge and policy discourse. We hope that this book will contribute to add value in Nepal's growth trajectory.

Last but not least, we are grateful to Ms. Nupoor Singh and her team for their meticulous efforts in bringing out this book.

Contents

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About the Editors

Dr. Ganesh Thapa worked for the International Fund for Agricultural Development (IFAD) from March 1998 to April 2014 as the Regional Economist for Asia and the Pacific region and as the Country Programme Manager for North Korea. He is currently a Visiting Scientist at the International Centre for Integrated Mountain Development (ICIMOD). He holds a Ph.D. in Agricultural Economics from Cornell University, USA, and degrees from the University of the Philippines and G.B. Pant University of Agriculture and Technology, India. As the Regional Economist, he led IFAD's work on policy analysis and strategy formulation for agricultural development and rural poverty reduction in Asia and the Pacific region. Prior to joining IFAD, he worked as the Country Director for Winrock International in Nepal and led a project on policy analysis in agriculture and natural resource management. He has also worked as a Senior Economist for the Ministry of Agriculture, Nepal. He has conducted research and published books and articles on such topics as risks, vulnerability, and poverty reduction; sustainability of micro-finance; indigenous peoples and poverty reduction; effects of new agricultural technologies on income distribution; constraints on agricultural marketing; and food security and environmental policies.

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Abbreviations and Acronyms

ACIAR	Australian Centre for International Agricultural Research
ADB	Asian Development Bank
ADBN	Agricultural Development Bank of Nepal
ADF	Augmented Dickey–Fuller (test)
ADS	Agricultural Development Strategy
AFND	Academic Foundation, New Delhi
AGDP	Agricultural gross domestic product
AIAT	Assessment Institute for Agricultural Technology (Indonesia)
AIC	Agriculture Inputs Corporation
APP	Agricultural Perspective Plan
APROSC	Agricultural Projects Service Centre
ATF	Agreement on Trade Facilitation (WTO)
BRICS	Brazil, Russia, India, China and South Africa
BS	Bikram Sambat (Nepali year)
CIF	Cost, Insurance and Freight
CADP	Commercial Agriculture Development Project
CAESC	Community-based Agricultural Extension Service Center
CAGR	Compound annual growth rate
CARP	Comprehensive Agrarian Reform Programme
CBM	Community-based Biodiversity Management
CBOs	Community-based organizations
CBS	Central Bureau of Statistics
CBSP	Community-based seed production
CDD	Crop Development Directorate
CEAPRED	Center for Environmental and Agricultural Policy Research, Extension and Development
CFUG	Community Forestry Users' Group
CGIAR	Consultative Group on International Agricultural Research
CMS	Consolidated Management Services Nepal
CoO	Country of origin

CPI	Consumer price index
CPI-IW	Consumer Price Index for Industrial Workers (India)
CPN	Communist Party of Nepal
CSAM	Center for Sustainable Agricultural Mechanization
CSB	Community seed bank
CSRC	Community Self-Reliance Centre
CTEVT	Council for Technical Education and Vocational Training
CTH	Change in tariff heading
DADO	District Agricultural Development Office
DADOs	District Agricultural Development Officers
DAFF	Department of Agriculture, Forestry and Fisheries (South Africa)
DANIDA	Danish International Development Agency
DAP	Diammonium phosphate
DCGE	Dynamic computable general equilibrium
DDC	Dairy Development Corporation
DDCs	District Development Committees
DFID	Department for International Development
DFRS	Department of Forest Research and Survey
DISSPRO	District Seed Self-Sufficiency Program
DLOs	District livestock officers
DOA	Department of Agriculture
DOI	Department of Irrigation
DoLIA	Department of Land Information and Archive
DOLIDAR	Department of Local Infrastructure Development and Agricultural Roads
DUS	Distinct Uniform and Stability
EAs	Enumeration areas
ECM	Error correction model
EFDB	Emission Factor Database
EU	European Union
FOB	Free on board
FAO	Food and Agriculture Organisation
FDI	Foreign direct investment
FNCCI	Federation of Nepalese Chambers of Commerce and Industry
FORWARD	Forum for Rural Welfare and Agricultural Reform for Development
FY	Fiscal year
GDP	Gross domestic product
GHG	Greenhouse gas
GLOF	Glacial lake outburst flood
GNDI	Gross National Disposable Income
GNP	Gross national product
GoI	Government of India
GoN	Government of Nepal
GTZ	German Agency for Technical Cooperation
Ha	Hectare

HM	Hills/mountains
HS	Harmonized system
HVAP	High-Value Agriculture Project
HYVs	High-yielding varieties
I/NGOs	International non-government organization(s)
IAARD	Indonesian Agency for Agricultural Research and Development (Indonesia)
ICAR	Indian Council for Agricultural Research (India)
ICBT	Informal cross-border trade
ICIMOD	International Center for Integrated Mountain Development
IDS	Integrated Development Study
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
IGC	Intergovernmental Committee (SAFTA)
IGSC	Intergovernmental Sub-committee (SAFTA)
Interim APP	Nepal Interim Agriculture Perspective Plan
IPCC	Intergovernmental Panel on Climate Change
IPNS	Integrated plant nutrient management system
IPs	Indigenous peoples
IRRI	International Rice Research Institute
ITP	Indicative Trade Potential
JICA	Japan International Cooperation Agency
JMA	John Mellor Associates
KUBK	*Kisankalagi Unnat Biu-Bijan Karyakaram*
KVKs	Krishi Vigyan Kendras (India)
LAPA	Local Adaptation Plan of Action
LDC	Least developed country
LFUG	Leasehold Forest Users' Group
LI-BIRD	Local Initiatives for Biodiversity, Research and Development
LRSC	Land Reform Saving Corporation
LSGA	Local Self-Governance Act
LULCF	Land use and land use change and forestry
MARDI	Malaysian Agricultural Research and Development Institute (Malaysia)
MECs	Members of the Executive Council (South Africa)
MFSC	Ministry of Forest and Soil Conservation
MI	Ministry of Industry
MINMECs	Ministers and Members of Provincial Executive Committees (South Africa)
MOLRM	Ministry of Land Reform and Management
MOAC	Ministry of Agriculture and Cooperatives
MoAD	Ministry of Agricultural Development
MoCPA	Ministry of Co-operatives and Poverty Alleviation
MoCS	Ministry of Commerce and Supplies
MoED	Ministry of Agricultural Development

MoE	Ministry of Energy
MOE	Ministry of Environment
MoFALD	Ministry of Federal Affairs and Local Development
MOF	Ministry of Finance
MoFSC	Ministry of Forestry and Soil Conservation
MoGA	Ministry of General Administration
MoHA	Ministry of Home Affairs
MoI	Ministry of Irrigation
MoLD	Ministry of Livestock Development
MOP	Muriate of potash
MOSTE	Ministry of Science, Technology and Environment
MRAs	Mutual Recognition Agreements
Mt	Metric ton
MoUD	Ministry of Urban Development
MVs	Modern varieties
NA	Not available
NAMC	National Agricultural Mechanization Committee
NAPA	National Adaptation Program of Action
NARC	Nepal Agricultural Research Council
NARES	National Agriculture Research and Extension System
NARI	National Agricultural Research Institute
NARMA	Centre for Natural Resources Management, Analysis, Training and Policy Research
NASPR	Nepal Agriculture Sector Performance Review
NASRI	National Animal Science Research Institute
NAST	Nepal Academy of Science and Technology
NBSAP	National Biodiversity Strategy and Action Plan
NDDB	Nepal Dairy Development Board
Nepal-SIMI	Nepal Smallholder Irrigation Market Initiative
NFP	National Fertilizer Policy
NGA	Non-governmental agency
NGOs	Non-government organizations
NLSS	Nepal Living Standard Survey
NMMSS	National Milk Marketing and Strategy Study
NOM	Non-originating material
NPC	National Planning Commission
NRB	Nepal Rastra Bank
NSB	National Seed Board
NSC	National Seed Company
NTB	Non-tariff barrier
NTIS	Nepal Trade Integration Strategy
NTM	Non-tariff measure
OPV	Open-pollinated variety
p.a.	Per annum
PACT	Project for Agriculture Commercialization and Trade

PDA	Provincial Department of Agriculture (South Africa)
PEMANDU	Performance Management and Delivery Unit (Malaysia)
PMAMP	Prime Minister's Agriculture Modernization Project
PPP	Public–private partnership
PSC	Public Service Commission
PSM	Propensity score matching
PTM	Para-tariff measure
PVP	Plant Variety Protection
PVS	Participatory varietal selection
R&D	Research and development
RCA	Revealed comparative advantage
RFID	Radio frequency identification device
RISMFP	Raising Incomes of Small and Medium Farmers' Project
RoO	Rules of origin
RoW	Rest of the world
RSTL	Regional Seed Testing Laboratory
SAARC	South Asian Association for Regional Cooperation
SAFTA	South Asian Free Trade Area
SALGA	South African Local Governance Association (South Africa)
SARSO	South Asian Regional Standards Organization
SDC	Swiss Agency for Development and Cooperation
SINA	Statistical Information on Nepalese Agriculture
SL	Sensitive list
SNV	SNV Netherlands Development Organisation
SPS	Sanitary and phytosanitary (WTO)
SQCC	Seed Quality Control Centre
SRR	Seed Replacement Rate
TBTs	Technical barriers to trade (WTO)
TCI	Trade complementarity index
TEPC	Trade and Export Promotion Centre (Nepal)
TFP	Total factor productivity
TLP	Tariff liberalization programme (SAFTA)
TU	Tribhuvan University
UHT	Ultra-heat treated
UK	United Kingdom
UNDP	United Nations Development Programme
UNIDO	United Nations Industrial Development Organization
USA	United States of America
USAID	United States Agency for International Development
USD	United States Dollar
VVDP	Value Chain Development Programme
VAT	Value-added tax
VC	Value chain
VCA	Value chain analysis
VDC	Village Development Committee

WFP	World Food Programme
WPI	Wholesale price index
WTO	World Trade Organization

List of Figures

Chapter 2

Chapter 4

Chapter 5

Chapter 8

Chapter 9

List of Tables

Chapter 5

Chapter 6

Chapter 7

Chapter 8

Chapter 9

Chapter 10

Chapter 11

Chapter 12

Chapter 13

Chapter 14

Chapter 15

Chapter 16

Chapter 17

Chapter 18

Chapter 19

List of Charts

Chapter 12

List of Boxes

Chapter 1
Introduction

Ganesh Thapa, Anjani Kumar and P. K. Joshi

Abstract The first chapter highlights the pertinent issues and briefly narrates the salient features of the different chapters of the proposed book. It also provides proposed structure of the book.

1 Introduction

Agriculture in Nepal is still the largest sector of the economy. It contributes 32% of the value added and accounts for 64% of employment (CBS 2015). Therefore, growth in this sector's productivity is critical to enhancing aggregate productivity. Agriculture also plays an important role in poverty reduction in the country. Most of the poverty reduction between fiscal year (FY) 2004 and FY 2011 occurred in rural areas and rising agricultural incomes contributed significantly to this (World Bank 2013). A decomposition of total income growth shows that farm income and agricultural wages had the fastest growth (24.4%) followed by remittances (23%), non-agricultural wages (23%), and enterprise income (18%).

However, the performance of agriculture sector in Nepal since 1995 has been poor. The growth of agricultural gross domestic product (AGDP) between 1995 and 2010 has only been about 3% per year, slower than in the neighboring countries such as China (4.1%), Bangladesh (3.6%), and Pakistan (3.7%) (MoAD 2014). Cereals, which cover most of the cultivated land in the country, have lower yields in Nepal (2748 kg per ha in 2014) than in neighboring countries—China (5886 kg/ha),

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G. Thapa et al. (eds.), *Agricultural Transformation in Nepal*,
https://doi.org/10.1007/978-981-32-9648-0_1

Bangladesh (4618 kg/ha), Bhutan (3130 kg/ha), and India (2984 kg/ha) (FAOSTAT 2017). As a result, much of the increase in agricultural incomes between 2004 and 2011 has come from gains in prices and not yields (World Bank 2013). More specifically, of the total increase in crop income of 21% between 2004 and 2011, yields contributed only about five percentage points, while about 18% points was due to increased food prices, and land contraction decreased crop income by about two percentage points.

In Nepal, the total factor productivity (TFP) growth rate for the period 1981–2013 was only 0.06% per year, which is the lowest in South Asia region (Anik et al. 2017). More importantly, the TFP growth rate has declined over time: 2.29% during 1981–90, 0.25% during 1991–2000, and 1.11% during 2001–13. The main factor for low agricultural productivity growth has been the low level of technical change and technical efficiency, mainly in the Tarai region which is the granary of the country (World Bank 2017).

Over time, Nepal's agriculture has become less competitive both in domestic and export markets. From being a net food exporter, Nepal is increasingly becoming a net food importer, both of staples such as rice, potatoes, and maize and of high-value foods like vegetables and fruits. Cereal imports increased dramatically during 2009–2013, with trend growth rates of 39% per annum for rice, 26% per annum for maize, and 126% per annum for wheat (Sharma 2019). During this period, imports of fruits and vegetables doubled.

Several studies have analyzed the factors behind low growth in agricultural productivity in Nepal in the past two decades (e.g., MoAD 2014; World Bank 2017). The 12-year armed conflict between 1996 and 2006 had adverse effects on the agriculture sector. Large-scale movements of rural people to urban areas and other countries due to the conflict led to agricultural labor scarcity leading to land abandonment in any areas. The flight of landowners from rural areas resulted in reduced investment and economic activities. The conflict also led to difficulties in accessing rural areas, particularly in remote locations for development projects. After the end of the conflict, the country embarked on a decade-long process of drafting a new constitution. Political instability during the post-conflict period has led to unstable governments and poor implementation of policies, plans, and programs. Several agricultural policies were formulated following the implementation of the Agricultural Perspective Plan in 1996. However, the implementation of such policies has been ineffective due to the lack of supporting legislation and resources for implementation. Institutional capacity including human resources has also been inadequate for effective implementation of projects and programs.

Both public and private investments in the agriculture sector have been limited in the last two decades. Between 2000 and 2007, average share of agriculture in total government budget has been around five percent (Sawtee 2015). From 2009, there has been an increasing trend of agriculture sector budget reaching an average of about 12% between 2011 and 2013. Donor assistance to the agriculture sector has averaged US$45.5 million per year between 2010/11 and 2015/16, and this constitutes less than five percent of the total official development assistance to the country. There has been limited private sector investment in agriculture, partly because of an unstable political environment and partly because of risk and the lack of a conducive environment for investment. Collateral requirement has been a major factor dampening private investment in agriculture.

Nepal's agriculture sector is now facing new sets of challenges. Several studies have shown adverse effects of climate change on the agriculture sector and the livelihoods of farmers. Rainfall patterns have become erratic, and a decreasing annual trend has been noted during the critical agricultural period of June–August. Shifts in precipitation patterns, longer droughts, more severe floods, and deficits in the recharge of groundwater are major factors affecting farming. Smallholder farmers will be the most vulnerable to the predicted impacts of climate change, as they tend to own fewer assets including land and livestock and have lower levels of education and lower access to community and government services.

In September 2015, Nepal adopted a new constitution, which is designed to transform the country into a federal, democratic, republican country. The new constitution has two important implications for the governance of the agriculture sector. First, the authority and autonomy for various agricultural and livestock activities will be devolved from the center to the seven anticipated provincial governments and newly constituted local bodies. Second, those new local bodies will be headed by elected rather than appointed executives, who will be able to set their own policy priorities. However, it is not clear how authority will be devolved and over which domains, as agriculture is listed as a concurrent function across all tiers of government in the constitution.

Nepal is experiencing rapid urbanization, which is leading to the conversion of large tracts peri-urban agricultural land to residential uses. This process is projected to accelerate, which will pose a significant challenge for food production. As indicated earlier, large-scale migration of rural youth abroad is leading to agricultural labor shortages and land abandonment, which will also have an adverse effect on agricultural production.

New opportunities are also emerging for the agriculture sector. Recent studies have shown that in recent years, there has been a shift in food consumption patterns toward high-value commodities like fruits, vegetables, milk, meat, fish, and eggs. This trend is attributed to factors like increasing incomes, urbanization, health consciousness, and changing occupation profile. This dietary diversity is leading to positive and significant impact on nutrition outcomes. Rising demand for high-value commodities is also presenting income-enhancing opportunities for farmers, including smallholders.

Several studies have demonstrated that financial and social remittances earned by migrants from rural areas have contributed positively to agricultural development and rural livelihoods in Nepal. Such remittances have helped in financing new technologies, as migrant households tend to be open to innovative ideas as a result of the migration experience. Remittances have also helped farmers transform from subsistence farming to cash crops, as remittances act as a co-insurance against the risks of such a transition. There is a huge potential to channel remittances for agricultural and rural development in Nepal, as only a small fraction of remittance flow is currently invested in agriculture.

Nepal's long political transition following the decade-long armed conflict is finally coming to an end with the gradual implementation of the new constitution, including the recent local level elections after nearly two decades. Anticipated political stability will present enormous opportunities for higher investment in the agriculture sector, both from public and private sectors. There are already encouraging signs in public sector investment in agriculture. Agriculture's share in national budget has remained higher than 10% of the total since 2011 compared to an average of about 5% during the conflict years. Potentials exist to attract foreign direct investment in agriculture, particularly in developing high-value chains and food industries.

This book presents policy options for the future of Nepal's agriculture. It is forward-looking and addresses the key strategic questions in the context of major new developments and emerging challenges in Nepal. Some of the strategic questions addressed by this book include:

(i) How does the role of agriculture change with economic growth and structural transformation?
(ii) How is the current investment level constraining the growth of agriculture sector?
(iii) What role can agriculture play in reducing poverty in the country?
(iv) How to ensure improved nutrition outcome through improved agricultural productivity and sustainable food imports?
(v) What impacts will climate change have on agriculture and what mitigation and adaptation measures can be taken to address these effects?
(vi) What policy measures can be taken to improve the delivery of critical production inputs (seeds, fertilizer, etc.) and services (credit, insurance services, etc.) to farmers?
(vii) How to ensure the participation of smallholders in high-value chains?
(viii) How can the increasing remittance flow into the country be invested in the agriculture sector?
(ix) How to achieve a more balanced agricultural trade for sustainable food security?
(x) How to enhance the access of the landless, marginal farmers, women, and indigenous peoples to land and associated infrastructure and support services?
(xi) What impacts will the new federal system and governance structure have on the delivery of agricultural technology and services?

The book is a rich source of analytical information on various aspects of agricultural development in Nepal. It covers a wide range of issues and provides policy options for the government and other stakeholders to address emerging challenges and to benefit from new opportunities. It is hoped that this book would be useful to policy makers, development partners, civil society, graduate students, and those interested in Nepal's economic and agricultural development.

2 Structure of the Book

The book is divided into five parts. Part I discusses the macro-issues in the agriculture sector. Chapter 2 analyzes the pattern of structural transformation in the Nepalese economy, its implications for the agriculture sector and provides policy directions for the future. Chapter 3 examines whether the accelerated growth of agriculture through agricultural expenditures, official development assistance, or investment makes a difference in reducing poverty in the country. It also identifies policy measures to significantly increase agricultural productivity growth and poverty reduction. Chapter 4 tries to understand Nepal's dynamics of food and nutrition security in terms of availability, accessibility, and absorption. It examines the progress in food supply in terms of availability at the national level, access to food and nutrition requirements at the household level, and drivers of dietary diversity and its implications for nutrition security. Chapter 5 presents an overview of the long-term trends in food and non-food inflation and estimates the relative contributions of various food products to overall food inflation. It also analyzes the linkages between food prices in Nepal and India and provides options to manage inflation within a range desired by policy makers. Climate change is projected to have far-reaching impacts on agricultural productivity and rural livelihoods in Nepal. Chapter 6 assesses the impact of climate change on agricultural production, food security, livelihoods, and economy. It reviews the ongoing and planned policies, plans, programs, and projects to respond to the impacts of climate change. It also identifies policy responses, and technology needs to help smallholders adapt to the climate change impacts.

Part II of the book focuses on agricultural productivity growth and its main drivers. Chapter 7 analyzes the long-term trends in food consumption and nutrient intake of households in the country, makes food demand projections based on predicted dietary patterns, makes food supply projections under different scenarios, and estimates food balance scenarios. Chapter 8 analyzes the key issues and constraints in the seed sector in Nepal, which represents one of the most important inputs for agricultural productivity growth. It analyzes the options and opportunities for improvements in the seed sector and identifies policy recommendations for this sector's development. Chapter 9 presents relevant empirical evidence to improve the understanding of issues related to the uses of chemical fertilizers, another important production input for agricultural productivity growth. It analyzes the trends of fertilizer use and prices in the country and their distribution across regions and crops and discusses the key emerging patterns of fertilizer use growth and their returns. It then summarizes the policy implications of these use patterns. Chapter 10 assesses the overall trends of mechanization in Nepal, identifies the determinants of its adoption, and assesses their impacts on household incomes and agricultural productivity. It mainly focuses on key agricultural machineries—tractors, threshers, and pumps—which all have generally substantive transformational effects compared to more traditional tools. The chapter also identifies policy implications for the adoption of mechanization by smallholders. Chapter 11 discusses the characteristics of agricultural research and extension system in Nepal, main challenges, and recent developments, which will have implications for future research and extension programs. It also identifies policy recommendations for reforms in agricultural research and extension system.

Part III of the book explores diversification in the agricultural and non-agricultural sectors by farmers and other rural people for livelihood improvement. Chapter 12 discusses diversification within the agriculture sector between 1995 and 2011, which highlights the expansion in the production of high-value agricultural products such as fruits, vegetables, livestock and fisheries' sub-sectors at the expense of cereal crops such as rice, maize, and wheat. It analyzes the main drivers of agricultural diversification, constraints to and opportunities for diversification, and identifies policy recommendations for faster pace of agricultural diversification. Chapter 13 discusses the importance of the non-timber forest produce, medicinal and aromatic plants, and agro-forestry products sub-sectors in the Nepalese economy as well as for rural livelihoods and reviews the policy, legal, and regulatory framework for the development of these sub-sectors. It assesses the constraints faced by these sub-sectors as well as opportunities for their development. It then provides policy recommendations to address the challenges. Chapter 14 reviews the impact of migration and remittances on crop yields, labor use in agriculture, land use, as well as macro-level impacts (impact on tradeables and non-tradeables, grain imports, etc.). It also makes policy recommendations for the use of remittances for productive investment in agriculture, particularly food production.

Part IV of the book deals with agricultural trade and marketing issues. Chapter 15 analyzes the trends and structure of agricultural trade in general and with India in particular and discusses the drivers of recent trends in agricultural trade. It presents the results of Nepal's trade competitiveness and export potential based on trade data and recommends a number of measures to respond to trade-related issues. Chapter 16 reviews the existing government policies and programs on high-value chain development and, by using a case study, demonstrates how value chains can benefit different stakeholders of agri-food systems. It then draws policy implications and recommendations on areas of immediate focus and further research.

Part V of the book focuses on institutions and governance issues, which are vital for agricultural development. Chapter 17 analyzes the main issues related to access to land and poverty, land ownership distribution, access to land for women and the indigenous peoples, landlessness and lack of viable landholdings, land rentals, tenancy rights, and fallow land. It reviews existing laws and policies on land and land rights, land reform in the context of smallholder agriculture, and land administration. It also draws lessons for Nepal from the experiences of other countries in land reform. Finally, it makes policy recommendations to enhance the access to the landless and marginal farmers to land and also to improve access to vital infrastructure such as farm roads and irrigation, technical support system, marketing, and land consolidation, which are vital for agricultural productivity enhancement and income increases. Chapter 18 reviews the government policies on agricultural credit and insurance services and assesses their coverage in the country.

It analyzes the issues and opportunities for expanding agricultural credit and insurance services to farmers and rural entrepreneurs and provides policy recommendations to enhance their access to such services in order to develop agriculture as a business. Chapter 19 deals with the implications of Nepal's new constitution, particularly federalism on broad agricultural policy planning as well as on agricultural research and extension. It evaluates how constitutional reforms will shape the three broad issues in governing the agriculture sector—authority, autonomy, and accountability. Using comparative cases, it offers policy options relevant to these three aspects of governance. This chapter also draws lessons for Nepal from the experiences of other countries such as Indonesia, Kenya, Malaysia, and South Africa.

In the concluding chapter, the editors summarize and synthesize major findings of various chapters of the book and develop a policy agenda for addressing the many challenges faced by the agriculture sector in Nepal and for making this sector more productive, competitive, sustainable, and inclusive.

References

Anik, R. A., Rahman, S., & Sarkar, J. R. (2017). Agricultural productivity growth and the role of capital in South Asia (1980–2013). *Sustainability*, *9*, 470. www.mdpi.com/journal/sustainability. https://doi.org/10.3390/su9030470.

Central Bureau of Statistics (CBS), Nepal. (2015). Nepal in Figures 2015. Kathmandu: CBS.

FAOSTAT. (2017). Statistics division, food and agriculture organization of the United Nations. http://www.fao.org/faostat/en/#data.

Ministry of Agricultural Development (MoAD), Nepal. (2014). Agricultural Development Strategy 2014, Kathmandus.

Sharma, R. (2019). Trends, structure and drivers of Nepal's agricultural trade. In: G. Thapa et al. (Eds.), Agricultural transformation in Nepal. https://doi.org/10.1007/978-981-32-9648-0_15

South Asian Watch on Trade, Economics and Environment (SAWTEE). (2015). Public investment in agriculture—policy issues in South Asia, Policy Brief 32, Kathmandu (www.sawtee.org/publication/Policy-Brief-32.pdf).

World Bank. (2013). Nepal: Poverty diagnostics: 1965–96 to 2010–11, bigger strides in post conflict poverty reduction? Unpublished Manuscript. Washington, D.C.: World Bank.

World Bank. (2017). Nepal country economic memorandum: Climbing higher-toward a middle Nepal, May 2017. Washington, D.C.: World Bank.

Part I
Macro-issues in Agriculture

Chapter 2
Structural Transformation and Growth: Whither Agriculture in Nepal?

Ramesh Paudel and Swarnim Waglé

Abstract This chapter analyses the pattern of structural transformation in the Nepalese economy and its implications for the agriculture sector and provides policy directions for the future. The chapter highlights the critical role of research, extension and infrastructure to ensure sustainable agricultural growth in Nepal. It also throws light on the emerging opportunities and challenges as the country moves towards a federal political system.

Acronyms

BRICS	Brazil, Russia, India, China and South Africa
DCGE	Dynamic computable general equilibrium
GDP	Gross domestic products
TFP	Total factor productivity

1 Context

Nepal's rate of growth remains disappointing despite its considerable potential. Notwithstanding its natural beauty, geographical location between two of the largest and fastest growing economies in the world, a young population, international goodwill, and competitive strength in generating clean hydro-powered energy in an era of climate change. Nepal's real per capita GDP grew, on average, at an anaemic rate of 1.8% per year between 1965 and 2014. Relative to the performance of several Asian countries in the neighbourhood (see Table 1), Nepal has fared dismally, seemingly trapped in chronic poverty.

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G. Thapa et al. (eds.), *Agricultural Transformation in Nepal*,
https://doi.org/10.1007/978-981-32-9648-0_2

Table 1 Nepal's per capita GDP (constant $, 2010), as a share (%) of other countries

	1960	1970	1980	1990	2000	2005	2010	2015
Bangladesh	72	71	81	89	90	84	78	71
Bhutan	–	–	71	45	38	33	27	27
China	141	127	82	49	26	19	13	11
India	84	75	70	64	58	50	43	38
Sri Lanka	–	40	31	30	25	23	21	19
Singapore	8	4	2	2	1	1	1	1
Thailand	47	31	20	14	13	12	12	12
Lao PDR	–	–	–	77	68	59	52	45

Source World Bank (2016)

There has been inadequate investment in the formation of physical and human capital, with returns constrained by its landlocked position as well as poor governance characterised for over 200 years by exploitative political and economic institutions. While the sectoral composition of the economy has undergone major shifts, notably after 1990, growth remains sluggish. This raises the most important policy challenge: How can per capita productivity be enhanced within and across agriculture, industry and services? What ought to be the nature of structural transformation in Nepal so that its full economic possibilities can be realised?

Economists view structural transformation as a process of reallocating resources among different economic sectors that exhibit varying productivity (Herrendorf et al. 2013). This typically involves, over time, a declining contribution of agriculture in gross domestic product (GDP) and total employment. As people move out of agriculture, they inevitably gravitate towards urban areas in search of higher-paying jobs in the "modern" sectors, such as industry and services. Timmer and Akkus (2008) described this pattern of development as one historical pathway to reducing poverty and enhancing social mobility.

The most dramatic fashion in which the world saw this phenomenon in action after the nineteenth century was the Industrial Revolution in the West and the transformation of East Asian economies, notably China, after the late 1970s. As shown by Brandt et al. (2008), China has reallocated hundreds of millions of people from rural agriculture to urban industry and services. Parts of South Asia, and more conspicuously, Latin America and sub-Saharan Africa have not seen anything on a comparable scale. The process of structural transformation is neither automatic nor guaranteed; it has to be pursued on the back of conscious national policies (McMillan and Rodrik 2011).

Through much of history, agriculture has been the most important source of sustenance. With improvements in technology and infrastructure, other modern sectors emerged, from manufacturing to services, which are now increasingly tradable across borders. In terms of value addition agriculture has lagged behind, even if it remains a reliable source of employment in developing countries at levels that have not yet been reached in the more modern sectors. In 1991, agriculture accounted for over 80% of employment and nearly half of GDP in Nepal. Today, over two-thirds of employment is generated by the agriculture sector even though it contributes to only about one-third of the value added in national production.

Globally, Fig. 1 illustrates this structural shift. The share of agriculture in total value added in GDP has declined consistently throughout the world. Each dot represents a country at three different time periods (coloured separately for 1994, 2004 and 2014). As income per capita rises, the share of the non-agriculture sector in GDP tends to grow.

Similarly, Fig. 2 shows the sectoral share of employment in agriculture as per capita incomes rise across a worldwide sample. This shift is predictable as long as agricultural productivity is less than competing opportunities in the industrial and service sectors.

These twentieth-century patterns are likely to undergo a shift in the age of sustainable development when issues such as climate change pose an existential threat. While the agriculture sector generally consumes freshwater in large quantities, sustainable agricultural practices are a bulwark against wanton environmental destruction. Within the industrial sector, the nature of production is changing with production being fragmented and becoming less labour-intensive. However, dependence on fossil fuel persists and industrialisation is often secured at a heavy environmental price.

This chapter presents three main messages. First, Nepal exhibits a peculiar pattern of structural transformation, in which agriculture shrinks, and manufacturing peaks prematurely before declining, a dramatic consequence of policy discontinuity and armed conflict. Second, the move-away from agriculture represents

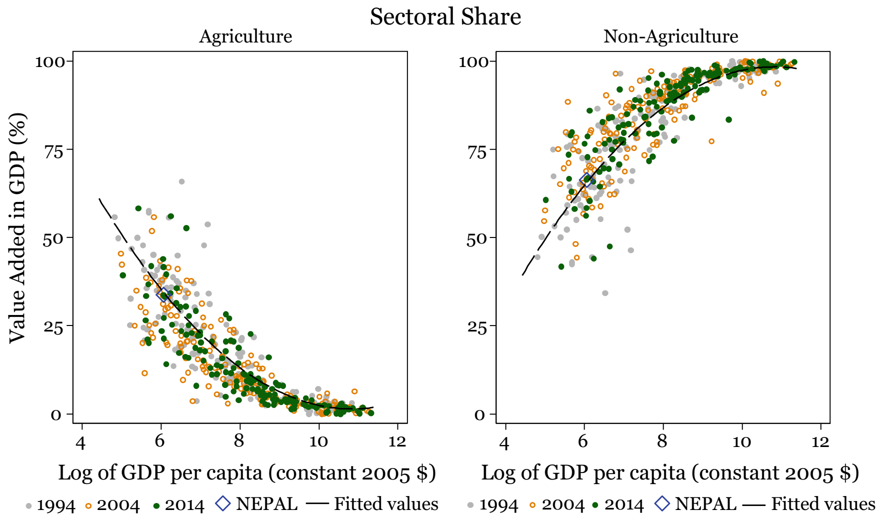

Fig. 1 Sectoral share of value-added and per capita income (worldwide). *Source* World Bank (2016)

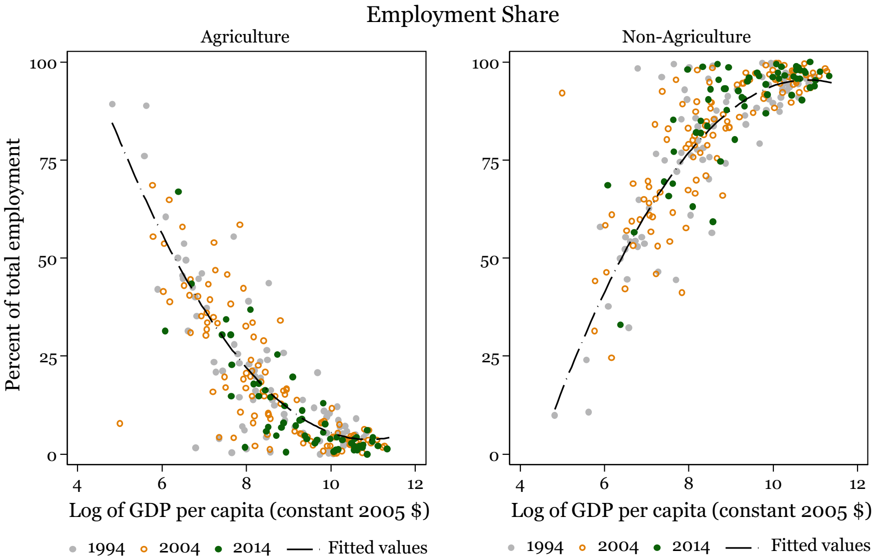

Fig. 2 Sectoral share of employment and per capita income (worldwide). *Source* World Bank (2016)

more of a transient, back-and-forth shift than a lasting transformation towards services which, in turn, comprise of both high- and low-productivity sectors. Third, Nepal's tepid transformation has meant that inequality has not risen, but it might in the future, necessitating continued investments to make agriculture a moderating economic force for equity.

In the subsequent sections, we present selected international evidence within a broad framework of the connection between structural transformation and growth, analyse the process of structural transformation in Nepal, and conclude with some policy directions.

2 Structural Transformation and Growth: Evidence and a Framework

The literature on structural transformation is vast and documents how the pace of structural transformation determines the nature of economic growth across countries. It primarily asks what motivates the reallocation of resources across economic sectors, and how shifts in the share of employment impact the value added of economic activities?

While the literature generally affirms the concept that the process of structural transformation is about shifting labour and other productive resources away from agriculture towards industry, and subsequently into services as the country develops

Table 2 A typology of structural transformation, institutional capabilities and growth

Speed of structural transformation			
		Slow	Fast
Institutional capabilities	Low	Stagnant growth (Africa, Nepal)	Episodic growth (Group of 83)
	High	Slow growth (Latin American countries)	Rapid, sustained growth (East Asian countries)

Note Authors' sketch based on Rodrik (2013) and Hausmann et al. (2004)

(Duarte and Restuccia 2010), this has also been questioned by some. What kind of economic growth this process generates is argued to depend crucially on idiosyncratic country conditions.

Table 2 presents a typology of the links between institutional capabilities and the speed of structural transformation and the quality of economic growth it might produce. Countries with low institutional capabilities and a slow speed of structural transformation end up with stagnant growth, as in the case of sub-Saharan Africa. Nepal, too, would belong to this category. In the main, Latin American countries have middle-income status and have acquired decent institutional capabilities over decades, but the speed of structural transformation has been slow, producing slow growth. This is particularly noticeable in comparison with East Asian countries whose rapid catch-up went hand in hand with the notable transformation of agrarian economies into globally integrated manufacturing powerhouses. Developing countries with less sophisticated institutional capabilities but a move towards faster transformation have seen growth spurts that were not sustained, as documented in Hausmann et al. (2004).

Based on the experiences of Asian economies, Foster and Verspagen (2016) stated that structural transformation largely depends on labour productivity and the rise in incomes. It is not necessary that the agriculture sector needs to lose labour and resources in the process of structural transformation. Additionally, Fagerberg (2000), using a sample of 39 countries covering 24 industries for the period of 1973–1990, points out that mere structural change on average has not been conducive to productivity growth. Those countries, however, which have chosen and managed industries amenable to the adoption of sophisticated technologies, such as electronics, have experienced higher productivity growth than others. Thus, this argument is that productivity of labour, overall, and not necessarily its move across sectors, has caused structural transformation.

Fan et al. (2003), too, concluded that structural change contributes to growth by reallocating resources from low-productivity sectors to high-productivity sectors and while this often implies a move from agriculture to manufacturing, it is neither necessary nor sufficient.

McMillan et al. (2014), taking a regional perspective, stated that structural change in Africa and Latin America since 1990 has, in fact, tended to reduce economic growth, while it has been found to be positive in the context of Asian economies. The authors argue that much of the difference in overall labour productivity growth among the three developing regions is due to different patterns of structural change. In Asia, labour moved from low- to high-productivity sectors; this was just the opposite in Latin America and Africa, with labour drawn towards the natural resource sector, which slowed growth, which was also partly attributable to "Dutch Disease" (n.b. **Dutch disease** is the negative impact on an economy of anything that gives rise to a sharp inflow of foreign currency, such as the discovery of large oil reserves. The currency inflows lead to currency appreciation, making the country's other products less price competitive on the export market).

In the context of Asian countries, rapid growth of income per capita in recent decades can be explained by two schools of thought. The first group argues that "fundamentals", namely, inputs and capital accumulation better explain the growth phenomenon than productivity growth, as discussed in Krugman (1994). The second group posits that Asia's growth was a direct result of factor productivity growth caused by the adoption of imported technology and rapid structural change reflected in growing firm size and areas of specialisation (Nelson and Pack 1999; Romer 1993).

Breisinger et al. (2009) evaluated sources of accelerated growth and structural transformation using a recursive dynamic computable general equilibrium (DCGE) model, focusing on Ghana where manufacturing growth is constrained by its high dependency on agricultural inputs indicating the need for diversification, as the service sector can merely support, rather than drive economy-wide growth. They suggest that agriculture will remain as the key source of growth to lift Ghana to middle income status.

Briones and Felipe (2013) stated that Asia has experienced a slower decline in the share of agriculture in employment compared to other regions. Rapid growth both in labour and land productivity on the one hand, and a shift from agricultural to high-value products, i.e. agriculture-led industrialisation, caused the pace of structural transformation to pick up in the region.

Chen et al. (2011), using a stochastic frontier sectoral production function, described how China's manufacturing sector experienced robust growth as a result of persistent structural reforms initiated since 1978. The paper suggests that the structural change contributed substantially to total factor productivity and output growth, but its rate of contribution fluctuated over time.

Another strand of literature has attempted to establish a causal link between international trade expansion and economic growth in relation to the process of structural transformation. Based on the Chilean experience of 30 years, de Piñeres and Ferrantino (1997) suggested that structural change over the long run diversifies trade. Similarly, Khalafalla and Webb (2001) employed the vector autoregressive analysis using Malaysian quarterly trade and GDP data from 1965 to 1996 to argue that structural change adjusts the source of growth itself and alters the dynamics of export–growth relationship. In this study, primary exports, including agriculture, had a stronger direct impact on economic growth than the impact of manufactures.

The rapid transformation of East Asia has long fascinated development economists, particularly the fact of cheap labour constituting the base of competitive exports which propelled manufacturing productivity. Diao et al. (2006) showed that

Thailand's economic growth, comparable to other neighbours, drew heavily on learning-by-exporting as labour-intensive manufacture forged links with, and vastly expanded domestic backward linkages. The authors use a Ramsey model to explain the structural shifts from agriculture to exportable manufacturing, facilitated by openness. This was also the case in South Korea as found by Uy et al. (2013) in studying the importance of international trade in structural change, having analysed the productivity and trade cost shocks in South Korea, 1971–2005.

Duarte and Restuccia (2010) investigated the role of sectoral labour productivity using an unbalanced panel of 29 countries for the period 1956–2004. They find that productivity difference is large across countries in agriculture and services compared to manufacturing, but these productivity gaps narrow substantially in agriculture, relative to services, over time.

There are some studies focused on North and South American economies. For example, Katz (2000) identified that the "catching up" and "lagging behind" industries during 1970–1996 comparing the cases of Argentina, Brazil, Colombia, Chile and Mexico with those of the USA. This research shows that economic reforms did not result in major discontinuity with the past trend of structural transformation.

After the 1990s, the traditional post-war understanding of structural transformation as a linear process of transforming resources from agriculture to services, via manufacturing, has changed. The approach today is that it is the inherent enhancement of productivity that determines structural transformation. The standard shift-share analysis is inadequate to measure the contribution of sectors to accelerations in productivity, and growth accelerations are explained by productivity increases within sectors, not by reallocation of employment to more productive sectors (Timmer and de Vries 2009). Country experiences vary by income levels as well. Even among the largest developing countries, such as Brazil, Russia, India, China and South Africa (BRICS), evidence is mixed: China, India and Russia benefited from increasing productivity from reallocation of labour sources, but this was not the case in Brazil (de Vries et al. 2012).

3 Structural Transformation of the Nepali Economy

Most countries begin their journey of accelerated structural transformation from a critical juncture in history, triggered by internal or external jolts, such as territorial invasion, economic crisis or the arrival of enlightened leadership. These historical triggers however need favourable initial conditions, from a decent educational base, urbanisation, or strategic opening to external trade and investment. In Nepal, despite hundreds of years of existence, suitable climatic diversity and wide spread awareness about the importance of agriculture, this sector has not yet seen a productivity overhaul.

The problems in Nepali agriculture are well known. The nation continues to rely on rain-fed traditional agriculture, with less than one-fifth of cultivable land irrigatable throughout the year. Public inputs, such as fertilisers, seeds, research and extension services are inadequate. Complementary infrastructure in the form of rural roads and electricity are expanding, but have not reached the levels necessary to support commercialisation and the reaping of scale economies. Financing instruments remain unsophisticated with the reach of concessional credit and insurance still largely confined to urban and peri-urban areas. And not all that is produced enters the market because of post-harvest loss, high cost of entry into the markets, weak managerial skills and the low supply of labour in rural areas due to workers migrating over the past decade.

Part of the challenge is that investments going into agriculture have declined over decades and have shown only a modest uptick in recent years, in contrast to manufacturing which is shrinking in relative terms (Table 3). This is problematic because agriculture and manufacturing remain sectors that can provide gainful employment to the masses. Because they are not expanding and not absorbing young people in large numbers, Nepal has seen migration on an epic scale over the past decade. In 2016, on average, about 40,000 people left the country every month in search of temporary employment opportunities abroad. Furthermore, it is the remittances sent by these workers that have fuelled growth in investment in services. The high growth services subsectors are transportation and communication, followed by education and health.

Figure 3 portrays the status of rural and urban employment in 1995 and 2010 to support the hypothesis of an unusual pattern of structural transformation occurring in Nepal. First, agriculture remains a dominant source of employment in the country: In 2010, around 80% were employed in agriculture in rural areas, and 33% in urban areas. Second, the number of people on regular wages is low in rural areas, at about five per cent; an overwhelming majority being self-employed. Third, a new form of agriculture is actually picking up in urban areas even as it shrinks in rural areas. Self-employed agriculture is, in fact, the largest sector of employment in urban areas. We hypothesise that this could be a result of migrant returnees who do not choose to return to their villages but instead apply their knowledge, exposure and capital to a new vocation, particularly in the Kathmandu Valley and surrounding areas like Kavrepalanchowk, Nuwakot, Dhading and Gorkha.[1]

Figure 4 shows that the sectoral contribution of agriculture in urban employment has dropped from 21.6% in 1995 to 4.9% in 2010. Even in the rural areas during the same period, it decreased by almost 50%. Wage employment in services has also seen a decrease, even though it still accounts for close to half of all wage employment. Further, the share of professional employment has increased

[1]We acknowledge that some of the above findings might be distorted by the fast evolving official classification of which local government units are villages and which are deemed to be municipal. At present, there are 217 municipalities in Nepal of which only 58 existed until 2014. Our data are for 2010. The other 72 were established in May 2014, 61 in December 2014 and 26 in September 2015, respectively.

Table 3 Sectoral investment (per cent of total investment)

Year	Agriculture	Manufacturing	Services
2010	11	12	77
2011	11	11	78
2012	11	11	78
2013	11	10	79
2014	12	9	79
2015	13	6	81

Source Aryal (2016)

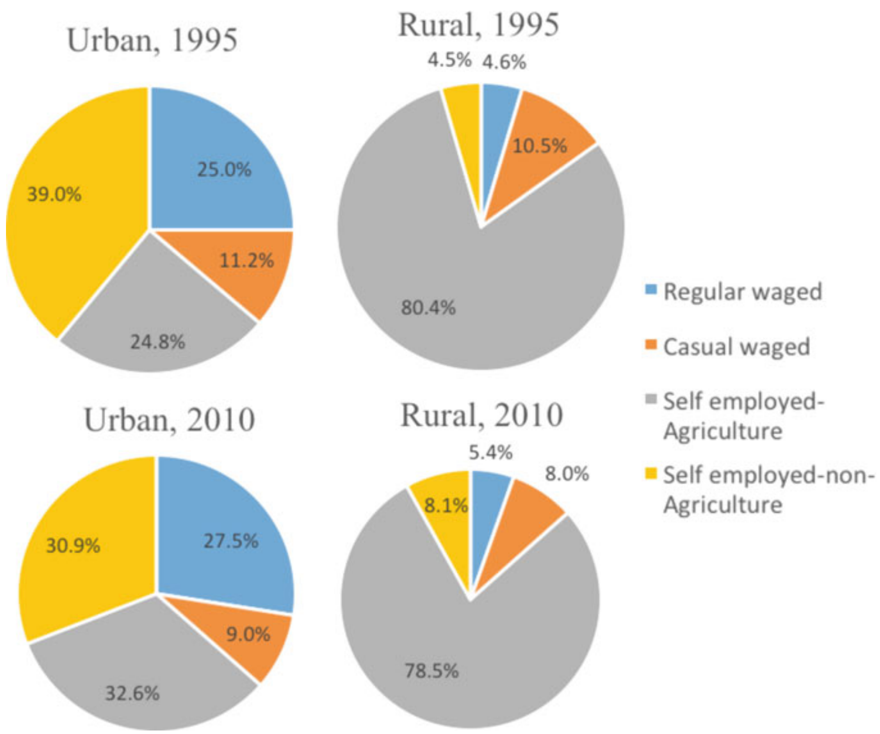

Fig. 3 Forms of rural and urban employment in 1995 and 2010. *Source* Tiwari et al. (2016)

three-fold and employment in manufacturing—in contrast to investment going into the sector—has doubled over the 15 year period. This could indicate a heightened focus on low-productivity, low value-adding modes of production. In rural areas, wage employment in agriculture has declined to about half during this period and much of the displaced labour has shifted to services and construction, where the employment share grew from 8.6 to 20.4%.

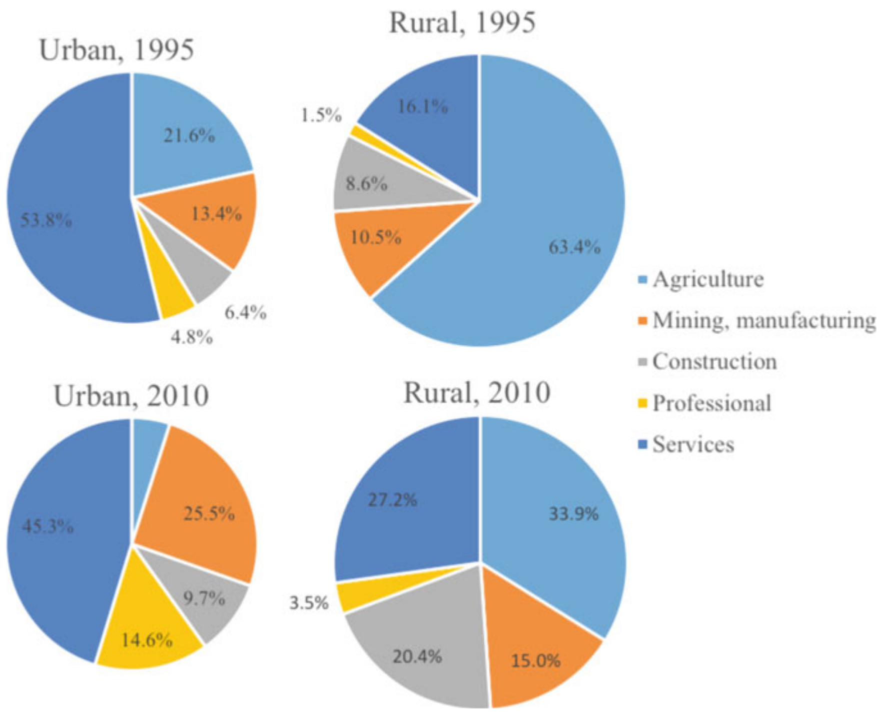

Fig. 4 Composition of employment in rural and urban areas, 1995 and 2010. *Source* Tiwari et al. (2016)

3.1 *Peculiar Pattern of a Mere Shift, Not Transformation*

Based on findings above, Nepal exhibits a peculiar pattern that defies a globally stylised fact. The twentieth-century consensus was that the process of structural transformation involves a "manufacturing hump" as resources move away from agriculture into manufacturing before declining. This has not been the case in Nepal. As can be seen from Fig. 5, the value added from agriculture now is exceeded by the service sector, significantly fuelled by remittances sent by migrant workers who in the absence of foreign employment opportunities might have remained in the subsistence agricultural sector (see Fig. 6).[2] Remittances have buoyed economic activities in the service sector of both varieties: highly efficient and productive subsectors like banking, finance, aviation and telecom, as well as services like wholesale and retail trade, hotels and restaurants characterised by high degrees of informality.

[2]Remittance inflows into Nepal today stand at over 30% of GDP. This trend accelerated after 2001, when armed conflict gripped rural areas and intensified in urban areas, instigating migration of young people to the cities and abroad.

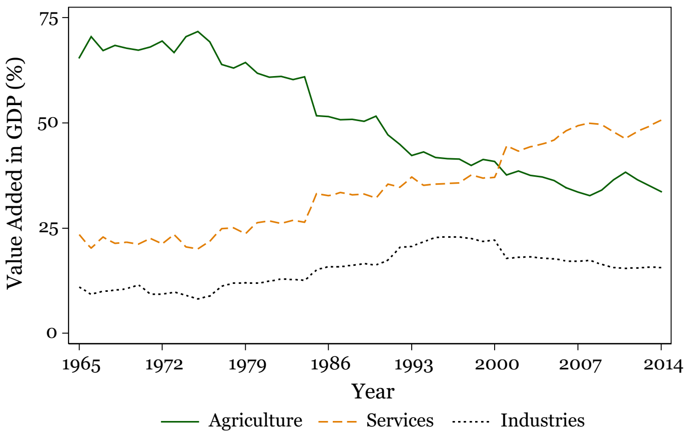

Fig. 5 Sectoral value added, 1965–2014. *Source* World Bank (2016)

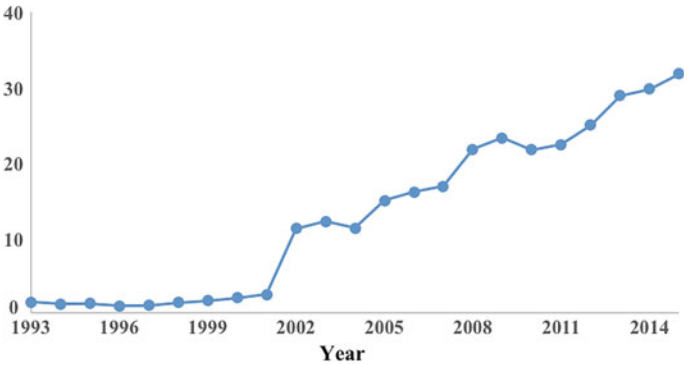

Fig. 6 Remittances as a share of GDP (%). *Source* World Bank (2016)

Changes in the structure of sectoral employment, value added, and output jointly account for the pattern of structural transformation. If we look at the growth of the sectoral value added, all sectors are stagnant, reflecting poor performance in the productivity of the labour force, as shown in Fig. 7. The same cohort of unskilled or semi-skilled workers appear to be moving away from, and into, agriculture, overseas employment, or informal services. A mere shift of resources or value added from one sector to another sector has not translated into better economic performance, and overall output growth has not exceeded five per cent in real terms over the past 20 years.

An area where Nepal's experience mimics that of other Asian countries is in the gradual fragmentation of landholdings. While the prominence of agriculture is declining, the number of farms is increasing and the average farm size is decreasing. This indicates that the rate of exit from agriculture is slow. This implies that the

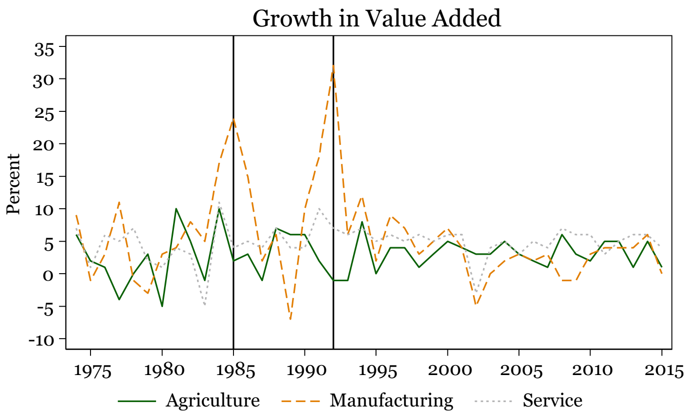

Fig. 7 Growth of sectoral value added, 1974–2015. *Source* World Bank (2016)

productivity gap between the agricultural and non-agricultural sectors and the incomes of farmers and non-farmers are likely to diverge.

Because temporary overseas migration is not a sustainable solution to Nepal's slow growth, the country needs to imagine and implement a range of "exit opportunities" for small farmers and landless workers within the country. The potential for increasing employment in the agriculture sector is mixed. In the cereal sector, the employment elasticity has fallen in recent years due to the adoption of mechanisation and capital-intensive farming, particularly in the Tarai. There are, however, better employment opportunities in the production of high-value products like fruits, vegetables and livestock products. These commodities have seen faster growth in recent years due to increasing demand arising from rising incomes and dietary transition. One important need would be to ensure that smallholders compete and participate in these growing markets. This would require investments in rural infrastructure and technology, improvements in marketing and distribution systems, and support for collective bargaining power of smallholders through land pooling, cooperatives and producers' groups.

Manufacturing did see a spike after economic liberalisation in the early 1990s, only to lose momentum during the period coinciding with political upheavals and armed conflict. As evident in Fig. 7, value-added growth in manufacturing had also seen a spike in the 1980s at a time of heavy state investment in industries and widespread protection from imports. Other than these two periods, growth of value added in manufacturing has remained at an indifferent level since the mid-1960s. Therefore, a tepid transformation process marked by a random shift from one sector to the other has not augured well for Nepal's efforts to expedite economic growth.

Furthermore, against this backdrop of lacklustre growth, Nepal stands out as a country where inequality has not exacerbated. According to Tiwari et al. (2016), the Gini index for consumption for Nepal was 0.33 in 2010–11, which is roughly where it stood in 1995–96. This lies at the lower end of the global sample. While inequality in rural areas has not changed much, it has actually decreased in urban areas.

Nepal's economy, it can therefore be argued, has not even embarked on the process of structural transformation at the pace and intensity which inevitably results in the more productive sectors pulling away from the traditional sectors, worsening inequality. The country is probably placed at around the starting point of the Kuznet's curve, which presents an inverted U-shaped relationship between inequality and stages of development. The traditional dominance of agriculture, and a significant inflow of remittances, in an otherwise stagnant economy can explain this pattern of declining poverty, low inequality and the lack of job-creating growth.

4 Future Directions

It is accepted that agriculture-driven growth is more equitable. In Nepal, where a shift towards manufacturing stalled prematurely, and a greater role for services is problematic as it encompasses both highly productive and less productive sectors, an efficiency overhaul *within* agriculture remains a development priority. Building on the achievements and improving the shortcomings of the Agricultural Perspective Plan (1995–2014), Nepal has just approved another long-term Agricultural Development Strategy (2015–2035). The strategy takes a leap from a piecemeal focus on seeds, fertilisers, irrigation and rural roads to the quality of governance, widespread commercialisation and enhancement of productivity. On this basis, the 14th periodic plan of the Government (2016–2019) also anticipates a substantial increase in the production of cereals, fruits, vegetables and fish.

Given Nepal's handicap of being a landlocked country, its manufactures need to divert from bulk exports dependent on shipping to high-value-to-weight products which can be transported via air transport or through low-cost overland containers. This approach will nudge productivity enhancements in agro-processing industries.

The use of modern technologies to forge national and regional value chains across clusters of specialisation would need a fresh impetus. This can be achieved by incentivising all domestic investment to invest in sustainable agriculture. More crucially, the potential of foreign direct investment, a long neglected source of cross-border capital flow in agriculture, needs to be harnessed. Nepal can curtail the mass migration it faces only by providing opportunities to earn decent wages at home.

The role of the state in investing in public areas such as research, extension services and infrastructure is ever more important. Infrastructural development also has cross-sectoral uses as roads built to connect farms to markets can also be availed of by the tourism industry. Nepal's proximity to hundreds of millions of middle class consumers and tourists in India, China and Southeast Asia also presents a potential for a development windfall.

Going forward, however, there will both be an opportunity and a challenge in governance. As the country moves towards a federal political system agricultural productivity can be expedited by provincial and local governments who take greater ownership of public investments. On the other hand, fragmenting of jurisdictions, in the absence of cooperative federalism, could stunt prospects for attaining economies of scale and securing productivity gains in agriculture.

References

Aryal, S. (2016). *Pattern of Sectoral Investment*. Unpublished data from Central Bureau of Statistics. Kathmandu, Nepal.

Brandt, L., Hsieh, C.-T., & Zhu, X. (2008). Growth and structural transformation in China. In L. Brandt & T. G. Rawski (Eds.), *China's great economic transformation* (pp. 683–728). Cambridge, UK: Cambridge University Press.

Breisinger, C., Diao, X., & Thurlow, J. (2009). Modeling growth options and structural change to reach middle income country status: The case of Ghana. *Economic Modelling, 26*(2), 514–525.

Briones, R., & Felipe, J. (2013). Agriculture and structural transformation in developing Asia: Review and outlook. *Asian Development Bank Economics Working Paper Series,* (363).

Chen, S., Jefferson, G. H., & Zhang, J. (2011). Structural change, productivity growth and industrial transformation in China. *China Economic Review, 22*(1), 133–150.

de Piñeres, S. A. G., & Ferrantino, M. (1997). Export diversification and structural dynamics in the growth process: The case of Chile. *Journal of Development Economics, 52*(2), 375–391.

de Vries, G. J., Erumban, A. A., Timmer, M. P., Voskoboynikov, I., & Wu, H. X. (2012). Deconstructing the BRICs: Structural transformation and aggregate productivity growth. *Journal of Comparative Economics, 40*(2), 211–227. https://doi.org/10.1016/j.jce.2012.02.004.

Diao, X., Rattsø, J., & Stokke, H. E. (2006). Learning by exporting and structural change: A Ramsey growth model of Thailand. *Journal of Policy Modeling, 28*(3), 293–306.

Duarte, M., & Restuccia, D. (2010). The role of the structural transformation in aggregate productivity. *The Quarterly Journal of Economics, 125*(1), 129–173.

Fagerberg, J. (2000). Technological progress, structural change and productivity growth: A comparative study. *Structural Change and Economic Dynamics, 11*(4), 393–411.

Fan, S., Zhang, X., & Robinson, S. (2003). Structural change and economic growth in China. *Review of Development Economics, 7*(3), 360–377.

Foster, N., & Verspagen, B. (2016). The role of structural change in the economic development of Asian economies. *Asian Development Review*.

Hausmann, R., Pritchett, L., Rodrik, D. (2004). *Growth Accelerations (draft)*. Harvard University, USA: John F. Kennedy School of Government.

Herrendorf, B., Rogerson, R., & Valentinyi, Á. (2013). Growth and structural transformation. *NBER Working Paper 18996*.

Katz, J. (2000). Structural change and labor productivity growth in Latin American manufacturing industries 1970–96. *World Development, 28*(9), 1583–1596.

Khalafalla, K. Y., & Webb, A. J. (2001). Export–led growth and structural change: Evidence from Malaysia. *Applied Economics, 33*(13), 1703–1715.

Krugman, P. (1994). Myth of Asia's miracle. *Foreign Affairs, 73*(6), 62–78.

McMillan, M., Rodrik, D., & Verduzco-Gallo, Í. (2014). Globalization, structural change, and productivity growth, with an update on Africa. *World Development, 63,* 11–32. https://doi.org/10.1016/j.worlddev.2013.10.012.

McMillan, M. S., & Rodrik, D. (2011). Globalization, structural change and productivity growth. *NBER Working Paper 17143, National Bureau of Economic Research*.

Nelson, R. R., & Pack, H. (1999). The Asian miracle and modern growth theory. *The Economic Journal, 109*(457), 416–436.
Rodrik, D. (2013). Structural change, fundamentals and growth: An overview. *Institute for Advanced Study*.
Romer, P. (1993). Idea gaps and object gaps in economic development. *Journal of Monetary Economics, 32*(3), 543–573.
Timmer, C. P., & Akkus, S. (2008). The structural transformation as a pathway out of poverty: Analytics, empirics and politics. *CGD Working Paper 150, Center for Global Development.*
Timmer, M. P., & de Vries, G. J. (2009). Structural change and growth accelerations in Asia and Latin America: A new sectoral data set. *Cliometrica, 3*(2), 165–190.
Tiwari, S., Uematsu, H., Shidiq, A. R., Salazar, C. F. B., Khadka, R. B., & Shrestha, M. (2016). *Moving up the ladder: Poverty reduction and social mobility in Nepal*. Retrieved from The World Bank Group, Kathmandu, Nepal.
Uy, T., Yi, K.-M., & Zhang, J. (2013). Structural change in an open economy. *Journal of Monetary Economics, 60*(6), 667–682.
World Bank. (2016). World Development Indicators. from World Bank. http://data.worldbank.org. Accessed on December 16, 2016.

Chapter 3
The Role of Agriculture in Poverty Reduction in Nepal

Ganesh Thapa, Raghav Gaiha and Katsushi Imai

Abstract Nepal has made impressive gains in poverty reduction in the last one and half decades. Based on the national poverty line, the incidence of poverty declined considerably from 41.8% in 1996 to 30.9% in 2004 and to 25.2% in 2011 (ADB 2013). During the same period, based on the international poverty line of US$1.25 per capita per day (extreme poverty), poverty incidence declined from 68% in 1996 to 53.1% in 2004 and further to 24.8% in 2011. Based on the threshold for moderate poverty (US$2 per capita per day), poverty incidence declined from 89% in 1996 to 77.3% in 2004 and 57.3% in 2011.

1 Introduction

Nepal has made impressive gains in poverty reduction in the last one and half decades. Based on the national poverty line, the incidence of poverty declined considerably from 41.8% in 1996 to 30.9% in 2004 and to 25.2% in 2011 (ADB 2013). During the same period, based on the international poverty line of US$1.25 per capita per day (extreme poverty), poverty incidence declined from 68% in 1996 to 53.1% in 2004 and further to 24.8% in 2011. Based on the threshold for moderate poverty (US$2 per capita per day), poverty incidence declined from 89% in 1996 to 77.3% in 2004 and 57.3% in 2011.

An earlier version of the paper (Thapa et al. 2015) was published in the Nepalese Journal of Agricultural Economics. We are grateful to Nidhi Kaicker and Y. B. Thapa for valuable assistance.

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G. Thapa et al. (eds.), *Agricultural Transformation in Nepal*,
https://doi.org/10.1007/978-981-32-9648-0_3

Poverty in Nepal is a rural phenomenon as 88.3% of the country's poor live in rural areas in 2011 (GON 2012). Also, the level of poverty in rural areas is significantly higher than in urban areas. However, rural poverty is declining at a faster rate than urban poverty. Urban poverty declined from 21.6% in 1996 to 10% in 2004 but rose to 15.5% in 2011. In contrast, rural poverty has declined monotonically from 43.3% in 1996 to 35% in 2004 and to 27.4% in 2011 (ADB 2013).

Also, in Asia and the Pacific region as a whole, poverty is concentrated in rural areas. Despite dramatic gains in poverty reduction since 1990, Asia and the Pacific region is still home to the largest number of the world's poor with about 560 million (55% of the global total) living below the US$1.25 per day poverty line in 2011 and 76% of them living in rural areas (IFAD 2016).

Rural poverty is a multidimensional phenomenon, which includes along with income, other intrinsically important dimensions such as lack of education and assets, and limited opportunities for economic advancement, among others. Rural women, youth and indigenous peoples experience such disadvantages disproportionately, making it harder for them to exit poverty. Women, particularly in developing countries, are more likely to be engaged in the informal sector, which offers low wages, no formal social protection and limited opportunity to gain skills. Disparities continue to exist between men and women in the workplace and in wages. Controlling for occupational differences, women on average earn around 50% of what men earn in South Asian countries. Similarly, Asia and the Pacific region youth (who constitute 61.5% of the 1 billion worldwide) live predominantly in rural areas and require assistance to escape poverty and lead better and more fulfilling lives. Many children (0–14 years) and youth (15–24 years) are unable to reach their potential because of poverty, hunger, poor health, and lack of education and skills. Poverty encourages child labour, which is common in developing countries. Of the 900 million poorest of the poor people in the world, at least one-third are indigenous peoples and more than half live in Asia and the Pacific region. Most of them are socially, politically and economically marginalized, endangering their survival in a rapidly changing environment.

Poverty is not just a matter of deprivation but also of vulnerability to exogenous shocks. Shocks can trap people in poverty by eroding their assets and capabilities to a point that they are unable to accumulate enough to move out of poverty. The shocks may be linked to climate change and pest outbreaks such as avian influenza, food price fluctuations, illness and death. Rural communities and households have a range of mechanisms for coping with downturns. As risk-coping mechanisms, households often resort to selling productive assets, borrowing at exorbitant interest rates, depleting savings, migrating, and reducing expenditure on food, healthcare and education (notably affecting women and children). Although they have developed relatively strong risk management and risk-coping strategies, vulnerability remains high. Asia and the Pacific region is also highly vulnerable to fluctuations in energy markets due to its high dependence on fossil fuels. This has a considerable impact in terms of vulnerability to food insecurity. Some parts of the region (e.g. Afghanistan, Sri Lanka, Nepal, Indonesia, the Philippines and Pakistan) are also affected by instability and conflict or have recently recovered from conflict.

Agriculture is critical for poverty reduction in Nepal, as agriculture is still the single most important productive sector in terms of its share in GDP and also in terms of the number of people it employs. Since the share of agriculture in overall employment is large, broad-based growth in agricultural incomes is essential to stimulate growth in the overall economy, including the non-farm sector selling goods to rural people.

One reason why agricultural growth is so strongly pro-poor is because it induces income growth in other sectors of the economy through multiplier effects (Haggblade et al. 2007; Christiansen et al. 2010). These multiplier effects could be an important source of poverty reduction because income from off-farm sources often constitutes a significant share of total income of poor farm families (De Janvry and Sadoulet 2002).

2 Objectives

The objective of the present study is to analyse the role of agriculture in reducing extreme poverty (estimated at the poverty cut-off point of $1.25) and moderate poverty estimated at the higher cut-off of $2 per capita in selected low-income countries in the APR with a focus on Nepal.[1] In this analysis, we will first estimate the likely contribution of agriculture to GDP growth and its implications for both extreme and moderate poverty. The next step is to assess the prospects of poverty reduction through extrapolations of historical trends in various drivers of agricultural growth: agricultural expenditure, investment and ODA in agriculture. If the likely or expected poverty reduction falls short of the desired, counterfactual simulations are carried out to illustrate required ranges of increases in these variables. Attention will be drawn to improvements in institutional quality to accelerate growth and poverty reduction. Questions relating to policy dilemmas arising from trade-offs between resource transfers and improvements in institutional quality will also be addressed.

After providing context and objectives of the study, Sect. 3 is devoted to salient features of the Nepalese economy in the context of other low-income countries such as Bangladesh, Lao PDR and Cambodia. This is followed by a discussion of poverty estimates in these countries in Sect. 4. Section 5 presents a literature review on the role of agriculture in poverty reduction. The data and model specification used for analysing agriculture's role in poverty reduction are discussed in Sect. 6.

[1]GNI per capita is used to classify countries as low income, lower middle income and upper middle income. For details, see WDI (2011).

In Sect. 7, the results obtained are used to simulate the effects of various drivers of agricultural growth on poverty in these countries. Section 8 draws together the main findings from a broad policy perspective.

3 Salient Features of Nepalese Economy[2]

Nepal's economic growth rate has been persistently low. In the post-conflict period of 2007–2014, the average GDP growth rate was 4.7% per year, which is higher than the growth rate during the armed conflict period of 1997–2006 (4%) but slightly lower than the pre-conflict period of 1986–1996 (5%). The economy is expected to grow at a much higher rate of 7.5% in FY 2017 (market prices) due to a low base year growth rate, increased agricultural production, improved supply of electricity, and greater investment on earthquake rehabilitation. The GDP growth rate was only 3.3% in 2015 due to the effects of massive earthquakes and only 0.4% in 2016 due to a severe disruption in trade with India.

There are four main reasons for Nepal's persistently low economic growth rate. First, Nepal's land-locked position and difficult topography make transportation and other forms of connectivity very challenging. Second, Nepal is vulnerable to natural disasters such as earthquakes, landslides and flooding. The third reason is its heavy dependence on India for trade and its inability to adopt an independent pricing policy due to open and porous border. Fourth, the country has been undergoing a protracted political transition following a decade-long armed conflict, which has resulted in unstable governments. Nepal's economic performance has been influenced by the weak performance of the large agriculture sector, low public investment and capital accumulation and low productivity growth. Although the economy grew at an average annual rate of 4% in the last three decades, agriculture grew at 2.8%, barely above the population growth rate of 2%. Due to its large relative size, slow growth in agriculture pulled down the overall growth rate.

Economic growth in Nepal has mainly been driven by agriculture and services, as the industrial sector has remained sluggish. Growing remittance flows and tourism receipts have played an important role in maintaining balance of payment stability despite a widening trade deficit. Although recurrent expenditures are rising, the fiscal deficit has remained below 2.2% of GDP mainly due to rapid growth in revenue mobilization, low capital expenditure and foreign assistance. Both tax and no-tax revenue mobilization has been strong in the post-conflict period, reaching around 17% of GDP in FY2013.

There has been a decline in merchandise exports due to loss of competitiveness and weak external demand, and exports constituted only 5.1% of GDP in FY2013. In contrast, imports have been rising fast reaching 32.2% of GDP in FY2013 resulting in a trade deficit equivalent to about 27% of GDP.

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[2]This draws upon an excellent review by Dahal (2011), World Bank (2017a, b), Sapkota (2014).

Remittances have been critical in maintaining a current account and balance of payments surplus despite wide trade deficit. In 2016, remittances contributed 30% of GDP making Nepal the second highest recipient in the world in terms of percentage of GDP. The dramatic increase in remittances has led to the improvements in living standards in the country both for the households receiving remittances and others who benefit through wage rate increases. However, large-scale migration is symptomatic of serious structural problems in the country.

Persistently low economic growth has led to low employment opportunities in the country favouring labour outmigration. Large-scale migration and remittance flows have contributed to the loss of competitiveness through appreciation of the real exchange rate and have led to the growth of low productivity services. Also, they have lessened pressure to create productive employment opportunities in the country. Because of this cycle, there is a real danger of Nepal falling into a low-growth, high-migration trap.

Nepal is going through a critical phase marked by growing inefficiency, corruption and political entrenchment that could jeopardise development. Inflow of FDI and domestic investment are adversely affected by inadequate infrastructure and poor industrial relations with rigid labour laws and tax regulations. Apart from political instability, corruption is rife. Nepal is among the most corrupt countries in South Asia.

4 Poverty in Nepal and Selected Low-Income Asian Countries

Table 1 gives poverty estimates for Nepal and some other selected low-income countries in Asia and the Pacific region.

Nepal has made impressive progress in poverty reduction in the last one and half decades. Using the international poverty line of US$1.25 per day, poverty incidence declined from 68.4% in 1996 to 53.1% in 2004 and 23.7% in 2010 (Table 1). Poverty incidence at US$2 per day declined from 88.1% in 1996 to 77.3% in 2004 and 56.0% in 2010. Poverty in Nepal is largely a rural phenomenon, as both the poverty rate and the number of poor are significantly higher in rural areas compared to urban areas. However, rural poverty is declining at a faster rate than urban poverty. Urban poverty, using the US$1.25 per day poverty line, declined from 21.6% in 1996 to 10% in 2004 but increased to 15.5% in 2011. In contrast, rural poverty declined from 43.3% in 1996 to 35% in 2004 and further to 27.4% in 2011 (ADB 2014).

These statistics, however, do not reveal large variation within country, especially between remote mountainous regions and the rest. The following box illustrates this.

Table 1 Poverty estimates in selected Asian countries

Country	Year	Poverty headcount (US$1.25/day)	Poverty headcount (US$2/day)
Bangladesh	1992	66.8	92.5
	1996	59.4	87.5
	2000	57.8	85.4
	2005	49.6	81.3
	2010	43.3	76.5
Cambodia	1994	48.6	77.9
	2004	40.2	68.2
	2007	25.8	57.8
	2008	22.8	53.3
	2010	11.3	40.9
	2011	10.1	41.3
Lao PDR	1992	55.7	84.8
	1997	49.3	79.9
	2002	44.0	76.9
	2007	35.1	68.3
	2008	33.9	66.0
	2012	30.3	62.0
Nepal	1996	68.4	88.1
	2003	53.1.	77.3
	2010	23.7	56.0

Source IFAD (2011), Imai et al. (2011), WDI (2011, 2012, 2014, 2015)

Box 1: Interregional and ethnic variations in poverty in Nepal

National poverty estimates do not reveal the differences between remote mountainous and other regions as well as among various ethnic groups. Not only is the poverty incidence often much higher in the former but the rate of reduction over time is also much slower *despite* substantial economic growth. In the mountains, the headcount ratio declined from 57.0% in 1995–96 to 42.3% in 2011; in the plains, poverty declined from 40.3 to 23.4%. In the mid-hills, poverty declined from 40.7 to 24.3%. There is a strong systematic relationship between isolation and poverty, as remoteness in terms of limited access to roads, markets and public services (mainly education and health care) is correlated with prevalence of poverty. Besides, greater vulnerability to natural hazards (e.g. wind storms, landslides) is compounded by the absence of social protection. The policy implications of such disparities in living standards are profound. Whether low population densities in such remote areas impede policy outreach merits close scrutiny.

In Nepal, poverty rate is also higher among the lower castes (Dalits) and indigenous peoples (Janjatis) compared to upper castes. For example, poverty rate was 43.6% among Hill Dalits, 38.2% among Tarai Dalits, 28.3% among Hill Janjatis, 25.9% among Tarai Janjatis compared to 10.3 for Hill Brahmins and Newars.

Source ICIMOD (2010), IFAD (2011), GON (2012).

In Bangladesh also, both extreme poverty ($1.25/day) and moderate poverty ($2/day) rates have declined from 1992 to 2010. However, the poverty rates in 2010 were the highest among the four low-income countries, as the rates of decline were the slowest.

Cambodia exhibited a sharp reduction in extreme poverty over the period 1994–2011, with only 10% of the population as extremely poor in 2011. A similar pattern is obtained when the higher poverty cut-off of $2/day is used, with nearly 41% of the population as moderately poor in 2011.

Lao PDR recorded a reduction of about 25% points in extreme poverty over a 20-year period, 1992–2012. However, the incidence of extreme poverty was high (30%). Using the higher poverty cut-off point ($2/day), the reduction was roughly 23% points, with about two-thirds of the population as moderately poor.

Despite dramatic gains in poverty reduction since 1990, Asia and the Pacific region is still home to the largest number of poor, with about 560 million (55% of the global total) living below the US$1.25 poverty line in 2011 and 76% of them living in rural areas (IFAD 2016). Despite wide-ranging diversities in the region, many poor rural people in Asia and the Pacific region are either landless or own a limited piece of land, possess large families, are less educated and have limited access to credit and technology. In addition, lack of market information, business and negotiating experience and collective organisations deprive them of the power to compete on equal terms in the marketplace.

A stylized fact about rural poverty in many parts of Asia and the Pacific region is that the poorer rural households derive the highest proportion of their incomes from farming and agricultural labour, while the better-off households derive the most from non-farm activities. Given the constraints on farm expansion and continuing growth of the rural population, greater attention is being given to non-farm activities in view of their potential for economic development and poverty reduction. In fact, countries that have succeeded in sustained rural poverty reduction have generally promoted both agriculture and non-farm rural economy (IFAD 2011). Occupational diversification is also a major way of managing risk for poor people with few risk management options. Development of rural non-farm economy (RNFE) is especially important for women and groups that are disadvantaged in agriculture.

It is now well recognized that income poverty is poverty of only one kind. Economists and policymakers, following Amartya Sen's[3] seminal contribution, have argued powerfully for the need to take a multidimensional approach to poverty and deprivation.[4] Multidimensional poverty includes other intrinsically important dimensions along with income. For instance, rural poverty can be defined primarily in terms of non-income deprivations. Interlocking disadvantages often reinforce each other and thus contribute to making it even more difficult to move out of poverty. Alkire and Santos (2010) construct a multidimensional poverty index (MPI) for households across 104 countries. The MPI is measured using ten indicators based on health (mortality and nutrition), education (years of schooling and child enrolment) and standard of living (electricity, sanitation, water, flooring, cooking fuel and ownership of consumer durables). The indicators chosen are along the lines of the Millennium Development Goals (MDGs).

While the estimates of income poverty and MPI are likely to differ, it is striking that some of the low-income countries in APR have high incidences of *both* income poverty (>0.25 and MPI (>0.25). Regardless of whether income poverty is estimated using the $1.25 or $2 cut-off, Bangladesh, Cambodia, Laos and Nepal exhibit high incidences of *both* income poverty and MPI. This overlap should not be taken to imply that mitigating income deprivation alone will help mitigate others. On the contrary, a broader anti-poverty agenda is needed that will address interlocking but distinct deprivation in income, health and education.

Within rural societies, women, youth and indigenous people are often disproportionately affected by disadvantages that tend to make mobility out of poverty even harder. However, people in these groups possess capabilities and assets (e.g. indigenous knowledge systems) that could be tapped to enhance their well-being. Unfortunately, social and political power distribution tends to undermine their ability to utilize these assets to move out of poverty (IFAD 2011).

4.1 Structural Characteristics

Although all four countries are classified as low income, there are some differences. Going by Table 2, Nepal is the poorest in terms of GDP per capita, followed by Cambodia, Bangladesh and Lao PDR. Although all four countries have achieved impressive growth in per capita GDP between 2001 and 2015, Laos has done the best followed by Bangladesh, Cambodia and Nepal. Per capita GDP in Nepal increased from US$924 in 2001 to US$2500 in 2015. Their dependence on agriculture varied too, as shown in Table 3.

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[3]Sen (1999).

[4]Sen (2000), Alkire and Santos (2010).

Table 2 GDP per capita PPP (constant 2005 international $)

Year	GDP per capita, PPP (constant 2005 international $)			
	Bangladesh	Cambodia	Laos	Nepal
2001	1002.7	1100.5	1399.1	924.0
2002	1028.9	1156.5	1458.1	904.1
2003	1065.1	1237.7	1523.6	918.9
2004	1114.6	1348.1	1596.8	941.2
2005	1164.6	1508.0	1684.6	953.8
2006	1226.4	1650.9	1800.9	966.4
2007	1290.7	1799.0	1907.4	980.3
2008	1356.3	1898.1	2018.7	1021.0
2009	1550.0	1820.0	2200.0	1180.0
2010	1810.0	2080.0	2460.0	1210.0
2013	3190.0	2890.0	4550.0	2260.0
2015	3560.0	3300.0	5400.0	2500.0

Source WDI (2011, 2012, 2015, 2017)

Table 3 Share of agriculture in GDP (%)

Year	Agriculture, value added (% of GDP)			
	Bangladesh	Cambodia	Laos	Nepal
2001	24.1	36.2	51.2	37.6
2002	22.7	32.9	50.4	38.6
2003	21.8	33.6	48.2	37.5
2004	21.0	31.2	46.7	37.2
2005	20.1	32.4	36.4	36.3
2006	19.6	31.7	35.2	34.6
2007	19.2	31.9	35.9	33.6
2008	19.0	34.9	34.9	32.7
2009	18.7	35.7	35.2	34.0
2010	18.6	36.0	33.0	36.1
2015	15.5	28.2	27.4	33.0

Source WDI (2011), World Bank data on agricultural value added

Bangladesh's share of agriculture in GDP in 2015 was the lowest −15.5%. There was a slight reduction over the period 2005–2010. Both Laos and Cambodia witnessed significant declines in the share of agriculture between 2001 and 2015. In Nepal, however, there was a moderate reduction (from 37.6 to 33%).

As cereals matter for food poverty (defined generally in terms of calorie deficiency relative to a norm), the rate at which their yields grow matters (Gaiha and Annim 2010; Gaiha and Azam 2011; IFAD 2011). Comparison of cereal yields growth rate over the period 1999–2005 shows that the lowest growth was recorded by Nepal (1.8% annually) and a slightly higher rate by Bangladesh (2.8%), Lao PDR (3.5%) and Cambodia (4%).[5]

As agricultural ODA helps supplement public expenditure in agriculture—especially in low-income countries—some illustrative estimates point to varying dependence of these countries on the former over the period 2003–2005. The share of agricultural ODA in total ODA was lowest in Bangladesh (2.4%) and highest in Lao PDR (13%). Between this range were Nepal (7.5%) and Cambodia (10.9%). It is worrying that these shares do not vary in accordance with the need to raise cereal yields growth rates or even relative importance of agriculture in GDP.

5 Role of Agriculture in Poverty Reduction: A Review of Literature

Several studies have argued that agriculture is more effective in reducing poverty than other sectors. For example, the World Development Report 2008, based on the evidence from several cross-country studies reported that GDP growth originating in agriculture was, on average, at least twice as effective in benefitting the poorest half of a country's population as growth generated in non-agricultural sectors (World Bank 2007). Using data from 42 developing countries covering 1981–2003 period, Ligon and Sadoulet (2007) found that growth in agricultural income had a greater effect on the poorest decile of the population, while growth in non-agricultural income had a greater effect on richer deciles (Ligon and Sadoulet 2007). Similarly, Christiansen and Demery (2007), based on a study of 82 countries over a similar period, found that when weighted by sectoral shares, the impact on poverty of growth in agriculture was 1.7 times larger than that of industry and 5.4 times larger than that of services.

In China, the primary sector rather than the secondary (manufacturing) or tertiary sectors was the real driving force in its dramatic success in reducing absolute poverty (Montalvo and Ravallion 2009). They reject the idea of a trade-off between these sectors in terms of overall progress against poverty in China, given how little evidence of any poverty impact of non-primary sector growth. McCulloch et al. (2007) using cross-section data in Indonesia from 1993 to 2002 found that while increased engagement of farmers in rural non-farm enterprises is an important pathway out of poverty, most of the rural agricultural poor that escape poverty do so while remaining in rural areas, employed in agriculture. They conclude that changes in agricultural prices, earnings and productivity play a critical role in reducing poverty.

[5]For details, see World Bank (2007).

World Bank (2017b) reports that most of the poverty reduction in Nepal between 2004 and 2011 occurred in rural areas and was driven by rising agricultural incomes. A decomposition of total income growth shows that farm income and agricultural wages rose by 24.4%, followed by remittances (23%), non-agricultural wages (22.8%) and enterprise income (18.3%). Also, the impact of agriculture on poverty reduction was the highest among the bottom 40%, where agricultural incomes contributed about 39% of their incomes.

6 Data and Results

6.1 Data

Our poverty estimates are the new World Bank headcount poverty estimates, based on the poverty lines of US$1.25 and US$2 per day, adjusted by purchasing power parity (PPP) in 2005 (Chen and Ravallion 2008). While the poverty estimates based on US$1.08 per day in 1993 PPP were widely used in the studies of the first Millennium Development Goal (MDG1) target, the new poverty estimates cover a larger number of countries and are assumed to be more reliable (ibid.). These estimates are taken from the World Bank's *PovcalNet*[6] website and *World Development Indicators 2010* (World Bank 2010). They cover 21 countries[7] in the Asia and the Pacific region over the period 1980–2006.

The variables used in the regression analyses are listed in Annex A with their data sources. Most of the variables are in logarithm to facilitate computation of elasticity estimates. Institutional data were taken from the World Bank's World Governance Indicators database. The data cover 1998, 2000, 2002, 2003, 2004, 2005 and 2006. The methodology for constructing the institutional indicators is discussed in Kaufmann, Kraay and Mastruzzi (2008).[8]

Different specifications are used to capture unobservable country-specific effects and to allow for endogeneity of some key variables (e.g. agricultural value added, public expenditure in agriculture and ODA in agriculture). These are discussed in Annex B.

[6]Data are available at http://iresearch.worldbank.org/PovcalNet/povcalSvy.html (accessed 23 December 2010).

[7]They are: Bangladesh, Bhutan, Cambodia, China, India, Indonesia, the Islamic Republic of Iran, Kazakhstan, the Kyrgyz Republic, the Lao People's Democratic Republic, Malaysia, Nepal, Pakistan, Papua New Guinea, the Philippines, Sri Lanka, Tajikistan, Thailand, Timor-Leste, Uzbekistan and Viet Nam.

[8]Full data are available at http://info.worldbank.org/governance/wgi/index.asp (accessed 23 December 2010).

6.2 Results

This section discusses econometric results based on the different specifications, based on a sample of countries in the Asia/Pacific region.[9] The key findings are: (i) agricultural expenditure (first lag) and agricultural ODA positively and significantly affect (the first lag of) agricultural value added; (ii) poverty headcounts are negatively associated with log GDP per capita, which is positively affected by (lagged) agricultural value added; (iii) poverty is positively associated with the expenditure/income Gini coefficient, but the estimate is not significant. Thus, agricultural ODA indirectly reduces poverty after taking account of its endogeneity; public expenditure in agriculture also indirectly reduces poverty (i.e. through its positive effects on agricultural value added and GDP).

The elasticity of poverty with respect to the second lag of agricultural ODA is −0.092 in Case 1 and −0.128 in Case 2.[10] In Case 1 (or Case 2), a 1% increase in annual agricultural ODA on average reduces poverty by 0.092% (or 0.128%), given the baseline poverty at US$2 per day in 2006. As the effect of agricultural ODA on poverty is cumulative over the years, the long-term effect of an increase in agricultural ODA on poverty (e.g. from 2006 to 2015) can be substantial.

The elasticity of poverty with respect to the first lag of agricultural expenditure in Case 3 is 0.351, which is larger than 0.202 in Case 1, given the larger coefficient estimate of lagged agricultural value added in the GDP Eq. (2.582) in Case 3 (Annex B). Poverty elasticity with respect to agricultural expenditure is larger than that of agricultural ODA.[11] In Case 4, the poverty elasticity with respect to fertilizer use is 0.287. When agricultural investment is used, in Case 5, the corresponding poverty elasticity is −0.349. This result, though plausible, cannot be accepted at face value, given the extrapolation of investment. Moreover, the small sample (26) precluded the use of country dummies.

The same models are also applied to the poverty headcount ratio on the US $1.25-per-day poverty line. The results are similar, except that the coefficients are generally higher, implying greater sensitivity of poverty indices at the lower poverty line.

A result of considerable policy significance is that, in *all* cases, poverty elasticity with respect to agricultural value added is substantially larger than that of GDP. In fact, it is almost twice as large as the corresponding elasticity with respect to GDP.

In sum, the results corroborate robustly that: (i) agriculture is important not just for economic growth, but also for poverty reduction and (ii) increases in agricultural ODA, expenditure, investment and fertilizer (as a proxy for technology) tend to reduce poverty. Thus, both national governments and donors have important roles in accelerating agricultural growth and poverty reduction.

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[9] For details, see Annex B.

[10] For details of Cases 1–5, see Annex B.

[11] We should not, however, straightforwardly conclude that agricultural ODA is more effective than agricultural expenditure, as the estimates of agricultural ODA are extrapolated.

7 Simulations

We report here selectively our simulation results on the feasibility of Millennium Development Goal 1 (MDG1) on the poverty lines of $2/day and $1.25/day, respectively. As several different specifications are used, a range of estimates is obtained.

In each case, we first compute expected poverty in 2015 based on the assumption that predetermined variables, such as agricultural ODA, expenditure and investment, follow the historical trend in 1980–2006. If expected poverty in 2015 is less than 50% of poverty level, based on US$2 per day in 1990 (or MDG1), it is inferred that the country is on track to achieve MDG1. In each case, MDG1 is compared with the expected poverty in 2015, and the necessary increase in agricultural ODA (or agricultural expenditure, fertilizer use or agricultural investment) is computed for the period 2007–2013, *relative* to the baseline scenario, where these variables follow the historical trend.

While the necessary increase in factors associated with growth in agriculture varies for different countries, depending on the current level of poverty or the share of agriculture in GDP, our simulations confirm that increases in agricultural ODA, agricultural expenditure, fertilizer use and agricultural investment are important in achieving MDG1.[12] As the results are voluminous, our remarks are *selective*.

As may be noted from Table 4, the prospects of achieving MDG 1 ($2/day) are bleak for low-income countries—especially for the four selected for the present study. The required increases vary with the different specifications and the details are given in Imai et al. (2011). To avoid repetition, we shall confine our remarks to the cases 1, 4 and 5 to illustrate the magnitudes of key drivers of agricultural growth in order to achieve halving of moderate poverty.

For low-income countries in general, the required increases (or annual growth rates) are not too daunting (over and above the historical rates). ODA in agriculture must increase at an annual rate of 14%; agricultural expenditure at a rate of 8 %; fertilizer use at a rate of 3% and agricultural investment at 7%. Among the four countries, agricultural ODA in Nepal must increase at an annual rate of 9%; agricultural expenditure at 5%; fertilizer use at a faster rate of 4% and agricultural investment at a slightly lower rate of 6%. Cambodia's requirements are mostly larger, whereas those of Bangladesh lower than those of Nepal. Lao PDR would require rates of growth of ODA and agricultural expenditure that are same as Nepal's but lower rates of growth of fertilizer use and agricultural investment.

[12]Note that the simulation results are essentially back-of-envelope calculations. A cautious interpretation is necessary, given that: (i) estimates of agricultural ODA and agricultural investment are extrapolated; (ii) the impact of each factor on poverty differs across countries, but the elasticities are averaged across countries (and being averages of large samples are more stable) and (iii) simulations are carried out under the assumption of 'other factors being unchanged'. But these limitations are imposed by patchy data on key variables.

Table 4 Simulation results for poverty headcount ratios ($2/day) in selected low-income countries in APR in 2013–15 (baseline year 2006)

Country	MDG1 ($2/day)	Whether on track to achieving MDG1?	Case 1: with agricultural ODA and expenditure		Case 4: with fertiliser use	Case 5: with agricultural investment
			(%) Required rate of annual growth of agricultural ODA (2007–13)	(%) Required rate of annual growth of agricultural expenditure (2007–13)	(%) Required rate of annual growth of fertiliser use (2007–13)	(%) Required rate of annual growth of agricultural investment (2007–13)
Nepal	45.5	No	9	5	4	6
Cambodia	38.9	No	12	7	2	7
Lao PDR	42.4	No	9	5	2	3
Bangladesh	44.5	No	7	4	3	2
Low income countries	37.6	No	14	8	3	7

Source Imai et al. (2011)

If we base our simulations on the poverty line of $1.25/day (or MDG1 of halving extreme poverty by 2015), the outlook for low-income countries is not so bleak. In order to achieve this goal, Nepal's ODA growth rate would have to increase by 3% per annum (as compared with 9% annually in the previous case), that of agricultural expenditure by 1% (as compared with 5% in the previous case). So the prospects of halving extreme poverty seem less daunting.

Simulation results are also aggregated for specific categories: (i) whether a country is in the low- or middle-income group; (ii) whether it is among the top 30 countries in the developing world in terms of aggregate governance or institutional quality; (iii) whether the trade share (or the share of imports and exports in GDP) is low (below 50%), middle (50–100%) or high (above 100%) and (iv) whether the rating of the World Bank's Ease of Doing Business Index[13] is low (above 150), middle low (100–150), middle high (50–100) or high (below 50). This index ranks countries according to their regulatory environment or ease of doing business, ranging from 1 to 183. A high ranking means that the regulatory environment is more conducive to the starting and operation of a local firm. The index averages a country's percentile rankings on a variety of indicators. This is meant to supplement the institutional analysis. A selection of the results is given below.

As expected, low-income countries (including Nepal, Cambodia and Lao PDR) would need a higher increase in agricultural ODA (an annual increase of 14% over

[13]Data are available at www.doingbusiness.org/rankings.

2007–2013 for US$2; a 8% increase for US$1.25, over and above the baseline scenario) than would middle-income countries (an 11% increase over 2007–2013 for US$2; a 4% increase for US$1.25).[14] Similarly, the necessary increase in agricultural investment over 2007–2013 is substantially higher for low-income countries (7% annually for US$2) than for middle-income ones (1% for US$2). For the purpose of poverty reduction in terms of both US$1.25 and US$2 per day, donors should mainly concentrate ODA in the agriculture sector of low-income countries, but *without* neglecting middle-income ones.

On the issue of governance, countries that rate low (e.g. Nepal and Cambodia) would need more agricultural ODA, agricultural expenditure, fertilizer use or agricultural investment to achieve MDG1 on both US$2- and US$1.25-per-day criteria. In particular, the requirement for increasing agricultural investment seems demanding for these countries. A policy dilemma that must be confronted is whether 'triggers' for institutional reform could partly compensate for higher transfers of resources to agriculture in low-rated countries.[15]

Historically, growth rates of agricultural expenditure and fertilizer use in Nepal have been higher than the rates required to achieve the MDG1 (both moderate and extreme poverty), whereas growth rates of agricultural ODA and agricultural investment are much lower than required growth rates. Agricultural expenditure in Nepal grew by 8.8% per year between 2002 and 2013 and fertilizer use at 6.6% per year between 2003 and 2010 (Sawtee 2015; Takeshima et al. 2016). In contrast, agricultural ODA increased by a low rate of 1.5% per year between 2010–11 and 2015–16, agricultural investment (as measured by the proportion of gross fixed capital formation) declined by 3.2% per annum between 1974–2007 and agricultural investment (as measured by agricultural capital stock or total accumulated investment by farmers) grew by only 1.5% between 1980 and 2007 (FAO 2012; Thapa 2011).

By contrast, trade openness is not amenable to easy generalization, partly because some of the poorest countries are highly trade dependent, but more affluent ones as well. Countries with low trade openness would need *higher* levels of increase in agricultural ODA, agricultural expenditure or fertilizer use, but *lower* levels of increase in agricultural investment. While a higher degree of trade openness is generally associated with economic growth and poverty reduction, it may also lead to the neglect of agriculture if not globally competitive. Whether a quick transition out of agriculture is desirable, let alone feasible, seems contentious. Our results imply that, even if a country is open to the rest of the world, a substantial agricultural investment is needed for poverty reduction for MDG1 at both US$1.25 and US$2 per day.

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[14] Recall that Cases 1 and 2 differ as to whether their effects are estimated jointly or singly. Given the overlap between the two variables, more precise estimates are ruled out.

[15] A few institutional triggers suffice here. For the rule of law to prevail, a better reporting of crime and insurgencies may help; for the management of corruption, an initiative such as the right to information, which allows official documents to be placed in the public domain, has had visible effects in India; and for the right to property, land titling may facilitate other protective measures.

Finally, countries with less business-friendly regulatory environments (e.g. Nepal) would need larger increases in agricultural ODA, agricultural expenditure, fertilizer use and agricultural investment. As in the case of governance or institutional quality, the policy dilemma is whether efforts should be directed towards improving the business environment and/or ensuring greater transfer of resources to agriculture.

8 Concluding Observations

This paper has examined whether accelerated growth of agriculture—through agricultural expenditure, ODA or investment—makes a difference in the prospects of achieving MDG1 in selected low-income countries (Nepal, Bangladesh, Cambodia and Lao PDR) in Asia and the Pacific region (using both US$1.25- and US$2-per-day poverty criteria). The prospects of achieving MDG1 ($2/day) are bleak if historical trends in drivers of agricultural growth continue over the period 2007–2013. The prospects are slightly less bleak if the lower poverty line of $1.25/day is used.

Our analysis confirms robustly that increases in agricultural ODA, agricultural expenditure, fertilizer use or agricultural investment would accelerate agricultural and GDP growth and, consequently, improve the prospects of achieving the more ambitious MDG1 (US$2 per day). The resource requirements are substantially lower in these low-income countries when the MDG1 is defined at the lower poverty line ($1.25/day).

Aggregation of the simulation results for individual countries into various categories reveals that low-income countries (all four countries studied are included) with a low level of governance or institutional quality (all four included with some variation), or with low ease of doing business (all four included with some variation), would need larger increases in agricultural ODA, expenditure or investment to achieve MDG1 at both US$2 and US$1.25 per day. These results raise two *related* but *distinct* policy dilemmas: one is the trade-off between real resource transfer to agriculture and institutional reform, and the other is a similar trade-off between resource transfers and the business environment. Our earlier work discussed 'triggers' for institutional reform (e.g. right to information, land titling, better reporting of crime and insurgencies). While some examples exist of how well these triggers work, policymakers and donors need to reflect on more cost-effective and more encompassing triggers, as institutional reform is not merely a by-product of growth or a causal factor. Indeed, arguments abound suggesting that institutional reform and growth may occur simultaneously, making it harder to pinpoint areas of intervention.

Another important insight that our analysis yields is that not just national governments, but also donors need to commit larger resources to agriculture—especially in many of the poorest countries. Mechanisms that would ensure larger budgetary outlays and donor funds for agriculture, and their allocation between rural infrastructure and sustainable technology, call for deep scrutiny.

Fortunately, fiscal deficit in Nepal has remained low, below 2.2% of GDP and does not pose a severe constraint. However, larger public outlays for agriculture—especially public investment—may impose difficult choices. A related concern is, of course, enhanced efficiency of public expenditure in agriculture.

In conclusion, while the challenge of reducing poverty, particularly moderate poverty (US$2/day) is daunting, the resource requirements for accelerated agricultural growth and institutional reforms delineated here could be the basis of a comprehensive and workable policy agenda. In particular, Nepal needs to significantly increase investment in agriculture through a much greater public investment and by mobilizing larger amounts of ODA in order to achieve the goal of poverty reduction.

Annex A: List of Variables

log Poverty	log of poverty headcount ratio based on US$2-per-day poverty line in t, 1980–2006, for the country i[16] (World Bank 2010; PovcalNet)
log Poverty Gap	log of poverty gap based on US$2-per-day poverty line (World Bank 2010; PovcalNet)
log GDP pc	log of GDP per capita
log Agri VA(−1)	log of agricultural value added per agricultural worker in the previous period, $t-1$ (World Bank 2010)
log Fertilizer Use(−1)	log of fertilizer consumption (kg per ha of arable land) (World Bank 2010)
log Agri Expenditure(−1)	log of agricultural expenditure per rural population (Statistics of Public Expenditure for Economic Development [SPEED], International Food Policy Research Institute)[17] used synonymously with 'public expenditure in agriculture'
log Agri ODA(−1)	log of ODA to agriculture per rural population (World Bank 2007, 322–323; World Bank 2010)
log Agri Investment(−1)	log of investment in agriculture sector per rural population (investment data from Harvard University's Centre for International Development)
log Gini Coef.	log of Gini coefficient of income/consumption distribution (PovcalNet)

[16]Subscripts t and i are omitted below.

[17]SPEED data are available at www.ifpri.org/book-39/ourwork/programs/priorities-public-investment/speed-database (accessed 23 December 2010).

Annex B: Econometric Specifications

Different specifications are used to capture unobservable country-specific effects and to allow for the endogeneity of some key variables (e.g. agricultural value added [Agri VA], public expenditure in agriculture [Agri Expenditure] and ODA in agriculture [Agri ODA]). These are discussed below.[18]

Case 1
The following system of equations is estimated by three-stage least squares (3SLS) to identify direct and indirect determinants of poverty in a country using panel data.

$$[\log \text{GDP pc}]_{it} = \alpha_0 + \alpha_1 [\log \text{Agri VA}]_{it-1} + D_i * \alpha_2 + e_{it} \tag{1}$$

where i denotes country and t denotes year (from 1980 to 2006), $[\log \text{GDP pc}]_{it}$ is log of GDP per capita, and $[\log \text{Agri VA}]_{it-1}$ is log of agricultural value added per agricultural worker in the previous year, $t - 1$. Following Imai et al. (2010), we consider the effect of agricultural income in the previous period on GDP per capita. In this case, we take account of country fixed effects by including D_i, a vector consisting of country dummy variables in each equation.[19] However, because we do not have sufficient observations in our unbalanced panel data, we cannot include year dummies. e_{it} (as well as ε_{it}, ϵ_{it} and ζ_{it}) is an error term that is assumed to be independent and identically distributed.

$$[\log \text{Agri VA}]_{it-1} = \beta_0 + \beta_1 [\log \text{Agri Expenditure}]_{it-1} + \beta_2 [\log \text{Agri ODA}]_{it-1} + D_i * \beta_3 + \epsilon_{it} \tag{2}$$

where agricultural value added is estimated by public expenditure on agriculture/agricultural expenditure and ODA in agriculture (or agricultural ODA), both normalized by rural population. $[\log \text{Agri Expenditure}]_{it-1}$ (or log of lagged agricultural expenditure) is a predetermined and weakly exogenous variable and is used as an instrument for $[\log \text{Agri VA}]_{it-1}$.

$$[\log \text{Poverty}]_{it} = \gamma_0 + \gamma_1 [\log \text{GDP pc}]_{it} + \gamma_2 [\log \text{Gini Coef.}]_{it} + D_i * \gamma_2 + \varepsilon_{it} \tag{3}$$

where [log Poverty] is log of poverty headcount ratio (or poverty gap), based on the US$2 (or US$1.25)-per-day poverty line in t, for country i. [log Gini Coef.] is log of Gini coefficient of income distribution. Here, poverty is premised as a function of the level of overall economic development, measured by GDP per capita, and the degree of income inequality in a country. It is assumed that a higher inequality is

[18]For further details, see Imai et al. (2011).

[19]These are unobservable country-specific effects (e.g. how 'welfarist' is a political regime?) that are not captured by any of the right side variables used in the GDP equation.

associated with a higher level of poverty. While GDP is hypothesized to reduce poverty, inequality increases it.

$$[\log \text{Agri ODA}]_{it-1} = \delta_0 + \delta_1[\log \text{Agri ODA}]_{it-2} + \delta_2[\log \text{Agri VA}]_{it-2} + D_i * \delta_3 + \zeta_{it} \quad (4)$$

$[\log \text{Agri ODA}]_{it-1}$ is estimated by its lag and $[\log \text{Agri VA}]_{it-2}$ to take account of a likely two-way causality between agricultural value added and agricultural ODA. $[\log \text{Poverty}]_{it}$ is either poverty headcount ratio (or poverty gap) at US$2 (or US $1.25)-per-day poverty line.

Cases 2 and 3

Case 2 is the same as Case 1 except that log Agri Expenditure (first lagged) is dropped from Eq. (2) on the presumption that a part of agricultural ODA is used for public expenditure in agriculture. Owing to lack of data, however, it is difficult to measure the overlap between them.[20] Hence, we use only log of Agri ODA (first lagged) in Case 2, or only log of Agri Expenditure (first lagged) in Case 3, in order to identify the effect of each factor on agricultural value added. In Case 3, Eq. (4) for log Agri ODA_{it-2} is dropped. Country fixed effects, or D_i, are included in these cases.

Case 4

In another specification, we have replaced $[\log \text{Agri Expenditure}]_{it-1}$ by $[\log \text{Fertilizer}]_{it-1}$ in Eq. (2) in Case 3. Agricultural ODA is not inserted in this case as its coefficient estimate turned out to be non-significant.

$$[\log \text{Agri VA}]_{it-1} = \beta_0 + \beta_1[\log \text{Fertilizer}]_{it-1} + D_i * \beta_3 + \epsilon_{it} \quad (2')$$

where $[\log \text{Fertilizer Use}]_{it-1}$ is log of fertilizer consumption (kg per ha of arable land).

Case 5

$$[\log \text{GDP pc}]_{it} = \alpha_0 + \alpha_1[\log \text{Agri VA}]_{it-1} + e'_{it} \quad (1')$$

$$[\log \text{Agri VA}]_{it-1} = \beta_0 + \beta_1[\log \text{Agri Investment}]_{it-1} + \epsilon_{it} \quad (2')$$

$$[\log \text{Poverty}]_{it} = \gamma_0 + \gamma_1[\log \text{GDP pc}]_{it} + \gamma_2[\log \text{Gini Coef.}]_{it} + \varepsilon'_{it} \quad (3')$$

In Case 5, we replace fertilizer by log of lagged investment in agriculture per capita for rural areas. Agricultural ODA is not included in Eq. (2) as the coefficient estimate is not significant. Here, due to the small number of observations on

[20] In Cambodia, for example, public expenditure on agriculture fluctuates with ODA.

agricultural investment ([log Agri Investment]$_{it}$), we cannot include country or year dummies. Also, as the data on agricultural investment are highly limited, we should interpret the results with caution.[21]

References

Alkire, S., & Santos, M. (2010). *Acute multidimensional poverty: A new Index for developing countries.* OPHI working papers No. 38.

Asian Development Bank (ADB). (2013). *Country poverty analysis (detailed) Nepal, Country Partnership Strategy: Nepal 2013–2017*. Asian Development Bank, Manila.

Asian Development Bank (ADB). (2014). *Country partnership strategy, 2013–17, country poverty analysis (detailed) Nepal*. Manila.

Chen, S., & Ravallion, M. (2008). *The developing world is poorer than we thought, but no less successful in the fight against poverty*. Policy research working paper WPS 4703. Washington, DC: World Bank.

Christiansen, L., & Demery, L. (2007). *Down to earth: Agriculture and poverty reduction in Africa*. The World Bank.

Christiansen, L., Demery, L., & Kuhl, J. (2010). *The (evolving) role of agriculture in poverty reduction.* United Nations University World Institute for Development Economics Research, Working paper No. 2010/36.

Dahal, M. K. (2011). Nepalese economy: A critique. *Nepalnews*, August 17, 2011.

De Janvry, A., & Sadoulet, E. (2002). World poverty and the role of agricultural technology: Direct and indirect effects. *Journal of Development Studies, 38*(4), 1–26.

FAO. (2012). *The state of food and agriculture: Investing in agriculture for a better future*. Rome.

Gaiha, R., & Azam, M. (2011). *Agriculture, GDP and prospects of MDGI: A study of Cambodia in transition*. APR, IFAD (in preparation).

Gaiha, R., & Annim, S. (2010). *Agriculture, GDP and prospects of MDG 1 in Lao PDR*. School of economics discussion paper 1012, University of Manchester, Mimeo.

Government of Nepal (GON), Central Bureau of Statistics (CBS). (2012). Poverty in Nepal 2010/11. Kathmandu.

Haggblade, S., Hazell, P., & Dorosh, P. (2007). *Sectoral growth linkages between agriculture and the rural non-farm economy*. Baltimore: Johns Hopkins University Press.

ICIMOD. (2010). *Understanding Mountain Poverty in Bhutan, India and Nepal, regional report*. Mimeo.

IFAD. (2011). *Agriculture-pathways to prosperity in Asia and the Pacific*. Rome: Asia and the Pacific Division.

IFAD. (2016). *Rural development report 2016. Fostering inclusive rural transformation*. Rome: IFAD.

Imai, K., Gaiha, R., & Thapa, G. (2010). Is the Millennium Goal on Poverty Still Achievable? The Role of Institutions, Finance and Opneness. *Oxford Development Studies 38*(3), 309–337.

Imai, K., Gaiha, R., & Thapa, G. (2011). *Role of agriculture in achieving MDG 1 in Asia and the Pacific Region.* Occasional paper 14, IFAD, Rome.

[21]Agricultural investment estimates are available only for 1980–1992 for a limited number of countries. Hence, we have regressed agricultural investment on total capital formation and agricultural expenditure during 1980–1992. Based on the regression results, we obtained out-of-sample predictions of agricultural investment in 1993–2006.

Kaufmann, D., Kraay, A., & Mastruzzi, M. (2008). *Governance matters VII: Aggregate and individual governance indicators, 1996–2007*. World Bank Policy Research Working Paper No. 4654. Washington, DC: World Bank.

Ligon, E., & Sadoulet, E. (2007). *Estimating the effects of aggregate agricultural growth on the distribution of expenditures*. Background paper for the world development report 2008.

McCulloch, N., Weisbrod, J., & Timmer, P. (2007). *Pathways out of poverty during an economic crisis: An empirical assessment of rural Indonesia*. World Bank policy research working paper 4173, March 2007.

Montalvo, J., & Ravallion, M. (2009). *The pattern of growth and poverty reduction in China*. Policy research working paper 5069, The World Bank.

Sapkota, C. (2014). Nepal: Recent macroeconomic analyses, Chandan Sapkota's blog on economic growth, trade and development policy. February 25, 2014. http://sapkotac.blogspot.com/2014/02/Nepal-recent-macroeconomic-analysis.html.

South Asia Watch on Trade, Economics and Environment (SAWTEE). (2015). Public investment in agriculture—Policy issues in South Asia, Policy Brief 32, Kathmandu. www.sawtee.org/publication/Policy-Brief-32.pdf.

Sen, A. (1999). *Development as Freedom*. New York: Oxford University Press.

Sen, A. (2000). A Decade of Human Development. *Journal of Human Development, 1*(1), 17–23.

Takeshima, H., Adhikari, R., Kaphle, B., Shivakoti, S., & Kumar, A. (2016). *Determinants of fertilizer use in Nepal—Insights based on price responsiveness and income effects*. IFPRI discussion paper 01507, February 2016.

Thapa, Y. B. (2011). *Updated notes about investment on agriculture in Nepal*. June 17, 2011, Mimeo.

Thapa, G., Gaiha, R., & Imai, K. (2015). Is agriculture central to achieving the Millennium Development Goal of halving poverty by 2015 in Nepal? *Nepalese Journal of Agricultural Economics, 2–3,* 1–21.

World Bank. (2007). *World development report 2008: Agriculture for development*. New York: Oxford University Press.

World Bank. (2010). *World development indicators 2010*. Washington, DC: Oxford University Press.

World Bank. (2011). *World development indicators 2010*. Washington, DC: Oxford University Press.

World Bank. (2017a). *Nepal country economic memorandum—Climbing higher: Toward a middle-income Nepal*, May 2017. Washington, DC.

World Bank. (2017b). *Nepal development update—Strong rebound, mounting risks.* May 2017, Washington, DC.

World Development Indicators (WDI). (2011). World Bank, Washington, DC.

World Development Indicators (WDI). (2012). World Bank, Washington, DC.

World Development Indicators (WDI). (2014). World Bank, Washington, DC.

World Development Indicators (WDI). (2015). World Bank, Washington, DC.

World Development Indicators (WDI). (2017). World Bank, Washington, DC.

Chapter 4
Household Food Expenditure, Dietary Diversity, and Child Nutrition in Nepal

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Abstract Over the past two decades, many developing countries have achieved remarkable progress in improving dietary quality and reducing child stunting rates. But our understanding of the linkages between food expenditures, dietary quality, and nutritional outcomes is limited. Using data from the 1995–1996 and 2010–2011 rounds of the Nepal Living Standards Survey, we study the empirical connections between household food expenditure and nutrition outcomes of children below the age of five years using multilevel and dose–response function approaches. We also examine the effects of dietary quality changes on child nutrition improvement between 1995 and 2011 employing Blinder–Oaxaca decomposition. We find that number of food groups consumed, monthly food expenditure, dietary diversity, and the expenditure shares on fruits and vegetables and animal protein have a positive impact on the expected height-for-age Z-scores. The dietary changes explain about 71% of the improvement in those scores between 1995 and 2011, underscoring the importance of dietary quantity, dietary diversity, and nutrient-dense food items for child nutrition outcomes.

1 Introduction

Undernutrition is an overarching issue in developing countries. About 35% of children under five years of age in Africa are stunted, and in Asia, that figure is 36% (UNICEF 2016). Undernutrition to such degree has serious consequences on

We are grateful to the U.S. Agency for International Development for extending financial support to undertake this study through the Policy Reform Initiative Project in Nepal. We express our sincere thanks to Nepal's Central Bureau of Statistics for providing household survey datasets.

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G. Thapa et al. (eds.), *Agricultural Transformation in Nepal*,
https://doi.org/10.1007/978-981-32-9648-0_4

individuals' long-term productivity and on a country's overall economic development (Mankew et al. 1992; Jo and Dercon 2012; Horton and Steckel 2013). According to the Institute of Development Studies (2013), stunted children are twice as likely to die as nonstunted children. Each year, about 2.9 million children under five die in the world due to undernutrition, which accounts for almost half of all under-five deaths (You et al. 2015). Such suffering and loss can be prevented through the consumption of a high-quality diet (Sari et al. 2010; Campbell et al. 2010; Mauludyani et al. 2014; IFPRI 2016a; Humphries et al. 2017).[1]

We developed a case study from Nepal, a poor developing country from South Asia, to estimate the impact of household's dietary quality and quantity on the long-term child nutrition outcomes, i.e., measured by the height-for-age Z-score (HAZ).[2] Nepal provides an interesting opportunity to study dietary quality and child malnutrition issues for several reasons. Nepal is representative of the overall global nutrition challenge with a child stunting rate (below five years of age) of about 41% (Nepal, Ministry of Health and Population 2012). About 54% of Nepal's total population faced chronic food insecurity in 2014 (FAO 2016). Nepal's score on the Global Hunger Index of 21.9 indicates serious food insecurity (IFPRI 2016b). Although Nepal still has an unacceptable rate of child malnutrition, the country's stunting rate fell by 10% between 1995 and 2011 (Nepal, Central Bureau of Statistics 1996, 2011). Moreover, there has been a significant dietary transition in Nepal. Figure 1 shows the distributions of the share of expenditure on cereals and of HAZs in 1995–2011. One sees a significant leftward shift in the distribution of the cereals expenditure share and a rightward shift in the distribution of the HAZs, illustrating a reduction in the cereals expenditure share and an improvement of child nutrition outcomes across time. This indicates that improvement in dietary quality (shown by the reduction of nonstaples in the diet) can be one of the factors influencing the recent improvement of HAZs and the decline of stunting in Nepal.

There are several studies on dietary quality and its effect on child nutrition outcomes. Dietary diversity (DD) is positively associated with child nutrition outcomes (Ruel and Menon 2002; Arimond and Ruel 2004; Arimond et al. 2010; Disha et al. 2012; Ruel et al. 2012; Bhutta et al. 2013), adequate nutrient intakes (Hatløy et al. 1998; Tarini et al. 1998; Rose et al. 2002; Kant 2004; Steyn et al. 2006; Kumar et al. 2016), reduced mortality rate (Bernstein et al. 2002; Lee et al. 2010; Marshall et al. 2001), and increased birthweight (Rao et al. 2001). All of these studies suggest the importance of diet on child nutrition and health. However, studies assessing the impact of household dietary quality (focusing, e.g., on the expenditure shares of cereals, fruits and vegetables, animal proteins, and plant

[1]Nutritionists define a high-quality diet as one with a higher dietary diversity (DD), or a diet rich in nutrient-dense foods such as vegetables, fruits, and animal-sourced foods.

[2]For detailed explanation on HAZ and how it is calculated, please refer to WHO standards (WHO 1995). We have information only on the monthly household expenditure for and consumption of various food items. In Nepal, a household prepares a common meal for a family. Thus, whatever food eaten by adult household members is also being shared with their children. Given Nepal's overwhelmingly high proportion (41%) of stunting in 2011, we focus on the HAZ.

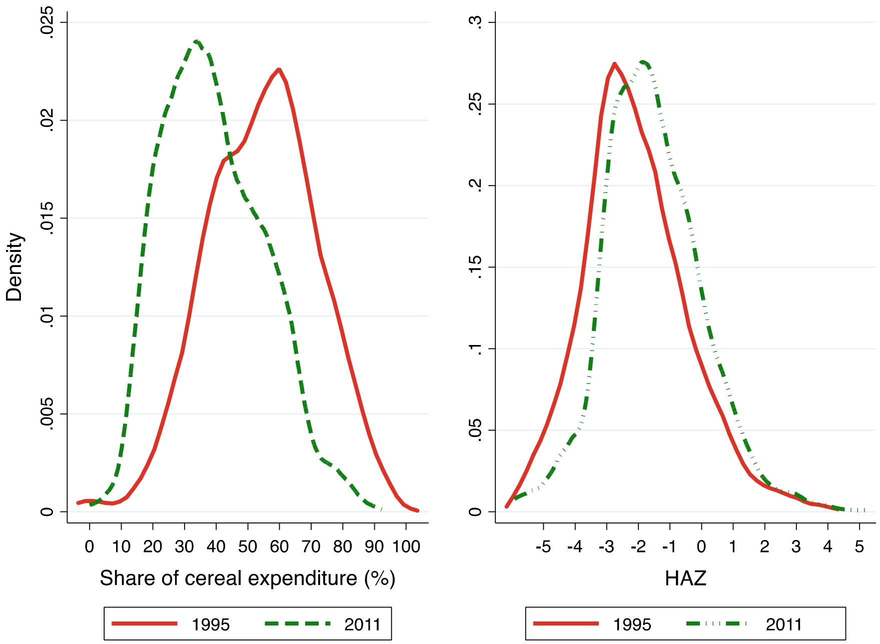

Fig. 1 Distribution of cereals' expenditure share and HAZ in 1995 and 2011. *Source* Nepal, Central Bureau of Statistics (1996, 2011)

proteins) on child nutrition outcomes are limited (Torlesse et al. 2003; Campbell et al. 2010; Sari et al. 2010; Humphries et al. 2017). Although Headey et al. (2017), Cunningham et al. (2017), and Headey and Hoddinott (2015) studied the contribution of various factors on the improvement of child nutrition outcomes between 1995 and 2011 in Nepal, the role of household dietary quality has not been assessed. Shively and Sununtnasuk (2015) studied the correlation between HAZ and the number of food groups consumed by children below five years of age failing to account the different food expenditure shares. Humphries et al. (2017) studied the association between household expenditures on food and child growth outcomes using data from Ethiopia, India, Vietnam, and Peru. However, that study controlled only for child age and sex and household location (rural or urban), raising the strong possibility of omitted-variable bias and potential model mis-specification. We address the gap in the literature by estimating the impact of dietary quality (proxied by the number of food varieties and food groups consumed by the household, and by the household's monthly expenditure shares going to cereals, fruits and vegetables, animal proteins, and pulses) and quantity (proxied by the household's monthly food expenditure) on HAZ and the stunting probability of children below five years of age.[3] We also decompose household dietary quality to explain how its various compositions explain the improvement in child nutrition outcomes in Nepal between 1995 and 2011.

A household's expenditures on and consumption of different food groups and food varieties may depend on various observed and unobserved factors, which may also influence child nutrition outcomes. We address the endogeneity problem by using a dose–response function (DRF) approach. In another innovation, we use a multilevel regression model that controls for child, household, community, and district characteristics. In doing so, we account for the rich heterogeneity in the data. To decompose the contribution of dietary quality to nutrition improvement between 1995 and 2011, we use the Blinder–Oaxaca method (Oaxaca 1973; Blinder 1973). We assess the robustness of our results using the quantile regression technique and conducting separate regressions based on farm size and household location (rural/urban). Our findings have important implications for promoting dietary quality and improving child nutrition and food security in the country. To our knowledge, this is the first empirical study assessing the effects of dietary quality on child nutrition outcomes in Nepal.

The paper is organized as follows. In Sect. 2, we describe our data sources and sample size. Section 3 presents the conceptual framework. A fourth section discusses methodology, and a fifth presents and discusses the results. Finally, in Sect. 6, we conclude and offer policy recommendations.

2 Data

The data for our study come from two rounds of the Nepal Living Standards Survey (NLSS) conducted by Nepal's Central Bureau of Statistics (CBS) in 1995–1996 and 2010–2011. The CBS used a two-stage stratified random sampling technique to select the samples. The surveys' household questionnaire collected information on socioeconomic and agricultural characteristics, including health and child anthropometric data. The CBS surveyed a total of 8399 households in the two rounds—2411 households in 1995–1996 and 5988 households in 2010–2011. We extracted nutrition data for children below the age of five years from the anthropometric information given in the two rounds of the NLSS. In total, we use 3859 children for the analysis: 1501 children sampled in 1995–1996 and 2358 children sampled in 2010–2011. We compiled road network data from Nepal's Department of Roads. For our analysis, we use information on the total length (kilometers) of earthen road, gravel road, and blacktop road in a district.

[3]Indicators of dietary quality are discussed in depth in the section "Dietary Quality Indicators."

3 Conceptual Framework

Our conceptual framework is based on the work of Smith and Haddad (2000). First of all, children's nutritional outcomes are influenced by immediate determinants—that is, child characteristics. Immediate determinants are themselves influenced by underlying determinants—that is, household and community characteristics. Finally, underlying determinants are themselves influenced by basic determinants—that is, district characteristics. This constitutes the multilevel approach (also called a hierarchical model) that we adopted in the econometric model.

Our framework is based on a multimember household economic model. Each household is composed of a mother (i = M), other adults (i = 1, …, A), and one or more children (i = 1, …, Ch). The household maximizes the utility of each household member (U^i), thus maximizing the total household welfare.[4] The household welfare function is represented as

$$\mathrm{W}^H = W\left(U_M, U^1, \ldots, U^A_{ad}, U^1, \ldots, U^C_{ch}; \beta\right)\beta = \left(\beta^M, \beta^1, \ldots, \beta^A_{ad}\right), \tag{1}$$

where β indicates household member status that influences the household decision-making process. The utility function for each household member can be expressed as

$$U^i = U(N, H, F, F_0, T_L)\ i = 1, \ldots, n = 1 + A + Ch, \tag{2}$$

where each household member derives utility from his or her nutritional outcomes (N), from the consumption of own-foods produced by the household (H) and food purchased from the market (F), from consumption of nonfood items (F_0), and from the time allocated to leisure (T_L). We consider the nutrition outcome as a household-produced good that depends on various factors such as consumption and good health care. We assume that the household utility is an additive function. Since we are interested in the nutrition production function for children, the nutrition function for a child i is expressed as follows:

$$N^i_c = N\left(E^i, H^i, F^i, F^i_0; K^i, H^i_0, \Omega_c, \Omega_d\right), \quad i = 1, \ldots, Ch, \tag{3}$$

where E^i is the care received by the ith child; H^i is the quantity of food consumed by the household from own production; F^i is the quantity of purchased food consumed by the household; F^i_0 indicates nonfood items; K_i represents child characteristics (age, sex, and so on); H^i_0 represents household characteristics; and Ω_c and Ω_d represent community and district characteristics, respectively. Since DD

[4]The welfare function takes into account the welfare (utility) of each member of the household. Since we assume this as an additive function and we are interested in maximizing household welfare through indirectly improving the nutritional outcomes of the children, we ultimately model the child nutrition outcomes.

is found to well represent per capita consumption (Hoddinott and Yohannes 2002) and nutrient adequacy (Steyn et al. 2006; Kant 2004; Rose et al. 2002), we replace H^i and F^i with D^i as follows:

$$N_c^i = N\left(E^i, D^i, F_0^i; K^i, H_0^i, \Omega_c, \Omega_d\right), \quad i = 1, \ldots, Ch, \tag{4}$$

where D^i is an indicator of DD that is expected to influence child nutrition outcomes. We use the Simpson Index (SI), the total number of food varieties consumed, and the expenditure shares for different food groups, as an indicator of DD.[5] We expect the partial derivative $\left(\frac{dN_c^i}{dD^i}\right)$ of child nutrition outcomes with the SI to be strictly positive. However, we expect the partial derivative of child nutrition outcomes with respect to the total number of food varieties consumed/expenditure share of food groups to be either negative or positive depending on the types of food consumed. The child's care (E^i) is an endogenous variable and expected to be influenced by household poverty status (P_0), mother's education (M), time allocated for care of children (T_c), and ethnicity (ξ). The child's care function is expressed as

$$E^i = C\left(P_0, M, T_c^i, \xi\right), \quad i = 1, \ldots, Ch. \tag{5}$$

All households maximize utility with respect to budget and time constraints. The budget constraint is expressed as follows:

$$PH + RF + P^{'}F_0 = wL + Y, \tag{6}$$

where P is the price of household-produced food, R is the price of purchased food, and P' is the price of nonfood items. The household sells labor (L) at the wage rate of w. Here L is the total time allocated for labor. The household also receives its exogenous income (Y) from remittances, transfers, and so forth. In addition to the budget constraint, households also face a time constraint as follows:

$$L = T - T_c - T_h - T_L, \tag{7}$$

where the household allocates its total time (T, say 24 h per day) for child care (T_c), household work (T_h), leisure (T_L), and labor (L). The following reduced-form equation can be obtained once the household maximizes total welfare (Eq. [1]) with respect to (2), (3), (4), (5), (6), and (7):

$$N_c^{i*} = \left(\beta, K^i, M, P_c, \xi, H_i, \Omega_c, \Omega_d, P, R, P^{'}, w, Y, T\right) \quad i = 1, \ldots, Ch. \tag{8}$$

[5]Food varieties constitute the types of food consumed such as rice, wheat, maize, tomato, and milk. While food group constitute the cereals, proteins, vegetables, fruits, etc.

In estimating Eq. (8), we focus on examining the relationship between the child nutrition outcome and various DD indicators.

4 Methodology

4.1 Dietary Quality Indicators

The literature reveals various indicators of DD ranging from simple counts of food varieties or groups consumed by the households in addition to the types and frequency of foods consumed by each household member. The NLSSs collect detailed information on food expenditures and home production, including the types and quantities of food purchased, expenditure, household consumption, and values of household consumption in a typical month. Since we have no information on the quantities of food each individual in the household consumes (or the frequencies with which food is consumed), we rely on using a count of the number of food items and number of food groups consumed by the household and the Simpson Index constructed using the share of household expenditure going to food items.

When calculating food expenditure shares, we account for the value of food consumed at home as well as food purchased from markets. Recent studies have used the shares of food expenses going to different food groups as an indicator of DD (Karamba et al. 2011; Nguyen and Winters 2011; Sharma and Chandrasekhar 2016). Past studies (Kant 1996; Hatløy et al. 1998; Ogle et al. 2001; Hoddinott and Yohannes 2002) used individual foods as well as the food groups to assess DD. We computed the DD variable using expenditure shares on 11 food groups (cereals, legumes/pulses, eggs, milk/milk products, fat/oil, vegetables, fruits, fish, meat, spices/condiments, and sugar/sugar products). We computed the SI as follows: $1 - \sum_{i}^{11} s_i^2$, where s_i is the share of expenditure on different food subgroups ($i = 1, \ldots, 11$). The SI accounts for both richness (number of foods) and evenness (distribution of food expenditure share). The index lies between 0 and 1, where a value of zero suggests that a household has consumed only one food item and a value of one indicates the equal distribution of expenditure share among all food items. We consider the SI, the household's monthly food expenditure and the shares devoted to cereals, fruits and vegetables, animal protein, and pulses, and the total number of food varieties and food groups consumed by the household in a typical month as indications of DD for the further analysis.

4.2 Empirical Framework

4.2.1 Multilevel Model

We employ a multilevel model to study the effects of DD on long-term child nutrition outcomes (HAZ). We consider four levels—child (the unit of analysis), household (second level), community (third level), and district (fourth level). Our sample comprises 73 districts, 749 communities, 3000 households, and 3859 children. The child nutrition patterns of households from the same community can be correlated with each other, as they are likely to share similar food prices, wage rates, market accessibility, and agricultural characteristics. Similarly, communities from the same district share similar district characteristics such as agroecology, and infrastructure. For such hierarchical data, the multilevel model takes into account the effects arising from the higher levels. The important assumption here is that the higher-level variables (household, community, and district levels) explain the significant variation at the lower level (children). This is captured by the intraclass correlation coefficients, which we report in a later section. The full model can be expressed as follows:

$$\begin{aligned} N_{ijkl} = \beta_{0000} + \beta_{1jkl}(Y2011) + \sum_{p=2}^{p} \beta_{p,jkl}\mathrm{C}_{p,jkl} + \sum_{c=1}^{C_p} \beta_{0,ckl}H_{c,jkl} \\ + \sum_{w=1}^{W_{cp}} \beta_{0,owl}Q_{w,jkl} + \sum_{t=1}^{T_{pcw}} \beta_{000t}D_{t,jkl} + \left(\gamma_{0001} + \gamma_{00kl} + \gamma_{0jkl} + \mathrm{e}_{ijkl}\right), \end{aligned} \tag{9}$$

where N_{ijkl} is the long-term child nutrition outcome of the ith child from the jth household belonging to the kth community from the lth district. $Y2011$ is a dummy variable representing 1 if the child was surveyed in 2010–2011 and 0 if surveyed in 1995–1996. $C_{p,jkl}$ represents the child-level characteristics, $H_{c,jkl}$ represents the household-level characteristics, $Q_{w,jkl}$ represents the community-level characteristics, and $D_{t,jkl}$ represents the district-level characteristics. γ_{0001} is the error term at the district level, γ_{00kl} is the error term at the community level, γ_{0jkl} is the error term at the household level, and e_{ijkl} is the error term at the child level. All error terms are assumed to be independently and identically distributed, and error terms at one level do not interact with error terms at another level.

We also calculate the intraclass correlation coefficients for the household, community, and district levels, respectively. Denoting the variance of e_{ijkl} as σ^2, γ_{0jkl} as σ_u^2, γ_{00kl} as σ_v^2, and γ_{0001} as σ_s^2, the percentage of variation at the child level explained by the higher levels (household, community, and district) can be calculated as follows:

$$\rho_h = \frac{\sigma_u^2}{\sigma^2 + \sigma_u^2 + \sigma_v^2 + \sigma_s^2} \tag{10}$$

$$\rho_c = \frac{\sigma_v^2}{\sigma^2 + \sigma_u^2 + \sigma_v^2 + \sigma_s^2} \tag{11}$$

$$\rho_d = \frac{\sigma_s^2}{\sigma^2 + \sigma_u^2 + \sigma_v^2 + \sigma_s^2}, \tag{12}$$

where ρ_h, ρ_c, and ρ_d denote the intraclass correlation coefficients for the household, community, and the district levels, respectively. The proportion of the variance explained in the first level can be calculated as follows: $(1 - \rho_h - \rho_c - \rho_d)$.

4.3 DRF Approach

We consider number of food varieties and food groups consumed and the expenditure shares going to fruits and vegetables, animal proteins, pulses, and cereals as treatment variables. The outcome of interest is the HAZ and the probability of stunting. Since all of our treatment variables are continuous, we use the DRF approach to estimate the causal effect of DD on the child nutrition outcome.

We implement the DRF approach as proposed by Hirano and Imbens (2004). Here we briefly discuss the basic ideas of the DRF approach. First, we estimate the generalized propensity score (GPS) at a given level of treatment and observed pretreatment covariates using a flexible parametric approach. These pretreatment covariates are expected to significantly influence DD. The treatment is assumed to follow a normal distribution given the covariates.[6] The GPS is simply the conditional density of the treatment calculated using the pretreatment covariates. We test the balancing property of the GPS to make sure that the bias associated with the differences in the observed covariates is removed.

Once the GPS is estimated and the balancing property is checked, we need to estimate the conditional expectation of the outcome ($E[Y_i|t_i, r_i]$) given the treatment (t) and GPS (indicated as r). This is a flexible function of the treatment and GPS. We use a quadratic approximation as follows:

$$E[Y_i|t_i, r_i] = b_0 + b_1 t_i + b_2 r_i + b_3 t_i^2 + b_4 r_i^2 + b_5 r_i \times t_i. \tag{13}$$

Once the parameters from Eq. (13) are estimated, we then estimate the DRF to examine treatment effects as well as the 95% confidence interval. The average potential outcome ($\hat{\mu}(t)$) is estimated as

[6] While the parametric model assumes a normal distribution, the actual distribution may not be normal. One can apply other transformations such as logarithm.

$$\hat{\mu}(t) = \widehat{E}[Y_i] = \frac{1}{N}\sum_{i=1}^{N}\left(\hat{b}_0 + \hat{b}_1 t + \hat{b}_2 \hat{r}_i^2 + \hat{b}_3 t^2 + \hat{b}_4 \hat{r}_i^2 + \hat{b}_5 \hat{r}_i^2 \times t\right). \tag{14}$$

Equation (14) provides the entire DRF that is mean-weighted by each different calculated *r,* associated with specific treatment *t*. The standard error and the 95% confidence interval are computed using a bootstrapping technique accounting for the estimation of the GPS and the beta parameters. Finally, we compute a non-constant marginal effect of treatment on the treated $\left(\hat{\theta}(t)\right)$ by subtracting the average potential outcome with the benchmark treatment level, considered as the lowest treatment level ($\tilde{t}$) observed in the data as follows:

$$\hat{\theta}(t) = \hat{\mu}(t) - \hat{\mu}(\hat{t})\,\forall t \varepsilon T. \tag{15}$$

All of the analyses are conducted using the "gp score" and "dose response" functions command in Stata 13.

4.4 Blinder–Oaxaca Decomposition Technique

The Blinder–Oaxaca decomposition technique has been widely used in the study of labor market discrimination (Blinder 1973; Oaxaca 1973). Economists and sociologists have used the approach to decompose wage and earning differences based on gender and race (Darity et al. 1996; Kim 2010; Stanley and Jarrell 1998). Researchers also have used the approach to decompose factors that are important in explaining nutrition improvement across time (Headey and Hoddinott 2015). The Blinder–Oaxaca decomposition approach explains what proportion of the difference in mean outcomes between two groups is due to group differences explained by the explanatory variables and what proportion is due to the differences in the magnitude of regression coefficients (Oaxaca 1973; Blinder 1973). We use the twofold decomposition approach that yields the mean outcomes for each group, the difference in mean outcomes across two groups, and the parts of the differences that are explained and unexplained by the explanatory variables. We have the two groups: children sampled in 1995–1996 (group A) and the children sampled in 2010–2011 (group B). The outcome of interest is the HAZ. The mean outcome difference to be explained is the difference in the mean outcomes for children sampled in 1995–1996 and children sampled in 2010–2011, denoted as $\Delta\overline{\mathrm{HAZ}}_A$ and $\Delta\overline{\mathrm{HAZ}}_B$, respectively:

$$\Delta\overline{\mathrm{HAZ}} = \Delta\overline{\mathrm{HAZ}}_A - \Delta\overline{\mathrm{HAZ}}_B. \tag{16}$$

We are interested in assessing the role the dietary quality variables play in explaining nutritional improvement between 1995 and 2011.

5 Results

5.1 *Effect of Dietary Quality on Child Nutrition Outcomes*

Before conducting the empirical analysis, we explore the relationship between the indicators of dietary diversity and HAZ (Fig. 2). We observe a positive relationship between HAZ and DD (SI and the number of food varieties consumed) suggesting that an increase in DD is correlated with an increase in child nutrition outcome. Child nutrition outcomes may also depend on the household dietary composition. Figure 3 plots the relationship between dietary quality and HAZ. We observe an interesting pattern. Households with a higher cereals expenditure share have poorer child nutrition outcomes, while households with a higher expenditure share going to nonstaple foods (fruits and vegetables, animal products, and pulses) have improved child nutrition outcomes.

There may exist a differential treatment impact of dietary quality on HAZ for children of different age groups. In fact, it is well established that proper nourishment during a child's first 1000 days (including from the day of conception) is critical for the child's growth and development. Therefore, we also separately assess the effect of DD (SI) on HAZ for children during their first 1000 days of growth and for children older than 1000 days. Figure 4 shows the positive relationship between DD and HAZ for both age categories. We also visualize the relationship between dietary

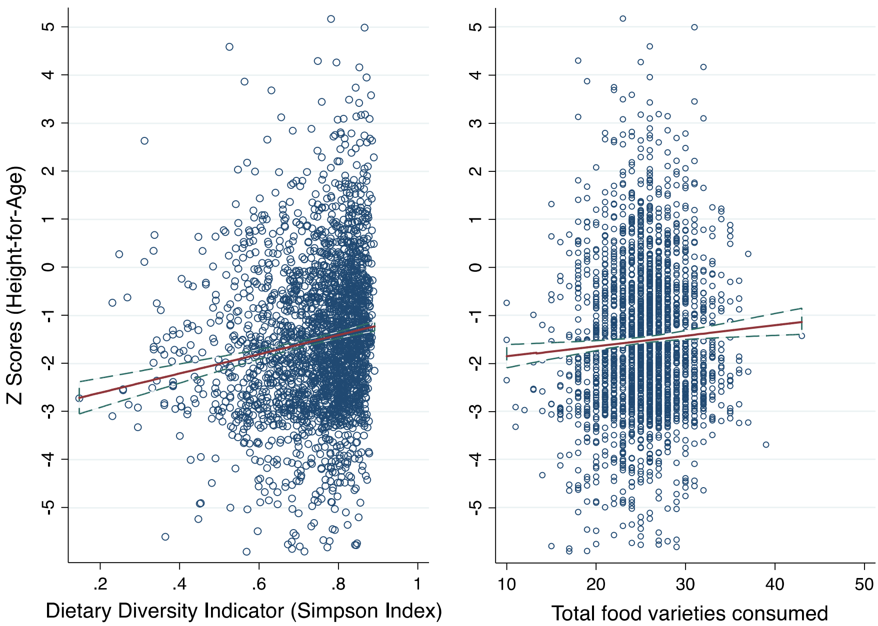

Fig. 2 HAZ and dietary diversity, Nepal. *Source* Nepal, Central Bureau of Statistics (2011)

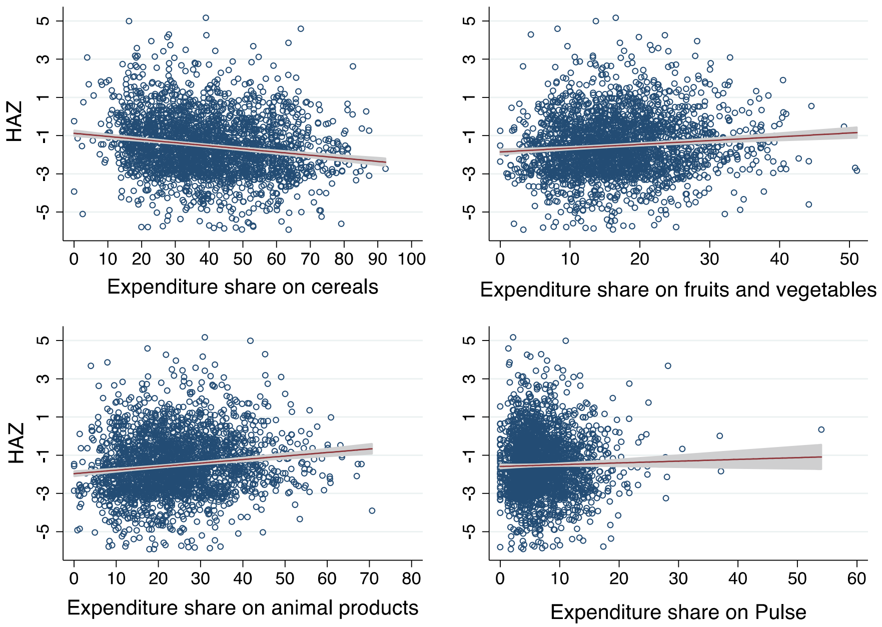

Fig. 3 HAZ and expenditure shares of major food items consumed in Nepal. *Source* Nepal, Central Bureau of Statistics (2011)

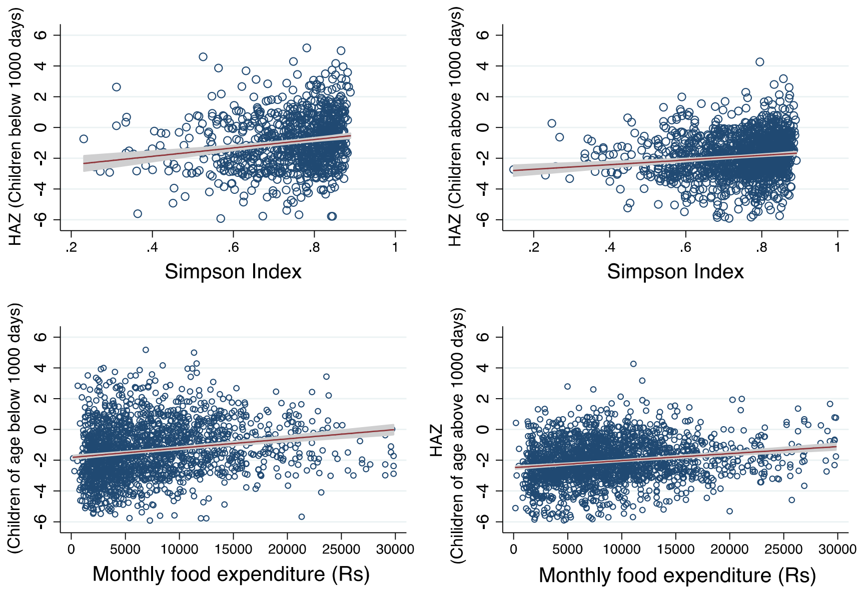

Fig. 4 HAZ and dietary quality for children of different age groups (up to 1000 days and greater than 1000 days), Nepal. *Source* Nepal, Central Bureau of Statistics (1996, 2011)

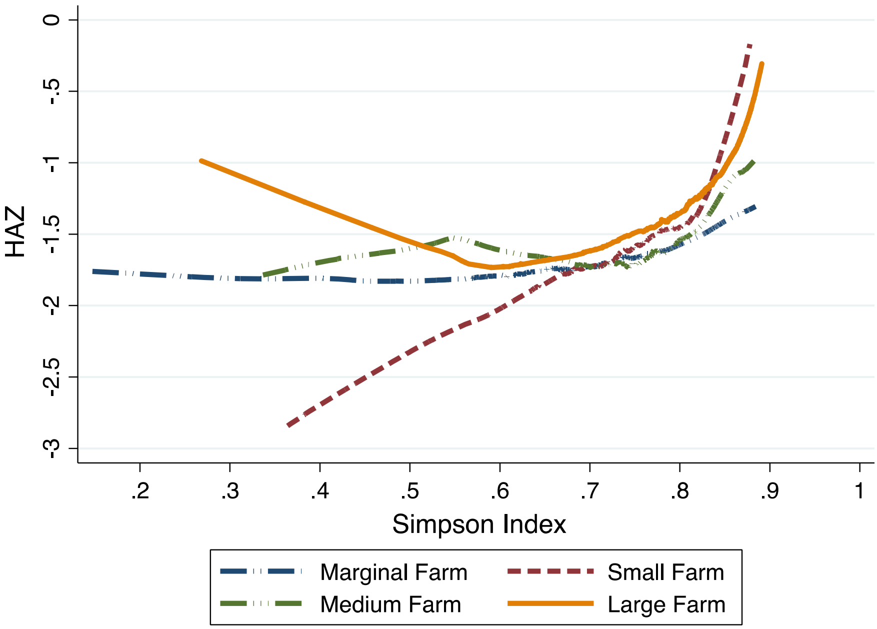

Fig. 5 Nonparametric regression showing the relationship between HAZ and dietary diversity (Simpson Index) based on farm size. *Source* Nepal, Central Bureau of Statistics (2011)

quality and child nutrition outcomes for different farm sizes using a simple non-parametric regression, $m(x) = E(y|x)$, that is, a LOWESS estimator with a bandwidth of 0.8 and used a tricube weighting function. In Fig. 5, y is the HAZ and x is the SI. We observe an interesting pattern. For the small-sized farm, an increase in DD is associated with an increased HAZ for the entire range of the SI. However, for the rest of the farm sizes, the HAZ increases only after an SI of 0.6.

The nonparametric approach helps us to understand the general pattern between HAZ and variables related to diet. However, we require a parametric approach that controls for confounding factors (variables that also influence child nutrition outcomes) as well. Thus, we employ a multilevel model that controls for child, household, community, and district characteristics. Although we incorporate various confounding factors into the multilevel model, the effects of DD on HAZ cannot be claimed to be causal. To estimate the impact of DD on HAZ, we rely on the DRF model.

5.2 *Descriptive Results*

Table 1 provides the summary statistics of the variables used in the empirical analysis. Our dependent variables are the HAZ (continuous variable) and the

Table 1 Descriptive statistics of variables used in the analysis

Variable	1995		2011	
	Mean	Std. Dev.	Mean	Std. Dev.
Dependent variables				
Height-for-age Z-score (HAZ)	−2.076	1.632	−1.521	1.556
Child is stunted (HAZ < −2)[a]	0.55	0.50	0.40	0.49
Child is severely stunted (HAZ < −3)[a]	0.29	0.45	0.14	0.34
Independent variables				
Simpson Index—indicator of dietary diversity	0.623	0.159	0.747	0.112
Number of food varieties consumed	18.738	3.595	25.468	4.137
Total number of food groups consumed	9.516	1.425	10.404	0.983
Total expenditure (Rs.)	3727.65	2231.84	10,943.48	5276.50
Expenditure share on fruits and vegetables	13.454	7.587	16.708	7.515
Expenditure share on animal protein	15.348	10.077	24.119	11.085
Expenditure share on pulses	6.380	5.100	7.004	4.526
Expenditure share on cereals	54.60	17.19	39.20	15.98
SI# Poor	0.27	0.31	0.74	0.11
Child characteristics				
If a child has received immunization, then 1, otherwise 0[a]	0.757	0.429	0.969	0.172
If a child has suffered from dysentery in past two weeks, then 1, otherwise 0[a]	0.054	0.226	0.079	0.270
If a child has suffered from fever in the past two weeks, then 1, otherwise 0[a]	0.077	0.266	0.188	0.391
If a child is male, then 1, otherwise 0[a]	0.480	0.500	0.480	0.500
Child age in months	19.988	11.737	30.297	16.842
Child born in monsoon season, then 1, otherwise 0[a]	0.346	0.476	0.322	0.467
Household characteristics				
If household is in urban region, then 1, otherwise 0[a]	0.125	0.330	0.248	0.432
If household is from Brahmin family, then 1, otherwise 0[a]	0.140	0.347	0.121	0.326
If household is from Mongolian family, then 1, otherwise 0[a]	0.237	0.425	0.248	0.432
If household is from Madhesi family, then 1, otherwise 0[a]	0.191	0.393	0.104	0.305
If household is from unprivileged family, then 1, otherwise 0[a]	0.231	0.422	0.335	0.472
Family size	7.486	3.684	6.422	2.677
Total number of family members less than age of 15 and greater than 65 divided by family size	0.510	0.147	0.507	0.163

(continued)

Table 1 (continued)

Variable	1995		2011	
	Mean	Std. Dev.	Mean	Std. Dev.
Age of household head	42.010	14.616	43.869	14.852
If a mother is illiterate, then 1, otherwise 0	0.843	0.364	0.304	0.460
If mother works in agriculture sector, then 1, otherwise 0[a]	0.635	0.482	0.232	0.422
If a household owns livestock, then 1, otherwise 0[a]	0.868	0.339	0.006	0.077
If household has access to irrigation, then 1, otherwise 0[a]	0.408	0.492	0.464	0.499
If household has used fertilizer, then 1, otherwise 0[a]	0.481	0.500	0.508	0.500
Total agricultural land owned, hectares	1.073	2.228	0.516	0.732
Marginal farm household	0.256	0.436	0.307	0.461
Small farm household	0.170	0.376	0.179	0.383
Medium farm household	0.285	0.452	0.246	0.431
Total remittance received by a household ('00000 Rs.)	0.051	0.380	0.455	1.923
If households is poor, then 1, otherwise 0[a]	0.478	0.500	0.348	0.476
Time taken to reach health post (minutes)	104.951	179.198	276.325	391.331
Community characteristics				
Price index	1.020	0.139	1.036	0.341
Average annual agricultural wage	3822.896	2129.204	11,442.860	10,379.75
Average time (minutes) required to reach the market	528.817	740.156	517.512	742.817
Average time (minutes) required to reach paved road	1423.954	1700.876	926.777	1461.272
District characteristics				
If a household is from mountainous region, then 1, otherwise 0[a]	0.139	0.346	0.077	0.267
If a household is from hilly region, then 1, otherwise 0[a]	0.438	0.496	0.494	0.500
Road density (km of road per 100 km^2 of district area)	14.766	15.879	47.674	71.981
Proportion of all-season roads in a district	45.516	31.143	55.111	23.384

Note Total sample size of 3859 households (1501 from 1995 to 1996 and 2358 from 2010 to 2011)
[a]Indicates dummy/binary variable
Source Authors calculation

indicators of whether the child is stunted or severely stunted (binary variables). The average HAZ improved by 27% (from −2.076 to −1.521) between 1995–1996 and 2010–2011. Similarly, the proportions of child stunting and severe stunting fell by about 15% during the study period. The explanatory variables of interest in our study are indicators of dietary quality and quantity: SI, total number of food varieties consumed, total number of food groups consumed, monthly food expenditure (Rs.), and expenditure share on fruits and vegetables, animal protein, and cereals. The SI and the number of food varieties and groups consumed increased between 1995–1996 and 2010–2011, showing improvement in dietary diversification. Figure 10 shows the histogram plot for the number of food varieties consumed in a sample. The plot clearly shows that consumption of food varieties is well dispersed and tends to follow the normal distribution. The monthly food expenditure increased from Rs. 3727.65 to Rs. 10,943.48 between 1995–1996 and 2010–2011. While the expenditure share for cereals decreased from 55 to 39%, the expenditure shares for fruits and vegetables, animal protein, and pulses increased from 13% to 17%, 15% to 24%, and 6% to 7%, respectively, during the period under study. All this evidence indicates that household dietary quality has improved in Nepal. Since poor households are likely to have higher expenditure shares for the limited food groups, we create an interaction term between poor households and the SI.

We control for the important child, household, community, and district characteristics that we expect to influence the HAZ. The variables used at the child level are immunization status, health condition, gender, age, and birth season. Children receiving immunization increased from 76 to 97% between 1995–1996 and 2010–2011. However, the proportion of children suffering from dysentery and fever increased from 5% to 8% and 7% to 19%, respectively. The proportions of male and female children sampled in 1995–1996 and 2010–2011 were the same. However, we find a significant difference in terms of the average age of children sampled, whereas the average age of child sampled in 1995–1996 was 20 months, and in 2010–2011, it was 30 months. Since child's age may behave in a quadratic fashion with the HAZ, we also included the square term of the child age. We include a monsoon season variable since children might receive less attention in terms of feeding and child care practices in monsoon season (paddy planting season) compared to other seasons in Nepal. A slightly lower proportion of the sampled children was born in monsoon season in 2010–2011 compared with 1995–1996.

At the household level, we include location in urban/rural region, ethnicity (Brahmin, Mongolian, Madhesi, and unprivileged), family size, dependent ratio, age of household head, mother's education status, mother's employment status, livestock farming, household access to irrigation, use of fertilizer, farm size and categories, total annual remittance received by a household, poverty status, and access to health infrastructure, whereas only 13% of the households were sampled from an urban region in 1995–1996; that number rose to about 25% in 2010–2011. Unlike the Madhesi and unprivileged family variables, the proportions of children in the sample from the other ethnic groups (Brahmin, Mongolian) remained similar. The average family size and dependent ratio (number of family members less than age 15 and greater than 65 divided by the family size) decreased slightly in 2010–2011 as compared to the first survey. On average, about 84% of households had an illiterate mother in 1995–1996; however, by 2010–2011, only 30% of households had an illiterate mother, a significant improvement. In addition, the proportion with the mother working in the agriculture sector decreased from 0.64 in 1995–1996 to 0.23 in 2010–2011. While households owning livestock decreased over the period, household access to irrigation and fertilizer increased. Households owning agricultural land decreased—from 1.07 to 0.5 ha—suggesting increasing land fragmentation across time. The proportions of marginal and small farm households increased, but the proportion of large farm households decreased across the time period. We see a lower poverty prevalence in 2010–2011 than in 1995–1996: a reduction from 48 to 35%. This may be due to increasing household incomes due in part to the increasing remittances in the country.

At the community level, we include variables for price index, annual average agricultural wage, and access to market and paved road. The average price index increased slightly. The annual average agricultural wage increased from Rs. 3823 to Rs. 11,443. The average time required to reach the market and that required to reach a paved road decreased, suggesting access to basic facilities in Nepal was improving. However, the average time of about 8 h to reach the market in 2010–2011 suggests the rural and remote nature of the country.

We include an agroecological indicator and road-related variables at the district level. In 2010–2011, about 8% of the sample households were from the mountainous region, 49% were sampled from the hilly region, and 44% were sampled from the Terai region. Road density increased from 14.77 to 47.67 during the period under study, and the proportion of all-season roads increased from 46 to 55%. This is evidence of improvement of the road infrastructure across time. We also account for yearly fixed effects. About 61% of the sampled households come from NLSS 2010–2011, while 39% of the sampled households come from NLSS 1995–1996.

5.3 Empirical Results

Table 2 presents the results of the multilevel model vis-à-vis the effects of dietary quality on child nutrition outcomes. We first predict the full model (including all the sampled children). Next, we estimate two separate models: for children of age less than or equal to 1000 days and for children greater than 1000 days old. Nutrition advocates emphasize proper nourishment of children in their first 1000 days. Any nutrition deficiency during this critical window is found to permanently affect the child's learning ability and his or her future productivity (Shariff et al. 2000; Galler and Barrett 2001; Glewwe 1999). For the full model, we predict intraclass correlation coefficients as follows: 0.03, 0.08, and 0.07 at the district, community, and household levels, respectively. All of these coefficients are statistically significant at

Table 2 Effects of dietary quality on HAZ using a multilevel model

Variable	Full model	Children 1000 days or less	Children above 1000 days
If year is 2011, then 1, otherwise 0	0.3325**	0.4972***	−0.0903
	(0.1441)	(0.1726)	(0.2087)
Monthly food expenditure ('000 Rs.)	0.0128*	−0.0039	0.0218**
	(0.0077)	(0.0112)	(0.0088)
Simpson Index—indicator of dietary diversity	0.6990**	0.0032	1.1847**
	(0.3520)	(0.5732)	(0.4885)
Interaction between Simpson Index and poor	−0.6482*	−0.5621	−0.7626
	(0.3326)	(0.5084)	(0.4897)
Number of food varieties consumed	−0.0080	−0.0051	−0.0098
	(0.0077)	(0.0123)	(0.0088)
Total number of food groups consumed	0.0592**	0.0712**	0.0520*
	(0.0268)	(0.0349)	(0.0300)
Expenditure share on fruits and vegetables	0.0043	0.0186***	−0.0069
	(0.0044)	(0.0071)	(0.0056)
Expenditure share on animal protein	−0.0000	0.0053	−0.0037
	(0.0035)	(0.0049)	(0.0042)
Expenditure share on pulses	−0.0027	0.0125	−0.0162**
	(0.0062)	(0.0082)	(0.0080)
If child has received immunization, then 1, otherwise 0	0.1574*	0.2913**	0.2199**
	(0.0900)	(0.1252)	(0.1034)
If child has suffered from dysentery in past two weeks, then 1, otherwise 0	−0.0821	0.1068	−0.1044
	(0.0994)	(0.1386)	(0.1326)
If child has suffered from fever in past two weeks, then 1, otherwise 0	−0.0496	0.1039	−0.0851
	(0.0581)	(0.1102)	(0.0864)
If child is male, then 1, otherwise 0	0.1093***	0.2243***	0.0197
	(0.0382)	(0.0587)	(0.0507)
Child age in months	−0.1142***	−0.2549***	0.0053
	(0.0069)	(0.0190)	(0.0242)
Child age in months, square	0.0014***	0.0062***	−0.0001
	(0.0001)	(0.0007)	(0.0003)
Child born in monsoon season, then 1, otherwise 0	−0.1702***	−0.2523***	−0.1195*
	(0.0502)	(0.0637)	(0.0617)
If household is in urban region, then 1, otherwise 0	0.1638	0.0899	0.1897
	(0.1009)	(0.1416)	(0.1276)
If household belongs to Brahmin family, then 1, otherwise 0	−0.0051	−0.0406	0.0051
	(0.0905)	(0.1259)	(0.1027)
If household belongs to Mongolian family, then 1, otherwise 0	−0.0054	0.1642*	−0.1296
	(0.0757)	(0.0989)	(0.0909)

(continued)

Table 2 (continued)

Variable	Full model	Children 1000 days or less	Children above 1000 days
If household belongs to Madhesi family, then 1, otherwise 0	−0.1431	−0.1123	−0.1512
	(0.1163)	(0.1515)	(0.1177)
If households belongs to unprivileged family, then 1, otherwise 0	−0.1712**	−0.2285**	−0.1369*
	(0.0703)	(0.1077)	(0.0824)
Family size	0.0033	0.0089	−0.0034
	(0.0108)	(0.0161)	(0.0143)
Total number of family members less than age of 15 and greater than 65 divided by family size	−0.2416	−0.4038**	−0.2324
	(0.1683)	(0.1963)	(0.2117)
Age of household head	0.0007	−0.0025	0.0031
	(0.0021)	(0.0030)	(0.0023)
If mother is illiterate, then 1, otherwise 0	−0.0430	−0.1116	0.0102
	(0.0551)	(0.0996)	(0.0621)
If mother works in agriculture sector, then 1, otherwise 0	−0.0490	−0.0443	−0.1118*
	(0.0651)	(0.0876)	(0.0673)
If household owns livestock, then 1, otherwise 0	−0.1489	0.0295	−0.4693***
	(0.1197)	(0.1223)	(0.1671)
If household has access to irrigation, then 1, otherwise 0	0.0650	0.0700	0.0876
	(0.0610)	(0.0877)	(0.0675)
If household has used fertilizer, then 1, otherwise 0	−0.0350	−0.0325	−0.0167
	(0.0628)	(0.0978)	(0.0750)
Total agricultural land owned, hectares	0.0224	0.0405	0.0059
	(0.0180)	(0.0269)	(0.0190)
Marginal farm household	0.0022	0.0840	−0.0548
	(0.0718)	(0.1189)	(0.0890)
Small farm household	0.0966	0.1375	0.0212
	(0.0816)	(0.1408)	(0.1082)
Medium farm household	0.0189	0.1008	−0.0855
	(0.0744)	(0.1386)	(0.0951)
Total remittance received by household ('00000 Rs.)	0.0121	0.0857***	−0.0047
	(0.0159)	(0.0302)	(0.0107)
If household is poor, then 1, otherwise 0	0.2108	0.2312	0.2514
	(0.2318)	(0.3472)	(0.3362)
Time taken to reach health post (minutes)	0.0001	0.0001	0.0002**
	(0.0001)	(0.0001)	(0.0001)
Price index	0.2348	0.4799**	−0.0482
	(0.1858)	(0.2098)	(0.2111)
Average annual agricultural wage in a community	0.0000	0.0000**	−0.0000
	(0.0000)	(0.0000)	(0.0000)

(continued)

Table 2 (continued)

Variable	Full model	Children 1000 days or less	Children above 1000 days
Average time (minutes) required to reach the market in a community	−0.0001**	−0.0001	−0.0001***
	(0.0000)	(0.0000)	(0.0000)
Average time (minutes) required to reach the paved road in a community	−0.0000	−0.0000	−0.0000
	(0.0000)	(0.0000)	(0.0000)
If household is from mountainous region, then 1, otherwise 0	−0.0244	0.0974	−0.1696
	(0.1125)	(0.1626)	(0.1306)
If household is from hilly region, then 1, otherwise 0	0.0098	0.0877	−0.0691
	(0.0819)	(0.1098)	(0.0929)
Road density (km of road per 100 km^2 of district area)	0.0006	−0.0008	0.0023**
	(0.0008)	(0.0007)	(0.0009)
Proportion of all-season roads in a district	0.0019	0.0034*	−0.0005
	(0.0014)	(0.0020)	(0.0016)
Constant	−1.5354***	−1.4831***	−2.7859***
	(0.3913)	(0.4977)	(0.7863)
Observations	3859	1861	1998
Number of groups	73	73	73
Fit statistics (AIC)	13,528.85	6830.12	6582.85
Random intercept			
District (variance)	0.01335	5.80e-10	0.0202
	(0.0103)	(2.84e-08)	(0.01192)
Community (variance)	0.1000	0.10737	0.13202
	(0.02653)	(0.0573)	(0.03905)
Household (variance)	0.3448	0.23414	0.33606
	(0.07673)	(0.2038)	(0.1166)
Residuals	1.4838	1.8502	1.0498
	(0.07929)	(0.2030)	(0.1119)

Source Authors' work based on NLSS datasets
Note Robust standard errors in parentheses
*** $p < 0.01$. ** $p < 0.05$. * $p < 0.1$

the less than 5% level. This implies that the district level accounts for 3% of the HAZ variation at the child level; the community level accounts for 8% of the HAZ variation at the child level; and the household level accounts for 7% of the HAZ variation at the child level.

We interpret those coefficients that are statistically significant at the less than 10% level. On average, HAZ increased by 0.40 between 1995–1996 and 2010–2011. The monthly food expenditure (Rs.) is positively associated with HAZ, implying the importance of dietary intake quantity on child nutrition outcomes, especially for children more than 1000 days old. The SI is positive and statistically significant at less than 10% only for children over 1000 days old. We also create an interaction term between SI and poverty with the assumption that poor households tend to have lower DD. We find a negative and statistically significant term for the full model. This suggests that the poorer households have lower DD. We find a positive and significant effect of the total number of food groups consumed for all models. The marginal effect of total number of food groups consumed is higher (0.07) for children up to 1000 days than that of children over 1000 days old. Different food groups supply diverse nutritional needs of children, thus improving nutrition outcomes. Only for the children 1000 days and younger do we find a positive and statistically significant effect of the expenditure share on fruits and vegetables. Overall, these findings highlight the importance of monthly food expenditure, SI, and the total number of food groups consumed on child nutrition outcomes. The random effects at all levels are statistically significant suggesting that rich heterogeneity prevails in the dataset. Since we are interested in understanding the effects of the DD-related variables, we do not interpret the rest of the coefficients.

We use a binary logistic model to understand which dietary variables are important in reducing the probability of stunting/severe stunting of children (Table 3). First, we run a parsimonious model including only the dietary variables and controlling for the agroecological indicators and yearly fixed effects. Then we include the rest of the variables controlling for confounding factors. In doing so, we assess the robustness of the results. We find that the monthly food expenditure and SI are associated with a reduced probability of severe child stunting, while the number of food groups consumed is associated with a reduced probability of child stunting. The coefficient of the interaction term between SI and poverty is positive and statistically significant for all models, implying that the poorer households have lower DD. Although the coefficient on the animal protein expenditure share is negative and significant in the parsimonious model, we do not find the coefficient to be statistically significant once we control for other variables. Sari et al. (2010) found that Indonesian households spending a relatively greater proportion of their budget on nongrain foods, particularly animal-source foods, had a lower incidence of child stunting.

5.4 Robustness Test

We estimate several models based on the location of residence (rural or urban) and farm type (marginal, small, medium, and large), and we employ a quantile regression approach to assess the robustness of the results (Table 4). The SI variable and its interaction term with the poverty variable are statistically significant for households in the rural areas, marginal farms, and households within the 30th percentile of the HAZ. The total number of food groups consumed is statistically significant for all the models except the households owning a farm larger than 0.33 ha and households within the 30th percentile of the HAZ. The fruits and

Table 3 Effects of dietary quality on the probability of child stunting in Nepal

Variables	Severely stunted (model A)	Severely stunted (model B)	Stunted (model C)	Stunted (model D)
If year is 2011, then 1, otherwise 0	−0.2973**	0.0763	−0.3650***	−0.6795***
	(0.1298)	(0.2591)	(0.1024)	(0.2015)
Monthly expenditure on food ('000 Rs.)	−0.0337***	−0.0386**	−0.0171**	−0.0102
	(0.0127)	(0.0151)	(0.0087)	(0.0112)
Interaction between Simpson Index and poverty	0.6614***	1.0864*	0.5665***	1.7773***
	(0.1359)	(0.6148)	(0.1063)	(0.5412)
Simpson Index—indicator of dietary diversity	−1.1035*	−1.3627*	−0.4333	−1.0103
	(0.6160)	(0.7857)	(0.5077)	(0.6542)
Number of food varieties	−0.0075	−0.0176	0.0168	0.0060
	(0.0138)	(0.0144)	(0.0107)	(0.0118)
Total number of food groups consumed	−0.0479	−0.0403	−0.0704**	−0.0469
	(0.0386)	(0.0399)	(0.0353)	(0.0382)
Expenditure share on fruits and vegetables	−0.0118	−0.0054	−0.0045	0.0042
	(0.0081)	(0.0085)	(0.0065)	(0.0071)
Expenditure share on animal protein	−0.0142**	−0.0078	−0.0125***	−0.0048
	(0.0065)	(0.0068)	(0.0048)	(0.0051)
Expenditure share on pulses	−0.0031	0.0020	−0.0075	−0.0017
	(0.0101)	(0.0101)	(0.0080)	(0.0085)
If child has received immunization, then 1, otherwise 0		−0.2523**		−0.1681
		(0.1283)		(0.1184)
If child has suffered from dysentery in past two weeks, then 1, otherwise 0		0.0626		0.2593*
		(0.1840)		(0.1450)
If child has suffered from fever in past two weeks, then 1, otherwise 0		−0.0621		0.0292
		(0.1377)		(0.1029)
If a child is male, then 1, otherwise 0		−0.1695*		−0.0531
		(0.0873)		(0.0703)
Child age in months		0.0313***		0.0382***
		(0.0029)		(0.0024)
If household belongs to Brahmin family, then 1, otherwise 0		−0.3342*		0.0137
		(0.1766)		(0.1326)
If households belongs to Mongolian family, then 1, otherwise 0		0.1172		0.2510**
		(0.1367)		(0.1094)
If household belongs to Madhesi family, then 1, otherwise 0		0.0589		0.3666**
		(0.1758)		(0.1445)
If household belongs to unprivileged family, then 1, otherwise 0		0.0807		0.3481***
		(0.1389)		(0.1153)
If household is in urban region, then 1, otherwise 0		−0.3181		−0.0288
		(0.2016)		(0.1462)

(continued)

Table 3 (continued)

Variables	Severely stunted (model A)	Severely stunted (model B)	Stunted (model C)	Stunted (model D)
Family size		0.0051		−0.0265*
		(0.0168)		(0.0145)
If mother is illiterate, then 1, otherwise 0		0.1714		0.1157
		(0.1094)		(0.0841)
If mother works in agriculture sector, then 1, otherwise 0		0.0805		0.1234
		(0.0954)		(0.0808)
If a household owns livestock, then 1, otherwise 0		0.3745*		0.0810
		(0.2207)		(0.1729)
Marginal farm household		−0.3114**		0.0410
		(0.1326)		(0.1070)
Small farm household		−0.1320		−0.0596
		(0.1472)		(0.1222)
Medium farm household		−0.0812		0.1538
		(0.1384)		(0.1126)
If household is poor, then 1, otherwise 0		−0.3865		−0.8454**
		(0.4165)		(0.3753)
Total remittance received by household (’00000 Rs.)		−0.1247		−0.0308
		(0.1158)		(0.0751)
Time taken to reach health post (minutes)		−0.0003*		−0.0003**
		(0.0002)		(0.0001)
Time taken to reach markets (minutes)		0.0001		0.0002***
		(0.0001)		(0.0001)
Price index		0.3405		−0.8412**
		(0.4773)		(0.3346)
Road density (km of road per 100 km^2 of district area)		−0.0052**		0.0011
		(0.0024)		(0.0014)
Proportion of all-season roads in a district		−0.0022		−0.0042**
		(0.0020)		(0.0018)
If household is from mountainous region, then 1, otherwise 0	0.0513	−0.2206	0.3402***	0.3785**
	(0.1438)	(0.2036)	(0.1230)	(0.1668)
If household is from hilly region, then 1, otherwise 0	−0.0866	−0.1451	0.0126	0.0739
	(0.0963)	(0.1472)	(0.0755)	(0.1149)
Constant	0.6936*	−0.0699	1.0088***	1.1266*
	(0.3638)	(0.7450)	(0.3330)	(0.6184)
Observations	3859	3859	3859	3859

Source Authors own calculation

Table 4 Robustness test: effects of dietary quality on HAZ

Variables	Full	Urban	Rural	Marginal farm	Small farm	Medium farm	Large farm	30th percentile	70th percentile
If year is 2011, then 1, otherwise 0	0.3325**	0.6883***	0.0680	0.0295	−1.4616***	0.5259	0.7609***	0.2598*	0.3395
	(0.1441)	(0.2445)	(0.2277)	(0.2692)	(0.4175)	(0.4777)	(0.2365)	(0.1528)	(0.2119)
Monthly food expenditure ('000 Rs.)	0.0128*	0.0024	0.0171*	0.0260**	0.0318*	0.0117	−0.0053	0.0142*	0.0056
	(0.0077)	(0.0130)	(0.0096)	(0.0120)	(0.0165)	(0.0127)	(0.0147)	(0.0080)	(0.0095)
Simpson Index—indicator of dietary diversity	0.6990**	−0.5651	1.0354**	1.8995**	1.0836	0.2134	0.2372	1.1283*	0.2848
	(0.3520)	(0.6767)	(0.4456)	(0.7431)	(1.0286)	(0.9231)	(0.6944)	(0.6064)	(0.5379)
Interaction between Simpson Index and poverty	−0.6482*	−1.0421	−0.6017*	−1.3654**	1.4974	−1.2510	−0.7451	−1.0125*	−0.4323
	(0.3326)	(1.0958)	(0.3349)	(0.5814)	(0.9498)	(0.7639)	(0.7147)	(0.5227)	(0.4259)
Number of food varieties consumed	−0.0080	0.0006	−0.0081	0.0010	−0.0038	−0.0065	−0.0188	−0.0047	−0.0131
	(0.0077)	(0.0200)	(0.0086)	(0.0138)	(0.0186)	(0.0125)	(0.0239)	(0.0099)	(0.0094)
Total number of food groups consumed	0.0592**	0.0989**	0.0567*	0.0784**	0.0467	0.0527	0.0498	0.0380	0.0634**
	(0.0268)	(0.0460)	(0.0300)	(0.0362)	(0.0772)	(0.0512)	(0.0475)	(0.0343)	(0.0276)
Expenditure share on fruits and vegetables	0.0043	0.0177***	−0.0002	0.0025	−0.0129	0.0024	0.0096	0.0016	−0.0043
	(0.0044)	(0.0063)	(0.0057)	(0.0086)	(0.0122)	(0.0091)	(0.0063)	(0.0054)	(0.0053)
Expenditure share on animal protein	−0.0000	−0.0009	−0.0013	−0.0065	−0.0075	0.0014	0.0028	0.0044	−0.0012
	(0.0035)	(0.0059)	(0.0045)	(0.0069)	(0.0077)	(0.0076)	(0.0069)	(0.0040)	(0.0047)

(continued)

Table 4 (continued)

Variables	Full	Urban	Rural	Marginal farm	Small farm	Medium farm	Large farm	30th percentile	70th percentile
Expenditure share on pulses	−0.0027	0.0051	−0.0072	−0.0077	−0.0126	0.0074	−0.0047	−0.0006	0.0017
	(0.0062)	(0.0104)	(0.0072)	(0.0116)	(0.0136)	(0.0149)	(0.0079)	(0.0096)	(0.0079)
Constant	−1.5354***	−1.4592	−1.3993**	−2.6906***	0.5132	−1.7077	−1.3257	−2.9456***	−0.0103
	(0.3913)	(0.9592)	(0.6953)	(0.6367)	(1.4191)	(1.0960)	(0.8359)	(0.5483)	(0.4811)
Observations	3859	772	3087	1108	677	1008	1066	3859	3859
Number of groups	73	43	73	72	72	71		67	

Source Authors' work based on NLSS datasets
Note Included all the control/explanatory variables as reported in Table 2. Robust standard errors in parentheses
***$p < 0.01$. **$p < 0.05$. *$p < 0.1$

vegetables' expenditure share variable is statistically significant only for urban children. Overall, the results from the main model are highly robust for households residing in rural areas, belonging to the marginal farm group, and falling within the 30th percentile of the HAZ. For urban households, households with larger farm sizes, and those falling within the 70th percentile of the HAZ, the results given by the full model should be cautiously interpreted.

5.5 *Results from DRF Approach*

We use the DRF approach to estimate the impact of number of food varieties and groups consumed, monthly food expenditure, and the expenditure shares on the different food groups (fruits and vegetables, cereals, animal and plant proteins) on HAZ and the probability of child stunting. The outcome variable of interest is HAZ and whether the child is stunted or not. We also estimate a separate DRF for children up to 1000 days old and for those greater than 1000 days old. Table 7 lists the pretreatment variables and the results of a balancing test.[7] There are significant differences in the average values of the covariates between the treatment groups for the GPS-unadjusted sample. However, after adjusting the GPS, those significant differences are ruled out. We also plot the GPS for the different treatment groups to see whether overlapping exists among the GPSs between the treatment and overall groups (Fig. 11). We observe significant overlapping especially at the higher values of propensity scores.

Figure 6 shows the estimated DRF (solid line) for the number of food varieties consumed and for the number of food groups consumed. The horizontal dashed line is the benchmark treatment level. The DRF is higher than the benchmark treatment in the case of number of food groups consumed across entire treatment levels. However, nonlinearity in the DRF is evident. Although the treatment effect steadily increases up to the treatment level of around 8, it declines between the treatment level of 8 and 9, and then again increases after the treatment level of 9 (Fig. 6, panel A). Consumption of more than seven food groups is found to exceed the stunting threshold of children. In Fig. 6, panel B, the slope of the DRF continuously increases until the treatment level of 30 is reached. However, after the treatment level of 30, the impact gradually declines. The treatment threshold that exceeds the stunting rate is around the treatment level of 17.

Figure 7 shows the DRF estimated for number of food varieties consumed and number of food groups consumed for children up to 1000 days old and over 1000 days old. For the treatment *number of food varieties consumed,* the estimated DRF is higher than the benchmark treatment level up to a certain treatment level (Fig. 7, panels A and B). However, the DRF is steeper for children more than

[7]For brevity, we show only the balancing test for the treatment *total number of food groups consumed.*

Table 5 Explaining observed improvements in HAZ between 1995–1996 and 2010–2011 in Nepal

	Dietary quality	Household characteristics	Community characteristics	District characteristics
Year 1995–1996	−2.07	−2.07	−2.07	−2.07
	0.042	0.042	0.042	0.042
Year 2010–2011	−1.52	−1.52	−1.52	−1.52
	0.03	0.03	0.03	0.03
Difference	−0.55	−0.55	−0.55	−0.55
	0.05	0.05	0.05	0.05
Explained	−0.39	−0.40	−0.06	−0.14
	0.06	0.11	0.03	0.02
Explained (%)	**71%**	**73%**	**11%**	**25%**

Source Authors own calculation
Note All coefficients are statistically significant at the less than 1% level

Table 6 Factors explaining improvement in nutrition between 1995–1996 and 2010–2011

Dietary quality variables	HAZ	Explained (%) change
Monthly expenditure on food ('000 Rs.)	−0.16	29.09
	(0.04)	
Dietary diversity (food groups consumed)	−0.08	14.54
	(0.02)	
Expenditure share on fruits and vegetables	−0.04	9.09
	(0.02)	
Expenditure share on animal protein	−0.09	18.18
	(0.03)	

Source Authors own calculation
Note Robust standard errors in parentheses

1000 days old. The impact of number of food varieties consumed decreases after the treatment level of 30 is reached. For the treatment *number of food groups consumed,* we find an increasing impact of the treatment for both age groups (Fig. 7, panels C and D), but the treatment impact is greater for the children up to 1000 days old. Overall, the findings suggest a differential treatment effect of dietary quality for children belonging to different age groups.

Figure 8 shows the impact on HAZ of the expenditure shares devoted to cereals, fruits and vegetables, animal protein, and plant protein. In the case of cereals, the estimated DRF is lower than the benchmark treatment level, suggesting that a higher cereals' expenditure share has a negative impact on average HAZ (Fig. 8, panel A). Campbell et al. (2010) found that households in Bangladesh spending a higher proportion of their food budget on rice have a greater prevalence of child malnutrition. After a treatment level of about 16, we see that the expenditure share

Table 7 Balancing test for covariates given the generalized propensity scores: t-statistics for the equality of means

Covariates	Adjusted		Unadjusted
	[4–9]	[9–11]	Between [4–9] and [9–11]
Family size	−0.43	0.66	0.40
Dependent ratio	0.94	−0.31	−3.77***
Adult ratio	0.87	−0.25	5.34***
Male headed	−1.09	1.29	1.77
Mother illiterate	−0.94	0.22	−1.38
Age	−1.17	0.71	0.16
Chhetri ethnicity	1.46	−1.76	1.59
Mongolian ethnicity	1.19	−0.96	3.71***
Madhesi ethnicity	0.00	0.45	2.30
Household has migrated in past	−0.69	0.17	−3.61***
Transfers (Lakh rupees)	−1.55	1.16	−0.38
Household receives remittance	1.47	−0.90	4.59***
Poor	−0.13	0.58	−7.99***
Nonfarm income	0.73	−0.33	2.11
Net buyers	1.76	−1.05	−0.16
Urban	0.94	0.03	5.15***
Crop diversity	−1.31	0.42	−3.27***
Kitchen garden	−1.48	0.33	−2.11
Mother employed in agriculture	0.58	−0.52	−3.65***
Total land	−1.34	0.98	−5.47***
Marginal farm	1.64	−1.43	−2.85***
Small farm	0.25	−0.45	−1.12
Large farm	1.08	−0.41	5.73***
Improved seed	0.31	0.10	3.06***
Irrigated	0.44	−0.42	2.10
Fertilizer	0.01	−0.83	2.64***
Telephone	−0.75	0.61	0.60
Annual ag. wage	1.21	−1.40	1.34
Time to reach paved roads (h)	0.05	−0.31	−4.99***
Price index	1.21	−0.50	3.88***
Mountain	−0.13	0.21	−2.47
Hill	0.14	−0.03	−4.79***
Terai	−0.07	−0.07	6.19***

Source Authors' work based on NLSS datasets
*** Significant at the less than 1% level

going to fruits and vegetables has a positive impact on the expected HAZ (Fig. 8, panel C). The higher expenditure share on both animal and plant proteins causes the expected higher HAZ (Fig. 8, panels B and D). These results suggest that a

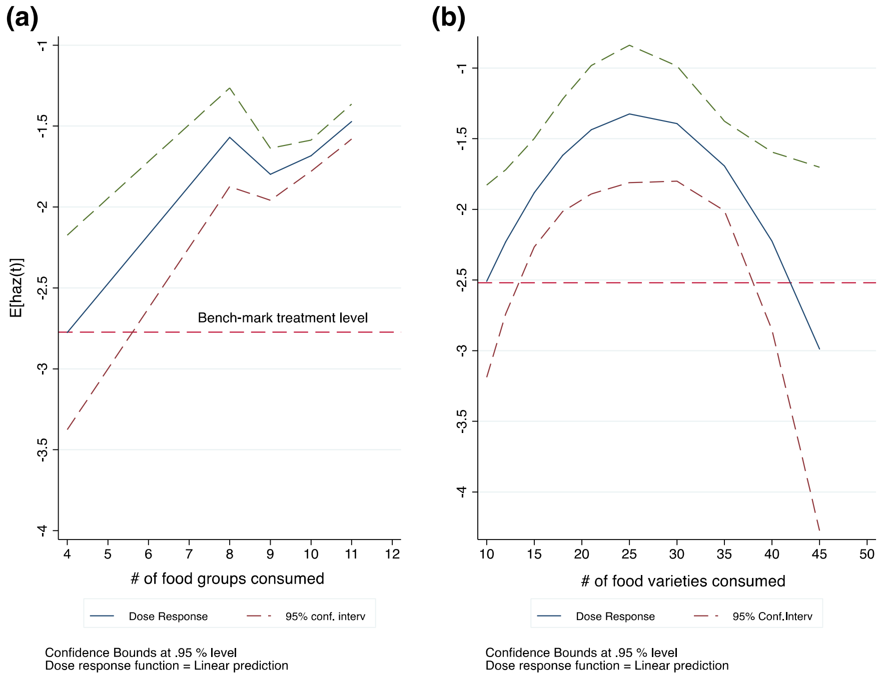

Fig. 6 Dose–response function assessing the impact of number of food varieties/groups consumed on HAZ. *Source* Authors own estimation

household diet characterized by a greater proportion of nonstaple foods and one that is nutritious improves children's long-term nutrition outcomes.

Figure 9 shows the impact of monthly food expenditure on HAZ (panel A) and on the probability of children being severely stunted (panel B). As expected, an increase in the household's monthly food expenditure leads to a better HAZ while reducing the incidence of severe stunting. This shows that not only dietary quality but also dietary quantity matters for child nutrition outcomes.

Figure 12 shows the estimated DRF (solid line) where the outcome is the child stunting rate and the treatment is number of food groups consumed or food varieties consumed. Except for the treatment interval between 8 and 9, an increase in number of food groups consumed leads to a reduction of child stunting incidence (Fig. 12, panel A). We expect greater food variety in the diet to reduce child stunting in a linear fashion. However, after a certain treatment level, the probability of child stunting increases (Fig. 12, panel B). Consumption of about 30 food varieties in a month seems to be an optimal dietary dose.

Figure 13 shows the impact of the expenditure shares of cereals, fruits and vegetables, animal protein, and plant protein on the probability of child stunting. In the case of cereals, we see a higher probability of child stunting at the higher treatment level (Fig. 13, panel A). But in the cases of fruits and vegetables, animal

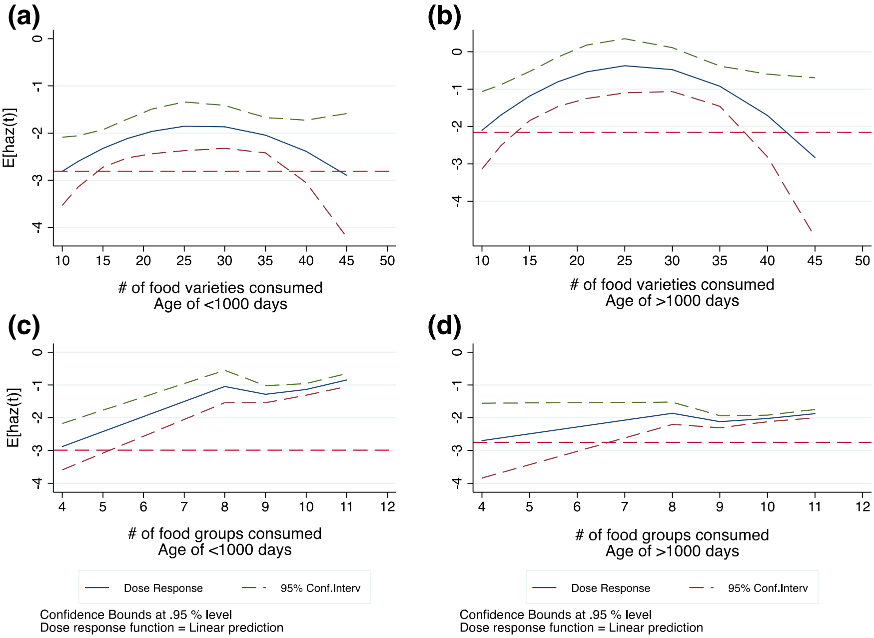

Fig. 7 Dose–response function assessing the impact of number of food varieties/groups consumed on HAZ for children up to and greater than 1000 days of age. *Source* Authors own estimation

protein, and pulses, the expected headcount of stunted children reduces as their expenditure share increases, suggesting the importance of a higher proportion of nonstaple foods in the household's diet (Fig. 13, panels B, C, and D).

5.6 Role of Dietary Quality in Child Nutrition Improvement Between 1995–1996 and 2010–2011 in Nepal

We estimate several multilevel models to assess whether changes in dietary quality explain the improvement in HAZ (Table 11). First, we run a model incorporating only yearly fixed effects. Then we add dietary quality and reestimate the model. Next, we add household characteristics to the yearly fixed-effects model. We do similarly for community- and district-level variables. We then examine how the magnitude of the yearly fixed-effects coefficients (from the parsimonious model) changes in the subsequent models. The biggest improvement in HAZ is explained by changes in dietary quality (coefficient reduced from 0.5671 to 0.202). This illustrates the importance of dietary quality improvement for child nutrition outcomes.

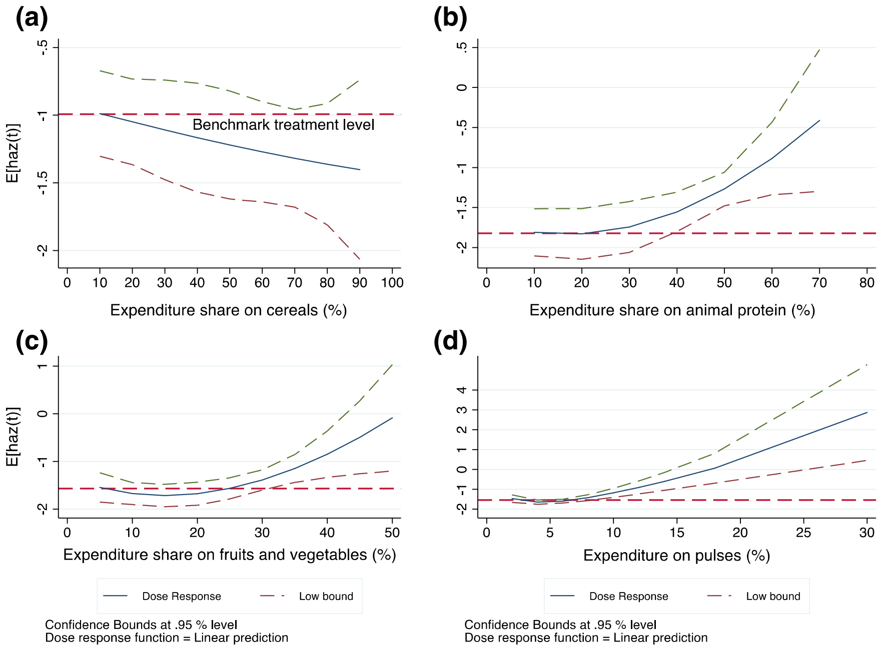

Fig. 8 Impact on HAZ of expenditure shares going to cereals, fruits and vegetables, animal proteins, and plant proteins. *Source* Authors own estimation

Further, we use a twofold Blinder–Oaxaca decomposition technique to assess what portion of the improvement in HAZ is explained by the improvement in dietary quality between 1995–1996 and 2010–2011. Table 5 shows average HAZs in 1995 and 2011 and the changes that are accounted for by differences in dietary quality and household, community, and district characteristics across the time period. The difference in household characteristics explains 73% of the nutrition improvement, followed by the change in dietary quality (71%), change in district characteristics (25%), and change in community characteristics (11%). The improvement in dietary quality played a huge role in the improving HAZs. Some things contributing to the improvement in dietary quality may be rising incomes of Nepalese households, increasing access to roads and markets, and higher levels of parental education (Nepal, Central Bureau of Statistics 2011).

Table 6 illustrates how the different dietary quality variables explain the improvement in HAZ. Among those variables, we find that monthly food expenditure, number of food groups in a diet, fruit and vegetable expenditure share, and animal protein expenditure share are important in explaining the nutritional improvement between 1995 and 2011. The improvements in monthly food expenditure, animal protein expenditure share, fruits and vegetables expenditure share, and number of food groups in the diet explain about 29%, 18%, 9%, and 15% of the HAZ improvement, respectively.

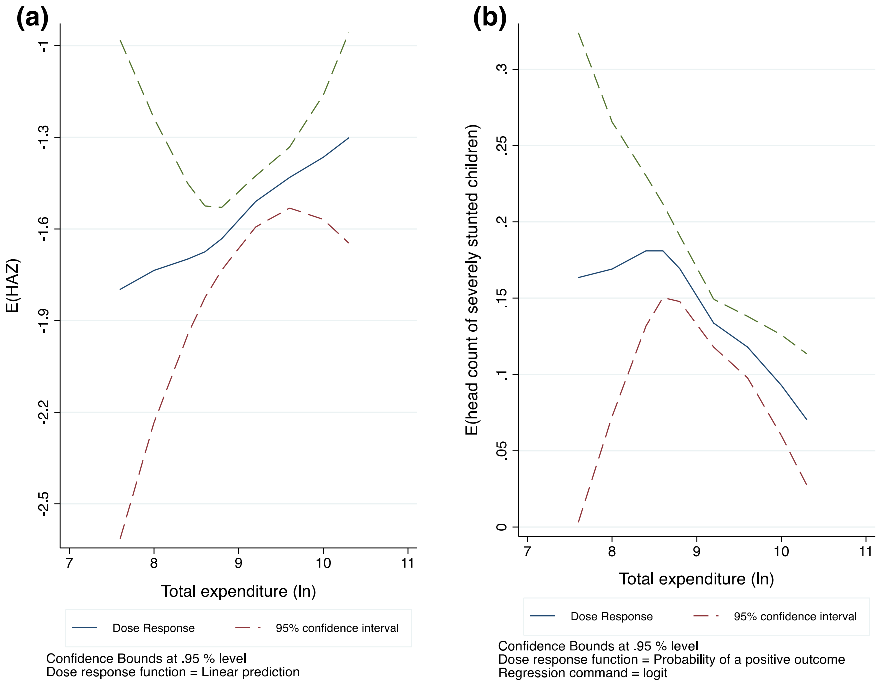

Fig. 9 Impact of monthly food expenditure on HAZ and on the probability of children being severely stunted. *Source* Authors own estimation

Table 8 Factors influencing child nutrition improvement between 1995–1996 and 2010–2011

Variables	Year	Dietary quality	Household	Community	District
If year is 2011, then 1, otherwise 0	0.5671***	0.2022**	0.2647*	0.5308***	0.4576***
	(0.0613)	(0.0840)	(0.1436)	(0.0636)	(0.0687)
Monthly expenditure on food ('000 Rs.)		0.0269***			
		(0.0060)			
Simpson Index—indicator of dietary diversity		0.6595*			
		(0.3743)			
Number of food varieties consumed		−0.0094			
		(0.0083)			
Total number of food groups consumed		0.0761***			
		(0.0250)			
Expenditure share on fruits and vegetables		0.0078			
		(0.0051)			
Expenditure share on animal protein		0.0068*			
		(0.0037)			

(continued)

Table 8 (continued)

Variables	Year	Dietary quality	Household	Community	District
Expenditure share on pulses		0.0006			
		(0.0063)			
If household is in urban region, then 1, otherwise 0			0.2849***		
			(0.0866)		
If household belongs to Brahmin family, then 1, otherwise 0			0.0075		
			(0.0960)		
If household belongs to Mongolian family, then 1, otherwise 0			−0.0273		
			(0.0853)		
If household belongs to Madhesi family, then 1, otherwise 0			−0.1473		
			(0.1233)		
If household belongs to unprivileged family, then 1, otherwise 0			−0.1749**		
			(0.0810)		
Family size			0.0202**		
			(0.0093)		
Total number of family members less than age of 15 and greater than 65 divided by family size			−0.7333***		
			(0.1894)		
Age of household head			0.0018		
			(0.0023)		
If mother is illiterate, then 1, otherwise 0			−0.0747		
			(0.0623)		
If mother works in agriculture sector, then 1, otherwise 0			−0.1022		
			(0.0699)		
If household owns livestock, then 1, otherwise 0			−0.1589		
			(0.1321)		
If household has access to irrigation, then 1, otherwise 0			0.0595		
			(0.0632)		
If household has used fertilizer, then 1, otherwise 0			0.0384		
			(0.0615)		
Total agricultural land owned, hectares			−0.0122		
			(0.0174)		

(continued)

Table 8 (continued)

Variables	Year	Dietary quality	Household	Community	District
Marginal farm household			−0.0887		
			(0.0730)		
Small farm household			0.0228		
			(0.0864)		
Medium farm household			−0.0330		
			(0.0771)		
Total remittance received by household ('00000 Rs.)			0.0096		
			(0.0199)		
If household is poor, then 1, otherwise 0			−0.2935***		
			(0.0544)		
Time taken to reach health post (minutes)			0.0001		
			(0.0001)		
Price index				0.5868***	
				(0.0705)	
Average annual agricultural wage in a community				−0.0000	
				(0.0000)	
Time (minutes) taken to reach market center				−0.0001***	
				(0.0000)	
Time (minutes) taken to reach paved roads				−0.0001***	
				(0.0000)	
If household is from mountainous region, then 1, otherwise 0					−0.1347
					(0.1125)
If household is from hilly region, then 1, otherwise 0					0.0195
					(0.0970)
Road density (km of road per 100 km^2 of district area)					0.0023***
					(0.0008)
Proportion of all-season roads in a district					0.0039***
					(0.0015)
Constant	−2.1397***	−3.3934***	−1.5416***	−2.4786***	−2.3007***
	(0.0596)	(0.2311)	(0.1962)	(0.1251)	(0.1179)
Observations	3859	3859	3859	3859	3859
Number of groups	73	73	73	73	73

Source Authors own work
Note Random effects not shown in the results. Robust standard errors in parentheses
*** $p < 0.01$. ** $p < 0.05$. * $p < 0.1$

6 Conclusion and Policy Implications

The paper examines the role of dietary quality changes in the improvement of height-for-age Z-scores between 1995 and 2011 in Nepal. We also estimate the impact of dietary quality and quantity on HAZ and the probability of child stunting in Nepal. We rely on nationally representative NLSS data from surveys conducted in 1995–1996 and 2010–2011. Various indicators of dietary quality and quantity are used in this study. We create three indicators of dietary diversity: the Simpson Index; number of food varieties consumed; and number of food groups consumed in a typical month. The monthly expenditure shares represented by cereals, fruits and vegetables, animal proteins, and pulses (plant proteins) are used as indicators of dietary quality while the monthly food expenditure is used as an indicator of dietary quantity. We use multilevel and DRF models to study the effects of dietary quality and quantity on child nutrition outcomes. To assess the role of dietary quality in the improvement of HAZs between 1995–1996 and 2010–2011, we use the Blinder–Oaxaca approach.

We found a positive effect of monthly food expenditure and number of food groups consumed on the expected HAZ. The fruits and vegetables' expenditure share positively influences the average HAZ of children up to 1000 days old. The SI, an indicator of dietary diversity, has a positive effect on the HAZ of children greater than 1000 days old. The DRF results suggest that consumption of at least 17 food varieties and seven food groups leads to children exceeding the stunting threshold. While a higher expenditure share on cereals leads to a reduction in the average HAZ, higher expenditure shares on nonstaple and nutrient-dense foods translate into better average HAZs, emphasizing the importance of a nutritious diet for child development. The expenditure share devoted to animal protein is negatively correlated with the probability of stunting/severe stunting in children. Our study shows that dietary quality improvement was an important factor responsible for improving child nutrition outcomes in Nepal between 1995–1996 and 2010–2011. The changes in dietary quality explain about 71% of the improvement in the HAZs between 1995 and 2011. Looking at the specific dietary quality variables, an increase in monthly food expenditure, increases in the expenditure shares devoted to animal protein and fruits and vegetables, and an increase in the number of food groups consumed explain the significant portion of the HAZ improvement. A robustness test shows that our results are highly robust with regard to the children from the rural sample and households with marginal farm size.

Since Nepal still has a high child stunting rate, it is important for the government to formulate policies that will lead to improvements in long-term child nutrition outcomes. Although many factors influence child nutrition outcomes, our results suggest that improving household dietary quality matters. Consumption of a nutritious diet with higher proportions of fruits and vegetables and animal/plant proteins should be encouraged, and the consumption of higher shares of staple foods needs to be discouraged to improve long-term outcomes in Nepal.

Measuring the dietary intake of individual members of a household is difficult, cumbersome, and expensive. Moreover, 24-h-recall assessment is expensive and relies on a short recall period. Based on our findings, we conclude that one can use food expenditure data as a credible proxy for the quality and quantity of child food consumption. In the absence of actual food consumption data, such food expenditure data may prove to be a fruitful avenue for assessing the efforts to improve child nutrition outcomes.

7 Appendix and Supplementary Figures

(See Figs. 10, 11, 12, and 13).

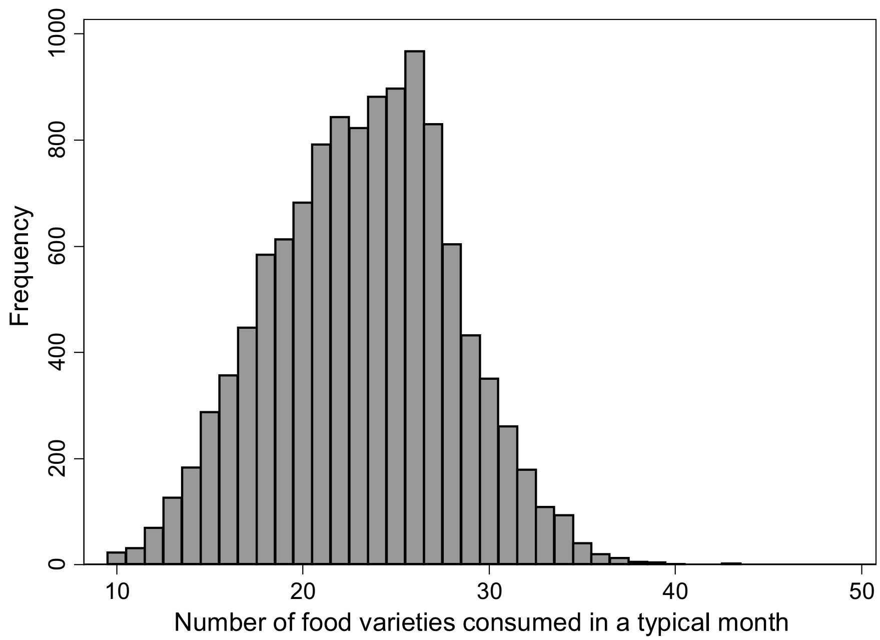

Fig. 10 Histogram plot of number of food varieties consumed in a typical month. *Source* Authors work based on the NLSS datasets

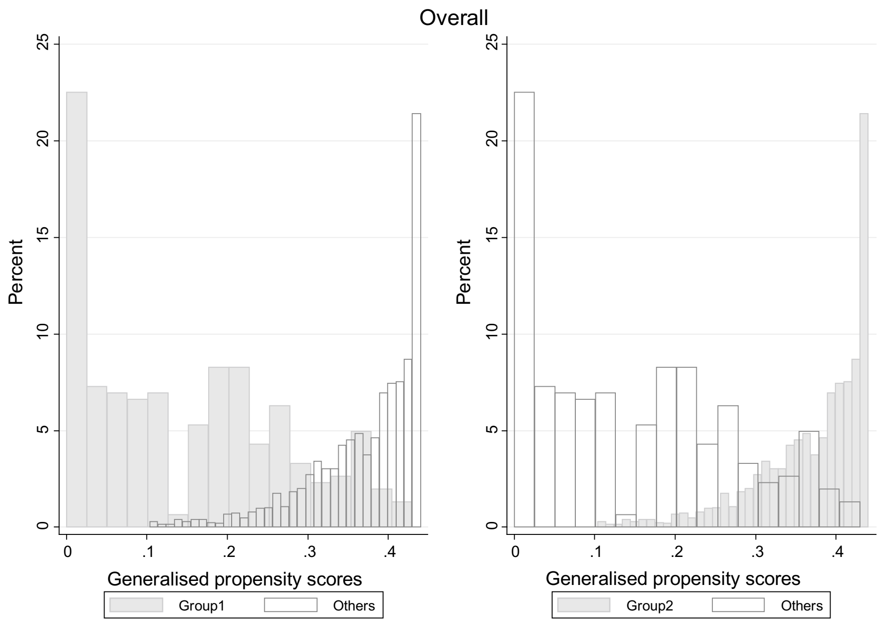

Fig. 11 Common support for the treatment *number of food varieties* (overall sample). *Source* Authors work based on the NLSS datasets

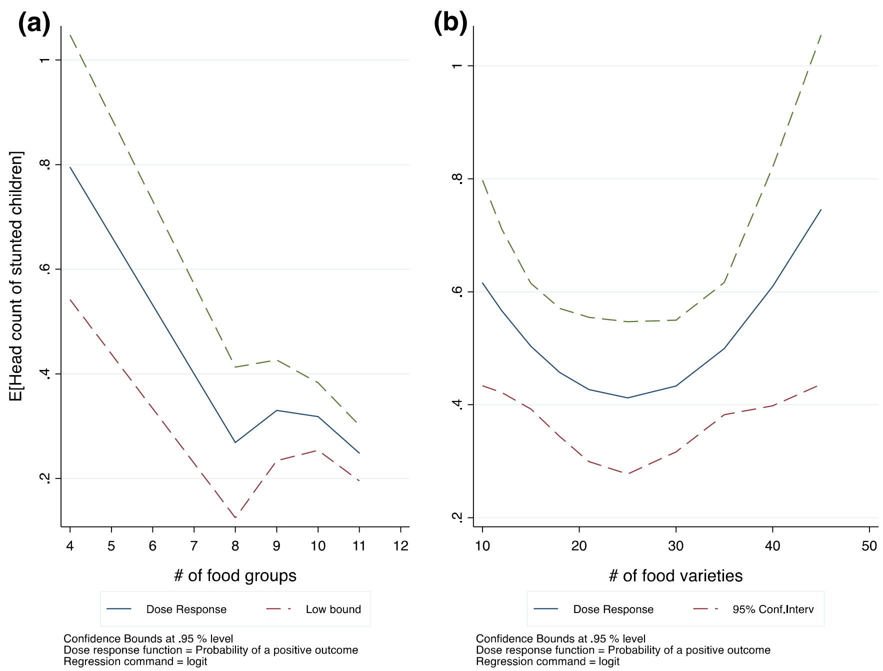

Fig. 12 Dose–response function assessing the impact of number of food groups/varieties consumed on child stunting outcomes. *Source* Authors work

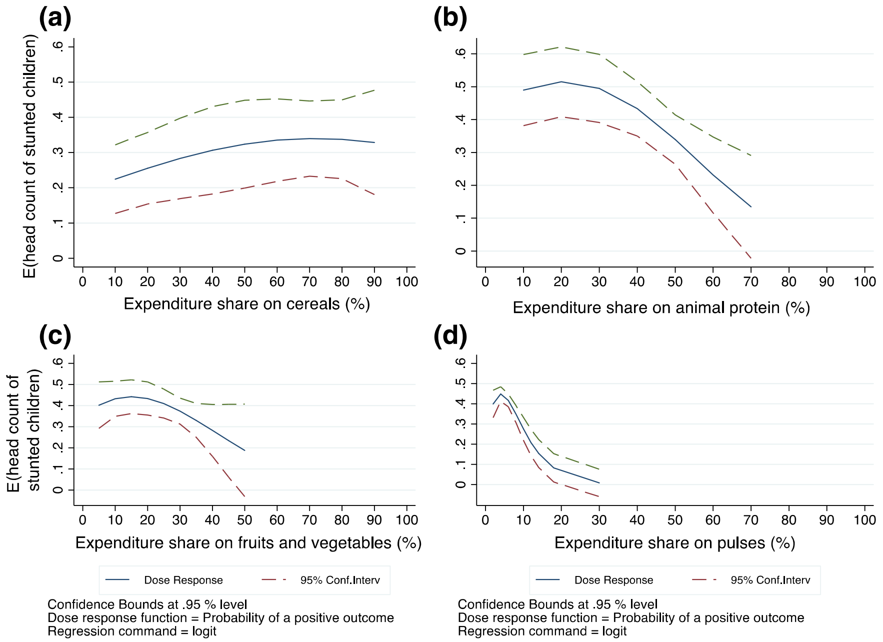

Fig. 13 Dose–response function assessing the impact of expenditure shares devoted to different food items on child stunting outcomes. *Source* Authors work

References

Arimond, M., & Ruel, M. T. (2004). Dietary diversity is associated with child nutritional status: Evidence from 11 demographic and health surveys. *Journal of Nutrition, 134*(10), 2579–2585.

Arimond, M., Wiesmann, D., Becquey, E., Carriquiry, A., Daniels, M. C., & Deitchler, M. (2010). Simple food group diversity indicators predict micronutrient adequacy of women's diets in 5 diverse, resource-poor settings. *Journal of Nutrition, 140*(11), 2059S–2069S.

Bernstein, M. A., Tucker, K. L., Ryan, N. D., O'Neill, E. F., Clements, K. M., Nelson, M. E., et al. (2002). Higher dietary variety is associated with better nutritional status in Frail elderly people. *Journal of the American Dietetic Association, 102*(8), 1096–1104.

Bhutta, Z. A., Das, J. K., Rizvi, A., Gaffey, M. F., Walker, N., & Horton, S. (2013). Evidence-based interventions for improvement of maternal and child nutrition: What can be done and at what cost? *Lancet, 382*(9890), 452–477.

Blinder, A. S. (1973). Wage discrimination: Reduced form and structural estimates. *Journal of Human Resources, 8,* 436–455.

Campbell, A. A., de Pee, S., Sun, K., Kraemer, K., Thorne-Lyman, A., Moench-Pfanner, R., et al. (2010). Household rice expenditure and maternal and child nutritional status in Bangladesh. *Journal of Nutrition, 140*(1), 189S–194S.

Cunningham, K., Headey, D., Singh, A., Karmacharya, C., & Rana, P. P. (2017). Maternal and child nutrition in Nepal: Examining drivers of progress from the mid-1990s to 2010s. *Global Food Security, 13,* 30–37.

Darity, W., Guilkey, D. K., & Winfrey, W. (1996). Explaining differences in economic performance among racial and ethnic groups in the USA. *American Journal of Economics and Sociology, 55*(4), 411–425.

Disha, A. D., Rawat, R., Subandoro, A., & Menon, P. (2012). Infant and Young Child Feeding (IYCF) practices in Ethiopia and Zambia and their association with child nutrition: Analysis of demographic and health survey data. *African Journal of Food, Agriculture, Nutrition and Development, 12*(2), 5895–5914.

FAO (Food and Agriculture Organization of the United Nations). (2016). *Food and nutrition security in Nepal: A status report.* Kathmandu.

Galler, J. R., & Barrett, L. R. (2001). Children and famine: Long-term impact on development. *Ambulatory Child Health, 7*(2), 85–95.

Glewwe, P. (1999). Why does mother's schooling raise child health in developing countries? Evidence from Morocco. *Journal of Human Resources, 34*(1), 124–159.

Hatløy, A., Torheim, L., & Oshaug, A. (1998). Food variety—A good indicator of nutritional adequacy of the Diet? A case study from an urban area in Mali, West Africa. *European Journal of Clinical Nutrition, 52,* 891–898.

Headey, D. D., & Hoddinott, J. (2015). Understanding the rapid reduction of undernutrition in Nepal, 2001–2011. *PloS One, 10*(12), e0145738.

Headey, D., Hoddinott, J., & Park, S. (2017). Accounting for nutritional changes in six success stories: A regression-decomposition approach. *Global Food Security, 13,* 12–20.

Hirano, K., & Imbens, G. W. (2004). The propensity score with continuous treatments. In A. Gelman & X.-L. Meng (Eds.), *Applied Bayesian modeling and causal inference from incomplete-data perspectives* (pp. 73–84). Chichester, UK: Wiley.

Hoddinott, J., & Yohannes, Y. (2002). *Dietary diversity as a food security indicator.* Food consumption and nutrition division discussion paper 136. Washington, DC: International Food Policy Research Institute.

Horton, S., & Steckel, R. H. (2013). Malnutrition: Global economic losses attributable to malnutrition 1900–2000 and projections to 2050. In B. Lomborg (Ed.), *How much have global problems cost the Earth? A scorecard from 1900 to 2050* (pp. 247–272). Cambridge, UK: Cambridge University Press.

Humphries, D. L., Dearden, K. A., Crookston, B. T., Woldehanna, T., Penny, M. E., & Behrman, J. R. (2017). Household food group expenditure patterns are associated with child anthropometry at ages 5, 8 and 12 years in Ethiopia, India, Peru and Vietnam. *Economics & Human Biology, 26,* 30–41.

IFPRI (International Food Policy Research Institute). (2016a). *Global Nutrition Report 2016: From promise to impact: Ending malnutrition by 2030.* Washington, DC.

IFPRI (International Food Policy Research Institute). (2016b). *2016 Global hunger index: Getting to zero hunger.* Washington, DC. http://ebrary.ifpri.org/utils/getfile/collection/p15738coll2/id/130707/filename/130918.pdf.

Institute of Development Studies. (2013). *Delivering demographic dividend in Africa: Investing in nutrition is the first step.* Sussex, UK.

Jo, B., & Dercon, S. (2012). *Child development and economic development: Lessons and future challenges*. Mimeo: Young Lives, Oxford University.

Kant, A. K. (1996). Indexes of overall diet quality: A review. *Journal of the American Dietetic Association, 96*(8), 785–791.

Kant, A. K. (2004). Dietary patterns and health outcomes. *Journal of the American Dietetic Association, 104*(4), 615–635.

Karamba, W. R., Quiñones, E. J., & Winters, P. (2011). Migration and food consumption patterns in Ghana. *Food Policy, 36*(1), 41–53.

Kim, C. (2010). Decomposing the change in the wage gap between white and black men over time, 1980–2005: An extension of the Blinder-Oaxaca decomposition method. *Sociological Methods and Research, 38*(4), 619–651.

Kumar, A., Sunil, S., Singh, R. K. P., & Shiv, J. (2016). Agricultural diversity, dietary diversity, and nutritional intake: An evidence on inter-linkages from village level studies in Eastern India. *Agricultural Economics Research Review, 29,* 15–29.

Lee, M.-S., Huang, Y.-C., & Wahlqvist, M. L. (2010). Chewing ability in conjunction with food intake and energy status in later life affects survival in taiwanese with the metabolic syndrome. *Journal of the American Geriatrics Society, 58*(6), 1072–1080.

Mankew, N. G., Romer, D., & Weil, D. N. (1992). A contribution to the empirics of economic growth. *Quarterly Journal of Economics, 107*(2), 407–437.

Marshall, T. A., Stumbo, P. J., Warren, J. J., & Xie, X.-J. (2001). Inadequate nutrient intakes are common and are associated with low diet variety in rural, community-dwelling elderly. *Journal of Nutrition, 131*(8), 2192–2196.

Mauludyani, A. V. R., Fahmida, U., & Santika, O. (2014). Relationship between household expenditures on strategic foods and prevalence of undernutrition among children 0–23 months of age in Indonesia. *Food and Nutrition Bulletin, 35*(4), 440–448.

Nepal, Central Bureau of Statistics. (1996). *Nepal living standards survey 1995–1996*. Kathmandu: Central Bureau of Statistics.

Nepal, Central Bureau of Statistics. (2011). *Nepal living standards survey 2010–2011*. Kathmandu: Central Bureau of Statistics.

Nepal, Ministry of Health and Population. (2012). *Nepal demographic and health survey 2011*. Kathmandu: Ministry of Health and Population.

Nguyen, M. C., & Winters, P. (2011). The impact of migration on food consumption patterns: The case of Vietnam. *Food Policy, 36*(1), 71–87.

Oaxaca, R. (1973). Male-Female wage differentials in urban labor markets. *International Economic Review, 14*(3), 693–709.

Ogle, B. M., Hung, P. H., & Tuyet, H. T. (2001). Significance of wild vegetables in micronutrient intakes of women in Vietnam: An analysis of food variety. *Asia Pacific Journal of Clinical Nutrition, 10*(1), 21–30.

Rao, S., Yajnik, C. S., Kanade, A., Fall, C. H., Margetts, B. M., Jackson, A. A., et al. (2001). Intake of micronutrient-rich foods in rural Indian mothers is associated with the size of their babies at birth: Pune maternal nutrition study. *The Journal of Nutrition, 131*(4), 1217–1224.

Rose, D., Meershoek, S., Ismael, C., & McEwan, M. (2002). Evaluation of a rapid field tool for assessing household diet quality in Mozambique. *Food and Nutrition Bulletin, 23*(2), 181–189.

Ruel, M., Harris, J., & Cunningham, K. (2012). Measuring dietary quality in developing countries: A review of the usefulness of individual dietary diversity indicators (Chap. 18). In V. R. Preedy (Ed.), *Diet quality: An evidence-based approach*. New York: Springer.

Ruel, M. T., & Menon, P. (2002). Child feeding practices are associated with child nutritional status in Latin America: Innovative uses of the demographic and health surveys. *Journal of Nutrition, 132,* 1180–1187.

Sari, M., de Pee, S., Bloem, M. W., Sun, K., Thorne-Lyman, A. L., Moench-Pfanner, R., et al. (2010). Higher household expenditure on animal-source and nongrain foods lowers the risk of stunting among children 0–59 months old in Indonesia: Implications of rising food prices. *Journal of Nutrition, 140*(1), 195S–200S.

Shariff, Z. M., Bond, J. T., & Johnson, N. E. (2000). Nutrition and educational achievement of urban primary school children in Malaysia. *Asia Pacific Journal of Clinical Nutrition, 9,* 264–273.

Sharma, A., & Chandrasekhar, S. (2016). Impact of commuting by workers on household dietary diversity in rural India. *Food Policy, 59,* 34–43.

Shively, G., & Sununtnasuk, C. (2015). Agricultural diversity and child stunting in Nepal. *Journal of Development Studies, 51*(8), 1078–1096.

Smith, L. C., & Haddad, L. J. (2000). *Explaining child malnutrition in developing countries: A cross-country analysis*. Research Report 111. Washington, DC: International Food Policy Research Institute. https://books.google.com/books?hl=en&lr=&id=cFvJ39bkNikC&oi=fnd&pg=PR4&dq=Explaining+child+malnutrition+in+developing+countries:+A+cross-country+analysis&ots=U-SiQUC63L&sig=OhRKOaJLSjKkslPdtS4m8CLYDwg.

Stanley, T. D., & Jarrell, S. B. (1998). Gender wage discrimination bias? A meta-regression analysis. *Journal of Human Resources, 33*(4), 947–973.

Steyn, N. P., Nel, J. H., Nantel, G., Kennedy, G., & Labadarios, D. (2006). Food variety and dietary diversity scores in children: Are they good indicators of dietary adequacy? *Public Health Nutrition, 9*(5), 644–650.

Tarini, A., Bakari, S., & Delisle, H. (1998). The overall nutritional quality of the diet is reflected in the growth of Nigerian children. *Santé (Montrouge, France), 9*(1), 23–31.

Torlesse, H., Kiess, L., & Bloem, M. W. (2003). Association of household rice expenditure with child nutritional status indicates a role for macroeconomic food policy in combating malnutrition. *Journal of Nutrition, 133*(5), 1320–1325.

UNICEF. (2016). UNICEF data: Monitoring the situation of children and women. *Child malnutrition data*. https://data.unicef.org/topic/nutrition/malnutrition/.

WHO. (1995). *Physical status: The use and interpretation of anthropometry* (WHO tech. Rep. Ser. No. 854). Geneva: World Health Organization.

You, D., Hug, L., Ejdemyr, S., & Beise, J. (2015). *Levels and trends in child mortality. Estimates developed by the UN inter-agency group for child mortality estimation.* Report 2015. New York: UNICEF. www.popline.org/node/637924.

Chapter 5
Food Inflation in Nepal and Its Implications

Ramesh Sharma

Abstract This chapter presents an overview of the long-term trends in food and non-food inflation, and estimates the relative contributions of various food products to overall food inflation. Key findings are that the underlying character of inflation in Nepal changed fundamentally since around 2007 with food inflation becoming much more prominent and a large contributor to overall inflation, vegetables were the top contributor to food inflation, and that food prices are strongly cointegrated with Indian prices, but not non-food price. Unrecorded informal trade with India should explain much of the close price linkages. Food prices tend to be more volatile during periods of high prices and ensuring price stability is a matter of great concern. Further, price surges do not necessarily lead to positive supply response.

Abbreviations (Food Inflation in Nepal chapter)

ADF	Augmented Dickey–Fuller (test)
CPI	Consumer price index
CPI-IW	Consumer price index for industrial workers (India)
ECM	Error-Correction Model
FY	Fiscal year
GoI	Government of India
GoN	Government of Nepal
ICBT	Informal Cross-border Trade
NLSS	Nepal living standards survey
NRB	Nepal Rastra Bank
p.a.	Per annum
WPI	Wholesale Price Index

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G. Thapa et al. (eds.), *Agricultural Transformation in Nepal*,
https://doi.org/10.1007/978-981-32-9648-0_5

1 Introduction

High, sustained, and volatile domestic food prices became a matter of considerable concern for most developing countries since the world food price crisis of 2008. The era of cheap food that prevailed for many decades previously was considered over and the medium-term outlook was one of high and volatile food prices, as said repeatedly by the OECD-FAO agricultural outlooks.

The food price crisis also triggered substantive responses at the global and national levels in the form of new agriculture and food security programs, including institutions and funds. The crisis also triggered numerous studies on the impact of food inflation on poverty. Most analyses show that high and sustained food prices slow down or even reverse the progress being made on poverty reduction as food accounts for a large share of household expenditure, e.g., 54% for Nepal as a whole but 71% for the poorest 25% of the households, according to Nepal's third living standards survey (NLSS III). Using these data, Shrestha and Chaudhary (NRB 2012) find that, when food prices rise by between 10 and 30%, the overall poverty in Nepal was likely to rise by between 4 and 12% points and food poverty by between 6 and 20% points. An ADB study (ADB 2011) provides similar estimates for Nepal and many other Asian countries.

Besides concerns on poverty and food insecurity, high and persistent food inflation has also been at the heart of a polarized debate on whether monetary policy should respond to food inflation also. This debate has been intense in India, as well as in other countries with a significant share of population in poverty. At the crux of the policy dilemma lies the link between food inflation and core inflation, which is what central banks traditionally target. For example, one argument by India's Reserve Bank, while resisting rate cuts, was that the high food price inflation, if persistent, would have a second-round effect spilling over to wage inflation and finally into core inflation. Therefore, the argument goes, a hike in the policy rate was needed when food inflation is high and persistent, even if this means some output loss. There has been a spurt of literature in India since 2008, both empirical studies and commentaries, on food inflation, including on this policy dilemma.

This chapter seeks to enhance the understanding of food inflation in Nepal by documenting its evolution and identifying key contributors.[1] Although trends going back to 1991 are also reviewed for some inflation aggregates, the focus is on food prices and on the past decade since 2007 when food inflation became a prominent concern worldwide. The analysis makes good use of the detailed statistics on price indices for 8–10 food products that make the overall food price index. In view of the role of the Indian prices in influencing food prices in Nepal, a substantive part of

[1]This study uses inflation data for Kathmandu valley as a proxy for inflation in Nepal for two main reasons: (i) data are considered to be much better for Kathmandu valley, notably for earlier years; and (ii) trends in monthly inflation rates in Kathmandu, Hills and Tarai move very closely although the levels could vary (for example, higher in the Hills than in Tarai).

the analysis is devoted to understanding the India–Nepal price linkages, including with the help of price transmission econometrics.

The chapter is organized as follows. Following this introduction, Sect. 2 presents an overview of the longer-term trends in food and non-food inflation in Nepal. Section 3 quantifies the relative contributions of various food products to overall food inflation in Nepal. Section 4 then analyses linkages between food prices in Nepal and India, separately for eight food products that make up the overall food index. Section 5 concludes. An Annex at the end of this chapter describes the inflation data used in this study.

2 Long-Term Trends in Inflation in Nepal, 1991–2015

Figure 1 shows long-term trends in consumer price indices (CPIs) and inflation rates derived from these CPIs. The trends in the CPIs show the following. First, both food and non-food CPIs increased fairly steadily for the entire 17 years since 1990/91 (FY1991, in short) until about FY2007 after which the indices broke with the past trends and surged. Linear growth rates of all three indices were about 4.1 points per annum (p.a.) during FY1991–2007 but were several times higher during FY2008–2016: to be exact, 23 points p.a. for food, 10 points p.a. for non-food and 16 points p.a. for the overall index. Second, although not as obvious visually in the graph, food indices have mostly been higher than non-food indices, with the gaps growing very high after FY2007. As for the inflation rates (right panel), three phases may be identified: steady declines in the inflation rates during FY1991–2001; steady but modest increases during FY2001–2007; and a third phase since FY2008 when inflation was both very high and volatile, with spikes in FY2009 and FY2011, a large slump in FY2012 and sharp rises again in FY2013 and FY2014.

A 2007 study on inflation by Nepal Rastra Bank (NRB 2007) provides some explanations for the high inflation during late 1980s/early 1990s. Prices surged towards the end of the 1980s and lingered for 1–2 years until around 1992 (in

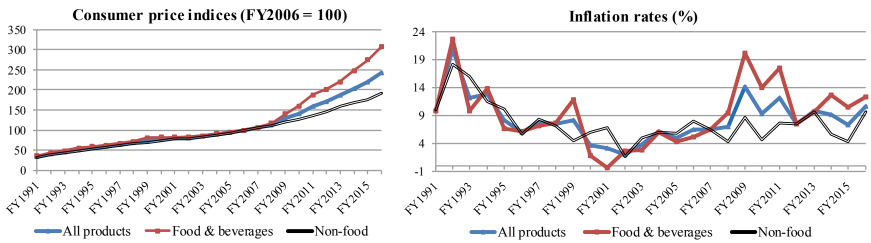


Fig. 1 Long-term trends in food, non-food and overall inflation.
Note FY1991 means 1990/91 (July/June), and so on. *Source* Based on the NRB data on price indices. Note that throughout this study, the data used for all analysis refer to those for Kathmandu valley. The inflation data are for Kathmandu valley (see footnote 1)

FY1992, inflation rates were 23%, 18% and 21% for food, non-food and all products, respectively). One reason was the trade and transit impasse with India leading to a long and severe blockade (March 1989 to June 1990) with a heavy rationing of petroleum products and hikes in the prices of most imported goods. Two, the devaluation of Nepalese rupees vis-à-vis US dollar and other convertible currencies by 21% on 1 July 1991 was also a factor. Three, Nepal followed the policy of current account convertibility, which pushed up import prices of raw materials, fuels, fertilizers, construction materials, and consumer goods as well as the prices of administered goods and services such as milk, petroleum products, education fees, and telephone and electricity charges. And four, inflation had also been high in India, which was the period when India faced serious economic crisis that triggered the economic reforms of 1991.

From those peaks, prices fell sharply and steadily, with trend growth rates during FY1992 to FY2000 in the range of negative 15–18% p.a. for all three measures of inflation. By the early 2000s, inflation rates were very low, in the 2–4% range. According to the 2007 NRB study, financial sector reforms and liberal economic policies contributed to improvements and supply responses in both the agriculture and non-agriculture sectors, and fiscal policy reforms led to improved revenue mobilization and reductions in deficit financing. From the trough in FY2001 for food and FY2002 for non-food, prices started to trend up, but were still relatively modest until FY2007, with the average inflation during FY2000–07 of 4%, 6% and 5% for food, non-food and all items. Note also that during those years, both food and non-food inflation rates were fairly similar.

Three other features of inflation trends in Nepal may be noted. First, the inflation differential between food and non-food categories increased markedly in recent years, 6% points on average during FY2008–2015, with as high as 12% points in FY2009 and 10% points in FY2011. That was not the case prior to 2008—in the 16 years during FY1991–FY2007, it was non-food inflation that exceeded the food inflation in 10 of those 16 years. Second, the overall inflation would have been higher if not for moderations in non-food inflation in exactly those years when food prices surged, e.g. in 2008, 2010, 2014 and 2015 when non-food inflation rates were in the low 4–6% range. And third, an analysis of the relative contributions of food and non-food inflation to overall inflation (computed using respective consumption weights) shows that while these vary from year to year, there was a pattern. Until FY2007, non-foods contributed relatively more to the overall inflation, 56% by non-food and 44% by food on average during FY1992–2007. From FY2008, this not only reversed but the role of food became more prominent, with the average contribution of 63% for food and 37% for non-food during FY2008–2015. For all these reasons, it may be concluded that the basic underlying character of inflation in Nepal has changed fundamentally since around 2007.

3 Contribution of Various Foods to Food Inflation During 2007–2015

Nepal's CPIs are published for 13 sub-groups under the foods and beverages category and 9 sub-groups under non-foods and services category. As weights in the consumption basket are known, relative contributions of different foods to a change in the overall food index can be computed. What follows summarizes the results on relative contributions. This is done for two periods because they provide additional insight—first for each fiscal year since FY2007, and, second, for selected six major episodes or periods when food prices surged markedly steadily for some months.

Table 1 shows relative contributions for 10 fiscal years since FY2007. Column 2 shows percentage changes in the overall food inflation while the rest of the columns show relative contributions. The results show that cereals contributed the most, 28% on average, to food inflation during the past 10 years, with a range of 12% in FY2012 and 41% in FY2015. Next to the cereals, vegetables contributed on average 18% with a range of 6 and 39%. The other two sub-groups with contributions on average of 10% or more are meat/fish and milk products. Indeed, meat products contributed to 10% or more in 8 of the 10 years covered, with 20% or more contributions in 2 years. One other way to assess the results is to compare the average contributions to consumption weights, noting that if inflation rates for various foods were to be equal, the relative contributions would be broadly in line with consumption weights, e.g. 32% for cereals, 12% for vegetables and so on. The results show that the contributions of three sub-groups—vegetables, fruits, and pulses—have been higher than their consumption weights, implying that their inflation rates were relatively higher. The contribution of cereals, on the other hand, has been lower than its consumption weight.

As prices fluctuate within a fiscal year (12 months), the average for the year fails to reflect episodes when prices really surged. For this reason, to gain additional insights on relative contributions during price surges, the same analysis was repeated for six major episodes or periods when food prices surged markedly. The episodes cover a period of 5–8 months when the food index rose strongly and steadily to its peak before receding.

The six episodes are listed in column 1 of Table 2. Column 2 shows percentage increases in the overall food index between the two months shown, e.g. in episode 3, the food index rose by 23% in 9 months between February and November 2010. As above, the relative contributions vary from episode to episode. One conspicuous result is the very high contribution of vegetables, 52% on average, which is almost three times the average contribution of this product in the annual data in Table 1. The contribution of vegetables was always high in all episodes, at least 33%, and reaching as high as 70% in the episode of 2010 and 74% in that of 2013. As vegetables contributed *relatively* more, the contributions of other foods were lower during the episodes. For example, cereals contributed only 20% on average despite the consumption weight of 32% (28% contribution in the annual data). Besides vegetables and cereals, which are significant contributors most of the time, other

Table 1 Nepal–relative contributions of different foods to overall *food* inflation by fiscal year (relative contributions in %)

Fiscal year	Food inflation (%)	Relative contributions of various food sub-groups (%)									
		Cereals	Pulses	Vegetables	Fruits	Edible oils	Meat/ fish	Milk/ egg	Other 3 foods[a]	Restaurant etc.[b]	Total
FY2007	6	26	11	14	6	6	13	11	7	6	100
FY2008	10	37	4	15	2	13	10	13	0	6	100
FY2009	20	35	5	6	4	5	14	9	11	11	100
FY2010	14	13	9	18	7	−3	20	7	17	11	100
FY2011	17	29	−3	39	4	2	8	8	6	6	100
FY2012	7	12	1	34	9	10	10	18	−1	8	100
FY2013	10	25	4	6	3	8	19	9	10	15	100
FY2014	13	37	2	24	10	0	22	7	1	−3	100
FY2015	10	41	7	8	8	−1	5	11	3	18	100
FY2016	12	23	12	13	8	15	11	9	4	5	100
Average	12	28	5	18	6	6	13	10	6	8	100
Minimum	6	12	−3	6	2	−3	5	7	−1	−3	–
Maximum	20	41	12	39	10	15	22	18	17	18	–
Food consump. weight (%)		32	4	12	5	6	12	11	8	11	100

Note Relative contributions are computed based on the percentage increase in the index of that food relative to that in the previous year and the consumption weight of that food sub-group. The first column shows the percentage increase in the price index of the overall food and beverage sub-group

[a]Other three foods are sugar, spices and soft drinks

[b]Besides restaurant, this also includes alcoholic drinks and tobacco

Source Computed based on inflation rates and consumption weights

Table 2 Relative contribution of different foods to overall *food* inflation during six episodes of high food inflation

Relative contributions of various food sub-groups (%)											
Six episodes	% Change in food index	Cereals	Pulses	Vegetables	Fruits	Edible oils	Meat/ fish	Milk/ egg	Other 3 foods[a]	Restaurant etc.[b]	Total
Consumption weights	100	32	4	12	5	6	12	11	8	11	100
1. May to Oct 2008	19	27	5	32	1	2	4	7	6	17	100
2. March to Sept 2009	16	12	7	47	7	−1	7	4	10	8	100
3. Feb to Nov 2010	23	20	−2	70	1	0	0	3	2	6	100
4. Feb to Sept 2012	15	19	4	56	3	5	10	3	9	−10	100
5. May to Oct 2013	13	22	1	74	5	0	16	1	−1	−19	100
6. March to Nov 2015	20	23	10	33	10	18	8	1	4	−7	100
Average of 6 episodes	18	20	4	52	5	4	7	3	5	−1	100

Notes See notes to Table 1. In this case, relative contributions are computed based on the percentage increase in the index of that food between the two months shown and the consumption weight of that food sub-group

Source Computed based on inflation rates and consumption weights foods that contributed markedly in some episodes but not always include edible oils (18% contribution in the episode of 2015), meat (in 2012–2013), pulses (in 2015), and fruits (in 2015).

4 Co-Movement of Food Prices in Nepal and India

The focus of this section is on understanding the influence of the Indian prices on food inflation in Nepal, which is widely acknowledged as being substantive for a number of reasons, notably the porous borders, large volumes of trade (recorded and unrecorded) and fixed exchange rate. Most of the section is devoted to assessing price linkages for nine different categories of food products that make up Nepal's food and beverages price index. Before this analysis, the first sub-section briefly reviews co-movement of inflation trends over a longer period, FY1992–2015. The section closes with a brief assessment of inflation differentials with India during political disruptions and trade blockade from September 2015 to March 2016.

While most papers on inflation in Nepal allude to the strong influence of the Indian prices, some have gone one step forward by quantifying the relationship using econometric methods. One of them was a NRB study (NRB 2007). It found that prices in Nepal are mainly determined by those in India in the long-run, while both narrow money supply and Indian prices influence prices in Nepal in the short-run (less than one year). However, the influence of money supply was found to be very small—the estimated coefficient for short-term impact was as large as seven times for the Indian prices than for the money supply. Another study, also using pre-2007 data, by an IMF staff (Ginting 2007), estimated that *core* inflation in Nepal converges with that in India in the long run but the speed of adjustment, when the two inflation rates deviate in the short term, was fairly small, adjusting about 7% per month. In another study by some IMF staffs (Dobrescu et al. 2011), it was found that food price inflation responds significantly and quickly to India's food inflation and to international oil price movements, with the impact of the latter being smaller but more persistent than India's food inflation.

This study contributes to this literature by estimating parameters for short- and long-run price transmissions from the Indian to the Nepalese markets for nine different food categories as well as for food, non-food and overall inflation. The estimates are based on monthly price indices for 117 months from July 2006 to March 2016. A brief on the econometric method used and the results obtained are presented in an Annex at the end of the chapter.

4.1 Long-Term Trends in Inflation Differentials

Figure 2 shows trends in food, non-food and overall inflation in Nepal and India for 25 years from FY1992 to FY2016 (July/June basis for both Nepal and India). The graphs show the fairly close movement of inflation rates in Nepal and India for food and overall inflation, but not for non-food (correlation coefficient of 0.77 for food, 0.06 for non-food and 0.64 for overall inflation). In those 25 years, Nepal's food inflation was higher than India's for 15 years, or 60% of the time, versus 48% of the time for both non-food and overall inflation. The average inflation differential for those 15 years was 3.4%, with relatively large differentials in FY1992, FY2009, FY2011 and FY2016, the most being 9.1% in FY2011. The data also show that positive differentials (Nepal's higher than India's) have increased for recent years for food (e.g. from 2.7% on average for FY1992–2006 to 4% for FY2007–15) but not for non-food (4.3% and 1.4% in the two periods, respectively). The very low correlation for non-food inflation was a surprise but a close inspection of the graph shows that non-food inflation in Nepal and India often moves in the opposite direction.

The data also show some asymmetry in inflation differentials. Thus, in contrast to the 3.2% average differential when Nepal's food inflation exceeded India's (in 15 of the 25 years), the average differential was only 1.9% when inflation was lower in Nepal in the other 10 years. But this was not the case for non-food, where the inflation differential was similar (about 3% on average) both when Nepal's was higher or lower than India's.

4.2 Co-movement of Food Inflation in Nepal and India

This section presents an assessment of the co-movements of inflation rates in Nepal and India for eight different food categories, as well as for three aggregates—food, non-food, and overall inflation. The analysis also utilizes results from the econometric analysis of price transmission.

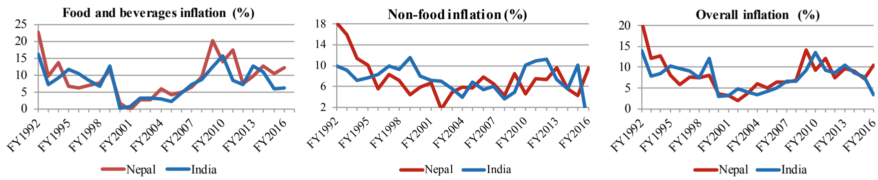


Fig. 2 Long-terms trends in food, non-food and overall inflation rates in Nepal and India, 1992–2015.
Note FY1992 refers to 1991/92 (July/June) and so on, for both Nepal and India. Data for FY2015/16 is up to March 2016. *Source* Based on Nepal's CPI data and India's CPI-IW data

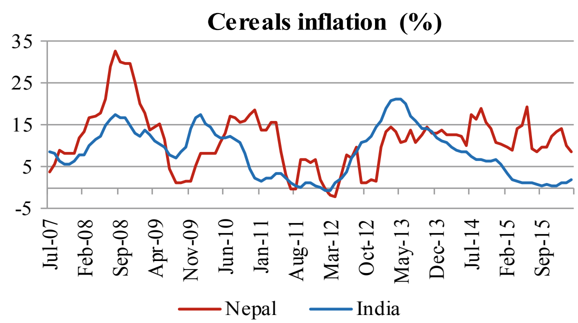
As food inflation became a major issue in India since 2008, many studies were undertaken in recent years. A number of them were consulted for this section. These include Chand (2010), Kumar et al. (2010), Chand et al. (2011), Mishra and Roy (2011), Nair and Eapen (2012), Ganguly and Gulati (2013), Gulati and Saini (2013) and Bhattacharya and Gupta (2015). One valuable source was the chapter on "price situation" in Government of India's annual *Economic Survey* (GoI, various years) which provides an in-depth account of the evolution of prices in that year and the underlying drivers of inflation.

4.2.1 Cereals and Products

Nepal's cereals inflation averaged 11% during 2007–2015, exceeding 10% for 60 of the 105 months covered, and over 20% for just 8 months during the food price crisis of 2008. Figure 3 shows that the trend in cereals inflation during 2007–2015 is essentially flat but with marked and frequent volatility. India accounts for 96% of Nepal's total imports of cereals and products (95% for rice). This factor, along with the porous borders, should mean strong influence of the Indian prices. The graph does show that the Indian and Nepalese cereal prices do co-move over time, but not as closely as expected or seen for some other products like pulses, sugar, and oils (see Fig. 3). As a result, inflation differentials are often large. For example, during the spike of 2008, for eight months from June 2008, Nepal's inflation was above 20% but never for India, and thus a large differential of 12% points on average (inflation of 27% in Nepal and 15% in India). Next, during June 2009—April 2011, inflation rates moved in the opposite direction, first with Nepal's inflation being lower than India's and then higher for one whole year from April 2011. During the spike in India in early 2013, Nepal's inflation also trended up but to a smaller extent, and when prices in India receded steadily from the beginning of 2014, they remained firm in Nepal.

Econometric analysis shows cereals prices in Nepal and India cointegrated highly significantly, but, as the graph also indicated, the influence of the Indian prices is weak in the short-run (months) with relatively small transmission elasticity (0.20) that is not significant statistically (all econometric results are presented in

Fig. 3 Cereals inflation (%)



the Annex). The estimated error-correction coefficient is significant statistically but fairly small in value (−0.11) which means that while prices in Nepal adjust to short-run deviations from the Indian prices and move towards long-run equilibrium, the process is relatively slow. A similar analysis using world export price (FAO cereals index) as the explanatory variable shows that Nepal's cereal prices are not cointegrated with the world price nor is the short-term transmission elasticity significant statistically. The same results were found for the Indian and FAO cereals indices.

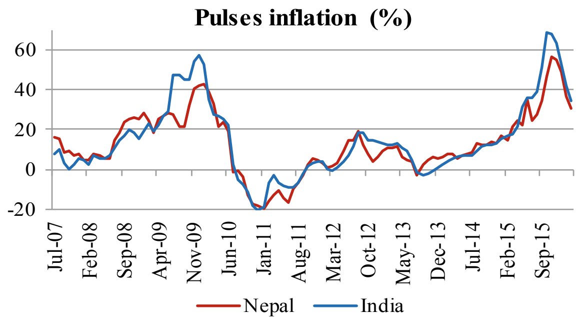
One hallmark of the Indian food policy is the pursuit for price stability. Trade interventions are used frequently, e.g. import and export restrictions, export subsidies and large-scale imports by parastatals during shortages. While production shocks are the primary drivers, trade and other interventions are actively deployed for maintaining price stability. The price surges of FY2009-early 2010 were due to large declines in cereals production due to the worst south-west monsoon since 1972. Inflation was also fuelled by some policies, e.g. according to India's Economic Survey, the sharpest hikes in support prices and reduced cereals availability in open market due to stepped-up public procurement (as high as close to 40% of output in some year) also sustained price surges in those years.

4.2.2 Pulses and Legumes

Pulses inflation in Nepal averaged 13% between July 2007 and-March 2016, slightly lower than India's 15%. Inflation rates exceeded 5% in 76 of the 105 months, over 10% in about half of the months and over 20% in about one-third of the months. Figure 4 shows two peaks and one slump. Inflation averaged 38% during the first surge between October 2009 and March 2010 and 40% during the second surge of June 2015 to March 2016. The slump occurred between October 2010 and September 2011 when inflation averaged negative 15.3%.

The graph shows Nepal's prices closely tracking the Indian prices, even during the surges and slumps, and econometric results also confirm that, with highly significant long-term co-integration between the two series. The short-term transmission elasticity is one of the largest (0.72) among various foods, indicating

Fig. 4 Pulses inflation (%)



significant and rapid transmissions of the Indian prices. The error-correction coefficient is also very high (−0.24) and significant at 1%, suggesting that it takes just 4 months for the short-term deviations in pulses prices to be fully adjusted to long-term equilibrium. This is in contrast to about 10 months for cereals.

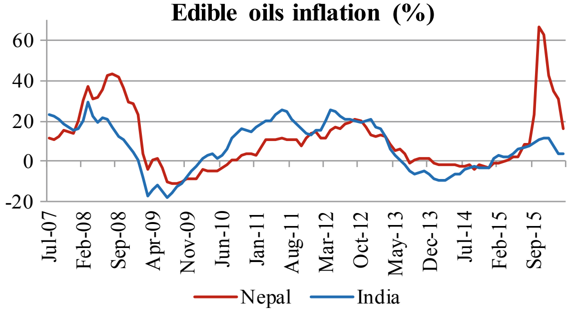
4.2.3 Edible Oils

Inflation in edible oils in Nepal has been relatively moderate most of the time, unlike with vegetables and pulses, with average inflation of 10% during the 105 months covered (and only 8.3% excluding the 7 months when prices spiked during September 2015 and March 2016). Inflation exceeded 5% in about half of the 98 months up to August 2015. Other than the unusual spike during the last 6–7 months, the largest surge occurred in 2008, and a large slump in 2009. Inflation exceeded 20% for 13 months during the 2008 surge averaging 33%, but still below the 40% average during the most recent 7 months of 2015/16.

Figure 5 shows that the Indian and Nepalese inflation rates moved closely. Econometric results show the two series to be cointegrated in the long run but only weakly (significant at the 10%). But the short-term transmission elasticity is fairly high (0.65) and significant at 1%. The error-correction coefficient is relatively smaller (−0.13) but significant at 1%. This means that it takes 7–8 months for short-term deviations to be corrected to their long-term equilibrium.

In India, about 40% of the domestic demand for edible oils is met by imports. Because imports are large and regular, the importing channels are well established and efficient, in contrast to pulses. According to Chand (2010), this is a major reason for holding edible oil prices lower and stable. Thus, prices were lower in 2009 compared to 2008 despite a decline in oilseed output by 5% in 2008–09 and an estimated decline of same order during 2009–10. India bans the export of edible oils except in small packets and so almost 100% of Nepal's imports are sourced from other countries. Despite this, Nepal's prices are cointegrated with the Indian prices, a surprise result. On the other hand, a similar analysis for Nepal's and world export prices (FAO oils index) shows poor relationship, with no long-term co-integration and a fairly low price transmission in the short-run (coefficient of

Fig. 5 Edible oils inflation (%)



0.14). These results point to the possibility of large-scale informal trade across the porous borders.

4.2.4 Vegetables

Vegetables, among all food sub-groups, contributed the most to high food inflation in Nepal, by 52% on average in six episodes when overall food prices had surged. Trade data show that Nepal sourced from India some 65% of the total imports of vegetables during 2011–13 (total imports US $91 million), which includes 100% of potatoes, tomatoes, and onions as well as many other green vegetables (Sharma et al. 2017). There should be large unrecorded trade as well.

Vegetable inflation in Nepal averaged 20% during the 105 months since July 2007, versus 12% in India. Nepal's inflation was higher than India's in 65 of the 105 months when average inflation differential was 25% (28% inflation for Nepal and 3% for India) (Fig. 6). The differential was also large (19%) for the other 40 months when India's inflation was higher. The very large differentials also indicate considerable space for local price formation in Nepal. The data also show marked seasonality in prices (higher during August–November) but the seasonal factor was statistically significant only for October.

There were two large spikes in inflation for Nepal, in 2009 and 2011, and one for India in 2013. In each case, prices in the other country also moved in that direction but only to some extent. For example, in the first spike during April–December 2009, inflation averaged 57% in Nepal but only 16% in India. In the Indian spike during June–December 2013, inflation averaged 21% in Nepal but 76% in India. Despite these large differentials during episodes of surges and slumps, the data indicate that prices in Nepal and India do co-move generally. This is also supported by econometric results which show that the two price series are cointegrated but the error-correction coefficient that corrects for short-term deviations from long-term equilibrium is fairly small, at −0.07, and statistically significant only at the 10% level. Also, the short-run price transmission elasticity is relatively small (0.32). These are indications that a considerable amount of price formation takes place in Nepal, independent of the Indian influence.

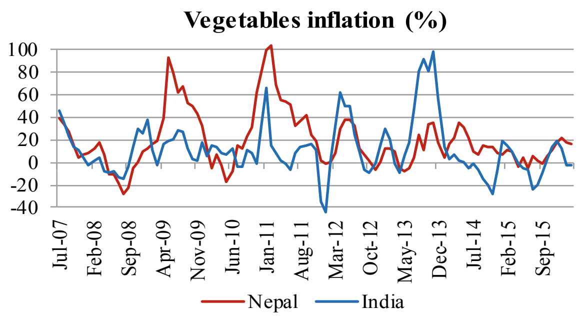


Fig. 6 Vegetables inflation (%)

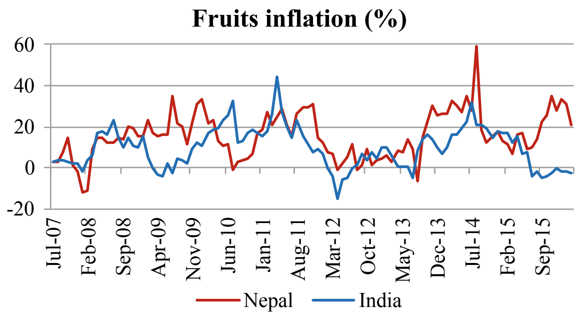
4.2.5 Fruits

Nepal's inflation in fruits was 16% on average during the 105 months since July 2007, 6% points higher than India's average of 10%. Nepal's inflation was higher than India's for 70 of the 105 months, with the averages for these months being 20% for Nepal and 7% for India. For the rest of the months, the averages were 8% for Nepal and 15% for India. The data do not show seasonality in prices and none of the monthly seasonal factors was significant statistically for both Nepal and India.

Nepal imported US$33 million worth of fruits in 2011–2013, 60% from India, which would have been closer to 100% if not for apples 70% of which are sourced from third countries. Fruits, in general, should be more tradable than vegetables and so fruit prices in Nepal and India could be linked more closely on account of the porous borders. Figure 7 shows that there were periods when inflation in Nepal followed fairly closely that in India and other periods when that was not the case. For example, inflation rates moved closely for the first 19 months until January 2009 when average rates were 9.5% for Nepal and 9.1% for India. For the next one year, the two rates moved differently, with averages of 21% for Nepal and 5% for India. During August 2011 to April 2012, India's inflation slumped and Nepal's followed that trend to some extent with a lag of one month. Thereafter, the two series moved closely for over a year, and then Nepal's inflation spiked to an all-time high of 60% in August 2014 while India's inflation, while also climbing similarly, was much more subdued. Finally, the substantive differential after April 2015, averaging 22% for Nepal and 1.5% for India, could be due to the April earthquake followed by trade blockade since September 2015.

Econometric analysis of the data show that fruit prices in Nepal and India are not cointegrated in the long run, or very weakly cointegrated based on some other tests (the other two prices with this result are milk and non-foods). The short-run (monthly) transmission elasticity was 0.28 and statistically significant at the 5% level, and 0.21 for the Indian prices lagged by one month, which was statistically significant at 10% level.

Fig. 7 Fruits inflation (%)



4.2.6 Sugar

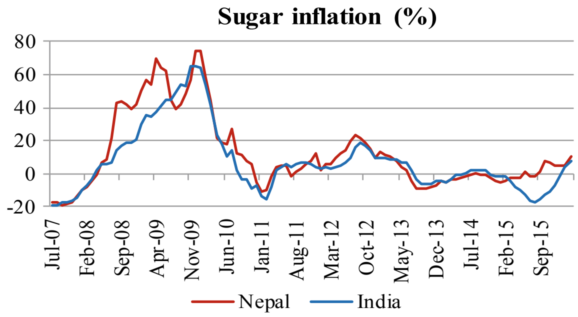
Inflation trend in sugar and products appeared somewhat different from other food products. Following two back-to-back surge episodes during 2008–2009, prices remained low and stable for five years from early-2011, with one exception of a short-lived and smaller surge in mid-2012 (Fig. 8). The average inflation rate during 2007–2015 was 12% but only 3.3% during the five years since early-2011, and 36% on average during 2008–2010 when inflation was over 20% for 2 years from mid-2008. The peak was 75% in January 2010.

India's share in Nepal's total imports of sugar and sugar products was about 75% of Nepal's total imports during 2011–13 (61% for sugar, 80% for confectionary), and so in theory the Indian prices should strongly influence prices in Nepal. Both the graph and econometric results support this view. The figure shows the two inflation rates moving fairly closely, with the only two periods when inflation differentials were marked were for one year from mid-2008 and since April 2015. In the former case, Nepal's sugar prices surged earlier as well as faster than India's and peaked in April 2009, seven months prior to India's hitting the peak. In the second case, while India's inflation started to recede rapidly from April 2015, Nepal's did not, leading to an 11% inflation differential on average for one year since April 2015.

The econometric results show that Nepal's and India's sugar prices are cointegrated at the 1% significant level, with complete price transmissions in the short-term (elasticity of 1.00). In contrast, the error-correction coefficient is relatively small (−0.089) but statistically significant, implying that while sugar prices move closely in the short run, differences from long-term equilibrium are adjusted very slowly. A similar analysis using world export prices (FAO sugar price index) shows that Nepal's sugar prices are not cointegrated with the world prices, and short-run elasticity was very small. This is also the case for the Indian and world sugar prices.

According to Mishra and Roy (2011), sugar prices in India are determined largely by cane and sugar production although policy interventions have played some role. For example, the spike of 2009 in India was associated with a large production shock when sugar output fell by almost 50% in 2009. Good harvests for

Fig. 8 Sugar inflation (%)



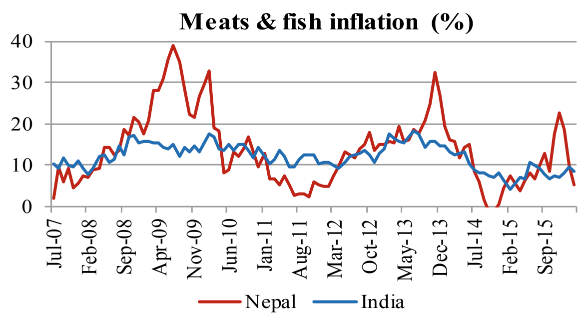
three consecutive years (FY2011 to FY2013) also explain the mostly low and deflationary inflation trend since 2011, as well as the uptrend in sugar prices since July 2015 as production declined. The Indian government also intervenes actively to stabilize sugar prices with measures such as cane support price, export restrictions as well as export subsidies, adjustments to levy from sugar mills, stocking limits for traders and restrictions on futures trading. The main message is that sugar prices would have been much more volatile without these interventions.

4.2.7 Meats, Fish, and Eggs

Nepal's inflation in meats, fish and eggs averaged 14% during the 105 months covered, very close to India's 12%, but was highly volatile in contrast to the relatively stable trend for India (Fig. 9) (the coefficient of variation of Nepal's inflation rate was about 2.4 times that of India). The two inflation rates diverged considerably during the 3–4 episodes when Nepal's inflation surged or slumped, but for the rest of the months they moved fairly similarly. India's inflation rates have been in the 10–20% range for almost 80% of the months, and never exceeding 20%. In Nepal, on the other hand, inflation was over 20% for about 20% of the time. Inflation differentials (Nepal's minus India's) have been typically very high during those months when Nepal's meat inflation had surged, e.g. during 2008–2009 when Nepal's inflation averaged 27% versus India's 15%.

The analysis of price linkages shows that meat prices in Nepal and India are cointegrated but somewhat weakly (at the 5% level). Moreover, the sign of the short-run transmission elasticity was negative but the coefficient was not significant statistically. A negative sign, if valid, would tell that meat price falls in Nepal when it rises in India. These results—and the graphs as well—could also be taken to imply that the tradability of meat and products is fairly low. Could this be so? Nepal-India trade data do not show much trade in these products although there is a general perception in Nepal that there is a large informal, unrecorded imports from India of live goats and buffaloes, and even fish (Sharma 2017). Aside from these perceptions and anecdotes, there is little evidence to make further sense of the results. But given that the demand for meat products in Nepal are surging, a better

Fig. 9 Meats and fish inflation (%)



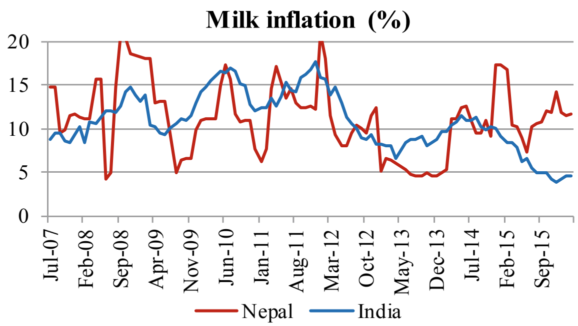
understanding of how meat and fish prices are formed could be valuable for articulating policy in these areas.

4.2.8 Milk and Dairy Products

As fresh milk dominates this basket of products, inflation is largely determined by the price of fresh milk. Moreover, if fresh milk is largely a non-traded product across the Nepal-India border, as is generally held, prices in Nepal and India should be largely independent. The data show a surprising closeness in the overall average inflation rates in Nepal and India during the 105 months since July 2007 (11.2% for Nepal and 10.9% for India). But Fig. 10 shows that inflation trends have been very different, with Nepal's inflation characterized by relatively more frequent and marked volatilities. A closer inspection of the graphs shows that there were periods when the two rates did move similarly, albeit with some lag and to different extents. For example, inflation in both countries surged in late 2009 to early 2010 although the patterns were different—Nepal's inflation spiked earlier than India's. Likewise, both inflation rates declined markedly for one year from the peak in early 2012. In contrast, prices diverged considerably since September 2014, with a steady and secular decline for India but not for Nepal (this could be due to earthquake and trade blockade). The correlation coefficient between the two inflation rates is relatively small, 0.35.

Econometric tests conveyed somewhat ambiguous results as regards the cointegration of milk prices in Nepal and India, with one test confirming cointegration and the other rejecting that. Moreover, as with meats, the short-run price transmission coefficient is negative but not statistically significant. But in contrast to all other food categories analyzed, the coefficient measuring the transmission of the Indian prices lagged by one month is very large, 0.81, as well as statistically significant at the 5% level. Could it be that the Indian milk and dairy prices have a large influence on the Nepalese prices with a lag of one month? Unfortunately, there is so little documented on the process of price formation of milk and dairy products in Nepal that it is difficult to have any definite view. Another factor that

Fig. 10 Milk inflation (%)



would explain the results would be a sizable volume of unrecorded, informal trade in fresh milk with India.

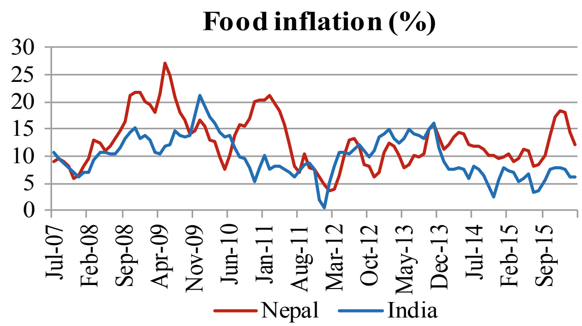
4.2.9 All Foods and Beverages

The price index for foods and beverages is a composite of the indices for 12 different food categories. The analysis in Sect. 3 on relative contributions of various foods to overall food inflation had shown that cereals and vegetables together contributed to almost 50% of the annual changes on average during the past 10 fiscal years, other notable contributors being meat and milk. The contribution was much higher during six episodes of high food inflation when vegetables alone accounted for 52% of the change in food inflation. A similar analysis for India for the same months as in Nepal's six high episodes also showed the high contribution of vegetables to India's food inflation: 47% by vegetables, 12% by milk, 11% by cereals, 10% by spices and 6% by pulses. Thus, vegetables stand out in both countries.

Nepal's food inflation averaged 13% during the 105 months since July 2007 compared to 10% for India. Figure 11 shows that there were three periods when food inflation in Nepal and India diverged markedly. First, during mid-2008 to late 2009, in the backdrop of the global food price crisis, Nepal's food inflation spiked, averaging 20% in those 16 months while India's remained much lower (13% average). Second, Nepal's food inflation surged again for 10 months from August 2010, averaging 18% versus 11% for India. This is most likely due to tighter export control of by India of most basic foods in that period as a response to the food price crisis. Third, there was a marked divergence during the blockade months from September 2015. Other than these three periods, the graphs show that food inflation in Nepal and India tends to move in similar directions. For 66 of the 105 months, average inflation differential was under 5%.

The cointegration analysis supports this impression. The results show that the two prices are cointegrated and statistically significant at the 1% level. The short-term elasticity of price transmission from India to Nepal is quite high, at 0.53,

Fig. 11 Food inflation (%)



and also significant at the 1% level. The error-correction coefficient of −0.15 can be considered to be relatively robust and also significant at the 1% level.

4.2.10 Non-food Goods and Services

Non-food goods and services include besides many types of goods several services such as housing and utilities, health, education, communication, transport, recreation, etc. As services have high non-traded contents, the expectation is that inflation rates in Nepal and India should be poorly cointegrated than for foods. This expectation is confirmed by the results from the cointegration analysis which shows that the two inflation rates are not cointegrated in the long run, or are very weakly cointegrated according to some other test. However, the short term (monthly) transmission elasticity is statistically significant although the value, 0.29, is smaller, about half of that for food inflation.

Nepal's non-food inflation has been lower than India's on average for the 105 months covered since July 2007 (7% for Nepal, 8% for India), the only category of products assessed in this study to be so other than pulses. Figure 12 shows that inflation in Nepal and India notably diverged several times, e.g. during 2008, 2009, late 2012 and from late 2015. Aside from these periods when inflation differentials were larger, there were also many months when the two rates moved similarly and with smaller differentials. The data show that inflation differential was below 5% points for 82 of the 105 months, averaging just 0.7% points in these months (with lower inflation in Nepal). Indeed, Nepal's inflation was lower than India's in 72 of the 105 months. Nepal's inflation exceeded India's by 5% points or more for only 9 months of which 6 were in 2015/16 (the blockade months) and 3 months in 2008. As this study is focused on food inflation, no analysis was undertaken of the relative contributions of various non-food components to overall non-food inflation, and how inflation in these components are influenced by, or cointegrated with, the corresponding prices in India. This analysis is doable and could be worth undertaking so as to have a complete picture on overall inflation in Nepal.

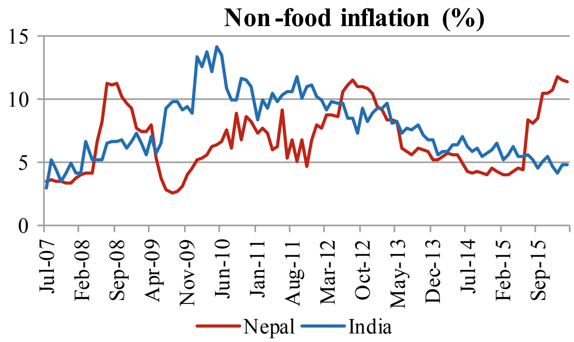


Fig. 12 Non-food inflation (%)

4.2.11 All Products—Overall Inflation

Overall inflation is the composite of the food and non-food inflation, aggregated with respective consumption weights (in Nepal's case, the food-non-food weights are 47–53% in indices with 2005/06 base, changed to 44–56% in the new 2014/15 base). Overall inflation in Nepal and India were similar on average for the 105 months covered—9.6% for Nepal and 8.8% for India. Nepal's inflation was higher than India's for 63 of the 105 months, with inflation differential of 5% points or lower for 13 months only. On the other hand, Nepal's inflation was lower than India's for 42 months with the differential of 5% points or more for six months, all of them in 2010 (Fig. 13).

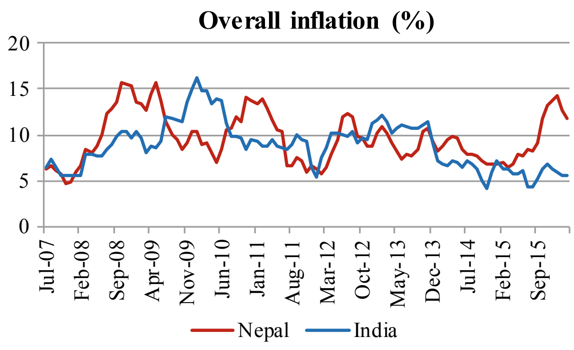
Econometric analysis shows that the two inflation rates are strongly cointegrated in the long run, with a robust short-term transmission elasticity of 0.52 and the error-correction coefficient of −0.12, which is lower than that for food but double than that for non-food.

4.3 *Inflation Differential During the Trade Blockade of 2015/16*

In 2015/16, Nepal's economy suffered from the lingering impact of the April 2015 earthquakes and the subsequent political disruptions along the Nepal-India borders and trade blockade for several months from September 2015. With India's share in Nepal's imports being as high as 60% for food and 66% for non-food, and transit for the rest of the imports as well affected, inflation in Nepal was bound to surge.

The impact of the disruptions and blockade is assessed using two indicators. The first compares average inflation in Nepal during the months of the blockade (September 2015 to March 2016) to the average for the same seven months in previous four years. This is like a "before-and-after" comparison. The second indicator is inflation differential between Nepal and India (Nepal's minus India's) for the same two periods. This is a "with-and-without" comparison, assuming that

Fig. 13 Overall inflation (%)



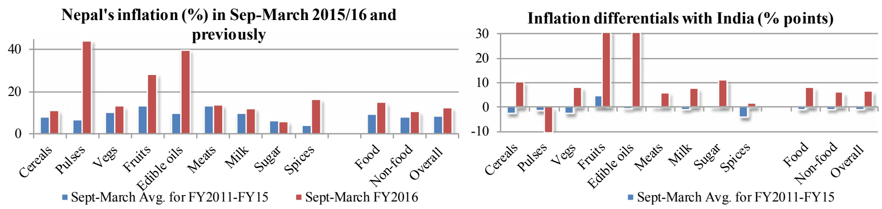


Fig. 14 Impact on inflation during trade blockade, September 2015–March 2016.
Note The left panel compares average inflation during September 2015–March 2016 with the average for the same months in the previous four years (FY2011–FY2015); the right panel shows inflation differential (Nepal's minus India's) during these two periods. *Source* Computed based on inflation data used in previous graphs and tables

the differential is the effect of the disturbances and blockade. Figure 14 shows the results.

The first indicator (left panel) shows that food inflation as a whole was 15% in FY2016 (September–March average) versus 9% for the same months in the previous four years. In other words, assuming the past four years as control, the impact of the blockade was an extra 6% points in food inflation. The differentials for non-food and overall inflation were lower, 3 and 4% points, respectively. Among different foods, the impact was most conspicuous for pulses and edible oils. For pulses, for example, Nepal's inflation averaged 44% during the blockade months versus 7% in the previous four years. For edible oils, the differential was 30% points. In addition, the impact was marked for fruits and spices as well.

The right panel compares average inflation differentials with India during the blockade months and the previous four years. It shows, for example for food inflation, that Nepal's inflation was 1% point lower than India's during the previous four years (inflation rates of 9.3% vs. 10.2%) but the differential shot up to 8% points during the blockade months (inflation rates of 15% vs. 7%). For non-food and overall inflation, the differentials were similar, about 7% points. The impact was very large for edible oils (differential of 32% points) and fruits (26% points), but also marked for cereals (13% points) and vegetables and sugar (both 11% points). Interestingly, the differential during the blockade months was negative 9% points for pulses (Nepal's inflation of 44% and India's 54%). Why this could have been the case needs to be explored.

5 Summary and Conclusions

The focus of this chapter was on three aspects of food inflation in Nepal: (i) its changing character over the long-run; (ii) relative contributions of various food products to overall food inflation during 2007–2015; and (iii) linkages between food prices in Nepal and India. Very briefly, the main findings of the data analysis were as follows. First, the underlying character of inflation in Nepal changed fundamentally since around 2007 with food inflation becoming much more prominent and a large contributor to overall inflation. Second, during several episodes since 2008 when food inflation surged in Nepal, vegetables were the top contributor, followed by cereals and meat and fish. Third, linkages between the prices of food products in Nepal and India were close, but not for non-food.

Econometric analysis was conducted to quantify the extent of the transmission of the Indian prices to Nepal for eight categories of food products. The results revealed some differences across various foods. The short-run transmission elasticity ranged from 0.20 for cereals to 1.0 for sugar, with relatively larger values (0.50 or more) for pulses and edible oils but lower for vegetables and fruits, while the elasticity was signed negative for meat/fish and milk although not significant statistically. As for long-run cointegration, this was confirmed for cereals, pulses, vegetables, edible oils, and sugar but not for milk and spices. Food price as a whole was strongly cointegrated but not non-food price. The analysis also showed that inflation in Nepal was generally much more volatile than in India, and when prices soared, inflation in Nepal typically rose to higher levels than in India. Overall, the results support a long-standing view that food markets in Nepal are closely linked to those in India.

Multi-country studies on market integration generally find that the degree of price transmission is influenced by factors such as the volume of imports, import dependency ratio and exchange rate. What factors could have driven Nepal's price linkages with India? One somewhat surprising finding was that prices in Nepal and India co-moved closely even for products such as edible oils and pulses that Nepal imported little or not much from India. Likewise, it seems that the volume of Nepal's imports from India relative to Nepal's consumption needs also did not seem to matter. Fairly close price linkages were also found for products with relatively lower tradability such as vegetables and fruits. Thus, some of the established drivers of price transmission did not seem to have played the same role in Nepal's case. One likely driver unique to Nepal could be unrecorded, informal trade which, if substantive, holds the potential for strengthening price linkages. No recent estimates are available for this trade but it is widely suspected to be substantive for many food products (Sharma 2017). Other factors that could be playing crucial role in Nepal's case would be the porous borders, free movement of people for trade and business, currency convertibility and free trade in food products on a reciprocal basis. At the end, it seems that markets in border areas of Nepal and India arbitrage effectively.

So what option does Nepal have in taming inflation within a range desired by Nepal's own policy makers? Given Nepal's small import needs, balancing demand with supply of most tradable goods to tame inflation should, in theory, not be an issue. In practice, it does not seem that Nepal's markets function in that fashion. This means that Indian prices will continue to be the main drivers of price stability in Nepal as well as occasional surges, as documented in detail in Sect. 4 for eight food products during 2007–2015.

On a positive note, pursuit of price stability has been a long-standing hallmark of the Indian food policy. During global food price crisis in 2008, and also in 2011, India was among the handful of developing countries to be able to avoid the spikes in cereal prices through, *inter alia*, export bans, and Nepal too was a beneficiary of that stability, aside from a period lasting several months when the bans seemed to work for Nepal also, as indicated by much higher inflation in Nepal. In the past decade, India has used trade interventions many times to stabilize prices of products such as rice and wheat, onions and sugar. Yet, unlike countries with small import needs, India also faces difficulty relying on imports for balancing its markets. One glaring example is pulses whose global market is very thin, with a total trade of around 10 million tonnes only out of which India alone imports 30–40%. This has been a reason for frequent surges in pulses prices in India, and by extension in Nepal too. In some other cases, prices in India have also surged because of the poor timing of policy responses, e.g. for onions and sugar. Cereal prices in India soared in 2009/10 in part due to one of the sharpest hikes in support prices and stepped-up public procurement, reducing availability in the open market. For some other foods, tradability is simply low and supply shocks frequent.

While Nepal's ability to counter "unwanted" price ripples from India is limited, there are things that Nepal could do itself to contain inflation. For example, given that vegetable prices have been the major contributor to food inflation, one response would be to incentivize investments in cold storage and farm-retail market infrastructure. Effective market information and early warning systems also help reduce price instability. More could be done on analyzing data on food prices so as to understand the drivers of occasional surges and slumps. Currently, official publications provide comprehensive *statistics* on inflation, but they do little to analyze the data for identifying drivers of the price changes. As a last point, there is a growing consensus in many recent studies on food inflation, including in India, that food inflation, at least its persistent components, should be considered in inflation targeting by monetary authority rather than just core inflation.

High food prices do not necessarily lead to positive production response, as evidence from around the world show. For example, an assessment by FAO (2009) following the high food prices during 2007–2009 concluded that high prices did not lead to positive supply response to the extent anticipated. Two reasons given for this were: (i) high prices in the world markets and in national capitals did not pass through to farmers; and (ii) technology, inputs, and infrastructure were not affordable or accessible to the vast majority of small farmers, limiting the ability to respond positively. Another study that also analyzed cross-country data on high prices and supply response made the same conclusion (Haile et al. 2014). Supply response could occur over the long run but not necessarily in the short run. One finding was that price-risk variables were statistically significant in regressions on cereals, indicating that volatility undermined supply response to high prices. Food prices tend to be more volatile during periods of high prices. The policy implication of this finding is that price stability does matter greatly, and price surges do not necessarily lead to positive supply responses.

Annex: The Data Sources, Error-Correction Model Used and the Results

Data Sources Used

All price data used in this study for Nepal are price indices published in Nepal Rastra Bank's *Quarterly Economic Bulletins*, with base period 2005/06. The NRB price indices are available for four areas—Kathmandu valley, hills, Tarai and Nepal as a whole. This study uses data for Kathmandu valley as a "proxy" for Nepal for two reasons: the data for Kathmandu valley is expected to be more "cleaner" than for other areas, and there is very little difference in trends in indices/inflation rates across the four areas. All inflation rates in the study were computed fresh from the monthly indices. The NRB released in mid-2015 new indices with 2014/15 base period. These new indices were used to extend the 2005/06 series for one year from mid-2015 to March 2016.

India's new CPI data, with 2012 consumption weights, are available from January 2011 only and so could not be used for analysis going back to 2006. Therefore, the study uses price indices used for CPI-IW (industrial workers) which has 2001 base. For vegetables, fruits, and sugar, the CPI-IW does not have disaggregated indices and so for these three foods, the Indian Wholesale Price Indices (WPI) are used.

Error-Correction Model (ECM) for Price Transmission Analysis

Price transmission analysis helps understand how price signals are being transmitted across markets, e.g. between India and Nepal. One popular econometric method for estimating price transmissions is the ECM which embeds within it both the short-run and long-run dynamic process of price transmissions across markets. Engle–Granger two-step procedure is commonly used for fitting the ECM. The two steps are as follows:

Step 1: Estimate (1) as the long-run (equilibrium) relation between y_t and x_t:

$$y_t = \alpha_0 + \alpha_1 x_t + u_t \tag{1}$$

where y_t and x_t are prices or price indices for the two markets (e.g. y_t for Nepal, x_t for India) and α_0 and α_1 are parameters to be estimated (the common practice, for good reasons, is to express prices in logarithms, i.e. y_t and x_t are the logs of the price levels or price indices). The u_t's ($= y_t - \alpha_0 - \alpha_1\ x_t$) are residual errors which measure disequilibrium from the long-run relation (1).

A test of cointegration between y and x variables is a test of whether u_t is stationary. This is undertaken with methods that test for stationary, most popular among them being the augmented Dickey–Fuller (ADF) test and the Phillips-Perron test. Once it is confirmed that u_t is stationary (or y and x are cointegrated), Eq. (2) is estimated as follows.

Step 2: Estimate the following ECM:

$$\Delta y_t = \phi_0 + \theta \Delta x_t + \lambda(y_{t-1} - \alpha_0 - \alpha_1 x_{t-1}) + \varepsilon_t \tag{2}$$

Note that $(y_{t-1} - \alpha_0 - \alpha_1 x_{t-1})$ in (2) is u_{t-1}, the vector of residuals (lagged 1) from (1).

In Eq. (2), λ is the coefficient for speed-of-adjustment, which measures the speed at which y adjusts to any discrepancy between y and x in the previous $(t - 1)$ period. For this to happen, λ must be negative, and if it is significantly different from zero, a dynamic process drives prices to converge to their long-run equilibrium as expressed in Eq. (1). The parameter θ measures contemporaneous effect of x on y, i.e. how much of a given change in x is transmitted to y in the current period (e.g. month). Some other variables may also be added, e.g. Δy_{t-1} to measure the effect of lagged prices in the same market as y, and Δx_{t-1} to measure the lagged which measures the speed at y. In addition, one or more lagged Δy variables are also added (e.g. Δy_{t-2}, Δy_{t-3} etc.) as needed for taking care of auto-correlation.

The following tables show the results for cointegration tests and the ECM regressions. Prior to testing for cointegration and ECM runs, each variable was subjected to ADF and Phillips–Perron tests to ensure its stationary in differences.

(a) Tests of long-term cointegration between Nepal and India price indices, July 2006 to March 2016

	ADF test			PP test (lags as in ADF)		Long-term cointegr.?
	Z(*t*)	# lags	Sig.	*Z*(*t*)	Sig.	
Cereals	−2.36	4	5%	−2.68	1%	Yes
Pulses	−4.08	0	1%	−4.08	1%	Yes
Vegetables	−3.23	2	1%	−3.67	1%	Yes
Fruits	−1.46	10	n.s.	−4.47	1%	???
Edible oils	−1.67	5	10%	−2.39	5%	Yes
Meats/fish	−2.52	6	5%	−3.53	1%	Yes
Milk	−1.25	8	n.s.	−3.11	1%	???
Sugar	−2.81	0	5%	−2.81	1%	Yes
Spices	−2.17	8	5%	−2.71	1%	Yes
Food and beverages	−2.87	3	1%	−2.97	1%	Yes
Non-food	−1.22	1	n.s.	−1.69	10%	???
Overall CPI	−2.76	1	1%	−2.36	5%	Yes

(b) Results of the Error-Correction Model (ECM) regressions

	Coefficients on Indian prices				Error-correction		Coeff. on Nepal price			Long-term cointegr.?
	Current		Lagged		Coefficient		Lagged		Adj R2	
	ΔXt	Sig.	ΔX_{t-1}	Sig.	EC_{t-1}	Sig.	ΔY_{t-1}	Sig.		
Cereals	0.20	n.s.	0.00	n.s.	−0.11	1%	0.22	5%	0.09	Yes
Pulses	0.72	1%	−0.03	n.s.	−0.24	1%	0.02	n.s.	0.45	Yes
Vegetables	0.32	1%	−0.01	n.s.	−0.07	10%	0.33	1%	0.32	Yes
Fruits	0.28	5%	0.21	10%	–	–	−0.01	n.s.	0.05	???
Edible oils	0.56	1%	−0.23	n.s.	−0.13	1%	0.51	1%	0.34	Yes
Meats/fish	−0.16	n.s.	0.09	n.s.	−0.19	1%	0.24	5%	0.12	Yes
Milk	−0.42	n.s.	0.81	5%	–	–	0.04	n.s.	0.03	???
Sugar	1.01	1%	−0.25	10%	−0.09	5%	0.12	n.s.	0.47	Yes
Spices	−0.10	n.s.	0.01	n.s.	−0.02	n.s.	0.27	1%	0.09	Yes
Food & beverages	0.53	1%	−0.23	5%	−0.15	1%	0.55	1%	0.49	Yes
Non-food	0.30	1%	−0.06	n.s.	–	–	−0.22	5%	0.07	???
Overall CPI	0.52	1%	−0.12	n.s.	−0.12	1%	0.41	1%	0.35	Yes
Number of observations = 115										
ECM results for 3 products with no cointegrated										
With ECM Fruits	0.35	1%	0.03	n.s.	−0.21	1%	0.08	n.s.	0.15	???
With ECM Milk	−0.39	n.s.	0.63	10%	−0.21	1%	0.15	n.s.	0.11	???
With ECM Non-food group	0.29	1%	−0.09	n.s.	−0.06	n.s.	−0.18	10%	0.08	???

References

ADB. (2011). *Global food price inflation and developing Asia*. Manila: Asian Development Bank.

Bhattacharya, R., & Gupta, A. S. (2015). *Food inflation in India*: *Causes and consequences*. Working Paper No. 2015-151, National Institute of Public Finance and Policy, New Delhi. http://www.nipfp.org.in/media/medialibrary/2015/07/WP_2015_151.pdf.

Chand, R. (2010). Understanding the nature and causes of food inflation. *Economic and Political Weekly, 45*(9), 10–13.

Chand, R., Gulati, A., Shinoj, P., & Ganguly, K. (2011). *Managing food inflation in India*: *Reforms and policy options*. Policy Brief No. 35. National Centre for Agricultural Economics and Policy Research, New Delhi. http://www.ncap.res.in/upload_files/policy_brief/pb35.pdf.

Dobrescu, G., Nelmes, J., & Yu, J. (2011). Inflation dynamics in Nepal. In *Nepal*: *Selected Issues*. IMF Country Report No. 11/319, November 2011, IMF.

FAO. (2009). *The state of agricultural commodity markets 2009*: *High food prices and the food crisis—Experiences and lessons learned.* FAO, Rome. ftp://ftp.fao.org/docrep/fao/012/i0854e/i0854e00.pdf.

Ganguly, K., & Gulati, A. (2013). *The political economy of food price policy*: *The case study of India*. WIDER Working Paper 34/2013, UNU-WIDER. https://www.wider.unu.edu/publication/political-economy-food-price-policy-3.

Ginting, E. (2007). *Is inflation in India an attractor of inflation in Nepal?* IMF Working Paper WP/07/269, November 2007. http://www.imf.org/external/pubs/ft/wp/2007/wp07269.pdf.

GoI (various years), *Economic Survey*. Ministry of Finance, Government of India, New Delhi. Available at http://indiabudget.nic.in/index.asp.

Gulati, A., & Saini, S. (2013). Taming food inflation in India. Discussion paper no. 4. Commission for Agricultural Costs and Prices, India.

Haile, M. G., Kalkuhl, M., & von Braun, J. (2014). *Agricultural supply response to international food prices and price volatility*: *A cross-country panel analysis*. Center for Development Research (ZEF), Bonn University, Germany. http://ageconsearch.umn.edu/bitstream/182725/2/Haile-Agricultural_supply_response_to_international_food_prices_and_price_volatility-216_a.pdf.

Kumar, R., Vashisht, P., & Kalita, G. (2010). Food inflation: Contingent and structural factors. *Economic and Political Weekly, 45*(10), 16–19.

Nair, S. R., & Eapen, M. L. (2012). Food price inflation in India (2008–2010). *Economic and Political Weekly, 47*(20), 46–54.

Mishra, P., & Roy, D. (2011). *Explaining inflation in India: The Role of Food Prices*. Mimeo: IMF and IFFPRI, October 31, 2011, Washington, D.C. http://www.prachimishra.net/mishra_roy_reviseddraft_ipf_oct25.pdf.

NRB. (2007). *Inflation in Nepal*. Kathmandu: Research Department, Nepal Rastra Bank. http://red.nrb.org.np/publications/special_publication/Special_Publications–Inflation%20in%20Nepal.pdf.

Sharma, R. (2017), *The scale and drivers of informal trade in agricultural products across the Nepal-India borders*. Paper prepared for the SAARC Agricultural Trade Forum, Organized by SAARC Agriculture Centre and FAO, 22–23 May 2017, Dhaka, Bangladesh.

Sharma, R., Kumar, A., & Joshi, P. K. (2017). Nepal-India agricultural trade: Trends, issues, and prospects. Policy Reform Initiative Project (PRIP)-Nepal Report 3, IFPRI.

Shrestha, M. B., & Chaudhary, S. K. (2012). The impact of food inflation on poverty in Nepal. *Nepal Rastra Bank Economic Review*, *24*(2).

Chapter 6
Climate Change Impact on Agricultural Sector of Nepal: Implications for Adaptation and Resilience Building

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Abstract The chapter assesses the impact of climate change on agricultural production, food security, livelihoods, and economy. It reviews the ongoing and planned policies, plans, programs and projects to respond to the impacts of climate change. It also identifies policy responses and technology needs to help smallholders adapt to climate change impacts. The mainstreaming of climate resilience at the policies, plans and programs, developing and strengthening institutions for better service delivery, and ensuring and increasing the finance for research and development activities should be prioritized.

Acronyms

ADB	Asian Development Bank
ADS	Agriculture Development Strategy
AGDP	Agricultural Gross Domestic Product
CAGR	Compound Annual Growth Rate
CBOs	Community-Based Organizations
CBS	Central Bureau of Statistics
DDCs	District Development Committees
DOA	Department of Agriculture
DOI	Department of Irrigation
DOLIDAR	Department of Local Infrastructure Development and Agricultural Roads
EFDB	Emission Factor Database
FAO	Food and Agriculture Organisation
FY	Fiscal Year
GDP	Gross Domestic Product
GHG	Green House Gas

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G. Thapa et al. (eds.), *Agricultural Transformation in Nepal*,
https://doi.org/10.1007/978-981-32-9648-0_6

GLOF	Glacial Lake Outburst Floods
ICIMOD	International center for Integrated Mountain Development
IPCC	Inter-governmental Panel on Climate Change
LAPA	Local Adaptation Plan of Action
LULCF	Land Use And Land Use Change And Forestry
MoED	Ministry of Agricultural Development
MOE	Ministry of Environment
MoHA	Ministry of Home Affairs
MoSTE	Ministry of Science, Technology and Environment
NAPA	National Adaptation Program of Action
NARC	Nepal Agriculture Research Council
NBSAP	National Biodiversity Strategy and Action Plan
NGOs	Non-governmental Organizations
UNDP	United Nations Development Program
VDCs	Village Development Committees

1 Introduction

Agriculture is the principal sector of the economy in Nepal. It contributes around one-third to Gross Domestic Product (GDP) and provides employment to around two-thirds of the economically active population. Nepalese economy has been experiencing structural changes over the years. The contribution of agricultural sector was 70% in 1974, which has decreased to 32% in 2014. This is about 1% decrease per annum in a 40 years period. The real growth rate of agricultural sector (AGDP) has been only 2.47% per annum during this period, which is lower compared to our neighbors (Joshi 2018).

The farm holdings are very small and marginal. Nearly 53% of the farms have less than 0.5 ha of land, while those with less than 1 ha of land constitute 80% of all holdings. The average landholding size in Nepal is declining in every census, which was 1.13 ha in 1981, declined to 0.79 ha in 2001 and further declined to 0.68 ha in 2011. The size of landholding and household level food self-sufficiency has a positive correlation. Over 60% of the holdings above 0.50 ha are self-sufficient (CBS 2013).

Agriculture in Nepal is mostly rainfed and climate-sensitive. This sector is highly vulnerable to climate change in comparison to other economic sectors. Although a rise in temperature could have some location-specific positive effects, increased agricultural yield, for instance, most of the gains will only be short-term and will be outstripped by the negative effects of rising temperature and drought.

In rural areas, the crop and livestock farming is prevalent in different combinations which is the main source of livelihood. Rice, wheat, maize, millet, barley, and buckwheat are the dominant cereal crops cultivated in different ecological regions. Nepal is much vulnerable to the impacts of climate change mainly because of variability in weather conditions related to rising temperature and changing rainfall pattern, including drought. As rice is the main staple crop of Nepal, the cultivation of this crop will be risky mainly due to unreliability of stream flows, erratic monsoon rainfall, and the flooding. In Nepal, about 64% of the cultivated areas heavily rely on monsoon rain and changes in the time, duration and intensity of rainfall may affect the agricultural production in general and rice productivity in particular. The level of vulnerability will differ across the ecological regions. The impact of climate change on agriculture is expected to be very high in the mountains and Himalayas as compared to plain areas. In the higher altitude, population mostly relies on agriculture for their livelihood and the extreme climatic events will create additional stress by affecting the status of agricultural production and food security (JVS 2015).

Nepal is the fourth vulnerable country from the perspective of climate change (Maplecroft 2011) despite Nepal's very low share of global greenhouse gas (GHG) emission. Weather variability in terms of rising temperature and changing pattern of rainfall and drought would adversely affect different aspects of agricultural production systems. The impacts, though expected to become higher in the mountains compared to Terai region, are harmful to both the regions and ultimately to agricultural production, food security, and the people's livelihood. Moreover, the agriculture sector performance that relied on favorable weather conditions, and the agricultural dependent community that showed higher intensity level of poverty in the country irrespective of the regions are sufferers of any adverse situation created due to the climate change (MoE 2010b).

Climate change may aggravate poverty in many developing countries and create new poverty pockets in countries with increasing inequality, in both developed and developing countries (IPCC 2014). Because of high dependence on the agricultural sector, loss of agricultural productivity due to climate change significantly affects the economy of many developing countries (Gebreegziabher et al. 2011).

Agricultural sector, especially rainfed agriculture, is highly sensitive to climate change (Ramay et al. 2011). The direct drivers of climate change include changes in temperature, precipitation, length of growing season, and timing of important stages of crop development. Several other factors, such as loss of biodiversity and common property resources, growing water stress for irrigation, frequent crop damage due to floods and droughts, possible damage to infrastructure, and inadequate institutional support, such as credit, crop insurance, and storage and processing facilities, will lead to decline in agricultural production and threatening food security. Several studies in the past have shown that the production of rice, corn, and wheat has declined due to increasing water stress arising partly from increasing temperature, and partly from a reduction in the number of rainy days (Agarwal et al. 2000).

A warming climate results in the increase of water demand and decrease of river flows. The major rivers of Nepal are fed by more than three thousand glaciers situated across the Nepal Himalayas. These rivers support irrigation systems, agro-processing mills and hydroelectric plants and provide drinking water to thousands of kilometers downstream. Climate change will contribute to increased variability of river runoff due to changes in timing and intensity of precipitation as well as melting of glaciers. Runoff will initially increase as glaciers melt, then decrease later as deglaciation progresses (Agrawala et al. 2003).

Climate change will affect people of different gender and class differently. Available studies suggest that women, children and elderly will have relatively more impacts than other groups of people. Out-migration of young men has resulted in the feminization of farming system, where the labor contribution of women is very high to generate income for livelihoods including food security for the family. As a result, rising temperatures, unpredictable precipitation patterns, and increased extreme-weather events will have a disproportionate impact on women who depend on subsistence farming for their livelihoods (Adhikari 2014).

Climate change will continue in the days to come and people will further realize its visible impacts. Countries having resources and technologies will prevent or reduce impacts to an acceptable level whereas technically and financially resource-poor countries such as Nepal will be affected immensely due to low or non-existing coping capacities. There are two sets of broad challenges: (i) GHGs emission reductions even by changing the gear of social and economic development and (ii) internalizing low emission and climate-resilient strategy by changing the direction of development (Joshi and Uprety 2011).

2 GHGs Emission from the Agricultural Sector

Nepal's contribution to the world's total greenhouse gas emission is only 0.027%. This is a small increase compared to the initial national communication (0.025%) reported in 1998.

Table 1 shows the growth of GHG by sectors. The total emission from energy and waste sectors increased during 1994–2000. It shows that compound annual growth rate (CAGR) for the energy and the waste sector was increasing while it was

Table 1 GHG emission by sectors in Nepal

S. No.	Sectors	1994 (CO_2 and Gg)		2000(CO_2 and Gg)		CAGR% (1994–2000)	2008 (CO_2 and Gg)	
		Total emission	% of Total	Total emission	% of Total		Total emission	% of total
1	Energy	1465	5	6827	27.8	29.24	7959	26.5
2	Industrial processes	165	0.6	131	0.5	−3.77	632	2.1
3	Agriculture	27,197	92.6	16,916	68.9	−7.58	20,662	68.8
4	Waste	520	1.8	667	2.7	4.23	758	2.5
	Total (without LULCF)	**29,347**	**100.0**	**24,541**	**100.0**	**−2.92**	**30,011**	**100.0**

Note Methodologies, definitions of activity data and emission factors adopted in the base year 1994 and 2000 differ from 2008 decreasing for the agriculture and industry. As agricultural sector is subsistence in nature, the use of machineries and fossil fuel is very less resulting very low emission of carbon dioxide (CO_2). The agriculture is one of the major sources of methane (CH_4) and nitrous oxide (N_2O) emission. The emission of CO_2 is the highest for agriculture (68.8%) followed by energy (26.5%). The increments in case of energy might be attributable to the increase in the economic activities leading to more energy consumption and more waste production (MoSTE 2014a).

2.1 GHG Emission for Base Year 2000

(a) *Enteric fermentation and manure management*: Cattle farming is considered the main source of methane emission from enteric fermentation. The lower level of methane emission per head is anticipated as it has been more fodder based rather than feed-based. In general, methane emission from manure management is usually smaller than that of enteric fermentation emission and is principally associated with confined animal management facilities where manure is handled as a liquid (IPCC 1997). However, manure is handled as a dry lot in Nepal.

As cattle farming in Nepal is generally semi-range-based, the emission from manure management per capita is expected to be lower than reported by the Intergovernmental Panel on Climate Change (IPCC). Methane is produced when the organic dung is decomposed in an anaerobic environment, but the small farmers put the dung in uncovered small heaps thus reducing the probability of anaerobic action on it and production of methane. Similarly, in Nepal, the manure is not stored as a liquid in ponds or lagoons, methane emission will be low. Methane emission from domestic livestock by enteric fermentation and manure management was 468.52 Gg in the year 2000. Similarly, the emission of nitrous oxide from animal waste management was 7.65 Gg.

(b) *Flooded rice field*: Flooded rice production practice restricts the oxygen supply at the deeper layers resulting into methane production by anaerobic decomposition of organic materials. In case of Nepal, although rice production under low lying areas is flooded, it is practiced under small terraces with limited water supply in hilly areas. In such areas, continuous flooding of rice field is not possible. In addition, upland rice farming is also practiced although in a limited scale under rainfed environment. Hence, methane emission from rainfed and upland rice farming will be much lower than rice farming under continuous flooding. Using emission factors defined in the IPCC database, methane emission from the rice field is estimated at 1.57 Gg per year.

(c) *Field burning of agricultural residues*: Burning of agricultural residues is practiced on a limited scale in some parts of the country. However, authentic information for such practice is not available. Although the emission from burning activity may be very small, this has not been estimated. Moreover, as the biomass burned is generally replaced by re-growth over the subsequent year, the CO_2 released is not considered to be the net emission. During re-growth, an equivalent amount of carbon is removed from the atmosphere to offset the total carbon released from burning. Therefore, the long-term net emission of CO_2 is considered to be zero (IPCC 1997). Hence, the emission from field burning of agricultural residues is not considered for estimation.

(d) *Agricultural soils*: The use of fertilizer, nitrogen from animal wastes, nitrogen from increased biological N-fixation, and nitrogen derived from cultivation of mineral and organic soils through enhanced organic matter mineralization are sources of nitrous oxide emission from the soil (IPCC 1997). As the level of use of fertilizers is 74.1 kg nutrients/ha of arable land in 2016 (data.worldbank.org/indicator) which is lower than Nepal's neighbor the emission is also low. The farming technologies and soil management practices adopted in Nepal do not perfectly match with those reported by the Emission Factor Database of IPCC. In Nepal, no emission factor is found reported the IPCC Emission Factor has been used for inventorying GHG from the agriculture sector as a whole.

In the base year, the direct nitrous oxide emission from agricultural fields, excluding cultivation of histosols was 13.26 Gg per year (MoSTE 2014a). Nitrous oxide soil emission from grazing animals from pasture range and paddock was estimated to be 3.37 Gg per year. The indirect nitrous oxide emission per year from atmospheric deposition of NH_3 and NO_X was 0.78 Gg while that from leaching was 2.08 Gg. In the base year 2000, methane and nitrous oxide emission from Nepalese agriculture was 470 Gg and 27 Gg, respectively. The percentage is given in Table 2.

2.2 *Projection of GHG Emission*

The linear projection of GHG emission from agricultural sector for a period from 2000 to 2030 is presented in Table 3. This shows that the CH_4, N_2O, and CO_2 eq emission, will reach from a level of 470.08, 27.14 and 18,285.08 Gg, respectively, in the base year to 795.84, 39.84 and 29,063.04 Gg by the year 2030. In agriculture, enteric fermentation, soil management, manure management, and rice cultivation are responsible for GHG emission.

Table 2 Estimated contribution of agriculture to Nepal's GHG emission, 2000

Contributors	Percentage contribution
Emissions from enteric fermentation	49.50
Emissions from paddy fields	0.25
Emissions from agricultural soils	32.25
Emissions from manure management	18.00

Table 3 Projection of GHGs emission in the agriculture sector

Year	CH_4 (Gg)	N_2O (Gg)	CO_2 eq. (Gg)
2000	470.08	27.14	18,285.08
2005	511.77	28.49	19,579.07
2009	564.30	30.14	21,193.7
2015	614.11	32.64	23,014.71
2020	669.53	34.88	24,872.93
2025	729.96	37.28	26,885.96
2030	795.84	39.84	29,063.04

3 Different Types of Impact on Agriculture

Agricultural sector is sensitive to a short-term weather change to long-term variation in climatic conditions. Increases of greenhouse gases or atmospheric air temperature directly affect the food supply and availability through their effect on crops, soils, livestock, fisheries, diseases, and insect pests. Nepal's vulnerable subsistence agricultural production system will additionally be affected due to changes in the reliability of stream flow, a more intense and erratic monsoon rainfall, and the flooding. Decline in rainfall from November to April has adversely affected the winter and spring crops (JVS 2015).

Recurring climate-related natural hazards undermine agricultural productivity causing poverty and food insecurity. Agriculture dependent livelihood activities are most often exposed to different forms of natural disasters such as floods, landslides, snow avalanches, Glacial Lake Outburst Floods (GLOF), hailstorms, thunderstorms, cold waves, heat waves, drought, and epidemics. Among them, floods, landslides, hailstorms, and drought spells occur almost in a regular manner. The flood and landslide occurred during the year 1993, 2008 and 2014 are the most catastrophic events that have caused huge loss to human lives and physical properties. The floods and landslide disasters of the year 2013 claimed the lives of 219 people and 241 people lost their lives in the year 2014 (MoHA 2015). Droughts in parts of the country occur from the end of March through June, that is, until the arrival of the monsoon season. However, some parts of the Trans-Himalayan region are extremely dry throughout the year. Droughts are also common in Terai and in the western hills (UNDP 2013). Similarly, the districts of hill and mountain ecological zone of Far and Mid-Western Development Region, and Terai ecological zone of Eastern Development Region are prone to drought risks (MoE 2010b).

Nepal experienced droughts in the year 1972, 1977, 1982, and 1992. Since 2002, the country has been experiencing frequent dry spells and during the years 2002, 2004, 2005, and 2006 the country faced dry spells in both dry and wet monsoon. The 2008–2009 winter droughts in Nepal were the worst on record. The country received less than 50% of average precipitation during the period from November 2008 to February 2009. Similarly, poor amount and delay in monsoon were observed between 2013 and 2016.The losses of major crops (paddy, maize, wheat, and millet) due to various droughts in Nepal are presented in Table 4.

Table 4 Losses due to droughts in different years

Year	Characteristics of rainfall	Region affected	Major crop loss (mt)
1972	Late onset	Eastern and Central	333,380
1976	Poor distribution during September	Western	218,480
1977	Late onset	Eastern and Central	322,320
1979	Late onset	Western	544,820
1982	Late onset	Eastern	727,460
1986	Poor distribution during August and September	Western	337,410
1992	Late onset	Eastern	917,260
1994	Poor distribution	All region	595,976
1997	Poor distribution	Eastern	69,790
2002	Poor distribution		83,965
2006	Poor distribution during July and August	Eastern and Central	774,884
2008	Poor distribution of rainfall during Nov 2008 to Feb 2009	All region	56,926
2009	Late onset	Eastern and Central	499,870
2012[a]	Late onset, long dry spell	Eastern and Central	757,629
2013[b]	Insufficient rainfall that affected paddy plantation	2 districts in Eastern Terai and 4 districts in Central Terai region	56,000
2015[b]	Monsoon was delayed and weak at the onset which delayed paddy transplantation	Eastern Terai	Not available
Mid-Nov. 2015 to Mid March 2016[b]	Poor monsoon and drought	Mid and far-western hills and mountains	300,000 people highly food insecure

Source UNDP 2013
[a]Poor summer monsoon due to late onset and long dry spell during growing season caused crop loss (MoAD and WFP 2012)
[b]Joshi (2018)

Compared to other sectors, the impacts of climate change in the agricultural sector are very complex. However, it should not be ignored in any development effort because it is related to livelihoods of poor and marginal people and stability of the society. Moreover, a well-planned agricultural development effort contributes to better adaptation to climate change and reduction of GHGs emissions, while that on haphazard planning worsens the situation (Pant 2009). Although agriculture development in Nepal is considering changes in its coping strategy, the small and marginal farmers are facing increasing challenges in their daily livelihoods. The farmers are expecting effective adaptation options and technologies as an urgent and immediate response to address their climate change.

3.1 Production and Productivity

The impacts of climate change on agricultural sector are multifaceted as it results from the interaction of several biotic and abiotic factors. Climate change affects various constituents of agricultural system including biophysical, social, and economic aspects. Impacts of changing climate through its various parameters on biophysical and socio-economic factors affecting a range of components in an agricultural system have ultimate negative effects on farm productivity. Agriculturists also presume some kind of positive impacts of climate change on crop and animal production (Gautam and Pokhrel 2010). However, exploiting such opportunities by farming communities is impossible and remains unproductive due to lack of relevant knowledge, skills, and technologies. Although the increase in atmospheric CO_2 concentration may enhance the growth and productivity of crops, but other factors like land use change, limited availability of water for irrigation, frequency and intensity of soil organic alteration, soil erosion and decline of arable lands is likely to create challenges to the production system.

The climate change also has adverse impacts on livestock production. The increased temperature would likely result in the change of breeding season and time. It would also result in more cases of infertility, sterility and repeated breeding, decline in production and productivity, reduced animal weight-gain and lower feed conversion efficiency in warmer regions. In temperate regions, increase in temperature in cold periods would result in reduced feed requirements and enhanced survival of young animals. Livestock such as cattle, buffaloes, goats, and sheep could also be vulnerable to an extensive range of nematodes infection and new skin diseases. Shifting of livestock at a higher altitude due to higher temperature and radiation-related diseases would likely to occur. Climate change would lead to changes in gene pool and animal genetic resources and could reach at the risk of extinction (Pathak et al. 2011). The forage production in natural pasture will be declined due to poor emergence of grasses, degradation of pastures, and occurrence of invasive alien species. The major concerns to animal production due to climate change would be in terms of increased occurrence of parasites and vector-borne and parasitic diseases, heat stresses especially in pig, declining breeds of sheep and pig, loss of transhumance system, changes in animal reproductive behavior especially in terms of heat-period and fertility, shortage of feed ingredient and increased emission of GHGs due to animal health reasons (Pokhrel and Pandey 2011). The outbreak of feed toxicity, nutritional diseases and poor health in livestock may lead to higher mortality rate, increasing production costs and lower productivity that ultimately affect the livelihoods of herders. Climate change is a major threat to animal husbandry through its likely effects on heat stress, food and water security, extreme weather events, vulnerable shelter, and population migration. The temperature and humidity are common variables that have harmful effect on growth, puberty, quality, and developmental competence of oocytes as well as milk production. The intensity of such stressors is likely to increase due to climate change and can have significant impacts on milk production, oocyte maturation, fertilization, and embryo development. Increased temperature has adverse effects on oocyte growth, protein synthesis, or formation of transcripts required for subsequent embryonic development (Sukanta and Reddy 2018).

The impacts projected in crop production include declining water availability for irrigation, obstacles in operation of traditional irrigation systems and decreasing water use efficiency, agricultural land degradation, loss of agricultural land, diseases and pests epidemics and increasing crop management risks. The issues related to poor availability of quality planting materials and technologies and addressing changing context needs are visualized to affect negatively the crop production and economic sustenance of farmers. Agro-ecological extension of some crops due to temperature rise and increased number of warmer days, occurrence of livestock diseases and parasites and decline in fodder and forage production is reported in high mountains. The impacts reported in middle mountains and Terai are decreasing availability of soil moisture, crop failures and decline in crop productivity, and those typical to Terai are climate-induced disasters contributing agricultural land uncultivable (MoE 2010b).

There could be several implications of climate change impacts on water resources. Climate-induced water stress directly affects agricultural productivity, human health, and sanitation and ultimately accelerates malnutrition. On the other hand, too much water negatively affects human settlements, infrastructure, and agricultural land. Increased temperature and rainfall variability have resulted in shifts in agro-ecological zones, prolonged dry spells, and higher incidences of pests and diseases. The winter drought of 2008/09 destroyed crops in many parts of Nepal, and wheat and barley production decreased by 14 and 17%, respectively. Some districts received less than half the average winter rainfall and crop yields declined by more than 50% (WFP 2009).

A study by ICIMOD (2011) focusing on poor rural farmers, mostly without irrigated land, for whom precipitation, and especially the monsoon, was fundamental for an optimum harvest revealed changes in the amount, timing, and intensity of rainfall was the primary concern. The delay in the onset of the monsoon, observed mainly in the western part of the study area, Nepal had significant implication for the production of the main food crop. It was leading to delays in the sowing of rice and affected the growth of maize. There was a perception that annual rainfall was reduced overall, which reduces the recharge of underground aquifers and the amount of drinking water available from springs for humans and livestock. Winter precipitation and snowfall at higher altitudes were seen to be erratic and decreasing substantially affecting crop production and productivity.

A study by Karn (2014) revealed a robust and significant non-linear relationship between maximum daily temperatures and rice yields in Nepal Terai. The results showed that rice yields are most sensitive to increases in daytime maximum temperature. In addition, the study found that a 1 °C rise in daytime maximum temperatures during the ripening phase increases rice harvests by 27 kg per ha up to a cut-off point of 29.9 °C. On the other hand, that the productivity declines and yields were harmed when daytime maximum temperatures go beyond 29.9 °C.

Gurung and Nayava (2010) reported the intensity and distribution of rainfall in time and space affects maize yield. High rainfall during maturity period caused diseases like rust and foliar blight that affects yield. They also reported that maize and wheat can increase production at 1 °C temperature rise in all agro-ecological zones. A 2 °C rise with doubling CO_2 can decrease yield in Terai while hill is not impacted. Doubling of CO_2 with 4 °C temperature rise can increase the yield of these C4 crops in mountains. CO_2 doesn't impact on productivity.

A Ricardian approach was used by Thapa et al. (2015) to assess the impact of climate change on agriculture in which net farm income was regressed on climatic and socio-economic variables. The findings showed significant impact of climatic variables on net farm income per hectare across Nepalese farm households. This indicates both positive and negative impact of precipitation and temperature. Net farm income is likely to be increased with low precipitation and high temperature during the fall and spring seasons which are the main harvesting seasons. Farmers are likely to increase their revenue with relatively low temperature and enough precipitation during the summer season. Similarly, net farm income is likely to be high on irrigated farm combined with farm credit. However, small farms manage better and get higher net income per hectare than large farms.

3.2 Food Security

The food security at global, national and household levels will be negatively affected by climate change. Among the climate parameters, the increase in minimum temperature impacts adversely yield of rainy season crops ultimately affecting national food self-sufficiency. The whole food system including production, processing, distribution, consumption, and utilization is affected. Food security in Nepal is vulnerable due to low level of human control over the water and temperature and delicate ecosystems that get affected by the climate change and related extreme weather events (Pant 2012). Rainfall in Nepal is not evenly distributed in different cropping seasons. Summer crops usually receive excess water while most winter crops and those planted during spring season receive less water, hence are affected by prolonged dry spells. Such variations have implications for agricultural productivity and ultimately for food security across all agro-ecological zones in Nepal.

The rising temperature has resulted into the expansion of agro-ecological areas into higher elevations and increased length of growing period for some crops in the mid-hill and mountains. On the other hand, animal raisers in the high hills have reported reduced availability of fodder and forages. This has led to the occurrence of livestock parasites and created challenges to meet the food demand of livestock. In the mid-hills, due to variation in rainfall and temperature, soil moisture availability has declined which resulted in early maturation of crops, crop failures, and poor agricultural productivity. Moreover, decreasing runoff water to feed natural streams has resulted in poor re-charging of natural ponds, reservoirs, and lakes. In case of Terai, common issues were perceived. But the most peculiar one is the reduced recharge rate of groundwater that has resulted in a reduction of discharge of water in shallow and even deep tube-wells to be used for agriculture (JVS 2015).

Improved access to irrigation water may help to mitigate the negative effects of increasing temperature and seasonal and erratic rains on agricultural production. However, in Nepal the year-round irrigation under the control of the farmer is available only for about one-third of the cultivated land which means majority of the agricultural land is rainfed. In Nepal, decreasing availability of food is presumed in the country due to climate-induced reduction in crop productivity, decreasing availability of agricultural water or inefficiency of conventional irrigation systems, unavailability of quality production inputs, under-utilization of available technologies, cereal-based food habit, depletion and degradation of agricultural land and, on account of those, possible occupational shifts, peoples' migration and land fallowing (Pokhrel and Pandey 2011).

3.3 Economy and Livelihoods of People

It has been estimated that direct cost of current climate variability and extreme events to be equivalent to 1.5–2% of current GDP per year. This amount would be approximately USD 270–360 million per year in 2013 prices. It would be much higher in years with extreme events (MoSTE 2014b).

The livelihoods of poor and marginal households, who depend on agriculture, are exposed to different climate extremes such as floods, droughts, hailstorms, thunderstorms, cold waves, and heat waves. Natural events such as floods and landslides and insects and disease outbreaks in plants and animals have been regular phenomenon in Nepal. It is estimated that about 90% of crop loss in Nepal is caused by weather-related events. Among the hydro-meteorological hazards, drought has the most severe impact on crops. Between 1971 and 2007, nearly 850, 000 ha of crops were lost to weather-and climate-related events: droughts accounted for 38.9% of lost agricultural crops, and floods for 23.2% (UNDP 2009). Disaster impact on the agriculture sector is on the increase. Since the 1990s the impact has increased substantially. The reasons for this could be the increase in the occurrence and intensities of damaging meteorological hazards (FAO 2014).

The agricultural sector of Nepal has suffered a lot due to climatic events in the past four decades. Climate change threats are bound to further increase the number of hazardous events. It is likely that a variety of climate-induced threats will extend the impacts of hazards in new areas. The cropping intensity in vulnerable areas is increasing because of demand for food.

During the last four decades, a lot of climatic events have occurred and have affected social, economic and environmental sectors. The impact on those sectors would be further aggravated by rapid population growth, shrinking farm size and unplanned agricultural system in hazard-prone marginal areas. The livelihoods of the poor and vulnerable people will be most affected as they are least able to cope with disasters, live in areas most at risk to hazards and generally have the least information, knowledge, and resources to reduce their risk. The small and marginal households including other vulnerable groups tend to own fewer assets including land and livestock receive lower-income, have lower levels of education and less access to community and government services. They are dependent on rainfed production system and occupy land prone to risks such as flood, drought, and landslide. Even small changes to rainfall patterns can have devastating outcomes throughout the growing season. Many of Nepal's poor farmers occupy small parcels of land that can hardly produce enough to meet the family requirement. They are more reliant on local natural resources such as forests and water and would, therefore, suffer most from the drying up of local water sources and changes to vegetation cover (FAO 2010).

4 Climatic Variations

The mean global surface temperature increased to 0.74 °C in the twentieth century (IPCC 2007). Nepal has also been experiencing a high rate of global warming. Shrestha et al. (1999) did an analysis of temperature trends in Nepal from 1977 to 1994 collected from 49 stations. This showed a consistent and continuous warming in the period with an annual rate of increase of 0.06 °C. Practical action (2009) conducted an analysis of data from 45 weather stations for the period 1996–2005 revealed an increase in maximum temperatures at an annual rate of 0.04 °C. These studies also indicate that the observed warming trend in the country is spatially variable (MOE 2010b). The precipitation data for Nepal does not show significant trends (Shrestha et al. 2000; Practical Action 2009). The inter-annual variation of rainfall, particularly monsoon precipitation, is so large that recent observed trends are very uncertain and could be a part of natural cycles (*El Niño* phenomenon or solar cycles). The IPCC (2007) projected that there will be a general rise in the intensity of heavy rainfall events in the future and an overall decline by up to 15 days in the annual number of rainy days over a large part of South Asia.

Nepal is observing intense rainfall and/or drought with increased frequencies of landslides, floods, droughts, and forest fires and with increased damage to life and assets. There is an average annual increase of precipitation of 3.6 mm in Nepal during 1976–2005. In some pocket areas, observed precipitation reached over 40 mm/year (Kaski district). At the same time, decreased annual rainfall has been realized in most parts of mid-western development region.

The projection of climate for Nepal shows an annual mean temperature by an average of 1.2 °C by 2030, 1.7 °C by 2050 and 3 °C by 2100 compared to a pre-2000 baseline (MoE 2010b). This indicates a shift in agro-ecological zones at higher elevation. At present, the rainfall patterns have become irregular and a declining annual trend has been observed specifically in the mid-Western region during June, July, and August. On contrary, increasing intensity of summer monsoon rains is causing flash floods, erosion and landslides. The rapid retreat of glaciers is leading to the formation of new glacial lakes with a possibility of outbursts. Shifts in precipitation patterns, longer droughts, more severe floods and deficit in the recharge of groundwater are major factors affecting hill and mountain farming. The projections exhibit higher temperature increase during winter as compared to the monsoon seasons. Higher increments in temperature are projected over western and central Nepal as compared to eastern Nepal for the years 2030, 2060, and 2090, with projections for western Nepal being the highest.

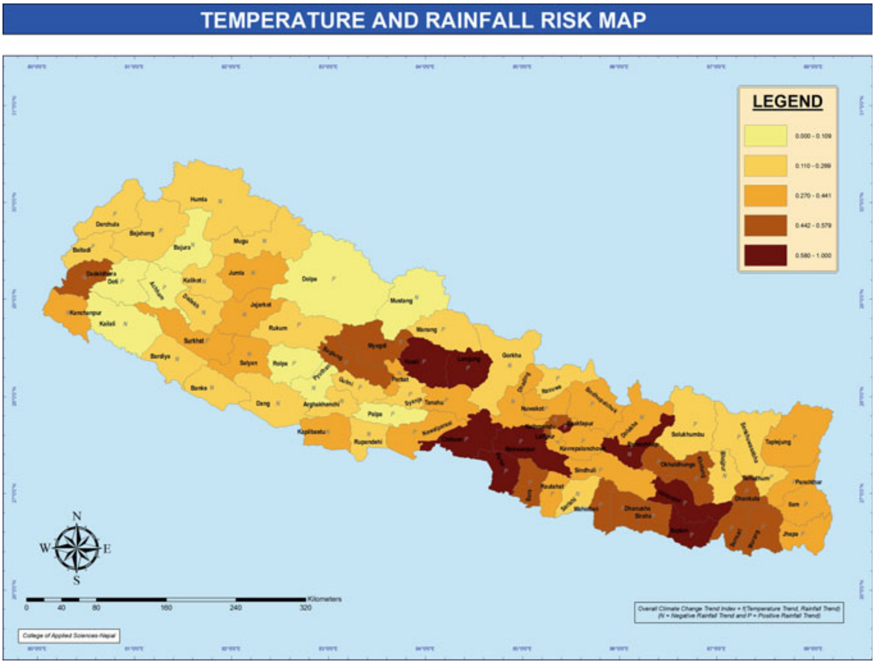
Precipitation projections reveal no change in western region and 5–10% increase in eastern Nepal during the winter season. During the summer season, precipitation is projected to increase by 15–20% for entire Nepal. A regional circulation model study projects both increase and decrease in the mean annual precipitation with no clear trends (MoE 2010b). In terms of region, an increase in monsoon rainfall is projected in eastern and central Nepal as compared to western Nepal. Moreover, the projections have shown an increase in monsoon and post-monsoon rainfall. It has also indicated an increase in the intensity of rainfall, and a decrease in winter precipitation.

As Nepal receives more than 80% of precipitation in the monsoon season (June to September), farmers/producers rely on this rain for farming in most part of Nepal. This implies that small producers suffer more since the resource poor farmers cultivate in rainfed ecosystem. The following is a summary of anticipated changes in temperature, precipitation, and runoff based on a review of current literature (FAO 2014):

- The temperature will increase over Nepal, especially at high elevations and during the winter season.
- The number of hot days and nights will increase.
- There will be a wide variation in average annual precipitation across the eco-regions (vary by different scenarios and models).
- Downstream river flows would be higher in the short term, but lower in the long term because of a shift from snow to rain in the winter months.
- Occurrence of extreme weather events will increase floods during the monsoon and the duration of droughts during the winter season.

4.1 Climate Vulnerability

The impacts due to climate change may differ by eco-regions. Based on this vulnerability index for Nepal is grouped at different levels. It shows that more than 1.9 million people are highly vulnerable while 10 million are at risk due to climate change. The vulnerability is spread all over Nepal. However, most of the people living in the mid and Far western region are among the most vulnerable as they heavily dependent on small scale rainfed agriculture which is largely affected by uneven rainfall pattern and they have limited options for livelihoods (MOE 2010a).



Temperature and rainfall risk map. *Source* MoE (2010a)

4.1.1 District Level

The districts are ranked based on the level of risks associated with temperature and rainfall (Table 5). The districts falling under Hill and Terai Ecological Zone of Eastern and Central Nepal and Mountain Ecological Zone of Western Nepal unveil higher exposure potential in terms of temperature and rainfall trends (MoE 2010a).

4.1.2 Community Level

Smallholder farmers, landless laborers, *Dalits*, *Janajatis* and people belonging to low-income brackets are the most vulnerable to climate variability and change. Even well-off and medium category producers will be at risk if their land is located along the side of riverbank or in the foothills. According to FAO (2014), several factors lead to the vulnerability of these livelihood groups and segments, including the following:

Table 5 Ranking of districts based on temperature and rainfall risk

Climate change trend	Districts' groupings
Very high (0.580–1.000)	Positive rainfall trend: Lamjung, Saptari, Makwanpur, Chitwan, Parsa, Kaski, Udayapur, Bhaktapur Negative rainfall trend: Ramechhap
High (0.442–0.579)	Positive rainfall trend: Morang, Bara, Kathmandu, Mahottari, Dhanusha, Dhankuta, Okhaldhunga, Myagdi, Khotang, Siraha, Baglung, Sunsari Negative rainfall trend: Dadeldhura
Moderate (0.270–0.441)	Positive rainfall trend: Parbat, Taplejung, Lalitpur, Jhapa, Panchthar, Tanahu, Ilam, Sindhupalchok, Kavrepalanchowk, Nuwakot, Surkhet, Nawalparasi, Rautahat, Sindhuli Negative rainfall trend: Kapilbastu, Jajarkot, Kanchanpur, Jumla, Dhading, Dolakha, Sallyan
Low (0.110–0.269)	Positive rainfall trend: Manang, Terhathum, Baitadi, Darchula, Solukhumbu, Sankhuwasabha, Gulmi, Syangja, Rasuwa, Rukum, Bajahang Negative rainfall trend: Mugu, Kalikot, Dailekh, Rupandehi, Sarlahi, Bhojpur, Gorkha, Banke, Bardiya, Humla, Arghakhanchi, Dang
Very low (0.000–0.109)	Positive rainfall trend: Doti, Achham, Dolpa, Rolpa, Palpa Negative rainfall trend: Kailali, Mustang, Bajura, Pyuthan

Frequent occurrence of floods and landslides: Houses and cultivated land located in flood and landslide-prone areas such as riverbanks and foothills are the most vulnerable to climate change. The destruction of asset and properties they own such as houses, sheds, canals, roads, weirs and dams and the sedimentation of cultivated land may seriously affect livelihood activities.

Small landholdings and dependence on rainwater for irrigation: Small and marginal farmers are vulnerable as the landholdings with them is not enough for diversification of farm activities and enterprises. As the irrigation is a critical input for increasing crop productivity, farmers who depend on rainwater for irrigation are more vulnerable than those having assured irrigation water.

Increasing number of landless people: The landless people are compelled to live near forest areas. Although the forest land is productive, these livelihood groups face threats and competition from wildlife, and most often disputes arise between forest user groups and landless people. They also lack resources to make investment in improved farm enterprises. Such poor farmers are prone to risks and are vulnerable to climatic shocks.

Flood and inundation areas: People living in areas often with flooding and inundation are vulnerable because such events destroy productive land and important properties such as houses, livestock, and crops.

Emergence of new diseases and pests: The emergence of diseases such as rust and lose smut in wheat, and late blight in potato—are often the result of abnormal climatic changes. The increased temperature and high-intensity rainfall followed by longer droughts encourage outbreaks of many insect pests. Sheath rot and northern blight in maize, aphids in winter vegetables, and ticks, scabies, lice and leaches in animals are perceived to be major problems.

Poor knowledge/skills and lack of on-farm employment: Farmers are unable to cure the diseases and pests of livestock, crops, and vegetables because of their poor knowledge and skills. Many males out migrate in search of employment as on-farm employment opportunities within their villages are not available. This results in leaving women, children and elderly people at home. Such phenomenon increases the vulnerability to climatic changes.

5 Responding to the Climate Change Impacts

In order to adapt to, and build resilience to the impacts of climate change and take benefit from international climate change regime, Nepal has initiated several measures in terms of formulating policies and strategies and implementation of programs. The climate change and related extreme events on agriculture have impacted on food security that affects mainly poor and marginalized people, including women and children, and ultimately has consequences on the national economic growth. Climate change has become a serious concern for the government for which the government is working to outweigh the impacts through implementing a number of policies, strategies, and programs, which are presented below.

5.1 Policies and Strategies

Many provisions of policies and strategies are directly and indirectly related with agricultural development in Nepal. The policies and strategies have focused on agricultural commercialization, agri-business promotion and entrepreneurship development, biodiversity conservation and their sustainable utilization, increasing productivity and strengthening food security, sustainable natural resources management, environment and climate change, low carbon economic development, etc. These policies are aimed at contributing to the national economic development, poverty reduction, employment generation, and attaining the millennium development goals. The implementation of these policies is reflected in the periodic plans, interim plans and annual programs of the government. These initiatives have contributed in augmenting agricultural production, increasing farm incomes, generating employment opportunities and reducing climate risks.

The main policies and strategies guiding agricultural development and adaptation and mitigation of climate change effects are National Agricultural Policy 2004, National Agro-biodiversity Policy 2007, National Strategy for Disaster Risk Management 2009, National Seed Policy 2000, Irrigation Policy 2014, Rangeland Policy 2012, Land use Policy 2015, Agricultural Mechanization Promotion

Policy 2014, Climate Change Policy 2011, Forest Policy 2015, National Seed Vision 2013, National Biodiversity Strategy and Action Plan 2014, Agriculture Development Strategy 2014, Forestry Sector Strategy 2016, etc.

Although the provisions/components of these major policies generally converge, there are some overlaps in the policy provisions and among the responsible institutions. For example, the policy components of agricultural policy have to converge with agro-biodiversity policy, agri-business policy, and irrigation policy. Similarly, some components of land use policy have to converge with agricultural policy and irrigation policy; rangeland policy with forest policy and Nepal Biodiversity Strategy and Action Plan (NBSAP); agro-biodiversity policy with NBSAP; climate change policy with forest policy and Agriculture Development Strategy (ADS). The policies are formulated but their implementation is not at optimum due to duplication and unclear policy provisions and responsibility of many institutions.

5.2 Periodic Plan—Thirteenth (2013/14–2015/16) and Fourteenth Plan (2016/17–2018/19)

The thirteenth plan aimed to achieve inclusive, broad-based and sustainable economic growth; develop physical infrastructure; enhance access to social services and improve the use and quality of those services; enhance good governance; empower targeted groups and sectors both socially and economically; and implement development programs which support climate change adaptation. This plan proposed to implement development programs that support climate change adaptation. The plan also emphasized on the development of green economy and its internalization in all the sectors of economic activities, development of the environment and climate-adaptive infrastructure and has embraced the policy of encouraging the use of environment-friendly fuel and pollution-less vehicles by developing and implementing necessary mechanisms to enforce "polluter pays" principle. The sectoral strategies were also oriented towards achieving the objective of this plan (NPC 2014).

The major strategies in agricultural sector in the 13th plan were ensuring quality production inputs, improved technology, infrastructure and credit for commercialization and diversification; enhancing the competitiveness of Nepalese agriculture; promoting value chain; developing and expanding environment-friendly technologies to reduce the adverse impacts of climate change; protecting, promoting and using agro-biodiversity; encouraging youths to take up commercial farming; and improving inter-agency coordination and collaboration for research and extension. The 14th plan has adopted the strategies to enhance the productivity and develop competitive strength of agriculture; attain self-sufficiency in basic food stuffs; attract people dependent on agricultural sector to non-agricultural sector; and develop and expand environment-friendly technologies to mitigate the negative impacts of climate change. Similarly, increasing the production and productivity of livestock;

promoting market-oriented livestock farming; developing livestock production as a sustainable source of income for the poor and vulnerable people; and promoting the environment and climate-friendly livestock enterprises are the strategies (NPC 2016).

In the irrigation sector, the strategies adopted in the 13th plan were to prioritize the implementation of small and medium surface and groundwater irrigation projects; provide year-round irrigation through multipurpose reservoir and irrigation programs; promote coordination among concerned agencies and interrelated programs; enhance the capacity of the users' committees; mainstream environment protection, climate change, and disaster management in irrigation projects; make irrigation services sustainable; and protect and promote local environment-friendly ponds, lakes, wetlands, and fountains. Similarly, in the 14th plan, the strategies have focused on providing year-round irrigation through various sources; developing innovative technologies that are feasible economically and socially; ensuring the participation of users in completed projects for their sustainable management; developing irrigation master plan in order to fulfill the targets of Agriculture Development Strategy and develop and expand irrigation systems in order to adapt with the climate change; and managing effectively the water-induced disasters.

In the case of forestry sector, the major strategies were to maintain the proportions of forests at least 40% of the total area of the country; conserve, sustainably manage and optimally use forest resources; utilize properly the forest products and ecosystem services; and promote good governance in the 13th plan. In the 14th plan, the strategies are adopting participatory sustainable and scientific forest management; distributing the benefits accruing from scientific forest management and climate change adaptation and mitigation up to the local level; and attaining self-sufficiency in forest products and promoting forest-based entrepreneurship.

The strategies for renewable energy, environment and climate change in the 13th plan were emphasizing research into and the development and technology transfer of renewable energy; mobilizing resources, including those received through carbon trading, for the promotion and development of renewable energies; integrating environmental management with development programs; adapting to climate change and sustainably conserving and managing natural resources; and strengthening the meteorological services in an effort to mitigate the impacts of climate change. In case of disaster risk reduction, the main strategies adopted were to develop legal and institutional mechanisms; enhance the coordination and collaboration among various sectors; and enhance the capacity to carry out disaster preparedness and response activities. In the 14th plan, the strategies adopted are internalizing environment management and enhancing institutional capacity for environment protection and pollution control and making environment as an integral part of the development programs. Similarly, increasing the national and international climate finance for mitigating the impact of climate change and integrating it with national budgetary system; and mobilizing the hydrology and meteorology services for minimizing the effects of climate change and disasters are other strategies.

5.3 Programs and Projects

There are several initiatives at present undertaken by the government to attain the objectives of climate-resilient and sustainable agricultural development. A number of programs and projects that support climate resilience building and technology adoption by farmers have been implemented. It includes the introduction of better adaptive crop varieties, adoption of organic farming thus reducing the application of fertilizer, integrated plant nutrient management; community-based integrated pest management, on-farm water management and enhancing water use efficiency, and the establishment of farmers' cooperatives to facilitate local adaptation. The adaptation priorities in agriculture include sustainable agriculture and land use system, agro-biodiversity management and sustainable utilization, and favorable governance mechanism to facilitate local-level adaptation responses. Hence, the proposed urgent and immediate adaptation options are specifically targeted to develop resilience of farming communities through better access to production inputs such as seed, appropriate technology and markets and support services, increase agro-ecosystem resilience and crop productivity and substantially improve the traditional type production system and cropping patterns (JVS 2015).

An 'Agricultural Revolution Decade' was proposed from FY 2014/15 to attain food self-sufficiency and for the overall development and transformation of the agricultural sector. The programs included were effective supply and the distribution of agricultural production inputs and services such as irrigation, electricity, transport, fertilizer, seed, and agro-credit and extension services, trainings, and research; subsidized credit for improved farming, livestock and poultry farming, medicinal and aromatic plants, vegetables and fruits, dairy enterprises, aquaculture and fishery, agro storage, cold storage, slaughter house and meat-related business for youths in the rural areas; program on land improvement and farm mechanization; resource centers development for seeds, breeds and saplings; support to organic farming and production of vermin-compost and bio-fertilizers and bio-pesticides; value chain promotion and marketing development; different commodity-based mission programs; up to 75% subsidy on the insurance premium to support farmers to cope with the vagaries of nature; programs on irrigated area expansion through conventional and non-conventional schemes; declared 'forest decade' with a campaign for tree plantation and protection of forest; forest-based enterprise development; institutional mechanism and programs to conserve Chure region; conservation and sustainable utilization of biodiversity; protection of water sources and bioengineering scheme to control landslides; 'peoples' embankment program to control river' and disaster risk reduction programs; renewable energy scaling up; adaptation and mitigation programs, etc.

Ministry of Agricultural Development and Department of Environment have identified and promoted Agriculture Management Information System (AMIS). They have established early warning system, promoted climate-smart agricultural technologies and scaled up the concept of climate-smart villages in different parts of Nepal (MoPE 2017).

5.4 Other Initiatives

The Government of Nepal has prepared and implemented the most urgent and immediate adaptation actions in line with the provisions of Climate Change Policy (2011) and as focused on the National Adaptation Program of Action (NAPA, 2010) using the National Framework on Local Adaptation Plan for Action (LAPA, 2011). Nepal has also reformed and strengthened and developed institutions and coordination mechanisms to foster climate change activities in the country during the last decade.

(1) *National Adaptation Program of Action to Climate Change* (*NAPA*):
NAPA visualizes to mainstreaming climate change into national development agenda and contributes to poverty reduction, diversify livelihood of people and building community resilience. In order to contribute to this vision, NAPA has identified and recommended the following nine major areas for action which needs an estimated amount of about USD 350 million (MoE 2010b).
(a) Increasing community-based adaptation through integrated management of agriculture, water, forests and biodiversity; (b) Building adaptive capacity of vulnerable communities through climate-resilient agricultural development; (c) Community-based disaster management for facilitating climate adaptation; (d) GLOF monitoring and disaster risk reduction; (e) Forest and ecosystem management for supporting climate-led adaptation innovations; (f) Adapting to climate change in public health; (g) Ecosystem management for climate adaptation; (i) Managing supply of water resources and clean energy; and (j) Promoting climate-smart urban settlement.

(2) *Local Adaptation Plan for Action* (*LAPA*) *Framework*:
In response to the threats and challenges posed by climate change, the Government of Nepal has initiated implementation of most urgent and immediate adaptation actions as prioritized in NAPA using National Framework on Local Adaptation Plan for Action (LAPA). LAPA framework has received adequate attention from national and international arena in implementing adaptation activities. This framework provides a mechanism to integrate local peoples' adaptation needs for climate change resilience into local to national planning system. In addition, this framework ensures that the integrating process is bottom-up, inclusive, responsive and flexible. The LAPA process has used climate vulnerability assessments to identify the VDCs, municipalities, and livelihoods most at risk to climate change impacts. It assumes that it is people-centered and is designed to ensure full and effective participation of, and benefits to, climate-vulnerable communities and ecosystems. LAPAs are prepared following a robust process with strong ownership of local communities, stakeholders, village development committees (VDCs) and district development committees (GoN 2011).

(3) *Climate-resilient planning* (*CRP*):
CRP is considered a tool or framework for long-term climate adaptation. The framework envisages to achieving a society and economy that is resilient to

changing climate. It has broadly recognized various issues of climate change, including its drivers and impact vulnerability, and delineates adaptation and mitigation measures to achieve its fundamental goal of sustainable development under the present and projected climate scenarios. The framework has identified cross-cutting issues that are important for the effective implementation of climate-resilient development programs so as to achieve the nation's development vision. It aims at mainstreaming climate-risk management in long-term plans and policies, and integrate climate risks and risk reduction efforts into periodic development plans and emphasizes the need to adopt a mechanism to screen development plans and programs and make them climate-resilient (NPC 2011).

(4) *Climate change budget code*:
The GON introduced and adopted climate change budget code in 2013 to direct climate finance and track public expenditure. It aims to promote sector-wise climate and related activities, simplify and improve coordination, and harmonize international support to sustain finance needed in the long term. According to the agreed criteria, if more than 60%; 20–60%; and less than 20% budget of the program is going to be spent on climate change-related activities the program is considered 'highly relevant', 'relevant' and 'not relevant', respectively (NPC 2012). The development activities related to any of the following topics/areas have been considered as related to climate change:

(1) Sustainable management of natural resources and greenery promotion
(2) Land use planning and climate-resilient infrastructure
(3) Prevention and control of climate change-induced health hazards
(5) Management of landfill sites and sewage treatment for GHG emissions reduction
(6) Sustainable use of water resource for energy, fishery, irrigation, and safe drinking water
(7) Plans/programs supporting food safety and security
(8) Promotion of renewable and alternative energy; technology development for emission reduction and low carbon energy use
(9) Preparedness for climate-induced disaster risk reduction
(10) Information generation, education, communication, research and development, and creation of data base
(11) Preparation of policy, legislation and plan of action related to climate change

Looking at the budget allocation for FY 2014/15, about 23% of the national budget fell between highly relevant to relevant category, whereas this was around 43% for agriculture sector in Nepal. In the FY 2016/17, only 5.9% of the budget was under highly relevant category while 13.32% was under relevant category to climate change (Joshi 2018).

(5) *Environment-friendly local governance framework*:

MoFALD (2013) developed this framework which stresses on the need for greater collaboration, cooperation, and partnership amongst conservation and development stakeholders ranging from households to policy, while planning and implementing environment and development activities. It was developed with a view to making individuals and families responsible for building community resilience. This framework focuses on bringing changes in individual behavior through adopting result-based incentive mechanism. The local bodies and citizens' forum lead the implementation of this framework. Environmental sensitivity is one of the major criteria for performance measurement of local bodies. The indicators have been developed with the premises that they help in assessing result-based monitoring mechanism. In addition, this framework helps local government to design and integrate environmental activities into local bodies' 14 step planning process.

This framework demands sustained changes in service delivery and users' behaviors in eight focus areas, namely, sustainable agriculture and promotion of greenery and beautification; waste management and pollution control; renewable energy and energy efficiency; biodiversity and ecosystems conservation; water, sanitation and hygiene; climate change and disaster risk reduction; sustainable urban planning and infrastructure development; and environmental governance.

6 Way Forward for Climate Adaptation and Resilience Building

Several challenges will emerge due to climate change in Nepal in general and the mountains in particular. The first challenge is related to its fragile geology which is inherent and natural, and need to live with nature in harmony. The second challenge is created by the activities of the developed and industrialized countries—the climate change for which we have single option for adaptation. Nepal needs to develop its capacity to live with what is happening and what will happen in future. The major challenge on climate change is that future of mountain people, and development in mountains will largely depend upon other's activities, understanding, and support (Joshi and Uprety 2010).

Agriculture is associated with nature and a form of natural resource management in order to produce food, fuel, and fiber, which solely depends on the resilience of both social and ecological systems. In social systems, resilience varies among households, communities, and regions, depending both on the assets and knowledge farmers can mobilize and the services provided by governments and other institutions. On the other hand, the resilience of agricultural-related ecosystems depends mostly on climate, land use, nutrient availability, and the size and type of the farming system. In addition, agriculture is a source of livelihood for millions of people including poor and marginal people and their income directly contributes to society's resilience. As a result, enacting measures to build agricultural resilience requires an understanding of strategies to reduce vulnerability while at the same time generating income and reducing poverty (ADB and IFPRI 2009). Few initiatives to adapt and build resilience to climate change have already been started in the country but which are inadequate. Some strategic and programmatic areas for future interventions to promote adaptation and build resilience in agricultural sector are presented below.

6.1 Policies and Programs

Nepal has formulated over two dozen policies, which are directly or indirectly related with climate adaptation and mitigation and building resilience of the agricultural and natural resource system. The integration among these policies is weak and in some cases lacking, which has constrained in realizing the planned outcome. In addition, some provisions of the policy are not implemented due to the absence of legal instruments (in terms of acts and regulations).

The programs to promote climate resilience in agriculture are prepared considering the policies and periodic plans. The program heads are more institution-based rather than theme-based, which has resulted in the implementation of a single program by many institutions. For example, quality seed production and seed self-sufficiency is implemented by crop development program, horticulture program, many projects such as Agriculture Development Project Janakpur (ADP/J), Irrigation and Water Resources Management Project, Community Managed Irrigated Agricultural Sector Project, Agriculture and Food Security Project, Improved Seeds and Breeds for Farmers Project, Nepal Agricultural Research Council (NARC) stations, etc. The program management and activities are scattered (and maybe overlapped) in the case of Shallow Tube Well and Deep Tube Well Programs which have been implemented by ADP/J of Dept of Agriculture (DOA) and Dept of Irrigation (DOI); non-conventional irrigation schemes (drip and sprinkler) implemented by DOA, DOI and many projects; and agricultural market center development and Farmers Field School implemented by DOA and Department of Local Infrastructure Development and Agricultural Roads (DOLIDAR) (under community irrigation). Similar is the situation of youth-targeted activities, value chain development, agri-business, and other programs. This has resulted in the duplication of efforts and thinly spreading of resources to many institutions even at grassroots and district levels. Hence, there is a need of consolidating similar activities under a single program head (umbrella program with thematic/discipline-based rather than the existing institution focused) and delineating the institutions to implement the specific activities, which will facilitate monitoring and tracking of implementation.

Immediate and urgent responses to climate change are under implementation in Nepal through NAPA. Nepal has also initiated medium to long-term response measures through National Adaptation Program (NAP) process of UNFCCC. The goal of the NAP formulation process for Nepal is to improve the institutional capacity of the government for implementing a climate-resilient development plan. This process aims to reduce vulnerability of climate-sensitive sectors to the impacts of climate change by building adaptive capacity and resilience and facilitates integration of climate change adaptation in a coherent manner into relevant new and existing policies, programs and activities, especially in development planning processes and strategies. This process supports in identifying entry points for adaptation planning in agricultural and natural resources management and taking action to strengthen country systems to improve management of the risks and opportunities of climate change (MoPE 2017).

The Climate Change Policy (2011) envisaged to formulate low carbon economic development strategy by 2013, which has not been materialized so far. Similarly, the Nepal Development Vision 2030 published by the National Planning Commission in 2011 states that Nepal will adopt climate-friendly plan and low carbon development approach. The processes of formulating such a strategy should get momentum.

The Agricultural Development Strategy 2014 considers many areas and aspects. It includes improving food security, increasing productivity, improving connectivity and resilience; sustaining production and managing resources through climate change mitigation; promoting adaptation and improving land and water management and water allocation; enhancing the participation of private sector in development (including cooperative sector), delivering fair reward to all stakeholders in the value chain; and formulating required policies, reforming institutions, and ensuring investments. These aspects need to be reflected in terms of programs and activities of line agencies (in periodic plans and annual programs).

The Government of Nepal approved the Forest Policy in 2015. This policy envisions to contributing prosperity at local and national level through the sustainable management of forests, biodiversity, and watersheds. The agro-forestry related provisions of this policy include integrated management of watershed areas for increasing land productivity through protecting land and water. This is planned to be achieved through the development and transfer of technology on low-cost soil and watershed protection and agro-forestry system by harmonizing forest and agricultural systems and contributing to food production and food security. The policy also aims at the creation of green employment through promoting forest-based enterprises, diversification of production and value addition through marketing. The implementation of this policy should be reflected in the annual and periodic plans of agriculture and forestry sector by revising the existing acts and regulations and enacting the new ones, and developing and strengthening the institutions (MoFSC 2015).

The Land Use Policy (2015) was formulated and implemented taking into account of the growing concerns about increasing fragmentation of fertile land and unplanned urbanization. The policy aimed to ensure the optimum use of land and control land fragmentation and help establish a link between agricultural and industrial sectors. This policy has divided land into eleven zones-agricultural, residential, commercial, industrial, mines and minerals, cultural and archaeological, river and lake reservoir, forest, public use and open space, building materials (stone, sands, concrete) excavation, and other zones as specified as per necessity (MoLRM 2015). It mentions that the fertile land is to be used for farming only, and has adopted land pooling concept to acquire land for development projects. The provisions of policy have not been implemented so far. These need to be implemented by developing legal instruments, required mechanisms and institutions.

6.2 Technology Development and Transfer

The technology development should consider the sustainability outcomes such as productivity enhancement with same or less land and water requirement, efficient use of inputs, minimization of GHG emission, increasing natural capital, strengthening resilience, etc. The extent to which Nepalese agriculture adequately adapts to climate change and climate variability determines the possibility of the success in agricultural growth and economic transformation. The adaptive capacity of agricultural systems, which are primarily rainfed, is inherently related to the ability to maintain or to buffer ecosystem productivity under climatic stress condition. This requires implementing measures that reduce vulnerability and build and promote resilience.

Climate-Smart Agriculture (CSA) includes a number of technological, policy, and institutional interventions (Aggarwal et al. 2004). These interventions are considered important and are related to seed, water, energy, and nutrients. There are some risk-averting and risk-insuring instruments that increase the resilience and stability of agricultural systems and thus help farmers adapt to and reduce the risk of climate change. The broader categories of climate-smart technological development and interventions as per IFPRI (2014) are as follows:

(i) *Water-smart technologies*: Such technologies reduce water requirements to achieve the same or a higher level of yield. The impact of climate change on agriculture will be experienced in the form of water stress due to rainfed nature of agricultural production system in Nepal. It is necessary to prepare a package of practices to solve the problem of water stress in agriculture. This may include land development, water harvesting (rainwater) and conservation practices, time and techniques of crop planting, and adopting appropriate irrigation techniques for increasing water use efficiency among others.

(ii) *Energy-smart technologies*: Such technologies and practices help to reduce energy consumption during land preparation without compromising yield levels. These techniques/technologies also help in reducing water requirements for crops. Conservation agriculture is considered to be an energy-smart emerging intervention for sustaining the production system (e.g., Direct seeded rice, zero tillage/minimum tillage). Such resource-conserving technologies need to be further refined. These not only save water and energy but also improve soil health, and increase crop productivity.

(iii) *Nutrient-smart technologies*: In this case, some technologies save while others supplement or reduce chemical fertilizer use for crops and commodities and enhance carbon in the soil. The practices that support the management of soil, nutrient, and carbon result in the conservation of resources, sequestration of carbon, and safeguarding of future food security. There are many practices associated with this group of technologies. Some examples include green manure to supplement the applied chemicals and improve the physical condition of the soil, integrated nutrient management, and organic manure (farmyard manure or vermin-compost).

(iv) *Introduction of stress-tolerant enterprises, and diversification*: Stress tolerant crops tolerate biotic and abiotic stresses and crop diversification reduces water demands and helps in harnessing nutrients from different soil layers. Efforts have been made in the recent years by the research system to develop crop and commodity varieties that are resistant to biotic (pests and disease) and abiotic (flood and drought; heat and cold) stresses in different production environments of Nepal. The potential response for addressing water stress and minimize weather-induced losses could be diversification of crops, cropping systems and farming systems.

(v) *Weather-smart instruments*: Such instruments provide services related to financial security and weather advisories to farmers. The vagaries of weather events such as floods, droughts, hailstones result in fluctuation of productivity and farm incomes in Nepal. Risk management through the dissemination of weather advisories and climate information (including early warning system), together with weather-based insurance, is a nonstructural intervention to reduce production losses and stabilize farmers' income. The weather and agriculture-related information can be disseminated to the farmers through the use of information and communication technologies. This has been practiced in Nepal as an "Agriculture Management Information System" through the support of Pilot Program on Climate Resilience (a project).

Synergies between adaptation and mitigation: There has been growing interest and awareness among researchers, practitioners and policy makers about adaptation and mitigation in agriculture and ways of achieving the co-benefits in addressing climate change. Glantz et al. (2009) suggested a number of adaptation and mitigation strategies and the underlying policy framework for agriculture to address climate change. They have suggested the strategies such as adjustment in planting dates; introduction of new crop varieties; crop relocation; land, water and soil management; adoption of agro-forestry, etc., as adaptation options, while improved crop and grazing land management to increase soil carbon storage, improved rice cultivation with conservation agriculture technologies, better livestock management, and afforestation, water and irrigation with low energy and external input, energy efficiency and use of renewable technologies as the important mitigation options in agriculture. The adoption of high-yielding crop varieties, a shift to rice–wheat production systems, and alternating dry–wet irrigation are some of the techniques that combine mitigation and adaptation objectives by reducing emissions, conserving water, and reducing land requirements and using fossil fuel. Other mitigation strategies that have substantial synergistic effects with adaptation include the restoration of degraded soils and efficient water use in crop cultivation. All of these strategies help conserve soil and water while enhancing ecosystem functioning, including water use efficiency and crop resilience to pests, diseases, and extreme weather events. GHG emissions from agriculture can be further mitigated through the appropriate management of nutrient, water, and tillage practices; through adopting improved crop varieties; and through the use of crop residues for renewable energy and carbon sequestration. Improved pasture management to control livestock overgrazing will help decelerate desertification.

Increasing resources for agricultural research and extension: Available technologies at present for adaptation and mitigation to climate change and promoting resilience in agricultural sector are inadequate. As the research system in Nepal is underfunded at present, it is not capable enough to generate technologies required for diverse crops/commodities and enterprises, ecological settings, and different categories of farmers. Most current agricultural practices and technologies have been developed under conditions of unevenly distributed (spatially and temporally) rainfall. The climate change scenarios and increased climatic variability may create new challenges for agricultural sector. There are lapses and inadequacies for technological innovations to ensure sustainability of initiated interventions and unclear demarcation between adaptation and development actions. Hence, for building resilience and sustainability of natural ecosystem, the technologies for agriculture, forests, soil and water conservation, clean energy, etc. need to be developed and already successful technologies up-scaled. For this, additional investment should be made by both public and private sectors.

For technological development and transfer, it is also important to identify, document, test and disseminate local knowledge and alternative practices; and promote sustainability through appropriate agricultural research and extension services that reduce external inputs, help to adapt to climate change, and build on and reinforce local knowledge. It is also equally important to re-orient extension services to support small and marginal producers in promoting sustainable agriculture for improving their food security in a climate change context. The extension services need to facilitate the process of building bridges between local and scientific knowledge, and promote site-specific, tailor-made sustainable production systems. They should also be trained and motivated in adopting participatory approaches to identify local potentials and challenges, and encourage local innovation.

6.3 Development of Institutions and Networks

The presence of institutions and networks at different levels are essential for agricultural adaptation by introducing new location-specific technologies. Farmers and their support institutions are the key players in technological innovations and have been considered as an integral part of overall agricultural development. The capacity to respond to changing climate depends on knowledge flow through a broad range of institutions, including farmer-to-farmer interactions. Although there is agriculture, livestock and forest-related institutions at the province and district and village/municipality levels in Nepal, these are not much responsive and have weak networks to address needs of climate-vulnerable farmers. These institutions each have their areas of focus, and together they provide services to farmers that facilitate improving agricultural practices. Involvement of those institutions in service delivery by improving their capacity and activating their networks is needed. Delivering innovative technologies at the local level is crucial for enhancing the adaptive capacity of farmers. Adaptation practices should be introduced with the full participation of farmers and the community-based organizations, as interactions among local institutions and farmers facilitate knowledge exchange and also create awareness. The development of multi-level institutional partnerships and collaboration among public organizations (agriculture and livestock, research, forests and soil conservation, irrigation), and with farmers and NGOs at critical stages of technological development and transfer, is important to advancing climate risk management, adaptation and resilience building. The technical and managerial capacity of the local level institutions and farmers' groups, farmers' federations, cooperatives, CBOs and NGOs working with the farmers need to be enhanced.

It is also necessary for strengthening national and local level institutions to enable farmer management of climate risks and adoption of context-suitable agricultural practices, technologies, and systems. Exchanging best practices and lessons learned among the stakeholders and farmers is also required. For this exchange to take place, institutional mechanisms must be created to identify best practices and facilitate their exchange. The Farmers' Field School (FFS) approach in specific areas/disciplines has already been introduced in Nepal. They can be imparted knowledge on climate and weather aspects such as rainfall, soil and water management, crop rotation, assessing losses and risk mitigation, etc.

6.4 Integrating Climate Adaptation and Mitigation at Different Levels

Some efforts have been made in integrating adaptation, mitigation and resilience-building aspects in the planning process at the national level. However, this has been less focused on program formulation and implementation in agricultural and allied sectors. Such actions neither prioritized by the local institutions before nor after federalization. There is inadequate technical capacity at local and provincial government level for integrating climate change in planning and budgeting process. Moreover, the current allocation of resources is not consistent with the priority set by NAPA and commitment made by climate change policy.

Empowerment of climate-vulnerable people is required so as to make them able to bring their voice and reflect their needs into local development planning and budgeting. This process should be flexible enough in terms of planning and implementation in order to adequately respond to the changing and diverse climate adaptation and mitigation needs of local people. The process should be sustainable, make efficient use of resources, especially local people's time, and should consider the value for the money invested. The planning and budgeting should promote local knowledge, resources, technologies, and practices available in the area and should consider medium-term time horizon and give considerations for various related activities rather than short term, 'project' type interventions. Adequate attention should be given to integrate at different levels of governance structures including local, district and provincial-planning processes.

The inadequacy of technical and managerial capacity of existing institutions at different levels, NGOs, and CBOs have not fostered "science and technology-based approach" to response to the challenges posed by the climate change in agricultural sector. Local farmers do not have enough scientific knowledge about climate change and its impact on their crops, commodities and enterprises. Moreover, concrete actions on climate change adaptation and mitigation are challenged by country's low financial capacity and inadequate coordination and collaboration among the government, civil society, cooperatives and non-government sectors working on climate change. Hence, the capacity of all stakeholders and service providers should be strengthened so that they can provide climate change responsive services and knowledge in a way that is inclusive, participatory, transparent and accountable.

6.5 Climate Financing

Nepal is committed to address the challenges and opportunities created by climate change and have introduced a climate change budget code to prioritize and track climate-sensitive initiatives and expenditure. Government of Nepal allocated 10.3% of its budget to climate change in 2013/14 which increased to 12.2% in 2014/15. The total adaptation-friendly commitment from international sources remained at US$236.62 million for 2009–2012 (IIED 2014).

In Nepal, various intermediaries, instruments and planning systems have been used by different stakeholder organizations. Increasing synergy among them is necessary so as to help avoid fragmentation and duplication in resource allocation and disbursement. Introducing a climate change fund or trust fund for climate change is the need in order to pool and disburse resources and build local capacity. This endeavor will also help to attain the government's target of investing NAPA's commitment of 80% of climate-sensitive budget at the local level. Nepal's 13th Plan made a commitment to adopting a green economy to minimize the impacts of climate change on its natural resources and sustain the economy. Similarly, the 14th plan spelled out to increase the national and international climate finance for mitigating the impact of climate change and integrating it with national budgetary system. The national framework for Local Adaptation Plan of Action (LAPA) aims to adopt a bottom-up approach by disbursing at least 80% of funds to support local adaptation activities.

As envisaged by the Climate Change Policy 2011, progress has not been made to form a climate change fund—to channel resources for climate financing, and establish climate change center—to coordinate activities and provide technical and policy advice to the government. Such a fund would enable the government to pool and allocate resources, and maintains synergy between different sources of finance. It will also encourage donors and partners to channel development aid through the government system. These mechanisms would also ensure to channel at least 80% of the total climate change finance to the field level activities as committed by the climate change policy.

The government should ensure sustainable, predictable and significant funding for adaptation and mitigation programs and projects related to agricultural development and natural resources management. Additional efforts have to be made by the government to get funding and technologies from the international climate change regime for adaptation and building resilience.

The present climate budget coding needs further refinement in terms of the relevance of activities and contribution to mitigation and adaptation to climate change, building resilience of the natural ecosystem, climate-induced disaster risk reduction, and creating synergies with other similar interventions. The existing classification (3 categories) of budget code should be made more realistic as there is a big interval/gap among the categories.

6.6 Knowledge Generation and Dissemination

Generation of right knowledge required by the farmers and their dissemination is inadequate and inefficient at present. Most of the currently generated knowledge on climate change is 'perception-based' rather than on 'fact-based' or 'science-based'. To effectively address climate adaptation and mitigation, a broader understanding of the factors that govern agricultural production system as well as the impact on its environment is needed. Scientific knowledge is required to support adaptation and resilience building. In many areas, more knowledge is needed, including the way to look at performances and impact especially over larger time and spatial scales. Continuous interaction between scientists, policy makers in the public and the private sector, including farmers, is needed to harmonize research and make decisions. A good starting point in this interaction is to integrate adaptation, mitigation and promoting resilience into current development plans, programs, and activities. Due to the existence of diverse local conditions, the measures to be adopted should be context-specific and require customized solutions.

Adaptation to emerging challenges and risks require easy access to innovative knowledge, skills, and technology. A key pathway is providing timely access to relevant climate information, which improves the quality of autonomous adaptation decisions and reduces losses and damage from climatic events. Different types and scales of climate information can be used for different purposes, from adjusting seasonal crop calendars to changing livelihood strategies. Examples include strengthening the network of weather stations to provide more reliable weather information for smallholder farmers; putting in place early warning systems to reduce losses and damage from climate hazards such as flash floods and droughts; and establishing a functional mechanism to monitor and track the effects on different development activities. It is very important to select right type of information and dissemination mechanism. In this regard, very small support through regular program/project can lead to adaptation actions at the national scale. It is also to be ensured that adaptation actions are incorporated into local level planning and the processes are effectively monitored.

Exchange of best practices and lessons learned provides a basis for concrete recommendations and for identifying further steps. For this exchange to take place, institutional mechanisms must be created to identify best practices and facilitate their exchange between sectors, provinces and districts and eco-regions. Farmers and entrepreneurs should be provided regular agro advisory services on different aspects of climate change, agricultural technologies availability and their usage, specific problems (disease and pest outbreak, and their control). The Agricultural Management Information System developed (under Ministry of Agriculture, Nepal) supported by Pilot Program for Climate Resilience would be useful in this direction if proper assessment is made towards the information needs of the different categories of farmers on different aspects of agricultural development.

6.7 Focusing on Small and Marginal Farmers

Small and marginal farmers who are vulnerable find it difficult to innovate and invest in better management systems when they are fully concerned about producing sufficient food for their survival. Many climate change adaptation and mitigation-related agricultural technologies and practices require establishment and maintenance costs. Such small producers do not have access to capital and markets, which restricts their ability to innovate and raise their income. In this context, the climate finance programs must focus on improving livelihoods and augmenting their income so that there is incentive for smallholder farmers to invest in climate-resilient and sustainable agriculture. It is also worth to combine practices that deliver short-term benefits with those that give longer-term benefits, which can help reduce opportunity costs and provide greater incentives to invest in better management practices.

An improvement in social safety nets is necessary to enable farmers particularly small ones and the rural poor to cope with external shocks such as climate-related disasters. This includes implementing a wide range of policies that support the economic viability of smallholder farms ways to reduce their vulnerability. Some of the policy support includes improving access to concessional credit for smallholders; and building and reinforcing basic infrastructure, such as water supplies and agricultural roads (farm to market roads) that can facilitate access to markets for the sale of farm products and buy of households' necessities.

In developing economies including Nepal, there are some legal provisions/measures that help to control/reduce the GHGs emission and mitigate adverse impacts on the environment. However, there are very few inbuilt incentives and mechanism for adopting improved and climate-resilient technologies (although developed in a limited scale). Hence, policies in the agricultural sector should be geared towards developing market-based mechanisms such as offset programs and conservation easements, as well as incentives and taxes. Appropriate guidelines and incentives in terms of sustainable farming practices, choices of farm enterprise, management of production factors (irrigation, fertilizer, pesticides, etc.), markets and information, etc. necessary for producers.

6.8 Analyzing Risks and Vulnerabilities

Assessment and analysis of risks and vulnerabilities have to be made regularly. Losses and damages to livelihood systems are increasing and becoming more unpredictable in recent years. The assessment and management of climate risks and shocks needs to be well integrated into the programs and projects. All sorts of climate-related risks and threats should be considered, that may include from rapid-onset events such as floods, storms, rainfall-induced erosion and landslides and hailstorms to slow-onset events such as droughts and heat waves, and persistent occurrence of lower-intensity damaging events such as soil erosion, degradation of different ecosystems and pollution of soils and groundwater.

Well-targeted and timely support programs on adaptation in agricultural practices help people to be less risk-averse. The adaptive options include resilient practices of agriculture, water, disaster and natural resource management, seed bank, water harvesting tank, drip irrigation, integrated pest management, sustainable soil and nutrient management, home gardening, public land management, bioengineering, multiple water use system, participatory variety selection, agro-forestry, etc. The mechanisms have to be developed to protect assets from loss or damage due to climate-induced disasters.

7 Conclusion

The agricultural sector is important in Nepal because of its contribution to the economy and its vulnerability to climate change. Nepal's contribution to the world's total greenhouse gas emission is very negligible (0.027%). However, Nepal is experiencing various impacts due to climate change in different development sectors. It has impacted economy and livelihood, food production, productivity, and food security. Climate Change has potential to lower the effectiveness of development interventions across the country, with impacts on food production and access and availability of water and energy. Agricultural dependent communities and groups are frequently exposed to a variety of climate extremes such as floods and landslides and droughts that are becoming regular phenomenon in Nepal.

Climate model projections for Nepal show a rise in annual mean temperature by 1.2 °C by the year 2030, 1.7 °C by 2050 and 3 °C by 2100 compared to a pre-2000. Such a rise may lead to the upward shift of agro-ecological zones, which is experienced by mountain farmers in Nepal. The rainfall patterns have become irregular and a decreasing annual trend has been observed in different parts of the country. The projections also show higher temperature increments during winter in comparison to monsoon season. Smallholder farmers, landless laborers, and vulnerable groups will be most affected by climate change. The ecosystems on which they rely are increasingly degraded and their access to appropriate agricultural land and forest resources is declining. Many small and marginal farmers produce on marginal rainfed land that is affected by increased water scarcity and soil erosion.

The national and sectoral policies are formulated and the periodic plans are prepared to address climate change impacts. Many institutions are implementing climate adaptation and mitigation-related programs and activities on a limited scale. These are not well integrated and there is duplication of efforts and resource use due to small scale activities and scattered over space. In order to overcome these lapses, a discipline-based program should be developed and relevant institutions should be entrusted to implement specific activities (with specified outcome/output indicators), which will facilitate monitoring and evaluation. There is a need to provide an integrated and systemic response to the combined challenges of production and productivity, food security, and livelihood through adaptation and mitigation and resilience building.

Policy responses to climate change should identify and support for scaling up of known best practices and technologies for the farmers. It is also necessary to develop technologies suitable to diverse ecosystem and need of different categories of farmers and enhance the capacity of stakeholders, and service providers at policy and program implementation level. It is also necessary in mainstreaming climate resilience at the policies, plans and programs, developing and strengthening institutions at different levels (federal to local level) for better service delivery, and ensuring and increasing the finance for research and development activities.

References

ADB and IFPRI. (2009). *Building climate resilience in the agriculture sector of Asia and the Pacific*. Manila, Philippines: Asian Development Bank.

Adhikari, J. (2014). *Agriculture adaptation practices in South Asia: A case of Nepal*. Working Paper No. 01(iii)/14. South Asia Watch on Economics and Environment, Kathmandu.

Agarwal, P. K., Bandyopadhyay, S. K., Pathak, H., Kalra, N., Chander, S., & Kumar, S. (2000). Analysis of yield trends of the rice-wheat system in North-Western India. *Outlook on Agriculture, 29*(4), 259–268.

Aggarwal, P. K., Joshi, P. K., Ingram, J. S. I., & Gupta, R. K. (2004). Adapting food systems of the indo-gangetic plains to global environmental change: Key information needs to improve policy formulation. *Environmental Science & Policy, 7,* 487–498.

Agrawala, S., Raksakulthai, V., Aalst, M., Larsen, P., Smith, J., & Reynolds, J. (2003). *Development and climate change in Nepal: Focus on water resources and hydropower*. Organization for Economic Cooperation and Development, Paris. Retrieved from http://calclimate.berkeley.edu/sites/default/files/OECD_Nepal_Hydropower_2003.pdf.

CBS. (2013). *National sample census of agriculture Nepal 2011/12*. Kathmandu: Central Bureau of Statistics.

FAO. (2010). *Implications of climate change for agriculture and food security and adaptation priorities in Nepal*. Rome: FAO.

FAO. (2014). *Managing climate risks and adapting to climate change in the agriculture sector in Nepal*. Rome: FAO.

Gautam, A. K., & Pokhrel, S. (2010). Climate change effects on agricultural crops in Nepal and adaptation measures. *Presented in Thematic Working Group (agriculture and food security) meeting*, February 23, 2010, Kathmandu, Nepal.

Gebreegziabher, Z., Stage, J., Mekonnen, A., & Alemu, A. (2011). *Climate change and the ethiopian economy*: *A computable general equilibrium analysis*. Environment for Development (EfD), Discussion Paper Series, October 2011, EfD DP 11-09.

Glantz, M. H., Gommes, R., & Selvaraju, R. (2009). *Coping with a changing climate: Considerations for adaptation and mitigation in agriculture*. Rome: Food and Agriculture Organization of the United Nations.

GoN. (2011). National Framework on Local Adaptation Plans for Action. Government of Nepal, Ministry of Environment, Singhdurbar.

Gurung, A. K., & Nayava, J. L. (2010). Impact of climate change on production and productivity: A case study of maize research and development in Nepal. *Journal of Agriculture and Environment, 11,* 59–67.

ICIMOD. (2011). *Climate variability and change in the Himalayas: Community perceptions and responses*. Kathmandu: ICIMOD.

IFPRI. (2014). *Farmers' preferences for climate-smart agriculture an assessment in the Indo-Gangetic Plain*. International Food Policy Research Institute, New Delhi, IFPRI Discussion Paper 01337.

IIED. (2014). *Climate change financing in Nepal*. Briefing, International Institute for Environment and Development, UK. Retrieved from http://pubs.iied.org/pdfs/17229IIED.pdf.

IPCC. (1997). *Revised 1996 IPCC guidelines for national greenhouse gas inventories*. Paris: United Nations Environment Programme, Organization for Economic Cooperation and Development.

IPCC. (2007). Climate change 2007: The physical science basis. In S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K. B. Averyt, M. Tignor, & H. L. Miller (Eds.), *Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (996 pp). Cambridge: Cambridge University Press.

IPCC. (2014). Climate change 2014: Synthesis report. In R. K. Pachauri & L. A. Meyer (Eds.), *Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Geneva, Switzerland: IPCC.

Joshi, G. R. (2018). *Agricultural economy of Nepal: Development challenges and opportunities*. Kathmandu Nepal: Sustainable Research and Development Center.

Joshi, G. R., & Uprety, B. K. (2010). Climate adaptation: A survival strategy for mountain people. Proceeding of Eastern Regional Organisation for Public Administration (EROPA) Seminar 2010, Kathmandu, pp. 30–39.

Joshi, G. R., & Uprety, B. K. (2011). *Climate screening, adaptation actions, financing and policies*: *Essentials for improving the livelihoods of the poor*. Paper Presented for the Nepal Country Workshop on Environment of the Poor in the Context of Climate Change and Green Economy. Organised by the National Planning Commission Secretariat, November 2010, Kathmandu, pp. 26–35.

JVS. (2015). Stocktaking: Climate vulnerability on agricultural sector for National Adaptation Plan Process. Final Report, Jalsrot Vikas Sanstha (JVS)/GWP Nepal. March 2015.

Karn, P. K. (2014). *The impact of climate change on agriculture—A case study from Nepal*. Policy Brief, South Asian Network on Development, Economics and Environment.

Maplecroft (Global Risk Analysis). (2011). *Climate change risk Atlas 2011*. Accessed June 12. http://maplecroft.com/search/?q=climate+change+vulnerability+ranking.

MoAD and WFP. (2012). *Crop Situation Joint Assessment Report*. Ministry of Agricultural Development and World Food Program.

MoE. (2010a). *Climate change vulnerability mapping for Nepal*. Ministry of environment, Singh Durbar, Kathmandu.

MoE. (2010b). *National adaptation program of action*. Ministry of Environment.

MoFALD. (2013). *Environment-friendly Local Governance Framework, 2013*. Ministry of Federal Affairs and Local Development, Singhdurbar, Kathmandu.

MoFSC. (2015). *Forest Policy 2015*. Government of Nepal, Ministry of Forests and Soil Conservation, Kathmandu.

MoHA. (2015). *Nepal disaster report 2015*. Ministry of Home Affairs (MoHA) and Disaster Preparedness Network-Nepal (DPNet-Nepal).

MoLRM. (2015). *Land Use Policy 2015*. Ministry of Land Reform and Management, Kathmandu.

MoPE. (2017). Synthesis of Stocktaking Report for National Adaptation Plan (NAP) Formulation Process in Nepal. Ministry of Population and Environment, Kathmandu.

MoSTE. (2014a). Nepal: Second National Communication, Submitted to UNFCCC. Ministry of Science, Technology and Environment, Singh Durbar, Kathmandu.

MoSTE. (2014b). Economic Assessment of the Climate Change of the Key Sectors in Nepal, Ministry of Science, Technology and Environment, IDS Nepal, PAC and GCAP.

NPC. (2011). *Climate-resilient planning*. Kathmandu, Nepal: Government of Nepal, National Planning Commission.

NPC. (2012). *Climate change budget code, documenting the national process of arriving at multi-sectoral consensus, criteria and method*. Kathmandu: Government of Nepal, National Planning Commission

NPC. (2014). *The Thirteenth plan*. Kathmandu: National Planning Commission.

NPC. (2016). *The Fourteenth Plan*. Kathmandu: National Planning Commission.

Pant, K. P. (2009). Effects of agriculture on climate change: A cross country study of factors affecting carbon emissions. *Journal of Agriculture and Environment, 10,* 72–88.

Pant, K. P. (2012). Climate change and food security in Nepal. *The Journal of Agriculture and Environment, 13,* 9–19.

Pathak, P., Thakur, U. C., & Shrestha, D. (2011). Climate change and livestock sector: Vulnerability and adaptation in Nepal. In T. B. Gurung, P. K. Pokharel, & I. Wright (Eds.), *Climate change: Livestock and vulnerability in Nepal*. *Proceedings of Consultative Technical Workshop in Kathmandu, Nepal*.

Pokhrel, D. M., & Pandey, B. (2011). Climate change adaptation: Strategic vision in agriculture. *The Journal of Agriculture and Environment, 12,* 104–112.

Practical Action. (2009). *Temporal and spatial variability of climate change over Nepal* (*1976–2005*). Practical Action, Katmandu Office.

Ramay, S., Munawar, Z., & Ahmad, M. (2011). *Climate change and food security in the HKH region*. Paper presented at the Authors' Workshop for the Regional Report on Climate Change in the Hindu Kush–Himalayas: The State of Current Knowledge. Kathmandu, Nepal: ICIMOD.

Shrestha, A. B., Wake, C. P., Mayewski, P. A., & Dibb, I. E. (1999). Maximum temperature trends in the Himalaya and its vicinity: An analysis based on temperature records from Nepal for the period 1971–94. *Journal of Climate, 12,* 2775–2786.

Shrestha, A. B., Wake, C. P., Dibb, J. E., Mayewski, P. A. (2000). Precipitation fluctuations in the Nepal Himalaya and its vicinity and relationship with some large scale climatological parameters. *International Journal of Climatology*, *20*(3), 317–327.

Sukanta, M., & Reddy, I. P. (2018). *Impact of climate change on livestock production* (*book chapter*). Biotechnology for sustainable agriculture: Emerging approaches and strategies. Elsevier. pp. 235–256. Retrieved from https://doi.org/10.1016/C2016-0-03289-8.

Thapa, S., Joshi, G. R., & Joshi, B. (2015). Impact of climate change on agricultural production in Nepal. *Nepalese Journal of Agricultural Economics*, *2 and 3*, 64–78.

UNDP. (2009). Nepal country report, Global Assessment of Risk. ISDR Global Assessment Report on Poverty and Disaster Risk. Kathmandu, UNDP Nepal.

UNDP. (2013). *Country Report Climate Risk Management for Agriculture in Nepal*. Regional Integrated Multi-Hazard Early Warning System for Africa and Asia, United Nations Development Program, New York.

WFP. (2009). Winter Drought Worsens Food Insecurity in Nepal. Kathmandu, Nepal: World Food Program. Retrieved from www.wfp.org/news/news-release/winter-drought-worsens-food-insecurity-nepal.

Part II
Productivity Growth and Its Drivers

Chapter 7
Food Demand System and Projections to 2035: Nepal

Praduman Kumar, Anjani Kumar and P. K. Joshi

Abstract Achieving food self-sufficiency has always been the primary objective of agricultural policy in Nepal. The empirical and realistic assessment of food demand is a prerequisite to accomplish this goal. This chapter analyzes the long-term trends in food consumption and nutrient intake of households in the country, makes food demand projections based on predicted dietary patterns, makes food supply projections under different scenarios and estimates food balance scenarios. The estimates of food balance under different scenarios would be helpful to develop the strategic framework for meeting the food demand in the country.

1 Introduction

Empirical studies on dynamics of demand of food crops are valuable for Nepal from the point of achieving food security and often provide deep insight to policy planners regarding the existing state of affairs and future directions for food self-sufficiency. Higher economic growth, population explosion, increase in urbanization and dietary diversification are driving forces that will increase food demand in future. Diversified food basket is exhibited in Nepal both in rural and urban areas in Mountain, Hill, and Terai geographic locations with higher levels of per capita consumption of horticultural, livestock, and fisheries products. An analysis of food consumption in response to changes in income and prices with appropriate assumptions are essential to understand future requirements of food in the country. In this study, an attempt has been made to project the demand of major food groups viz. cereals, pulses, vegetables, fruits, edible oil, sugar, milk, meat, fish, and eggs (MFE) by 2030. A better understanding of food demand elasticities

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G. Thapa et al. (eds.), *Agricultural Transformation in Nepal*,
https://doi.org/10.1007/978-981-32-9648-0_7

helps to predict future demand of food group and individual commodities could prove worthy for the policy planners on important policy decisions on commodities production and trade (export and imports).

1.1 Data Source

Central Bureau of Statistics has conducted the three rounds of Nepal Living standard survey (NLSS) which provide unit level of household data on food consumption pattern pertained to year 1995 (NLSS I), 2003 (NLSS II), and 2011 (NLSS III) (CBS 1995, 2003 and 2011). The questionnaire data on food consumption pattern were used to analyze food consumption pattern, estimation of price, and income elasticities for food demand system and predict the food demand to 2035 for Nepal. The per capita expenditure is used as proxy for per capita income and is categorized into four expenditure/income groups: Quartile I: bottom 25%, Quartile II: 25–50%, Quartile III: 50–75%, and Quartile IV: more than 75% households in Nepal.

1.2 Food Diversity Index

Simpson Index of Diversity for the food group, K (SID_k) is used to measure the diversity in food consumption. It is estimated by using Eq. (1):

$$\mathrm{SID}_k = 1 - \sum_{i=1}^{k} P_{ik}^2 \tag{1}$$

where P_i is the proportion of ith food item in total monthly consumption of all items in the kth food group by the members of a household. The weighted Simpson Index of Diversity (SID) was computed using Eq. (2):

$$\mathrm{SID} = \sum_{k=1}^{n} w_k * \mathrm{SID}_k \tag{2}$$

where w_k is the relative cost per unit of calories of the kth food group as compared to cereals group, and n is the number of food groups, i.e., cereals, pulses, vegetables, fruits, edible oils, sugar, milk, livestock products, poultry products, and processed food products. The Simpson Index value ranges between 0 and 1, with its value moving towards 0 in the case of complete specialization.

1.3 Demand Analysis

For estimating the income and price elasticities of demand for the Nepal food system, a multistage budgeting framework has been used. In addition to this model, other important models which have received considerable attention are the Linear Expenditure System (LEDS) (Stone 1954), and Almost Ideal Demand System (AIDS) (Deaton and Muellbauer 1980). These models are centered around complete demand systems which take into account mutual interdependence of a large number of food groups in the budgetary allocations of a consumer. The main limitation of these models is that they do not allow the quadratic effects of income on elasticities. To avoid these problems, Normalized Quadratic Demand System (NQDS), Transcendental Logarithmic Demand System (TLDS) were followed by Swamy and Binswanger (1983). In the present study, the Quadratic Almost Ideal Demand System (QUAIDS) with multistage budgeting framework is used. The modified model assumes that there is a non-linear relationship between income and consumption of a household. The QUAIDS model with three-stage estimation has been used by several authors (Blundell et al. 1993; Meenakshi and Ray 1999; Dey 2000; Kumar and Dey 2004; Dey et al. 2008; Kumar et al. 2011).

1.4 Model and Estimation Procedure

A multistage (three-stage) budgeting framework has been used for demand analysis of various food groups, viz. cereals, pulses; vegetables; fruits; edible oils; meat, fish, and eggs (MFE); milk and sugar. In the first stage, the household makes decisions on how much of its total expenditure is to be allocated for food consumption, conditional on consumption of non-food goods and the household and demographic characteristics. In the second stage, the households allocate a portion of food expenditure (for example eight food group expenditure in this study) to households. In the third stage, the household distributes a portion of food expenditure among eight food groups viz. cereals, pulses, vegetables, fruits, edible oils, MFE, milk, and sugar. The specific functional forms used in three stages and estimated parameters are as follows.

1.4.1 Food Expenditure Function

At the first stage, the food expenditure function is specified as follows:

$$\mathrm{Ln}(M) = \alpha + \gamma_1 \mathrm{Ln}(P_f) + \gamma_2 \mathrm{Ln}(P_{nf}) + \beta \mathrm{Ln}(Y) + \sum \theta_j Z \qquad (3)$$

where M is the per capita food expenditure; Y is the per capita total expenditure (income); P_f is the household-specific Stone price index for food; P_{nf} is the per capita non-food expenditure. The socio-demographic and conditioning variables (vector Z) include family size, urban dummy, dietary diversification index, and time trend (year).

The parameter β varies in Eq. (3) as:

$$\beta = \beta_0 + \beta_1 \mathrm{Ln}(Y)$$

Equation (1) was estimated by the ordinary least squares (OLS) method, and homogeneity of degree zero in prices and income was imposed by restricting $\gamma_1 + \gamma_2 + \beta_0 + 2\beta_1 \mathrm{Ln}(Y) = 0$ at the sample mean of $\mathrm{Ln}(Y)$. The estimated parameters of total food expenditure function are presented in Table 1.

The significant variation by the explanatory variables included in the model account to total food expenditure. F statistics is significant at 1% level of significance. The coefficient of food and non-food price index had a negative and significant effect on total food expenditure, as expected. The linear and squared-terms of total expenditure (income) variable were significantly different from zero, indicating that the response of the income to the change in food expenditure was non-linear. At the mean level, food expenditure elasticity with respect to income was estimated to be 0.83. It meant that the household would allocate 83% of their additional income to food. Urbanization and dietary diversification are at slow pace at Nepal and did not have significant influence on food expenditure. However, with time trend, food expenditure would increase.

Table 1 Estimated total food expenditure function, Nepal

Variables	Regression coefficient	t-value
Ln(stone price index for food)	−0.71182	−121.43
Ln(stone price index for non-food)	−0.12215	−46.33
Ln(per capita total expenditure)	0.98339	25.19
Ln(per capita total expenditure)×	−0.00786	−3.82
Ln(per capita total expenditure)		
Family size	−0.01179	−18.25
Urban dummy	0.00525	0.97
Dietary diversification index	−0.00026	−0.02
Year	0.07497	205.58
Intercept	−149.17	−212.75
Observations	12,161	
F statistics	23,195.37	

2 Commodity Expenditure Function

At the second stage, the selected group's food expenditure was specified as follows:

$$\mathrm{Ln}(F) = \alpha' + \sum \gamma_i' \mathrm{Ln}(P_i) + \beta' \mathrm{Ln}(M) + \sum \theta_j' Z \tag{4}$$

where F is the per capita expenditure on eight food groups under study; P_i is the vector of food group prices. M is the predicted per capita food expenditure from Eq. (3).

The parameter β' is allowed to vary as follows:

$$\beta' = \beta_0' + \beta_1' \mathrm{Ln}(M)$$

Equation (2) was estimated by OLS method by imposing homogeneity restriction of degree zero in prices and food expenditure at sample mean of $\mathrm{Ln}(M)$ and given in Table 2.

The coefficients of the total food expenditure variable and its square-term were significant. The response to food expenditure was non-linear. At mean level, the selected group food expenditure elasticity with respect to total food expenditure was estimated to be 0.85. The prices of cereals, pulses, edible oil, and MFE had negative effect on per capita consumption of selected food groups. The coefficient

Table 2 Estimated parameters of selected group's food expenditure function, Nepal: 1995–2011

Variables	Regression coefficient	*t*-value
Ln(price of cereals)	−0.39128	−20.14
Ln(price of pulses)	−0.37014	−19.98
Ln(price of vegetables)	0.40224	24.6
Ln(price of fruits)	0.15403	10.38
Ln(price of edible oils)	−0.71709	−44.29
Ln(price of MFE)	−0.04289	−4.15
Ln(price of milk)	0.02993	2.84
Ln(price of sugar)	0.08564	15.65
Ln(per capita food expenditure)	0.85567	12.52
Ln(per capita food expenditure)×	−0.00033	−0.09
Ln(per capita food expenditure)		
Family size	−0.00803	−9.28
Urban dummy	−0.02511	−3.5
Dietary diversification index	−0.08053	−3.88
Year	0.05871	79.78
Intercept	−112.15	−80.19
Observations	11,652	
F statistics	6433.8	

of vegetable, fruits, milk, and sugar prices were positive and significant indicative of substitutive relationship of these food groups and vegetables, fruits, milk, and sugar with the selected food group. The larger family size in the households reduced the per capita consumption of selected food group expenditure.

3 Quadratic AIDS (QUAIDS) Model

At stage 3 of analysis, quadratic extension of almost ideal demand system (QUAIDS) for commodity demand system was used. The specific functional form for the ith food group was specified as follows:

$$S_i = a_i + \sum_j b_{ij}\mathrm{Ln}(FP_i) + c_i\mathrm{Ln}(F/I) + \sum \theta_j' Z \tag{5}$$

where FP_i is the price of ith food group; I is the Stone food price index. The coefficient c_i is allowed to vary with per capita food expenditure as:

$$c_i = c_{i0} + c_{i1}\mathrm{Ln}(F/I) \tag{6}$$

The parameters (a_i, b_{ij}, c_i, d_i, and $e_{ik)}$ of model were estimated by imposing the homogeneity (degree zero in prices), symmetry (cross-price effects are same across commodity), and adding up (all the budget shares add up to one) restrictions. The following restrictions were econometrically imposed:

$$\text{Homogeneity: } \sum_{j=1}^{n} b_{ij} = 0;$$

$$\text{Symmetry: } b_{ij} = b_{ji},$$

$$\text{Adding up: } \sum a_i = 1,\ \sum_i c_{i0} = \sum_i b_{ij} = \sum_i d_i = 0$$

The homogeneity and symmetry restrictions were imposed at the sample mean of variables. Adding up restriction was imposed while computing the parameters of the omitted equation of the model, which was not included in the estimation. The predicted value of commodity expenditure obtained from stage 2 was used as the explanatory variable. The coefficients of sugar equation were obtained by using theoretical restrictions in conjunction with the estimated coefficients of seven food group viz. cereal, pulses, vegetables, fruits, edible oil, MFE, and milk.

Estimates on the parameters of the quadratic AIDS demand system for different food groups are given in Table 3. The explanatory variables included in the model explained 32% of the variation in cereal share equation followed by milk (25.7%), MFE and fruits (18.7%), vegetables (10%), edible oils (8.3%) and pulses (6.5%) share equations, respectively. The own and cross prices have a significant effect of

Table 3 Estimated parameters of the QUAIDS food demand system for Nepal, 1995–2011

Variables	Cereals		Pulses		Vegetables		Fruits		Edible oil		MFE		Milk		Sugar
	Regression Coefficient	*t*-value	Regression Coefficient	*t*-value	Regression Coefficient	*t*-value	Regression Coefficient	*t*-value	Regression coefficient	*t*-value	Regression Coefficient	*t*-value	Regression Coefficient	*t*-value	Regression coefficient
Ln(price of cereals)	0.05524	6.4	0.01718	5.89	0.00168	0.51	0.00754	4.11	−0.04172	−14.34	0.00955	5.36	−0.03772	−9.63	−0.01176
Ln(price of pulses)	0.01718	5.89	0.02098	7.41	−0.00977	−4.88	−0.00092	−0.81	−0.01581	−8.71	−0.00156	−1.5	−0.00953	−5.94	−0.00057
Ln(price of vegetables)	0.00168	0.51	−0.00977	−4.88	0.00661	2.42	−0.01142	−9.98	−0.00482	−2.5	−0.01196	−11	0.01845	10.44	0.00163
Ln(price of fruits)	0.00754	4.11	−0.00092	−0.81	−0.01142	−9.98	−0.00284	−2.88	0.00444	2.13	−0.00284	−3.35	0.01067	10.24	0.00421
Ln(price of edible oil)	−0.04172	−14.34	−0.01581	−8.71	−0.00482	−2.5	−0.00440	−2.86	0.06048	24.66	−0.00471	−3.2	−0.02957	−10.88	−0.00337
Ln(price of MFE)	0.00955	5.36	−0.00156	−1.5	−0.01196	−11	−0.00284	−3.35	0.00573	4.31	−0.00289	−3.43	0.01029	10.24	0.00411
Ln(price of milk)	−0.03772	−9.63	−0.00953	−5.94	0.01845	10.44	0.01067	10.24	−0.00492	−2.98	0.01029	10.24	0.02442	8.29	0.01298
Ln(price of sugar)	−0.01176	−4.87	−0.00057	−0.71	0.00163	1.76	0.00421	7.52	−0.00337	−3.97	0.00411	7.58	0.01298	9.43	−0.00722
Ln(per capita expenditure of food system)	0.29274	3.25	−0.02851	−1.01	0.05596	1.69	−0.13451	−6.65	−0.05746	−1.9	−0.13466	−6.85	−0.23908	−4.67	0.24552
Ln(per capita expenditure of food system)×	−0.02605	−4.79	0.00207	1.21	−0.00237	−1.19	0.00943	7.72	0.00392	2.15	0.00943	7.95	0.01660	5.37	−0.01304
Ln(per capita expenditure of food system)															
Year	−0.00935	−36.33	0.00030	3.05	0.00313	14.73	0.00118	16.69	0.00155	14.57	0.00117	17.19	0.00267	16.4	
Urban dummy	0.04587	13.45	−0.00327	−3.02	−0.00640	−5.02	−0.00253	−3.27	−0.00357	−3.05	−0.00243	−3.22	−0.01009	−5.2	
Dietary diversification index	−0.17680	−17.37	0.02532	7.87	0.00510	1.35	0.02507	10.9	−0.00298	−0.86	0.02495	11.16	0.18678	32.32	
Intercept	18.6348	30.17	−0.43178	−1.92	−6.40360	−14.9	−1.86576	−11.53	−2.91519	−11.91	−1.85323	−11.84	−4.42438	−11.6	
Observations	11,652		11,652		11,652		11,652		11,652		11,652		11,652		
Chi-square	5878.69		871.03		1434.58		2638.52		1140.09		2811.43		4226.63		
R-square	0.3221		0.065		0.0995		0.186		0.0831		0.1865		0.2567		

the share equations with expected sign. Cereals are the staple food. Even when the cereal prices go up, the households did not reduce the cereal share in total expenditure. The squared-terms of per capita expenditure on selected food groups were significantly different from zero with a positive sign suggesting additional expenditure allocation would induce higher demand for fruits, edible oils, MFE, and milk. With time trend, consumption of cereals would decline and induce the consumption other food groups leading to dietary diversification. The response of dietary diversification on share equations is negative for cereal and edible oils and positive for pulses, vegetables, fruits, MFE, and milk. Dietary diversified from cereals and edible oils to vegetables, fruits, MFE, and milk were observed. The food demand elasticities with respect to selected food group expenditure were computed 0.56 for cereals, 1.13 for pulses, 1.12 for vegetables, 1.85 for fruits, 1.15 for edible oils, 1.24 for MFE, 1.69 for milk, and 1.27 for sugar.

Using the estimated parameters in stage 1, stage 2, and stage 3, the income and price elasticities for major food groups are computed as follows.

4 Food Expenditure Elasticity

Based on the estimated coefficients of Equations in stage 1, the food expenditure elasticity η^y with respect to total expenditure is computed as:

$$\eta^y = \frac{\partial M}{\partial Y} \times \frac{Y}{M}$$

Based on the estimated coefficients of Equations in stage 2, all food group expenditure elasticity η^f with respect to food expenditure is computed as:

$$\eta^f = \frac{\partial M}{\partial Y} \times \frac{Y}{M}$$

Individual food group expenditure elasticity with respect to all food group expenditure is computed from stage 3 as:

$$\eta_i = (c_{i0} + 2c_{i1}\mathrm{Ln}(F)/w_i) + 1$$

The income elasticity of demand for ith food group (η_i^y) with respect to total expenditure (income) is workout by multiplying all the three elasticities computed above.

$$\eta_i^y = \eta_i \times \eta^f \times \eta^y$$

Uncompensated price elasticity was computed from stage 3 as:

$$\xi_{ij} = \left(\frac{b_{ij}}{w_i}\right) - (c_{i0} + 2c_{i1}\mathrm{Ln}(F))\left(w_j/w_i\right) - k_{ij}$$

where k_{ij} is the Kronecker delta, which takes the value of one for own-price elasticity and zero for cross-price elasticity; and w_i is the share of the ith food group in total eight group food expenditure.

5 Compensated Price Elasticity from Stage 3

Once the expenditure and uncompensated price elasticities were estimated, the compensated own and cross-price elasticities are computed using the Slutsky equation in elasticity form:

$$\xi_{ij}^{H} = \xi_{ij} + w_j\eta_i$$

where ξ_{ij}^{H} is the compensated (hicksian) price elasticity.

6 Food Demand at Home

The per capita food demand at household level is predicted by Eq. (7):

$$d_t = d_{t-1}[1 + y_t.e(1 - s)] \tag{7}$$

The total household demand at the national level is obtained by multiplying the per capita food demand at the household level by the population (N_t), i.e.,

$$D_t = d_t \cdot N_t \tag{8}$$

The aggregate household demand at the National level is obtained from Eq. (8):

d = Per capita consumption of a pulse,
e = Expenditure elasticity of the pulse,
s = saving rate assumed at 30%.
N = Population,
Y = Per capita GDP growth,
D = Total household demand for different food groups,
t = Projected year and base year 2011 is taken in the study.

The expenditure elasticities were estimated at the national levels as discussed in the next section.

Cereals continue to be the most important food for meeting nutritional requirements and are the cheapest source of energy and protein. The low levels of income prevent households from substituting cereals with fruits, vegetables, milk, meat, fish, eggs, etc. The food consumption patterns have significant implications on future demand and resource allocation to achieve food and nutritional security in the country. The consumption pattern as observed in the year 2011 is used as the base year consumption while projecting the demand for food items.

7 Food Basket in Nepal: The Changing Trends

Dietary habits of people are determined mainly by the availability of foods locally, traditional practices, consumer's income, and food prices. The long-term trends in food consumption and nutrients intake of households in Nepal are presented in Table 4. The food basket is diversifying slowly from a cereal-dominated one to a mix of high-value commodities. The shift is evident a reduction of only 7.7% in the average annual consumption of cereals by the sample population between 1993 and 2011. On the other hand, a gain was noticed in the consumption of sugar by 48.5%, pulses by 55.1%, vegetables by 73.4%, meat, fish and eggs (MFE) by 111.2%, milk by 121.3%, and fruits by 141.3% in 2011 over the year 1993. The consumers gradually moved away from low-cost calorie food to high-cost calorie food items and diversified the dietary pattern towards livestock, fisheries and horticultural products that they afford due to rise in their incomes, lifestyle, etc. During the period 1993–2011, the expenditure share of cereals in total food expenditure declined from 44.5% to 28.9%. This share has been diverted to high-value food commodities. The food share in total expenditure has declined from 75.2% in 1993 to 64.5% in 2011.

Dietary diversification has improved the calorie intake by 12.4% from 1924 kcal/day in 1993 to 2162 kcal/day in 2011. The intake of protein has increased by 11.9% from 52.8 g/day in 1983 to 59.1 g/day in 2011. The additional nutrient requirement is being met from non-cereals and non-crop commodities. Despite increasing demand for high-value commodities, the importance of cereals for attaining nutritional security in the country will continue, because cereal accounts 71% share in total calorie intake and 66% share in total protein intake. Using threshold level below 75% of the adult recommended intake (2400 kcal/person/day for energy and 48 g/person/day for protein), the undernourished and malnourished population (headcount ration) was estimated. The incidence of deficit population had declined from 43% in 1993 to 34% in 2011 for energy intake and from 46% in 1993 to 37% in 2011. The decline is noticed by 20.8% for energy calories intake and 18.4% for protein intake in 15 years which is appreciable declined, however, nearly one-third households are still undernourished and malnourished in Nepal.

Table 4 Food basket in Nepal: the changing trends

Food commodities	1993	2003	2011	Change, % 2011 over 1993
Annual per capita food consumption (kg)				
Cereal	177.1	160.4	163.4	−7.7
Pulses	7.1	8.3	11.1	55.1
Milk	18.0	35.4	39.8	121.3
Edible oils	3.8	4.8	7.4	97.3
Vegetables	31.4	42.1	54.5	73.4
Fruits	6.0	10.0	14.5	141.3
Meat, fish and eggs	4.6	6.2	9.8	111.2
Sugar	3.09	3.79	4.59	48.5
Share in total food expenditure (%)				
Cereal	44.5	36.1	28.9	−35.2
Pulses	4.8	4.7	6.0	25.7
Milk	7.1	8.2	7.1	−0.3
Edible oils	8.3	11.4	8.9	7.4
Vegetables	7.0	7.6	8.7	23.4
Fruits	2.0	2.9	3.7	83.2
Meat, fish and eggs	8.0	9.6	13.3	65.3
Sugar	1.8	1.6	2.1	16.8
Beverages and others	16.5	18.1	21.5	29.9
Percentage of total calories by sources				
Cereal	83.7	75.5	70.7	−15.5
Pulses	3.4	4.0	4.2	21.8
Milk	4.7	6.0	8.5	79.1
Edible oils	2.4	4.6	4.9	105.4
Vegetables and fruits	0.9	1.1	1.6	81.8
Meat, fish and eggs	3.1	4.3	4.8	51.3
Others	1.7	4.5	5.4	212.2
Percentage of total proteins by sources				
Cereals	80.7	71.0	66.5	−17.6
Pulses	8.6	9.8	10.4	21.1
Meat, fish, and eggs	4.4	5.8	8.5	95.9
Milk	3.5	6.9	7.4	111.1
Vegetables and fruits	2.9	3.9	3.9	35.3
Beverages and others	1.0	2.6	3.3	231.0
Total expenditure on food and non-food commodities (%)				
Food	75.2	67.8	64.5	−14.2
Non-food	24.8	32.2	35.5	43.1
Calories and protein intake per capita per day				
Calories (kcal)	1924.0	1980.0	2162.0	12.4
Protein (g)	52.8	54.8	59.1	11.9
Dynamics of undernourishment and malnourished (*head count ratio*, %)				
Calorie-deficit	43.2	44.8	34.2	−20.8
Protein-deficit	45.7	46.5	37.3	−18.4

8 Food Demand Elasticities

The price and income elasticities of food groups at national-level based on QUAIDS model have been presented in Table 5. The income (expenditure) and price elasticities are found in accordance with *a priori* expectations. The magnitude of income elasticities declined with rise in income across income quartile. At aggregate, the income elasticities for cereals (0.40) have been highly inelastic being a staple food. The income elasticity was much higher for fruits (1.27) followed by milk (0.99), MFE (0.84), edible oils (0.81), sugar (0.81), pulses (0.79), and vegetables (0.79), respectively. Demand for high-value food commodities will increase faster with rise in income.

Own-price elasticities for all the food groups are negative and have been found to vary widely across commodities groups ranges between −0.38 for edible oils and

Table 5 Demand elasticities of food groups, Nepal, 2011

Income group	Cereal	Pulses	Vegetables	Fruits	Edible oils	MFE	Milk	Sugar
Expenditure elasticities								
Quartile 1	0.52	0.78	0.83	1.38	0.80	0.85	0.98	1.28
Quartile 2	0.45	0.79	0.80	1.36	0.81	0.87	1.04	0.92
Quartile 3	0.37	0.79	0.78	1.32	0.81	0.85	1.06	0.74
Quartile 4	0.23	0.80	0.76	1.22	0.82	0.83	1.09	0.51
All income	0.40	0.79	0.79	1.27	0.81	0.84	0.99	0.81
Uncompensated own and cross-price elasticities								
Cereal	−0.68	0.07	0.05	0.04	−0.06	0.09	−0.07	−0.01
Pulses	0.19	−0.72	−0.15	−0.02	−0.21	−0.05	−0.16	−0.01
Vegetables	−0.03	−0.10	−0.95	−0.12	−0.03	−0.14	0.13	0.10
Fruits	−0.19	−0.09	−0.37	−1.15	0.01	−0.24	0.10	0.07
Edible oils	−0.49	−0.16	−0.04	0.04	−0.38	0.01	−0.09	−0.03
MFE	−0.04	−0.03	−0.11	−0.04	0.00	−1.07	0.03	0.02
Milk	−0.77	−0.17	0.10	0.05	−0.15	−0.02	−0.82	0.09
Sugar	−0.50	−0.04	0.05	0.15	−0.11	0.12	0.35	−1.29
Compensated own and cross-price elasticities								
Cereal	−0.55	0.20	0.18	0.16	0.07	0.18	0.16	0.07
Pulses	0.23	−0.68	−0.10	0.02	−0.17	−0.10	0.02	−0.17
Vegetables	0.04	−0.03	−0.88	−0.05	0.03	−0.88	−0.05	0.03
Fruits	−0.15	−0.05	−0.33	−1.10	0.05	−0.33	−1.10	0.05
Edible oils	−0.43	−0.10	0.02	0.09	−0.32	0.02	0.09	−0.32
MFE	0.06	0.07	0.00	0.06	0.10	0.00	0.06	0.10
Milk	−0.70	−0.10	0.17	0.12	−0.08	0.17	0.12	−0.08
Sugar	−0.44	0.02	0.10	0.21	−0.06	0.10	0.21	−0.06

Table 6 Price and income effect on food demand, Nepal, 2011

Food group	Income effect	Price effect	Net effect
Cereal	0.40	−0.57	−0.17
Pulses	0.79	−1.13	−0.34
Vegetables	0.79	−1.14	−0.35
Fruits	1.27	−1.86	−0.59
Edible oils	0.81	−1.14	−0.33
Meat, fish, and eggs	0.84	−1.24	−0.40
Milk	0.99	−1.69	−0.70
Sugar	0.81	−1.27	−0.46

−1.29 for sugar. The uncompensated elasticities are higher than compensated elasticities. The positive sign of cross-price elasticities indicates a substitution relationship while a negative sign indicates a complementary relationship among the pair of goods. The cross-price elasticities of each pair of commodities are highly inelastic and all food groups are independent except milk and cereal with cross-price elasticity −0.77. All the food groups are independent except cereal and milk group which is complementary to each other.

9 Income and Price Effect on Food Demand

The income effect, price effect (sum of own and cross-price elasticities) and net effect (sum of income and price effect) on food demand have been presented in Table 6. The income effect was positive and price effect was negative for all the food groups. The pure price inflation (sum of income and price elasticities) on food demand was negative for all food groups mild for cereals, moderate for pulses, vegetables, edible oils, MFE, and sugar and high for milk and fruits. Thus, increase in inflation of food prices will adversely affect the dietary diversification towards non-cereal food commodities and may lead to undernourishment of consumers. If inflation in food prices remains unabated for an extended period, the dietary pattern will shift towards cereal-dominated diet and consumer will be deficit of quality food and nutrients in Nepal.

10 Bases of Food Demand

Total demand for food can be divided into three categories. One, food consumed by the household at home in various forms, also referred to as “direct demand of food” at home, two, food consumed outside homes, referred as home away demand and three, food commodities used as feed, seed, wastages and in the industry refers as indirect demand. The net availability of food for human consumption at home and outside home are derived from total production, adjusted for trade and change in stocks, after setting aside a fixed percentage of production for seed, feed, wastage, and industrial use. However, no estimates are available for indirect demand going into seed, feed, industrial use and wastage for Nepal. Similarly, food consumed as food outside homes. The indirect food demand and home away estimates derived for India by Kumar and Joshi (2016) are used for Nepal. The NLS data on household consumption was used to estimate food consumption at home. The food consumption outside home is obtained by subtracting food consumption at home from net availability of food for human consumption at home and outside home. The percentage share of household food consumption at home and outside home and indirect use in total demand for food commodities are given in Table 7. These parameters are used to drive home away and indirect demand from the household demand for each food group.

The indirect use in the form of seed, feed, wastages and industrial use in total demand is taken 11.62% for cereals, 19.5% for pulses, 11.3% for vegetables, 20.9% for fruits, 17.2% for edible oils, 12.8% for sugar 2.4% for milk and 6.9% Meat, fish and eggs (Kumar and Joshi 2016). The direct food consumption at home is estimated to be 77.9% for cereals, 62.7% for pulses, 65.7% for vegetables, 20.3% for fruits, 61.1% for edible oils, 43.1% for sugar, 66.5% for milk, and 49.4% meat, fish, and eggs. The share of home away food consumption in total domestic demand of food is computed to be 58.7% which highest followed by sugar (44.1%), MFE (43.8), milk (31.1%), pulses (19.5%), and minimum for cereals and vegetables (11%).

The baseline consumption during 2011–12 based on NLS survey, food demand elasticity, income growth, and population are the important factors for projecting food demand. The growth rates in per capita income were obtained by subtracting

Table 7 Per cent share of household consumption and indirect use of food in total food demand at Nepal

Food group	Household consumption		Indirect use
	At home	Home away	
Cereals	77.93	10.45	11.62
Pulses	62.76	17.77	19.47
Vegetables	65.74	22.96	11.30
Fruits	20.29	58.73	20.98
Edible oils	61.05	21.74	17.20
Sugar	43.13	44.06	12.81
Milk	66.50	31.14	2.36
Meat, fish, and eggs	49.37	43.78	6.86

Table 8 Assumptions for projecting food demand in Nepal

Assumption	Base year	Projected year				
	2011–12	2015–16	2020–21	2025–26	2030–31	2035–36
Base year and projected population in thousand						
	27,179	28,513	30,184	31,754	33,104	34,187
Annual population growth, %						
	1.20	1.20	1.11	0.95	0.76	0.58
Recent and projected growth rates in income (National product at factor cost), %						
	4.61	0.77	4.5	4.5	4.5	4.5
Per capita income growth						
	3.41	−0.43	3.39	3.55	3.74	3.92
Expenditure Elasticity in the base year and projected year						
Cereals	0.400	0.391	0.346	0.300	0.260	0.225
Pulses	0.790	0.772	0.684	0.593	0.513	0.444
Vegetables	0.790	0.772	0.684	0.593	0.513	0.444
Fruits	1.270	1.241	1.100	0.953	0.825	0.714
Edible oils	0.810	0.792	0.701	0.608	0.526	0.456
Sugar and Gur	0.810	0.792	0.701	0.608	0.526	0.456
Milk	0.990	0.967	0.857	0.743	0.643	0.557
Meat, fish, and eggs	0.840	0.821	0.727	0.630	0.546	0.473

Table 9 Annual per capita consumption of food (kg) in past and future years

Year	Cereals	Pulses	Vegetables	Fruits	Edible oils	Sugar	Milk	MFE
1995	177.10	7.13	31.44	6.01	3.77	3.09	18.00	4.64
2003	160.35	8.28	42.11	9.96	4.82	3.79	35.36	6.16
2011	163.40	11.06	54.53	14.50	7.44	4.59	39.83	9.80
2015	166.93	11.60	57.21	15.66	7.82	4.82	42.29	10.31
2020	173.79	12.56	61.93	17.77	8.48	5.23	46.70	11.22
2025	180.63	13.55	66.81	20.07	9.16	5.65	51.35	12.16
2030	187.10	14.52	71.60	22.42	9.84	6.07	56.00	13.09
2035	193.19	15.47	76.27	24.80	10.49	6.47	60.60	14.00
Annual growth in per capita consumption in Nepal								
2015–25	0.79	1.56	1.56	2.51	1.60	1.60	1.96	1.66
2025–35	0.67	1.33	1.33	2.14	1.37	1.37	1.67	1.42
2015–35	0.73	1.45	1.45	2.33	1.48	1.48	1.81	1.54

MFE: Meat, fish and eggs

Table 10 Annual growth (%) of food demand in Nepal

Food	2015–2025	2025–2035	2015–2035
Cereals	1.88	1.42	1.65
Pulses	2.66	2.08	2.37
Vegetables	2.66	2.08	2.37
Fruits	3.62	2.90	3.26
Edible oils (Cooking oils)	2.70	2.12	2.41
Sugar	2.70	2.12	2.41
Milk	3.06	2.42	2.74
Meat, fish, and eggs	2.76	2.17	2.47

Table 11 Demand for cereals in Nepal

Cereals	2011	2015	2020	2025	2030	2035
(*Thousand tons*)						
Direct household demand	4441.0	4759.7	5245.8	5735.7	6193.6	6604.6
Home away demand	595.5	638.3	703.4	769.1	830.5	885.6
Total household demand	5036.6	5398.0	5949.3	6504.8	7024.2	7490.2
Indirect demand	662.2	709.7	782.2	855.2	923.5	984.8
Total domestic demand	5698.8	6107.7	6731.4	7360.1	7947.7	8475.0
Demand for major cereals						
Fine rice	950.0	1018.1	1122.1	1226.9	1324.9	1412.8
Coarse rice	2684.6	2877.2	3171.1	3467.2	3744.0	3992.5
Beaten rice	156.6	167.8	185.0	202.2	218.4	232.9
Total rice	3791.2	4063.2	4478.2	4896.4	5287.3	5638.1
Maize	831.4	891.1	982.1	1073.8	1159.5	1236.4
Wheat	834.2	894.0	985.4	1077.4	1163.4	1240.6
Millets and others	242.0	259.4	285.9	312.6	337.5	359.9
All cereals	5698.8	6107.7	6731.4	7360.1	7947.7	8475.0

population growth rate from economic (GDP) growth rate and were used in predicting per capita consumption under the assumptions listed in Appendix Table 19. Magnitudes of income elasticity decline with rise in income, urbanization and changes in production environment, tastes and food preferences. Thus, it is expected that the elasticities will decline in future (Table 8). Thus, it is assumed that the estimated expenditure elasticities based on past consumer budget data will decline by 25% by the year 2020 and further 25% declined by the year 2035 (Appendix Tables 20 and 26).

Table 12 Demand for pulses in Nepal

Pulses	2011	2015	2020	2025	2030	2035
Thousand Tons						
Direct household demand	300.6	330.9	379.1	430.3	480.8	528.8
Home away demand	85.1	93.7	107.4	121.8	136.1	149.7
Total household demand	385.7	424.5	486.5	552.2	616.9	678.6
Indirect demand	93.3	102.6	117.6	133.5	149.1	164.1
Total domestic demand	479.0	527.2	604.1	685.7	766.0	842.6
Demand for major pulses						
Black gram	102.3	112.7	129.1	146.5	163.7	180.1
Lentil	169.4	186.5	213.7	242.5	270.9	298.0
Red gram	47.9	52.7	60.4	68.6	76.6	84.3
Horse gram	70.1	77.1	88.4	100.3	112.1	123.3
Beans	48.4	53.3	61.0	69.3	77.4	85.2
Other pulses	40.8	44.9	51.5	58.5	65.3	71.8
All pulses	479.0	527.2	604.1	685.7	766.0	842.6

Table 13 Demand for vegetables in Nepal

Pulses	2011	2015	2020	2025	2030	2035
(*Thousand tons*)						
Direct household demand	1482.1	1631.3	1869.3	2121.6	2370.4	2607.4
Home away demand	517.6	569.7	652.9	741.0	827.9	910.6
Total household demand	1999.7	2201.0	2522.2	2862.6	3198.2	3518.0
Indirect demand	254.8	280.4	321.3	364.7	407.4	448.2
Total domestic demand	2254.4	2481.4	2843.5	3227.3	3605.7	3966.2
Demand for major vegetables						
Potato	1020.1	1122.8	1286.6	1460.3	1631.5	1794.6
Onion	271.7	299.0	342.7	388.9	434.5	478.0
Tomato	228.6	251.6	288.4	327.3	365.6	402.2
Cauliflower/Cabbage	247.1	271.9	311.6	353.7	395.2	434.7
Green leafy	438.3	482.4	552.8	627.4	701.0	771.1
Others vegetables	48.7	53.6	61.4	69.7	77.9	85.7
All vegetables	48.7	53.6	61.4	69.7	77.9	85.7

11 Predicted Dietary Pattern

Using the expenditure elasticity, saving ration (30%) and per capita income growth, the per capita annual consumption is predicted year-wise from 2011 to the year 2035 for cereals, pulses, vegetables, fruits, edible oils (cooking oil), sugar and Gur, milk and MFE (Appendix Table 21). The summary results for the selected years are presented in Table 9.

Table 14 Demand for fruits in Nepal

Pulses	2011	2015	2020	2025	2030	2035
(*Thousand tons*)						
Direct household demand	394.1	446.4	536.4	637.2	742.2	848.0
Home away demand	1140.7	1292.1	1552.7	1844.4	2148.2	2454.5
Total household demand	1534.8	1738.4	2089.2	2481.7	2890.4	3302.4
Indirect demand	407.5	461.6	554.7	658.9	767.4	876.8
Total domestic demand	1942.3	2200.0	2643.8	3140.5	3657.8	4179.2
Demand for major fruits						
Bananas	498.3	564.4	678.3	805.7	938.4	1072.2
Citrus fruits	274.6	311.0	373.8	444.0	517.1	590.9
Mangoes	538.5	609.9	733.0	870.7	1014.1	1158.7
Apples	174.1	197.2	237.0	281.6	327.9	374.7
Papaya	218.3	247.3	297.2	353.0	411.2	469.8
Pineapple	40.2	45.5	54.7	65.0	75.7	86.5
Others	198.2	224.6	269.9	320.6	373.3	426.6
All Fruits	1942.3	2200.0	2643.8	3140.5	3657.8	4179.2

Table 15 Demand for edible oils in Nepal

Edible oils	2011	2015	2020	2025	2030	2035
(*Thousand tons*)						
Direct household demand	202.2	222.8	255.9	291.0	325.6	358.8
Home away demand	72.0	79.4	91.1	103.6	116.0	127.8
Total household demand	274.2	302.2	347.0	394.6	441.6	486.5
Indirect demand	57.0	62.8	72.1	82.0	91.7	101.1
Total domestic demand	331.2	365.0	419.1	476.6	533.4	587.6
Demand for major edible oils						
Ghee	49.4	54.5	62.5	71.1	79.6	87.7
Vegetable oils	13.8	15.2	17.5	19.9	22.2	24.5
Mustard oil	233.3	257.1	295.2	335.7	375.7	413.9
Other oil	34.7	38.3	43.9	50.0	55.9	61.6
All edible oils	331.2	365.0	419.1	476.6	533.4	587.6

The increasing trend in per capita consumption is projected for all the food groups with annual growth rate of 0.73% for cereals, 1.45% for pulses and vegetables, 2.33% for fruits, 1.48% for cocking edible oils and sugar, 1.81% for milk and 1.54% for MFE. The dietary pattern will diversify towards horticultural and livestock products. The food basket in Nepal will continue to diversify with increasing consumption of milk, fruits, vegetables, meat, poultry products, and fish. Consequently, the demand for horticultural, livestock, poultry and fishery products will rise considerably in the coming years. The government should plan for a

Table 16 Year-wise demand for sugar and Gur in Nepal

Year	Household demand			Indirect demand	Total demand
	At home	Home away	Total		
(*Thousand tons*)					
2011 (base year)	124.8	127.4	252.2	37.1	289.2
2015	137.5	140.4	277.9	40.8	318.7
2020	157.9	161.3	319.1	46.9	366.0
2025	179.5	183.4	362.9	53.3	416.2
2030	200.9	205.2	406.1	59.7	465.8
2035	221.3	226.1	447.4	65.7	513.2

Table 17 Year-wise demand for milk in Nepal

Year	Household demand			Indirect demand	Total demand
	At home	Home away	Total		
(*Thousand tons*)					
2011	1082.5	506.9	1589.5	38.4	1627.9
2015	1205.9	564.7	1770.6	42.8	1813.4
2020	1409.6	660.1	2069.7	50.0	2119.7
2025	1630.6	763.6	2394.1	57.9	2452.0
2030	1853.7	868.0	2721.7	65.8	2787.5
2035	2071.6	970.1	3041.7	73.5	3115.2

Table 18 Demand for meat, fish and eggs in Nepal

Meat, fish, and eggs	2011	2015	2020	2025	2030	2035
(*Thousand tons*)						
Direct household demand	266.4	294.1	338.7	386.2	433.4	478.6
Home away demand	236.2	260.8	300.3	342.5	384.3	424.4
Total household demand	502.6	554.8	639.0	728.7	817.7	903.0
Indirect demand	37.0	40.8	47.0	53.6	60.1	66.4
Total domestic MFE demand	539.6	595.6	686.0	782.3	877.8	969.4
Mutton	106.1	117.1	134.9	153.8	172.6	190.6
Buffalo meat	98.9	109.2	125.8	143.5	161.0	177.8
Chicken	127.5	140.8	162.1	184.9	207.5	229.1
Others	24.7	27.3	31.4	35.9	40.2	44.4
All meat	357.3	394.4	454.2	518.0	581.3	641.9
Fish	102.4	113.0	130.2	148.5	166.6	184.0
Eggs	79.9	88.2	101.5	115.8	129.9	143.5
Meat, fish, and eggs	539.6	595.6	686.0	782.3	877.8	969.4

Table 19 Projected population and income growth in Nepal: 2005–2035

Year	Population in thousand	Population growth, %	Annual GDP growth, %	Per capita GDP growth, %
2005	25,506	1.45	2.75	1.30
2010	26,876	1.05	5.80	4.75
2011	27,179	1.20	4.61	3.41
2012	27,500	1.18	3.76	2.58
2013	27,834	1.21	5.72	4.51
2014	28,174	1.22	2.32	1.10
2015	28,513	1.20	0.77	−0.43
2016	28,850	1.18	4.10	2.92
2017	29,187	1.17	4.20	3.03
2018	29,521	1.14	4.30	3.16
2019	29,854	1.13	4.40	3.27
2020	30,184	1.11	4.50	3.39
2021	30,510	1.08	4.50	3.42
2022	30,831	1.05	4.50	3.45
2023	31,147	1.02	4.50	3.48
2024	31,454	0.99	4.50	3.51
2025	31,754	0.95	4.50	3.55
2026	32,044	0.91	4.50	3.59
2027	32,324	0.87	4.50	3.63
2028	32,595	0.84	4.50	3.66
2029	32,855	0.80	4.50	3.70
2030	33,104	0.76	4.50	3.74
2031	33,342	0.72	4.50	3.78
2032	33,569	0.68	4.50	3.82
2033	33,785	0.64	4.50	3.86
2034	33,991	0.61	4.50	3.89
2035	34,187	0.58	4.50	3.92
2036	34,372	0.54	4.50	3.96

Source United Nations Department of Economics and Social Affairs Population Division. World Population Prospects

Table 20 Expenditure elasticities in the base year and predicted years for Nepal: 2011–2035

Year	Cereals	Pulses	Vegetables	Fruits	Edible oils	Sugar	Milk	MFE
2011	0.40	0.79	0.79	1.27	0.81	0.81	0.99	0.84
2012	0.40	0.79	0.79	1.26	0.81	0.81	0.98	0.84
2013	0.40	0.78	0.78	1.26	0.80	0.80	0.98	0.83
2014	0.39	0.78	0.78	1.25	0.80	0.80	0.97	0.83

(continued)

Table 20 (continued)

Year	Cereals	Pulses	Vegetables	Fruits	Edible oils	Sugar	Milk	MFE
2015	0.39	0.77	0.77	1.24	0.79	0.79	0.97	0.82
2016	0.39	0.77	0.77	1.23	0.79	0.79	0.96	0.82
2017	0.38	0.75	0.75	1.20	0.76	0.76	0.93	0.79
2018	0.37	0.72	0.72	1.16	0.74	0.74	0.91	0.77
2019	0.36	0.70	0.70	1.13	0.72	0.72	0.88	0.75
2020	0.35	0.68	0.68	1.10	0.70	0.70	0.86	0.73
2021	0.34	0.66	0.66	1.07	0.68	0.68	0.83	0.71
2022	0.33	0.65	0.65	1.04	0.66	0.66	0.81	0.69
2023	0.32	0.63	0.63	1.01	0.64	0.64	0.79	0.67
2024	0.31	0.61	0.61	0.98	0.63	0.63	0.76	0.65
2025	0.30	0.59	0.59	0.95	0.61	0.61	0.74	0.63
2026	0.29	0.58	0.58	0.93	0.59	0.59	0.72	0.61
2027	0.28	0.56	0.56	0.90	0.57	0.57	0.70	0.59
2028	0.28	0.54	0.54	0.87	0.56	0.56	0.68	0.58
2029	0.27	0.53	0.53	0.85	0.54	0.54	0.66	0.56
2030	0.26	0.51	0.51	0.82	0.53	0.53	0.64	0.55
2031	0.25	0.50	0.50	0.80	0.51	0.51	0.62	0.53
2032	0.25	0.48	0.48	0.78	0.50	0.50	0.61	0.52
2033	0.24	0.47	0.47	0.76	0.48	0.48	0.59	0.50
2034	0.23	0.46	0.46	0.74	0.47	0.47	0.57	0.49
2035	0.23	0.44	0.44	0.71	0.46	0.46	0.56	0.47
2036	0.23	0.44	0.44	0.71	0.46	0.46	0.56	0.47

MFE: Meat, fish, and eggs. Assumption: Elasticity declined by 25% during the year 2011–2025 and further 25% declined during the year 2025–2035

Table 21 Annual per capita consumption of food (kg) in past and future in Nepal: 2011–2035

Year	Cereals	Pulses	Vegetables	Fruits	Edible oils	Sugar	Milk	MFE
1995	177.10	7.13	31.44	6.01	3.77	3.09	18.00	4.64
2003	160.35	8.28	42.11	9.96	4.82	3.79	35.36	6.16
2011 (base year)	163.40	11.06	54.53	14.50	7.44	4.59	39.83	9.80
2012	164.57	11.28	55.63	14.97	7.59	4.69	40.84	10.01
2013	166.63	11.56	57.00	15.57	7.79	4.80	42.10	10.27
2014	167.13	11.63	57.35	15.71	7.83	4.83	42.42	10.34
2015	166.93	11.60	57.21	15.66	7.82	4.82	42.29	10.31
2016	168.26	11.79	58.11	16.05	7.94	4.90	43.12	10.49
2017	169.60	11.97	59.03	16.46	8.07	4.98	43.98	10.66
2018	170.98	12.16	59.97	16.88	8.20	5.06	44.86	10.84

(continued)

Table 21 (continued)

Year	Cereals	Pulses	Vegetables	Fruits	Edible oils	Sugar	Milk	MFE
2019	172.38	12.36	60.94	17.32	8.34	5.14	45.77	11.03
2020	173.79	12.56	61.93	17.77	8.48	5.23	46.70	11.22
2021	175.20	12.76	62.92	18.23	8.62	5.31	47.63	11.41
2022	176.58	12.96	63.90	18.68	8.75	5.40	48.56	11.60
2023	177.94	13.16	64.87	19.14	8.89	5.48	49.49	11.79
2024	179.29	13.36	65.85	19.60	9.03	5.57	50.42	11.98
2025	180.63	13.55	66.81	20.07	9.16	5.65	51.35	12.16
2026	181.95	13.75	67.78	20.53	9.30	5.74	52.28	12.35
2027	183.26	13.94	68.74	21.00	9.43	5.82	53.21	12.54
2028	184.55	14.14	69.70	21.47	9.57	5.90	54.14	12.72
2029	185.83	14.33	70.65	21.95	9.70	5.99	55.07	12.91
2030	187.10	14.52	71.60	22.42	9.84	6.07	56.00	13.09
2031	188.35	14.71	72.55	22.89	9.97	6.15	56.92	13.27
2032	189.58	14.91	73.49	23.37	10.10	6.23	57.85	13.46
2033	190.80	15.09	74.42	23.85	10.23	6.31	58.77	13.64
2034	192.00	15.28	75.35	24.33	10.36	6.39	59.68	13.82
2035	193.19	15.47	76.27	24.80	10.49	6.47	60.60	14.00
2036	194.39	15.66	77.21	25.29	10.63	6.56	61.53	14.18
Annual growth in per capita consumption in Nepal								
Period	Cereals	Pulses	Vegetables	Fruits	Edible oils	Sugar	Milk	MFE
2015–25	0.79	1.56	1.56	2.51	1.60	1.60	1.96	1.66
2025–35	0.67	1.33	1.33	2.14	1.37	1.37	1.67	1.42
2015–35	0.73	1.45	1.45	2.33	1.48	1.48	1.81	1.54

MFE: Meat, fish, and eggs

relatively bigger supply of high-value food to fight inflation in food prices. With inflation in food prices, the food basket with nutritive diet will be adversely affected. The consumer would shift from high value food chain to cereals to meet their basic calories requirement and accentuating undernourishment.

12 Food Demand Projection

The estimated per capita consumption (Appendix Table 21) of commodities was multiplied by the projected population (Appendix Table 19) to arrive at direct demand at the household level for different food groups. By using direct household demand and estimated parameters as shown in Table 6, total domestic demand, indirect demand, and home away demand are derived year-wise from 2011 to 2035 at the national level and presented in Appendix Table 22 for cereals, Appendix

Table 22 Year-wise demand for cereals in Nepal: 2011–2035

Year	Household demand			Indirect demand	Total demand
	At home	Home away	Total		
Thousand tons					
2011 (base year)	4441.0	595.5	5036.6	662.2	5698.8
2012	4525.8	606.9	5132.6	674.8	5807.5
2013	4637.9	621.9	5259.8	691.5	5951.3
2014	4708.7	631.4	5340.1	702.1	6042.2
2015	4759.7	638.3	5398.0	709.7	6107.7
2016	4854.2	650.9	5505.1	723.8	6228.9
2017	4950.3	663.8	5614.1	738.1	6352.2
2018	5047.5	676.8	5724.3	752.6	6477.0
2019	5146.1	690.1	5836.2	767.3	6603.5
2020	5245.8	703.4	5949.3	782.2	6731.4
2021	5345.2	716.8	6062.0	797.0	6859.0
2022	5444.1	730.0	6174.1	811.8	6985.9
2023	5542.4	743.2	6285.6	826.4	7112.0
2024	5639.5	756.2	6395.8	840.9	7236.7
2025	5735.7	769.1	6504.8	855.2	7360.1
2026	5830.5	781.8	6612.3	869.4	7481.7
2027	5923.7	794.3	6718.0	883.3	7601.3
2028	6015.5	806.6	6822.1	897.0	7719.1
2029	6105.5	818.7	6924.2	910.4	7834.6
2030	6193.6	830.5	7024.2	923.5	7947.7
2031	6279.8	842.1	7121.9	936.4	8058.3
2032	6364.0	853.4	7217.4	948.9	8166.4
2033	6446.2	864.4	7310.6	961.2	8271.8
2034	6526.4	875.2	7401.6	973.1	8374.7
2035	6604.6	885.6	7490.2	984.8	8475.0
2036	6681.7	896.0	7577.7	996.3	8574.0

Table 23 for pulses, Appendix Table 24 for vegetables, Appendix Table 25 for fruits, Appendix Table 26 for cooking edible oils, Appendix Table 27 for sugar and raw sugar (*Gur*), Appendix Table 28 for milk and Appendix Table 29 for MFE. The annual growth in domestic demand for major food groups are computed during 2015–2025, 2025–2035 and 2015–2035 and shown in Table 10. The projected demand for food at the disaggregated levels is presented in Appendix Table 30 to Appendix Table 35 for cereals, pulses, vegetables, fruits, edible oils, and meat, respectively.

The demand for fruits has grown fastest during 2015–2025 with an annual growth rate of 3.62%, followed by milk (3.06), meat, fish and eggs (2.76%), edible oils, sugar, pulses and vegetables (2.7%) and is slow rate for cereals (1.88%).

Table 23 Year-wise demand for pulses in Nepal: 2011–2035

Year	Household demand			Indirect demand	Total demand
	At home	Home away	Total		
(*Thousand tons*)					
2011 (base year)	300.6	85.1	385.7	93.3	479.0
2012	310.3	87.9	398.2	96.3	494.4
2013	321.8	91.1	412.9	99.8	512.8
2014	327.7	92.8	420.5	101.7	522.1
2015	330.9	93.7	424.5	102.6	527.2
2016	340.0	96.3	436.3	105.5	541.8
2017	349.4	98.9	448.4	108.4	556.8
2018	359.1	101.7	460.8	111.4	572.2
2019	369.0	104.5	473.5	114.5	588.0
2020	379.1	107.4	486.5	117.6	604.1
2021	389.3	110.2	499.6	120.8	620.4
2022	399.6	113.1	512.7	124.0	636.7
2023	409.8	116.0	525.9	127.1	653.0
2024	420.1	118.9	539.0	130.3	669.3
2025	430.3	121.8	552.2	133.5	685.7
2026	440.5	124.7	565.3	136.7	701.9
2027	450.7	127.6	578.3	139.8	718.1
2028	460.8	130.5	591.3	143.0	734.2
2029	470.8	133.3	604.1	146.1	750.2
2030	480.8	136.1	616.9	149.1	766.0
2031	490.6	138.9	629.5	152.2	781.7
2032	500.3	141.7	642.0	155.2	797.2
2033	510.0	144.4	654.4	158.2	812.6
2034	519.5	147.1	666.6	161.2	827.7
2035	528.8	149.7	678.6	164.1	842.6
2036	538.2	152.4	690.6	167.0	857.6

Table 24 Year-wise demand for vegetables in Nepal: 2011–2035

Year	Household demand			Indirect demand	Total demand
	At home	Home away	Total		
Thousand tons					
2011 (base year)	1482.1	517.6	1999.7	254.8	2254.4
2012	1530.0	534.3	2064.3	263.0	2327.3
2013	1586.7	554.2	2140.8	272.7	2413.6
2014	1615.6	564.3	2179.9	277.7	2457.6

(continued)

Table 24 (continued)

Year	Household demand			Indirect demand	Total demand
	At home	Home away	Total		
2015	1631.3	569.7	2201.0	280.4	2481.4
2016	1676.4	585.5	2261.9	288.2	2550.1
2017	1722.8	601.7	2324.6	296.1	2620.7
2018	1770.5	618.3	2388.8	304.3	2693.1
2019	1819.3	635.4	2454.7	312.7	2767.4
2020	1869.3	652.9	2522.2	321.3	2843.5
2021	1919.6	670.4	2590.0	330.0	2919.9
2022	1970.0	688.0	2658.0	338.6	2996.7
2023	2020.6	705.7	2726.3	347.3	3073.6
2024	2071.1	723.3	2794.5	356.0	3150.5
2025	2121.6	741.0	2862.6	364.7	3227.3
2026	2171.9	758.6	2930.5	373.3	3303.8
2027	2222.0	776.1	2998.1	381.9	3380.0
2028	2271.9	793.5	3065.3	390.5	3455.8
2029	2321.3	810.7	3132.1	399.0	3531.1
2030	2370.4	827.9	3198.2	407.4	3605.7
2031	2418.9	844.8	3263.7	415.8	3679.5
2032	2466.9	861.6	3328.5	424.0	3752.5
2033	2514.3	878.1	3392.5	432.2	3824.7
2034	2561.2	894.5	3455.7	440.2	3895.9
2035	2607.4	910.6	3518.0	448.2	3966.2
2036	2653.8	926.8	3580.6	456.2	4036.8

Table 25 Year-wise demand for fruits in Nepal: 2011–2035

Year	Household demand			Indirect demand	Total demand
	At home	Home away	Total		
Thousand tons					
2011 (base year)	394.1	1140.7	1534.8	407.5	1942.3
2012	411.7	1191.8	1603.5	425.7	2029.3
2013	433.2	1254.0	1687.3	448.0	2135.2
2014	442.7	1281.5	1724.3	457.8	2182.0
2015	446.4	1292.1	1738.4	461.6	2200.0
2016	463.0	1340.3	1803.3	478.8	2282.1
2017	480.4	1390.4	1870.8	496.7	2367.5
2018	498.4	1442.5	1940.9	515.3	2456.2

(continued)

Table 25 (continued)

Year	Household demand			Indirect demand	Total demand
	At home	Home away	Total		
2019	517.1	1496.6	2013.7	534.6	2548.3
2020	536.4	1552.7	2089.2	554.7	2643.8
2021	556.1	1609.6	2165.7	575.0	2740.8
2022	576.0	1667.3	2243.4	595.6	2839.0
2023	596.2	1725.8	2322.0	616.5	2938.5
2024	616.6	1784.8	2401.4	637.6	3039.0
2025	637.2	1844.4	2481.7	658.9	3140.5
2026	658.0	1904.5	2562.5	680.4	3242.9
2027	678.9	1965.0	2643.9	702.0	3345.9
2028	699.9	2025.9	2725.8	723.7	3449.5
2029	721.0	2087.0	2808.0	745.5	3553.5
2030	742.2	2148.2	2890.4	767.4	3657.8
2031	763.4	2209.6	2972.9	789.3	3762.2
2032	784.6	2270.9	3055.5	811.2	3866.7
2033	805.7	2332.2	3138.0	833.1	3971.1
2034	826.9	2393.4	3220.3	855.0	4075.3
2035	848.0	2454.5	3302.4	876.8	4179.2
2036	869.4	2516.6	3386.0	899.0	4285.0

Table 26 Year-wise demand for edible oils in Nepal: 2011–2035

Year	Household demand			Indirect demand	Total demand
	At home	Home away	Total		
Thousand tons					
2011 (base year)	202.2	72.0	274.2	57.0	331.2
2012	208.8	74.4	283.2	58.8	342.1
2013	216.7	77.2	293.9	61.1	355.0
2014	220.7	78.6	299.3	62.2	361.5
2015	222.8	79.4	302.2	62.8	365.0
2016	229.1	81.6	310.7	64.5	375.3
2017	235.5	83.9	319.4	66.4	385.8
2018	242.1	86.2	328.4	68.2	396.6
2019	248.9	88.6	337.6	70.1	407.7
2020	255.9	91.1	347.0	72.1	419.1
2021	262.8	93.6	356.4	74.1	430.5
2022	269.9	96.1	366.0	76.0	442.0
2023	276.9	98.6	375.5	78.0	453.5

(continued)

Table 26 (continued)

Year	Household demand			Indirect demand	Total demand
	At home	Home away	Total		
2024	283.9	101.1	385.0	80.0	465.1
2025	291.0	103.6	394.6	82.0	476.6
2026	298.0	106.1	404.1	83.9	488.1
2027	304.9	108.6	413.5	85.9	499.5
2028	311.9	111.1	422.9	87.9	510.9
2029	318.8	113.5	432.3	89.8	522.2
2030	325.6	116.0	441.6	91.7	533.4
2031	332.4	118.4	450.8	93.7	544.5
2032	339.1	120.8	459.9	95.5	555.5
2033	345.7	123.1	468.9	97.4	566.3
2034	352.3	125.5	477.7	99.3	577.1
2035	358.8	127.8	486.5	101.1	587.6
2036	365.3	130.1	495.3	102.9	598.3

Consequently, the demand for horticultural, livestock, poultry and fishery products will rise considerably in the coming years. A deceleration in the growth rate of demand for all food groups has been observed. It is because of deceleration in expenditure elasticities and population growth. However, the demand growth for all the food groups is higher than the population growth and food consumption will continue to increase in future and undernourished and malnourished population in Nepal will decline if supply matches with demand either through domestic production or import. Thus, Nepal needs to pay greater attention in maintaining its self-reliance in food production by producing the additional food by increasing the public investment in irrigation, rural infrastructure and rapid spread of modern technology with improved food production practices. These policies will help in maintaining the total factor productivity growth (TFPG) in long run and country will be in a position to keep the balance between domestic production and demand. Resources need to be augmented for investment in research, extension, irrigation, infrastructure and introducing new technologies.

13 Cereals

The total demand for cereals, except for export, was arrived by adding their direct demand (human food consumption at home and outside home) and indirect demand (seed, feed, industrial uses, and wastages). The domestic demand for cereals for the selected years 2015, 2020, 2025, 2030 and 2035 are given in Table 11. The cereals demand will increase from 5.7 million tons (Mt) in 2011 to 7.4 Mt towards the end

Table 27 Year-wise demand for sugar in Nepal: 2011–2035

Year	Household demand			Indirect demand	Total demand
	At home	Home away	Total		
Thousand tons					
2011 (base year)	124.8	127.4	252.2	37.1	289.2
2012	128.8	131.6	260.5	38.3	298.7
2013	133.7	136.6	270.3	39.7	310.0
2014	136.2	139.1	275.3	40.4	315.7
2015	137.5	140.4	277.9	40.8	318.7
2016	141.3	144.4	285.7	42.0	327.7
2017	145.3	148.4	293.7	43.2	336.9
2018	149.4	152.6	302.0	44.4	346.4
2019	153.6	156.9	310.4	45.6	356.1
2020	157.9	161.3	319.1	46.9	366.0
2021	162.2	165.7	327.8	48.2	376.0
2022	166.5	170.1	336.6	49.4	386.0
2023	170.8	174.5	345.3	50.7	396.1
2024	175.2	178.9	354.1	52.0	406.1
2025	179.5	183.4	362.9	53.3	416.2
2026	183.8	187.8	371.6	54.6	426.2
2027	188.1	192.2	380.3	55.9	436.2
2028	192.4	196.6	389.0	57.1	446.1
2029	196.7	200.9	397.6	58.4	456.0
2030	200.9	205.2	406.1	59.7	465.8
2031	205.1	209.5	414.6	60.9	475.5
2032	209.2	213.7	422.9	62.1	485.1
2033	213.3	217.9	431.2	63.4	494.6
2034	217.3	222.0	439.4	64.6	503.9
2035	221.3	226.1	447.4	65.7	513.2
2036	225.3	230.2	455.5	66.9	522.5

Table 28 Year-wise demand for milk in Nepal: 2011–2035

Year	Household demand			Indirect demand	Total demand
	At home	Home away	Total		
Thousand tons					
2011 (base year)	1082.5	506.9	1589.5	38.4	1627.9
2012	1123.1	525.9	1649.1	39.9	1688.9
2013	1171.9	548.7	1720.6	41.6	1762.2
2014	1195.0	559.6	1754.7	42.4	1797.1
2015	1205.9	564.7	1770.6	42.8	1813.4
2016	1244.1	582.6	1826.7	44.2	1870.8
2017	1283.6	601.1	1884.7	45.6	1930.2
2018	1324.3	620.1	1944.5	47.0	1991.5
2019	1366.3	639.8	2006.2	48.5	2054.7

(continued)

Table 28 (continued)

Year	Household demand			Indirect demand	Total demand
	At home	Home away	Total		
2020	1409.6	660.1	2069.7	50.0	2119.7
2021	1453.2	680.5	2133.7	51.6	2185.3
2022	1497.2	701.1	2198.3	53.1	2251.4
2023	1541.5	721.8	2263.3	54.7	2318.0
2024	1585.9	742.7	2328.6	56.3	2384.9
2025	1630.6	763.6	2394.1	57.9	2452.0
2026	1675.3	784.5	2459.8	59.5	2519.2
2027	1720.0	805.4	2525.4	61.0	2586.5
2028	1764.7	826.4	2591.0	62.6	2653.7
2029	1809.3	847.2	2656.5	64.2	2720.7
2030	1853.7	868.0	2721.7	65.8	2787.5
2031	1897.9	888.7	2786.6	67.4	2854.0
2032	1941.8	909.3	2851.1	68.9	2920.0
2033	1985.4	929.7	2915.2	70.5	2985.6
2034	2028.7	950.0	2978.7	72.0	3050.7
2035	2071.6	970.1	3041.7	73.5	3115.2
2036	2115.0	990.4	3105.4	75.1	3180.4

Table 29 Year-wise demand for meat, fish, and eggs in Nepal: 2011–2035

Year	Household demand			Indirect demand	Total demand
	At home	Home away	Total		
Thousand tons					
2011 (base year)	266.4	236.2	502.6	37.0	539.6
2012	275.3	244.2	519.5	38.2	557.7
2013	286.0	253.6	539.6	39.7	579.2
2014	291.3	258.3	549.6	40.4	590.0
2015	294.1	260.8	554.8	40.8	595.6
2016	302.5	268.3	570.8	42.0	612.7
2017	311.2	276.0	587.1	43.2	630.3
2018	320.1	283.9	604.0	44.4	648.4
2019	329.3	292.0	621.3	45.7	666.9
2020	338.7	300.3	639.0	47.0	686.0
2021	348.1	308.7	656.8	48.3	705.1
2022	357.6	317.1	674.7	49.6	724.3
2023	367.1	325.6	692.7	50.9	743.7
2024	376.7	334.0	710.7	52.3	763.0
2025	386.2	342.5	728.7	53.6	782.3
2026	395.7	350.9	746.7	54.9	801.6
2027	405.2	359.3	764.5	56.2	820.8
2028	414.7	367.7	782.4	57.5	839.9

(continued)

Table 29 (continued)

Year	Household demand			Indirect demand	Total demand
	At home	Home away	Total		
2029	424.1	376.0	800.1	58.8	858.9
2030	433.4	384.3	817.7	60.1	877.8
2031	442.6	392.5	835.1	61.4	896.5
2032	451.8	400.6	852.4	62.7	915.1
2033	460.8	408.6	869.5	63.9	933.4
2034	469.8	416.6	886.3	65.2	951.5
2035	478.6	424.4	903.0	66.4	969.4
2036	487.5	432.3	919.8	67.6	987.4

Table 30 Demand for major cereals in Nepal: 2011–2035

Year	Fine rice	Coarse rice	Beaten rice	Rice	Maize	Wheat	Millets and others	Cereals
Thousand tons								
2011 (base year)	950.0	2684.6	156.6	3791.2	831.4	834.2	242.0	5698.8
2012	968.1	2735.8	159.6	3863.5	847.3	850.1	246.6	5807.5
2013	992.1	2803.6	163.5	3959.2	868.2	871.2	252.8	5951.3
2014	1007.2	2846.4	166.0	4019.6	881.5	884.5	256.6	6042.2
2015	1018.1	2877.2	167.8	4063.2	891.1	894.0	259.4	6107.7
2016	1038.3	2934.4	171.2	4143.8	908.7	911.8	264.5	6228.9
2017	1058.9	2992.4	174.5	4225.8	926.7	929.8	269.8	6352.2
2018	1079.7	3051.2	178.0	4308.9	944.9	948.1	275.1	6477.0
2019	1100.8	3110.8	181.4	4393.0	963.4	966.6	280.4	6603.5
2020	1122.1	3171.1	185.0	4478.2	982.1	985.4	285.9	6731.4
2021	1143.4	3231.2	188.5	4563.0	1000.7	1004.0	291.3	6859.0
2022	1164.5	3290.9	191.9	4647.4	1019.2	1022.6	296.7	6985.9
2023	1185.6	3350.4	195.4	4731.3	1037.6	1041.1	302.0	7112.0
2024	1206.3	3409.1	198.8	4814.3	1055.8	1059.3	307.3	7236.7
2025	1226.9	3467.2	202.2	4896.4	1073.8	1077.4	312.6	7360.1
2026	1247.2	3524.5	205.6	4977.2	1091.5	1095.2	317.7	7481.7
2027	1267.1	3580.9	208.9	5056.8	1109.0	1112.7	322.8	7601.3
2028	1286.8	3636.3	212.1	5135.2	1126.1	1129.9	327.8	7719.1
2029	1306.0	3690.8	215.3	5212.0	1143.0	1146.8	332.7	7834.6
2030	1324.9	3744.0	218.4	5287.3	1159.5	1163.4	337.5	7947.7
2031	1343.3	3796.1	221.4	5360.9	1175.6	1179.6	342.2	8058.3
2032	1361.3	3847.1	224.4	5432.7	1191.4	1195.4	346.8	8166.4
2033	1378.9	3896.7	227.3	5502.9	1206.8	1210.8	351.3	8271.8
2034	1396.0	3945.2	230.1	5571.3	1221.8	1225.9	355.7	8374.7
2035	1412.8	3992.5	232.9	5638.1	1236.4	1240.6	359.9	8475.0
2036	1429.3	4039.1	235.6	5704.0	1250.9	1255.1	364.1	8574.0
% share in total cereals	16.7	47.1	2.7	66.5	14.6	14.6	4.2	100

Table 31 Demand for major pulses in Nepal: 2011–2035

Year	Black gram	Lentil	Red gram	Horse gram	Beans	Other pulses	Total pulses
Thousand tons							
2011 (base year)	102.3	169.4	47.9	70.1	48.4	40.8	479.0
2012	105.7	174.9	49.4	72.3	50.0	42.2	494.4
2013	109.6	181.4	51.3	75.0	51.8	43.7	512.8
2014	111.6	184.7	52.2	76.4	52.8	44.5	522.1
2015	112.7	186.5	52.7	77.1	53.3	44.9	527.2
2016	115.8	191.6	54.2	79.3	54.7	46.2	541.8
2017	119.0	196.9	55.7	81.5	56.3	47.5	556.8
2018	122.3	202.4	57.2	83.7	57.8	48.8	572.2
2019	125.6	207.9	58.8	86.0	59.4	50.1	588.0
2020	129.1	213.7	60.4	88.4	61.0	51.5	604.1
2021	132.6	219.4	62.0	90.8	62.7	52.9	620.4
2022	136.0	225.2	63.7	93.2	64.3	54.3	636.7
2023	139.5	231.0	65.3	95.5	66.0	55.7	653.0
2024	143.0	236.7	66.9	97.9	67.6	57.1	669.3
2025	146.5	242.5	68.6	100.3	69.3	58.5	685.7
2026	150.0	248.3	70.2	102.7	70.9	59.8	701.9
2027	153.4	254.0	71.8	105.1	72.6	61.2	718.1
2028	156.9	259.7	73.4	107.4	74.2	62.6	734.2
2029	160.3	265.3	75.0	109.8	75.8	64.0	750.2
2030	163.7	270.9	76.6	112.1	77.4	65.3	766.0
2031	167.0	276.5	78.2	114.4	79.0	66.7	781.7
2032	170.4	282.0	79.7	116.6	80.6	68.0	797.2
2033	173.6	287.4	81.3	118.9	82.1	69.3	812.6
2034	176.9	292.7	82.8	121.1	83.6	70.6	827.7
2035	180.1	298.0	84.3	123.3	85.2	71.8	842.6
2036	183.3	303.3	85.8	125.5	86.7	73.1	857.6
% share in total pulses	21.4	35.4	10.0	14.6	10.1	8.5	100

of 2025, with a grain mix of 4.9 Mt, rice, 1 Mt each maize and wheat and 0.31 Mt of millets and other minor cereals. By the year 2035, cereals demand is projected to be 8.5 Mt, comprising 5.6 Mt of rice, 1.23 Mt of maize, 1.24 Mt of wheat and 0.36 Mt millets and others. Fine rice demand constitutes one-fourth of total rice demand in Nepal. The coarse rice demand is projected 3.5 Mt by the year 2025 and rise to about 4 Mt by the year 2035. The home away demand for cereals has been estimated at 0.89 Mt by the year 2035 which is about 10% of the total demand. The indirect demand for cereals is estimated to be 0.85 Mt in 2025 and increase to 0.98 Mt by 2035 constitutes about 11.6% of total demand.

Table 32 Demand for major vegetables in Nepal: 2011–2035

Year	Potato	Onion	Tomato	Cauliflower/ Cabbage	Green leafy	Others vegetables	Total vegetables
Thousand tons							
2011 (base year)	1020.1	271.7	228.6	247.1	438.3	48.7	2254.4
2012	1053.0	280.5	236.0	255.1	452.4	50.3	2327.3
2013	1092.1	290.9	244.8	264.5	469.2	52.1	2413.6
2014	1112.0	296.2	249.2	269.3	477.8	53.1	2457.6
2015	1122.8	299.0	251.6	271.9	482.4	53.6	2481.4
2016	1153.9	307.3	258.6	279.5	495.8	55.1	2550.1
2017	1185.8	315.8	265.8	287.2	509.5	56.6	2620.7
2018	1218.6	324.5	273.1	295.2	523.6	58.2	2693.1
2019	1252.2	333.5	280.6	303.3	538.0	59.8	2767.4
2020	1286.6	342.7	288.4	311.6	552.8	61.4	2843.5
2021	1321.2	351.9	296.1	320.0	567.7	63.1	2919.9
2022	1355.9	361.1	303.9	328.4	582.6	64.7	2996.7
2023	1390.7	370.4	311.7	336.9	597.5	66.4	3073.6
2024	1425.5	379.7	319.5	345.3	612.5	68.1	3150.5
2025	1460.3	388.9	327.3	353.7	627.4	69.7	3227.3
2026	1494.9	398.1	335.0	362.1	642.3	71.4	3303.8
2027	1529.4	407.3	342.8	370.4	657.1	73.0	3380.0
2028	1563.7	416.5	350.5	378.7	671.8	74.6	3455.8
2029	1597.7	425.5	358.1	387.0	686.5	76.3	3531.1
2030	1631.5	434.5	365.6	395.2	701.0	77.9	3605.7
2031	1664.9	443.4	373.1	403.3	715.3	79.5	3679.5
2032	1697.9	452.2	380.5	411.3	729.5	81.1	3752.5
2033	1730.6	460.9	387.9	419.2	743.5	82.6	3824.7
2034	1762.8	469.5	395.1	427.0	757.4	84.2	3895.9
2035	1794.6	478.0	402.2	434.7	771.1	85.7	3966.2
2036	1826.5	486.5	409.4	442.4	784.8	87.2	4036.8
% share in total vegetables	45.2	12.1	10.1	11.0	19.4	2.2	100

A deceleration in the growth rate of cereal demand has been observed from 1.88% during 2015–2025 to 1.42% during the period 2025–2035. Still, the demand growth is higher than the population growth, which resulted in an increase in per capita consumption of cereals in future as observed in NLS survey data for the years 2003–2011. Cereals will continue to be major staple food in Nepalese diet.

Table 33 Demand for major fruits in Nepal: 2011–2035

Year	Bananas	Citrus fruits	Mangoes	Apples	Papaya	Pineapple	Others	Total fruits
Thousand tons								
2011 (base year)	498.3	274.6	538.5	174.1	218.3	40.2	198.2	1942.3
2012	520.6	286.9	562.6	181.9	228.1	42.0	207.1	2029.3
2013	547.8	301.9	592.0	191.4	240.0	44.2	217.9	2135.2
2014	559.8	308.5	605.0	195.6	245.3	45.1	222.7	2182.0
2015	564.4	311.0	609.9	197.2	247.3	45.5	224.6	2200.0
2016	585.5	322.6	632.7	204.6	256.5	47.2	232.9	2282.1
2017	607.4	334.7	656.4	212.3	266.1	49.0	241.6	2367.5
2018	630.1	347.3	681.0	220.2	276.1	50.8	250.7	2456.2
2019	653.8	360.3	706.5	228.5	286.5	52.7	260.1	2548.3
2020	678.3	373.8	733.0	237.0	297.2	54.7	269.9	2643.8
2021	703.1	387.5	759.9	245.7	308.1	56.7	279.7	2740.8
2022	728.4	401.4	787.1	254.5	319.1	58.7	289.8	2839.0
2023	753.9	415.4	814.7	263.5	330.3	60.8	299.9	2938.5
2024	779.7	429.7	842.5	272.5	341.6	62.9	310.2	3039.0
2025	805.7	444.0	870.7	281.6	353.0	65.0	320.6	3140.5
2026	832.0	458.5	899.1	290.7	364.5	67.1	331.0	3242.9
2027	858.4	473.0	927.6	300.0	376.1	69.2	341.5	3345.9
2028	885.0	487.7	956.3	309.3	387.8	71.4	352.1	3449.5
2029	911.7	502.4	985.2	318.6	399.5	73.5	362.7	3553.5
2030	938.4	517.1	1014.1	327.9	411.2	75.7	373.3	3657.8
2031	965.2	531.9	1043.1	337.3	422.9	77.8	384.0	3762.2
2032	992.0	546.7	1072.0	346.7	434.7	80.0	394.7	3866.7
2033	1018.8	561.4	1101.0	356.0	446.4	82.2	405.3	3971.1
2034	1045.5	576.2	1129.8	365.4	458.1	84.3	416.0	4075.3
2035	1072.2	590.9	1158.7	374.7	469.8	86.5	426.6	4179.2
2036	1099.3	605.8	1188.0	384.2	481.7	88.7	437.4	4285.0
% share in total fruits	25.7	14.1	27.7	9.0	11.2	2.1	10.2069	100.00

14 Pulses

The demand for pulses in Nepal is projected by the year 2035 and given in Table 12 for selected years. The requirement of pulses at home in the base year (2011) has been estimated as 0.301 Mt. This requirement is projected to rise to 0.379 Mt by the year 2020 and further to 0.529 Mt by 2035. The home away consumption of

Table 34 Demand for major edible oils in Nepal: 2011–2035

Year	Ghee	Vegetable oils	Mustered oil	Other oils	Total edible oils
Thousand tons					
2011 (base year)	49.4	13.8	233.3	34.7	331.2
2012	51.0	14.3	240.9	35.9	342.1
2013	53.0	14.8	250.0	37.2	355.0
2014	53.9	15.1	254.6	37.9	361.5
2015	54.5	15.2	257.1	38.3	365.0
2016	56.0	15.6	264.3	39.3	375.3
2017	57.6	16.1	271.7	40.4	385.8
2018	59.2	16.5	279.3	41.6	396.6
2019	60.8	17.0	287.2	42.7	407.7
2020	62.5	17.5	295.2	43.9	419.1
2021	64.2	17.9	303.2	45.1	430.5
2022	65.9	18.4	311.3	46.3	442.0
2023	67.7	18.9	319.4	47.5	453.5
2024	69.4	19.4	327.5	48.8	465.1
2025	71.1	19.9	335.7	50.0	476.6
2026	72.8	20.3	343.7	51.2	488.1
2027	74.5	20.8	351.8	52.4	499.5
2028	76.2	21.3	359.8	53.6	510.9
2029	77.9	21.8	367.8	54.7	522.2
2030	79.6	22.2	375.7	55.9	533.4
2031	81.2	22.7	383.5	57.1	544.5
2032	82.9	23.1	391.2	58.2	555.5
2033	84.5	23.6	398.9	59.4	566.3
2034	86.1	24.0	406.4	60.5	577.1
2035	87.7	24.5	413.9	61.6	587.6
2036	89.3	24.9	421.4	62.7	598.3
% share in total edible oils	14.9	4.2	70.4	10.5	100.0

pulses has been estimated to be 0.107 Mt by the year 2020 and will rise to 0.150 Mt by 2035. The total household human demand for pulses at home and outside home worked out to be 0.486 Mt by the year 2020 and further rise to 0.679 Mt by the year 2035. Including indirect demand, the total domestic demand in the base year 2011 was estimated to be 0.479 Mt and rise to 0.527 Mt in 2015. Pulses demand will rise to 0.604 Mt by 2020 and 0.843 Mt by the year 2035 comprising 0.180 Mt for black gram, 0.298 for Lentil, 0.084 for red gram, 0.123 Mt horse grams, 0.085 Mt for beans and 0.072 other pulses. In the period 2015–2025, pulses demand will grow at the annual compound growth rate 2.66% during 2015–2025 and 2.08% in the period 2025–2035.

Table 35 Demand for major meat, fish and eggs in Nepal: 2011–2035

Year	Mutton	Buffalo meat	Chicken	Others meat	Total meat	Fish	Eggs	MFE
Thousand tons								
2011 (base year)	106.1	98.9	127.5	24.7	357.3	102.4	79.9	539.6
2012	109.7	102.3	131.8	25.6	369.3	105.8	82.6	557.7
2013	113.9	106.2	136.9	26.6	383.6	109.9	85.7	579.2
2014	116.0	108.2	139.5	27.0	390.7	112.0	87.3	590.0
2015	117.1	109.2	140.8	27.3	394.4	113.0	88.2	595.6
2016	120.5	112.4	144.8	28.1	405.7	116.3	90.7	612.7
2017	123.9	115.6	149.0	28.9	417.4	119.6	93.3	630.3
2018	127.5	118.9	153.2	29.7	429.4	123.1	96.0	648.4
2019	131.1	122.3	157.6	30.6	441.6	126.6	98.7	666.9
2020	134.9	125.8	162.1	31.4	454.2	130.2	101.5	686.0
2021	138.6	129.3	166.7	32.3	466.9	133.8	104.4	705.1
2022	142.4	132.8	171.2	33.2	479.7	137.5	107.2	724.3
2023	146.2	136.4	175.8	34.1	492.4	141.1	110.1	743.7
2024	150.0	139.9	180.3	35.0	505.2	144.8	112.9	763.0
2025	153.8	143.5	184.9	35.9	518.0	148.5	115.8	782.3
2026	157.6	147.0	189.4	36.7	530.8	152.1	118.7	801.6
2027	161.4	150.5	194.0	37.6	543.5	155.8	121.5	820.8
2028	165.1	154.0	198.5	38.5	556.2	159.4	124.3	839.9
2029	168.9	157.5	203.0	39.4	568.8	163.0	127.1	858.9
2030	172.6	161.0	207.5	40.2	581.3	166.6	129.9	877.8
2031	176.3	164.4	211.9	41.1	593.7	170.1	132.7	896.5
2032	179.9	167.8	216.3	41.9	605.9	173.7	135.5	915.1
2033	183.5	171.2	220.6	42.8	618.1	177.1	138.2	933.4
2034	187.1	174.5	224.9	43.6	630.1	180.6	140.9	951.5
2035	190.6	177.8	229.1	44.4	641.9	184.0	143.5	969.4
2036	194.1	181.1	233.4	45.3	653.9	187.4	146.2	987.4
% share in total MFE	19.7	18.3	23.6	4.6	66.2	19.0	**14.80**	100.0

15 Vegetables

The total demand for vegetables in Nepal is projected year-wise from 2011 (base year) to 2035. The household demand and total demand for vegetable group and selected major vegetables are given in Table 13 for selected years 2015, 2020, 2025, 2030, and 2035. Total domestic demand for vegetables is projected to be 2.84 Mt by the year 2020 and rise to 3.23 Mt in the year 2025 and further rise to 3.97 Mt by the year 2035 with the annual growth rate of 2.37%. Total domestic demand for major vegetables is assessed to be about 1.46 Mt for potato, 0.389 Mt for onion, 0.327 Mt for tomato, 0.354 Mt for cauliflower/cabbage, 0.697 Mt for green leafy and other miscellaneous vegetables by the year 2025. It will rise by the year 2035 at the level of 1.79 Mt for potato, 0.478 Mt for onion, 0.402 Mt for tomato, 0.435 Mt for cauliflower/cabbage, 0.857 Mt for green leafy and other vegetables. The domestic requirement of vegetables is derived by 66% at home, 23% at outside home and 11% in the form of industrial use and wastages and spired (Table 13).

16 Fruits

The demand for fruits in Nepal is projected during the period 2011–2035 and presented in Table 14. The direct household demand for fruits has been projected to be 0.536 Mt by 2020 and 0.848 Mt by 2035. The major share of fruits demand coming from outside home constituted about 59% of the total requirement. Due to substantial home away consumption of fruits by the household and post-harvest losses and their industrial use for processed products, the total domestic demand for fruits is projected to be 2.20 Mt in the year 2015, rise to 2.64 Mt by 2020, 3.14 Mt by 2025, 3.66 Mt by 2030 and 4.18 Mt by 2035 with an annual growth rate of 3.3% during 2015–2035. Looking at the status of individual fruits; bananas demand was 0.498 Mt in the base year 2011 and it is estimated to be 0.806 Mt by 2025 and 1.07 Mt by the year 2035. Citrus fruits demand is assessed to be 0.373 Mt by 2020 and 0.591 Mt by 2035. Mangoes demand will rise from 0.538 Mt in 2011 to 0.871 Mt by 2025 and 1.16 Mt by 2035. By the year 2025, the demand is assessed about 0.281 Mt for apples, 0.353 Mt for papaya, 0.385 for pineapple and other fruits. By the year 2035, these fruits requirement is assessed to be about 0.375 Mt for apples, 0.470 Mt for papaya, 0.513 Mt for pineapple and other fruits.

17 Cooking Edible Oils

As seen in Table 15, total domestic demand for cooking edible oils in Nepal is projected to grow annually by 2.70% during 2015–2025 and 2.12% in the period 2025–2035 and increase from 0.331 Mt in 2011 to 0.444 Mt by 2025 and 0.578 Mt by the year 2035 with a break-up of about 0.071 Mt for ghee, 0.020 Mt for vegetable oils, 0.336 for mustard oils and 0.050 for other oils. By the year 2035, the demand for important source of cooking oils would rise to 0.088 Mt for ghee, 0.025 Mt for vegetable oils, 0.414 for mustard oils and 0.061 for others. Out of these demand, 61% demand is generated at household level, 22% outside home and 17% indirect demand.

18 Sugar and Gur (Unrefined Sugar)

The sugar comprises sugar and Gur. The demand of sugar at the household and national level has been projected for the years 2011–2035 and presented in Table 16. The demand for sugar at the household level, away from home and national levels is estimated to be 0.158 Mt, 0.161 Mt, and 0.366 Mt, respectively, by the year 2020. The sugar demand at the national level is projected to be 0.416 Mt in year 2025, 0.466 Mt in year 2030 and 0.513 Mt by 2035 with annual growth rate of 2.41% during 2015–2035. The substantial share of domestic demand for sugar is home away and processing industrial use (about 60%).

19 Milk

As seen in Table 17, the milk demand at household level has been 1.59 Mt in the base year (2011) and rise to 2.07 Mt by 2020, 2.39 Mt by 2025, 2.72 Mt by 2030, and 3.04 Mt by the year 2035. The total milk demand at national level is projected to be 2.1 Mt by 2020, 2.45 Mt by 2025, and 2.79 Mt by 2030 and 3.11 Mt by the year 3035. The milk demand will rise with an annual growth rate of 2.74% in Nepal. The two-third domestic requirement of milk is coming at the household level from home and one-third from the outside home as the indirect demand.

20 Meat, Fish, and Eggs

The meat includes the mutton, buffalo meat, chicken and other minor meat. The demand for meat, fish, and eggs are likely to increase at an annual growth rate of 2.76% during 2015–2025, 2.17% during 2025–2035 and 2.47% during 2015–2035. The demand for meat is assessed to be 0.357 Mt in the base year 2011 and is projected to be 0.518 Mt by 2025, and rise to 0.642 Mt by the year 2035 (Table 18). The domestic demand for fish at the national level is projected to be 0.148 Mt by the year 2025 and 0.184 by 2035. The egg demand is assessed to be 0.116 Mt by 2025 and 0.144 Mt by 2035. Thus, the total demand for meat, fish and egg are projected to be about 0.782 Mt in the year 2025 and rise to 0.969 Mt by 2035. The household demand at home comprises 49% of total demand. A substantial demand for meat, fish, and eggs is generated by the households at outside home. It contributes nearly 44% of total domestic demand.

21 Summary and Conclusions

Achieving food self-sufficiency has always been the primary objective of agricultural policy in Nepal. The empirical estimate of food demand is essential to facilitate efficient functioning of food production and management for achieving food security and often provide deep insights to policy planners. Thus, there is a need to pay greater attention in maintaining its self-reliance in food production by producing the additional food by increasing the public investment in irrigation, rural infrastructural and rapid spread of modern technology with improved food production practices.

The price and income elasticities of food groups at national-level based on QUAIDS model have been computed. The income elasticities have declined over time with rise in income. The income elasticities for cereals (0.40) have been highly inelastic being a staple food. The income elasticity was much higher for fruits (1.27) followed by milk (0.99), MFE (0.84), edible oils (0.81), sugar (0.81), pulses (0.79) and vegetables (0.79), respectively. Own-price elasticities for all the food groups are negative and vary widely across commodities (−038 for edible oils to −1.29 for sugar).

The demand for fruits has grown with an annual growth rate of 3.62%, followed by milk (3.06), meat, fish and eggs (2.76%), edible oils, sugar, pulses and vegetables (2.7%), and cereals (1.88%). The food demand growth is higher than the population growth. The food consumption will rise and undernourished and malnourished population will decline in Nepal, if supply matches with demand either through domestic production or import.

The cereals demand is projected to be 7.4 Mt in 2025 with a grain mix of 4.9 Mt of rice, 1 Mt each of maize and wheat and 0.31 Mt of millets and other minor cereals. By the year 2035, cereals demand is projected to be 8.5 Mt, comprising 5.6 Mt of rice, 1.23 Mt of maize, 1.24 Mt of wheat and 0.36 Mt of millets and others. Fine rice demand constitutes one-fourth of total rice demand in Nepal. The coarse rice demand is projected to be 3.5 Mt by the year 2025 and rise to about 4 Mt by the year 2035.

Pulses demand will rise to 0.604 Mt by 2020 and 0.843 Mt by the year 2035 comprising 0.180 Mt for black gram, 0.298 for Lentil, 0.084 for red gram, 0.123 Mt horse grams, 0.085 Mt for beans and 0.072 other pulses. In the period 2015–2025, pulses demand will grow at the annual compound growth rate of 2.66% during 2015–2025 and 2.08% in the period 2025–2035.

Total domestic demand for major vegetables is assessed to be about 1.46 Mt for potato, 0.389 Mt for onion, 0.327 Mt for tomato, 0.354 Mt for cauliflower/cabbage, 0.697 Mt for green leafy and other miscellaneous vegetables by the year 2025. It will rise by the year 2035 to the level of 1.79 Mt for potato, 0.478 Mt for onion, 0.402 Mt for tomato, 0.435 Mt for cauliflower/cabbage, 0.857 Mt for green leafy and other vegetables.

Total domestic demand for fruits is projected to be 2.20 Mt in the year 2015, which will rise to 2.64 Mt by 2020, 3.14 Mt by 2025, 3.66 Mt by 2030, and 4.18 Mt by 2035 with an annual growth rate of 3.3% during 2015–2035.

Total domestic demand for cooking edible oils is projected to grow annually by 2.70% during 2015–2025 and 2.12% in the period 2025–2035 and increase from 0.331 Mt in 2011 to 0.444 Mt by 2025 and 0.578 Mt by the year 2035.

The sugar demand at the national level is projected to be 0.416 Mt in year 2025, 0.466 Mt in year 2030 and 0.513 Mt by 2035 with annual growth rate of 2.41% during 2015–2035.

The total milk demand at national level is projected to be 2.1 Mt by 2020, 2.45 Mt by 2025, and 2.79 Mt by 2030 and 3.11 Mt by the year 3035. The milk demand will rise with an annual growth rate of 2.74% in Nepal. Two-thirds of domestic requirement of milk is coming at the household level from home and one-third from the outside home as the indirect demand.

The meat includes the mutton, buffalo meat, chicken and other minor meat. The demand for meat, fish, and eggs is likely to increase at an annual growth rate of 2.76% during 2015–2025, 2.17% during 2025–2035 and 2.47% during 2015–2035. The demand for meat is assessed to be 0.357 Mt in the base year 2011 and is projected to be 0.518 Mt by 2025 and rise to 0.642 Mt by the year 2035 (Table 18). The domestic demand for fish at the national level is projected to be 0.148 Mt by the year 2025 and 0.184 Mt by 2035. The egg demand is assessed to be 0.116 Mt by 2025 and 0.144 Mt by 2035. Thus, the total demand for meat, fish, and egg is projected to be about 0.782 Mt in the year 2025 and rise to 0.969 Mt by 2035. The household demand at home comprises 49% of total demand. A substantial demand for meat, fish, and eggs is generated by the households outside home. It contributes nearly 44% of total domestic demand.

Appendix

(See Tables 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34 and 35).

References

Blundell, R., Potshards, P., & Weber, G. (1993). What do we learn about consumer demand patterns from micro data? *American Economic Review, 83,* 570–597.

CBS. (1995). Nepal Living Standards Survey-I 1995/96. Household Questionnaire, Central Bureau, Kathmandu.

CBS. (2003). Nepal Living Standards Survey-II 2003/03. Household Questionnaire, Central Bureau, Kathmandu.

CBS. (2011). Nepal Living Standards Survey-III 2011/11. Household Questionnaire, Central Bureau, Kathmandu.

Deaton, A., & Muellbauer, J. (1980). An almost ideal demand system. *The American Economic Review, 70,* 312–326.

Dey, M. M. (2000). Analysis of demand for fish in Bangladesh. *Aquaculture Economics & Management, 4,* 63–79.

Dey, M. M., Garcia, Y. T., Praduman, K., Piumsombun, S., Haque, M. S., Li, L., et al. (2008). Demand for fish in Asia: A cross-country analysis. *The Australian Journal and Resource Economics, 52,* 321–338.

Kumar, P., & Joshi P. K. (2016). Food demand and supply projections to 2030: India. In F. Brouwer & P. K. Joshi (Eds.), *International trade and food security: Future of Indian Agriculture* (pp 29–63). CABI International 2016.

Kumar, P., & Dey, M. M. (2004). A study on modelling of household demand for fish in India. *Indian Journal of Agricultural Economics, 59*(3), 465–475.

Kumar, P., Anjani, K. P., Shinoj, P., & Raju, S. S. (2011). Estimation of demand elasticity for food commodities in India. *Agricultural Economics Research Review, 24*(1), 1–14.

Meenakshi, J. V., & Ranjan, R. (1999). Regional differences in India's food expenditure pattern: A complete demand systems approach. *Journal of International Development, 11*(1), 47–74.

Stone, R. (1954). Linear expenditure system and demand analysis: An application to the pattern of British demand. *Economic Journal, 64,* 511–527.

Swamy, G., & Binswanger, H. P. (1983). Flexible consumer demand systems and linear estimation: Food in India. *American Journal of Agricultural Economics, 63*(2), 237–246.

Chapter 8
Seed Sector Development in Nepal: Opportunities and Options for Improvement

Devendra Gauchan

Abstract The chapter analyzes the key issues and constraints in the seed sector in Nepal, which represents one of the most important inputs for agricultural productivity growth. It analyzes the options and opportunities for improvement in the seed sector and identifies policy recommendations for this sector's development. The chapter suggests that a clearly designed seed policy should be developed to create enabling environments for public–private partnership and provide coherence for a level playing field for the development of a dynamic, pluralistic and sustainable seed system in Nepal.

1 Introduction

Agricultural development is dependent on farmers' access to inputs, among which timely availability of quality seed is extremely important. Ensuring farmers' access to quality seed can only be achieved through a viable, dynamic and holistic seed system that can source new diversity, multiply, market and promote use of quality seeds to small farmers timely and efficiently in affordable price. Seed represents one of the most important inputs for agricultural productivity growth, income generation and a source of germplasm for crop improvement. The use of quality seeds of well-adapted and better-performing varieties also enhances efficiency and productivity of other important inputs such as fertilizers, irrigation, farm machinery and human labor. Evidence shows that about 50% of the global increase in crop yields over the past 50 years has been derived from genetic progress in plant breeding and better seed quality, in combination with agronomic improvement and phytosanitary product uses (FAO 2011). Fresh use of quality seed of better-performing varieties not only increases yields but also reduces cost of production since seed rate requirement for good-quality seed will be less due to its high seed vigor, genetic purity and disease-free status. Replacement of old low-yielding varieties and

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G. Thapa et al. (eds.), *Agricultural Transformation in Nepal*,
https://doi.org/10.1007/978-981-32-9648-0_8

poor-quality seeds with improved variety and better quality thus provides a more meaningful measure of the performance of a seed industry in terms of supplying better-quality seed to farmers (Spielman and Kennedy 2016). However, current seed system in Nepal is inefficient to ensure farmers' access to quality seeds of wide range of choice varieties and promoting diversity and seed innovation in seed value chains linking both formal and informal channels. Therefore, a well-functioning holistic and pluralistic seed system is essential that plays dynamic roles in sourcing and deploying new diversity, facilitating timely access to seeds to smallholder farmers at affordable price and promoting seed production, marketing, use and seed-based innovation.

Presently, low productivity in agriculture is one of the major problems that Nepal needs to address to ensure food security and income increase of two-thirds of the agriculture-dependent population (MoAD 2015). Low productivity in agriculture is the result of low use of better-performing varieties, poor-quality seeds and other inputs (e.g., fertilizer, irrigation, farm machinery) and production technologies. Crop yields in Nepal are among the lowest in the region with average cereals yield of lower than 4 mt/ha (FAOSTAT 2014). Considering the importance of quality seeds and better-performing varieties for increased crop productivity and ensuring local and national food security, the Government of Nepal in 2013 formulated National Seed Vision (2013–2025). The Vision is a national seed sector strategy that aims to increase productivity and income of farmers through seed self-sufficiency, import substitution and export promotion (MoAD 2013). It has an ambitious plan of doubling seed replacement rate (SRR) from baseline level of 10% in 2010 to 25% for self-pollinated crops (e.g., rice and wheat) and 33% level for cross-pollinated crops (e.g., maize) in 2025 through increased production and supply of improved quality seeds and development and dissemination of high-yielding varieties. The Vision has strong emphasis on strengthening seed sector development through improving availability and use of quality seeds and better-performing varieties to farmers, seed producers and entrepreneurs. Implementation of this Vision with an effective, holistic and sustainable seed system development in Nepal therefore can help improve the food security and livelihoods of small farmers and benefit other seed actors and consumers as well, serving as an important element in strategies for agricultural development and poverty reduction. This paper aims to document current issues, gaps and status of seed sector development and outlines potential options and opportunities for improvement in Nepal.

The paper is organized in five sections as follows. Following the introduction in Sect. 1, the paper in Sect. 2 provides current status of seed sector growth specifically focusing on seed system development, value chains, seed production, supply and gaps. It explores key issues and constraints in seed system development in Sect. 3, and it then briefly describes options and opportunity for improvement of seed sector in Sect. 4. Finally, Sect. 5 provides summary, conclusions and way forward.

2 Status of Seed System Development

2.1 Evolution of Seed Policy and Legislation

Nepal's history of seed sector development starts with the development of Seed Act in 1988. Following this, seed policy, legislation, guidelines and national seed vision are formulated and revised to promote seed sector growth (Table 1). The major shift in seed policy development started with formulation of the Ninth Development Plan (1997/1998 to 2001/2002) after the advent of liberal economic policy in 1990s. During this plan period, Seed Policy (1999), Seed Regulation (1997), Community-Based Seed Production Guideline (1998) and guidelines for launching District-level Seed Self-Sufficiency Programme (DISSPRO) in 1998 were formulated and National Seed Company (NSC) Ltd. (2002) was established. Agriculture Perspective Plan (1995–2015) and subsequently formulation of National Agriculture Policy (2004) also played a critical role in the evolution of seed system structure including participation of different actors and sectors in seed production, supply and development of agriculture. Seed Act (1988) was the first seed-related policy formulated in 1988, which was later amended in 2008 to facilitate participation of private sectors in seed business and improve quality assurance system. Seed regulation of 1997 version was also revised and reformulated in 2013 to harmonize with amended Seed Act (2008), Seed Policy (1999) and National Seed Vision (2013–2025). The new Seed Regulation (2013) defines the rules for production and marketing of quality seeds as well as process for seed registration and release with relaxed provisions for registration of farmers' varieties. National Seed

Table 1 Seed policies, legislation, regulation and guidelines addressing seed sector growth

Policy	Date	Objectives and focus area
Seed Act, First Amendment	1988 (2008)	Provide legal framework for quality seed production, supply and quality assurance to increase crop productivity and income of farmers
Seed Production Guidelines	1998	Provide guidelines and technical support in seed production, processing, storage and distribution including subsidies for seed
National Seed Policy	1999	Policy framework for production and supply of high-quality seeds with increased support for participation of farmers and other private sectors
Community Seed Bank Guidelines	2009	Provide support and guidance for the establishment and management of seed banks at the community levels
Seed Regulation	2013	Provides rules for release and registration of crop varieties and production and marketing of seeds with defined quality assurance services
National Seed Vision	2013–2025	A long-term seed sector strategy with provision of improving availability and quality of seed through increased production and supply as well as conservation of indigenous genetic resources

Vision 2025—a national seed sector development strategy was approved in 2013 that has emphasized seed sector development for increased crop productivity, household food security and improved livelihood of smallholder farmers.

The recent formulation and implementation of Agricultural Development Strategy (ADS) has adopted the strategic approach of National Seed Vision with strong emphasis given on private-led seed sector growth (MoAD 2015). The Agrobiodiversity Policy (2007) revised in 2014 also supports seed sector development through strong focus on conservation and use of indigenous genetic resources and strengthening community seed banks for local seed security.

2.2 Seed System Development

Development of seed system is crucial in timely provision of adapted seed of diverse crops and varieties to farmers and the flexibility of obtaining seed at required time during cropping seasons (Kansiime and Mastenbroek 2016). A well-developed seed system constitutes various actors, institutions and organizations in the seed value chain that are involved in different components and activities ranging from variety development, source seed production, multiplication, processing, procuring, storage, distribution, marketing and seed use. It also includes the upstream parallel and downstream activities of research and development, certification and extension as well as seed industry itself (Pray and Ramaswami 1991). The cross-cutting issues in each of the component of the seed system such as quality assurance services, institutional framework and enabling policy environment are also part of the system. A sustainable and pluralistic seed system uses the appropriate combinations of formal and informal system covering both market and non-market channels to efficiently fulfill farmers' evolving demand for seed quality, diversity and reliability (Fig. 1). In the conventional literature, the seed system is composed of mainly two types: formal and informal systems[1] (Alminkenders and De Boef 2000), but most recent literature also includes a third type of the seed system which is referred as "integrated seed system." Recently, integrated seed system is increasingly being focused in the literature due to its holistic and pluralistic nature. This integrated seed system recognizes the co-existence, evolution and importance of the formal and informal systems and looks for opportunities and options to improve them both by recognizing and supporting integrations (Louwaars and DeBoef 2012).

Informal or farmers' seed system is a dominant form globally particularly in developing countries, where 60–90% of the seeds on which smallholder farmers depends upon are derived from informal system that are saved and exchanged

[1]The formal seed system is characterized by an institutionally organized production and distribution of improved varieties using officially defined quality assurance mechanism. The informal seed system (often referred to as farmers' seed system) is characterized by traditional system of saving, production, exchange and management of seeds by farmers and communities to meet their seed requirements for subsequent planting.

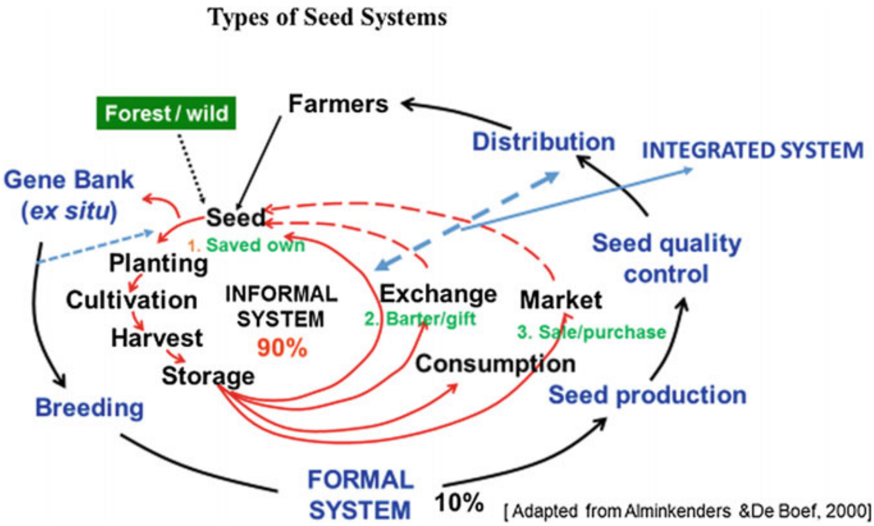

Fig. 1 Types of seed systems, formal, informal and integrated seed system

on-farm or obtained through community sharing systems or local markets (Vernooy et al. 2016). However, the importance of the informal systems is currently ignored or undermined by the prevailing structure of the formal seed system and its organization through existing policy and regulatory frameworks (Louwaars and De Boef 2012). In Nepal, informal seed system accounts for nearly 90% of the total seed requirements of farmers (MoAD 2013; SQCC 2017).

2.3 *Effective Functioning of Seed System*

An effective and well-functioning seed system meets the seed needs of farmers and other actors in desired time for the quality, quantity, diversity and affordability of various crops and varieties in diverse agroecologies and farming systems. It plays an important role in meeting users' seed demand and facilitating the development of vibrant, pluralistic and sustainable seed system by engaging a wide range of actors from public and private sectors. Presently, the seed system in Nepal is in its infancy and evolving stage with increasing role of private sector in seed business. The role of public sector is dominant in varietal development, release and maintenance, while the role of private sector is increasing in seed multiplication and marketing of seed. Although the role of the private sector is dominant in commercial and favorable production systems, it has not yet transformed it into the full-fledged actor driving holistic seed value chain. Moreover, the presence of private sector is limited in remote areas and for minor food crops due to small size of market and low return from seed business. The relative importance and role of private and public sectors in the seed value chain depends upon the stage of agricultural development and policy environment available for the development of dynamic and pluralistic seed sector in the country.

2.4 Seed Value Chain Components

The seed system constitutes complex value chain of diverse seed actors, sectors and technical orientation and functions. It is more diverse and longer than other commodity value chains and composed of several components and actors. It starts from seed and ends in seed and starts from the very initial point of management of parent genetic resources, from which the new seeds are developed, and ends in the use of seeds for production of the associated commodities by the farmers (MoAD 2013; SQCC 2017). The formal sector seed value chains mainly include (a) genetic resource management, variety development and maintenance, (b) seed multiplication and supply, (c) post-harvest handling, processing and storage, (d) seed quality assurance services, (e) seed marketing and (f) final seed use. The seed value chain is currently maintained by combination of public-community–private actors, each with their unique role in seed business and seed system development. Currently, seed value chain in Nepal is not effective and well-functioning to meet the seed needs of diverse actors for various crops in diverse agroecologies and production systems. The linkages, networking and collaboration among actors are weak resulting in inefficient farm-level supply and slow deployment of quality seeds of new and better-performing varieties. Furthermore, small farmers involved in seed production, supply and use are mainly seen as passive actors and users, not as an active partner in the seed value chain. The key components and features of seed value chain presently operating in Nepal are presented below.

2.4.1 Genetic Resource Management, Variety Development and Maintenance

The easy availability and use of diverse original, parent sources of new varieties (traditional landraces, farmers varieties) and other genetic resources (improved, prebreeding materials) are critical for development and for making availability of high-yielding farmer-preferred varieties for specific domains and socioeconomic categories of farmers. Public-sector research agency such as Nepal Agricultural Research Council (NARC) through its various research centers, national commodity programs and National Gene Bank are important players in genetic resource management, variety development and maintenance. However, presently availability and use of diverse genetic resources for variety development and release is limited in the country. Trained human resources (seed scientists, crop breeders, geneticists, biotechnologists) and infrastructure facilities are critical constraints in the management, supply and making use of diverse germplasm for variety development and seed innovation in agriculture. Specifically, collection, conservation and use of traditional underutilized crops for developing improved varieties that are climate-resilient and nutrient-dense are limited. Similarly, research investment in modern plant breeding and participatory client-oriented and evolutionary breeding including collaboration and linkage with international and national research organizations, universities and private companies are weak. Furthermore, released and registered varieties are not produced and maintained well in their ecological domains to retain their original genetic vigor, unique characteristics and to produce and supply good-quality source seeds. The pace of development of new crop varieties is slow and their dissemination is poor, resulting in low uptake or adoption of many of the existing varieties by farmers. The private sector is small, weak and constrained by lack of adequate incentives, qualified scientific manpower and infrastructure facilities to invest in variety development and maintenance. Breeders, researchers and farmers also lack clear incentives to collaborate in the development, maintenance and promotion of better-performing nutrient-dense and climate-resilient varieties adapted to diverse ecologies and farming systems.

2.4.2 Crop Varieties Released and Registered

The status of varietal options available for seed producers, suppliers and farmers in the country is the proxy indicator for the varietal development, release and registration system in the country. Improved varieties are released rapidly by national research system as a measure of their success of the program (Evenson and Gollin 2003). The Government of Nepal formally started research on development, release and promotion of crop varieties from late 1950s. The national cultivar list was initiated by releasing first time CH-45 variety of rice in 1959 (Mallick 1981). Until 2015, the national agriculture research and extension system (NARES) in Nepal has developed, tested and officially released and registered a total of 605 crop varieties of 65 crops from start of research in 1950s (SQCC 2015). Table 2 presents release and registration of major crop varieties and annual rate of variety notification (release and registration) for the last 60 years (1955–2015).

The estimation of the annual rate of variety released/registered in the last 60 years is about 1 for rice and maize, less than half (0.4 per annum) for wheat and about 6 for vegetables. The pace of notification (release and registration) of crop

Table 2 Release and registration of key crop varieties in the last 60 years (1955–2015)

Crops	Total varieties	Released	Registered	Average rate of release/registration (1955–2015)/annum
Rice	95	61	34	1.58
Wheat	24	24	0	0.40
Maize	57	21	36	1.08
Vegetables	340	48	292	5.66

Source Compiled and estimated from SQCC (2015) varieties has been fairly high in vegetables (6 varieties/annum) and surged in the recent decade (2005–2015) after 2005 with the favorable seed policy development for the introduction and registration of exotic hybrids by the private sectors. Presently, private sector contributes making availability of about 90% of notified varieties of vegetables and 60% of the maize that mainly constitute hybrids registered in the country. However, the contribution and share of private sector in making availability of improved and locally adapted wheat varieties is very much limited.

2.4.3 Source Seed Multiplication and Maintenance

Multiplication and maintenance of quality source seeds play important role in effective functioning of seed system. Seed multiplication cycle in Nepal covers four distinct phases starting from breeder seed, foundation seed, certified and improved seed. Breeder and foundation seeds are often referred as source seeds for subsequent multiplication of later generation cycle of seeds (certified and improved seed). This phase-wise multiplication of seeds and the involvement of different actors, sectors and institutions in each of the phase make seed multiplication cycle slow and complicated. The demand and supply of source seeds is generally estimated and maintained in national Seed Balance Sheet by SQCC. The public-sector research and development agencies such as NARC and Department of Agriculture (DoA) maintain and supply source seeds (breeder and foundation) in food crops and vegetables. Some national NGOs also contribute some roles in the maintenance, production and supply of source seeds. These include Local Initiatives for Biodiversity Research and Development (LI-BIRD) and Forum for Rural Welfare and Agricultural Reform for Development (FORWARD) for food crops and Center for Environmental and Agricultural Policy Research, Extension and Development (CEAPRED) in vegetables. However, the certified and truthfully labeled seeds are mainly multiplied by private seed companies and some community sectors representing community-based seed producer (CBSP) groups, cooperatives and community seed banks (CSBs).

Source seed production which is a prime source and foremost component of seed value chain for sustaining seed flow of subsequent cycle of certified and improved seeds is often constrained by inadequate coordination, planning and poor technical support from public-sector organizations. Private sector is also not putting adequate efforts to produce and maintain source seeds of major cereals due to their relatively low value, high volume, low profit margin and competition from public-sector agencies. Foundation seed is the critical constraints for farmers' groups and cooperatives to enhancing crop productivity in many locations including the project districts of Improved Seeds for Farmers' Programme (*Kisankalagi Unnat Biubijan Karyakaram: KUBK*) in Nepal (IFAD 2015). Moreover, the demand for breeder and foundation seed has varied over the years with varying demand in specific regions and ecologies. This occurs due to variability in production of specific varieties as a result of drought, scarcity of fertilizer and farmers' own saving, exchange and replanting of saved seeds. Furthermore, source seed multiplication and maintenance are riskier for cross-pollinated crops (e.g., maize, carrot, mustard) and require longer period of production cycle particularly in longer duration seed crops.

2.4.4 Status of Seed Production and Supply

Formal sector production and supply of seeds officially initiated in early 1980s focusing on wheat by parastatal organization such as Agriculture Inputs Corporation (AIC). But it took momentum only lately after the operationalization of District-level Seed Self-Sufficiency Programme (DISSPRO) of the Department of Agriculture (DoA) in 1998, the creation of separate public-sector National Seed Company (NSC) in 2001 and the emergence of the Private Seed Companies particularly in the Terai in the beginning of 2000. The growth of seed production and supply is increasing rapidly in recent years in major cereals (rice, maize and wheat), lentils, vegetables and oil seeds (Table 3).

The production and supply of major cereal seeds in the last one and half decades increased by five times from 5584 mt in 2001 to 26,188 mt in 2014 (MoAD 2013; SQCC 2016). This growth is remarkable with the growth of private and community sectors recently, which contributed in increasing seed production, supply and import. The role of private sector (private seed entrepreneurs including community-based seed suppliers) in Nepal is increasing recently in seed production and supply. The current share of private sector in seed production actually ranges from 67% in wheat, 85% in maize and 87% in rice (Gauchan 2017).

Despite increasing rate of seed production in the major crops recently, there is still huge gap to meet the projected seed production by 2025 as envisaged by National Seed Vision (MoAD 2013). As a result, there is a severe constraint of availability of improved seeds to farmers for increased food production. This necessitates the rapid increase of seed production in the coming years through engagement of private and community sectors. However, producers and seed actors (seed cooperatives and seed companies) are often constrained by timely and reliable

Table 3 Status of seed production and supply of important crops in Nepal (mt)

S. No.	Crop	2001	2005	2010	2014	Projected in 2025
1	Rice	542	4142	8470	9621	19,450
2	Maize	163	565	1592	2294	6132
3	Wheat	2878	5796	9680	12,259	16,325
	Total major cereals	5584	12,508	21,752	26,188	41,907
4	Lentil	27	22	246	352	1862
5	Oilseeds (Tori)	–	–	57	166	298
6	Vegetables	629	764	1100	1200	2407

Source MoAD (2013) and SQCC (2016)

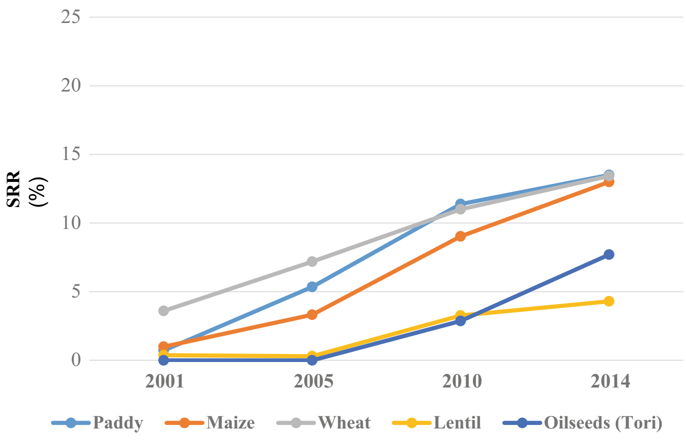

Fig. 2 Trend in seed replacement rate (SRR) in major food crops in Nepal

access of quality source seeds of choice crops and varieties to multiply and maintain quality seed production for improved productivity and profitability. Mechanisms and practices for maintaining a regularly updated national/regional/district seed balance sheet also do not exist resulting in lack of timely estimation of seed demand and supply. Furthermore, demand of seed crops and varieties often fluctuate and market price for quality seed produced by farmers often decline as a result of ad-hoc supply and competition from external suppliers.

2.4.5 Seed Replacement Rate (SRR)

The status of formal sector seed production and supply is estimated by the seed replacement rate (SRR). This is a good measure and an indicator of the use of quality seeds of the crops in the country in terms of quantity and tentative area coverage. The data shows that there is an increasing trend of seed replacement rate (SRR)[2] in major crops (rice, maize, wheat, lentil and oilseeds) in the last one and half decades in Nepal (Fig. 2). The rate of SRR increased from 1 to 3% in 2001 to 13% in 2014 (SQCC 2016). The growth of SRR increased rapidly from the beginning of 2001 for major cereals (rice, maize and wheat), while the increment started only after 2005 for oil seeds and lentils. Despite the rapid growth in recent years, the current level of SRR is very low for these food crops, which is less than half of the projected SRR of 25% in National Seed Vision (2013–2025). However, the SRR is higher in vegetables (about 75%) largely due to the use of hybrid seeds that are mainly imported from overseas. The current level of low seed replacement

[2]The seed replacement rate (SRR) however does not provide true picture of number of households using improved quality seeds and the age of the varieties used by the farmers.

rate in food crops is certainly a strong evidence of lack of limited production, supply, access and use of new, quality seeds to farmers.

2.4.6 Post-harvest Handling, Processing and Storage Facilities

Post-harvest handling, processing and storage facilities are important for maintaining quality seeds and ensuring timely availability during cropping seasons, emergency periods and future needs. Nevertheless, presently post-harvest handling, processing, storage and testing facilities for seed quality are limited in most of the rural hills, mountains and interior part of the Terai. The available facilities are mainly located in major market centers and market accessible areas. Private sectors also have no adequate incentives for investments in such infrastructure facilities due to unavailability of soft loans and easy credit facilities. The facilities that exist in the public sector are old, inadequate and inefficient and those available are also underutilized. There is no clear provision or mechanism for private sector to access these facilities. A few seed cooperatives and community-based seed producer (CBSP) groups have developed some processing facilities with external support from donors, I/NGOs or government projects. But these are far too minimal to meet the entire processing needs to ensure optimum seed quality. There are no set standards developed yet for seed processing (e.g., cleaning, grading, storing, packaging, labeling, etc.) and emergency storage structure for seed relief and recovery. Furthermore, maintenance and management of seed buffer stocks for emergency needs and future use is not practiced despite National Seed Vision's recommendation for 10–20% of seed quantity to be stored as buffer stock by 2025 (MoAD 2013).

2.4.7 Quality Assurance Services

The quality of seed is maintained and monitored through the process of certification and other less stringent measures of quality control such as truthful labeling. In Nepal, both the system of certification and truthful labeling are adopted, where certification is optional, while truthful labeling is compulsory if certification is not done. Seed certification is done by authorized agency such as Seed Quality Control Centre (SQCC) and Regional Seed Testing Laboratories (RSTLs). But the truthful labeling is done by producers and suppliers themselves after fulfilling the quality requirements. Since certification is optional, there is an increasing trend of truthful labeling in the formal sector seed production and marketing. A recent study in rice revealed that about 70% of seeds produced and supplied in the market are truthfully labeled, while certification accounts for only one-third of marketed seeds (Gauchan et al. 2014, 2016a). The National Seed Board (NSB) has introduced an elaborate set of quality standards for various cycle of seeds (breeder, foundation, certified, improved) to be monitored and enforced by SQCC, RSTL and District Agricultural Development Offices (DADOs). However, presently, the capacity of current public-sector institutions to fully, effectively and efficiently monitor and enforce quality standards is seriously constrained by lack of qualified manpower, resources and physical facilities. As a result, quality assurance services are only available to a limited extent for major cereal crops in market accessible areas of Terai and hills. Furthermore, there are no regulatory provisions, programs and mechanisms to monitor and ensure the quality of farmer-saved and locally exchanged seeds, which dominate nearly 90% of the seed use in Nepal. In addition, the seeds supplied in the market from domestic and exotic sources are also not quality assured due to poor market monitoring and quality enforcement mechanisms. Inadequate awareness of quality seeds, weak field monitoring programs and the long open and porous border with India make the task of monitoring and quality assurance even more difficult.

2.4.8 Seed Marketing

The role of marketing is to effectively deliver and deploy required amount of good-quality seeds of desired varieties in timely manner at affordable price to farmers and other seed actors. Seeds are marketed and supplied through different channels involving seed companies, dealers, retailers, individual trader, cooperatives, CBSP groups and local farmers. Domestic production and sales start from the seed multiplication phase and continue till the seeds reach end users (farmers) via conditioning, storing, packaging, labeling, wholesaling and retailing. A wide range of activities are performed at all these stages to maintain or to increase the quality of seeds so that the end users get maximum possible value from their use. Recently, dealers-cum-retailers (agrovets) are increasingly involved in marketing of seeds, while bulk of the seeds are marketed directly through own stores of seed company, cooperatives, CBSP groups and direct sales by individual traders including distribution and sales through public research stations and farms (e.g., NARC and DoA). However, due to unregulated flow of exotic hybrids and spurious quality of seeds (some of them unregistered) in the market, sustainable marketing of seeds is threatened resulting in poor incentives for local seed entrepreneurs who sell domestic varieties. The trend of seed import is increasing in recently in rice, maize and vegetables (Table 4).

Table 4 Quantity of formally imported seeds in the past four years (tons)

S. No.	Crops	2010/11	2011/12	2012/13	2013/14	2014/15
1	Rice	–	555	953	977	1120
2	Maize	225	261	751	787	1519
3	Vegetables	30	59	66	54	103
4	Oilseeds					0.54
	Total	255	875	1770	1818	2742.54

Source SQCC (2016) and Khanal (2017)

Among imported seeds, hybrid seeds still dominate in volume (>90%) and value of seeds handled by seed traders. These seeds are imported mainly from Japan, India, Thailand, Korea and China. However, the extent of export of domestic seeds is very minimal due to lack of effective public and private sector focus on production and marketing of good-quality domestic seeds with attractive packaging, labeling and support for seed business. Moreover, demand of seed crops and varieties often fluctuate and market price for quality seed produced by farmers often decline as a result of ad- hoc supply and competition from external agencies and traders. Several factors such as lack of reliable assessment of effective demand and supply and poor coordination among seed producers, cooperatives, seed entrepreneurs and enablers of seed value chains (e.g., government, donors and development agencies) are responsible for this.

2.5 Extent of Farm Households Using Improved Seed

The extent of the use of high-yielding improved seeds is an indicator of use of quality improved seeds. According to a recent national agriculture sample survey of 2011/12 (Table 5), the proportions of households using high-yielding variety seeds (improved and hybrid seeds) is low in all crops with low in rice (32%), wheat (31%), potato (26%), sugarcane (34%), vegetables (25%) and maize (18%). Few proportion of households use hybrids in limited amount mainly in rice, maize and vegetables. Furthermore, households using improved seeds in other crops (minor cereals) such as millet, barley, buckwheat, grain legumes and oilseeds are very low (6%). This figure indicates that there is a limited access to and use of quality seeds of improved and better-performing varieties particularly that of minor underutilized crops, where farming system is largely a smallholder subsistence, low input and low productive such as remote hills and mountains. A recent study of underutilized mountain crops (barley, buckwheat, millets, beans) in the representative

Table 5 Percent households using type of seeds in agricultural production (2011/12)

Use of type of seeds	Rice	Maize	Wheat	Potato	Sugarcane	Vegetables	Other crops[a]
Use of local seed	68.16	81.93	68.77	71.76	66.28	75.43	93.60
Use of improved seed	26.43	12.89	31.23	25.97	33.72	19.89	5.95
Hybrids	5.41	5.19	0.0	2.27	0.00	4.68	0.46
Use of HYV seeds	31.84	18.08	31.23	28.24	33.72	24.57	6.41

Source CBS (2013)

[a]Other crops include minor crops like millet, barley, buckwheat, grain legumes

high-altitude mountain regions of Nepal indicated the dominance of informal system, where over 95% of the households meet their seed requirement from informal sources (Gurung et al. 2016) indicating with less than 5% of SRR.

2.6 Varietal Age, Adoption Lags and On-Farm Diversity

Varietal age and diversity of varieties available, used and adopted by the farmers are important for the smooth functioning of the seed system. Paradoxically, a large number of crop varieties have been released and registered in food crops and vegetables recently in Nepal, but the actual market popularity and farm-level adoption and use of these varieties are limited and dominated by few old varieties released before year 2000 particularly in major cereals (rice, wheat, maize). This is evident from the available adoption data for major crops (Velasco et al. 2013; CDD 2015; Gauchan et al. 2012, 2014; Gauchan and Dongol 2015) and source seeds demanded in the national balance sheet for major cereals (rice, wheat, maize) in recent three years (2012–2014) including seed sales data based on dealers' survey (Gauchan et al. 2014). Joshi et al. (2012) also report that 85% of all the foundation seeds demanded in rice in 2010 were varieties released before 1995. Moreover, the seed companies and most of the community sectors are also producing and multiplying seeds of few dominant old varieties in market accessible areas because of their high market demand, high profit margin and low risk of marketing them. This supply, demand and production of few dominant old varieties occur because of the lack of awareness among farmers about the performance of new diverse varieties, lack of timely access to quality seeds of these varieties and the failure of the new available varieties to respond to the needs and preference of the farmers as well as adaptation to changing climatic conditions. As a result, varietal adoption lag in crop is high particularly in developing countries where seed system is weak. Studies show that it normally takes over 5 years after official release of crop varieties before their appreciable farm-level adoption is achieved (Morris et al. 1994). Slow replacement of older varieties with newer improved ones in farmers' fields delays the transfer of benefits of breeding research to farmers and heightens the risk of disease epidemics, especially with limited diversification of crop varieties (Brennan and Byerlee 1991).

2.7 Dominance of Varieties Derived from Foreign Sources

Modern varieties promoted and being adopted at the farm level in Nepal come through both domestic and foreign sources. Those derived from foreign sources are coming to Nepal either formally introduced or obtained through informal cross-border flow from India. A recent analysis shows that about 73% of the crop varieties formally released until 2015 had foreign origin and only 27% of the 605 crop varieties released and registered in the country were from domestic origin indicating huge dependence on foreign supplied germplasms (Joshi et al. 2016). Similarly, in terms of farm-level adoption from an expert elicitation study conducted in 2014 in Nepal showed a larger proportion of farm-level adopted varieties are derived from foreign sourced germplasm in rice, maize and wheat (Gauchan et al. 2016b; Gauchan and Dongol 2015). In addition, a large proportion of popular varieties of major cereals and vegetables currently grown by farmers in some Terai districts and market accessible hills come through informal sources mainly cross-border flow from India. Some studies show that the proportion of adoption of informally supplied rice varieties from India was significant, covering about 38% of the area in 2012 (Gauchan et al. 2016a) and 30% in 2008 (Witcombe et al. 2008). Recently the flow of exotic hybrids has increased rapidly in rice, maize and vegetables in market accessible Terai and lower hills. However, the quality and varietal identity of such seeds is not always certain. The cases of non-performance of imported hybrid seeds and the resulting crop failure have every now and then become a political issue warranting serious attention of the government (SQCC 2017). This has occurred due to lack of proper field monitoring, poor awareness about new better-performing varieties and non-accessibility of seeds due to ineffective extension systems (Joshi et al. 2014) and unsuitability of the varieties to the local growing conditions and farmer's choices. The slow release and registration system and delayed farm-level availability of crop varieties from the national research and extension system (NARES) are also the main bottlenecks that cannot keep up with demand for improved seeds. The linkage and partnerships between national and international research institutes and universities including CGIAR centers are also presently weak. Furthermore, the domestic private sector has limited collaboration with public research organizations to access to improved breeding lines developed by national and international research agencies and companies.

2.8 Status of R&D Investment in Seed Sector Development

The current investment of the Government of Nepal in research and development (R&D) is low for developing dynamic, inclusive and sustainable seed sector development. Both public and private sectors in Nepal have underinvested in seed sectors and technologies that are vital to the food security and livelihoods of the poor and smallholder farmers. The current investment in agricultural research is only 0.28% of the AGDP in Nepal (Stads et al. 2015; Gauchan and Pandey 2011), and plant breeding and seed research accounts only about 26% of the total agricultural research budget (MoAD 2013). Furthermore, public-sector investment for human resources and research infrastructure in minor food and horticultural crops is very much limited. The investment in seed and fertilizer subsidy is mainly directed for major food crops (rice and wheat) in the Terai and market accessible areas of Kathmandu. Moreover, the price subsidy on improved seeds of these major crops is channeled only through the dealers of state-owned National Seed Company (Bista et al. 2016). As a result, private sector faces disincentives in seed business as they have to compete with subsidized seeds of state-owned National Seed Company. The benefits of seed subsidy are also mainly accessible to better-off farmers in accessible market centers of Terai and Kathmandu valley. In addition, seed industry is not a priority sector investment in the country; hence, private sector in Nepal does not receive special tax breaks, infrastructural support, research grant and credit subsidies from the government that are available in neighboring countries (India, Bangladesh) in South Asia (Sah and Gill 2014). Furthermore, research investment on local crops and locally adapted farmer varieties is limited that are important for developing resilient seed system in marginal farming system under changing market and climatic conditions. The country also presently lacks well-developed guidelines[3] and incentives mechanisms for promoting underutilized crops and local varieties and making their availability through official registration and release process.

3 Constraints and Issues in Seed Sector Development

A well-functioning seed system is important in improving agricultural productivity and ensuring food security of people for an agrarian-based economy of Nepal. The system has undergone a substantive change during the past two decades with the evolving role of private sector in seed business. Several actors from both public and private sectors including seed researchers, plant breeders, entrepreneurs and seed users are engaged in seed sector development. But, still the sector is unable to ensure sustainable access to diverse quality seed of choice varieties to farmers in the right quantity, of the right quality, at affordable price and in a timely manner. The quality seeds of diverse improved varieties are not reaching small farmers in marginal farming systems and risk-prone environments due to the absence of an efficiently functioning robust, pluralistic seed system. Inadequate access to quality seeds of wide range of choice varieties suited to diverse production systems limits choices to farmers and consequently limits their ability to cope with shocks and risks related to climate change, pests and diseases including their ability to fulfill changing market preferences. Furthermore, seed system is under stress from rapidly changing climate, youth outmigration and ad hoc commercialization. There are several constraints and issues in resilient and pluralistic seed system development to achieving the goals of increased agricultural productivity, food security and poverty reduction among the rural farm households. The important ones are briefly outlined below.

[3]The recently revised Seed Regulation (2013) has some relaxation for the registration of local farmers' varieties (such as requirement of only one year data and no need of DUS test requirement), but farmers' varieties adapted well and preferred by the farmers are not being adequately released and registered due to lack of well-defined implementation guidelines and lack of awareness of the provisions of relaxed registration process for local varieties.

3.1 Dominance of Informal Seed System

The seed replacement rate (SRR) which is an indicator of formal system that supplies fresh quality seeds of improved and better-performing varieties in major cereals is only about 13% in Nepal (SQCC 2016). Furthermore, the SRR in minor cereals and other food crops and those in marginal farming systems of remote hills and mountain region is far lower (less than 5%). A recent study of seed system of traditional crops in high mountain regions in Nepal showed that over 97% of the farm households depend on seed requirements of their crops from their own informal seed system (Gurung et al. 2016). Therefore, nearly 90% of the seeds on which small farmers in Nepal depend are from their informal seed system that are saved on-farm or obtained through informal channels, such as exchanges between farmers, community sharing systems and local markets. However, the quality and reliability of seeds supplied in this system are often poor, unregulated and the productivity is low. Hence, one of the many constraints small farmers face in this dominant informal seed system is limited choices, inconsistent supply and limited use of quality seeds of improved crop varieties (Joshi et al. 2012; MoAD 2013; Gauchan et al. 2014).

3.2 Dominance of Seed Sector in Major Cereals and Market Accessible Areas

Presently, the formal seed system of Nepal is dominated by major cereals and modern varieties of rice, maize and wheat in market accessible areas, where formal sector agencies are focusing their seed production, supply and quality regulation. Both public and private seed companies and other seed actors are focusing seed business in these major crops and market accessible areas due to their less perceived risk and higher profit margins from economic volume of seed business. Seed sector development is very much limited in minor crops and in marginal regions (remote hills and mountains), where farmers continue to recycle and use their low-yielding own-farm-produced and community-exchanged poor-quality seeds. Furthermore, public-sector participation is limited in marginal rainfed and remote regions of hills and mountains due to human resource and financial constraints. Private sector has also no incentives to supply improved quality seeds in the marginal environments and for minor crops (e.g., barley, buckwheat, millets, amaranths, beans) due to low formal sector demand, limited technological options and low return from their seed business. Public education, research and extension programs often provide information and knowledge about seeds of improved varieties of only few major cereal crops such as rice, wheat and maize.

3.3 Supply of Old and Obsolete and Narrow Range of Varieties

The type of crop varieties presently supplied through formal seed system in Nepal is outdated and those released mainly before 1990 (Witcombe et al. 2008; Joshi et al. 2012; CDD 2015). A handful of varieties dominate formal seed market of major food crops with market flow of low varietal diversity and high age of varieties. The development and supply of crop varieties are mainly dominated by the public sector, where release, registration and dissemination processes take longer time. This occurs because of slow pace of variety release and dissemination process, presence of long adoption lag after a new variety is developed and released and limited participation of farmers and private seed actors in the early stage of variety development and dissemination process. As a result, adoption lag (time taken from release to actual farm-level adoption) is very high. Evidence from rice in South Asia shows that it takes about 12 years for large-scale adoption of new varieties after it is released in rainfed regions of Nepal, Bangladesh and eastern India (Velasco et al. 2013). The slow turnover of new better-performing varieties also occurs due to poor linkages and collaboration of seed actors involved in variety development, seed production and supply (Gauchan et al. 2014). For instance, the source seeds produced are poorly linked to seed multiplication and marketing chains to produce and market for the multiplication of subsequent cycles of certified and improved seeds. Similarly, public seed subsidy policy is flatly being implemented without discriminating newly released high-yielding stress-tolerant varieties from old and obsolete varieties. Consumers' education of the value of new seed varieties is also often poor due to lack of public and private sector programs on orientation and awareness on the value of the new seed varieties. As a result, a narrow range of older varieties continue to dominate in the farmers' fields in Nepal.

3.4 Weak Enforcement of Regulatory Framework and Quality Assurance System

Production and marketing of quality seeds require easy access to seed testing services, seed inspection, certification and monitoring of quality seeds. But the current state of quality assurance, regulation and monitoring is very weak in the country due to poor enforcement of regulations, inadequate facilities and low human resource capacity (MoAD 2013; Khanal 2017; SQCC 2017). Presently, the certification system is in place for major food crops (rice, wheat and maize), and it is not yet formally adopted for cash crops, minor cereals (millet, barley, buckwheat) and horticultural crops (vegetables). Furthermore, local producers and entrepreneurs have poor incentives to produce and market quality seeds due to unregulated flow of exotic hybrids and spurious quality of open-pollinated variety (OPV) seeds in the urban markets. There is practically no way to monitor and ensure the quality of farmer-saved seeds, which dominate the seeds currently used in Nepal (SQCC 2017). Furthermore, weak enforcement of existing seed policy, legislation and regulation has constrained to ensure quality assurance services in seed value chain of released and registered varieties.

3.5 Weak Human Resource Capacity and Poor Infrastructural Facilities

The human resource constraint is prevalent in most parts of the seed value chains including in applied plant breeding, varietal maintenance, source seed production and quality assurance activities. Present variety development, source seed production and quality assurance service are dominated by public-sector agencies, and private sector participation in varietal development, maintenance and seed research is very limited. Despite the dominance of public-sector agencies in agricultural R&D, there are critical gaps in human resource capacity and infrastructural facilities (Gauchan 2017; SQCC 2017). Public agricultural research organization and agricultural extension systems are constrained by lack of adequate trained human resources, poor incentive system and high staff turnover. For instance, Nepal Agricultural Research Council (NARC), a public-sector research organization engaged in variety development and maintenance and a major supplier of source seeds is constrained by low salaries, limited training opportunities, restricted recruitment, inequitable system of staff promotion and a lack of performance-based incentives (Stads et al. 2015).

3.6 Weak Participation and Presence of Private Sector in Seed System R&D

Presently, private sector in Nepal is small, weak and constrained by lack of qualified scientific manpower and infrastructure facilities, although recently it is evolving and emerging as an important actor in seed sector development. Therefore, participation of private sector in seed research and development (R&D) is currently weak due to lack of adequate incentives and favorable environment to invest in R&D. Private seed companies and agro-entrepreneurs are mainly investing on short-term business focusing on seed multiplication and marketing as against long-term investment in plant breeding research. Domestic private companies willing to invest in country's seed R&D have to compete with public research and development organizations, which are subsidized and supported by the government, and with regional and international private companies, which are large, well established and equipped with modern scientific manpower, resources and facilities. The legal incentives that promote private sector investment in R&D such as Plant

Variety Protection and Biosafety laws are not in place yet. Private sector also lacks adequate support to access desired germplasm (breeding lines) from public sector including reliable policy support (credit subsidies, research grant, tax break, etc.) and other monetary and non-monetary incentives in investment in plant breeding and seed research from national and international sources.

3.7 Gaps and Issues in Policy and Regulatory Environment

Nepal lacks a clear framework and legislation in place for protection of plant varieties and farmers' rights including sustainable management of rich genetic resources that are useful for strengthening seed system. The absence of legislation on plant variety protection in place constrains the entry of domestic and international private companies and reduces incentives for innovations for seed sector R&D in Nepal. Similarly, legislations are lacking on provisions for benefit sharing and participation of farmers in policy matters relating to their access to and control over traditional genetic resources. There are also other regulatory constraints such as lack of specific policy on seed as an export commodity for investment in seed industry development. As a result, there are no preferential treatments in the export. The variety release and registration system in Nepal is also relatively more stringent for some crops than in some other Asian countries (e.g., Bangladesh, India, Thailand) making it difficult to promote private sector participation and investment in the growth of seed sector (USAID 2014). There are multiple regulatory and licensing agencies that a private agro-dealer, such as agrovet, has to face if it engages in seed business with agro-chemicals and veterinary medicines (SQCC 2017). As a cumulative effect of these gaps, there is a lack of incentives for breeders, farmers and private sector seed entrepreneurs to use effectively and continue managing rich genetic resources to develop, promote and use quality-assured new varieties. In addition, currently, effective enforcement of pre-contract agreement on seed production and supply is constrained by inadequate legal framework (e.g., Contract Farming Act). The country lacks harmonization of seed policies responsive to latest international and national developments. Furthermore, small and poor farmers have limited or almost non-existent access to credit and seed insurance schemes to minimize risks in seed production.[4] Despite the emphasis on seed production of vegetables and cash crops, agricultural insurance policy introduced and implemented recently in Nepal contains no special provision for seed crop insurance that takes longer period and risky to grow.

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[4]Seed crop is a long duration and risky commodity as compared to crop grown for food production. Hence, it requires adequate support to mitigate the risks from adverse production environments (climatic, pest) and marketing risks (price and product sale), particularly for resource constrained farm households.

4 Options for Improvement of Seed System

The vast agroecological and farming system diversity and rich biodiversity that exist in Nepal offer unique comparative advantage to produce under natural conditions, a range of high-quality high-value seeds of food crops, vegetables, forage and flowers for both domestic and international markets. Additional considerations that add to Nepal's advantage in seed sector include relatively favorable liberal policy and regulatory environment, stakeholder readiness, and low agricultural wages and surplus family labor. The economic environment, seed policy and legislation also support the role of private sector in most aspects of the seed value chain. There is already a significant and expanding private sector involvement, especially in hybrid seed market, and hence, there is a strong rationale for Nepal to invest in its own domestic seed sector (SQCC 2017). As a small economy with relatively low agricultural wages and favorable agroecology, Nepal can tap the growing market potential for export of high-value low-volume seeds to various countries by making improvement in some of the specific areas as suggested below.

4.1 Integrated Seed Sector Development

At present, both formal and informal seed systems are not meeting seed needs of diverse group of farmers and seed actors for diverse crops and farming systems. A formal institutionalized seed system is not adequately meeting seed needs of small farmers in remote areas and also for many of the underutilized food, cash crops and agricultural commodities. On the other hand, farmers' local seed system which still dominates (nearly 90% of seed requirements) in Nepal is under severe stress from climate change, youth outmigration and ad hoc commercialization. Therefore, there is a need of resilient integrated seed system that supports seed needs of diverse crops and group of farmers and regions by integrating both formal and informal seed system. Such an integrated seed system strengthens individual seed systems, while actively seeking opportunities for integration and complementarities between formal and informal seed systems (Louwaars and De Boef 2012). It also fosters participation of diverse actors from diverse regions including smallholder farmers from marginal farming system to promote use of availability of quality seeds of better-performing varieties, thereby contributing to food security and economic development. Nepal, therefore, needs to develop and integrate its various seed systems to promote use of diversity, increase agricultural productivity and improve livelihood of smallholders. This will require quality improvements in the farmer (informal) seed systems and diversification of seed supply sources in formal system and fostering sustained linkages and integration between them. A strategic partnership of research, seed enterprise, government quality assurance services and informal sector institutions such as farmers' group is necessary to achieve this goal.

4.2 Strengthening Local Seed System in Marginal Areas

With commercialization, youth outmigration and changes in food culture, Nepal risks losing unique local crop diversity through replacement by exotic modern varieties (MVs), hybrids and land use changes. Strengthening local seed system through community-based approach such as community seed banks[5] (CSBs) is therefore critical for not only enhancing access to seeds of locally adapted varieties to farming communities but also conserving agrobiodiversity and supporting livelihoods of smallholder farmers in changing climatic conditions (see Box 1)

Box 1: Community Seed Banks for Local Seed System and Adaptation to Climate Change

Recently, community seed banks (CSBs) are emerging to offer local solutions to produce, store and supply seeds locally that are critical for smallholders' food security and adaptation to changing climate (Shrestha et al. 2013; Vernooy et al. 2015). They strengthen collective capacity of local communities to access and adopt new species and varieties as well as enhance availability of sources of information and inputs to adapt to changing weather extremities. In Nepal, farmers' groups, I/NGOs and community-based organizations (CBOs) are currently maintaining over 100 CSBs and similar number of CBSP groups in different parts of Nepal. However, in contrast to cooperatives, and officially promoted seed companies, they are not adequately recognized and receive adequate support and recognition from government and donor agencies. There is a growing evidence that CSBs give the greater priority of seed access for resource-poor farmers who are not able to save for their own needs or purchase them from the markets. Lately, community seed banks are increasingly emerging as an important source of planting materials during stress periods to strengthen local seed system in developing countries. They also provide a suitable avenue and options for availability of locally adapted seeds of neglected and underutilized crops that are often not supplied by formal sector agencies. However, the most challenging aspect of community seed banks is its sustainability with its legal identification, financial viability, effective operational mechanisms and community empowerment (Vernooy et al. 2015).

[5]Community seed bank (CSB) is defined as a community-based effort to conserve and use both local and improved varieties for ensuring food security and improving the livelihoods of farmers (Sthapit 2013; Vernooy et al. 2015). These community seed banks are owned, controlled and governed by local community and are relatively inexpensive as they operate employing simple low-cost storage technologies at the local level.

Since nearly 90% of the seed requirements of farmers in Nepal are currently met through farmers' own seed system, it is important to strengthen this system by strengthening farmers' local organizations and community-based institutions through collective actions. These include community seed banks, community-based seed production (CBSP) groups, cooperatives and community-based biodiversity management (CBM) approach. Community-based seed development projects have fairly a long history in Nepal with initiative such as District-level Seed Self-Sufficiency Programme (DISSPRO), CBSP and community seed bank initiatives. Recently, Department of Agriculture (DoA) has also piloted community seed banks in few districts focusing on production, supply and storage mainly focusing on improved varieties. Government of Nepal through various donor-funded projects (e.g., KUBK, HVAP, PACT) is also supporting the establishment of some seed-related infrastructure at the community level to strengthen the capacity and efficiency of cooperatives and CBSP groups in seed business. However, these initiatives are not adequate to improve the local seed systems that focus on the use of local diversity in marginal production systems of rural remote areas. Special plans and programs are needed to strengthen and support community seed banks and community-based seed infrastructure in rural marginal production system for strengthening local seed system, conservation of agrobiodiversity and adaptation to climate change. In more favorable areas, community-based seed producer (CBSP) groups are to be facilitated to graduate into cooperatives and specialized seed enterprises such as seed companies through technical assistance and matching grants to ensure supply and distribution of quality seeds.

4.3 Incentives for Private Sector Participation

In recent years with liberal economic policy, private sector and other non-state actors (NGO, CBOs, cooperatives, etc.) are emerging as key providers of inputs, seeds, exotic varieties and technical services. This requires creation of enabling environments with better provision of incentive system to attract and incentivize private seed companies, plant breeders and agribusiness firms in developing competent varieties and hybrids. Incentives should be created based on assessment of potential options and practices globally available. These may include intellectual property rights on genetic resources, recognition and reward, royalties from revenue of seed sales, soft loans and subsidies for private sector, research block grant for breeding and breeders' seed production. Private sector also needs increased access to diverse germplasm, advance breeding lines to invest and promote their own R&D. There is also need for protecting plant varieties with the development and enforcement of Plant Variety Protection Act that will encourage investment and participation of private sector and plant breeders in variety development and promotion. Development of legislation and its enforcement for contractual agreement on production and marketing is also essential to incentivize private sector participation by reducing risk and assuring production and marketing of quality seeds.

Governments can also provide investment incentives to private firms to invest on seed sector development through research grants—a form of research and development subsidies (Naseem et al. 2010). A substantial opportunity exists for private sector investment in seed sector R&D in partnership with public sector. A policy is needed for private sectors to develop and promote strategic partnerships with public sector along with strategic mechanism to promote corporate social responsibility after the private firm's break-even is recommended. Public–private partnership (PPP) model is accepted model in Nepal to promote seed sector development by capturing synergy and utilizing comparative advantages of each of the public and private actors. One of the partnership modalities could be in hybrid research as envisaged in National Seed Vision of Nepal (MoAD 2013), where public research organizations can hand over public bred parental lines and advance breeding materials to private seed companies to multiply and market them. However, the R&D programs undertaken by private sector should avoid duplication and should complement the public-sector efforts.

4.4 Strengthening Investment in Seed Sector Development

National agriculture research and extension system (NARES) in Nepal needs to invest more financial and human resources and develop strategies and action plans to facilitate and promote fast-track development, release and make available wide range of new competent choice varieties for farmers to reduce adoption lags and faster replacement of older obsolete varieties. This can be done by shortening breeding cycle such as through marker-assisted breeding, shuttle breeding and prerelease seed multiplication with prenotification and early generation testing of varieties in multiple domains and seasons (Gauchan 2017). Focus is also needed for decentralized and participatory plant breeding for marginal regions and underutilized crops to provide diverse seed options and choices to farmers in different agroecologies including remote hills and mountains. In order to promote quality seeds of newer better-performing stress-tolerant varieties, the public policy should target subsidy schemes targeted for newly released and registered varieties including those of the traditional native crops in remote marginal areas, where private sector has limited incentives in seed delivery. Policy should also facilitate incentives to plant breeders engaged in the development of new varieties by devising and implementing a system of royalty payment on the basis of sale of seeds of the new better-performing varieties. Substantial investment on community-level small-scale seed infrastructure is required to make seed business competitive and meet the seed supply needs of seed users in various ecological regions, domains and market centers. External support is needed to strengthen and promote small-scale seed processing and conditioning plants owned by cooperatives, community seed banks and farmers groups in remote and rural areas. Investment in mobile seed processing plants to the community seed banks and seed producer groups will be useful in remote hilly and mountain areas of Nepal to reduce cost of processing and minimize high drudgery among women and youth from manual processing and handling.

4.5 Strengthening Quality Assurance Services

Seed production and marketing in formal system requires adoption of defined regulatory framework of quality assurance system during production, storage, processing and marketing. Recently, existing seed regulatory framework assigned for flexible quality assurance services (e.g., truthful labeling) is supporting and encouraging growth of seed enterprises in community and private sectors. But there is an increasing flow of spurious seeds in the market which requires strong quality-monitoring mechanisms. This requires capacity building of seed producers, local communities and small-scale seed entrepreneurs to monitor, market and regulate the use of good-quality seeds. Hence, special emphasis is to be given to invest more resources to increasing the quality assurance capacities of seed producers and entrepreneurs and helping farmers appreciate the value of quality seeds and recognize the varieties that best meet their needs rather than increased emphasis on "upstream" regulation—seed certification and variety registration (Tripp 2003). In Nepal, the Seeds Act (1988) amended in 2008 and Seeds Rules (2013) have decentralized the responsibility of seed quality control to various public and private organizations, such as the District Agriculture Development Offices (DADO), seed testing laboratories established by the government or private sector organizations, NARC research centers involved in seed production and processing, and seed entrepreneurs under the leadership of the SQCC (Khanal 2017). But the capacity of these organizations is poor to implement effectively the required quality assurance services particularly in the hills and mountain regions. Therefore, there is a need of improvement of capacity of these organizations in terms of availability of sufficient trained human resources (inspectors and seed specialists) and offices in hills and mountains with better infrastructure facilities (seed testing laboratories).

4.6 Seed Policy Revision and Harmonization

The revision and harmonization of seed policy and legislations are essential to provide incentives to plant breeders and researchers for the faster development, release and supply of farmer-preferred better-performing varieties (Sah and Gills 2014; Gauchan 2017). The revision of current Seed Act (1988) amended in 2008 and Seed Policy (1999) is essential to harmonize with latest development of international and regional policy regimes to develop competitive seed industries and promote sustainable seed business in the country. The reform process should support adoption of smart regulations of the seed sector that do not obstruct the timely introduction of improved varieties to the market and avoid long and costly procedures of variety release and registration while guaranteeing quality seed (World Bank 2016). In addition, flexible, simplified release procedures and implementation modality (a differentiated approach for food and non-food crops) are needed that facilitate the release and registration of traditional and new varieties, which can contribute to adaptation in adverse rainfed conditions of hills and mountains. Policy development and revisions are also required to regulate informal flow of unintended hybrids and varieties and encourage public–private partnership for the effective development, release and marketing of competitive varieties for different ecologies and farming systems in the country. Approval and implementation of plant variety protection (PVP) and farmers rights law is critical to provide incentives for plant breeders and private sector in breeding of new varieties and ensure rights and ownership of farmers' traditional seed varieties. Policy measures and development of markets should support, promote and strengthen market networks in rural areas, not only for production and marketing of seeds but also for related inputs (fertilizers, pesticides and small-scale tools and equipment) and outputs.

Recently, Nepal in collaboration with neighboring countries, India and Bangladesh, signed a protocol on cooperation in the evaluation data of rice varieties released and registered in their respective countries to promote harmonization for release, wider-scale promotion and commercialization. This has paved the way for lower regulatory burdens and more rapid release, promotion and sharing of improved varieties developed in all of these member countries (IRRI 2014). Member countries of South Asian Association for Regional Cooperation (SAARC) also signed agreement recently for SAARC regional seed security reserves through harmonized seed testing, quality assurance and seed trading. In addition, Nepal also needs to promote harmonization of trade-related policies, rules and regulations to promote foreign direct investment in seed sector from private sectors, mitigating current bottlenecks and hassles in seed trade at the regional level.

4.7 Capacity Building of Seed Actors and Consumer Education on Seeds

Capacity building of seed actors is essential to enhance and promote quality seeds of better-performing varieties for seed system strengthening in diverse seed chains and markets. Consumer education on seed is the most important component of capacity building to maintain quality assurance services that allows farmers and other seed actors to recognize and appreciate the good-quality seeds and their preferred varieties and to redress the problems if they are not satisfied (Tripp 2003). In this context, training, orientation and exposer visits of seed producers, entrepreneurs and seed users (farmers) are suggested. Training focused specifically on seed dealers and retailers is also essential as they provide advisory services to farmers on the use of quality seeds and varieties including related inputs for crop production. The training must be designed to provide latest information on seed technologies, varietal selection and management of diversity, disease and pest management, seed processing and quality assurances including seed business planning and management. The training and orientation programs can also be the options to strengthen networking among diverse seed actors from both informal and formal seed channels and enhance flow of information of new adapted varieties and quality seeds in seed value chains. Capacity building of farmers as consumers is also essential to provide adequate information and knowledge about the diversity of varieties and quality of seeds available in the market and source them from different channels and market networks. Educating consumes about the value of good quality and diversity of seed varieties as well as their rights and choices to access quality seeds of preferred crop varieties are instrumental in supporting sustainable seed system development. Advertisement and seed marketing campaigns on the value of quality and diversity of seeds and their recommendation domains and production seasons are also part of the consumer education on seeds. A range of participatory research tools and approaches such as participatory varietal selection (PVS) and participatory seed production field trials, farmers' field school programs, minikits, diversity kits, seed demonstration and seed fairs all can promote awareness about the seeds to farmers and seed entrepreneurs. National Seed Board, districts and local governments including various public, private and community-based institutions need to monitor regular flow of quality and diversity of seeds in both formal and informal channels and their use by farmers in different crops, ecologies and production systems.

5 Summary, Conclusions and Way Forward

Seed can be an important entry point for ensuring small farmers' food security, supporting livelihoods and a prerequisite for agricultural development in agro-based economy of Nepal. Effective seed system plays dynamic roles in sourcing and deploying new diversity, facilitating timely access to seeds to smallholder farmers at affordable price and promoting seed production, marketing and use. However, current seed system is inefficient to ensure farmers' access to quality seeds of wide range of choice varieties and promoting diversity and seed innovation in seed value chains linking both formal and informal channels. The seed value chain starting from genetic resource management, variety development and maintenance are often poorly integrated with commercial seed multiplication and marketing chains resulting in lack of sustained flow and farm-level deployment of quality seeds of choice varieties. Although the role of private sector is evolving and increasing gradually in recent years, their capacity is still weak to function as the key value chain promoter for dynamic seed sector development. There is a poor integration of variety development, seed conservation and maintenance process with seed multiplication, marketing and consumption chains resulting in poor popularization and dissemination of newly developed varieties. Consequently, flow, uptake and adoption of newly developed better-performing crop varieties are low among farmers. Moreover, the capacity of national agencies and stakeholders is weak in implementation and enforcement of existing seed policies as well as consumer education on the value of good-quality seeds to assure sustained supply of quality seeds of choice varieties to consumers. Therefore, the process of variety development, release and multiplication and dissemination of quality seeds of farmers preferred varieties is often inefficient and slow.

A great potential exists to increase crop productivity and income of resource-poor farmers in diverse environments by integrating formal and informal seed systems and strengthening existing seed actors. Quality improvements in the local farmers' seed systems and its transformation and enhanced linkages with the formal seed systems and markets are critical to make effective functioning of pluralistic seed system for increasing agricultural productivity and income of small famers. This will require investment, collaboration and coordination with all actors and sectors from public, private and community groups since private or public sector alone cannot meet requirement of quality seeds and promote sustained delivery of new improved and adapted varieties to resource-poor farmers. Therefore, building the capacity of farmers, breeders, seed entrepreneurs and other stakeholders in seed value chains is critical to develop sustainable seed system through fast-track development and release of preferred varieties, timely production and supply of quality seeds, strengthening collective capacity of seed producers for community seed banks, especially women groups, and empowering them to effectively source new diversity and market them efficiently. Potentiality also exists for seed-based innovation and business enterprise development in fulfilling the local and national requirement as well as tapping export markets. Nepal has very good agroclimatic conditions, soil types, biodiversity and isolation distance and cost advantage to produce quality seeds and export to foreign countries. Hence, private sector development in the seed sector is possible by employing an integrated approach that brings R&D investment and support from public-sector institutions, incentives and tax break environment, infrastructure development, favorable regulatory environment and support and strategic partnerships with public sectors and foreign companies. A clearly designed strategic public–private partnership modality is suggested that is inclusive and holistic for the development of integrated resilient seed system to meet farmers' preferences and cope with the changing climate and market requirements. Policy should also create enabling environment for partnership and provide coherence for a level playing field for the development of a dynamic, pluralistic and sustainable seed system in Nepal.

References

Almekinders, C. J. M., & de Boef, W. S. (Eds.). (2000). *Encouraging diversity. Plant genetic resource conservation and crop development* (pp. 330–338). London: IT Publications.

Bista, D. R., Dhungel, S., & Adhikari, S. (2016). Status of fertilizer and seed subsidy in Nepal: Review and recommendation. *The Journal of Agriculture and Environment, 17*, 1–10.

Brennan, J. P., & Byerlee, D. (1991). The rate of crop varietal replacement on farms: Measures and empirical results for wheat. *Plant Varieties Seeds, 4*, 99–106.

CBS. (2013). National sample census of agriculture Nepal, 2011/12. Central Bureau of Statistics (CBS), National Planning Commission, Government of Nepal, Kathmandu.

CDD. (2015). Rice varietal mapping in Nepal: Implication for development and adoption. Crop Development Directorate (CDD), Department of Agriculture, Ministry of Agricultural Development, Government of Nepal, Hariharbhavan, Lalitpur, Nepal.

Evenson, R. E., & Gollin, D. (2003). Crop genetic improvement in developing countries: Overview and summary. In R. E. Evenson & D. Gollin (Eds.), *Crop variety improvement and its effect on productivity* (pp. 7–38). Oxford: CABI Publishers.

FAO. (2011). Strengthening seed systems: Gap analysis of the seed sector. Commission on Genetic Resources for Food and Agriculture (CGRFA). Thirteenth regular session, Rome 18–22. July 2011. Food and Agriculture Organization (FAO) of the United Nation, Rome.

FAOSTAT. (2014). *Food and Agriculture Organization (FAO) of the United Nation*. Rome, Italy. Website http://faostat3.fao.org/home/index.html#DOWNLOAD.

Gauchan, D. (2017). Research and support services in seed production and supply in Nepal. In M. P. Khanal & R. P. Adhikari (Eds.), *Seed industry development in Nepal.* National Seed Submit. Kathmandu, Nepal: Seed Quality Control Centre (SQCC).

Gauchan, D., Thapa Magar, D. B., & Gautam, S. (2016a). Rice seed production and marketing practices in Nepal. *The Journal of Agriculture and Environment, 17,* 111–117.

Gauchan, D., Pant, K. P., & Joshi, B. K. (2016b). Economic benefits of foreign sourced germplasm in domestic crop improvement program: A case of an improved Khumal-4 rice variety in Nepal. *Agronomy Journal of Nepal, 4,* 107–119.

Gauchan, D., & Dongol, D. (2015). Country report for wheat and maize expert elicitation studies, Nepal. CIMMYT/NARC, Nepal. Strengthening Impact Assessment in CGIAR (SIAC) Project. USA: Michigan University.

Gauchan, D., Thapa Magar, D. B., Gautam, S., Singh, S., & Singh, U. S. (2014). *Strengthening seed system for rice seed production and supply in Nepal*. IRRI-NARC collaborative EC-IFAD funded project on Seed Net Development. Socioeconomics and Agricultural Research Policy Division, Nepal Agricultural Research Council, Nepal. 40p.

Gauchan, D., Pant, H. K., Gautam, S., & Nepali, M. B. (2012). Patterns of adoption of improved rice varieties and farm level impact in stress prone rainfed areas of Nepal. In S. Pandey, D. Gauchan, M. Malabayabas, M. Bool-Emerick, & B. Hardy (Eds.), *Patterns of adoption of improved rice varieties and farm-level impacts in stress-prone rainfed areas in South Asia* (p. 318). Los Baños, Philippines: International Rice Research Institute (IRRI).

Gauchan, D., & Pandey, S. (2011). Is investment in rice research in Nepal adequate and balanced across production environments? Some empirical evidence. *Quarterly Journal of International Agriculture, 50*(4), 305–324.

Gurung, R., Palikhe, E., Sthapit, S., Pudasaini, N., Subedi, A., Gauchan, D., & Sthapit, B. (2016). Seed systems and management practices of high altitude traditional crops in Nepal. *A paper presented in International Conference on Mountains in Changing World*, October 2–3, 2016. Kathmandu, Nepal.

IFAD. (2015). Improved Seeds for Farmers' Programme (*Kisankalagi Unnat Biubijan Karyakaram)*. Review of seed component activities, Main report and Appendices, KUBK-ISFP, 23 November–31 December, 2015, Nepal.

IRRI. (2014). Annual report 2014. IRRI (International Rice Research Institute). Bangladesh, India and Nepal sign historic agreement in the evaluation of rice varieties. http://irri-news.blogspot.com/2014/10/bangladesh-india-and-nepal-sign.html.

Joshi, B. K., Bhatt, M. R., Ghimire, K. H., Chaudhary, P., & Singh, D. (2016). Mapping and measuring the flow and interdependence of plant genetic resources. Chapter II. In B. K. Joshi, P. Chaudhary, D. Upadhyay, & R. Vernooy, (Eds.). *Implementing the International Treaty on Plant Genetic Resources for Food and Agriculture in Nepal: Achievements and Challenges*. LI-BIRD, NARC, MoAD and Bioversity International 2016. p. 134.

Joshi, K. D., Conroy, C., & Witcombe, J. R. (2012). Agriculture, seed and innovation in Nepal: Industry and policy for the future. Paper, Dec. 2012, IFPRI, Washington, DC.

Joshi, K. D., Khanal, N. P., Harris, D., Khanal, N. N., Sapkota, A., Khadka, K., et al. (2014). Regulatory reform of seed systems: Benefits and impacts from a mungbean case study in Nepal. *Field Crops Research, 158*(2014), 15–23.

Kansiime, M. K., & Mastenbroek, A. (2016). Enhancing resilience of farmer seed system to climate-induced stresses: Insights from a case study in West Nile region, Uganda. *Journal of Rural Studies, 47*(2016), 220–230.

Khanal, M. (2017). Seed quality assurance and marketing system in Nepal. In M. P. Khanal & R. P. Adhikari (Eds.), *Seed Industry Development in Nepal*. National Seed Submit, 2015. Seed Quality Control Centre (SQCC), Kathmandu, Nepal.

Louwaars, N. P., & de Boef, W. S. (2012). Integrated seed sector development in Africa: A conceptual framework for creating coherence between practices, programmes, and policies. *Journal of Crop Improvement, 26,* 39–59.

Mallik, R. N. (1981). *Rice in Nepal*. Kathmandu, Nepal: KalaPrakasan.

Morris, M. L., Dubin, H. J., & Pokherel, T. (1994). Returns to wheat breeding research in Nepal. *Agricultural Economics, 10,* 269–282.

MoAD. (2013). National Seed vision 2025, Seed Act (1988) amended in 2008 and Seed Regulation (2013). National Seed Board (NSB), Ministry of Agriculture Development (MoAD), Kathmandu, Nepal.

MoAD. (2015). Agriculture Development Strategy (ADS). Ministry of Agricultural Development (MoAD), Government of Nepal, Kathmandu, Nepal.

Naseem, A., Spielman, D. J., & Omamo, S. W. (2010). Private-sector investment in R&D: A review of policy options to promote its growth in developing-country agriculture. *Agribusiness, 26*(1), 143–173.

Pray, C. E., & Ramaswami, B. (1991). *A framework for seed policy analysis in developing countries.* Washington, DC, USA: International Food Policy Research Institute

Sah, R. P., & Gill, G. S. (2014). Policy recommendations for enhancing private sector investment in seed business in Nepal. Private sector seed report, IFPRI/USAID, Institute of Integrated Development Studies (IIDS), November 14, 2014, Kathmandu, Nepal.

Shrestha, P., Gezu, G., Swain, S., Lassaigne, B., Subedi, A., & De Boef, W. S. (2013). The community seed bank: A common driver for community biodiversity management. In W. S. De Boef, A. Subedi, N. Peroni & M. Thijssen (Eds.), *Community biodiversity management: Promoting resilience and the conservation of plant genetic resources*. London, UK: Earthscan from Routledge.

Spielman, D. J., & Kennedy, A. (2016). Towards metrics and policymaking for seed system development: Insights form Asia's seed Industry. *Agricultural System, 147,* 111–122.

Sthapit, B. (2013). Emerging theory and practice: Community seed banks, seed system resilience and food security. In P. Shrestha, R. Vernooy & P. Chaudhary (Eds.), *Community seed banks in Nepal: Past, present, future*. *Proceedings of a National Workshop*. LI-BIRD/USC Canada/Oxfam/The Development Fund/IFAD/Bioversity International, 14–15, June 2012, Pokhara, Nepal.

SQCC. (2015). Notified varieties of crops in Nepal. Seed Quality Control Centre (SQCC), Ministry of Agriculture Development (MoAD), Pulchowk, Lalitpur, Nepal.

SQCC. (2016). Annual progress and third trimester review of FY 2016/17 (2072/73) of Seed Quality Control Centre (SQCC). A paper presented in third trimester and annual progress review and subcommittee meeting of development problem resolving Ministerial level meeting, Ministry of Agricultural Development, Kathmandu.

SQCC. (2017). *Proceedings National Seed Summit*, September 14–15, 2015, Kathmandu. Seed Quality Control Centre (SQCC), Ministry of Agricultural Development, Government of Nepal, Kathmandu.

Stads, G.-J., Shrestha, H. K., Manandhar, H. K., & Gao, L. (2015). Agricultural R&D indicators factsheet, February 2015. Agricultural Science Technology Indicators (ASTI) led by International Food Policy Research Institute (IFPRI) and Nepal Agricultural Research Council (NARC), Nepal.

Tripp, R. (2003). *How to cultivate a commercial seed sector*? Paper prepared for the symposium "Sustainable agriculture in the Sahel". Bamako, Mali, December 1–5, 2003. London: Overseas Development Institute (ODI).

USAID. (2014). Enabling agricultural trade (EAT): Regional trade in seed, fertilizer and strategic grains—a review of the legal, regulatory and is intuitional constraints to growth across south Asia. United States Agency for International Development (USAID), Nepal.

Velasco, M. L., Tsusaka, T. W., & Yamano, T. (2013). Tracking of improved varieties in South Asia (TRIVSA). TRIVSA Synthesis Report on Rice. International Rice Research Institute (IRRI). Los Banos, Philippines.

Vernooy, R., Bessette, G., & Rudebjer, P. (Eds.). (2016). *Resource box for resilient seed systems: Handbook*. Rome, Italy: Bioversity International. http://www.bioversityinternational.org/e-library/publications/detail/resource-box-for-resilient-seed-systems-handbook/.

Vernooy, R., Shrestha, P., & Sthapit, B. (Eds.). (2015). *Community seed banks: Origins, evolution and prospects*. London: Routledge. Available http://www.bioversityinternational.org/e-library/publications/detail/community-seed-banks-origins-evolution-and-prospects.

Witcombe, J. R., Lal, K. K., & Joshi, K. D. (2008). *Scoping study on adoption of rice varieties from Client-Oriented Breeding in the Nepal Rice Innovation System*. Kathmandu, Nepal: CAZS Natural Resources, Bangor University.

World Bank Group. (2016). *Enabling the business of agriculture 2016: Comparing regulatory good practices*. Washington, DC: The World Bank.

Chapter 9
Use of Chemical Fertilizers in Nepal—Issues and Implications

Hiroyuki Takeshima

Abstract This chapter presents relevant empirical evidence to improve the understanding of issues related to the uses of chemical fertilizers, another important production input for agricultural productivity growth. It analyzes the trends of fertilizer use and prices in the country and their distribution across regions and crops and discusses the key emerging patterns of fertilizer use growth and their returns. It then summarizes the policy implications of these patterns.

Acronyms

ADB	Asian Development Bank
AIC	Agriculture Input Corporation
APROSC	Agricultural Projects Services Centre
CBS	Central Bureau of Statistics
DAP	Diammonium phosphate
EAs	Enumeration areas
FAO	Food and Agriculture Organization
IPNS	Integrated plant nutrient management system
MoAD	Ministry of Agricultural Development
MoP	Muriate of potash
NFP	National Fertilizer Policy
NLSS	Nepal Living Standard Survey
VDC	Village Development Committee

Many sections of this chapter draw from the IFPRI Discussion Paper 1507.

Takeshima, Hiroyuki; Adhikari, Rajendra Prasad; Kaphle, Basu Dev; Shivakoti, Sabnam; and Kumar, Anjani. 2016. IFPRI Discussion Paper 1507. Washington, D.C.: International Food Policy Research Institute (IFPRI). http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/130159.

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G. Thapa et al. (eds.), *Agricultural Transformation in Nepal*,
https://doi.org/10.1007/978-981-32-9648-0_9

1 Introduction

The increased use of inorganic fertilizer is considered an important process of agricultural transformation in Nepal. Inorganic fertilizer is often considered an important land-saving input, allowing farmers to increase the returns from land, one of the scarce resources they own. Although the use of inorganic fertilizer has increased in Nepal in the past few decades, its overall intensity of use still lags behind that of many other Asian countries, when measured on fertilizer use per farm household or cultivated area. Identifying the factors that affect the uses of chemical fertilizer, as well as its roles in transforming agricultural sector, are therefore of considerable importance to the Nepalese government.

Major issues regarding the uses of chemical fertilizer and returns from it in Nepal include (1) growing divergence between Terai and Hills/Mountains; (2) growing differences between smallholders and medium-to-large farmers. Regarding (1), while chemical fertilizer use has grown considerably in the Terai, it has rather stagnated in the Hills/Mountains agroecological zones. The differences are not entirely explained by the differences in price change patterns across agroecological belts. While Nepali government is primarily concerned about the chemical fertilizer price, it appears that it is the returns that affect the demand for chemical fertilizer and thus price responsiveness. The relatively mountainous landscape of Hills/Mountains suggests that the country may follow the path of other similarly mountainous countries in the world, many of which rely more on organic fertilizer such as manure than on inorganic chemical fertilizer.

Regarding (2), the patterns in the Terai, which are examined closely in this chapter, suggest that, while agricultural sector in the Terai is still largely dominated by farms cultivating less than 2 ha a year, the growth of chemical fertilizer use has been increasingly led by relatively larger farms among these smallholders, rather than the relatively smaller farms. Such patterns are clearly observed both spatially (between the Terai and Hills/Mountains) and over time (within the Terai). This pattern has important implications in the Terai where the comparative advantages of labor-intensive smallholder farming over more land-intensive farming are becoming increasingly uncertain, due to rising agricultural wages and labor costs.

This chapter presents relevant empirical evidence to improve our understanding of these issues. It first provides the overview of the key fertilizer sector policies in Nepal up to today, and how its focuses and policy instruments have evolved over time. It then provides various descriptive statistics, based mostly on the Nepal Living Standard Survey (NLSS) data, regarding the trends of fertilizer uses and prices in Nepal and their distributions across regions and crops, as well as their breakdown between chemical and organic fertilizer, to show clearer picture for the aforementioned divergences in the trends between the Terai and Hills/Mountains. It then discusses more in detail the key emerging patterns of chemical fertilizer use growths and their returns, and how they differ across farm sizes. The chapter then concludes by summarizing the implications of these patterns.

1.1 Chemical Fertilizer Policies in Nepal

Chemical fertilizer was introduced in Nepal during the 1950s. Formal importation and distribution of fertilizer started with the establishment of the Agriculture Input Corporation (AIC) under the then Ministry of Agriculture in 1966. AIC, as a public-sector enterprise, was fully responsible for the import and distribution of chemical fertilizers in Nepal, especially those from India. After a few years, AIC also started importing fertilizer from the international market. With the introduction of AIC into the fertilizer business, demand for and use of fertilizer increased gradually.

With the aim of increasing food production by encouraging farmers to use chemical fertilizer, the government introduced fertilizer subsidies in 1973–1974 (APROSC 1995). The subsidy policy included both a price subsidy on fertilizer throughout the country and a transport subsidy for selected Hills and mid-Hills districts (APROSC 1995). The transport subsidy applied to costs incurred while transporting fertilizer from the Terai region to the Hills. Fertilizer prices gradually rose over time in international markets, and AIC began operating at a loss, becoming unable to import and distribute fertilizer as before.

In-country demand for chemical fertilizer as well as the price of fertilizer on the international market increased toward the mid-1990s, and the subsidy became a huge financial burden on the government. As a result, in 1997 the government decided to deregulate the fertilizer trade, removing the subsidy on fertilizer and allowing the private sector to import and distribute it. Initially, the subsidy was phased out for diammonium phosphate (DAP) and muriate of potash (MoP); the subsidy for urea was phased out later. After November 1999 no subsidies remained.

After deregulation, the AIC was dissolved and in its place two companies were formed: the Agriculture Inputs Company Limited, responsible for the fertilizer business, and the National Seed Company Limited, responsible for the crop seed business. Thus, deregulation removed the AIC's monopoly in the fertilizer trade and provided opportunities for the private sector to participate.

Furthermore, in 2002, the National Fertilizer Policy (NFP) was formulated. The NFP aimed to (1) provide conditions (policy and infrastructure management) for increased use of fertilizer and (2) promote an integrated plant nutrient management system (IPNS) for the efficient and balanced use of fertilizers. Under the NFP, policy coverage was expanded to three types of fertilizer—organic, chemical, and microbial. Promotion of the IPNS under the NFP reflected to some degree a shift away from the intensification of chemical fertilizer use to minimizing environmental degradation, even though the economic rationale for that was not clear. The NFP continued to pursue deregulation by treating equally private and cooperative firms involved in the fertilizer business, and by the government's limiting the use of subsidy to the aforementioned transport subsidies. The NFP continued to maintain a concern about fertilizer prices, and it promoted the provision of a buffer stock to prevent acute shortages of fertilizer during the main cropping season and started encouraging the domestic production of fertilizer and investments in the fertilizer industries of neighboring countries.

Recently, a major policy shift occurred in 2009. The government reintroduced the subsidy for chemical fertilizer. This was likely in response to both a seeming increase in the real price of chemical fertilizer observed since 2008 and the growing perception of quality adulteration of fertilizer traded in the private markets supplied outside government schemes. By directly procuring and distributing chemical fertilizer at a subsidized price, the government aims to both contain the price of chemical fertilizer and maintain its quality. Currently, most of the formal-sector channel supplying fertilizer is government owned—that is, through the Agriculture Inputs Company Limited and the National Salt Trading Corporation—and under government subsidy, although the majority of chemical fertilizer used in Nepal is still obtained through informal channels (Pandey 2013; ADB 2013). The government still provides a transportation subsidy for chemical fertilizer for 26 remote districts, as per the chemical fertilizer and seed transportation subsidy directives, 2069.

One of the major challenges for fertilizer price policies in Nepal, such as subsidies, is the long open and porous border with India which has become a major regional supplier of chemical fertilizer to countries including Nepal. India has long implemented substantial domestic fertilizer subsidies of varying rates (Sharma 2012; Rashid et al. 2013), and given the relatively small market of Nepal, fertilizer prices in Nepal have often been influenced more by Indian subsidy policies, rather than Nepal's own policies. This problem is likely to have persisted under the recent subsidy programs in Nepal, potentially undermining their effectiveness.

Nepali government also recognizes that subsidies are short-term rather than long-term solutions. The latest agricultural policy documents, Agricultural Development Strategy of 2014 (long-term perspective plan), explicitly acknowledges such short-term nature of subsidies, and states government's intentions to phase out subsidies in the long term, while focusing on generation and adoption of sustainable technologies and practices, as well as providing farmers the options to choose preferred combinations of inputs and extension services (MoAD 2015).

2 Data Used in This Chapter

This chapter mostly relies on Nepal Living Standard Survey (NLSS) conducted by the Nepal's Central Bureau of Statistics in 1995, 2003, and 2010, respectively. The NLSS contains detailed information on various aspects of household characteristics. To control for the heterogeneity in agricultural production environments, we combined NLSS data with various spatial data describing agroecological conditions. In each round of the NLSS, data were collected based on multistage, stratified random sampling methods. The sampling involved enumeration areas (EAs) that were randomly selected from six strata across Nepal. These EAs consisted of urban and rural areas in each of three agroecological zones: Terai, Hills, and Mountains. The EAs for NLSS 1995 consisted of 275 wards, from which 3388 households were sampled. The EAs for NLSS 2003 consisted of 800 EAs, from which 4008 cross-section samples were randomly selected. In addition, 1232 panel samples were randomly selected from NLSS 1995. The EAs for NLSS 2010 consisted of 500 EAs redefined from 800 EAs in NLSS 2003, from which 5988 cross-section samples were randomly selected. In addition, 1032 panel samples were randomly selected from NLSS 2003 (Nepal CBS 1996, 2004, 2011). Our analysis utilizes mostly the panel portion of the NLSS.

In addition, we use various agroecological data and estimated manure endowments calculated based on livestock ownership. For detailed discussions of the sources and measurements of these data, see Takeshima et al. (2016a).

3 Patterns of Chemical Fertilizer Use Growth in Nepal

This section provides various descriptive statistics to show how chemical fertilizer use has changed over time across agroecological belts, how their prices have changed, and how the relative importance of chemical fertilizer over manure as a source of soil nutrient has evolved in the Terai over time but remained relatively minor in the Hills/Mountains. It also briefly shows that the private markets have remained the dominant source of chemical fertilizer in Nepal, providing largely the desired amount of chemical fertilizer among those who use it.

3.1 Chemical Fertilizer Use

Use of inorganic fertilizer has increased in Nepal, particularly between 2003 and 2010, from 262,000 metric tons to 409,000 metric tons with statistical significance (Table 1). Much of this increase came from the Terai (171,000 metric tons to 322,000 metric tons), while no statistically significant increase has been observed in the Hills and Mountains.

The growth in inorganic fertilizer use in Nepal is partly reflected by the growth in the share of farm households using it, from 53% in 1995 to 61% in 2003 to 69% in 2010 (Table 2). Again, the increase in that share has been led by the growth in the Terai (66% in 2003 to 79% in 2010).

Table 2 also reports annual consumption of inorganic fertilizer per hectare of cultivated area and per farm household. Relative to the share of farm households using fertilizer, quantities used exhibit greater variations across ecological belts as well as across regions. In the Terai, consumption increased from 48 kg and 63 kg/ha in 1995 and 2003 to 117 kg/ha in 2010, while it remained fairly stagnant in the Hills and even declined in the Mountains. In both the Terai and the Hills, the central region exhibits considerably higher use of inorganic fertilizer (159 kg/ha in the

Table 1 *Total inorganic fertilizer* use (1000 metric tons)

	1995	2003	2010
Total Nepal	209 ± 38	262 ± 46	409 ± 70
Terai	146 ± 30	171 ± 37	322 ± 61
Eastern	28 ± 9	45 ± 19	82 ± 25
Central	52 ± 19	60 ± 16	152 ± 49
Western	35 ± 10	34 ± 23	50 ± 15
Midwestern	22 ± 19	15 ± 10	19 ± 7
Far-western	8 ± 8	17 ± 17	19 ± 15
Hills	55 ± 15	76 ± 24	78 ± 20
Mountains	9 ± 5	15 ± 7	9 ± 5

Source Authors' calculations based on the NLSS 1995, 2003, and 2010
Note Margins of error are adjusted for cluster sample with enumeration area as the cluster

Table 2 Use of inorganic fertilizer at farm household level

	% of farm households using inorganic fertilizer[a]			Kilograms per hectare of cultivated area, annual[b]			Kilograms per farm household, annual		
	1995	2003	2010	1995	2003	2010	1995	2003	2010
Nepal	53	61	69	36	53	76	69	80	93
Terai	57	66	79	48	63	117	114	118	169
Eastern	42	57	74	34	47	95	91	106	141
Central	60	69	80	56	88	159	104	123	237
Western	77	81	88	61	79	123	152	139	177
Midwestern	59	64	78	61	49	70	167	98	86
Far-western	46	66	78	25	52	77	77	120	103
Hills	52	59	61	26	42	36	37	50	37
Eastern	36	43	58	7	18	21	15	28	33
Central	80	88	86	73	113	99	86	120	89
Western	61	60	65	24	21	20	23	22	16
Midwestern	40	49	44	13	13	13	21	16	13
Far-western	23	43	35	5	6	7	10	6	8
Mountains	40	47	52	15	31	20	31	49	25

Source Authors' calculations based on the NLSS
Note Farm households here include small fractions of landless households that only provide agricultural workers
[a]Figures for the% shares are weighted by sample weights
[b]Weighted by the sample weights as well as cultivated area (annual)

central Terai, and 99 kg/ha in the central Hills, both in 2010) than other regions within the ecological belts.

Additionally, in the Terai, the average quantity per farm household is relatively larger than the average quantity per hectare, compared with the Hills and the

Table 3 Inorganic fertilizer use (kilograms/hectare of cultivated area, annual)

Country/Belt	Type	1995	2003	2010
Nepal	Urea	23	35	43
	Complex	3	1	1
	DAP	10	16	29
	Others	0	0	3
Terai	Urea	28	38	63
	Complex	3	2	2
	DAP	17	23	47
	Others	0	0	5
Hills	Urea	18	33	24
	Complex	4	1	0
	DAP	3	9	10
	Others	0	0	1
Mountains	Urea	12	27	15
	Complex	2	0	0
	DAP	1	5	4
	Others	0	0	1

Source Authors' calculations based on the NLSS 1995, 2003, and 2010

Note Weighted by the sample weights as well as cultivated area (annual)

Mountains (e.g., 169/117 in the Terai versus 36/37 in the Hills). This is primarily because land-use intensity is higher in the Terai (average cultivated area in two seasons compared with land owned), indicating that in the Terai, farmers use more of both inorganic nutrients and land.[1]

A majority of inorganic fertilizer used is urea and DAP, while little complex fertilizer is used (Table 3). In the Terai, consumption of urea per hectare of the cultivated area increased from 28 kg in 1995 to 38 kg in 2003 to 63 kg in 2010, while consumption of DAP increased from 17 kg in 1995 to 23 kg in 2003 to 47 kg in 2010.

[1]Note that the estimates of manure used here are based on the household endowment of each type of livestock, rather than the actual measures of quantities used. The actual usage of manure must be estimated by separate surveys. The lower livestock holdings in the Terai versus those in the Hills or Mountains imply lower manure usage in the Terai. While future studies must investigate the reasons for lower livestock holdings in the Terai zone, possible reasons may include the hotter and more humid climate in the Terai, which sometimes leads to greater incidence of livestock diseases.

3.2 Chemical Fertilizer Price

Table 4 presents the price of urea in each agroecological belt (and region within the Terai), averaged across all farm households reporting the price (weighted by the sample weights). Real prices of urea and DAP are first calculated for farmers reporting the purchase quantities and prices, and then replaced with the Village Development Committee (VDC)-level median if the VDC median value is available from the sample, the district-level median if the district median value is available from the sample but the VDC median value is not, and the regional median and zonal median and so on. Real prices are approximated by dividing the fertilizer price by the average prices of rice and wheat, two major staples in Nepal.

The real price of inorganic fertilizer (measured in kilograms of cereals) generally rose considerably between 1995 and 2003 (price of a kilogram of urea equivalent to 1.05 kg of cereals in 1995–1.61 in 2003) and declined between 2003 and 2010 (1.61–1.36). The decline in the real price between 2003 and 2010 is despite a significant increase in the nominal price during that period. This is because the nominal price of cereals increased even more during that period. The extent of the decrease in real price was particularly large in the Terai, with the eastern and central regions experiencing almost a 30% decline between 2003 and 2010. The extent of the price decrease in the other regions within the Terai, as well as in the Hills and the Mountains, has been slower. The patterns are similar for DAP (Table 5).

Table 4 Urea price by region

Region	Nominal, rupees per kg			Urea price per kg/ cereal price per kg		
	1995	2003	2010	1995	2003	2010
Terai	6.8	12.9	19.4	1.10	1.51	1.18
Eastern	7.7	12.5	16.9	1.25	1.44	1.02
Central	6.7	12.6	16.9	1.06	1.47	1.03
Western	6.3	13.5	21.5	1.03	1.62	1.31
Midwestern	6.2	13.9	27.9	1.06	1.64	1.72
Far-western	7.1	12.9	23.9	1.17	1.62	1.49
Hills	7.0	16.7	27.7	1.01	1.69	1.55
Mountains	7.0	17.0	30.3	0.98	1.87	1.77
Nepal	6.9	14.7	23.4	1.05	1.61	1.36

Source Authors' calculations based on the NLSS 1995, 2003, and 2010

Note Weighted by the sample weights

Table 5 DAP price by region

Region	Nominal, rupee per kg			DAP price per kg/ cereal price per kg		
	1995	2003	2010	1995	2003	2010
Terai	12.6	20.1	32.1	2.05	2.34	1.97
Eastern	12.0	19.7	28.8	1.94	2.26	1.76
Central	12.8	20.1	30.2	2.05	2.34	1.84
Western	12.7	20.1	35.1	2.06	2.38	2.15
Midwestern	13.0	19.7	40.1	2.18	2.30	2.47
Far-western	13.9	21.8	38.0	2.27	2.66	2.36
Hills	13.0	22.9	39.0	1.87	2.33	2.11
Mountains	13.2	22.7	42.3	1.81	2.48	2.47
Nepal	12.9	21.5	36.1	1.95	2.35	2.07

Source Authors' calculations based on the NLSS 1995, 2003, and 2010
Note Weighted by the sample weights

3.3 Inorganic and Organic Fertilizer

As was briefly described earlier, unlike in many countries, farmers in Nepal may rely relatively more on livestock manure for farm nutrients, particularly in the Hills and the Mountains. Table 6 provides some estimates of the use of three major nutrients sourced from inorganic fertilizer as well as manure. These are only rough estimates based on the typical chemical composition of inorganic fertilizer distributed in the South Asia region, as well as the typical quantities of nutrients derived from manure, which are assessed from national-level figures and interpolated into the NLSS data. NLSS data provide neither of such information, and all figures must be verified in future studies (see the appendix for the methodologies used to calculate the nutrient composition of inorganic and organic fertilizer).

Based on the estimate, we see certain patterns in nutrient use. First, some of the chemical nutrient deficiencies in the Hills and Mountains are offset (though not entirely) by the use of manure; in 2010, nitrogen from manure was applied at a rate of 22 kg/ha of cultivated area in the Hills and 19 kg in the Mountains as opposed to 11 kg in the Terai, while nitrogen from inorganic fertilizer was applied at 13 kg and 8 kg, respectively, as opposed to 38 kg in the Terai. The greater role of manure than chemical fertilizer as the source of nitrogen is consistent with earlier studies.[2] Second, most potassium might be obtained from manure rather than inorganic fertilizer. For Nepal as a whole, an average farm household applied less than 1 kg of potassium from inorganic fertilizer per year, but given livestock holdings and typical nutrients extracted, the household can be applying 22 kg of potassium from manure.

[2]For example, Pilbeam et al. (2000) reported that manure provided four times more nitrogen than chemical fertilizer in the mid-Hills in the late 1990s.

Table 6 Estimated nitrogen, phosphate, and potassium use (kilogram per farm household, year)

Variable	Nutrient	Belt	1995		2003		2010	
			Inorganic	Manure	Inorganic	Manure	Inorganic	Manure
Kilograms per farm household per year	Nitrogen	Nepal	24	25	29	23	31	20
		Terai	38	23	40	18	55	16
		Hills	14	26	20	26	13	23
		Mountains	12	28	20	29	10	24
	Phosphate	Nepal	10	6	12	5	17	5
		Terai	20	5	21	4	34	4
		Hills	4	6	5	6	5	5
		Mountains	2	6	4	6	3	6
	Potassium	Nepal	1	27	0	25	0	22
		Terai	1	25	0	20	1	18
		Hills	1	29	0	28	0	26
		Mountains	1	32	0	33	0	27
Kilograms per cultivated area (hectares) per year	Nitrogen	Nepal	13	13	19	15	25	16
		Terai	16	10	22	10	38	11
		Hills	10	18	16	22	13	22
		Mountains	6	13	13	18	8	19
	Phosphate	Nepal	5	3	8	3	14	4
		Terai	9	2	11	2	23	3
		Hills	2	4	4	5	5	5
		Mountains	1	3	2	4	2	4

(continued)

Table 6 (continued)

Variable	Nutrient	Belt	1995		2003		2010	
			Inorganic	Manure	Inorganic	Manure	Inorganic	Manure
		Nepal	1	14	0	17	0	18
		Terai	1	11	0	11	1	12
		Hills	1	20	0	24	0	25
		Mountains	0	15	0	21	0	22

Source Authors' calculations using the NLSS

Note Farm households here are defined as households reporting positive areas cultivated. They exclude households that provide only agricultural laborers that are hired by other farm households

As we discussed earlier, overall nutrient use per cultivated area is still low in Nepal, even when we take manure nutrients into account. However, the relative importance of manure nutrients should be considered when assessing the demand for inorganic fertilizer, particularly in the Hills and Mountains, relative to the Terai where cattle manure is mostly used as cooking fuel.

3.4 Fertilizer Use and Crops

Although the NLSS does not report quantities of fertilizer used for each crop, it reports for which crops fertilizer was mainly used. Figure 1 presents the share (%) of farm households growing major crops and using fertilizer for each crop. Crops listed in Fig. 1 account for most of the fertilizer use.

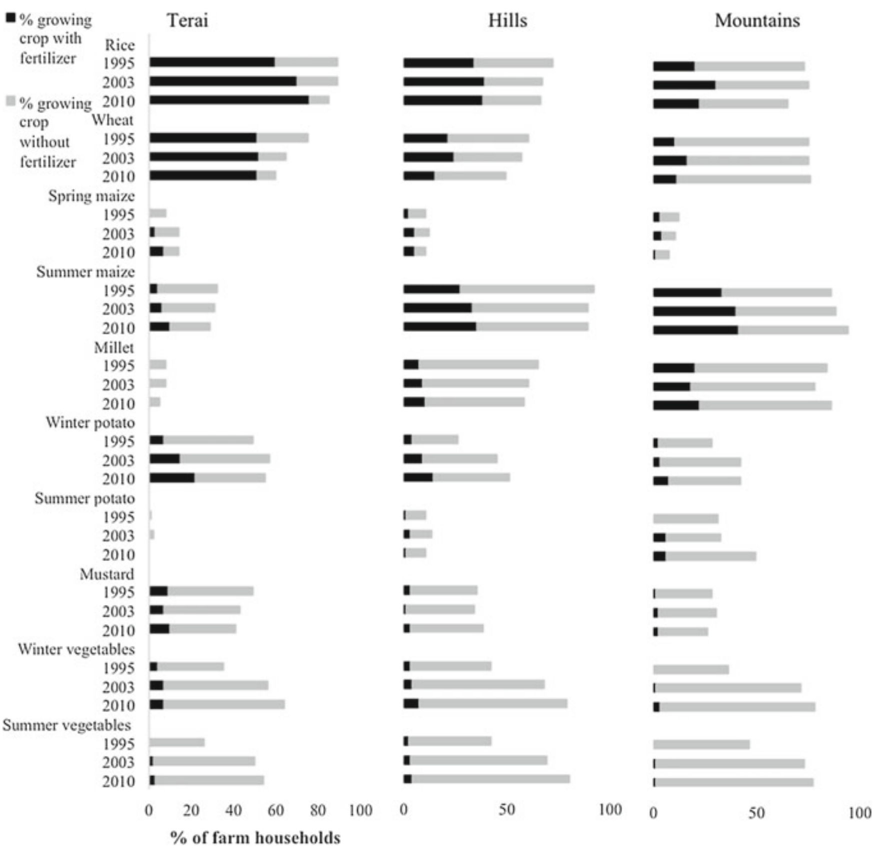

Fig. 1 Major crops for which inorganic fertilizer is used, by agroecological belt, year. *Source* Authors' estimations based on the NLSS

Some variations are observed across crops as well as agroecological belts. In the Terai, most rice and wheat growers apply inorganic fertilizer to those crops, while few growers of other crops apply inorganic fertilizer to those crops. Use of inorganic fertilizer seems, however, to be on the rise for certain crops such as winter potato, vegetables, and sugarcane.

In the Hills, most households apply inorganic fertilizer to rice, vegetables on a commercial scale, and summer maize. Farmers applying inorganic fertilizer are, however, a relative minority among summer maize growers. Use of inorganic fertilizer on wheat seems to be declining in the Hills. In the Mountains, patterns are similar to those of the Hills. In the Mountains, millet is as commonly grown as rice and receives more fertilizer compared with crops like wheat.

3.5 Sources of Chemical Fertilizer

Table 7 summarizes the major sources of fertilizer for fertilizer-using households by agroecological belts, with all three rounds of the NLSS combined. Approximately 80% of fertilizer users obtained chemical fertilizer from the private market, while government, non-governmental organizations, and cooperatives accounted for approximately 3–6% each. The share breakdown in Table 7 is statistically significant across agroecological belts. A greater share of fertilizer-using households in the Terai get their fertilizer from the private market, compared with the Hills and Mountains, where the share of cooperatives is relatively higher than that in the

Table 7 Shares of chemical fertilizer obtained from major sources by fertilizer-using households in each agroecological belt

Type of fertilizer	Agroecological belt	Government	Non-governmental organization	Cooperative	Private market
All chemical fertilizer	Terai	5.2	6.0	3.5	85.3
	Hills	4.4	2.4	12.0	81.2
	Mountains	5.4	0.7	9.8	84.1
Urea	Terai	5.2	6.0	3.2	85.6
	Hills	4.3	2.3	10.4	83.0
	Mountains	5.4	0.9	7.9	85.8
DAP	Terai	4.9	6.5	3.3	85.2
	Hills	4.7	2.6	14.5	78.3
	Mountains	5.2	0.0	16.9	77.9

Source Authors' calculations based on the NLSS
Note The figures in the tables are at the end-user level. Therefore, if fertilizer was distributed through more than one channel, the last channel of distribution is counted. For example, some cooperatives receive fertilizer from the government, which is then distributed to farmers. Such a channel is counted under the cooperative, rather than the government, in the table

Terai. Considering that the consumption of chemical fertilizer is growing the most in the Terai, the private market has been the major source of such growth.

3.6 Access to Fertilizer

The information is limited regarding how access to chemical fertilizer is constrained. The NLSS 2010 asks chemical-fertilizer-using households whether they could obtain the desired amount. In 2010, about 90% of households using fertilizer in each agroecological belt said yes, indicating that where fertilizer is supplied, availability may be generally high. However, the NLSS does not report whether households wanted to use fertilizer but could not obtain it. As the share of those not using fertilizer is still relatively high, particularly in the Hills and the Mountains (40–50% in 2010 in Table 2, as opposed to 20% in the Terai), future studies must investigate whether access to fertilizer is significantly constraining those households.

Chemical fertilizer and smallholders in Nepal—insights from comparative analyses between smallholders and medium-to-larger farmers

Chemical fertilizer is conventionally considered a land-saving input, as opposed to agricultural machineries like tractors. Around the world, chemical fertilizer use in regions with small farm size, such as Asia, is higher than regions with larger farm size, such as the USA. For example, the consumption of chemical fertilizer nutrients per hectare of arable land in 2013 was 246 kg/ha in East Asia and Pacific, 153 kg/ha in European Union, 149 kg/ha in South Asia, higher than North America (122 kg/ha), Latin America and Caribbean (126 kg/ha) (World Bank 2016) where average farm sizes are typically larger. Such negative relationship between chemical fertilizer use intensity and farm size suggests is consistent with the notion that its return may be higher in areas with smaller average farm size.

At the same time, due to rising rural wages and labor costs, future of small farmers is becoming increasingly uncertain (e.g., Rigg et al. 2016). In Nepal as well, the comparative advantages of chemical fertilizer use by smallholder farmers over medium-to-large farmers are becoming unclear. Figure 2a shows the local polynomial regression of chemical nutrient use per hectare on the cultivated area and confidence intervals of the estimates in the Terai and the Hills. While the intensity of chemical fertilizer use drops rapidly as the size of cultivated area per household rises in the Hills, the rate of that reduction is much slower in the Terai region. In other words, part of the difference in chemical fertilizer use intensity between the Terai and the Hills accrues to the differences in the intensity of use among the medium-to-large-size farms. This is also consistent with the changes within the Terai between 2003 and 2010, as is shown in Fig. 2b.

It is therefore important to understand what roles chemical fertilizer plays for smallholders. The remaining sections of this chapter provide a few sets of evidence. First sets of evidence show how the returns to chemical fertilizer uses vary across

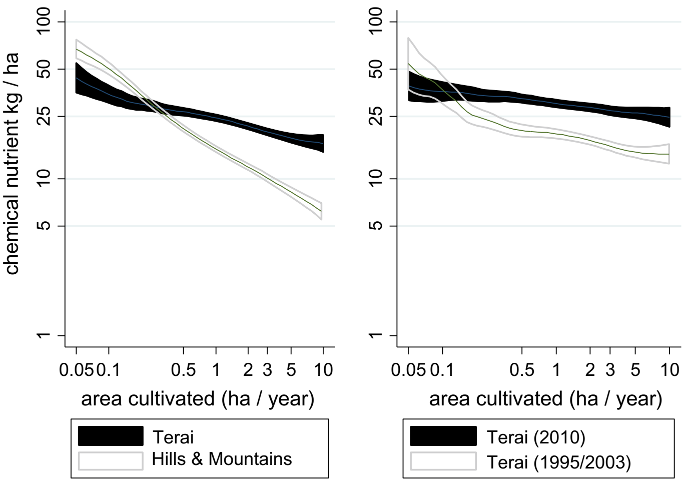

Fig. 2 Chemical fertilizer intensity and farm size; **a** (Left panel) comparison between the Terai and the Hills; **b** (Right panel) comparison between 2003 and 2010 in the Terai (bands indicate 90% confidence interval, while the middle lines inside the bands are the estimated averages). *Source* Authors' estimation based on NLSS data

farm households of different farm sizes. We also briefly discuss based on earlier study how the chemical fertilizer uses respond to the changes in fertilizer prices, and how they are associated with the returns to its uses. Second, we show how the effects of chemical fertilizer prices on farm household incomes vary across farm sizes. While the first sets of evidence are drawn from cross-sectional data analyses, second sets of evidence rely on the pure panel data analyses. This is because, the income effects of price changes may be more relevant in short-term (for which panel data analyses tend to be more suitable), compared to the changes in chemical fertilizer uses or effects of intensive chemical fertilizer uses that may realize in the longer-term (for which cross-sectional data analyses tend to more suitable). This is because, the government can relatively easily change chemical fertilizer price in the short term, but the substantial change in chemical fertilizer use by farm households may happen only in the long run, accompanied by the changes in various characteristics of these households. A similar distinction between cross-sectional data and panel data are made in other studies (Gollin et al. 2016; Takeshima 2017).

3.7 Returns to Chemical Fertilizer Use

An important pattern observed in Nepal is the divergence of returns to chemical fertilizer use intensity, between agroecological belts. Takeshima et al. (2016a, 2017) estimates how intensive chemical fertilizer uses affect the incomes of farm households, and how they vary across different types of farm households, in terms of agroecological belts they are located (Terai or Hills/Mountains), farm size owned, and asset levels, using the generalized propensity score matching method. Specifically, Table 8 summarizes the subgroups of farm households. Their analyses also focus on areas that are homogeneous in soil types, Eutric Fluvisols for Terai and Dystric Cambisols for Hills, two major soil types for these regions identified by FAO et al. (2012), because soil type is an important determinant of farming systems and returns to fertilizer. Four subgroups are defined based on the sample median of two key farm household characteristics: farm size and household assets. Takeshima et al. (2016a) shows that the balancing properties are satisfied based on these classifications, indicating that household characteristics do not differ significantly conditional on the estimated chemical fertilizer uses within each subgroup. Among medium-to-large-scale households in the Terai (own land size of at least 0.5 ha), those owning more than 1.5 ha of farmland are excluded because their characteristics are quite different from the rest of the medium-to-large-scale households and violate the balancing properties. As Table 8 shows, the identified subgroups account for two-thirds of farm households using chemical fertilizer and at least half of the quantity of chemical fertilizer used in the Terai, and at least three-quarters of households using chemical fertilizer and of the quantity used for the Hills excluding the central zone. The analysis based on these subgroups, therefore, has important implications for the returns to fertilizer for the whole of each zone.

Figures 3, 4, 5, and 6 illustrate the estimated effects of quantities (kilograms) of nutrients from chemical fertilizer used by the household on the natural log of household income (measured in kilograms of cereals), for each subgroup of farm households classified as above [the estimation methods are described in Takeshima et al. (2016a)].

Key patterns are summarized as follows: small-size, low-asset owners do not exhibit statistically significant returns from the increased use of chemical fertilizer (Fig. 3). For small-size, high-asset owners, returns from chemical fertilizer use appear to increase up to a certain level in the Terai, while the statistical significance for the Hills is low (Fig. 4). For medium-scale, low-asset farmers returns to chemical fertilizer in the Terai seem to maximize around 100–150 kg of nutrients with statistical significance, while patterns are less clear for the Hills (Fig. 5). For medium-sale, high-asset farmers, patterns are less precise than for low-asset farmers, but again the returns in the Terai seem to exhibit clearer signs that the marginal returns are statistically significantly positive up to a certain level of chemical fertilizer (Fig. 6).

Altogether, income effects of chemical fertilizer use for the typical household in each subgroup continue to rise to a much higher level in the Terai than they do in the Hills, often on the order of three times or more, particularly among larger farms. In the Terai, chemical fertilizer can be applied fairly intensively per unit of the area across medium-to-large-scale farms and still generate sufficient profits. This is also consistent with the finding in Takeshima et al. (2015) that the pattern of input use intensification in the Terai is largely homothetic and the intensive use of chemical fertilizer is often associated with greater use of mechanization and land. In the Hills outside the central zone, on the other hand, raising the intensity of chemical

Table 8 Subgroups of farm households defined for assessing returns to chemical fertilizer use (among farm households using chemical fertilizer)[a]

Terai (soil = Eutric Fluvisols)					Hills excluding the central region (soil = Dystric Cambisols)				
Type		Cultivated area per year*	Share (%) of farm households	Share (%) of fertilizer use	Type		Cultivated area per year *	Share (%) of farm households	Share (%) of fertilizer use
Own land size (ha)	Real household assets^				Own land size (ha)	Real household assets^			
<0.5	<25,000	0.6/0.9	20	8	<0.5	<30,000	0.5/0.7	23	13
<0.5	$\geq$ 25,000	0.7/0.9	17	11	<0.5	$\geq$ 30,000	0.5/0.6	17	14
0.5 ~ 5.0	<75,000	1.8/2.3	15	15	>0.5	<50,000	1.4/1.9	23	22
0.5 ~ 1.5	$\geq$ 75,000	2.0/2.0	12	17	>0.5	$\geq$ 50,000	1.5/1.9	19	26
Total			64	51				82	75

Source Authors

Note ha=hectares; kg=kilograms. ^kg of cereals; * ha, median/mean

[a]For the Hills zone, the central region is excluded because the much higher level of fertilizer use there, as shown in Table 2, indicates that the production characteristics may be quite different from those of the rest of the Hills zone

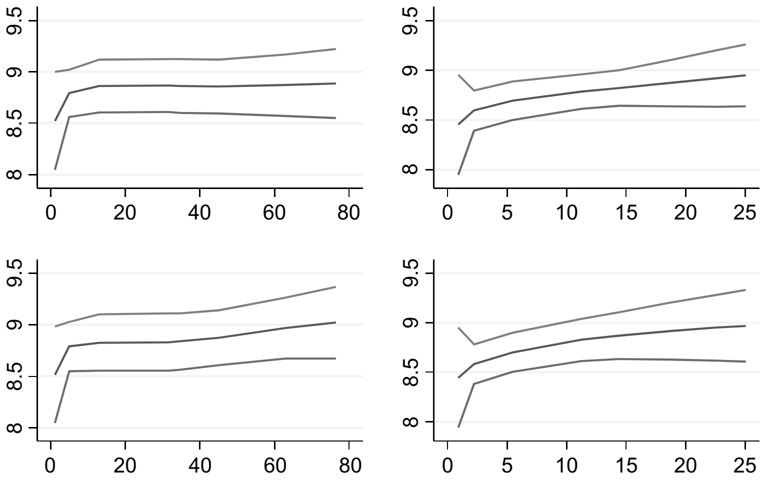

Fig. 3 Small-size and low-asset owners. *Source* Authors

Notes for Fig. 3 through Fig. 6: Left=Terai; right=Hills excluding central region; top=short specification; bottom=full specification. The lines show the mean estimates as well as the 90% confidence interval based on 100 bootstrap processes. The vertical axis measures the natural log of annual household income measured in terms of kilograms of cereals valued at local prices. The horizontal axis measures chemical fertilizer nutrients used (kilograms per household per year)

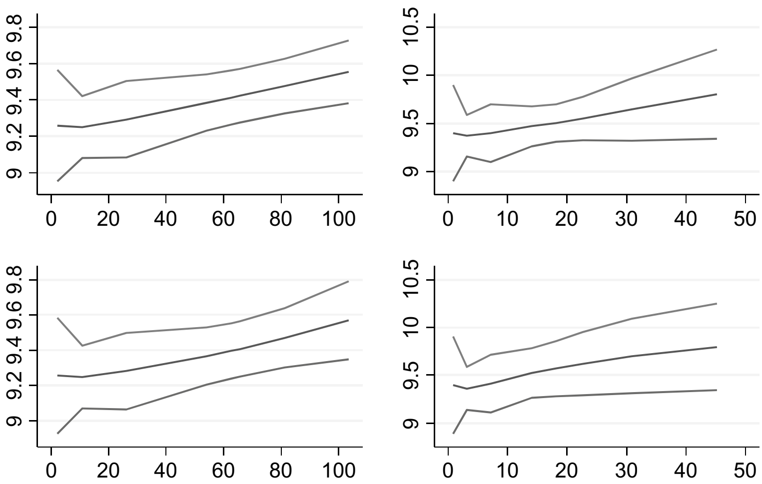

Fig. 4 Small-size and high-asset owner. *Source* Authors

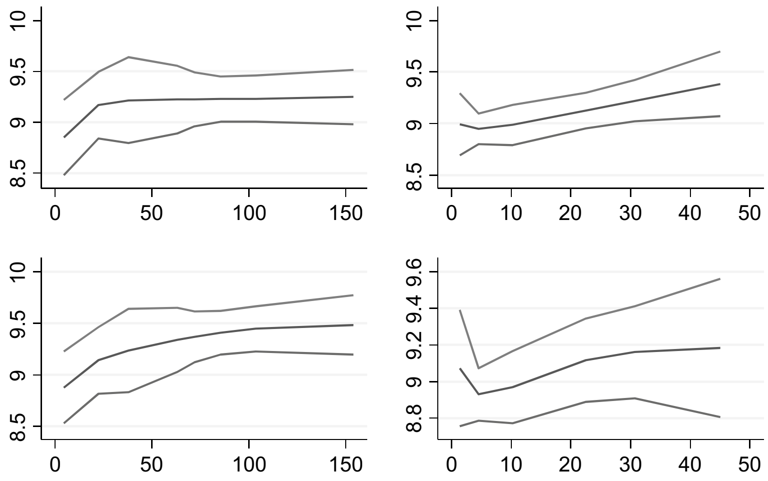

Fig. 5 Medium-to-large-size and low-asset owner. *Source* Authors

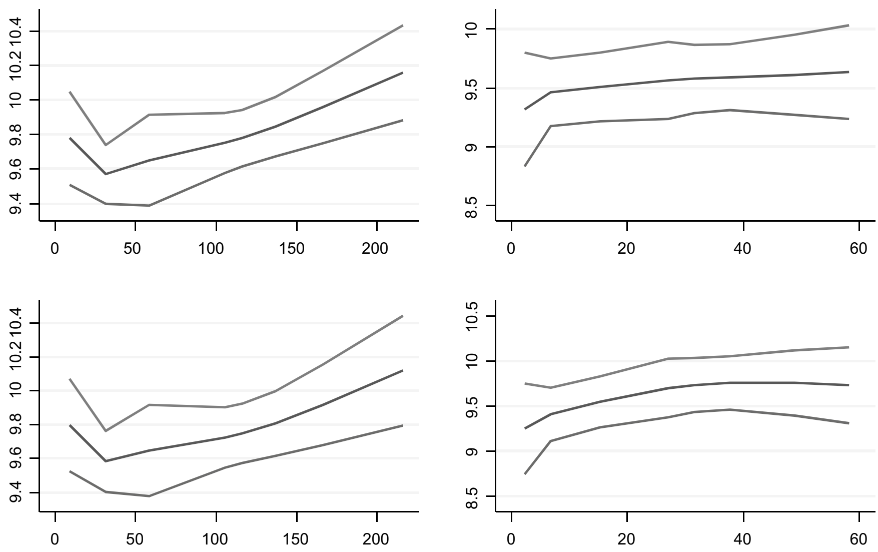

Fig. 6 Medium-to-large-size and high-asset owner. *Source* Authors

fertilizer per unit of area among medium-to-large-scale farms will face rapidly declining returns. Investigating the causes of such a difference is beyond the scope of this chapter, although the growth in technologies that can generate greater scale effects, such as tractors (Takeshima 2017), in the Terai may be one cause. It is important to note that these differences are only partly driven by the differences in the typical size of total land cultivated. As was shown in Table 8, the typically cultivated areas in each subgroup do not differ by more than 50% between the Terai and the Hills. The results, therefore, suggest that income returns from intensive chemical fertilizer use per cultivated area are inherently higher than those in the Hills.

These variations in returns to chemical fertilizer uses are found to be associated with the price elasticity of chemical fertilizer use and its variation. While sometimes prices may be insignificant determinants of chemical fertilizer uses in the short-term due to an imperfect market and sometime constrained supply, Takeshima et al. (2017) finds that, in the long run, they are still elastic to prices. Furthermore, the price elasticity of demand for chemical fertilizer is also found greater in the Terai, than in Hills or Mountains, with widening differences between these zones over time (Takeshima et al. 2017). Takeshima et al. (2017) argues that, despite lingering inefficiencies, chemical fertilizer market still functions in ways that are consistent with economic theories, where the demand for chemical fertilizer largely depend on the relationship between its marginal returns and the prices.

3.8 *Income Effects of Chemical Fertilizer Price*

While the previous section focused on the effects of chemical fertilizer uses, it is also informative to assess the effect of chemical fertilizer price, which is a more direct policy instrument that the government can control.

3.8.1 Empirical Specifications

Our model is a standard first-difference panel data specification. In particular, we estimate the following model:

$$\Delta y_{it} = \alpha + \beta_p \cdot \Delta p_{it} + \beta_{pA} \cdot \Delta p_{it} \cdot \Delta_{it-1} + \beta_A \cdot \Delta_{it-1} + \beta_{\Delta Z} \cdot \Delta Z_{it} + \beta_Z \cdot Z_{it-1} + \varepsilon_{it} \tag{1}$$

in which Δy_{it} is the vector of changes (or growth rates) in key outcome variables for household i between periods t and $t - 1$ (t indicates the year 2010 and $t - 1$ is the year 2003), Δp_{it} is the change in chemical fertilizer prices between t and $t - 1$ in areas where household i is located, Δ_{it-1} is the size of lowland farm plots owned at $t - 1$, Z_{it} is other key explanatory variables, including time-invariant factors (in which case $\Delta Z_{it} = 0$). Notations $\alpha, \beta_p, \beta_{pA}, \beta_A, \beta_{\Delta x}$ and β_Z indicate the set of estimated parameters, and ε_{it} is the idiosyncratic error term.

In the specification (2), the key variable of interests is β_{pA} which captures the differential effects of chemical fertilizer price change by the size of farm land owned at $t - 1$. Note that, we do not include the farm land owned at t because it may be endogenous to the outcome variables. This is particularly so given that the gap between NLSS survey was 7 years and might have been long enough for some households to make farm land sales or purchase transactions. Therefore, the model captures the reduced form relationship between farm size in 2003 and the effects of chemical fertilizer price change on the changes in various outcome variables.

Selections of key explanatory variables and their measurements, as well as sources, are described in Takeshima et al. (2016b). Since we are using the panel data, the number of included variables is kept relatively small, because the effects of most time-invariant variables may be captured by the household fixed effects. The number of variables is kept small also because, given the small sample of panel households, an excessive number of variables will lead to large loss of efficiency with little gain in consistency of the estimates.

3.8.2 Effects of the Changes in Chemical Fertilizer Price on Household Income and Impact Pathways

Table 9 summarizes the effects of chemical fertilizer price changes on real per capita income, agricultural income, agricultural revenues, and off-farm incomes. For all outcomes, possibly due to the small sample, the coefficients for ΔP and ΔP*land size($t - 1$) are not statistically significant at 10% level for per capita total income and agricultural income. However, their estimates (signs and magnitudes) and standard errors are such that, the effects of ΔP can be clearer and statistically more significant for farms with larger land size. This can be seen in Figs. 7 and 8, which show how the estimated effects of the reduction in chemical fertilizer prices ($-\Delta P$) on changes in real per capita total income, agricultural income and agriculture revenue, as well as their confidence intervals vary depending on the size of lowland farm owned in 2003, based on the estimates in Table 9. While the confidence intervals straddle over zero for the smaller farms (so that the effects of ΔP are less clear for these households), they remain significantly different from zero for households with larger lowland farm. The results are consistent with the hypotheses that the lower chemical fertilizer price benefits larger farmers more, in terms of their per capita agricultural income and per capita total household income.

Other estimated coefficients can be interpreted in the reduced form context, which reflects both supply and demand sides of those factors. For example, significantly positive effects of real farm wage on agricultural income and revenue may contradict the standard production theory. However, this result may be because, at the equilibrium, agricultural production adjusts in a way that returns to labor is equated with wage rates, and because most labor used is still predominantly family labor instead of hired labor, returns to labor is close to returns to family labor that is often close to per capita agricultural income of the household.

The size of non-working age household members in 2003 is sometimes positively associated with these key outcomes. This may be because, in the case of children, their labor productivity might have risen considerably during 7 year periods (between 2003 and 2010) as they grew older, compared to those who had already reached working age by 2003.

Table 9 Effects of chemical fertilizer price on key household outcomes

Explanatory variables	Dependent variables			
	Change in real per capita income	Change in real per capita agricultural income	Change in real per capita agricultural revenue	Change in real per capita off-farm income
ΔP	−3231.360 (2040.218)	−468.969 (285.596)	−991.162** (406.067)	−246.118 (2197.441)
Land size($t-1$)	−389.148 (358.131)	−186.630 (140.371)	−112.721 (168.779)	−571.514 (378.580)
ΔP*land size($t-1$)	−962.294 (861.458)	−475.524 (348.101)	−295.258 (422.896)	−1401.853 (846.827)
Δln(real farm wage)	−330.101 (398.331)	47.359** (23.103)	59.242* (31.574)	−507.947 (367.474)
Δln(tractor rental cost)	−426.764 (821.260)	−175.581 (181.732)	−562.448** (246.012)	−761.308 (727.505)
Household size (working age members) ($t-1$)	−172.733 (106.887)	−58.502* (28.937)	−42.140 (29.682)	1.119 (80.724)
Household size (non-working age members) ($t-1$)	192.227*** (62.538)	48.824* (24.987)	62.363** (30.491)	−25.970 (38.671)
Average education level of non-working age members ($t-1$)	199.455** (95.837)	50.212** (24.804)	46.884* (27.524)	53.425 (61.885)
Gender of household head ($t-1$)	−443.675 (610.903)	246.219* (138.263)	202.953 (145.084)	886.591 (535.435)
ln(manure endowment) ($t-1$)	367.321 (355.188)	85.325 (95.280)	127.440 (120.980)	−277.326 (201.471)
ln(agricultural capital) ($t-1$)	−518.030 (391.868)	−135.569 (81.509)	−152.411 (102.987)	−109.842 (206.613)
ln(household asset) ($t-1$)	143.987 (256.308)	54.495 (48.405)	112.593** (52.358)	306.554* (174.623)
Ruggedness	−13.907** (6.228)	0.777 (0.663)	0.877 (0.784)	3.765* (2.199)
Rural dummy (=1 if rural)	Yes	Yes	Yes	Yes
District dummy	Yes	Yes	Yes	Yes
Rural*District dummy	Yes	Yes	Yes	Yes
Constant term	Yes	Yes	Yes	Yes
Number of observations	251	258	258	258
p-value (H_0: model jointly insignificant)	0.000	0.000	0.000	0.000

Source Authors
Note Asterisks indicate the statistical significance of coefficients: *** 1%, ** 5%, * 1%
Numbers in parentheses are heteroskedasticity-robust standard errors

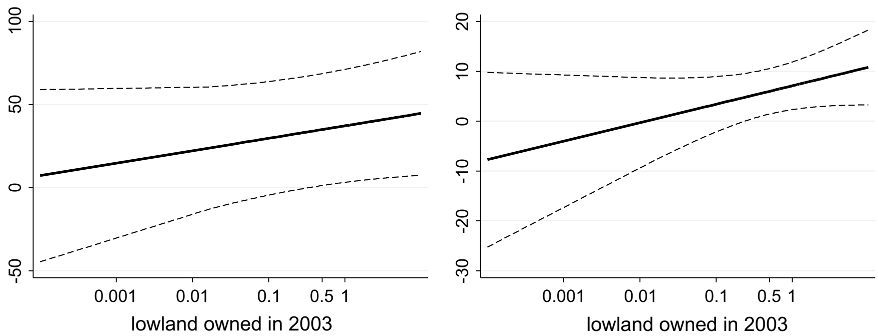

Fig. 7 Changes in per capita household income and agricultural income in response to chemical fertilizer price change, differentiated by the size of lowland owned in 2003; **a** household income; **b** agricultural income. *Source* Authors
Note y-axis shows the change in annual per capita household expenditure (equivalent to kilogram of cereals measured at local price)

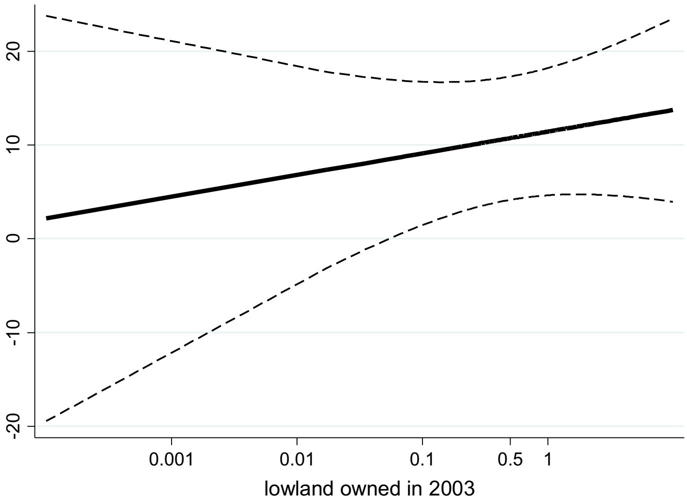

Fig. 8 Change in per capita agricultural revenue in response to chemical fertilizer price change, differentiated by the size of lowland owned in 2003. *Source* Authors
Note y-axis shows the change in annual per capita agricultural income (equivalent to kilogram of cereals measured at local price)

Potential Impact Pathways

Table 10 shows how the effects on total agricultural revenues are disaggregated across three categories, crop production, livestock production, and farmland rental revenues, while Fig. 9 illustrates a plot for livestock revenue, similar to Figs. 7 and 8. Aforementioned effects on agricultural income are driven by the effects on livestock

Table 10 Effects of chemical fertilizer price on livestock revenue, land rental revenue and crop revenue

Explanatory variables	Dependent variables		
	Change in per capita livestock revenue	Change in per capita renting revenue (including sharecropping revenue)	Change in per capita crop revenue
ΔP	−1198.83*** (138.487)	435.702** (192.649)	−535.875 (691.148)
Land size($t-1$)	−60.263 (49.464)	−119.619* (62.135)	47.147 (128.096)
ΔP*land size($t-1$)	−191.769 (138.535)	−311.224* (159.355)	176.271 (314.561)
Δln(real farm wage)	16.282 (28.414)	−0.494 (23.350)	16.997 (69.641)
Δln(tractor rental cost)	−43.974 (40.493)	−180.043* (102.223)	−1023.535** (431.003)
Household size (working age members) ($t-1$)	−26.981* (13.549)	−14.753 (15.275)	6.850 (36.427)
Household size (non-working age members) ($t-1$)	11.140 (13.103)	14.376 (12.978)	−5.796 (37.814)
Average education level of non-working age members ($t-1$)	16.258 (9.810)	25.586 (17.513)	−9.658 (28.986)
Gender of household head ($t-1$)	112.592 (82.264)	117.031* (60.011)	−45.629 (158.713)
ln(manure endowment) ($t-1$)	82.904 (54.854)	−65.158 (73.447)	−42.388 (94.084)
ln(agricultural capital) ($t-1$)	−39.924 (36.828)	20.955 (55.229)	−0.280 (73.967)
ln(household asset)($t-1$)	28.434 (28.731)	26.143* (13.595)	113.263 (107.016)
Ruggedness	0.926** (0.353)	−0.611 (0.408)	2.038*** (0.706)
Rural dummy (= 1 if rural)	Yes	Yes	Yes
District dummy	Yes	Yes	Yes
Rural*District dummy	Yes	Yes	Yes
Constant term	Yes	Yes	Yes
Number of observations	258	258	258
p-value (H_0: model jointly insignificant)	0.000	0.000	0.000

Source Authors
Note Asterisks indicate the statistical significance of coefficients: *** 1%, ** 5%, * 1%
Numbers in parentheses are heteroskedasticity-robust standard errors

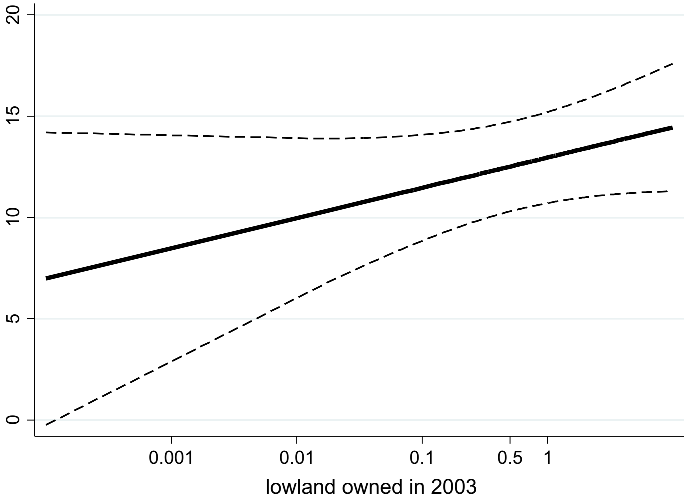

Fig. 9 Effects of reduced chemical fertilizer price on per capita livestock revenue, differentiated by the size of lowland owned in 2003. *Source* Authors
Note y-axis shows the change in annual per capita agricultural income (equivalent to kilogram of cereals measured at local price)

revenues and farmland rental revenues. On the other hand, the effects of chemical fertilizer prices on per capita crop revenues are generally insignificant across all farm sizes. Altogether, the findings suggest that the lower chemical fertilizer price increases per capita agricultural revenues or incomes for larger farms than small farms, through greater increases in per capita livestock revenues and farmland rental revenues. Larger farms, in the face of lower chemical fertilizer, typically increase livestock production without reducing farmland rental revenues. In contrast, for smaller farms, the clearest change is the shift from renting out farmland to own production, which does not lead to an increase in overall incomes from farmland.

Table 11 shows the effects of chemical fertilizer prices on the change in per capita livestock production costs, the change in per capita livestock fodder costs. Lower chemical fertilizer prices generally increase the livestock production costs, reflecting increased livestock production in Table 10. At the same time, lower chemical fertilizer price leads to lower livestock fodder costs. It is likely that the lower chemical fertilizer price leads to much greater fodder production on own farms, to the extent that overall expenditure on purchased fodder actually decreases in the presence of expanded livestock production. At the same time, effects on livestock production costs do not significantly vary across farm sizes. Furthermore, the coefficients on ΔP*land size$(t-1)$ for livestock fodder costs suggest that lower chemical fertilizer price leads to greater reduction in livestock fodder costs among larger farms, than among smaller farms.

Table 11 Effects of chemical fertilizer price on livestock production costs and expenses on purchased fodders

Explanatory variables	Dependent variables		
	Change in per capita livestock production costs	Change in per capita livestock fodder costs	Change in per capita values of surplus maize
ΔP	−288.893*** (30.625)	151.982*** (11.231)	−80.380*** (19.745)
Land size(t − 1)	−1.170 (7.248)	3.833* (2.164)	−4.470 (7.079)
ΔP*land size(t − 1)	3.949 (14.419)	8.960* (5.038)	−9.812 (15.296)
Δln(real farm wage)	2.245 (5.106)	0.319 (2.124)	−6.008 (5.723)
Δln(tractor rental cost)	−15.991 (18.965)	−7.793 (4.812)	−3.724 (9.405)
Household size (working age members) (t − 1)	−6.399** (2.543)	2.063 (1.369)	−2.393* (1.398)
Household size (non-working age members) (t − 1)	0.983 (1.999)	1.151 (0.932)	0.145 (0.934)
Average education level of non-working age members (t − 1)	0.735 (1.881)	−0.599 (0.667)	0.349 (1.074)
Gender of household head (t − 1)	3.653 (11.044)	−6.739 (7.375)	−4.501 (6.037)
ln(manure endowment) (t − 1)	28.269*** (8.722)	−5.148 (3.332)	−0.525 (3.561)
ln(agricultural capital) (t − 1)	−14.200** (6.477)	0.948 (1.808)	6.612 (5.013)
ln(household asset)(t − 1)	10.032 (6.557)	−1.428 (2.859)	−3.048 (3.027)
Ruggedness	−0.067 (0.063)	−0.509*** (0.022)	−0.014 (0.028)
Rural dummy (=1 if rural)	Yes	Yes	Yes
District dummy	Yes	Yes	Yes
Rural * District dummy	Yes	Yes	Yes
Constant term	Yes	Yes	Yes
Number of observations	258	258	258
p-value (H_0: model jointly insignificant)	0.000	0.000	0.000

Source Authors
Note Asterisks indicate the statistical significance of coefficients: *** 1%, ** 5%, * 1%
Numbers in parentheses are heteroskedasticity-robust standard errors

Results in Tables 10 and 11, suggest that, for larger farms, lower chemical fertilizer price leads to greater livestock revenues combined with lower fodder costs. Lower chemical fertilizer price may lead to the greater supply of fodder crops either from sharecropped tenants or from own farms, and this effect is greater among larger farms. NLSS data do not explicitly report the production of crops for fodder. However, from reported production and uses of maize, which is one of the most important sources of fodder in Nepal (Matthews and Pilbeam 2005), we can gain some insights into the quantities that were likely to have been allocated for fodder. Specifically, we calculated the amount of "surplus" maize, which is the total harvest minus the amount sold, given out to the landlord as rent, and consumed at home. While some of the remaining maize may be used for other purposes than fodder (such as seed), a significant share of it is likely to be used as fodder. Figure 10 shows that lower chemical fertilizer leads to greater production of surplus maize, with clearer effects observed among large farms, compared to small farms.

In addition, crops like maize tend to be more likely to be grown on sharecropped/rented plots, compared to other major crops in Nepal (Table 12). The share of harvests given out as payments to landlord among all harvested crops (in values) is about 8%, and 9–10% for rice and wheat, but about 19% for maize. This is again consistent with the hypothesis that lower chemical fertilizer price leads to greater livestock production through fodders supplied from own farms (through own production, or through renting/sharecropping out their farms).

The set of results presented above suggest that overall the lower chemical fertilizer price benefits larger farms more than smaller farms. The lower chemical

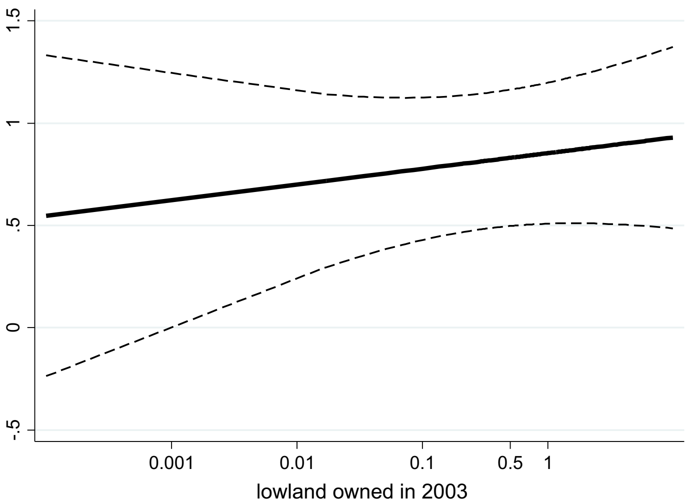

Fig. 10 The effects of lower chemical fertilizer price on the per capita value of surplus maize, differentiated by the size of lowland owned in 2003. *Source* Authors
Note y-axis shows the change in annual per capita agricultural income (equivalent to kilogram of cereals measured at local price)

Table 12 Share (%) of the harvest of each crop giving out to the landlord through sharecropping in Nepal Terai in 2010

Rice	Wheat	Maize	Lentils	All crops
9.8	8.6	18.9	17.8	8.4

Source Authors

fertilizer seems to encourage more large farms to rent/sharecrop out farmland (at the same time discourage more small farms from renting/sharecropping out farmland), from which they obtain relatively more forage that is then used to expand their livestock production. Large farms seem to extract greater overall benefits by receiving a greater share of the overall benefits from sharecropping/renting, than smaller farms do. One of potential technical factors that give large farms greater bargaining power is may be that the returns to intensive chemical fertilizer in is growing for large farms in Terai, as discussed in the previous section.

4 Conclusions

Fertilizer plays important roles in Nepalese agriculture. Its uses in the country have been low from the international standard, and increasing the intensity of its use has long been considered critical for agricultural sector development in Nepal. There has, however, been knowledge gap on how this can be achieved, and how exactly it would contribute to the agricultural sector development. This chapter, investigating the recent trends in chemical fertilizer use in Nepal, offers key insights that can partly fill such knowledge gap. In particular, it highlights the following aspects that are associated with both unique characteristics of Nepal, and an emerging agricultural sector issue; (1) comparisons between Terai and Hills/Mountains; (2) linkage between the growth of chemical fertilizer use and farm size in the Terai.

Chemical fertilizer use growths in the Terai and the Hills/Mountains have experienced diverging patterns, particularly in the last 10 or 20 years. During this period, both Terai and Hills/Mountains zones have seen reductions in real chemical fertilizer price, relative to the food price. Chemical fertilizer use in the Terai had grown considerably partly in response to such reduction in chemical fertilizer price, but it has stagnated in the Hills/Mountains as the demand has remained irresponsive to price.

The stagnation of chemical fertilizer use growth in the Hills/Mountains is consistent with the patterns in hilly, mountainous countries around the world, where organic manure, relative to chemical fertilizer, has remained an important source of soil nutrients. In the Nepal Hills/Mountains, a balanced promotion of chemical fertilizer and organic fertilizer (manure) may be important, drawing lessons from other countries.

At the same time, the trends of chemical fertilizer use growth in the Terai which accounts for the majority of farmland in Nepal have also exhibited important patterns that have implications on agricultural transformation in Nepal, including, among others, the future of smallholders. The set of evidence indicates that the recent growth of chemical fertilizer use in the Terai has been led by substantial growth of uses among relatively larger farms. While various market factors can potentially explain such pattern, the growing returns to intensive chemical fertilizer among relatively larger farms compared to smaller farms seem one of the primary factors. Such growths in returns to intensive chemical fertilizer use are partly enabled by the growing tractor adoptions through custom-hiring service that has contributed to the overall increases in returns to scale in agricultural production. Such technical advantages among relatively larger farms might have given them better bargaining power over smaller farms for sharecropping/land rental. While lower chemical fertilizer price currently leads to land transfer from larger farms to smaller farms through sharecropping or rental, a significant share of the gains from low price accrue to greater livestock production among relatively larger farms, potentially through increased supply of fodder from tenants.

The findings have important implications for the Nepalese government's efforts for promoting more intensive chemical fertilizer use in the country. The effects of reduced chemical fertilizer price are likely to differ across farm sizes and depend on interrelationships between crop and livestock, land transactions that farms are engaged in, and other external factors like growing mechanization. Lowering chemical fertilizer price with the aim of supporting smallholders may not always benefit them sufficiently, both in the Terai and the Hills/Mountains. Other more effective direct supports for smallholders may be necessary. At the same time, lowering chemical fertilizer prices can complement the growth of larger, more commercial farm households, particularly in the Terai. Altogether, fertilizer policy in Nepal should be designed within the broader framework of longer-term agricultural sector strategies for hilly/mountainous regions, and the future of smallholder farmers.

References

ADB (Asian Development Bank). (2013). *Draft final report. Technical assistance for the preparation of the agricultural development strategy*. 7762-NEP. Washington, DC.

APROSC (Agricultural Projects Services Centre). (1995). *Nepal agriculture perspective plan.* Kathmandu, Nepal/Washington, DC: Agricultural Projects Services Centre/John Mellor Associates, Inc.

FAO/IIASA (International Institute for Applied Systems Analysis)/ISRIC (International Soil Reference and Information Centre)/ISSCAS (Institute of Soil Science–Chinese Academy of Sciences) JRC (Joint Research Centre of the European Commission). (2012). *Harmonized world soil database, version 1.2*. Rome, Laxenburg, Austria: FAO, IIASA. http://webarchive.iiasa.ac.at/Research/LUC/External-World-soil-database/HTML/.

Gollin, D., Jedwab, R., & Vollrath, D. (2016). Urbanization with and without industrialization. *Journal of Economic Growth, 21*(1), 35–70.

Matthews, R. B., & Pilbeam, C. (2005). Modelling the long-term productivity and soil fertility of maize/millet cropping systems in the mid-hills of Nepal. *Agriculture, Ecosystems & Environment, 111*(1), 119–139.

Ministry of Agricultural Development of Nepal (MOAD). (2015). *Agriculture Development Strategy (ADS) 2015 to 2035*. Kathmandu, Nepal.

Nepal, CBS (Central Bureau of Statistics). (1996). *Nepal Living Standards Survey Report 1996: Main Findings*. Vol. 1. Computer disk. Washington, DC.

Nepal, CBS (Central Bureau of Statistics). (2004). *Nepal Living Standards Survey II (2003/04): Survey Design and Implementation.* Computer disk. Washington, DC.

Nepal, CBS (Central Bureau of Statistics). (2011). *Nepal Living Standards Survey 2011/11: Statistical Report.* Vol. 1. Computer disk. Washington, DC.

Pandey S. (2013). *Role of fertilizer in transforming agricultural economy in Nepal.* Unpublished report prepared for RESAKSS-ASIA, Washington, DC.

Pilbeam, C. J., Tripathi, B. P., Sherchan, D. P., Gregory, P. J., & Gaunt, J. (2000). Nitrogen balances for households in the Mid-Hills of Nepal. *Agriculture, Ecosystems & Environment, 79* (1), 61–72.

Rashid, S., Dorosh, P. A., Malek, M., & Lenma, S. (2013). Modern input promotion in sub-Saharan Africa: insights from Asian green revolution. *Agricultural Economics, 44*(6), 705–721.

Rigg, J., Salamanca, A., & Thompson, E. C. (2016). The puzzle of East and Southeast Asia's persistent smallholder. *Journal of Rural Studies, 43,* 118–133.

Sharma, V. P. (2012). *Dismantling fertilizer subsidies in India: Some issues and concerns for farm sector growth*. Indian Institute of Management Working paper. September 1, 2012. Indian Institute of Management, Ahmadabad, India.

Takeshima, H. (2017). Custom-hired tractor services and returns to scale in smallholder agriculture: A production function approach. *Agricultural Economics, 48*(3), 363–372.

Takeshima, H., Adhikari, R., Poudel, M. N., & Kumar, A. (2015). *Farm household typologies and mechanization patterns in Nepal Terai.* IFPRI Discussion Paper 01488.

Takeshima, H., Adhikari, R., Kaphle, B. D., Shivakoti, S., & Kumar, A. (2016a). *Determinants of chemical fertilizer use in Nepal: Insights based on price responsiveness and income effects.* IFPRI Discussion Paper 01507.

Takeshima, H., Shivakoti, S., Bhattarai, B., Karkee, M., Pokhrel, S., & Kumar, A. (2016b). *Farms size and effects of chemical fertilizer price on farm households: Insights from Nepal Terai.* IFPRI Discussion Paper 01578.

Takeshima, H., Adhikari, R., Kaphle, B. D., Shivakoti, S., & Kumar, A. (2017). Heterogeneous returns to chemical fertilizer at the intensive margins: Insights from Nepal. *Food Policy, 69,* 97–109.

World Bank. (2016). *World Bank Development Indicator*. Accessed on July 28, 2016.

Chapter 10
Agricultural Mechanization in Nepal—Patterns, Impacts, and Enabling Strategies for Promotion

Hiroyuki Takeshima and Madhusudan Bhattarai

Abstract This chapter assesses the overall trends of mechanization in Nepal, identifies the determinants of its adoption, and assesses their impacts on household incomes and agricultural productivity. It mainly focuses on key agricultural machineries—tractors, threshers, and pumps, which all have generally substantive transformational effects compared to more traditional tools. The chapter also identifies policy implications for the adoption of mechanization by smallholders.

Acronyms

ADBN	Agricultural Development Bank of Nepal
APP	Agricultural Perspective Plan
CSAM	Center for Sustainable Agricultural Mechanization
HM	Hills/Mountains
IRRI	International Rice Research Institute
LRSC	Land Reform Saving Corporation
MoAD	Ministry of Agricultural Development
NAMC	National Agricultural Mechanization Committee
NARMA	Centre for Natural Resources Management, Analysis, Training and Policy Research
NLSS	Nepal Living Standard Survey
PSM	Propensity score matching
USD	US Dollar

Sections of this chapter draw from IFPRI Discussion Paper 1662 (Takeshima 2017b).

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G. Thapa et al. (eds.), *Agricultural Transformation in Nepal*,
https://doi.org/10.1007/978-981-32-9648-0_10

VAT	Value-added tax
VDC	Village Development Committee

1 Background

Agricultural mechanization plays important roles in agricultural development, particularly modernizing the ways farm power is provided that are needed for various operations. Mechanization in Nepal has grown steadily, particularly, in the last 20 years, although the pace has varied considerably across regions and agroecological belts, as well as the type of machinery. While tractor use in the Terai has grown at relatively fast rates, tractors and power tillers in Hills, as well as mechanical threshers and irrigation pumps in Terai had seen some growths. Their adoption patterns do not necessarily coincide those for tractors in the Terai and may have different implications on agricultural production than tractors do.

Tractors provide important motive forces that are necessary for various farming operations. At an early stage of mechanization, they are primarily used for power-intensive operations like tillage and/or transportation. In countries like Nepal where smallholder farms dominate, some farmers may have greater incentives to operate intensive tillage on the farms to improve soil conditions and raise the efficiency of fertilizer nutrients applied or improve water retention for certain crops like rice. Tractors may also be used for transporting goods where other vehicles like pickups have trouble reaching, particularly in Hilly/Mountainous areas in Nepal.

Mechanical threshing in Nepal is mostly used for the threshing of its major cereal crops (rice and wheat), as well as lentils. Threshing activities were previously done by human and animals. Crop intensity in Nepal is generally high, with most farmland cultivated multiple times a year. The need for timely harvesting and threshing can be high, and mechanical threshers can mitigate the potential labor shortages during the harvesting seasons and land preparation for the next production seasons (Pingali 2007). This is particularly true if the harvesting period falls on rainy seasons (particularly for wheat in Nepal), where timely threshing is necessary so that grains do not spoil from moisture (Pingali 2007). The threshing operation, although power intensive, is generally not mechanized where wages are low and harvested volumes are small. Even when land is abundant, therefore, if agricultural production is mainly for subsistence, threshing is the last of the power-intensive operations to be mechanized (Pingali 2007). In areas with Nepal where farming is still mostly subsistence, adoption of threshing machines can be limited. Cereal in Nepal is also harvested for livestock fodders, such as rice stalk. As the livestock production continues to grow, harvests per person continue to grow, which is an important precondition for mechanization of threshing activity (Pingali 2007).

Pumps in Nepal may be increasingly used for extracting groundwater for irrigation, as opposed to relying on canals for irrigation (Shah et al. 2006, 2009).

Where the maintenance of public irrigation infrastructure is insufficient but returns from irrigation are high, farmers may have incentives to invest in irrigation pumps. Groundwater is becoming an increasingly important source of irrigation in Nepal (particularly in Terai) (Takeshima et al. 2015b), and consequently the demand may be growing for pumps.

Despite the growths in the adoptions of tractors, threshers, and pumps in Nepal, the evidence is still scarce regarding the determinants of their adoptions and impacts on household incomes, as well as various agricultural production practices. This chapter attempts to partly fill this gap by showing some evidence on the patterns of the growing adoptions of these three types of machines in Terai, various socioeconomic/agroecological factors that are likely to be causing the adoptions, and the impacts of these adoptions. It shows that adoptions of different machines are affected by different factors. Adoptions are also affected by the indicators of the proximity to machine owners, suggesting the accessibility constraints that still exist despite the growths. The examinations of determinants offer various insights into potential enabling strategies that can facilitate the mechanization where it is currently at suboptimal levels. It then shows that adoptions of these machineries have significant effects on agricultural practices and, in many cases, on agricultural incomes of the households, suggesting the important roles played by mechanization on overall agricultural development in Nepal.

2 History of Nepalese Agricultural Mechanization Policies with Particular Focus on Tractors, Threshers, and Water Pumps[1]

Agricultural mechanization in Nepal has a long history, although widespread mechanization growths did not happen until the twenty-first century. In 1924, the first single cylinder tractor was introduced into Nepal (CSAM 2014). In 1964, 64 tractors and 30 pump sets were introduced (CSAM 2014). In 1964, the privately owned Kalpana Trading Company became the Nepalese distributor of Indian-made Kirloskar diesel engine pump sets (Khoju 1983). Mechanization of water-lifting for irrigation through pumps started growing on noticeable scales in Nepal in the early 1960s when early adopters purchased pump sets from nearby Indian border towns (Khoju 1983).

From the late 1960s and throughout the 1970s, machines had been imported consecutively under various government initiatives, part of which had been financed by the external donors. Within the Nepalese institutions, the Agricultural Development Bank of Nepal (ADBN) had started providing formal finance to the agricultural sector in 1967 and continued such support through the 1970s (Khoju 1983). In 1975, two other commercial banks, Rastriya Baniya Bank and Nepal

[1]This section draws largely on CSAM (2014), Biggs et al. (2002) and Khoju (1983).

Bank, following a directive from the Nepal Rastra Bank, began providing finance for agricultural enterprises (Khoju 1983). Pumps had been imported in large quantities several times; in 1969, the former Land Reform Saving Corporation (LRSC) imported 1000 pump set units from Japan, which had been a major boost (Khoju 1983); in 1976, while the ADBN imported 1160 pump sets as part of the second Agricultural Credit Projects funded by the Asian Development Bank, the Agricultural Inputs Corporation imported 898 pump sets in addition to regular imports by private dealers (Khoju 1983); in 1978, ADBN again imported 1400 pump sets. By 1979, there were approximately 9000 pump sets in Nepal. By early 1980, mechanization of water-lifting through pump sets (5hp) had been becoming popular in the Terai (Khoju 1983).

In the 1980s, the support for mechanization had generally weakened. In 1980–85, while the sixth five-year plan initially aimed for distributing 5900 pump sets under various integrated agricultural projects (Khoju 1983), ADBN discouraged financing tractor/machines. This was partly due to the fear of labor displacement (Biggs et al. 2002). During this time, private importers had continued importing pump sets, threshers, tractors and power tillers, including power tillers from Korea, and wheat threshers from India (Biggs et al. 2002). International Rice Research Institute (IRRI)'s axial-flow threshers had been fabricated in Nepal since 1984; by mid-1980s, Nepal had one manufacturer and 100 fabricators collaborating with IRRI (1986 p. 383). The local production of wheat threshers had been some of the few areas for which Nepal had involved in productions of small machinery by 2000 (Biggs et al. 2002).

In 1987, the first National Agricultural Mechanization Committee (NAMC) meeting was held (Biggs et al. 2002), indicating government's renewed focus on mechanization. However, the focus on mechanization had remained low. In 1995, subsidies in pump sets were removed (CSAM 2014). The importation of power tillers had been discontinued between 1993 and 1999 (Biggs et al. 2002). The NAMC did not become reactivated until 1999 (Biggs et al. 2002).

During this time, some support measures had been put in place. VAT Act in 1996 provided tax exemptions for selected agricultural products including agricultural machinery. In 2004, Poverty Alleviation Fund in Nepal was prepared to refinance loans for two-wheel tractors and other smaller-scale equipment to poorer rural households (Biggs and Justice 2015).

The Agricultural Perspective Plan (APP), a long-term agricultural strategic plan launched in 1995/96, continued to take a conservative stance against mechanization and promoted only labor-intensive machine technology to be popularized (Biggs et al. 2002). This stance had remained in the 2006 National Agriculture Policy, as it did not provide specific government programs or activities for promoting mechanization (NARMA 2016).

Finally, in 2014, Ministry of Agricultural Development (MoAD) approved Agricultural Mechanization Subsidy Mobilization Directives 2070 for distributing subsidy through the Department of Agricultural Engineering (NARMA 2016). In 2015, Agricultural Development Strategy: acknowledged agricultural mechanization as one of 13 priority areas.

At the same time, as is described in the next section, the use of tractors and threshers started growing at a wider scale in the Terai zone, particularly since the late 1990s. The number of pump sets increased from 10,000 in 1979 to 50,000 in 1999 (Biggs et al. 2002), although this is still low compared to other Asian countries. The number of tractors had increased from approximately 2000 in 1978 (Roumasset and Thapa 1983) to approximately 7000 in 1990 and 20,000 in 2000 (CSAM 2014). According to Biggs et al. (2002), by 2002, Indian-made diesel-powered pump sets had become relatively widely used in Nepal Terai, providing the stationary small power units. During the same period, wheat threshers had become increasingly adopted, mostly operated by the pump set's diesel engine. By 2002, these mechanical threshers had been threshing considerable shares of Terai wheat. Biggs et al. (2002) further document that oftentimes, it is the local zamindhars who provide threshing service on a rent basis to surrounding villagers (up to 15% of threshed wheat taken in kind payment) (Biggs et al. 2002). Lately, these are increasingly powered by the diesel engines of pump sets of Chinese origin (Joshi et al. 2012).

3 Mechanization Growth Patterns in Terai and Hills/Mountains

This section summarizes the patterns of mechanization growths (adoptions of tractors, threshers, and pumps) over time, across agroecological belts and development regions, based on Nepal Living Standard Survey (NLSS) data.

3.1 Growths of Tractors, Threshers, and Pumps Uses

Table 1 summarizes the trends of the share (%) of farm households using and owning tractors, threshers, and pumps, calculated from the NLSS data. In Nepal as a whole, the uses of all three types of machines grew between 1995 and 2010.

Tractor users grew from 5 to 23% of total farm households between 1995 and 2010. This increase had been mostly led by the growth in the Terai where it increased from 8 to 46%. Within the Terai, it first grew in the Western and Central regions, and later spread to Eastern and Mid-Far-Western regions. In the Hills, while the Central region had seen some growth, from 6 to 20%, the growth in the rest of the region had been slow. The shares of tractor owners had remained low at 1 or 2% in the Terai, suggesting that much of the growths in tractor uses had been through machine rentals rather than ownerships.

Thresher users grew from 4 to 21% between 1995 and 2010. Again, this increase had been led by the growth in the Terai where it increased from 8 to 43%. Within the Terai, it grew in the Central and Mid-Far-Western regions, and later on in the

Table 1 Adoptions of tractors, threshers, and pumps in Nepal (% of farm household using and owning)[a]

	Tractors			Threshers			Pump		
	1995	2003	2010	1995	2003	2010	1995	2003	2010
Nepal	5 (1)	16 (0)	23 (1)	4 (1)	14 (0)	21 (0)	2	2	7
Terai	8 (1)	29 (1)	46 (2)	8 (1)	25 (0)	43 (0)	5	4	14
Eastern	2 (1)	13 (1)	33 (2)	2 (1)	20 (0)	38 (0)	2	4	15
Central	11 (1)	39 (1)	56 (2)	13 (0)	31 (0)	52 (0)	2	3	14
Western	15 (2)	56 (1)	72 (3)	15 (1)	19 (0)	43 (0)	6	6	16
Mid-Western/ Far-Western	4 (1)	11 (1)	28 (1)	1 (1)	28 (0)	34 (0)	11	6	12
Hills	3 (1)	5 (0)	8 (0)	1 (0)	3 (0)	3 (0)	0	0	1
Central	6 (1)	9 (0)	20 (1)	2 (1)	10 (0)	8 (0)	0	0	1
Excl. Central	1 (1)	2 (0)	3 (0)	0 (0)	0 (0)	1 (0)	0	0	0
Mountains	1 (1)	1 (0)	2 (0)	0 (0)	0 (0)	0 (0)	0	0	0

Source NLSS
Note [a]The shares are calculated among all households in which at least one household member is engaged in agricultural activities

Western and Eastern regions. Therefore, the regional variations in the growths of thresher uses within the Terai are somewhat different from those of the tractors. The growths of threshers had remained low in the Hills, including the Central region. Similar to tractors, the growth of owners had remained very low, suggesting that much of the growths in thresher uses had been through rentals rather than ownerships.

Pump ownership had increased from 2 to 7% between 1995 and 2010. The growth had been slightly faster in the Terai (5–14%). The growth has been relatively even across regions within the Terai. The adoptions have remained very low in the Hills. Lastly, adoption in the Mountains zone has remained low for all three types of machines.

There are also treadle pumps that are widely used in Nepal. NLSS does not differentiate the types of pumps and therefore cannot be distinguished from treadle pumps. However, NLSS also reports the value of pumps. The median prices of pumps in the Terai in NLSS data are around 15,000 rupee. In Nepal, diesel/electric pumps can typically cost at least 15,000 rupees (http://www.naef-nepal.org/Chinesepumpset.htm), while treadle pumps can cost around USD50–100 in Africa where the price is likely to be higher than in Nepal (Giordano et al. 2012). Therefore, approximately half of the pumps owned in Nepal are likely to be motorized pumps, while the remaining half may be manually operated treadle pumps.

3.2 Wage Increases

During 1995 and 2010, real farm wages have also risen in all of Terai, together with Hills and Mountains (Table 2). In Terai, real wages have increased by about 50% between 1995 and 2010, with relatively small variations across regions. Although real wages were relatively lower in the Central regions and higher in the Far-Western region in 1995 and 2003, these variations have almost disappeared in 2010 (though there may still be intra-regional variations). Generally, rising real farm wages are consistent with growing mechanization. Interestingly, while wages have risen at similar paces in the Hills and Mountains, tractor adoption is much slower in these regions as we saw earlier. The increase in real wages, therefore, partly explains the growths in mechanization in Terai, but the effects of wages seem to differ between Terai and other zones.

3.3 Mechanization and Cropping Patterns

Uses of tractors, threshers, and pumps are associated with different cropping patterns than non-users. Table 3 shows the share of farmers growing each of widely grown crops in Nepal, and how they differ between the users of each type of machine. Generally, the uses of machines are associated with higher shares of farmers growing each crop, except a few crops like maize, vegetables, or fruits. The adoptions of mechanizations and cropping patterns may therefore differ between crops.

At the same time, the share of farm households using irrigation through tube well and borehole had increased from 14 to 22% in 1995 and 2003 to 41% in 2010, partly replacing canal irrigation. The increase in water pump ownership is likely to have changed the mechanization of irrigation practices and potentially has important implications for various agricultural outcomes. The comparisons between tube well/borehole irrigators and canal irrigators suggest that uses of pumps are slightly less associated with certain crops like maize, compared to other irrigators.

Table 2 Real farm wages (village district median) (ratio of daily wage to 1 kg of rice and wheat price)

Ecological belts/ Development regions	1995					2003					2010/11				
	All	Tractor owners	Tractor renters	Draft anima users	Non-mechanized	All	Tractor owners	Tractor renters	Draft anima users	Non-mechanized	All	Tractor owners	Tractor renters	Draft anima users	Non-mechanized
Terai	**8**	**8**	**8**	**8**	**8**	**10**	**10**	**10**	**10**	**10**	**12**	**12**	**12**	**12**	**12**
Eastern	8	8	8	8	8	10	10	10	10	10	12	12	12	12	12
Central	7	7	8	7	6	10	10	10	10	10	12	12	12	12	12
Western	8	8	8	8	8	10	11	11	11	10	12	12	12	12	12
Mid-Western	8	8	8	8	8	10		11	10	10	12	12	12	12	12
Far-Western	9		8		10	10	12	12	11	10	12	12	12	12	12
Hills	7	7	8	7	7	9	9	11	9	9	11	11	11	11	11
Mountains	7	6		7	7	10			10	10	12		12	12	12

Source Authors' calculations

[a]Wages are averages of daily male wages for plowing, planting, weeding, and harvesting

Table 3 Mechanization and cropping patterns (% of farmers growing in 2010, Terai)

	Tractors		Threshers		Pumps			Irrigation		
	Users	Non-users	Users	Non-users	High-value pump owners	Low-value pump owners	No pump owners	Tube well/ borehole irrigators	Canal irrigators	Non-irrigators
Rice	95	74	98	73	98	89	81	94	93	67
Wheat	70	50	83	40	72	58	58	77	71	39
Maize	38	44	34	47	53	49	39	32	48	42
Black Gram	26	24	26	24	41	34	23	20	30	13
Lentil	58	41	58	43	66	56	48	58	58	37
Winter potato	57	53	60	51	70	79	52	62	61	40
Mustard	48	35	48	36	61	59	38	47	49	28
Onions	37	37	43	31	47	57	34	41	36	23
Garlic	42	40	45	38	49	55	39	43	38	32
Winter vegetables	60	67	61	66	77	74	62	63	60	56
Summer vegetables	51	57	50	58	62	60	53	48	53	51
Mango	35	27	36	27	55	55	27	32	22	26
Banana	18	19	18	20	33	33	16	17	17	14
Papaya	17	17	16	18	31	21	16	13	14	13

Source Authors

4 Determinants of Mechanization by Smallholders with the Primary Focus on Tractor, Thresher, and Water Pump

4.1 Determinants—Tractors, Threshers, Water Pump

This section describes the determinants of decisions to rent tractors, threshers, or own pumps, and how much to pay for them. We base the estimators on Heckman's (1979) sample selection model. It is extended to include pseudo-panel specifications that incorporate Chamberlain (1984)-style correlated random effects to control for Village Development Committee (VDC) level unobserved time-invariant fixed effects (similar approaches are used in other studies including Takeshima and Nkonya 2014). The analyses are conducted using data from three rounds of the NLSS, conducted in 1995, 2003, and 2010, respectively. Three rounds of data are combined, but time variables are included to capture the year-specific effects on adoptions. Key sets of variables are selected from both socioeconomic conditions and agroecological conditions. Their definitions and data sources are described in Takeshima et al. (2016a, b).

Table 4 summarizes the determinants of (a) probability that a farm household adopts hired tractors, threshers, or invests into pumps and (b) the expenditures on hired tractors or threshers, or pump upon adoption/investment. While (a) captures the determinants of what types of farmers adopt or invest, (b) captures the determinants on the intensity of such adoptions or investments. The numbers represent marginal effects evaluated using the means of all explanatory variables. For example, for an average household in the sample, a 1-ha increase in the lowland farm area owned by a farm household is associated with a 0.43% point increase in the probability that the household rents in tractors, holding other factors constant. The number of observations is smaller in column (b) because, as Heckman's model prescribes, it was restricted to those who actually adopted or invested in respective machines.

These results in Table 4 are reduced form determinants, which combine both supply and demand factors, as well as sources of market and institutional imperfections, all of which can affect the equilibrium adoption/investment and spending patterns. Therefore, coefficients are interpreted with such mechanisms in mind.

The set of statistically significant determinants is generally consistent with the economic theory of agricultural mechanization. While certain factors are commonly associated with the adoptions or investments into more than one types of machine, effects of some factors vary considerably across machines. For example, greater sizes of lowland area owned are associated with both the adoption and intensive uses of all machines, except the spending intensity on the value of pump. However, similar effects were not consistently observed for the size of upland owned. The demand for rented tractors/threshers and investments into pumps is particularly strong in the lowlands. These are consistent with the conventional views that mechanization and farm size are often complementary to each other, and overall

Table 4 Determinants of tractor use based on Heckman's (1979) estimation model (all agroecological belts combined)[a]

	Tractors		Threshing machine		Pump	
Explanatory variables	(a) Probability (%) of adopting hired tractors	(b) Real annual expenditures for hired tractors (in 100 kg of cereal)	(a) Probability (%) of adopting hired threshers	(b) Real annual expenditures for hired threshers (in 100 kg of cereal)	(a) Probability (%) of investing in pump	(b) real value in pump upon investment (in 100 kg of cereal)
Land area owned (lowland, ha)	0.426*	0.488***	0.360*	0.442***	0.034*	0.139
Land area owned (upland, ha)	−0.302	0.420**	−1.057**	−0.156	0.045**	-0.253
Number of owned farm plots	0.002	0.010	0.092	0.019	0.010	0.283
Ln (real asset value of farmland)	0.819***	0.350***	0.615***	0.257**	0.078***	−0.630
Ln (real asset value of livestock)	0.201***	0.098***	0.148***	0.062*	0.010	0.078
Ln (real asset value of farm equipment)[b]	0.243***	0.137***	0.068	0.068*	0.004	1.123***
Ln (real asset value of other assets)	0.173	0.073	−0.070	0.034	0.055***	1.253**
Piped-in water as main source of drinking water (1 = yes)	−0.244	−0.150	−0.002	0.055	−0.073	−2.372
Owns house (1 = yes)	−1.494	−1.065*	−0.552	−0.771	0.080	−1.043
Electricity the main source of light (1 = yes)	1.997***	0.812***	0.343	0.141	0.101*	−1.625
	−0.171	−0.235	−0.170	−0.061	−0.026	1.605

(continued)

Table 4 (continued)

	Tractors		Threshing machine		Pump	
Explanatory variables	(a) Probability (%) of adopting hired tractors	(b) Real annual expenditures for hired tractors (in 100 kg of cereal)	(a) Probability (%) of adopting hired threshers	(b) Real annual expenditures for hired threshers (in 100 kg of cereal)	(a) Probability (%) of investing in pump	(b) real value in pump upon investment (in 100 kg of cereal)
Wood the main source of cooking fuel (1 = yes)						
Access to garbage disposal services (1 = yes)	−0.262	−0.649*	−0.453	−0.227	0.130	8.502**
Uses garbage for fertilizer (1 = yes)	−0.285	−0.049	−0.470	−0.117	0.033	−0.737
Household male member ≥ 20 years old	−0.556**	−0.109	0.168	0.096	0.026	−0.130
Household female member ≥ 20	0.477**	0.138	0.266	0.117	0.007	−0.017
Household (children) (<20)	−0.298***	−0.046	−0.002	0.017	0.299***	−0.193
Household head gender (female = 1)	−0.250	0.131	0.374	0.158	0.005	1.615
Household head literate (yes = 1)	1.188***	0.373**	0.466	0.041	0.065	0.601
Average years of education (working-age member)	0.059	0.043*	0.023	0.025	0.015**	−0.250
Real wage (daily wage) (kg of cereals)	0.108	0.119***	−0.108	0.022	0.021	−0.785

(continued)

Table 4 (continued)

	Tractors		Threshing machine		Pump	
Explanatory variables	(a) Probability (%) of adopting hired tractors	(b) Real annual expenditures for hired tractors (in 100 kg of cereal)	(a) Probability (%) of adopting hired threshers	(b) Real annual expenditures for hired threshers (in 100 kg of cereal)	(a) Probability (%) of investing in pump	(b) real value in pump upon investment (in 100 kg of cereal)
Owns draft animal (yes = 1)	−0.005	−0.003	0.005	0.025	0.000	−0.079
Real price of urea	0.319	−0.006	−0.386	−0.317	−0.020	0.467
Real price of DAP	−0.395	0.217	−0.411	0.027	−0.074	−1.201
Real rental price of machines per hour reported in the community survey[c]	−0.006	−0.001	0.007	0.004	0.007	0.390**
Farmers within VDC irrigating (%)	0.000	−0.008	0.012	0.001	−0.003	0.110**
Whether credit was obtained in previous year (yes = 1)	0.003	0.001	0.007**	0.001	0.000	−0.024
Whether formal credit was obtained in previous year (yes = 1)	0.007	0.001	0.009	0.003	0.000	0.013
Terrain ruggedness index	−0.009***	−0.002	−0.005**	−0.004	0.000	0.022
Elevation (VDC median, m)	−0.002*	−0.001	0.000	0.001	0.000	0.010
Rainfall (historical average, mm)	0.030	0.014*	−0.033*	−0.013	−0.002	−0.167*

(continued)

Table 4 (continued)

	Tractors		Threshing machine		Pump	
Explanatory variables	(a) Probability (%) of adopting hired tractors	(b) Real annual expenditures for hired tractors (in 100 kg of cereal)	(a) Probability (%) of adopting hired threshers	(b) Real annual expenditures for hired threshers (in 100 kg of cereal)	(a) Probability (%) of investing in pump	(b) real value in pump upon investment (in 100 kg of cereal)
Rainfall (historical standard deviation, mm)	0.024	−0.017	0.109***	0.039	0.004	0.000
Average solar radiation index	0.001	0.000	0.008***	0.003**	0.000	−0.007
Euclidean distance to the nearest major river	−0.441**	−0.210**	−0.044	−0.070	−0.034	−0.099
Euclidean distance to the nearest Indian border	0.176	0.006	0.427***	0.123	0.019	2.433***
Euclidean distance to the nearest ARS	0.032	−0.009	−0.361**	−0.079	−0.014	−0.973
Similarity of soils to ARS-located areas	1.463	0.366	−1.348	−0.371	0.111	2.971
Ln (minutes to travel to the nearest bank)	−0.036	−0.144	−0.078	−0.023	0.004	1.166
Ln (minutes to travel to the nearest bus stop)	0.040	0.088	0.309	0.089	−0.038	1.356
Ln (minutes to travel to the nearest cooperatives)	−0.038	0.156	−0.146	0.168	0.038	0.124
Ln (minutes to travel to the nearest market center)	−0.301	−0.358***	−0.060	−0.223*	−0.012	−0.445
	−0.420*	−0.089	−0.237	−0.092	0.055**	−1.661*

(continued)

Table 4 (continued)

	Tractors		Threshing machine		Pump	
Explanatory variables	(a) Probability (%) of adopting hired tractors	(b) Real annual expenditures for hired tractors (in 100 kg of cereal)	(a) Probability (%) of adopting hired threshers	(b) Real annual expenditures for hired threshers (in 100 kg of cereal)	(a) Probability (%) of investing in pump	(b) real value in pump upon investment (in 100 kg of cereal)
Ln (minutes to travel to the nearest paved road)						
Ln (minutes to travel to the nearest shop)	−0.043	−0.058	−0.499**	−0.178	−0.002	−0.068
Advanced caste (sample share within VDC) (%)	0.038	−0.005	−0.064**	−0.037*	0.003	−0.060
Non-indigenous population (sample share within VDC) (%)	0.006	0.015	−0.051**	−0.021	0.000	0.155
Sector (rural = 1)	−1.224**	−0.123	−0.106	−0.191	−0.130*	3.313
Agricultural land per capita within VDC (10,000 hectares [ha] per capita)	−0.286	−0.281	0.114	0.615	0.358	1.300
Households growing rice within VDC (%)	0.077***	0.026***	0.031***	0.014*	0.002	0.038
Households growing wheat within VDC (%)	−0.003	0.002	0.074***	0.030***	−0.001	−0.139***
Households growing maize within VDC (%)	−0.030***	−0.003	0.002	−0.001	0.000	−0.086**
Households growing lentil within VDC (%)	−0.019**	−0.005	−0.019***	−0.004	−0.001	0.000

(continued)

Table 4 (continued)

Explanatory variables	Tractors: (a) Probability (%) of adopting hired tractors	Tractors: (b) Real annual expenditures for hired tractors (in 100 kg of cereal)	Threshing machine: (a) Probability (%) of adopting hired threshers	Threshing machine: (b) Real annual expenditures for hired threshers (in 100 kg of cereal)	Pump: (a) Probability (%) of investing in pump	Pump: (b) real value in pump upon investment (in 100 kg of cereal)
Households growing vegetables within VDC (%)	0.030***	0.004	0.008	0.004	0.000	0.019
Households owning tractors within VDC (%) (sample mean) in HM	0.340**					
Households owning tractors within VDC (%) (sample mean) in the Terai	−0.131					
Households owning threshers within VDC (%) (sample mean) in HM			0.284**			
Households owning threshers within VDC (%) (sample mean) in the Terai			0.070			
Households owning pump within district (%) (sample mean) in HM					0.086***	
Farm households owning pump within district (%) (sample mean) in the Terai					0.024	
District time average	Included	Included	Included	Included	Included	Included

(continued)

Table 4 (continued)

	Tractors		Threshing machine		Pump	
Explanatory variables	(a) Probability (%) of adopting hired tractors	(b) Real annual expenditures for hired tractors (in 100 kg of cereal)	(a) Probability (%) of adopting hired threshers	(b) Real annual expenditures for hired threshers (in 100 kg of cereal)	(a) Probability (%) of investing in pump	(b) real value in pump upon investment (in 100 kg of cereal)
Region, agroecological belt, soil, year dummies, constant	Included	Included	Included	Included	Included	Included
Number of observations[d]	7153	1345	6435	1159	6495	336
p value (H_0: coefficients are jointly insignificant)	0.000	0.000	0.000	0.000	0.000	0.000

Source Authors' estimations. Asterisks indicate the statistical significance; *10%; **5%; ***1%. HM = Hills/Mountains [a]Numbers are marginal effects on (a) the probability (%) of renting tractors, threshers, or investing in pumps and (b) the expenses for hiring tractors, threshers, or pumps upon the adoptions

[b]For pump equation, values of pumps are subtracted

[c]This variable is the rental rate of each corresponding machine

[d]Samples for threshers and pumps are smaller because there are no adopters in the Mountains zone in the sample and the estimations cause perfect collinearity. In addition, for thresher equation, areas with minor soils are excluded for the same reasons

demands are greater in the lowlands where farming tends to use power more intensively. Conditional on the size of farmland owned, the higher value of such land is associated with a greater adoptions or investments into machineries. This may be because more valuable land may be more fertile and responds well to intensive cultivation and, as a result, raises the demand for mechanization. Greater holdings of livestock and farm equipment likewise seemed to generally encourage the use of hired tractors and threshers, either because of the need to intensively grow feed crops or the availability of complementary equipment to raise the returns on mechanized land preparation, threshing, or transport.

Having electricity as the main source of lighting in the house potentially releases household members from generating alternative sources of light and increases the availability of household members to meet the greater labor needs (such as weeding, planting, and harvesting) that follow land preparation with tractors. Electricity also allows running electric pump, often saving operational costs relative to running pump on diesel in South Asia (Singh and Kumar 2008; Shah et al. 2009).

Households with many adult female household members may be more likely to rent tractors because their labor can complement tractors in carrying out subsequent farming activities. On the other hand, male family members tend to be engaged in power-intensive activities and tend to substitute tractors. Higher education level and literacy of household members may both raise their opportunity costs for farming and may induce mechanization through tractors or pumps. Higher literacy and education may also be important in understanding the complex roles of land preparations on soils, outputs, and how using tractors have different effects on these than manual labor. Similarly, higher real wages within an area seem to induce more intensive use of hired tractors. Adoptions and spending for threshers or pumps are generally less responsive to these factors, possibly because both threshing and water extraction may be relatively more gender-neutral activities than land preparation that is substituted by tractors. Also, understanding the effects of mechanization of threshing may not require greater literacy or education, relative to aforementioned needs to understand the effects of mechanization of land preparation on soils structures and outputs.

Prices of chemical fertilizer generally have insignificant effects. This reflects the possibility that demand for mechanization is unlikely to be unaffected by the changes in the prices of complementary inputs alone. Rental prices of each machine reported at the community also generally have little effects, possibly because the adoption is affected more by the accessibility to custom hiring services, rather than the prices. Only the values of pumps invested are associated with higher pump rental costs, because pumps are cheaper than tractors and threshers and relatively easier to invest in. Similarly, history of obtaining credit has generally little effect.

The adoptions of hired tractors and threshers are discouraged in areas with more rugged terrain (and also with higher elevations for the case of tractors) because greater ruggedness may raise the costs of tractor movement between farms. Investment values for pumps are greater in areas with historically lower rainfall. In areas with greater rainfall uncertainty, the adoption of threshing is higher possibly because of greater demand to complete threshing of dry season harvests before the rain starts. While in some arid countries irrigation pump is also used to mitigate the effects of rainfall risks (Takeshima and Yamauchi 2012), such relationship is not observed in Nepal possibly because the overall rainfall is generally sufficient. This is also consistent with strong associations of thresher uses and production of wheat which is predominantly grown in dry season in Nepal. Greater average solar radiation during the year is positively associated with threshers, possibly because of greater harvests for many crops that tend to respond to higher solar radiation. Its effect is less clear for tractors or pumps, since farmers may not see the effects of higher solar radiation until harvest periods.

Proximity to the nearest major rivers is positively associated with tractor adoptions, possibly because of fertile soils that withstand and respond to intensive and continuous tillage. Threshers and pumps adoptions are greater in areas further away from the Indian border, possibly because of lower availability of seasonal laborers from neighboring Indian states like Bihar where agricultural wages are sometimes lower (note that aforementioned wage variable reported at the community level may not capture detailed seasonal, intra-communal variations in informal wages which may be more affected by the proximity to Indian border).[2] Thresher adoptions are higher in areas closer to the nearest Agricultural Research Stations, possibly because of greater availability of higher-yielding varieties that bear greater harvests.

Non-indigenous households[3] tended to spend less on thresher services, suggesting heterogeneous effects across different ethnicities. Adoptions are higher in more urban areas, or areas with better access to the nearest market center, paved road, or shops and a paved road, consistent with the hypotheses that greater market demand for crops generally induce intensifications and growth of mechanization demand (Boserup 1965).[4] However, since population density relative to agricultural area in Nepal is already generally high, its spatial variation does not significantly affect the mechanization adoptions.

The mechanization adoptions are also correlated with cropping systems in the area. Rice grown areas observe higher adoptions of tractors and threshers. Threshers adoptions are particularly higher in wheat-producing areas. On the other hand, while pump adoption is not affected, real values of pumps upon adoption are lower in wheat or maize producing areas, despite that these crops are often produced in the dry season. This may be possible because there is a greater spatial concentration

[2]Inflow of Bihar migrants to Nepal, and Nepalese migrants to the other states in India appear to have occurred simultaneously, suggesting complex labor movements between Nepal and India (Seddon 1995; Hattleback 2016).

[3]Non-indigenous population is defined as Chhetri, Brahman (Hills), or Brahman (Terai) based on Gellner (2007).

[4]While the positive association between pump adoptions and distance to the nearest paved road is surprising, it may reflect the fact the pump is more easily transportable on poor roads compared to tractors or threshers.

of suppliers of pumps in these areas, resulting in reduced pump prices.[5] Maize and lentil growing areas also observe lower tractor and/or thresher adoptions. Vegetable producing areas observe higher tractor adoptions as well.

Lastly, a greater share of tractor and thresher owners within the VDC encourage adoptions of hired tractors or threshers in the Hills and Mountains, suggesting that access to tractors and threshers within the vicinity may influence the adoptions, although this effect seemed to disappear in the Terai. This finding is consistent with the limited spatial mobility of tractors and geographical coverage of tractor hiring services in countries with low coverage of mechanization services (observed in Nigeria, where similarly four-wheel tractors provide most tractor services through custom hiring) (Takeshima et al. 2015a). Similarly, pump ownership appears more spatially correlated in the Hills/Mountains than in the Terai.

5 Effects of Mechanization (Tractor, Thresher, and Water Pump) on Various Agricultural Production Patterns, Productivity, and Agricultural/Household Incomes

We assess the impacts of the uses of tractors, threshers, and water pumps on various economic behaviors and outcomes. In some cases, the results can be only interpreted as associations rather than causality. However, we can still draw insights the roles played by each type of machine. The analyses are based on the propensity score matching (PSM) method (Rosenbaum and Rubin 1983) conducted using the same set of explanatory variables used for the analyses in Table 4.

Since PSM relies on having samples that are fairly comparable between adopters and non-adopters, and require that all samples used have sufficient probabilities (that is, significantly greater than 0) of adopting each machine, our analyses in this section focus on VDCs where at least one observation in the sample adopt the respective machines. This is based on the assumption that, adoptions patterns are spatially correlated, households in areas with no adoptions are likely to have very different characteristics from households in areas with some adoptions, and comparing adopters with households in areas with no adoptions may not correctly attribute their differences to the machine adoptions. In addition, because the samples of adopters in Hills/Mountains for threshers and pumps are too small, they are excluded from the analyses.

Table 5 briefly summarizes the balancing properties of PSM for the analyses of each type of machines and agroecological belts. Based on Cochran and Rubin (1973), Rubin (2001), balancing properties are satisfactory if Rubin's B is less than 0.4, Rubin's R is between 0.5 and 2, and few variables have significantly different

[5]Such spatial aspects of price variations may be more important for smaller machines like pumps, because spatial distributions of demands for pumps may be largely affected by the distributions of hydrological conditions.

Table 5 Balancing properties of propensity score matching method for the analyses of each type machine/agroecological belts

	Tractors	Tractors	Threshers	Pumps
	Terai	Hills	Terai	Terai
Rubin's B	0.31	0.39	0.17	0.35
Rubin's R	0.84	0.76	1.00	1.07
% of PS adjusted variables with significant difference in means	2	0	0	0
No. observations				
Treatment	703	257	997	190
Treatment (on support)	680	233	976	171
Control	891	677	969	905
Total	1594	934	1966	1095

Source Authors

means between treatment (adopters) and control group (non-adopters). Table 5 suggests that our methods have satisfactory balancing properties for all cases and, therefore, can correctly attribute differences to the adoptions of each type of machinery.

5.1 *Effects of Mechanization on Household Incomes and Agricultural Incomes*

Table 6 summarizes the effects of the adoptions of various agricultural machines on real per capita household incomes and real per capita agricultural incomes. We show both the effects on incomes and natural log of incomes. The significant differences between the effects on incomes and natural log of incomes can suggest that effects may be highly heterogeneous across households.

The adoptions of tractors have generally significant effects on agricultural incomes, in both the Terai and the Hills. In particular, tractor adoptions seem to increase per capita agricultural incomes by 20–30%. However, the effects on total household income are generally weaker and less significant, suggesting that, the adoptions of tractors mostly benefit agricultural activities but may not have significant spillover effects into non-agricultural activities within the households. This may be also related to the effects on family labor uses, as described below, and the fact that our analyses only focus on households who remain in farming. Similarly, the adoption of pumps in Terai generally has a significant effect on agricultural incomes (approximately 30%). Again, its effects on household income are insignificant. As opposed to tractors or pumps, the effects of thresher adoptions on incomes in the Terai are generally insignificant. However, as is shown later, adoptions of mechanizations still lead to a significant change in various agricultural production practices, which we interpret in the next section.

Table 6 Effects of adopting various tractors, threshers and pumps on household incomes (total incomes and agricultural incomes)

	Tractors	Tractors	Threshers	Pumps
	Terai	Hills	Terai	Terai
Real per capita household income (kg of cereals)	42.166 (191.987)	−307.716 (465.889)	−44.987 (129.212)	−85.002 (289.101)
Growth rate of real per capita household income (natural log)	0.059 (0.052)	−0.053 (0.087)	−0.002 (0.044)	0.013 (0.075)
Per capita agricultural income (kg of cereals)	109.099* (62.235)	192.850** (78.291)	18.653 (57.022)	214.925*** (76.298)
Growth rate of per capita agricultural income (natural log)	0.241*** (0.086)	0.278* (0.151)	0.040 (0.066)	0.326*** (0.107)

Source Authors. Asterisks indicate the statistical significance; *10%; **5%; ***1%

5.2 *Effects of Mechanization on Agricultural Inputs Uses*

Table 7 summarizes the effects of adoptions of various agricultural machineries on agricultural inputs uses among farm households, including cultivated area, chemical fertilizer use, irrigation, and labor uses, estimated by the same PSM as above.

Adoptions of tractors and threshers generally induce significant increases in area cultivated, typically at the rate of 40%, or 0.2–0.4 ha per year. A substantial share of this increase seems to come from increases in net area sharecropped in (about 0.3 ha for tractors in the Terai and 0.16 ha for threshers in the Terai). Adoptions of pumps, on the other hand, do not lead to significant increases in cultivated areas.

In the Terai, adoptions of tractors and threshers also lead to approximately 7 kg increases in chemical fertilizer nutrients use per hectare of cultivated area, which is approximately 10% of the application levels in 2010 (Takeshima et al. 2016b). In the case of tractors in the Hills, the effects seem much smaller. Similarly, effects of pump adoptions are less significant.

The adoptions of tractors and threshers also lead to approximately 10% point increase in the share of farm households using irrigation in the dry season and rainy season, respectively. Note that in Nepal, based on the NLSS, irrigation is generally equally used in rainy season and dry season. Therefore, mechanization through tractors and threshers raise irrigation intensity across both seasons. On the other hand, adoptions of pumps do not lead to significant increase in irrigation. This is possibly because pumps mostly substitute other modes of irrigation, rather than expanding irrigation.

Lastly, mechanization adoptions generally lead to increases in the uses of both family and hired labor. In particular, tractor adoptions in the Terai increase both female and child family labor (by 30 person-days and 51 person-days per year, respectively), and hired male and female labor (6 and 7 person-days per year,

Table 7 Effects of mechanizations on agricultural inputs uses (land, fertilizer, labor)

	Tractors	Tractors	Threshers	Pumps
	Terai	Hills	Terai	Terai
Area cultivated per year (ha)	0.351*** (0.122)	0.080 (0.103)	0.209** (0.095)	−0.181 (0.193)
Growth in area cultivated per year (ha)	0.467*** (0.094)	0.434*** (0.127)	0.367*** (0.073)	−0.045 (0.110)
Net area sharecropped in (ha)	0.294*** (0.077)	0.065 (0.044)	0.160*** (0.053)	−0.057 (0.091)
Net area rented in (ha)	0.009 (0.020)	0.010 (0.014)	0.015 (0.015)	0.005 (0.037)
Chemical fertilizer use per ha (kg of nutrients/ha)	6.883* (4.004)	−1.844 (15.995)	6.693* (3.544)	9.591 (7.570)
Irrigation in dry season (%)	9.915*** (3.483)	15.737*** (5.018)	10.357*** (2.860)	5.838 (4.600)
Irrigation in wet season (%)	11.752*** (3.460)	18.205*** (4.887)	11.202*** (2.853)	6.262 (4.569)
Family labor male (days per year)	6.425 (11.048)	14.578 (11.612)	5.408 (9.285)	14.422 (18.486)
Family labor female (days per year)	29.832*** (10.321)	23.001 (14.775)	9.713 (8.261)	28.804* (17.245)
Family labor child (days per year)	50.694** (21.384)	172.742 (236.070)	22.944 (17.539)	44.822 (42.458)
Hired labor male (days per year)	6.116*** (1.487)	2.964* (1.533)	2.941** (1.360)	0.196 (3.391)
Hired labor female (days per year)	7.247*** (2.296)	6.942*** (2.431)	2.436 (2.086)	3.154 (5.031)

Source Authors Asterisks indicate the statistical significance; *10%; **5%; ***1%

respectively). This is possibly because, while tractors substitute some of the labor (particularly male family labor), overall they increase the demand for labors as a result of greater area cultivated, and intensifications through irrigation and chemical fertilizer uses. The adoptions of tractors in the Hills, threshers, and pumps in the Terai also lead to increased uses of certain types of family or hired labor, although at lower rates than tractors in the Terai.

The effects of mechanization on land productivity are generally limited, except the case of the adoptions of pumps. Since NLSS does not report the area planted to each crop within the plot, obtaining crop-specific land productivity is challenging except for smaller samples of mono-cropped plots. We therefore focus on the total crop production revenue per total cultivated area by the households, while also providing complementary results for the effects on yields of two major crops (rice and wheat). In addition, the effects on the other dimension of land productivity and production intensity are also assessed. The results are summarized in Table 8.

Table 8 Effects of mechanization on land productivity

	Tractors	Tractors	Threshers	Pump
	Terai	Hills	Terai	Terai
Growth rate of crop revenue per ha of cultivated area per season	−0.064 (0.067)	0.115 (0.098)	−0.098* (0.052)	0.211*** (0.081)
Rice yield on mono-cropped plots (%/100 change)	0.197 (0.121)	0.252 (0.228)	0.044 (0.100)	−0.189 (0.235)
Wheat yield on mono-cropped plots (%/100 change)	0.208 (0.249)	NA	0.238 (0.169)	NA
Production intensity (%/100 change)[a]	0.387*** (0.075)	0.268*** (0.088)	0.278*** (0.061)	−0.104 (0.088)
Rice production intensity[a]	0.189*** (0.029)	0.259*** (0.053)	0.088*** (0.021)	0.035 (0.034)
Wheat production intensity[a]	0.111*** (0.036)	0.062 (0.052)	0.341*** (0.027)	−0.040 (0.047)
Maize production intensity[a]	0.008 (0.041)	0.019 (0.051)	−0.065** (0.032)	0.088 (0.056)

Source Authors. Asterisks indicate the statistical significance; *10%; **5%; ***1%. NA = results not available due to small samples

[a]Overall production intensity is defined as total cultivated areas within a year, divided by the area owned. Production intensities for each crop are the number of times each crop are grown in year (= 2 if grown twice, 1 if grown once, 0 if not grown)

Adoptions of tractors do not lead to significant changes in crop revenue per area or yields for rice and wheat. Adoptions of threshers in the Terai may actually lead to reduced crop revenue per ha. However, adoptions of tractors or threshers generally lead to increased overall production intensity, as well as for major crops like rice and wheat. This is potentially a result of speedier land preparations (and possibly speedier transportations of harvests to some extent), which allow increased production frequency at optimal timings. Production intensity of crops like maize may be negatively affected by thresher adoptions, but this may be due to potential substitutions with rice or wheat in production resource uses. For both tractors and threshers, the increase in area cultivated largely drives the overall increase in crop revenue.

On the contrary, pump adoptions may lead to 20% increases in crop revenue per cultivated area. Since pump adoptions do not lead to the area increase (Table 7), much revenue growth from pump adoptions arises from increased land productivity. However, these effects are likely to be through the production of non-staple crops, as the adoption of pumps does not affect rice yield significantly. This is possibly because, for rice, pumps in Terai may be mostly substituting the other modes of irrigation that have already been practiced.

The adoptions of tractors and threshers generally lead to the increase in market participations of farm households (Table 9). The adoptions of tractors lead to 17% point and 10% point increase in the shares of farm households selling their crops in

Table 9 Effects of mechanization on market participations

	Tractors	Tractors	Threshers	Pump
	Terai	Hills	Terai	Terai
Selling any crops in the market	16.959*** (3.411)	10.408** (5.072)	9.358*** (2.788)	4.614 (4.129)

Source: Authors. Asterisks indicate the statistical significance; *10%; **5%; ***1%

the market in Terai and Hills, respectively. Similarly, the adoptions of threshers lead to 9% point increase. The effect of pump adoptions is positive but insignificant.

Lastly, we investigate how the adoption of each type of machinery led to the changes in non-crop production or other income earning activities. Similar to the assessments above, while we cannot analyze the mechanisms through which estimated impacts arise, we still shed light on the impacts themselves.

We specifically assess the effects on livestock production revenue, land rental revenue (combining sharecropping and fixed-rent leasing), land rental payments, and off-farm incomes. Off-farm incomes are the sums of wage incomes, profit from non-farm enterprises, and net remittances received. To make them comparable to the incomes in Table 6, we focus on the per capita figures. Table 10 summarizes the estimated impacts.

The adoptions of tractors and pumps seem to lead to significant increases in per capita livestock revenues, which are on average worth 100 kg of cereals in values. Adoptions of tractors may lead to the increase in cultivated area and harvests, which potentially increase the production of fodders, and thus increased livestock production. Adoptions of pumps, on the other hand, may increase the yield per area, which again increase the production fodders and increased livestock production. The effects of the adoptions of threshers on livestock revenue are much smaller, possibly because threshers seem widely used for wheat but not for maize which is one of the most important fodder crops in Nepal (Matthews and Pilbeam 2005).

The adoptions of tractors and threshers in Terai seem to lead to reduced land rental revenues. This is consistent with Table 7, which suggests that their adoptions

Table 10 Effects on livestock revenue, land rental revenue, off-farm income

	Tractors	Tractors	Threshers	Pump
	Terai	Hills	Terai	Terai
Real per capita livestock revenue (kg of cereal)	103.101*** (40.073)	73.712* (43.491)	4.877 (45.036)	109.152*** (40.383)
Real per capita land rental revenue (kg of cereal)	−43.453** (21.102)	−15.608 (12.320)	−36.004** (16.172)	15.536 (29.465)
Real per capita land rental payment (kg of cereal)	8.512 (32.360)	13.049 (11.282)	19.620 (19.032)	−0.072 (14.018)
Real per capita off-farm income	−525.108** (210.587)	−840.236*** (310.450)	−128.167 (143.857)	-177.957 (376.756)

Source Authors. Asterisks indicate the statistical significance; *10%; **5%; ***1%

in the Terai lead to an increase in net area sharecropped in. Given that the adoptions of mechanization have insignificant effects on land rental payment, the adoptions of tractors and threshers in Terai mostly reduce sharecropping out, rather than increasing sharecropping in.

The adoptions of tractors in both Terai and the Hills also seem to lead to significant reductions in off-farm incomes. This is consistent with the findings in Table 7 that adoptions of tractors generally induce farm households to use more family labor for farming. The effects on off-farm incomes are less significant for threshers or pump adoptions, although signs are still negative.

Adoptions of tractors, threshers, and pumps have significant effects on agricultural production practices. However, they may not always lead to the findings of significant effects on household income or agricultural income, particularly for threshers in the Terai, and to some extent for tractors and pumps. These may not necessarily suggest that the adoptions of particular agricultural machinery have no economic effects. They may be only capturing the short-term effects that are small because farmers who adopted new production practices can be less efficient in the beginning, but can become more efficient in the long term. For example, the adoptions of threshers may induce agricultural intensification, such as increases in area cultivated per year, chemical fertilizer use per ha, and intensive uses of both family and hired labor, but they may not initially gain from these because they may be still in the process of transitions. Their significant effects on agricultural production practices are therefore still important, regardless of their reported effects on incomes.

6 Conclusions and Policy Implications

Agricultural mechanization plays important roles in agricultural development, particularly modernizing the ways farm power is provided that are needed for various operations. Nepal has historically seen growing farm power needs which have been driven by the growing demand for intensifications, and rising labor costs driven by non-farm sector growth, out-migration, or education levels, among others. While these trends have gradually continued, they have recently reached the level where the adoptions of various modern agricultural machinery have started rising, particularly in the Terai zone.

This chapter assessed the overall trends of mechanization in Nepal, determinants or adoptions, and their impacts on household incomes and agricultural productions. It particularly focuses on key agricultural machinery, tractors, threshers, and pumps, which all have generally substantive transformational effects compared to more traditional tools.

Overall, the adoptions of mechanizations have important effects on various agricultural production practices. In particular, the adoptions of tractors and pumps also lead to significant increases in per capita agricultural incomes. Generally, the adoptions of tractors or threshers lead to increases in areas cultivated and intensive uses of chemical fertilizer and irrigation. In addition, because of such intensifications in land uses, and other potentially labor-using inputs, and production increases, the adoptions of machines generally lead to increased uses of labors. While the overall effects on agricultural labor also depend on how the trends in rising wages lead to the change in overall agricultural households, the patterns suggest that mechanizations do not lead to labor displacements.

Generally, tractors lead to agricultural income increases through land expansion, while pumps lead to increases through increased revenues per area cultivated. While these effects on agricultural practices do not seem to lead to significant changes in overall household incomes, they may lead to greater changes in outcomes in the long-run. The positive effects on agricultural incomes are still important, since it provides greater returns to farmland, one of the main productive resources of the agricultural households. It provides rural households more options to raise household incomes in the long-run.

The fact that agricultural mechanization currently has significant income effects in Nepal also suggests that, adoptions are still constrained to some extent. The analyses of the determinants of adoptions, or associations between adoptions and various household characteristics, provide insights into some enabling strategies that can further accelerate the agricultural mechanization where the adoption level is below optimal. For example, while continued support for educational development may lead to wage increases, it also facilitates the adoptions and intensive uses of various machines (particularly tractors and pumps). Controlling rental prices of machines may not necessarily induce mechanization growths. Investments into more expensive pumps are also induced by higher pump rental prices. Formal credit may not be viable options, as it generally had little effect on mechanization adoptions (partly due to the difficulty in offering formal credit in sustainable ways). Consolidation of lowland farm (through improved farmland sales/purchase market) may facilitate mechanization. While consolidation of land can also be facilitated through the development of more active land rental markets, landowners are reluctant to rent out land due to fears that they may lose land rights are eventually taken by those renting in the land (Takeshima et al. 2016c). Part of such inefficiency may be overcome by the mechanization technologies themselves; economies of scale enabled by mechanization technologies (Takeshima 2017a) can give greater bargaining powers to larger farms who can now offer higher rental prices to smallholder landowners. However, more formal land policies, such as granting stronger land tenure rights to landowners and strengthening enforcement may further facilitate land rental transactions. Improved transportation infrastructure to improve accesses to market centers may facilitate the intensive uses of tractors and threshers. Similarly, adoptions of tractors and investment into pumps are higher in urban areas than rural areas—improvement into access to the urban centers may facilitate these patterns. Lastly, improved electricity access may facilitate the ownership of pump.

Certain crops, such as maize and lentils, are not necessarily positively associated with mechanization through tractors, threshers, or pumps. Therefore, balanced promotions of these crops must be designed. Alternatively, research and development in mechanization applicable to these crops may further induce mechanization growth.

Lastly, access to mechanization services may be affected by the proximity to machine owners (possibly due to limited mobility of large agricultural machines). Therefore, identifying the areas with high potentials and appropriately supporting the growths of private owners of machines are important in improving the accessibility to services by potential users. Evidence elsewhere (e.g., Takeshima et al. 2015a) suggests that government should not handpick such owners, but rather focus on supporting the natural growths of efficient private owners.

References

Biggs, S., & Justice, S. (2015). *Rural and agricultural mechanization: A history of the spread of small engines in selected Asian countries*. IFPRI Discussion Paper 01443.

Biggs, S., Justice, S., Gurung, C., Tripathi, J., & Sah, G. (2002, November). The changing power tiller innovation system in Nepal: An actor-oriented analysis. In *A workshop on Agricultural and Rural Mechanization, Bangladesh Agricultural University*. Bangladesh: Mymensingh.

Boserup, E. (1965). *The conditions of agricultural growth: The economics of agrarian change under population pressure*. London: Allen & Unwin Ltd.

Chamberlain, G. (1984). Panel data. In Z. Grilliches & M. D. Intriligator (Eds.), *Handbook of econometrics* (Vol. 2, pp. 1247–1318). Amsterdam: North-Holland.

Cochran, W. G., & Rubin, D. B. (1973). Controlling bias in observational studies: A review. *Sankhyā: The Indian Journal of Statistics, Series A, 35*(4), 417–446.

CSAM (Center for Sustainable Agricultural Mechanization). (2014). *Country Pages*. http://un-csam.org/cp_index.htm. Accessed July 2, 2014.

Gellner, D. N. (2007). Caste, ethnicity and inequality in Nepal. *Economic and Political Weekly, 42* (20), 1823–1828.

Giordano, M., de Fraiture, C., Weight, E., & van der Bliek, J. (2012). *Water for wealth and food security*: *Supporting farmer-driven investments in agricultural water management: Synthesis report of the AgWater solutions project*, 38.

Hatlebakk, M. (2016). Inter-generational determinants of migration decisions: The case of International Labour Migration from Nepal. *Oxford Development Studies, 44*(1), 93–112.

Heckman, J. J. (1979). Sample selection bias as a specification error. *Econometrica, 47*(1), 153–161.

IRRI. (1986). *Small farm equipment for developing countries*. Los Banos, The Philippines: IRRI.

Joshi, K. D., Conroy, C., & Witcombe, J. R. (2012). *Agriculture, seed, and innovation in Nepal: Industry and policy issues for the future* (pp. 1–60). Washington, DC, United States: International Food Policy Research Institute.

Khoju, M. R. (1983). Economics of pump irrigation in Eastern Nepal. In *Consequences of small-farm mechanization.* IRRI.

Matthews, R. B., & Pilbeam, C. (2005). Modelling the long-term productivity and soil fertility of maize/millet cropping systems in the mid-hills of Nepal. *Agriculture, Ecosystems & Environment, 111*(1), 119–139.

NARMA Consultancy Private Limited. (2016). *Agri-mechanization Promotion Strategy Implementation Plan and Budgeting*. Draft report.

Pingali, P. (2007). Agricultural mechanization: Adoption patterns and economic impact. In R. Evenson & P. Pingali (Eds.), *Handbook of agricultural economics* (pp. 2779–2805). Amsterdam: Elsevier.

Rosenbaum, P. R., & Rubin, D. B. (1983). The central role of the propensity score in observational studies for causal effects. *Biometrica, 70,* 41–55.

Roumasset, J., & Thapa, G. (1983). Explaining tractorization in Nepal: An alternative to the 'consequences approach'. *Journal of Development Economics, 12*(3), 377–395.

Rubin, D. B. (2001). Using propensity scores to help design observational studies: Application to the tobacco litigation. *Health Services and Outcomes Research Methodology, 2*(3–4), 169–188.

Seddon, D. (1995). Migration: Nepal and India. In R. Cohen (Ed.), *The Cambridge survey of world migration* (pp. 367–370). Cambridge: Cambridge University Press.

Shah, T., Hassan, M., Khattak, M. Z., Banerjee, P. S., Singh, O. P., & Rehman, S. U. (2009). Is irrigation water free? A reality check in the Indo-Gangetic Basin. *World Development, 37*(2), 422–434.

Shah, T., Singh, O. P., & Mukherji, A. (2006). Some aspects of South Asia's groundwater irrigation economy: Analyses from a survey in India, Pakistan. *Nepal Terai and Bangladesh. Hydrogeology Journal, 14*(3), 286–309.

Singh, O. P., & Kumar, M. D. (2008). *Using energy pricing as a tool for efficient, equitable and sustainable use of groundwater for irrigation: Evidence from three locations of India*. Proceedings of the 7th Annual Meeting of IWMI-Tata Water Policy Program (Vol. 1, pp. 413–438). Hyderabad, India: International Water Management Institute.

Takeshima, H. (2017a). Custom-hired tractor services and returns to scale in smallholder agriculture: a production function approach. *Agricultural Economics 48*(3), 363–372.

Takeshima, H. (2017b). *Overview of the evolution of agricultural mechanization in Nepal*: *A focus on tractors and combine harvesters*. IFPRI Discussion Paper 1662. Washington, D.C. http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/131358.

Takeshima, H., Adhikari R., & Kumar, A. (2016a). *Is access to tractor service a binding constraint for Nepali Terai farmers?* IFPRI Discussion Paper 01508.

Takeshima, H., Adhikari, R., Kaphle, B. D., Shivakoti, S., & Kumar, A. (2016b). *Determinants of chemical fertilizer use in Nepal: Insights based on price responsiveness and income effects*. IFPRI Discussion Paper 01507.

Takeshima, H., Shrestha, R. B., Kaphle, B. D., Karkee, M., Pokhrel, S., Kumar, A. (2016c). *Effects of agricultural mechanization on smallholders and their self-selection into farming: An insight from the Nepal Terai*. IFPRI Discussion Paper 01583.

Takeshima, H., Edeh, E., Lawal, A., & Isiaka, M. (2015a). Characteristics of private-sector tractor service provisions: Insights from Nigeria. *Developing Economies, 53*(3), 188–217.

Takeshima, H., Adhikari, R., Poudel, M. N., & Kumar, A. (2015b). *Farm Household Typologies and Mechanization Patterns in Nepal Terai*. IFPRI Discussion Paper 01488.

Takeshima, H., & Nkonya, E. (2014). Government fertilizer subsidy and commercial sector fertilizer demand: Evidence from the Federal Market Stabilization Program (FMSP) in Nigeria. *Food Policy, 47,* 1–12.

Takeshima, H., & Yamauchi, F. (2012). Risks and farmers' investment in productive assets in Nigeria. *Agricultural Economics, 43*(2), 143–153.

Chapter 11
Agricultural Research and Extension System in Nepal: An Organizational Review

Suresh Chandra Babu and Ram Pratap Sah

Abstract This report aims to address the status and challenges of agriculture research, extension and their linkages in Nepal. Agriculture plays the vital role in Nepal's economy, employment, and livelihoods, contributing nearly 28% to GDP, 66% to employment, and 50% to export. In spite of GON's priority and policy supports for more than two decades, the growth of agriculture has been very slow (<3.0%). This is mainly due to inadequate access to demand-driven technologies and extension services, and to inputs, credits, markets and incentives. Dynamic agriculture research and extension systems are instrumental for bringing transformations in agriculture. Nepal's agricultural R&D is largely dominated by public sector institutions (NARC, DOA, DOLS) under the MOAD and MOLD with their national-, regional- and local-level networks. The institutional capacity (manpower, infrastructure, funds and others resources) is inadequate to address the diverse technological and service demands of the diverse clients including farmers, entrepreneurs and industries. While GON has advocated promotion of private sector in research and development, not much has been achieved due to weak coordination and linkage mechanisms to foster public–private partnership in R&D. Strengthening of both public and private actors with proactive policies and program interventions for functional participations and linkages are crucial. This will also require the involvement of diverse R&D actors in planning, in monitoring, and in sharing of resources, incentives and recognition. GON's commitment to promote agriculture R&D with enabling policies, funding, and capacity building is vital for sustainable impacts. Implementation of the recommendations to reform and strengthen research and extension systems and promote linkages among actors, service providers and key stakeholders in Nepal's federal system will be critical for bringing the anticipated outcomes.

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G. Thapa et al. (eds.), *Agricultural Transformation in Nepal*,
https://doi.org/10.1007/978-981-32-9648-0_11

1 Introduction

The agriculture sector is pivotal to ensure food and nutritional securities, enhance income, reduce poverty and increase the living standard of the people. This sector has a major role contributing 28% to GDP, 66% to employment and 50% to the total national export. Recently, the performance of this sector is slow to make all these contributions. Only 43 districts out of 75 have surplus food production, while the rest 32 show a deficit (NAP 2016), and approximately 5 million people are undernourished with moderate to severe food insecurity (WFP 2015). Despite concerted efforts in the national plans and programs, the growth and contributions of agriculture are very slow (MOAC 2012; MOAD 2013).

Cereals are the major contributors to GDP and AGDP followed by livestock and vegetables (Fig. 1). There are considerable variations in access to new varieties, production technologies, inputs (seeds, fertilizers, irrigation, and pesticides), markets and services across agro-ecological regions. The new technologies, inputs, markets and services are less accessible in the remote hills and mountains due to limited road and R&D institutional connectivity. The agriculture growth has been seriously constrained with inadequate access to technologies, services, inputs and markets (Joshi and Witcombe 2012). The critical challenges to agriculture transformation are (Sah 2013; NARC 2016):

- Inadequate production of demand-driven varieties, production technologies and low seed replacement rates (SRR),
- Lack of robust extension and service delivery mechanism to address diverse clients,
- Inadequate access to land, inputs, credits and markets,
- Limited capacity and resources for adaptation and mitigation to climate change,
- Inadequate safety nets for poor and targeted groups: insurance, grants, soft loans, contact farming, and
- Lack of effective policies and programs for collaboration with national, regional and global actors in R&D

National public agriculture research system, NARC and extension systems, DOA and DOLS are not very proactive and capable to address these challenges due to its limited institutional, human and funding resources.

This paper highlights the status and challenges of agriculture research and extension systems, and their linkages in Nepal, and areas of proactive reforms to address the national needs. Section 2 highlights present status challenges of research and extension system, ADS recommendations, donors' recent initiatives, and contributions and challenges of livestock in agriculture. Section 3 focuses on current capacity, challenges, and areas of reforms and strengthening of the national research system; Section 4 highlights the status, challenges, and areas of reforms and strengthening of national extension system, and its linkages with research, and Sect. 5 covers final recommendations and conclusions for institutional reforms and

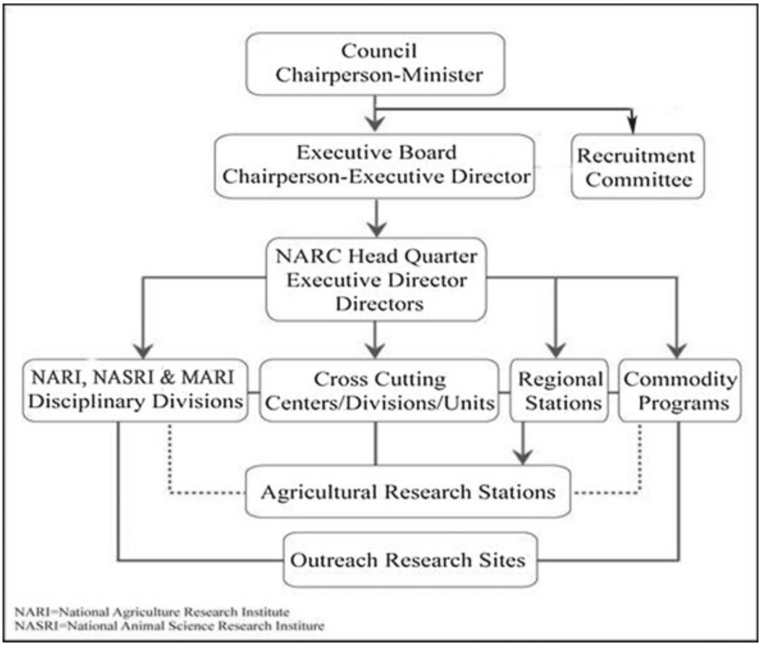

Fig. 1 NARC's organizational structure

strengthening of research, extension systems and promoting their functional linkages for larger impacts on Nepal's agriculture. The information provided is primarily based on the secondary data and had limited access to disaggregated data on FTE, funding and other contributions of NGOs and private sector actors in national R&D interventions.

2 Public Agriculture Research and Extension Systems

2.1 Agricultural Research System

Though agriculture research and development in Nepal started during late 1930s with the introduction of improved fruits and cattle, it was only after 1970s when organized research programs were initiated with larger international collaborations, and in 1991 NARC was established to provide greater impacts through institutional strengthening.

The organizational structure of NARC is presented in Fig. 1. It has a two-tire organizational setup: the council and the executive board. The council is the apex body for making policies with sixteen members and chaired by the minister of agriculture. The executive director of NARC works as the member secretary of the council. The eight-member executive board chaired by the executive director of NARC implements and executes research program approved by the council. The executive director is assisted by a team of five directors at the headquarters for crops and horticulture, livestock and fishery, planning and coordination, finance, an NARC conducts, collaborates, promotes, supports, and coordinates agricultural research activities on crops, horticulture, livestock, fishery, and natural resources, and their disseminations to clients (NARC Strategic Vision 2011–2030). Major responsibilities are to:

- Develop national research agenda and allocate resources to address diverse technological needs of farmers, entrepreneurs and agro-industries,
- Promote participation and collaboration of key stakeholders (national/ international) public/private, GOs/NGOs, university, including farmers and agro-entrepreneurs.

2.1.1 Project Planning, Implementation and Monitoring

The research programs are focused to national policies and priorities, and the needs and opportunities of the farmers and agro-entrepreneurs. The process involves annual planning workshops at regional and national levels with active participation of key stakeholders including DOA, DOLS, NGOs, universities, private sector and farmers' groups. The proposals are requested on the priority areas, mostly from NARC, and reviewed and approved through well-established professional committees and process. NARC's research is implemented by its own institutions and centers, and collaborating partners, and monitored by NARC. The projects are more focused and capacitated on food crops than horticulture, livestock and non-timber forest products. Limited scientific capacity in these areas is the major constraint.

2.2 Agriculture Extension System (FAO 2010)

DOA and DOLS are the major players in providing extension services to farmers. However, large number of donor-funded projects, I/NGOs, university system and few private seed and feed companies are also contributing to some degrees in specific locations and time frame as per their project objectives. The broad objectives of the agriculture and livestock departments are robust extension services, training and capacity building, and diversification and commercialization interventions (DOA 2017).

The DOA and DOLS implement their agriculture programs through their respective five regional and 75 district agriculture and livestock offices. The district programs are technically supported by the regional and program directorates and are administratively under the District Development Committee (DDC) according to Local Self-Governance Act 1999. The districts are further divided into 378

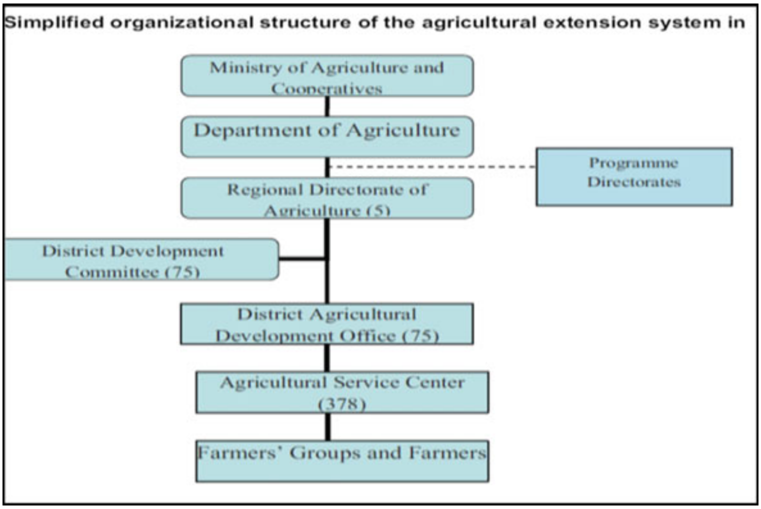

Fig. 2 Organizational structure of MOAD/MOLD

agriculture service centers (ASCs) and 999 livestock service centers (LSCs) to provide extension services to farmers (Fig. 2).

2.2.1 Project Planning, Implementation and Monitoring System

DOA/DOLS coordinate their respective planning process as per the priorities and guidelines of their respective ministries and NPC, and priorities from the districts and local levels. Bottom-up planning process begins at district followed by regional and central levels. These meetings are participated by key stakeholders involving farmers' groups/associations, I/NGOs, private sector, agro-entrepreneurs and R&D actors. Annual programs are finalized and funded at the ministry and implemented by the respective departments. Multistakeholders are involved in joint monitoring, reviews, and final assessment and reporting.

3 National Agriculture Research System (NARS) and National Agriculture Extension System (NAES)

3.1 National Agriculture Research System (NARS)

At present, more than seven agencies conduct agricultural R&D in Nepal, NARC with 411 scientists is the largest by far. The nature of research conducted by NGOs is mostly participatory with farmers as per the interest of the funding/donor agencies, and also in line with the national priorities for a specific location and time frame. The university researches by TU, AFU and HICAST are mostly basic/higher-level field/laboratory works for MS/Ph.D. degree research. There is usually no continuation and follow-up of such initiative for final impacts at the farmers' production levels. NARC is the major player and lead in the National Agriculture Research System (NARS) with over 80% contribution in national research resources and outputs (ASTI 2015a). In addition to national partners, NARC has rich collaborations with international agriculture research institutes (IARCs), regional programs, and overseas universities and institutes and national partners (Fig. 3).

3.1.1 NARC's Main Institutions

The headquarters of NARC is located in Kathmandu, and the programs are operated through its five regional agricultural research stations, 13 agricultural research stations and 16 national commodity programs located in the various agro-ecological zones. NARC has two central institutions—National Agriculture Research Institute (NARI) and National Animal Science Research Institute (NASRI) with 11 and 5 disciplinary divisions, respectively, and one national Genebank located in Kathmandu. There are 18 research laboratories in NARC (mostly in Kathmandu) to provide critical support to research programs and services to clients. Newly established Mountain Agriculture Research Institute (MARI) is located at Jumla. In addition, there are 52 outreach research sites attached to regional/area research stations for participatory on-farm technology verification, training and scaling-up of the smart technologies to farmers and other clients.

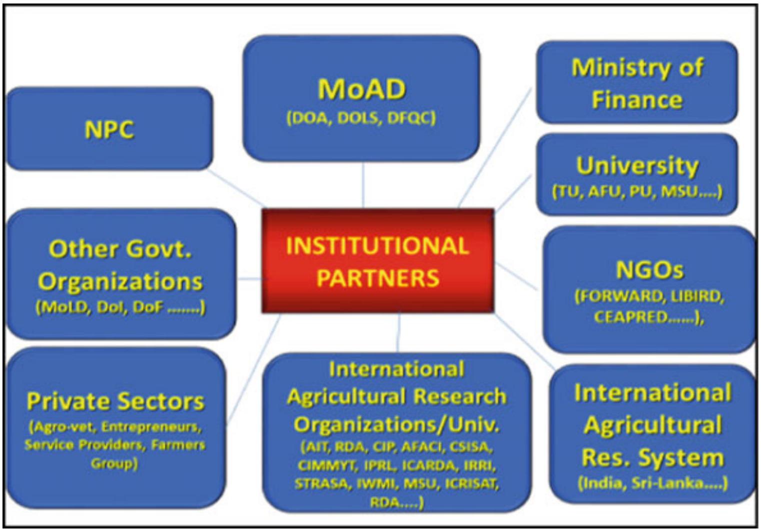

Fig. 3 NARC's institutional partners

3.1.2 Investments and Research Projects

Inadequate funding from GON/MOAD has been the major constraint in NARC to implement its priority programs and activities and maintain resources for quality research. Only in recent years, while there have been some visible increments, the fund for research has not increased in real sense considering inflations. NARC received NRs. 1.74 billion from GON in 2014/2015, which is about 0.28 and 7.45% of national and of Ministry of Agriculture Development budget, respectively. Out of the total budget, Rs. 584 million (33.69%) was for staff expenses, Rs. 570 million (32.85%) for operation expenses, Rs. 145 million (8.34%) for office expenses and Rs. 436 million (24.9%) for capital expenses. A total of 516 research projects (3229 activities) covering field crops, horticultural crops, livestock, fisheries, multisectoral, outreach research, source seed/sapling/breed production and farm management were executed during the year. In addition to these regular research projects, 48 special projects were also implemented in collaboration with other international and national organizations with additional funds of Rs. 134.0 million (NARC 2016).

The operational/program budget for 2014/15 with sectoral projects, institutions and activity type is presented in Tables 1 and 2, respectively. Crop research program is the major sector with national, divisional and regional projects, human resources and collaboration with national/international institutions sharing 29% of the operational budget for 157 projects. The institutional capabilities, and projects and activities are comparatively weak in horticulture and livestock using 13.3% and 17.1% budget, respectively, and hence are less effective to adequately address their sectoral needs.

On further disaggregation of the projects and budget based on research types (Table 2), nearly 60% of the projects are for basic and applied with around 38% budget, 12% on outreach with 14% budget, while nearly 50% budget is for production and managements. This clearly reflects that the real project expenses are just half of the allocated operational budget which is extremely low for effectively implementing the priority projects. Similarly, around 63% of the total budget is allocated to national programs, RARS and ARS, while rest 37% are for NARC center, NARI, and NASRI their respective divisions in Kathmandu (NARC 2016). These program and expenses need review and judicial allocations as per their contributions to the NARC's overall achievements.

Table 1 NARC's sectoral projects and budget allocation in 2014–15

Sector	Projects		Budget	
	Number	%	Rs. ('000)	%
Crop	157	30.4	165,297	29.00
Horticulture	99	19.2	76320	13.39
Livestock	127	24.6	97631	17.13
Fishery	41	7.9	35696	6.26
Multisector	92	17.8	195,056	34.22
Total	**516**	**100.0**	**570,000**	**100.00**

Source NARC Annual Report, 2014–15

Table 2 NARC's project category and operational budget allocations, 2014–15

Project category	Projects (activity)			Budget	
	Number/activity		% Project	Rs. ('000)	% Budget
Research	315	(1699)	61.0	214,612	37.65
Outreach	61	(571)	11.8	77053	13.52
Production	34	(228)	6.6	99195	17.40
Research supply	53	(520)	10.3	65321	11.46
Management	53	(211)	10.3	113,819	19.97
Total	**516**	**(3229)**	**100.0**	**570,000**	**100.00**

Source NARC Annual Report, 2014–15

NARC's budget trend during 2000–2014 revealed that agricultural R&D investment in Nepal has considerably increased in recent years due to increased government funding (Table 3). However, much more is needed to enhance NARC's capacity to utilize available resources (ASTI 2015b).

3.1.3 Human Resources

The total human capital in NARC has been nearly static with regard to its approved, working and vacant positions since long. Of the total 1823 positions, only 22.5% are for scientist, and of that nearly 30% are vacant most of the time (Table 4). The professional competence, qualification, national/international exposure and their research quality of major scientific cadre are fairly of high standards. They are competent to design and implement national priority projects and produce quality results. However, due to lack of enabling environments, they are constrained to produce satisfactory outputs. Considerable number of senior qualified scientists are retiring, and those newly recruited have tendency to migrate overseas and/or to more lucrative positions at I/NGOs in the country. This leaves the research programs and centers always under stress with inadequate critical mass of researchers to design focused priority projects and address clients emerging aspirations. One of the interesting fact emerging from this elucidates that scientists' positions are only

Table 3 Analysis of NARC's budget trends over 2000–2014

Total agricultural research spending	2000	2009	2012	2014[a]
Nepalese rupees (million constant 2011 prices)	965.8	996.0	1,314.3	1735.0 actual
PPP dollars (million constant 2011 prices)	39.2	40.4	53.4	
Overall growth	**3%**		**32%**	**32% actual**
Agricultural research intensity				
Spending as a share of agricultural GDP	0.28%	0.25%	0.28%	0.72%

Source Adapted from ASTI 2015, and [a]calculations from NARC annual report 2016

Table 4 NARC staffing status 2016

Category	Position (%)		Working (%)		Vacant (%)	
Scientist	411	22.5	243	19.4	168	29.6
Technical officer	413	22.6	316	25.2	97	17.1
Tech. assistant	590	32.4	357	28.5	233	41.0
Accountant	70	3.8	59	4.7	11	1.9
Administrative	339+1	18.7	279+1	22.3	59	10.4
Total	1823	100	1254 (68.8%)	100	568 (31.2%)	100

Source NARC Annual Report 2014–15

22.5%, and those of technical assistants (B.Sc. or less) and administrative are much higher 32.4% and 18.7%, respectively. This clearly reflects that human strength is more loaded with non-professional and support staff. Even under scientific category, there is higher proportion of newly recruited and young ones who would require higher degrees, trainings and work experience to lead projects and make significant contributions.

The trend of agricultural researchers during 2000–14 presented in Table 5 (ASTI 2015a) clearly reveals that overall growth has been very slow, and the proportion of scientists per 100,000 farmers has declined from 4.74 to 1.71 during this period.

3.1.4 NARC's Major Challenges

Since NARC's establishment in 1991, it is struggling with challenges—internal and external in nature with regard to effective resource management, strengthening, funding and staffing. Some of the critical challenges are presented herein for consideration and improvement.

(a) NARC's institutional autonomy: While NARC is bestowed with autonomy by its act 1991, this has simply been theoretical. MOAD and its departments consider this as alien and real support has been minimal with regard to its management, strengthening, funding (<0.28% of AGDP) and stability.
(b) Though the funding has slightly increased in recent years, the operational/program budget has not changed in real terms. The analysis has clearly revealed

Table 5 Total number of agricultural researchers' trend during 2000–2014

Year	2000	2009	2012	2014[a]
Full-time equivalents (FTEs)	391.2	374.6	403.4	411
Overall growth		**−4%**	**8%**	**1.9%**
FTE researchers per 100,000 farmers	4.74	3.55	3.57	1.71

Source Adapted from ASTI 2015
[a]NARC (2016)

that the actual research budget is just 50% of the operational or 16% of the NARC's total.

(c) Staff recruitment, training, retention and their commitment is also a prolonged problem that leads to inadequate staffing at most centers particularly out of Kathmandu. Most centers in the absence of a multidisciplinary critical team are not able to effectively manage priority project activities and deliver quality results. Frequent transfers of leaders and professionals also affect overall performance.

(d) Salary, incentives and motivation are critical to scientists' dedication and contributions. NARC salary and incentives are not competitive (50–100% less of I/NGOs) that leads fast migration of scientists.

(e) The absence of NARC's Secretariat for agricultural research at MOAD has impeded its access to ministry, effective management and strengthening, and NARC's autonomy.

3.2 National Agriculture Extension Systems (NAES)

The extension strategy of Nepal's agriculture development has primary focus on institutional pluralism, privatization and decentralization of the services. Accordingly, Nepal is gradually moving to a pluralistic extension service system, though the major contributors are still agriculture and livestock ministries, their departments and extension network. Besides, several GON/donor projects and programs I/NGOs, industries, CBOs, farmers' groups, and private companies (seed traders, agro-vets) do have contribution in training, capacity building and dissemination of new technologies and services. Similarly, the universities (AFU, IAAS/TU, HICAST), while they have important roles in teaching and research, do have some training and extension activities around their setup. This has called a need to outline in detail how institutions communicate and cooperate with each other for achieving food security, livelihoods and other goals. In practice however, the functional coordination and linkages among extension service providers are still weak to support various clients. Technological and service demands by these diverse clients are different and call for robust policies and program interventions (ADS 2015).

The Nepalese extension system is largely dominated by the public extension that has primarily the regular set of extension activities, trainings and services. In spite of the national institutional setup with regional (5), district (75) and ASC 378/LSS 999 network with nearly 10,000 total staff under MOAD and MOLD, the staffing at local level is not adequate to address the needs of the diverse farming entrepreneurs. There is a dire need of a more demand-driven proactive extension system to address diverse needs of the clients. Some of the popular extension systems of Nepal are (a) conventional public extension, (b) private extension, (c) co-financed extension, (d) paid extension, and (e) farmer field School with their own strength and weaknesses.

Usually, donor-funded project extension (private) system is time- and location-bound with adequate technical and financial supports to make visible impacts.

3.2.1 Major Challenges in Agriculture Extension

- Weak institutional capacity to address diverse needs of the farmers, agro-entrepreneurs and industries,
- Inadequate staffing, funds and resources at the district and ASCs/LSCs level to cater the needs of large number of clients,
- Weak staff management, performance monitoring and evaluations at the district and ASCs levels,
- Inadequate capacity on agribusiness, climate change mitigation and smart technologies, post-harvest and processing, and marketing, and
- Inadequate initiatives to promote PPP in extension due to lack of robust polices and mechanisms.

3.3 Agriculture Research–Extension Linkages

Nepal's agriculture growth has been very slow primarily due to inadequate research and extension linkage and coordination among public and private partners, in technology generation, transfer and services to farmers and agro-based industries (USAID/MEANS 2012; NEFPORT 2015). The new varieties and production technologies have not reached the targeted clients adequately, and yield gaps are still high (>50 to 100%) between research and farmers' fields (Paudel 2016). There is no mechanism of functional integration of public–private actors in priority setting, program planning, implementation, monitoring and up-scaling for sustainable impacts. At times, this results in duplication of programs and resources and lacks continuity.

The MOAD and MOLD have initiated mechanisms and guidelines for greater coordination and linkages among key players at district, regional and central levels. In this line, NARC has adopted outreach research with 52 locations across the country (as interface between research and extension) that facilitates interaction among key players including research, extension, I/NGOs, private sector, CBOs, and farmers in technology verification and transfer. However, they are under different administrative controls that constrain sustainable functional commitments, coordination and linkages for effective extension and service delivery. Efforts to promote coordination and linkages are mentioned herein (NARC Vision 2010):

- Institutionalize Agriculture Technical Working Group (ATWG) meetings at the district and regional levels, and National Agriculture Technical Working Group (NATWG) meeting at the central levels with active participation of all key stakeholders,
- Encourage mechanism of integrated program planning, implementation, monitoring, reviews and up-scaling of smart technologies, and share institutional resources under public and private domains for supporting R&D programs,
- Expand and strengthen research to cover diverse domains using farms and resources of public and/or private domains,
- Initiate scientists' exchange program between research and extension and other key players for capacity building and involvement for cross-contributions, and
- Strengthen institutional capacity of R&D actors for delivering targeted outputs and services through integrated projects and activities.

4 Agriculture Developments Strategy (ADS) for Research and Extension Reforms

The open political environment and incentives have ignited private sector, NGOs/CBOs and agro-entrepreneurs, and farmers' groups for a more proactive participation in agricultural R&D interventions (Devkota et al. 2016)[1]; All have envisioned and focused decentralized and pluralistic research and extension provisions. Recently, MOAD has developed Agriculture Development Strategy (2015–2035) in addition to other key reforms and has highly advocated decentralized science, technology, education and extension programs (DSTEP) (ADS 2015; NASDP 2016). Important ADS recommendations for strengthening and reforming research and extension in Nepal are mentioned below.

4.1 ADS Decentralized Research System and Community Agricultural Extension Service Centers

The ADS aims at reforms in structure, process, implementation and coordination of research and extension in addition to other related programs and institutions to help effectively promote demand-driven technology and services. Accordingly, reforms have been suggested as mentioned below.

[1]South Asia Institute of Advanced Studies (SIAS)/Nepal Development Research Institute (NDRI), Kathmandu.

4.1.1 Decentralized Research System for Farmers and Agro-Entrepreneurs

(a) The National Agriculture Research Fund (NARF) will be integrated in NARC. NARF will fund action research projects conducted by public, private and NGOs sectors to address immediate needs of the farmers and agro-enterprises.
(b) Restructure NARC vision in line with ADS strategy to address needs of commercial and subsistence agriculture.
(c) Increase number of research institutes: In addition to existing NARI and NASRI, establish national Horticulture Research Institute (NHRI), National Animal Health Research Institute (NAHRI) and National Aquaculture and Fisheries Research Institute (NAFRI).
(d) Establish needed Agriculture Research Stations in the different agro-environments (high hills, mid hills and terai) in the far-western region. Upgrade Doti ARS into RARS status for the far-western region.
(e) Establish Agriculture Mechanization Centers in terai (2), mid hills (1) and high hills (1) within the existing research centers.

Combine the existing research centers and farms that are located nearby and carry similar functions. This will help reduce duplications of programs and operational costs.

4.1.2 Decentralized Extension System for Farmers and Agro-Entrepreneurs

Current grassroots level extension network of agricultural service centers (378 ASC) and livestock service centers (999 LSC/SC) is not capable to reach out clients in all the 3278 VDCs and 191 municipalities to address the diverse needs of the clients.

4.2 The Recent Initiatives in Promoting the Role of Private Sector in Extension

Nepal's priorities for agriculture duly promote participation of private sectors in R&D (MOF and NPC).[2,3] Accordingly, recent bilateral and multilateral projects are focused to contribute to these priorities including increased participation of private sector in production, commercialization, and access to inputs, credits, and markets through capacity building and motivation. Some of the project's reflections are presented herein (Table 6).

[2]MOF and GON (2015).
[3]NPC and GON (2013).

Table 6 Agricultural projects promoting agribusiness and private sector in Nepal

Project/year	Donor	Private sector involvement/roles
Nepal Economic, Agriculture, and Trade (NEAT) project 2010–13	USAID/Chemonics	• Worked with 20 private firms (encourage competitiveness and exports of tea, ginger, lentils and coffee) and almost 67,000 farmers • Facilitated the disbursement of more than $3.67 million in rural loans by financial sector partners, creating much-needed cash flow in local economies and supporting small-businesses • Built the capacity of more than 40 local organizations, including financial service institutions, business service providers and private firms, to implement key economic growth and food security efforts
Knowledge-based Integrated Sustainable Agriculture and Nutrition (KISAN) project 2013–17	USAID/Winrock International	• 83,286 farmers trained and now implementing improved agricultural practices and technologies on 60,713 ha • Increased yields for rice, maize, lentil and vegetables from 29 to 91% • $71.8 million in farm-level incremental sales for target commodities • Implemented cost-sharing PPPs with 6 agribusiness targeting 11,600 farmers
Integrated Pest Management Innovation Lab (IPM IL), 2013–16	USAID/Virginia Tech University/ IDE/CEAPRED/ NARC	• Increased supply and availability of IPM products and bio-pesticides through private sector channels • Scaling-up of IPM practices through partnerships with the private sector, KISAN, government agriculture extension services and agro-vets • Improved market linkages for farmers through the establishment of collection centers–PPP
Nepal Flood Recovery Program (NFRP), 2008–12	USAID/Fintrac	• Private sector counterparts varied widely from national-level associations (Agro-Enterprise Center, Seed Entrepreneurs Association, Agro-Vet and Pesticide Associations) to district- and VDC-level enterprises such as wholesale market dealers, traders,

(continued)

Table 6 (continued)

Project/year	Donor	Private sector involvement/roles
		input suppliers and other relevant service providers • NFRP was implemented with a diverse group of local partners. By program completion, a total of 187 subcontracts were issued to 14 NGOs and 37 private contractors
Hill Maize Research Project (HMRP) 1999–2014	SDC/USAID/ CIMMYT	• The HMRP IV was implemented through 10 NARC stations and divisions, 20 DADOs, 5 regional seed testing laboratories, 5 regional agricultural directorates, 18 NGOs and 5 private companies • Efforts were made to develop the capacity of project partners—government agencies, NGOs and the private sector (cooperatives, seed companies, agro-vets, etc.), through technical training, and financial and material support
Nepal Agricultural Services Development Program(NASDP) 2016–19	SDC/HELVITAS	• NASDP closely collaborates with MOAD, MOLD, MOFALD and support decentralized and pluralistic (PPP) agricultural extension and research system at the local level • Provide capacity development programs for public and private agricultural extension and research institutions in partnership with private sector actors
Nepal: Zero Hunger Challenge National Action Plan (ZHC/NAP) 2016–2025	UN/MOAD	• Promoting public–private partnerships process, 100% access to adequate food all year round, zero stunted children less than 2 years. All food systems are sustainable • 100% increase in smallholder productivity and income, zero loss or waste of food
Vegetable Seed Project (VSP) 2004–2010	SDC/CEAPRED	• Capacity building of farmers and collaborators in production, post-harvest, storage and marketing of vegetable seeds • Model farms at different agro-climatic zones to produce nuclear and source seeds

(continued)

Table 6 (continued)

Project/year	Donor	Private sector involvement/roles
		• Collaboration with other line agencies, FGs, cooperative, and private traders
HIMALI 2011/12–2015/16	ADB	• Promote public–private participation in agriculture: production, agribusinesses and value chain, through contract farming, input supply, infrastructure and marketing • Major products are wool, yak cheese, traditional paper, seeds, fruits, off-season vegetables, dairy, meat, and medicinal and aromatic plant products

Source Authors' compilation

4.3 Implications of the Federalism on Agricultural Research and Extension

4.3.1 Implications of Federal System on Agriculture Research

The 2072 constitution explicitly mentions that agriculture research would be the primary responsibility of the federal and provincial governments, while extension would be the responsibility of the provincial and local governments (IFPRI 2016). In its small territory, Nepal is extremely diverse in terms of geography, agro-ecology, socioeconomic domains, and in the technological needs to address diverse clients. The largest player, NARC, has been criticized for its inability to deliver required technologies and services to farmers, agro-entrepreneurs, and industries. NARC has been struggling from its inception for its strengthening, adequate funding, quality scientific manpower, and for a more conducive work environment (NARC Vision 2010). MOAD has shown supports for improvements but are inadequate to bring substantial impacts in its outputs and services. Out of total 1823 staff positions, only 411 (22.5%) are scientists with limited ones duly qualified and experienced. The retention of staff in scientific positions is the most critical challenge. Nearly one-third of the total positions are vacant of which around 30% are scientist positions. This has emerged due to retirements of existing scientists, delay in recruitments, better salary and incentives in the private and I/NGOs sectors, and lack of good scientific work environment in NARC. Trend of research funding is also not very encouraging, and FTE scientists are lowest (3.2 per 100,000 people) in the region.

ADS 2015 and 2072 Constitution have advocated to disaggregate research roles at national and province levels. The national system (NARC institutes, national programs, regional station) will take responsibility of higher level and AE research, and area-specific adaptive research (ARS, OR) will be the responsibility of the province and local governments. There is extremely high linkage of research and technology needs of the subnational levels with national/higher level and would be very challenging to isolate and design one to address ambiguous situation. Some of the key implications to design and implement a proactive system are summarized herein (Table 7).

Table 7 Challenges, implications and potential solutions of NARC reforms under federal system

Area	Challenges and implications	Potential solutions
National Research network of NARC	Existing network of NARC is not adequately addressing the diverse needs. There are deficiencies and duplication of resources. Required policies and program reorientations may be critical in line with ADS recommendations. A more scientific network of multicommodity regional centers based on agro-ecology will be required	Reform/develop national institutions and programs to cater present needs and options, including NARI, NASRI, MRI, HRI and FRI. The national programs also need prioritization and judicial placements A set of 9 AE-RARS 3 each (east, center and west) in terai, hills and mountain may be needed. RARS could also be used for HQ of some the minor crops programs
Infrastructure strengthening	Basic infrastructure for different levels of institutions and programs are inadequate for productive outcomes	Minimum standard infrastructure and facilities guidelines for need to be formulated and developed
Delineation of responsibility	There may be conflict on the ownership of roles of national and provincial levels on various types and levels of activities	The national system takes total responsibility for national institutions, national commodity programs and RARS, while province takes on ARS and OR research
Funding	The new federal system will create concerns how the funding of different institutions, currently all funded by national system will be addressed. How the necessary balance in required funding support between center and province will be made to achieve joint outcomes at the farmers and industry levels	The federal government takes full responsibility of funding of central institutions, while province takes for ARS and OR research and local training, seed production and services. This will require integrated planning and implementation of programs
Research prioritization and networking	The existing network may not be adequate to fairly represent to scientifically set national, regional, area clients' needs. The diversity requires fair representation of stakeholders in priority setting and program planning at each level	PPP representatives/stakeholders from each 9 AEs be involved in the process—district, regional and national levels. More OR sites for verification research in diverse domains and system be developed around NARC/DOA/DLS/university/private farms—developing collaboration

(continued)

Table 7 (continued)

Area	Challenges and implications	Potential solutions
		mechanism. Guidelines, process and capacity building of stakeholders will be critical
Staff and incentives	Existing staff is not adequate to effectively address the priorities. While recruitments of required professionals must be done, their placements, retention and sincere contributions must be made	Staff recruitments be made on time without much hurdles, and retained in positions at various centers—national, regional and area with motivating work environments. Incentive package and salary structure reviewed and made competitive to other private sectors/INGOs. Other elements are training, higher degree, promotion, project top-ups and job satisfactions/recognition
Autonomy and accountability	NARC has been struggling to reform in the past and strengthen its capacity and resources. Restructure must be based on a very scientific basis—with required institutions, staffing and funding for contributing with needed technology and services—to help contribute agriculture development. NARC programs and outputs are not periodically reviewed internal/ external-and reforms made. In the absence of full autonomy, NARC has not been fully accountable for outputs. NARC like other organizations in Nepal has turned to be a more political house that may be further polluted with higher political representations in the country at various levels	Restructure and strengthen NARC as advised to federal system-with institutions, staff, fund and resources, and enabling policy supports. Develop external review system for evaluation and periodic reforms Discourage political interference and activity with strict regulations and actions. NARC while enjoying enriched authority and autonomy be made accountable for the outputs and contributions
Coordination	There has been always coordination problem in transfer of technology and services to bring impacts in agriculture —big gaps between yields in research and national average. Increasing partners in R&D will require greater coordination and communication mechanism for joint work initiatives	Institutionalized interaction forum–priority setting, planning, implementation and monitoring/ visits functional mechanism be developed. The current DWGM, RTWGM and national meetings be continued and strengthened. DOA/DLS farms could be used for ARS research, and the staff be devolved with training and OR research in their locations. Functional mechanism for such collaboration be institutionalized

Source Author's compilation

4.3.2 Implications of Federal System on Agriculture Extension

Under the new Constitution 2015, Nepal has adopted a three-tier structure of federalism, i.e., federal, province (7) and local (753). The local bodies include 460 rural municipalities, 276 municipalities, 11 sub-metromunicipalities and 6 metropolitan cities. These local bodies are divided into 6740 wards as the lowest units of the government. After federalism came into operation, elections for these three tiers of government were held in 2017. There has been a major structural reform in agriculture extension (Fig. 4). Currently, the Federal Ministry of Agriculture and Livestock Development (MOAD) is comprised of the central departments, central laboratories and commodity development centers along with national priority projects. At the province level, the Ministry of Land Management, Agriculture and Cooperative (MOLMAC) has been established. This operates agriculture and livestock development directorates, agribusiness and training centers, and province-level laboratories, agriculture knowledge centers, veterinary hospitals and livestock expert centers at the district level. Agriculture and livestock learning centers are recently in the district by replacing the earlier DADO and DLSO offices. At the local government, there are separate sections for agriculture, livestock and fisheries development. However, these sections lack adequate staff, expertise, resources and functional linkages to cater the needs of the diverse clients. Further, many of the responsibilities are allocated across multiple tiers (Table 8) making it ambiguous and conflicting.

It is vital to support and empower the local- and provincial-level bodies with required policies, infrastructure, human resources and funding to make desired achievements for agriculture transformation. The proposed decentralized system's challenges, implications and potential solutions are summarized below (Table 9).

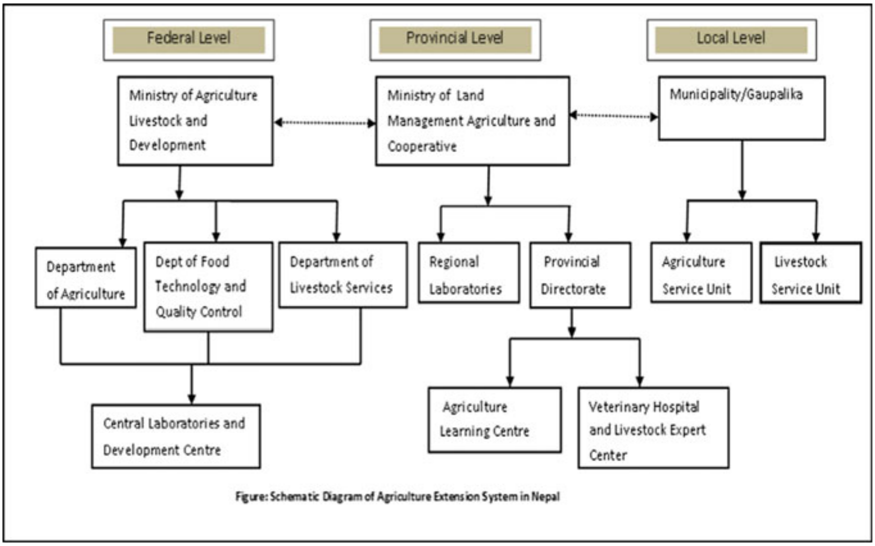

Fig. 4 Federal organizational structure of agriculture extension *Source* Thapa and Devkota (2019)

Table 8 Allocation of responsibility across tiers of federal system for agriculture sector

Characteristics	Responsibility
Regulatory services: food safety	Federal, province
Plant and livestock quarantine	Federal
Seed safety	Unspecified
Research and development	Federal and province
Agriculture education	Unspecified
Agriculture and livestock extension service	Local
Environment protection and conservation: soil, forest, water	Federal, province, local
Land use, land tenure, land reform	Federal, province, local
Irrigation	Federal, province, local
Rural infrastructure	Federal, province, local

Source IFPRI (Kyle and Resnick) 2016. The constitution of Nepal 2015

Table 9 Challenges, implications and potential solutions of decentralized extension in federal system

Features	Challenges and implications	Potential solutions
Staff recruitment and placement	The mechanism of recruitment is not set for new staff. The already existing staff may not have interest to work in the target district, subcenter or CAESCs in the far and remote areas. Inadequate and lack of competent staff would lead to less effective programs and services to clients	Explicit mechanism/guidelines for staff recruitment, placement and control across province, district and ASCs are needed
Training and capacity building	The required institutions and capacity in each district and province may not be adequate. The local/provincial governments may not have priority and capacity to develop them as required. The extension program will be weak and less sensitive to deliver needed outputs	Collaboration of training programs at the existing centers and resources until such facilities are not developed
Funding	The resources may not be adequate at the province and local levels to implement the desired programs. Supports from the federal government may not be substantial and timely to successfully program implementation. There may disconnect/dual control of staff from central and province levels. External funding from donors,	A policy for minimum of 20% earmarked grant funds could be allocated to province/district/CAESC levels for agriculture. Explicit guidelines for work/project that will be covered under this is needed to control misuse for other purposes

(continued)

Table 9 (continued)

Features	Challenges and implications	Potential solutions
	collaboration and private sector will be variable across subnational levels, and their status of programs may be different with different outputs and impacts	
Salary and incentives	Full dedication and contribution of staff in extension and services will require their commitments and continuity. How the province and local governments will set salary and incentive package for increased motivation and contribution is not clear. The provincial/local governments require authority and capacity to design and implement such packages	The federal government provides national standard salary and benefits, while the province provides top-ups as per the needs and remoteness to attract and retain good staff
Coordination	The complex nature of agriculture needs greater vertical and horizontal coordination in priority setting, planning, implementation, capacity building at various levels. Disconnect and weak coordination will hamper the programs and service delivery. There may be differences between national/ADS priorities and programs with the province and local levels—creating ambiguity and conflicts	The central government might consider providing funds for meeting national priorities, while local/province supports their local priorities. Effective mechanism of timely budget transfer, program monitoring, financial audit of expenditure will be needed
Accountability	The complex nature of agriculture linked to central–province–district–ASC/LSC–CAESC makes it extremely challenging for smooth planning, implementation and outputs. Further, the total impacts will be affected by how the staff, institutions, resources and funds are effectively managed	The province and local governments take lead and adopt participatory method in planning, implementation and monitoring involving key stakeholders

Source Author's compilation

5 Reformation of Agriculture Research and Extension System in Nepal

NARC's focus has been mainly on research implementation within its own network, with a little involvement in research coordination, funding strategies and policy formulation. In addition to NARC, though on limited scale, few new agriculture research providers from public and private sectors and universities have come up to contribute in the National Agriculture Research System (NARS) (ASTI 2015a), their integration, coordination and participation in the national agriculture research system are critical to address technological needs and services in the country.

5.1 Suggested Reforms of National Agriculture Research System

(a) At present, NARC is headed by the Executive Director, who is not well attached to the MOAD and Government of Nepal for direct information access, resources and policy influence in agriculture research. *Adopt Indian Council of Agricultural Research (ICAR) model of India where, Director General of ICAR is one of the secretaries at Ministry of Agriculture heading Department of Agricultural Research and Education (DARE).*

(b) As recommended by ADS, NARC will work as NARS to formulate policies and coordinate with line ministries, research providers (public and private), agro-industries/entrepreneurs, national/international agencies and donors for national agriculture research system. The respective national institutes will implement programs through NARC's existing and/or collaborative networks. *This looks complex and complicated for Nepal, as the staff and resources are all with present NARC, and there might be conflict in program implementation by different institutions on its common network and resources. The existing NARC's setup and management process looks fine though it needs strengthening.*

(c) The existing research network of NARC's centers may not be adequately representative to diverse agro-environments of Nepal, and to fit into the new feral and provincial needs; this requires a critical review and reforms. *It will be important to gauge the present NARC's network and capacity and design a more scientific NARS involving public and private sectors, universities and I/NGOs and other actors in addressing national diverse agenda and priorities.*

(d) Nepal's agriculture can be broadly classified into nine AEs: three each in terai, hills and mountains for eastern, central and western/far-western regions. These centers could be designated as the Regional Agriculture Research Station (RARS) for specific AEs with multidisciplinary teams and programs for crops, horticulture, livestock, fisheries and others of regional significance. *The RARS should focus on demand-driven adaptive research of the region. The RARS on-station research may not be adequate to address diversity of the regional needs. Hence, RARS should have a subnetwork of its own sites at NARC-ARS, DOA and DOLS farms, and private farms in the required domains for adaptive and participatory outreach research with farmers' resources (as adopted by Lumle and Pakhribas).*

(e) The existing RARS (5) and ARS (13) can be re-oriented accordingly. It is assumed that most of the RARS of NARC will fit into one of the AEs, except a few more in the far-west need to be established. *It will be wise and cost* *effective to use resources of DOA and DOLS, and private farms for adaptive and OR research in the respective domains. The ARS of NARC, and farms of DOA and DOLS can also be designated alternatively as the Krishi Vigyan Kendra (KVK) as in India and dedicated to adaptive and OR research, training, seed production and services to clients. Each district should have at least one KVK, and they provide technical support to their district CAESCs through district line agencies.*

(f) NARC have currently three national research institutes, NARI (11 divisions), NASRI (5 divisions) and MARI (Jumala). In addition to these existing institutes, ADS 2015 has recommended to establish NHRI, NAHRI and NAFRI. *The detail criteria and justifications for the institutes with mandate, type of research, institutional structure, human/scientific capability and funding need to be explicitly defined and developed for anticipated outputs.*

(g) Similarly, NARC has 13 national crops and horticulture research programs and 4 livestock research programs that need review and reforms. *In addition to their mandated roles, they need to be employed for collaborative research, training and seed production, and implementation of OR research activities.*

5.2 Suggested Reforms of National Extension System

While the higher-level public institutions (DOA/DOLS) help in policy formulation, coordination among actors, and facilitating access to inputs, credits and markets, the technical directorates help with new technologies and information for supporting PPP model district/local extension programs.

(a) Extension services provided by private sector has comparatively better impacts in areas of social mobilization, and services to commercial agriculture, agribusiness and entrepreneurs where the clients are willing to contribute for services (e.g., poultry, livestock, sugarcane, irrigation, etc.).

(b) Promote pluralistic model of extension through coordination and networking for priority setting, planning, implementation, monitoring and impact assessment; and accessing smart technologies, services, inputs, credit, processing and marketing.

(c) Policy and program reforms are needed to redirect rural youth migration from overseas jobs to in-country agribusiness and investment of their resources as well.

(d) Increasing trends of women involvement in Nepalese agriculture call for enabling policies, women extension workers, and women-friendly technology and services in extension through capacity building and services.

(e) The present public extension system is inadequately equipped with technologies and resources for natural resources management (soil, water and biodiversity), post-harvest management and climate change—need strengthening.

5.3 Suggested Reforms for Promoting Research and Extension Linkages

While there have been some improvements, the effective functional linkage between research and extension remains inadequate at different levels (central, regional and district/local) and across actors (public–public, public–private and private–private). This calls for a more proactive mechanism for institutional communication and cooperation in effective technology generation and transfer for transformation of agriculture (Devkota et al. 2016). The major challenges listed below need to be duly addressed.

(a) Develop policy and guidelines for functional integration: The R&D actors are housed indifferent public and private institutions with their respective agenda and resources. It is very challenging to bring them for consensus on common goals and objectives and contributions to priority agenda.
(b) Strengthen institutional research capacity to address clients' demands: The capacity of the research is inadequate to address current technological needs of farmers, entrepreneurs and industries with quality and competitive products and services: hybrid seeds[4], hybrid chicks, new breeds of livestock, fruits and vegetables, NTFPs, MAPs, and climate smart production and managements technologies and services. For example, Nepal imports over $40.0 million worth hybrid rice, maize and vegetable seeds annually (Sah and Gill 2016).
(c) Institutionalize mechanism and participation of R&D actors: There are inadequate efforts made to really prioritize the clients' technological needs and integrate them in the research programs. Avenues for Technical Working Group Meetings (TWGM) are designed for regional and national levels for promoting interactions and collaboration but have limited gains. Similarly, extension programs are planned and implemented in isolation of the research system.
(d) Expedite for research–extension joint ventures and OR research: There is less opportunity for research and extension actors to work for joint venture-like OR research, training, seed production and scaling-up initiatives of the successful practices.
(e) Discourage monopolistic attitudes of public research and extension systems: While recent GON's policies and programs promote pluralistic institutional participation in research and extension, there is still inadequate functional participation due to lack of guidelines and initiatives for effective program participation and contributions. The pluralistic approach is critical for effective and efficient research and extension services.

[4]In 2015/16 Nepal imported over $40m worth of hybrid seeds of rice, maize and vegetables (Sah and Gill 2016).

6 Conclusions and Recommendations

6.1 Conclusions

Agriculture plays the vital role in Nepalese economy, employment, and food and nutritional securities. It contributes nearly one-third to national GDP and two-thirds to employment and over 50% to the export. In spite of Nepal's continued enabling policies, priorities and program interventions for agriculture development for past more than two decades, the overall agriculture growth has been very slow (around 3.0%) with little impacts. This is mainly due to inadequate access to demand-driven technologies and extension services, and to inputs, credits, markets and incentives. Agriculture research and extension are instrumental for promoting access to new technologies and contribute agricultural transformation.

Nepal's agricultural R&D is largely dominated by public sector institutions (NARC, DOA, DOLS) under the MOAD and MOLD with their national-, regional- and local-level networks. The capacity and resources of these institutions (manpower, infrastructure, funds and other resources) are inadequate to address the diverse technological and service demands of the diverse clients including farmers, entrepreneurs and industries. While GON has advocated promotion of private sector in research and development, not much has been achieved due to weak coordination and linkages to foster public–private partnership in R&D.

Strengthening of both public–private institutions and actors with proactive policies and program interventions for functional participations and linkages is crucial. This will also require the involvement of diverse R&D actors in planning, in monitoring, and in sharing of resources, incentives and recognition. GON's commitment to promote pluralism in agriculture R&D with enabling policies, funding and capacity building is vital for sustainable impacts. Implementation of the ADS recommendations to reform and strengthen research and extension systems, and promote linkages among actors, service providers and key stakeholders in Nepal's federal system will be critical for bringing the anticipated outcomes. Necessary policy and program recommendations are given for implementation.

6.2 Strengthening National Agriculture Research System (NARS)

(1) NARC as the lead of National Agriculture Research System takes proactive initiatives to functionally integrate new actors (universities, DOF, private institutes and NGOs) in research system through enabling policies and mechanism. A bottom-up planning process needs to be institutionalized.

(2) Strengthen the national research network of institutions and programs to cater present needs and opportunities with required human resources and funding. Maintain critical mass of scientists with multidisciplinary teams for desired

outputs. Increase NARC's funding (from 0.27 to 0.5–1.0% of AGDP) over 5 years in line with UN recommendations (India 0.3%, China 0.62%).

(3) The roles and authority of NARI, NASRI, MARI, HRI and FRI be made explicit to contribute to address the priority technological needs. The national programs also need reviews and logical placements. A set of 9 Agro-Ecological (AE)-RARS 3 each (east, center and west) in terai, hills and mountain be established for scientific representation and coverage (most of RARS are already in the right AE domains).

(4) The federal/national system takes total responsibility of funding and management of national institutions, national commodity programs and RARS, while province takes on ARS and OR research. A gradual transitional plan for handover from national to province should be developed over 3–5 years.

(5) More OR sites for verification research in diverse domains and system be developed around NARC/DOA/DLS/university/private farms—developing and promoting collaboration mechanism. Increased involvement of stakeholders sharing resources and recognition, and their capacity building will be instrumental. The farm sites can be also used as Krishi Vigyan Kendra (KVK) as in India with added responsibilities—adaptive/OR research, training, seed production and technical advice.

(6) NARC in addition to other regular programs takes on new initiatives, such as hybrid seeds, hybrid chicks, new breeds of livestock, fruits and vegetables, NTFPs, MAPs, and climate smart production and managements technologies and services.

(7) NARC is made more autonomous and accountable to reforms and strengthens its capacity. Staff recruitments be made on time without much hurdles and retained in positions with motivating work environments, incentive package and salary structure.

8) Institutionalize platforms for increased interactions of R&D actors (priority setting, planning, implementation and monitoring and visits). The current planning meetings (DWGM, RTWGM and NWGM) need to be continued and strengthened.

(9) Promote collaboration with international and regional R&D institutions (IARCs and SAARC countries: India, Bangladesh and Pakistan) and China to benefit from their vast research products and skills. This will boost technology access and save time and costs.[5]

(10) NARC must demonstrate to be a respected scientific institution, away from political hitch, and institutionalize a periodic internal and external reviews, public audit system for evaluation and reforms.

[5]In this line IRRI has launched a collaborative project involving Nepal, India and Bangladesh for rice- to access technologies, share information through joint ventures. More such initiatives should be explored.

6.3 Strengthening National Agriculture Extension System (NAES)

(1) Develop explicit policies and guidelines for promoting pluralistic model of extension through coordination and networking with public–private institutions.
(2) In the new federal system, higher-level public institutions (DOA/DOLS) help in policy formulation, coordination among actors, and facilitating access to inputs, credits, markets, and developing effective strategies; technical directorates help in updating with new technologies and information for assisting and capacitating the district/local programs and partner agencies. The regional extension should be terminated, while the ARS and DADO/DLSO district programs under local government work to address the priority agenda of the local governments through CAESCs.
(3) Technical, staffing and funding supports and capacity building to the DADOs/DLSOs and CAESCs are duly addressed jointly by the federal, provincial and local governments initially to provide needed momentum in agriculture development at the grassroots level.
(4) Provincial government promotes private extension service providers through capacity building and incentives to contribute in areas of commercial agriculture, inputs supply, agribusiness and industries where the clientele are willing to share the cost of services as well.
(5) "Pocket production programs" with comparative advantage be designed in potential areas by province with explicit business plans, research and development policies and program supports. Such programs must be linked to potential markets, and access to inputs, credits and technological services to communities and industries.
(6) Promote youths and women in agriculture and related agribusiness through more enabling policies, funding, incentives and capacity building.

6.4 Enhancing Research–Extension Linkages

(7) Formulate and promote enabling policies and guidelines for functional integration for functional participation of research–extension actors in R&D initiatives (program planning and implementation, and sharing resources, incentives and achievements).
(8) Enhance platforms for research–extension partnership—through cross-involvement (researchers in extension and vice versa), joint programs and scientist exchange program.
(9) Mechanism be developed to bring more ARSs/farms (DOA, DOLS and private sector) under OR network for extensive coverage and their integrated

involvement in OR research, training, seed production and technology dissemination.

(10) DADOs/DLSOs and CAESCs play instrumental roles to address clients' needs. They must be well supported with qualified and committed staff, funds and resources.

(11) MOAD and donor-funded agriculture projects have all advocated institutional pluralism in agriculture R&D. However, their roles, mechanisms of coordination and policy bindings are still not yet explicit to bring diverse actors at a point.

(12) The mechanism needs review and reforms for grater linkage at the programs level—promoting complementation and avoiding duplications.

(13) Promote scientists' exchange programs, collaborative programs (research/extension, trainings, seed production and services to clients), resource sharing (farms and laboratories), and sharing of incentives and recognitions.

(14) Institutionalize reviews and reform, and public audit process of R&D projects and institutions for increased participation of actors and stakeholders.

References

ADS. (2015). *Agriculture Development Strategy (ADS) 2015 to 2035*. Government of Nepal, Ministry of Agricultural Development (MOAD), Singhdurbar, Kathmandu.

ASTI. (2015a). *Nepal's agricultural R&D indicators, factsheet, 2002–12*. ASTI/IFPRI Washington, DC, and NARC Kathmandu.

ASTI. (2015b). *Nepal's fact sheet on agriculture R&D*. ASTI/IFPRI, Washington, DC.

DOA. (2017). *DOA history, objectives and resources*. http://www.doanepal.gov.np/content.php?id=194. Accessed July 10, 2017.

Devkota, K., Thapa, D., & Dhungana, H. (2016). Weak institutional interaction: Reason for poor agricultural extension services delivery in Nepal. *Nepal Journal of Social Science and Public Policy*, *4*(1), 1–16.

FAO. (2010). *Agricultural extension services delivery system in Nepal*. Food and Agriculture Organization of the United Nations UN Complex. Pulchowk, Nepal.

Joshi, K. D., Conroy, C., & Witcombe, J. (2012). *Agriculture, seed and innovation in Nepal: Industry and policy issues for the future*. IFPRI/CSISA Study, Washington.

Kyle, J., & Resnick, D. (2016). *Nepal's 2072 federal constitution: Implications for the Governance of the agricultural sector*. ASTI/IFPRI Discussion Paper 01589, December 2016. https://ssrn.com/abstract=2897060.

MOAC. (2012). *Agriculture atlas of Nepal*. Singhdurbar, Kathmandu.

MOAD. (2013). *Statistical information on Nepalese agriculture*, *Time Series 1999/2000–2011/12*. Government of Nepal, Ministry of Agricultural Development. Singhadurbar, Kathmandu: Agribusiness promotion and statistics division.

MOF/GON. (2015). *Nepal Portfolio Performance Review (NPPR)*. Ministry of Finance Government of Nepal, Kathmandu.

NEFPORT. (2015). *Nepal economic forum: Agriculture special*. Issue 20, 2015.

NARC. (2016). *NARC Annual Report 2015–16.* Singhdurbar Plaza, Kathmandu.

NPC/GON. (2013 and 2016). *13th and 14th National Plans*. National Planning Commission/Government of Nepal, Singha Durbar, Kathmandu, Nepal.

NAP/MOAD. (2016). *Nepal: Zero Hunger Challenge: National Action Plan* (*2016–2025*). Ministry of Agricultural Development, Singhadurbar, Kathmandu Nepal.

NASDP/SDC. (2016). *Nepal agricultural services development program*: *Project brief.* SDC/HELVITAS, Nepal.

Paudel, M. N. (2016). Prospects and limitations of agriculture industrialization in Nepal. *Agron JN, 4*(2016), 38–63.

Sah, R. P. (2013). *ReSAAKS report on role of seeds in transforming agriculture in Nepal*. Washington, DC: International Food Policy Research Institute (IFPRI).

Sah, R. P., & Gill, G. S. (2016). *Attracting private sector investment in seed business in Nepal: Context, issues, and policy imperatives*. PRIP Nepal Report 1, USAID/IFPRI, Kathmandu.

Thapa, D., & Devakota, K. (2019). *Agriculture extension service delivery in Federal Nepal: Issues and challenges*. PPT presentation at National Policy Dialogue on Agriculture Extension System in Federal Nepal, Kathmandu, 9 April 2019. Agricultural Extension in South Asia (AESA).

USAID/MEANS. (2012). *Strengthening the pluralistic agricultural extension system in Nepal*. Modernizing Extension and Advisory Services (MEANS), U.S. Agency for International Development (USAID), Kathmandu.

WFP. (2015). 10 Facts about Hunger in Nepal. *World Food Program*. http://reliefweb.int/report/nepal/10-facts-about-hunger-nepal.

Part III
Agricultural Diversification

Chapter 12
Agricultural Diversification in Nepal

Champak Pokharel

Abstract Agricultural diversification into high-value commodities improves the livelihoods of small-scale farmers in poor countries like Nepal. This chapter discusses diversification within the agriculture sector between 1995 and 2015, which highlights the expansion in the production of high-value agricultural products such as fruits, vegetables, livestock and fishery sub-sectors at the expense of cereal crops such as rice, maize and wheat. It analyses the main drivers of agricultural diversification, constraints to and opportunities for diversification, and identifies policy recommendations for faster pace of agricultural diversification.

Abbreviations

AFND	Academic Foundation, New Delhi
APROSC	Agricultural Projects Service Centre
AgGDP	Agricultural gross domestic product
APP	Agriculture Perspective Plan
CBS	Central Bureau of Statistics
CFUG	Community Forestry Users' Group
CMS	Consolidated Management Services Nepal
DOA	Department of Agriculture
DoLIDAR	Department of Local Infrastructure and Agricultural Road
DDC	Dairy Development Corporation
FNCCI	Federation of Nepalese Chambers of Commerce and Industry
GDP	Gross domestic product
GNP	Gross national product
ha	Hector
Interim APP	Nepal Interim Agriculture Perspective Plan
JMA	John Mellor Associates
MI	Ministry of Industry
MOAD	Ministry of Agricultural Development
MOF	Ministry of Finance

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G. Thapa et al. (eds.), *Agricultural Transformation in Nepal*,
https://doi.org/10.1007/978-981-32-9648-0_12

Mt	Metric ton
MUD	Ministry of Urban Development
NASPR	Nepal Agriculture Sector Performance Review
NDDB	Nepal Dairy Development Board
NLSS	Nepal Living Standard Survey
NGOs	Non-government organizations
NMMSS	National Milk Marketing and Strategy Study
NPC	National Planning Commission
NRB	Nepal Rastra Bank
SAARC	South Asian Association for Regional Cooperation
PMAMP	Prime Minister's Agriculture Modernization Project
SINA	Statistical Information on Nepalese Agriculture
UHT	Ultra-heat treated
UNDP	United Nations Development Programme
WTO	World Trade Organization

1 Approach to Analysis

In developed countries where agriculture is monoculture dominant, Simpson index[1] and similar other modified forms are used in analysing agricultural diversification. The analysis gets more wider in developing countries, as a number of crops and livestock types farmed by individual farm families are already many (typically 8–10 or more), due to subsistence character. For the diversification analysis, economists in developing countries use various proxy indicators, including Simpson index, to see how the shifts are occurring in the traditional subsistence production towards commercialization of farming to augmenting income and employment. Agricultural diversification in this paper has been analysed in the above context based on secondary data. It covers diversification efforts to commercialization towards more beneficial commodities, food systems and agro-processing and reviews also the important drivers.

2 Country Background

The country constitutes flat land (Terai), hills and mountains from south to north with the land areas of 23%, 41.6% and 35.2%, respectively. Climate ranges from tropical in Terai to tundra in high-altitude mountains giving rise to multiple microclimate sub-pockets within the hills and mountains due to several river basins,

[1]Simpson index is defined as $1 - \sum (P_i)^2$ with P_i as proportionate share of ith crop.

ridges and valleys. There is high prospect for developing multiple agriculture products in cereals, horticulture, spices and livestock due to varied agro-ecologies, good soil structure, plenty of water resources and border with fast-growing large market economies—India and China. Prospects of agroforestry are also good as the sector provides more than 50% of fodders[2] to livestock, and there is good potential for the production of herbs of different kinds. Recent estimate of urban population in 2016 is 25% (Economic Survey).[3] Rate of urbanization is high with average annual urban population growth of 5.3% between 1981 and 2015,[4] giving rise to a fast-growing market for high-value agriculture commodities. However, efforts in the past lagged to address the potentials. The longer-term agriculture growth is about 3% a year. The country is poor (per capita income $752 in 2016) with 83% of the population depending mostly on agriculture.[5]

The total cultivated area (gross) is 2.5 million ha (18% of the total land area) for the population of 26.6 million (2011). Agricultural land is distributed as 8.5% in the mountains, 39% in the hills and 52.5% in the Terai[6] with the population distribution of 7.6, 48.7 and 54.6, respectively. Annual precipitation ranges between 1500 and 2500 mm from west to east with 70–80% of the annual rainfall in summer (June to September) due to monsoon. Irrigated area is 1375 thousand ha (51.7% of the agricultural land) by 2015. But, the year-round irrigation is available in only about one-third (36%) of the cultivated land (13th plan: 2014–16). Forest area constitutes 39.6%[7] of the total land area (5.8 million ha). However, more than one-third is in the degraded form. In recent years, forest coverage has started increasing mainly due to community forestry programme.

The latest government estimate of national poverty incidence is 23.8% (2013). The devastating earthquake of 2014 is estimated to have increased it by 2.5–3.5% age points (Economic Survey, 2016). The self-employed in agriculture have poverty rate of 26.7%, and the agricultural labour group has poverty rate of 47% (the highest among the labour categories). Sixty per cent of the farm families are food deficit. HDI of Nepal is 0.472 with the lowest (0.398–0.423) in western and far western hills and mountains, and mid-western region.[8] Literacy rate (above 15 years of age) is low as 65.9% (2013). Twenty-two per cent of the farm families

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[2]Statistical Year Book, 2011, CBS.

[3]The government's declaration of 159 new municipalities during 2014 and 2015 makes the total urban population 42%. However, declaration of some municipalities was based on political decision and is still rural type (National Urban Development Strategy, 2015, Ministry of Urban Development). Urban population estimate by Economic Survey, 2016, is 25%.

[4]Based on the population census data and including 61 new municipalities added by the government in 2014.

[5]Summary Results of Agriculture Census, 2012, CBS.

[6]Author's Estimates Based on National Sample Census of Agriculture, 2011/12, Central Bureau of Statistics and Population Census, 2011.

[7]CBS Pocket Book of Statistics, 2014.

[8]Nepal Human Development Report, 2014, UNDP.

have received agriculture credit, and 42% would like to receive credit if available (Sample Census of Agriculture, 2011).

A dual economic character is persistent in the economy. Consumption pattern is modernizing faster due to remittance effects. Urban areas also import a large quantity of agricultural products of different kinds, which constitutes about 16% of total imports (Economic Survey, 2016). Agricultural products are exported mostly to neighbouring India during harvest due to lack of storage and are imported back during off seasons. Interregional market is gradually developing due to faster expansion of strategic road infrastructure and increased consumption of demand-driven products like milk, meat, vegetables and fruits from hills to Terai and trade of surplus food grains from Terai to hills. However, connectivity in the rural areas is poor. For tourists, packed foods are mostly imported due to poor quality of the local brands.

3 Agriculture in the National Economy

3.1 Farming Structure and Agricultural Productivity

Farmers are mostly small with subsistence farming, and the percentage of households owning land did not change significantly between 1996 and 2011 (Nepal Leaving Standard Survey, 2011). About 55% hold less than 0.5 ha, and 80% hold less than 1 ha (Agriculture Census, 2011). The average size of holdings in the mountains, hills and Terai is 0.66 ha, 0.66 ha and 0.58 ha, respectively. Within a decade between Agriculture Censuses, 2001 and 2011, the percentages of holdings with less than 0.5 ha and less than 1 ha further increased by 7% and 4.5%, respectively. The percentage of holdings with renting in land is small and increased from 12.3 to 14.2% only between 2001 and 2011, and the rent in land area increased only from 8.68 to 11.4%. Rental market system in agriculture is stagnated due to weak institutional structure. People still have strong attachment to land for personal security (Table 1).

Integrated farming comprising of field crops, livestock and horticulture (some fruits and vegetables) is a typical characteristics of Nepalese agriculture. Cereal crops are dominant crops (Chart 1) covering three-fourths of the arable land (Agriculture Census, 2012). Livestock provides an important part of protein diets (milk, meat and eggs), manure for crops and draught animal power for field. Horticulture includes kitchen garden for vegetables, spices and fruits. About 87.5% farm families own some kinds of livestock in small numbers[9] (Chart 2). However,

[9]On average, 59% of farm families raise cattle (2.8 animals/holding), 44% buffaloes (1.9/holding), 61% goats (4.7/per holding), 12% pigs (1.8/per holding), 3% sheep (6.3/holding) and other animals in much small percentages. Likewise, about 47% of farm holdings raise poultry birds (14.5 % bird per family, on average).

Table 1 Landholding structure in Nepal

	Family (%)	Average size of holding (ha)	Cultivated area (%)
<0.2	24.36	0.1	4.50
0.2–0.5	30.53	0.34	15.70
0.5–1.0	25.69	0.71	27.50
1.0–2.0	14.33	1.37	29.70
2.0–3.0	3.38	2.39	12.20
3.0–4.0	1.03	3.40	5.30
4.0–5.0	0.39	4.39	2.50
>5.0	0.31	7.2	2.60
Total	100.00	0.66	100.00

Source Recompiled from National Sample Census of Agriculture, Nepal, 2011/12

Chart 1 Share of different crops in arable cropped area (%). *Source* of Data Agriculture Census 2011

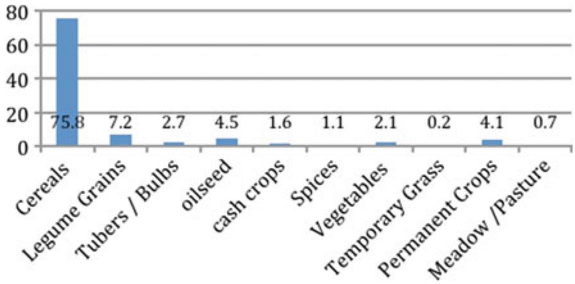
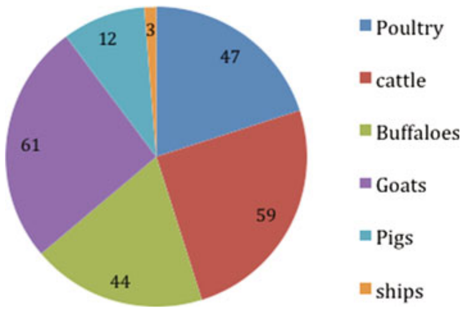


Chart 2 Percentage of farmers raising different animals. *Source* of Data Agriculture Census 2011



only 3.3% of the total livestock heads and 43% of poultry are of improved breed. In cash crops, about one-third (34%) of farmers who grow sugar cane, one-fourth (28%) who grow potato and one-fourth (25%) who grow vegetables use improved seeds (Agriculture Census, 2012). In cereal crops, improved variety coverage is more than 95% in maize, wheat and rice (SINA, MOAD, 2015). Other crops are mostly local varieties with some exceptions in fruits. More analysis of these crops is presented later.

Agriculture has not been able to attract young generations adequately, leading to high migration abroad for unskilled jobs (about 400–500 thousand a year, almost close to annual new entry of the youths in the job market in the country). Productivities are very low (Table 2). Compared to developed countries, it is less than half to one-third in cereals and cash crops, less than one-tenth in milk and almost one-third in meat and eggs.

Poor access to inputs, weak research and extension supports, poor connectivity and weak performance in promoting exports are the cause of low productivities (more analysis later). The sales of chemical fertilizer (nutrient) in the country in 2015 were only 68 kg per ha. Level of use in developed countries and bordering China is around 300–350 kg per ha. Only about half (52%) of the agricultural land is irrigated, with year-round irrigation in about one-third (35.6%) of the cultivated land (Thirteenth Plan, 2013–16). The level of mechanization is very low. For example, only 2% of farmers use power tiller. Farmers' access to credit is limited as those willing to borrow but not having access to credit are high as 42% (Agriculture

Table 2 Key indicators of agriculture sector in Nepal[a]

Indicators	Value	Productivity (land and livestock)	Year 2015
Average size of landholding, ha (2011)	0.66	Paddy Mt/ha[a]	3.31
Active population ($\geq$ 10 years age) employed in agriculture (2011) %	64	Maize Mt/ha[a]	2.42
Irrigated area as % of cultivated area 2015	51.8	Wheat Mt/ha[a]	2.52
Year-round irrigation (% agricultural land) 2014	36	Vegetables Mt/ha[a]	14.3
Chemical fertilizer sale, kg of nutrients (N, P, K) per ha 2015	68.2	Potato[a]	14.5
Families with access to electricity from transmission line (2016) %	59	Fruits Mt/ha	9.0
Farmers using agriculture credit (2011) %	22	Cow milk/milking cow/year, kg	544
Farmers who want to borrow but do not have access (2011) %	42	Buffalo milk/milking buffalo/year, kg	868
Road density (blacktopped) per 100 km^2(2015)	8.1	Eggs (poultry)/laying hen/year	103
Literacy rate (>15 years) (2013)	65.9%	Buffalo meat, kg	34
Users of power tillers (2011) %	1.9	Goat meat, kg	6
User of pump sets (2011) %	14.8	Pig meat, kg	17
User of sprayer 15.4 (2011) %	15.4	Foul meat, kg	0.9
Households having agriculture as main source of income (2011) %	83		

[a]Average of three years (preceding, current and the following) taken due to weather cycle effects in those crops

Source Drawn from or estimates based on Statistical Information on Nepalese Agriculture, MOAD, 2014/15; Economic Survey, 2016, Approach Paper to 14th plan (2016 June), NPC and Sample Census in Agriculture, 2011 census, 2011). Likewise, connectivity is poor, one of the lowest in road density per land area in the region (analysed later). However, bright side of the picture is that low productivities due to low level of input—use, poor connectivity and traditional management practices given the availability of good agro-ecology in the country and emerging regional markets—imply high potentials for developing agriculture in the country through appropriate interventions. More analysis of these will be presented later.

3.2 Agriculture is Dominant and Contributes Strongly also to Non-agricultural Growth

Agriculture sector is dominant with 32% share in GDP and is a major source of employment (more later). However, agriculture being largely rain-fed, there are significant variations in farm production depending on weather. The structure of economy is gradually changing due to higher growth in service sector (about 5% a year over last 10 years). The share of agriculture in GDP has come down from 43%, on average, in 1992–96 to 33% in 2012–16 (Chart 3). However, during the last decade (2007–16), it has changed only marginally due to fall in growth in both agriculture and non-agriculture sectors. Agro-industries being two-thirds of the industries, a slow pace in agriculture growth of around 3% a year, have been a constraint in attaining higher economic growth and faster alleviation of poverty in the country.

Chart 4 shows the movement of growth in GDP, AGDP and NAGDP over last 10 years (2007–2016). A regression analysis of growth rates of 10 years (2007–16) in GDP and non-AGDP against AGDP reveals that the growth relationship is

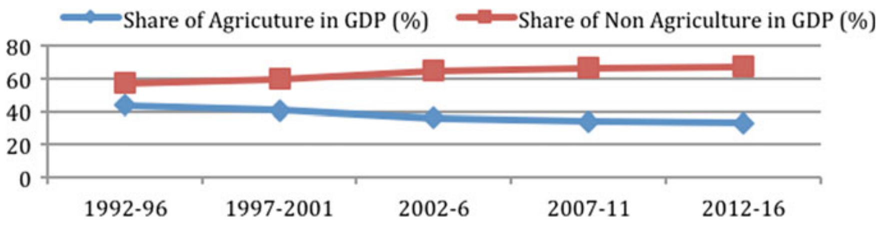


Chart 3 Average share of agriculture and non-agriculture GDP. *Source* Estimates by the Author based on National Account Series, CBS

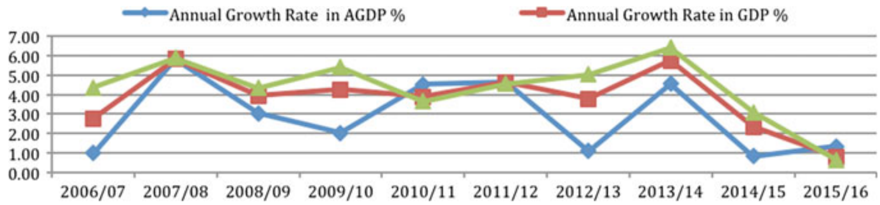


Chart 4 Annual growth rates in AGDP, non-AGDP and GDP (2007–16) %. *Source* of Data: Economic Survey, 2072/73; Ministry of Finance, Government of Nepal

strong.[10] It shows that AGDP growth explains 88.6% variation in GDP growth and 77.8% variation in non-AGDP growth. One percentage point growth in AGDP leads to 1.21 percentage point growth in non-agricultural GDP, a multiplier of 1.21.[11] Likewise, one percentage point growth in AGDP leads to 1.13 percentage point growth in GDP, a multiplier of 1.13. The contribution of agriculture is much higher than the agriculture sector share of 0.33 in national GDP due to own sector effects and multiplier effects on non-agriculture sector. It is rationalized by the fact that almost two-thirds of industries operating in Nepal are broadly agriculture-based, and use of services like restaurants, trades, credits, real estate, construction and transports is affected by growth in rural income augmented by agriculture. This means, faster acceleration of economic growth in the country needs accelerating agricultural growth and will be intensified by diversification towards commercialization of agriculture. The Agricultural Perspective Plan (APP) (1995–2015) and the Agricultural Development Strategy (ADS) (2015–30) have also strongly advocated this.

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[10]The estimated ordinary least square regression equations for the period 2007–16

$$\text{Estimate of GDP annual growth rate} = 1.13 \text{ AGDP annual growth rate} + \text{e (error term)} \quad (1)$$

(*Number of observations = 10; estimated R-square = 0.89, T-statistics of beta coefficient* (*1.13*) = *8.4; F-stat = 69.9 and ρ = 0.000,002*)

$$\text{Estimate of non-AGDP annual growth rate} = 1.21 \text{ AGDP annual growth rate} + \text{e (error term)} \quad (2)$$

(*Number of observations = 10; estimated R-square = 0.79, T-statistics of beta coefficient (1.21) = 5.8 and F-stat = 33.3, ρ = 0.0003*)

Estimated ‘R-squares’ showing the power of AGDP in explaining variation in GDP and NAGDP in the equations are high around 80% or more, and beta coefficients are highly significant, at more than 99% confidence level, implying high reliability of the relations estimated

Source Estimates by the author.

[11]Nepal Agriculture Perspective Plan, 1995–2015, had expected it to be 1.5%. General understanding internationally is also similar in case of agriculture-dominated economies.

3.3 Regional Agricultural GDP (AGDP)

In the country, agricultural land is largely covered (84.1%) by temporary crops with 79.6% of the coverage in the mountains, 74.4% in hills and 92% in Terai.[12] The shares of mountains, hills and Terai in AGDP are 8.1%, 40.7% and 51.2%, respectively (Table 3). Agriculture in the mountains is limited due to difficult terrain. The percentage shares of mountains, hills and Terai in GDP are 5.6%, 48.8% and 45.6%, respectively; almost close to their AGDP shares, implying that agriculture is the major player in the economy of each region. As per APP 1995, field crops were dominant in AGDP (with more than 40% in mountains and hills to about half in Terai) followed by livestock (about one-third in mountains and hill and one-fourth in Terai) and horticulture (about 12–14% in all regions).[13] Nationally, hills dominated in the contribution to livestock GDP and Terai on both the field crops and horticulture. Regional distribution of AGDP is not available in the national account.

3.4 Employment in Agriculture

The Population Census of 2011 has shown that the active population of 10 years and above is 62.5%[14] of the total population. Agriculture sector (including forestry and fishery) is still the single largest sector for employment (Chart 5), engages about two-thirds (64%) of the usually active population having at least six months of engagement[15] and serves as the main occupation for three-fifths (60.43%). By gender, the sector is the main occupation for about half (50.5%) of the male and three-fourths (73.6%) of the female workforce. Every year, about 450 thousand persons enter into labour market. Among the active labour force, 30% are partially employed and 2.3% are fully unemployed. The government has targeted to increase employment at the rate of 3.2% a year (Thirteenth Plan, 2013–16). Employment in agriculture sector fell only marginally from 65.7 to 64% between 2001 and 2011, as the growth in non-agriculture sector remained sluggish over this period. The share had declined faster from 81.2 to 65.7% between 1991 and 2001 due to higher growth in non-agriculture sector during this period.

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[12]Computed from Nepal Sample Census of Agriculture; Mountain, Hills and Terai Issues, 2011/12.

[13]Champak Pokharel, agriculture diversification in Nepal, agriculture diversification and smallholders in South Asia, Academic Foundation, New Delhi, 2007.

[14]Nepal Population and Housing Census, CBS, 2011, defined economically active population as those who perform at least one month of economic works (agricultural activities, wage/salary earnings, own non-agricultural business activities, extended economic activities and seeking jobs) in a year.

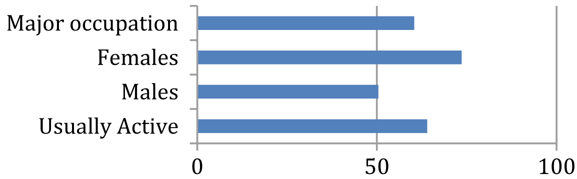
[15]NPHS (Nepal Population and Housing Census 2011) has shown 54.20% (11.1 million) of the population ten years of age. Among them, 90.5% are usually active having at least six months of engagement.

Table 3 GDP and regional GDP by agriculture, non-agriculture and sub-sectors of agriculture, 2011 (Rs. million)

	Agriculture[a]			Non-agriculture		Total	
	Value added	Share in GDP %	Share in AGDP %	Value added	Share in GDP %	GDP	Share in GDP %
Mountain	38634	2.8	8.1	37915	2.8	76549	5.6
Hill	194635	14.2	40.7	472,500	34.6	667,135	48.8
Terai	244,880	17.9	51.2	378,390	27.7	623,270	45.6
Nepal	478,149	35	100	888,805	65	1,366,954	100

Source Regional agriculture and non-agricultural GDPs for 2011 are from Human Development Report of Nepal 2014, UNDP
[a]Includes agriculture, forestry and fishery

Chart 5 Engagement of active population in agriculture. *Source* Data from Nepal Population and Housing Census, CBS, 2011



There is high prospect for increasing employment is agriculture through its commercialization and changes in crop mix including a shift towards livestock. A study by the Department of Agriculture (2014)[16] has shown that the benefit–cost ratio in vegetable farming is generally 1.5–2.5 times and employment per hectare is 1.5–3 times compared to paddy and wheat farming. In fruits, the return per ha is two to three times higher but it is labour saving by 30–40% compared to rice and wheat[17] and is more profitable than traditional food grain cultivation on lower-quality slope lands. Livestock is also more employment- and income-generating, as land is not necessarily a constraint, since stall-feeding of large animals and multi-storey animal rising are possible for small animals and birds. A national-level evaluation study of Small Farmer Development Program for Nepal has shown that the financial rate of return even on small-scale livestock farming is generally more than 40% and employment generation is 0.5 adult equivalent in raising 50 poultry birds, or a pair of pigs, or 5 goats/sheep and 0.8 adults person year equivalent in farming one milking high-breed buffalo/cow with calf.[18]

[16]Source: Average Cost, Returns, and Net Profit of Major Vegetable and Spice crops, Statistical Information on Nepalese Agriculture, MOA 2014/15 (for Net profit and B-C ration) and Cost of production Year book, 2013–14 for labour use, Agribusiness Promotion Centre DOA.

[17]Average Cost of Production and Gross Profit of Fruit Farming in Nepal 2071/072 (2014/15), Netra Bahadur Bhandari, Maniratna Aryal, Agribusiness Promotion and Marketing Development Directorate Market Research and Statistics Management Program, Department of Agriculture, Lalitpur, Nepal.

[18]Evaluation and Impact Assessment of Third Small Farmer Development Project, 1997; Agricultural Projects Services Centre, Kathmandu, Nepal.

4 Agricultural Diversification

4.1 *AGDP Growths and Change in Agriculture GDP Composition by Sub-sector and Ecological Region*

Growth in value added across ecological belts signals the diversification in the context of interplay of output, input and price factors in the regions. The growth estimated in this study for the country and the ecological belts for 1995–2011 (Table 4) shows that AGDP of Nepal had a moderate annual growth of 3.6% a year, over the period.[19] However, the growth in value added by ecological belt varied considerably. Across regions, Terai performed better with the annual growth rate of 4.5% a year followed by the mountains 3.7% a year. Hills were the least performer possibly because the effect of conflict was highest in the hills, as the large number of families left the villages in hills during intensified conflict period of first half of the 2010s.

4.2 *Movement in Commodity Production Index of Major Sectors of Agriculture*

As the growth in production is a result of productivity growth and area growth, more resource allocation in inputs for some crops or livestock types, or more use of land area in them also implies diversification. The average annual growth in national production in agriculture over 2001–15 was 2.9% (Table 5). However, the sub-sector growth varied widely. Food grain sector grew slowly at 1.6% a year due to inadequate supply of chemical fertilizer, drought and lower seed quality. Although more than 90% of the paddy, maize and wheat area is claimed to be under improved variety, replenishment rate of seed is very low (less than 5% a year).[20] Cash crop output grew at a moderate rate of 3.3%, a year. Fishery and horticulture which are facing more favourable price (analysed later) and market due to faster urbanization grew higher at 5.6% and 6.6% a year, respectively. Fertilizer supply had remained severely constrained after the gradual withdrawal of fertilizer subsidy by the government between 1995 and 2009. The growth of food grains declined as other more profitable crops, mainly horticultural and cash crops, received priority in the use of available limited fertilizer. The growth is generally faster in the later five years including some improvements in cereal crops due to increased public expenditure in agriculture, reintroduction of subsidy and increased supply of

[19]Regional breakdown of AGDP growth is not available in CBS growth accounting.

[20]Current sale of improved seed form the National Seed Company stands only at 2.6 kg per ha of paddy, 7.6 kg per ha of wheat and none in maize. Private sector supply has low reliability due to weak regulations.

Table 4 AGDP annual growth by regions (between 1995 and 2011) at 2001 price (Rs. million)

	1995		2011		1995–2011
	AGDP at 1995 price	AGDP at 2001 price	AGDP at 2011 price	AGDP at 2001 price	Annual growth rate at 2001 price %
Mountain	6855	9734	38,634	17,356	3.7
Hill	39,295	55,801	194,635	87,437	2.8
Terai	40,629	57,695	244,880	110,009	4.1
Nepal	85,569	121,507	478,149	214,802	3.6

Source Estimated by author using AGDP deflator on regional data from APP, and Nepal Human Development Report 2014

Table 5 Index of agriculture production 2001–15 and share in value added

	Agriculture GDP weight % (2001)	Production index of agriculture, forestry and fishery[a]				Annual cumulative growth (%)		Share of different agriculture commodities in total value added (%)[a]		
		2001	2005	2010	2015	2001–15	2010–15	1995	2001	2015
Food grains	36.4	100	108.8	109.0	124.9	1.6	2.8	33.68	36.36	30.0
Cash crops	13.1	100	111.9	139.0	157.1	3.3	2.5	6.9	13.05	13.5
Horticulture	16.8	100	126.6	170.2	217.5	5.7	5.0	21.6	16.75	24.0
Livestock	25.7	100	111.4	123.7	141.5	2.5	2.7	27.7	25.68	24.0
Forestry	8.1	100	105.1	102.4	119.2	1.3	3.1	9.2	8.07	6.3
Agriculture/forestry without fishery	100	100	112.7	127.7	148.4	2.9	3.1			
Fishery (% of agriculture and forestry)	1.2	100	131.9	162.2	270.8	6.6	10.8	0.99	1.18	2.1

[a]Breakdown and regrouping by the author based on the Commodity Production Index of Agriculture and commodity weights. Shares for 1995 and 2001 are from economic surveys and for 2015 are the study estimates based on value of outputs weighted by respective shares of 2001
Source data Various issues of Economic Survey/Agricultural Statistics CBS

fertilizer (explained later under drivers of diversification). Faster diversification occurred in horticulture and fisheries and moderately in cash crops.

Livestock output grew slowly at 2.5% a year. Livestock products are demand-driven, and marketing arrangements are more capital-intensive and cumbersome due to sanitary requirements. Also, imports are constrained for the same reasons. Consequently, the growth of the sector is confined mostly in the close proximity of urban areas or road corridors. Forestry sector growth stagnated due to conflicts in the past. In the later period, resolution of the conflicts, extension of community-managed forestry, promotion of agroforestry and entry to carbon trading improved the growth in the sector to about 3% a year. Estimates by this study show that the share of value of outputs is increasing faster in horticulture and decreasing gradually in cereals and cash crops. Micro-pictures of diversification within sub-sectors can vary and are analysed later.

4.3 Sub-sector Diversification

4.3.1 Food Grains, Cash Crops and Horticultural Crops

Area

The cropped area grew slowest at about 0.7% a year between 2000 and 2015 (Table 6). While other crops are expanding relatively faster, cereal crops still occupy about 72% of the total cropped area in 2015. The areas occupied by cash crops, horticultural crops (vegetables and fruits) and pulses are 10.6%, 8.5% and 7%, respectively. Speciality crops like spices and others cover small area of less than 2%. High growth in area occurred in summer fruits and citrus at about 5–6% a year. Vegetable area grew in the medium range of 3.5% a year. Cash crops, vegetables and fruits have gained the share in the cropped area. Large increases in the cropped area over last 15 years were in fruits followed by vegetables and cash crops. Cereals lost their share by 6 percentage point over the same period. In crops, diversification has been occurring at a higher rate in fruits, medium rate in vegetables and slower rate in cash crops.

Production

Chart 6 analyses the growth in the production of different crops in two time periods: 2000–2015 and 2010–2015. Within horticulture, vegetable and fruit production both grew at high rates of 5–7% a year during 2001–15, implying faster diversification towards these crops. The diversification is moderate in cash crops with growth of about 3% a year. Comparison of area and production growth shows that diversification in fruits occurred from area growth and in vegetables and cash crops from both area and yield growths. During 2010–15, production improved, in general, due to increases in government expenditure in agriculture, subsidies and fertilizer supply (analysed in Drivers section).

Details of area, production and yields by crops and their growth for 2000–15 are shown in Annex Tables 11, 12, 13, 14 and 15. Summary of area and production growths by specific crops are shown in Charts 7 and 8. The analysis shows that paddy, barley, tobacco and jute areas have declined over the period. Yield growth in paddy is low (1.65% per year) during this period, although yield growth has increased to 2.85% per year during 2010–2015, compared to 0.59% per year during the previous period (2005–2010) (Annex 11). Yield growth in maize and wheat, two

Table 6 Mix of major crop areas in the country 2000–15 (‘000 ha)

	Cereals	Cash crops	Pulses	Vegetables	Fruits			Speciality crops	Total
					Citrus	Winter deciduous	Summer tropical		
1999/00	3296	387	307	149	19	15	36		4208
2004/05	3352	410	315	181	26	19	45		4349
2009/10	3423	450	322	235	34	23	51	68	4606
2014/15	3380	495	328	250	39	27	84	86	4689
Annual growth in area (2000–15)%	0.2	1.7	0.4	3.5	4.9	4.0	5.8	4.8*	0.7
Share of area in 2000 (%)	78.3	9.2	7.3	3.5	0.5	0.4	0.9		100
Share of area in 2015 (%)	72.1	10.6	7.0	5.3	0.8	0.6	1.8	1.8	100.0
Change in Area, percentage point, (2001–15)	2.5	27.9	6.8	67.8	105.3	80	133.3		11.4
Change in share, percentage point, (2001–15)	−6.2	1.4	−0.3	1.8	0.3	0.2	0.9	1.8	0

Source Basic data from SINA Issues, MOAD

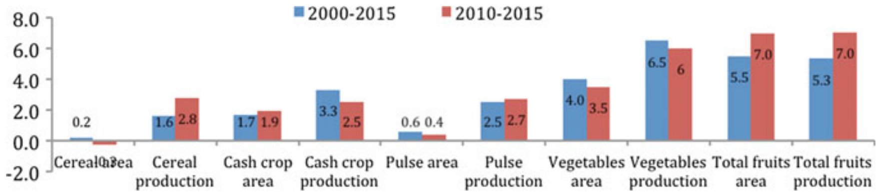


Chart 6 Sub-sector annual growth % in area and production. *Source* Author's Estimate Based on MOAD Cross Data Series, SINA Issues

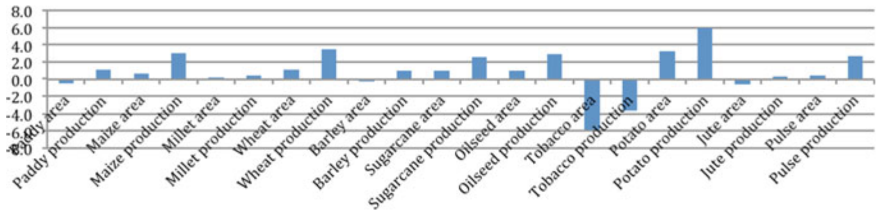


Chart 7 Annual cumulative growth rates (%) in area and production of field crops over 2000–2015. *Note* 'prod'. stands for production. Areas; production and yields by crops and their growths are shown in Annex Tables 11, 12 and 13. *Source* Author's analysis based on Production Data Series, SINA Issues, MOAD

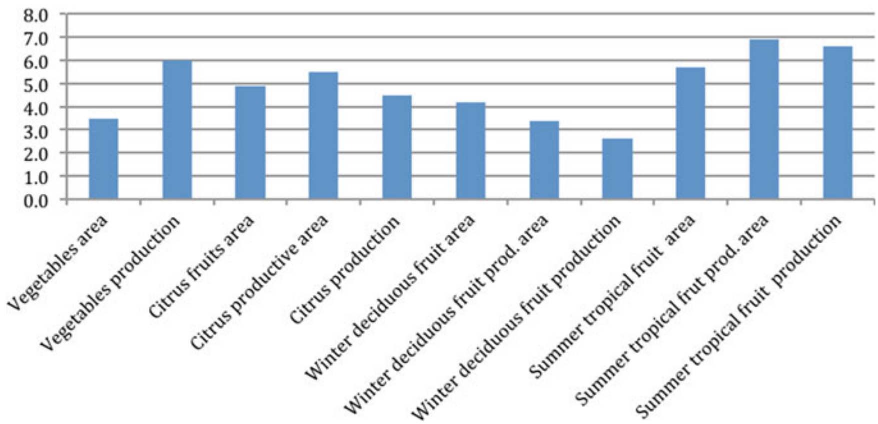


Chart 8 Annual cumulative growth rates (%) in area and production of horticulture crops over 2000–2015. *Note* 'prod'. stands for production. areas; production and yields by crops and their growths are shown in Annex Tables 14 and 15. *Source* Author's analysis based on Production Data Series, SINA Issues, MOAD

other important cereal crops, was 2.3% per year during 2001–2015, for both crops; yield growth was higher during 2010–2015 compared to the previous period. Higher rate of decline in area led to a decline in the production of tobacco despite positive yield growth (Annex 12). Crop diversification was higher with high growth rates in production (more than 4.5% a year) in potato, vegetables, citrus and summer tropical fruits. Moderate growth of more than 3% a year has occurred in wheat and maize. There have been both area growth and yield growth in potato, vegetables, maize and wheat. In all fruits, only area growth has occurred and growth in production is slower than growth in area due to yield declines. Being longer gestation crops and land being constrained, low-quality lands may have been utilized in fruit cultivation leading to decline in yields. Vegetables and fruits have high demand due to urbanization effect. While about 25% of the vegetables and larger part of the fruit demand in the urban areas are met from imports, some vegetables and fruits get exported in the bordering towns and also to some western countries to a limited extent (particularly, organic products). Maize and wheat being used for animal feeds, they have higher demand due to higher growth in poultry (shown in livestock). Production is increasing faster than other food grains in these crops.

Market-oriented economic policy adopted by the government, credit expansion and packaged supports to vegetable growing pockets through various projects for generating cash income at farm sector, NGO efforts and increased government expenditure in later years including reintroduction of subsidy in fertilizer have made positive impacts on production growth. An annual growth of yields (based on three years moving average of area and production) has been 2–2.5% in maize, wheat, potato, pulses and vegetables. Paddy, sugar cane and oilseed yields are growing at about 1.5–2% a year. Yields have declined in all fruits, as mentioned earlier. Other crops have only marginal growth in yield. The yield growth being slow even in crops with high production growth implies weaknesses in research and its outreach efforts.

Speciality Crops

Spices and other speciality crops like cardamom, ginger, garlic, turmeric and chilly and specific cash crops like tea, coffee, silk cocoon and honey are produced in specific climate locations and have good prospects for expansion, including export. They occupy about 2% (86 thousand ha) of the cropped area of the country (Annex Table 16). Being highly labour intensive, they play important roles for cash generation by small farmers in those locations. Cardamom, ginger and tea are important export crops of the country and occupy about 70% of specific crops area. Farmers involved in cultivating those three crops number about 300 thousand with about 80% in ginger cultivation, 15% in cardamom and 5% in tea (Agriculture Census, 2011). Coffee is also exported in small amount. Its production level is 414 Mt, and export is about one-fourth of production (Tea and Coffee Board Data, 2016). Production of other crops is small. The crops, which have annual growth rates of more than 5% between 2007 and 2015, are coffee, ginger, turmeric, chilli, honey, mushroom and flowers. Floriculture has been a recently emerging crop and is commercially grown in 38 districts. Yearly sale of flowers is of about Rs. 1.2 billion (2013); export is of Rs. 12 million and import Rs. 95 million (MOAD/Floriculture Association Data, 2015). Flowers and cut flowers (fresh or dried) are exported mainly to India, China, Australia, Japan and UK.[21] Nepal Floriculture Survey, 2016, shows that commercial farms are concentrated mostly in Kathmandu Valley (60%). Being ornamental, yearly sales revenue from floriculture farming is very high at about Rs. 4.1 million per ha and the farming is very labour intensive and skill-based. It is more women-friendly needing serious dedication. Women-operated farms are 29%, at present, and are growing.

Cardamom worth Rs. 3.4 billion and ginger worth Rs. 0.5 billion were exported to India in 2014. Small part of tea is exported to Europe and India and coffee to Europe, Japan and Australia. The price of cardamom and ginger fluctuates heavily over the years and faces border hurdles unexpectedly in export (like sudden excess surcharge and antidumping duty) during good crop years in India, despite the trade treaty of duty-free status with her for agricultural exports. Pest control and assured markets are the major issues in the growth and expansion of these crops. Growth in floriculture requires development of export contacts, good quality maintenance and transport management (Chart 9).

The analysis of field crops, fruits, vegetables and specialty crops analysed in the charts above and Annex Tables 11, 12, 13, 14 and 15 indicates that growth in area and production is close implying that diversifications are mostly occurring through area expansion as the yield growth is either much slower or stagnated. For example, diversification in vegetable is slowing down due to fall in growth of area expansion and yield growth is slow around 2.4%. In fruits, diversification is occurring only through area expansion as yield has declined. Likewise, in field crops, where the area growth is very small (with decline in paddy and barley), annual yield growth is less than 2% in longer term (2001–15) with recent pick up to 2–3%. Also in specialty crops, most of the diversification is through area expansion with stagnated yield growth. Pulse crops and cash crops are doing fine as both the yield and the area increasing with yield growth are closer to 2.5% a year. From historical experience, yield growth is expected to contribute to about 70% of total growth a healthy agriculture in developing countries. In case of Nepal where bringing additional land into cultivation is limited, yield growth has to be more than 3.5% a year. This shows a need for investment on research to develop and disseminate improved varieties and associated cultural practices.

4.4 Livestock

Development of livestock sector is at very low stage, as seen from the analysis of numbers of animal heads, production, productivity and their growth (Table 7 and Annex Table17). Encouraging diversifications towards cows, goats and chicken is taking place. During 2000–2015, chickens grew at very fast rate of 7–8% a year in meat production and herd size, respectively, and at 4.2% a year in egg production.

[21]Nepal Trade Statistics, Department of Custom, Nepal 2016.

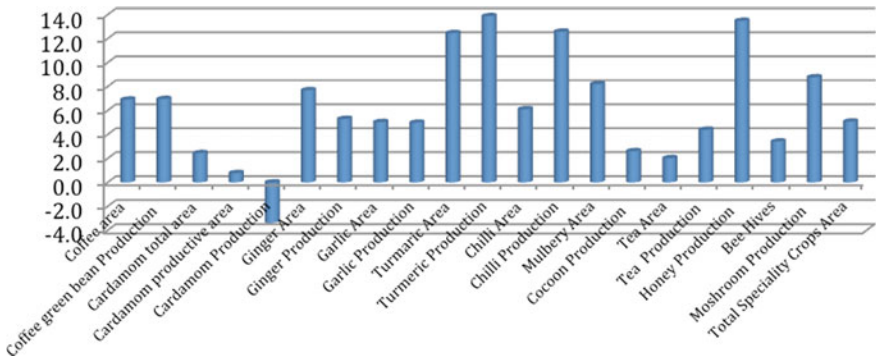


Chart 9 Growth rate of speciality crops (2007–15) %. *Source* basic data from SINA Issue MOAD

The production in cow (milk) and goat (meat) grew at a moderate rate of about 3.5% per year. However, growth in production from buffaloes (both milk and meat) and pigs (meat) was slow, less than 3% per year. In recent five years (2010–15), production grew at a higher rate, except in buffaloes, sheep and goats. Growth in production from buffaloes has slowed further down to 2% a year, was negative in sheep and stagnated in ducks. Encouraging annual growth in productivity of more than 3% has occurred in chicken meat (7.1%), cow milk (3.9%) and hen eggs (3.6%) during 2010–10. In other commodities, productivity growth is generally low.

As seen in Chart 10, the proportion of milking cows in total cattle has increased by only 2 percentage point in the last 15 years. Though recent data on improved cows is not available, increase in the productivity of cows was at about 4% a year over 2010–15, which is indicative of herds being diversified faster towards improved breeds in the recent period. Likewise, chicken meat productivity has improved by almost 50%, implying faster improvement also in their breeds. Migrant returnees from abroad and the youth are gradually getting involved in raising improved breeds of cows, goats, pigs and chicken with commercial approach, leading to faster diversification in them. Due to management difficulty compared to cows, popularity of buffaloes is slowing down. The proportion of laying chicken is declining fast from 30 to 16% of total chicken population from 2000 to 2015, implying that the raising of chicken is diversified towards more meat producing varieties due to higher demands. Similar trend is visualized in ducks, though the number is very small. Overall, the diversification trend in milk and meat animals has been faster in later five years. Increase in government support on interest rate and insurance for commercial farming over last five years including some capital subsidy seems to have contributed to this. The efforts need to be continued with priority to breed improvement, commercial farming and feed development and market promotion.

Table 7 Production performance of livestock products in Nepal (2000–2015)

Production of milk and meat '000 Mt, animal heads '000 number, eggs 'million number, wool production' Mt

Commodity/ animals	1999/00		2004/05		2009/10		2014/15		Annual growth rate % (2000–15)		Annual growth rate % (2010–2015)	
	Production	Animal heads	Production	Animal heads	Production	Animal heads	Production	Animal heads	Production	Animal heads	Production	Animal heads
Cattle		7023		6994		7199		7241		0.2		0.12
Milk	1097		1274		1496		1725		3.1		2.9	
– Cow[a]	337	841	380	902	429	955	558	1026	3.4	1.3	5.4	1.5
– Buffalo[a]	760	911	895	1051	1067	1253	1167	1345	2.9	2.6	1.8	1.4
Meat	189		215		249		303		3.2		4.1	
– Buffalo[b]	122	3526	139	4081	162	4837	174	5168	2.4	2.6	1.4	1.3
– Sheep	3	852	3	817	3	801	3	789	−0.5	−0.5	−0.2	−0.3
– Goat	37	6325	42	7154	50	8844	61	10,252	3.4	3.3	4.1	3.0
– Pig	15	878	16	948	17	1065	20	1203	2.1	2.1	3.4	2.5
– Chicken[c]	13	18,620	15	22,790	17	25,760	45	50,195	8.9	6.8	22.4	14.3
– Duck[c]	0.3	425	0.2	392	0.2	380	0.2	390	−1.6	−0.6	0.6	0.5
Egg	481		590		643		880		4.1		6.5	
– Hen	465	5668	577	6643	630	7291	866	8413	4.2	2.7	6.6	2.9
– Duck	16	222	14	183.2	13	175.3	14	180	−1.2	−1.4	0.2	0.5
Wool (Mt)	615	852	590	817	580	801	569	789	−0.5	−0.5	−0.4	−0.3

[a]In milking
[b]Including milking heads
[c]Including milking heads; yields are given in annex table
Source Basic Data from SINA Issues, MOAD

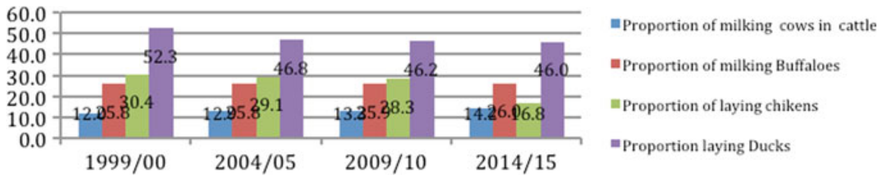


Chart 10 Proportion of milking cows and buffaloes and laying poultry birds (%). *Source* Basic data from SINA, MOAD

4.5 Fisheries

Fisheries have been playing an important role in the livelihood of very small farmers and landless. Fish production from capture fisheries (in rivers, lakes, reservoirs, swamps, low land-irrigated paddy fields, etc.) is nearly half of the production from ponds. Annual fish production in the country is about 70 thousand metric tons (Mt), with production from ponds of 42 thousand Mt (Table 8). About 19 thousand households are involved in fisheries as ancillary agricultural activity, and more than 90% are in Terai (Agric Census, 2011). The government for more than three decades has promoted fish culture in ponds. Fish is produced in community groups (usually poor farmers) and also individually. Poor community groups are organized to raise fish in community ponds mostly through poverty alleviation programmes implemented by multiple agencies. The total pond area in the country is 36.6 thousand ha. Average size of the ponds is 0.4 ha, and productivity per ha is 4.5 Mt. Annual growth in pond fisheries has been high at 7.5% during 2000–15 and more than 10% during 2010–15. Farmers have started substituting cereal production area for commercial production of fish. Due to development of urban towns, demand for fish is increasing fast and there is considerable amount of fish import in the country. Only about 35% of the fish demand is met by domestic production (Karobar Daily, 29 December 2016). Promoting commercial fishery in smallholders can benefit them in increasing both the income and the employment, significantly.

Census Results on Overall Expansion and Contraction in Farming (2001–11)
Agriculture Sample Census, 2012, has shown that area of cereal crops, pulses and some fruits (junar, lemon and mango) and the population of large animals (cattle, yaks and buffaloes) and small domestic birds (pigeon) have declined over the census interval 2002–12. This broadly resembles with MOAD data which shows that compared to 2002, paddy areas have declined, cattle number stagnated around 2010 with a decline from 2013, and horticulture had stagnated during 2010–11 due to pest problems, though picked up again later (Chart 11).

Table 8 Fish farming in ponds, 1999/00–2014/15

	1999/00	2004/05	2009/10	2014/15	Annual growth%	Annual growth%
					2000–2015	2010–2015
Pond no. (000)	22.0	23.0	24.4	36.7	3.5	8.5
Pond area (000 ha)	8.8	9.6	10.6	14.2	3.2	5.9
Water surface (000 ha) (area	5.8	6.2	6.9	9.2	3.1	5.9
Total fish production	14.0	20.2	24.9	41.5	7.5	10.8
Yield Mt/ha	2.39,722	3.24,968	3.60,414	4.6	4.4	4.9

Source Basic data from SINA Issues, 2016

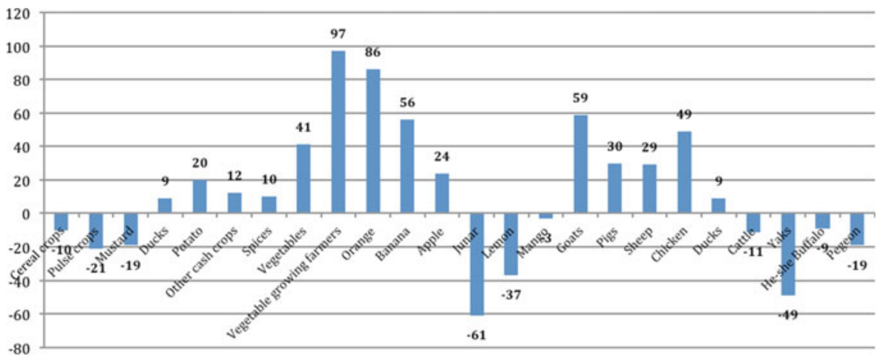


Chart 11 Contraction and expansion in farming (in %) within the intervals of sample of agriculture censuses 2002 and 2012 (farmers and animals in numbers and crops in area). *Source* Basic Data from Nepal Sample Census of Agriculture, 2012, CBS

4.6 Forestry

Forest is also a prime sector related to agriculture basically for firewood (73% of households' energy consumption), fodder to livestock and manures to field crops. The country's forest area is 3.8 million ha, 39.6% area of the country's land area (CBS). About 25% of this is believed to be in degraded form. In addition to protection of national forest and reserves, government policy promotes also agro-forestry, community forestry and private forestry. Agroforestry is a traditional practice, private forestry is small, and its growth is very slow. Community forestry involves handing over part of state forest land to nearby communities for regenerating, managing and consuming the products within specified norms for community use, local development activities and benefit sharing with the government. The community forestry of Nepal has been expanding and is one of the successful cases also in the international context. By 2016, 1.7 million ha (about 45% of the total forest area of the nation) has been handed over to the community and it involves 35% of the population (Department of Forest website). Revenue from forest involves occasional large auctions and regular sales. Average regular revenue of the government from the forest was Rs. 0.67 billion over 2011–14, in which the sale of timber constitutes about 73%, herbs 3% and the rest 24% (Statistical Year Book, 2014, CBS). Informal exports of herbs are believed to be considerable due to lack of processing and weak monitoring.

Timber, plywood and other wood material worth Rs. 2.5 billion a year were imported in 2015/16 (Trade Statistics, Department of Custom, Nepal, 2073), and there is increasing demand for timber for residential and other purposes. Some international companies like Patanjali Yogpeeth and Dabur Company are involved in commercial cultivation of herbs in Nepal, at present. The forest-related products, basically herbs and related Ayurvedic medicine, are exported, which grew from Rs. 62 million to Rs. 141.6 million between 2010 and 2015 (CBS and Economic Survey, 2016). From a broader perspective of agricultural diversification, there is a good potential for community involvement in herb cultivation including agro-forestry in the degraded forest area of the country. Likewise, initiating managed timber cultivation is a good possibility to replace current imports of wood products and timber, meeting increasing domestic demand for timbers and for export promotion of processed herbs and Ayurvedic medicines with appropriate branding.

4.7 Agro-industries

Manufacturing industries in the country had poor performance with the annual growth rates of 1.7% between 2001 and 2007 and 1.3% between 2007 and 2016 due to conflicts in the previous period, and increasingly long hours of load shedding, poor business environment and insecurities and political instabilities in the latter period. Agricultural industries were equally affected by these disturbances (data from Economic Survey). Analysis of Census of Manufacturing Establishments, 2002 and 2012 (Chart 12), shows that the share of agro-industries in total manufacturing industry was 51.2% in 2002 and it dropped to 46.5% by 2012. Annual growth in agro-industrial sector was very low, 0.2% a year over the period. However, some agro-industries were able to do better while some others lost. Exports were basically of the primary agricultural commodities. Manufacturing establishments with higher investments and healthy growth in agro-industries are basically the ones driven by the internal market demand, except the wood products, which are partly exported as crafted doors and windows for the buildings. The industries, in general, are concentrated in a few locations leading to higher cost of transportation of raw materials and less spillover of industrialization benefit in the locations of raw material supply,

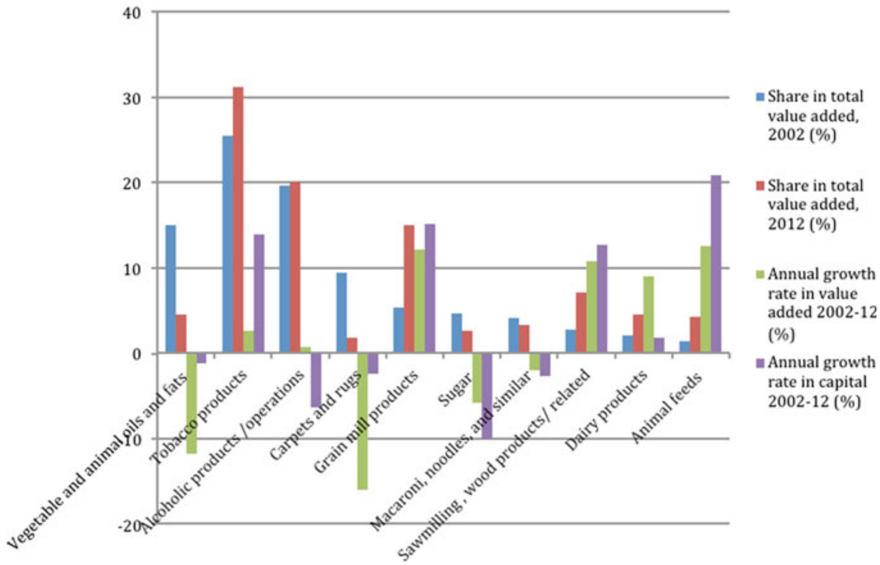


Chart 12 Share in total value-added growth in capital (%) of largest 10 agro-industrial groups in 2002 and 2012. *Source* Author's analysis based on manufacturing establishment census data 2002 and 2012

including quality control. Because of long hours of load shedding, capital-intensive industries are gradually shifting towards labour-based.[22]

Excluding those with small shares of 4% or less in value added by agro-industries in both censuses, the industries which grew at about 10% or higher in value added in real terms during 2002–12 were grain mill products, animal feeds, dairy products, sawmilling and wood products (Annex Table 18). These industries also attained healthy annual growth in capital of more than 10% a year in real terms and obviously were also the large gainers in their shares in value added. The industries that grew moderately at about three per cent a year were bakery and tobacco products. Processing and preserving of fruits and vegetable grew slowly at about 1% a year. This might be due to traditional habits of consuming fresh products instead of frozen and dried forms and lack of entry to export by the products due to inadequate sanitary standards.

Manufacturing of carpet, leather and jute declined faster due to competition with synthetic products in the international market. Likewise, sugar production also grew slowly due to high subsidy across the border (India). Noodle products which had high growth in value added in the 1990s and the early 2010s were pushed to negative growth of 2% a year. This industry has started facing competition from

[22]Development of Manufacturing Industries in Nepal: Current State and Future Challenges, Government of Nepal, National Planning Commission Secretariat, Central Bureau of Statistics, November 2014.

imported noodles basically from Thailand and India. Alcoholic products were able to maintain their shares in value added over the census periods. Big losers in shares in value added were the industries on vegetable and animal fats, carpets/rugs, sugar and noodles/macaroni types. These industries have moved towards disinvestment. Growth in alcoholic products, however, has been showing over-consumption of existing capital, as seen from the positive growth in value added associated with high negative growth in capital investment (Chart 12). Possibly, this is due to shifting production efforts to other countries because of easier adjustability in its production and marketing.

Most of the industrial establishments which improved value added-to-inputs ratio (an efficiency indicator) have maintained healthy growth in capital (measured by growth in gross fixed asset). Instability in the government policies, ad hoc interventions in the market, labour issues and cumbersome regulations are often identified problems in developing agro-industries in Nepal.

5 Drivers of Agricultural Diversification in Nepal

Factors influencing production environment such as infrastructure (irrigation, roads, market centres), technology (seeds, breeds, research, extension and mechanization), domestic market forces (change in consumption pattern and price trend), risk mitigation measures (insurance and support price), international trade (export, import and future prospects) and credit facilitations are major drivers of agricultural diversification. However, it may vary by country to some extent, depending on specific situations. Described below are important drivers of agricultural diversification in the context of Nepal.

5.1 Infrastructure

5.1.1 Addition in Irrigation Facilities

The Department of Irrigation, government-assisted farmer-managed irrigation systems (FMIS), indigenous FMIS, groundwater schemes and the Agricultural Development Bank/Nepal are the main sources of irrigation development in Nepal. So far, 1343.4 thousand ha of land has been irrigated in the country, which is 50.9% of the arable land. About two-third of the arable land is irrigable from surface irrigation and groundwater. However, only about a third (36%) of the irrigated area is year round. Likewise, one-third of irrigation is from groundwater. Of the irrigated area developed by government agencies, 82% is in Terai, 15% in hills and 3% in

Chart 13 Arable land irrigated (%). *Source* National plan Document NPC and Economic Survey Ministry of Finance

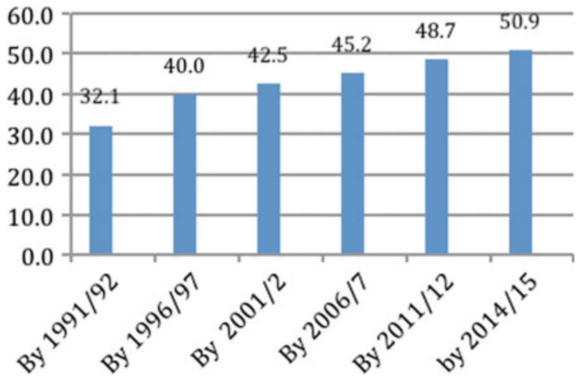
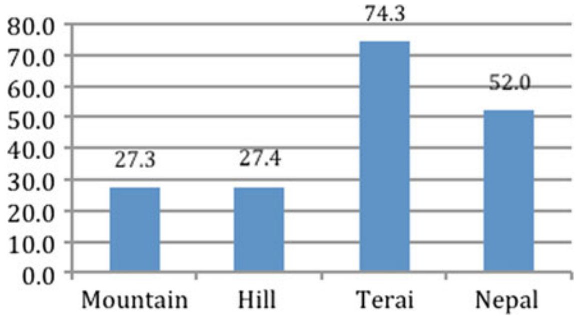


Chart 14 Irrigated land and percentage of arable land by region. *Source* Census of Agriculture, CBS, 2012



mountains.[23] Regionally, about three-fourths of the land in Terai and one-fourth of the land in hills and mountains are irrigated from all sources (Agriculture Census, 2011). The pace of additional irrigation development has slowed down in recent years due to low absorption capacity of capital expenditure in the country (Charts 13 and 14).

5.2 *Construction of Roads*

Presently, blacktopped road density stands at about 8.1 km per 100 km^2, one of the lowest in the region (Table 9). The Department of Road (DOR) constructs roads by developing strategic road networks from regular government budgets and by local bodies (District Development Committees, and Municipalities and Village Development Committees) by developing district, urban and village roads from the grants received by them and from their internal revenue sources. Local bodies have

[23]Author's estimates based on Irrigation Status Database Study: MOWR (2006) and area added later (based on Economic Surveys, Government of Nepal).

Table 9 Road density and % distribution of rural roads in mountain, hills and Terai

	Road density	Distribution by region (%)			
	km road per 100 km^2	Blacktopped	Gravelled	Earthen	Total
Mountain	9.4	8.0	2.6	18.4	13.8
Hill	43.0	45.4	17.1	67.5	54.2
Terai	63.9	46.6	80.3	14.1	32.0
Nepal	34.6	100	100	100	100

Source Draft DoLIDAR Annual Report, 2016

been playing important roles in connecting rural pockets to urban and suburban areas (which facilitates markets) and the strategic road networks developed by DOR. The Department of Local Infrastructure and Agricultural Road (DoLIDAR) under the Ministry of Federal Affairs and Local Development provides local bodies' additional resources and technical supports. Most of the blacktopped roads are strategic network roads (more than three-fourths), and feeder roads in rural areas are mostly earthen and some gravelled, not that reliable for travel during rainy seasons due to frequent landslides and lack of bridges.

DoLIDAR Data (2016) shows that village road network has reached 31 thousand km with about one-fourth all weather and three-fourths earthen. Nepal has reached road density of 34.6 km per 100 km^2 including earthen, which is still one of the lowest in the region. Overall, roads are increasing at about 4% a year. Between 2002 and 2015, blacktopped roads grew at 8% a year and fair-weather road (blacktopped and gravelled) at 5.5% a year (Chart 15). Through much simpler construction, local bodies are contributing roughly additional half to fair-weather roads and almost twice as much to earthen roads compared to DOR.

Construction of strategic roads and rural roads has been faster with (i) the initiation of regular grants to local-level governments from the mid-1990s, after implementation of Local Self-Governance act (LSGA) 1991 which authorizes local bodies to raise local taxes, (ii) special initiatives of the government in connecting district headquarters by blacktopped road and north–south corridors and (iii) initiation of agricultural roads under APP by involving local bodies. These

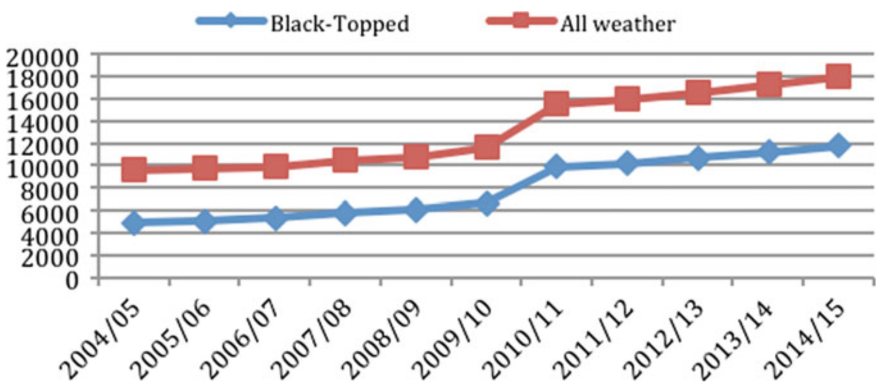


Chart 15 Road construction by department of road (km). *Source* Basic data from Economic Survey 2015–16

infrastructure policies have contributed considerably in improving the agriculture market connectivity in the country. Local bodies spend major parts of their resources on infrastructure, specially rural road construction and improvements by mobilizing also peoples' participation, which makes them capable of carrying out relatively more construction activities from the resources spent, compared to the government agencies. Also, their road activities at the local level create pressure to the government to convert the constructed earthen roads to all-weather roads, faster. In 2015, local bodies constructed about 2900 km road in which 20% were all weather. The DOR had added about 1100 km in which 75% were all weather.

5.3 Technology

5.3.1 Chemical Fertilizer

Chemical fertilizer is one of the prime components of modern agricultural technology. As the current use of nutrient is low at 68 kg per ha, and yield is low at around 2.5 Mt per ha of cereals, it needs to be increased multiple times by promoting a balanced use of fertilizer. Its use in developed countries is almost four to five times higher for optimal production. However, use of chemical fertilizer in Nepal is much constrained because of unavailability and policy inconsistency of subsidy. Lack of irrigation is partly a constraint in the bordering areas where the farmers can arrange supply privately. From the latter part of the mid-1990s to 2009, fertilizer supply remained severely constrained due to withdrawal of subsidy and involvement of private sector in the business without adequate preparation, supports and planning. Price rise was not a major issue, as marginal revenue/productivity is much higher than the price of fertilizer at low application. This policy change adversely affected production leading to increasing rice imports. After 2010, the government reintroduced the subsidy and eased the supply, as indicated previously. However, supply is expected to meet only half of the present demand. The present supply is more concentrated in accessible areas (Chart 16).

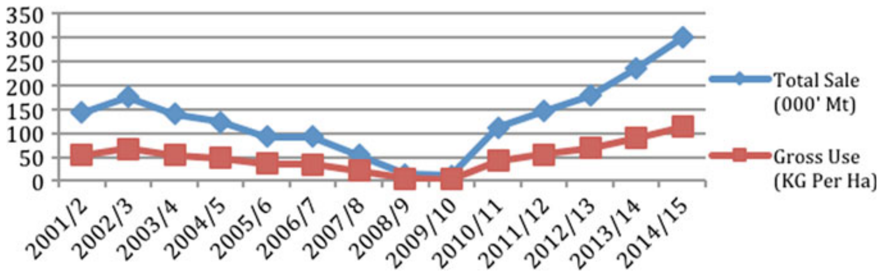


Chart 16 Sale of chemical fertilizer in the country and uses (gross) per Ha of land. *Note* Use in nutrient equivalent is about half the gross use in sales from *Source* of Data: SINA Issue, MOAD

5.3.2 Improved Seeds, Research, Extension and Adoption

Seeds and breed quality are very important in improving diversification either on own initiatives or from demonstration effects of the neighbours who first adopt new varieties and crops. Except for paddy, maize and wheat, the adoption of improved seed varieties is low in Nepal. The use of improved seeds is more than 90% in maize, wheat and paddy (SINA, MOAD, 2016). In sugar cane and potato, improved seed users are one-third of total farmers growing these crops (NSCA, 2011, CBS). In animals, the percentage of farmers who have adopted improved breeds is about 3–4% in cattle, buffaloes and goat and 7% in pigs. In chicken, it is 43%. Government support in research and extension is low, and less than 0.3% of AGDP is spent on research and less than 0.4% on extension. This implies that agricultural research and extension programmes are weak. Use of improved seeds/breeds by farmers in combination with other technologies is also weak due to low spending on research. The replacement rate of seeds is very low, 11% in maize and wheat, and 13% in paddy. In vegetables, however, replacement rate is high at 73% (Seed Quality Control Centre, Nepal, 2014), due to relatively higher proportion of commercial production and active participation of private sector in vegetable seeds. However, overall users of improved seeds in vegetables are also low, with one-fourth of vegetable growers using improved varieties.

5.3.3 Mechanization

Nepal has started facing labour shortage in agriculture as the youth are leaving villages, being less attracted to agriculture due to low productivity and emerging opportunities in developed countries for labour. The labour cost is rising fast in rural areas. In such a situation, mechanization helps is reducing the production cost. However, the level of mechanization is very low. Among the farm holdings, users of power tillers, motors/pump sets, tractor and threshers are 1.9%, 23%, 22% and 24%, respectively. In irrigation, ten per cent use shallow tube wells and 4% deep tube wells. Mechanization is negligible in the mountains and hills. Some mechanization has occurred in Terai. The indicators of mechanization in Terai region are about twice the national level (Statistical Year Book, CBS, 2013). As the labour force is migrating to foreign countries for higher-paying jobs than in rural agriculture, the sector is facing labour shortage and increasing areas of land are being left fallow. In this context, mechanization has a role for commercialization in agriculture to increase marginal productivity of labour and overall production. Government policy has started promoting mechanization in recent years through subsidies and tax exemptions in the small-size machinery, basically pump sets, threshers, tillers, small harvesters, etc.

5.4 Public Policy

5.4.1 Public Sector Expenditure in Agriculture

Withdrawal of subsidy on fertilizer and shallow tube wells after APP implementation as part of reform for encouraging private sector participation considerably reduced the public sector expenditure on agriculture starting in 1997 and continued till 2009. Consequently, it affected growth in agriculture due to lack of fertilizer and retardation in irrigation development, as private sector was not ready to provide marketing for fertilizer outside urban centres and shallow tube well (STW) installation dropped almost to none for several years, until another project was designed to cover STW together with infrastructure package. Later, the government reintroduced the subsidy on fertilizer and other activities (more later) to promote commercialization—starting 2009. This improved public expenditure in agriculture in the later years (Chart 17). Annual growth in government expenditure during 2006–16 has been 14.5% a year in real terms with 13.4% in capital expenditure and 26.1% in recurrent expenditure. However, this high growth reflects comparison with low initial level and should be interpreted with caution. The issues of lack of prioritization, low absorption capacity in infrastructure and thinly spreading of resources continue.

5.4.2 Government Policy on Production and Processing

Strategy

The Agricultural Perspective Plan (APP) (1995–2015) was implemented by the government with liberalized policy and infrastructure development such as

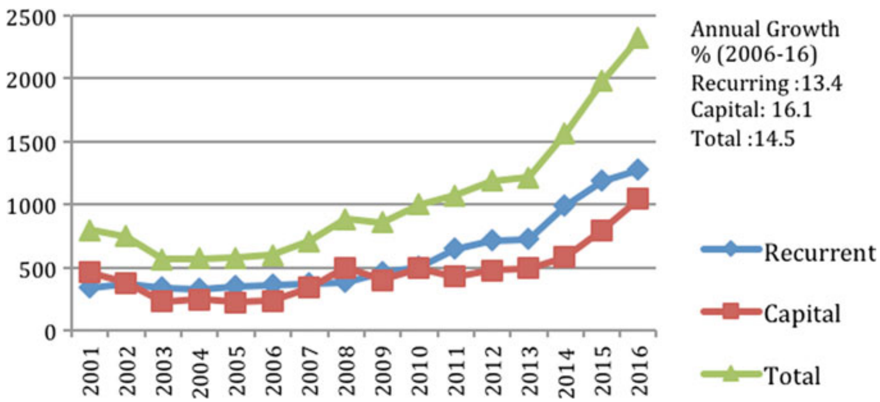


Chart 17 Public expenditure in agriculture (2001–16) at 2001 price (Rs. 10 million). *Source* Basic Data from various Issues of Economic survey, MOF

irrigation, agriculture roads, construction of market centres and commercialization drive in agriculture for supply push by promoting also private sector enterprises. Many corporations were privatized or sold in the process. The impact has been positive in developing rural connectivity and initiation of commercialization, as revealed in the analysis. The Agricultural Development Strategy (ADS) (2015–35) has been implemented recently, which focuses mainly on commercialization and processing of agricultural production. It also emphasizes export promotion and import substitution, given slow growth in agricultural export and fast increase in imports including agricultural products (more on agriculture import). Nepal Trade Integration Strategy (NTIS) (2016) recognizes 15 potential priority export products for promotion such as cardamom, ginger, tea, medicinal and aromatic plants, leather, footwear, chyangra pashmina, knotted carpets, fruits and vegetable juices, lentil, instant noodles, wool products, honey and coffee.

For enhancing commercialization of agriculture, the government has come up with the policy of developing pockets, blocks, zones and super zones[24] with special packages of facilitation to increase production through technical supports along with various subsidies (described later under direct subsidy). In forestry, community forestry has been the main priority for developing and protecting degraded area by involving nearby communities with the provision of sharing revenue between the government and the community (more in forestry). Overall agricultural credit environment has been considerably improved through Central Bank requirement for the banking system to increase supply of and access to agricultural credit through directives of mandatory credit disbursement in agriculture. There is also government's support on credit and insurance premium (described later).

Direct Subsidy

The withdrawal and reintroduction of subsidy on fertilizer and groundwater irrigation have already been discussed above. There is a subsidy of Rs. 5.47 billion for fertilizer and seeds for this year. From 2016, the government announced Prime Minister's Agriculture Modernization Project (PMAMP) with allocation of Rs. 5.75 billion for the project and various subsidies also under it. Though the rates of subsidy are announced, amount available for various subsidies is less clear. Total subsidy available from various sources could be around Rs. 7 billion (1% of AGDP including Prime Ministerial Programme). Major subsidies include about 50% on urea and 25% on other fertilizers (the same as last year), 75% on livestock insurance premium, 50% on farm machinery, 85% on processing and marketing 5% on the interest of agriculture loans, 50% on fish pond construction and various other small subheads. Since there are numerous headings under a limited budget of Rs. 5.75

[24]Budget speech 2017 specifies 2100 pockets each of minimum 10 ha along road, two agriculture production blocks (greater than 100 ha each) per district, 30 agriculture production and processing zones per district and one super zone of 1000 ha per province (7 provinces are proposed in constitution of Nepal).

billion including fertilizer subsidy under PMAMP, access and efficacy could be limited. Government has given priority to provide subsidy through cooperatives or organized groups on processing and marketing.

5.4.3 Market Interventions and Price

The government has adopted market-based approach in agriculture and tries to influence the price of milk and milk products and rice in the cities (mostly in major cities) through purchase and sales of those products from respective corporations (Nepal Food Corporation and Dairy Development Corporation) owned by it. Milk market is fairly competitive. In milk, private sector share is about 40% in the market and DDC is 60%. Though the private sector sells most of its milk in small towns, it broadly seems to base its price on DDC sales. Government supplies transportation-subsidized food grains (mostly rice) in some locations of remote hills and mountain districts not adequately connected by all-weather road (23 out of 75 districts of Nepal at present) through NFC (Nepal Food Corporation). NFC buys about 45 thousand Mt of food grains (mostly paddy) per year from some surplus districts of Terai to manage its operations of food subsidy programme, sales in cities (mostly Kathmandu Valley) and for food security reserve. The total purchase is only about 1.3% of the total paddy production, very small to be influential in the market. The government announces purchase prices as facilitation prices for paddy, sugar, coffee and tea in mutual understanding with traders (millers) and some farmers' representatives through a meeting facilitated by the chief district officer in the case of paddy and sugar, and on tea and coffee by the respective commodity boards. These are neither contract price nor a minimum support price, as there is no legal obligation to purchase the supported products by the miller or the government, should the market price fall below the announced price.

5.5 Risk Mitigation Measures: Insurance and Support Price

Insurance and support price are important tools for farmers to save themselves from natural risks and downward risks. There is no support price in Nepal, as explained earlier. The coverage of agricultural insurance is low. It was started from the Agriculture Development Bank in livestock sector about 30 years ago with partial government support of 50% on the premium to be paid by farmers. It did not pick up then. From 2013, the government directed non-life insurance companies (there are 17 now) to include agricultural insurance mandatorily in their portfolio by issuing Crop and Livestock Insurance Directives in 2012 and also increased subsidy on premium from 50 to 75% and by expanding agricultural insurance to cover both crops and livestock. The agriculture production insured at present is very low at 0.9% of AGDP (Rs. 6.6 billion), and portfolio share is mostly (80.6%) livestock (Insurance Board, data). The progress has yet to be seen, though the initial response appears to be encouraging. Small farmers are expected to benefit from it considerably as they are intensively involved in livestock and vegetable farming under income-generating activities. A microfinance institution, which serves about one-third of the small farmers, is one of the prime users of the insurance facility. The constraints to agricultural insurance are the lack of risk-related data system, weak expertise in the insurers about the sector, lack of understanding of insurance system by farmers and weak promotional efforts.

5.6 Access to Credit Facilities

Total outstanding credit from all institutional sources—commercial banks (including Agriculture Development Bank, Nepal—ADB/N), development banks, finance companies, microfinance institutions and agriculture-related cooperatives—was Rs. 76.5 billion (11.6% of AGDP) in 2015. The commercial banks are the largest institutional source (66.3%) of agricultural credit (Charts 18 and 19). Outstanding credit from them stood at Rs. 50.7 billion in 2015 and grew at the rate of more than 20% a year in real terms between 2012 and 2015. However, only about 22% of the total holdings in the country had borrowed agricultural credit and among them only 37% had borrowed from institutional sources (42.5% from

Chart 18 Agriculture credit outstanding from institutional source (2015), Rs. million. *Source* Quarterly Economic Bulletins, Nepal Rastra Bank

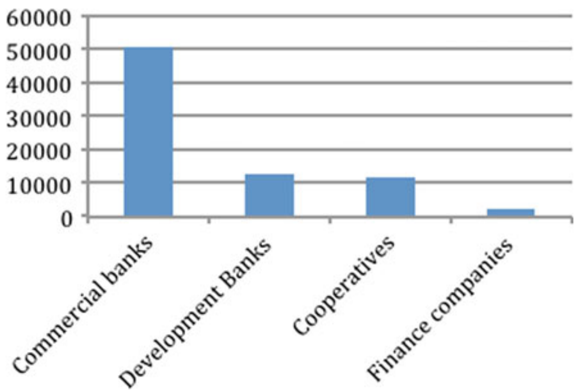
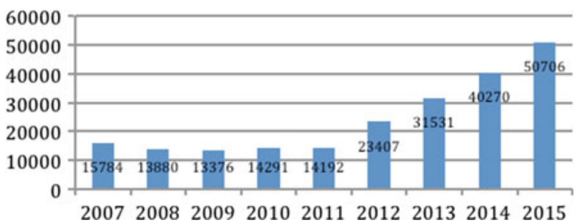


Chart 19 Outstanding credit of commercial banks (Rs. million). *Source* Quarterly Economic Bulletins, Nepal Rastra Bank



cooperatives, 34.1% from ADB/N and 23.5% from commercial banks excluding ADB/N). Farmers who want to borrow but do not have access to credit are high as 42% (Sample Census of Agriculture, 2011). The microfinance institutions are mainly funded through the banking system under wholesale lending from the mandated funding from the deprived sector credit directed by Central Bank.

The Central Bank has mandated banks and financial institutions to invest in deprived sector (5%, 4.5% and 4% of lending by commercial bank, development bank and finance companies, respectively). Deprived sector includes small farmers and women, who are the prime beneficiary of the deprived sector credit. Central Bank also mandates commercial banks to disburse 20% of their total credit in productive sector, which also includes agriculture. Interest rate on agriculture loans is 6% under government subsidy. Additionally, Central Bank provides refinance facility to the banks on agriculture credit. Subsidized credits are provided through Small Farmer Development Bank and Youth Development Program of the government. Generally, the banks get short-term borrowings in their deposit culture and there is often a problem for providing longer-term credits in agriculture.

5.7 Market Drivers in Domestic Market

5.7.1 Changes in Consumption Pattern in Urban and Rural Sectors

Rate of urbanization is high with average annual urban population growth of 5.3% during 1981–2015 and 5.5% during 2001–15.[25] Table 10 shows the change in consumption pattern in real and nominal terms for the period from 2001 to 2015 for rural sector and 1996 to 2015 for urban sector.

Urban Sector

Total household consumption expenditure on food items constitutes almost half (50, 1%) in urban sector in 2015. Real per capita consumption increased at 1.7% a year between 1996 and 2015 with a decline in the interim period 2006–15 due to slow growth in the economy. However, continued higher consumption growth has occurred in food and non-alcoholic beverages by 2–3% a year with substitution against non-food sector even during the interim period, as revealed by negative growth in their consumption period during that interval. The data also reveals a decline in share of expenditure in grain and cereal products with shifts occurring consistently towards increased share in consumption of high-value products like vegetable, fruits, meat, fish, milk and eggs. The growth in their consumption has increased 3–7% a year, with heist ones being meat, fish and fruit categories. Such change in consumption pattern is expected with rising income.

[25]It would be 5.5% a year for the recent one and half decade based on population of 2001 and the estimated urban population 25% in 2016 by Economic Survey.

Table 10 Per capita annual consumption pattern and growth in urban and rural area (expenditure in Rs.)

(a) Urban sector

	1996		2006		2015		Annual growth 1996–2006		Annual growth 2006–15		Annual growth 1996–2015	
	Current price	Share %	Current price	Share %	Current price	Share	Nominal	Real	Nominal	Real	Nominal	Real
Total consumption	17,268	100.0	**39,116**	100.0	76,821	100.0	9.5	4.4	7.8	−1.1	8.6	1.7
1. Food and non-alcoholic beverages	**6257**	36.2	**11,685**	29.9	**32,545**	42.4	7.2	2.1	12.1	3.2	9.6	2.7
Grain and cereal products including pulses	**2934**	17.0	**4710**	**12**	**9648**	12.6	5.4	0.3	8.3	−0.6	6.8	−0.1
Vegetables	828	4.8	1716	4.4	4720	6.1	8.4	3.3	11.9	3.0	10.2	3.3
Fruits	235	1.4	769	2.0	2040	2.7	14.1	9.0	11.4	2.5	12.8	5.9
Spices	242	1.4	398	1.0	1388	1.8	5.7	0.6	14.9	6.0	10.2	3.3
Meat and fish	632	3.7	1154	3.0	6454	8.4	6.9	1.8	21.1	12.2	13.8	6.9
Milk products and eggs	701	4.1	1532	3.9	3748	4.9	9.1	4.0	10.4	1.5	9.8	2.9
Oils and fats	429	2.5	761	1.9	2495	3.2	6.6	1.5	14.1	5.2	10.3	3.4
Sugar, tea, coffee, non-alcoholic beverages, etc.	256	1.5	645	1.6	2052	2.7	10.8	5.7	13.7	4.8	12.3	5.4
2. Restaurant, hotels, alcoholic beverages	950	5.5	2077	5	4417	6	9.1	4.0	8.7	−0.2	8.9	2.0
Restaurants and hotels	768	4.4	1618	4.1	673	0.9	8.6	3.5	−9.3	−18.2	−0.7	−7.6
Alcoholic beverages	182	1.1	459	1.2	**3744**	4.9	10.8	5.7	26.3	17.4	18.3	11.4
3. Tobacco and related products	219	1.3	243	0.6	**1512**	2.0	1.2	−3.9	22.5	13.6	11.3	4.4
4. Other non-food goods and services	**9842**	57.0	**25,110**	64.2	38,347	49.9	11.0	5.9	4.8	−4.1	7.8	0.9

(continued)

Table 10 (continued)

(b) Rural Sector	2001		2006		2015		Growth (2001–2006)		Growth (2006–2015)		Growth (2001–15)	
	Current price	Share %	Current price	Share %	Current price	Share	Nominal	Real	Nominal	Real	Nominal	Real
(b) Rural Sector												
	2001		2006		2015		Growth (2001–2006)		Growth (2006–2015)		Growth (2001–15)	
	Current price	Share %	Current price	Share %	Current price	Share	Nominal	Real	Nominal	Real	Nominal	Real
Total consumption	11,928	100	27,598	100.0	49,049	100.0	18.3	13.5	6.6	−2.3	10.6	3.2
1. Food and non-alcoholic beverages	6745	56.5	10,296	37.3	27,217	55.5	8.8	4.0	11.4	2.5	10.5	3.1
Grain and cereal products including pulses	3382	28.4	4471	16.2	9835	20.1	5.7	0.9	9.2	0.3	7.9	0.5
Vegetables	492	4.1	1453	5.3	3774	7.7	24.2	19.4	11.2	2.3	15.7	8.3
Fruits	160	1.3	438	1.6	919	1.9	22.3	17.5	8.6	−0.3	13.3	5.9
Spices	433	3.6	410	1.5	1274	2.6	−1.1	−5.9	13.4	4.5	8.0	0.6
Meat and fish	629	5.3	1232	4.5	5470	11.2	14.4	9.6	18.0	9.1	16.7	9.3
Milk products and eggs	652	5.5	1115	4.0	2508	5.1	11.3	6.5	9.4	0.5	10.1	2.7
Oils and fats	478	4.0	700	2.5	2294	4.7	7.9	3.1	14.1	5.2	11.9	4.5
Sugar, tea, coffee, non-alcoholic beverages, etc.	222	1.9	477	1.7	1143	2.3	16.5	11.7	10.2	1.3	12.4	5.0
2. Restaurant, hotels, alcoholic beverages	NA	NA	1633	5.9	**2168**	4.4	NA	NA	3.2	−5.7	NA	NA

(continued)

Table 10 (continued)

(b) Rural Sector

	2001		2006		2015		Growth (2001–2006)		Growth (2006–2015)		Growth (2001–15)	
	Current price	Share %	Current price	Share %	Current price	Share	Nominal	Real	Nominal	Real	Nominal	Real
Restaurants and hotels	NA	NA	1108	4.0	675	1.4	NA	NA	-5.4	−14.3	NA	NA
Alcoholic beverages	476	4.0	525	1.9	1493	3.0	2.0	−2.8	12.3	3.4	8.5	1.1
3. Tobacco and related products	NA	NA	242	0.9	**1341**	2.7	NA	NA	21.0	12.1	NA	NA
4. Other non-food goods and services	**4707**	39.5	15,430	55.9	18,323	37.4	26.8	22.0	1.9	−7.0	10.2	2.8

Source Derived from Household Consumption Survey 1996, 2001 and 2015 by CBS and Household Budget Survey 2006 by Central Bank

Consumption expenditure in hotel and restaurant has a mixed result possibly due to definitional problem in accounting alcoholic drinks under food or non-food categories in different surveys. To avoid ambiguity, this study has combined restaurant, hotel and alcoholic beverages as an amalgamated indicator for dining out. There has been a growth in this category of expenditure at 2% a year in real terms during 1996–2015. Alcoholic beverage alone is increasing at 11.4% a year in real terms during the period and is rationalized on the ground that young generation in urban sector is adopting fast to modern lifestyle. The HBS has shown that the share of hotel and restaurant in household-level food consumption had almost doubled from 6.7 to 10.5% within a decade during 2006–15.

Rural Sector

Total household consumption expenditure on food items constitutes almost two-third (62.6%) in rural sector in 2015. Per capita consumption has increased by about 3% a year during 1996–2015, with a decline in the interim period 2006–15 due to slow growth in the economy. The growth in consumption of cereals is low (0.5% a year). However, there has been consistently higher growth in consumption of high-value products, vegetables, meat, fish, eggs and fruits at more than 5% a year due to faster growth in the household production of high-value products due to commercialization of agriculture in the recent decades. Consumption data on restaurant and hotel is understandably scanty due to lack of facilities. The growth in consumption of alcoholic beverages in rural sector is slow at 1.1% a year.

Recent Household Budget Survey (HBS) (2015) by Central Bank shows that food and beverages occupied 40%[26] in the national expenditure and five food categories—high-quality rice, medium-quality rice, mutton, local milk and broiler meat (chicken) each occupied 2–3% of the monthly consumption expenditure and they fall in top 10 items in the consumption basket. This survey also indicates that consumption pattern has changed significantly in favour of livestock products, vegetables and higher-quality rice, with the rise in income.

5.7.2 Change in Relative Market Price of Agricultural Commodities

The trend of the movement in the price of commodities in the market is an important driver for diversification. Chart 20 shows the relative change in the urban consumer price index of agricultural commodities across the major groups, in relation to non-agriculture groups and overall commodities in the market. It has been measured by shifting base year to 2005/6 by reconstructing the series for 2006–15 based on Central Bank's urban consumer price index data. The analysis shows that the change in consumer price index in the urban centres across the commodity groups differed widely and there is some variability in price trend of ghee and oil, sugar and sweets, spices and legumes. In all other commodities, the

[26]This figure closely resembles also with the CBS Household Survey, 2015.

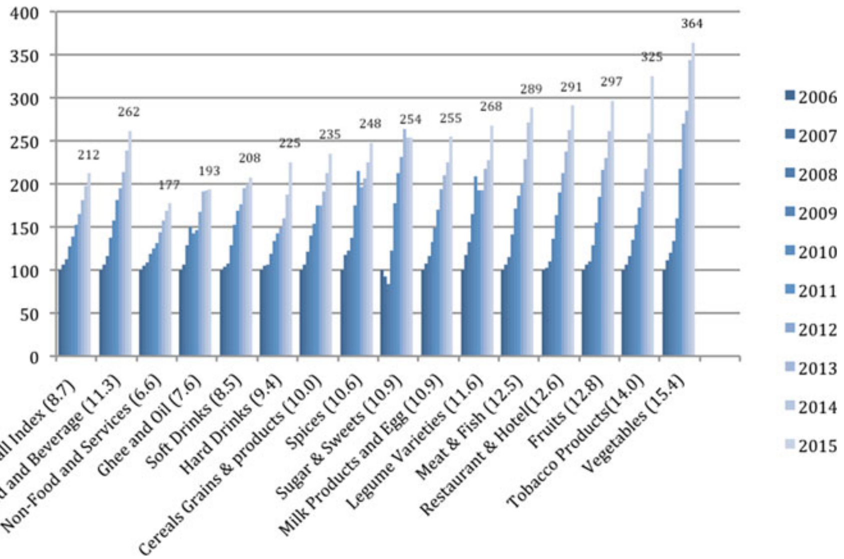


Chart 20 Urban consumer price index of various commodities and groups (year 2006 = 100). *Note* Figures in parentheses represent cumulative annual growth rates (2006–15). *Source* Indexes Reworked by the author by shifting base to 2006 from the urban Consumer Price Indexes by Nepal Rastra Bank for different

price rise is continuous. The annual growth in price level in food and beverage group was 11.3% a year, 71% higher compared to non-food and service groups with the price rise of 6.6% a year. Within the food and beverage groups, the price of vegetables, tobacco, fruit and meat group increased much faster, more than 13% a year. In other agricultural groups also, the annual price rise was 10% (in food grains) or more (in others) except in ghee and oil. Growth in agricultural diversification analysed earlier appears to bear a resemblance to the price growth trend in the market.

5.8 Tariffs and Trade

5.8.1 National Tariff on Agricultural Trade

Protection level in the domestic market is low. Average tariff (tariff revenue divided by value of goods imported) in 2015–16 stands at 10.2%, which is one of the lowest in the region. In general, import tax on agricultural products mostly varies between 6% for SAARC countries and 10% for others. The tariff on concentrated preparations (powdered and condensed milk) and butter is 20%, on other preparations, tea and coffee between 20 and 30%, on cereal items like rice and wheat flour 9–

10%, on tobacco products 15–80%, on beer 30% and on hard liquors up to Rs. 1600 per litre depending on the concentration and quality. Export tax is negligible at Rs. 1 per kg in most cases. Tariff on forest-based products is up to Rs. 7 per kg. Some high-value products like yarchagumba have a special tax of Rs. 5000/kg. Woods and wood-related processing materials are taxed at 200%. VAT is mostly exempted on agricultural goods of mass consumption. However, Nepal faces constraints on technical requirements and SPS and standards from importing countries for which she has to strengthen herself considerably.

5.8.2 Export and Import of Agricultural Products

Export, import and gap between export and import of agricultural products (the sum of food and live animals; tobacco and beverages; animals and vegetable oils and fats under standard classifications) are shown in Charts 21 and 22. The imports of agricultural products are increasing much faster than exports. Overall, agricultural export has a negative growth of 2.3% a year in real terms (6.4% nominal terms) between 2005 and 2015. On the contrary, import of agricultural products is increasing fast at the real rate of 13.7% a year (22.4% nominal terms) and the gap is

Chart 21 Import–export gap of agriculture products of Nepal (Rs. 10 million). *Source* Basic Data from Economic survey, 2016

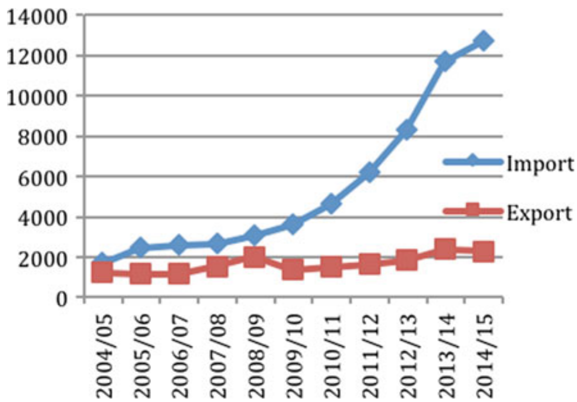
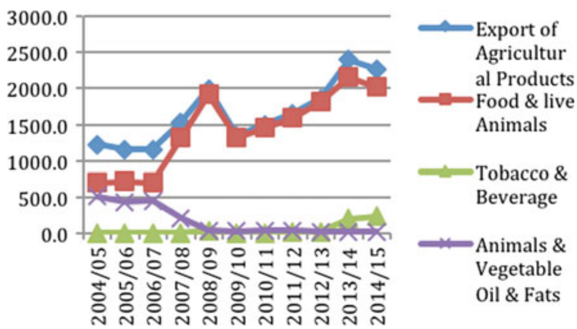


Chart 22 Export of agriculture products of Nepal by major category 2005–15 (Rs. 10 million). *Source* Basic Data from Economic survey, 2016



increasing at 15% a year (16% nominal terms). For an agricultural country, it should have been other way round. Export of animal and vegetable fats and oil has almost collapsed. Food and live animal group have a slow growth of 2.5% a year in real terms. Tobacco products have started picking up in recent years, but the trade is too small. Of the total exports, about two-thirds is with India, 3% with China (other neighbour) and the rest with other countries. Major agricultural exports of Nepal are juice, jute goods, cardamom, cattle feed, ginger, herbs, Ayurvedic medicine and noodles to India; tanned skin and hand-knotted woollen carpet to China; and hand-knotted woollen carpets, garment, pashmina, and hides and skins to other countries. Government has been implementing special projects in promoting export products including agricultural exports. But, it has not picked up due to constraints related to production growth, sanitary and phytosanitary conditions, and grading and quality certifications. Agriculture diversification should gear also towards substituting high-growth import products rather than focusing only on export.

5.8.3 External Trade Environment

Nepal has already entered into various multilateral, regional and bilateral trade agreements. She ranked third among 138 countries in 2013 in terms of market access and second in terms of margin of preferences. Average tariff faced was 4.9% on values. The treaty between Nepal and India allows Nepalese products duty-free entry except in some negative lists if they meet rules of origin. South Asian Free Trade Agreement (SAFTA) also facilitates market access to its member countries. Additionally, Nepal as a least developed country (LDC) is eligible for preferential treatment under Generalized System of Preferences (GSP) for lower tariffs than the most favoured nation (MFN) tariffs. Nepal enjoys also duty-free, quota-free access to European market under its 'Everything but Arms' (EBA) initiative. Nepal is also a member of Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC). She also has duty-free status in the Chinese market if the goods meet rules of origin with technical requirements and SPS standards.[27] From 2016, the USA has granted additional duty-free tariff benefits for up to 66 types of Nepali items not currently eligible for benefits for export under the General System of Preferences (GSP). The Nepal programme is authorized for ten years. Despite these, Nepal has not been able to take full advantage due to stringent non-tariff measures (NTMs) and para-tariff measures applied by the importing countries. Domestic constraints and challenges also hinder significantly the Nepalese traders from accessing international markets.

[27]More on these are available in Nepal Trade and Integration Strategy, 2016, Ministry of Industry.

6 Constraints to Diversification

Major constraints to product diversification in Nepal are the following.

6.1 Farm Production

6.1.1 Traditional Orientation and Small Size of Holding

Agriculture in Nepal is still dominated by traditional pattern. Commercialization is in the initial stage. Most of the farmers being small tend to minimize production and income risk. Thus, their response to diversification in the present condition is slow, in general. It is also hindered by small size of holding.

6.1.2 Weak Institutional Base of Contract Farming

Presently, only 11% of the land is under contract farming and it increased only by 3 percentage point between 2001 and 2011 (NSCA 2012). Land rental market system in agriculture is stagnated due to weak institutional base.

6.1.3 Lack of Priorities in Research and Extension

Research and extension in the country are weak. Public sector expenditure on research is very small, less than 0.3% of AGDP, and that on extension is less than 0.4% of AGDP. Research and extension are less focused on priorities because of the need for covering many things from small budget. Analysis shows that there is a significant gap in investment on research to develop and disseminate improved varieties and associated practices in field crops and horticulture and development of breeds in livestock for improving yields.

6.1.4 Lack of Essential Infrastructure

Essential infrastructures like irrigation, rural roads, rural electrification and market network development including wholesale and collection centres are inadequate, though the situation is improving in recent years. The road density is one of the lowest in the region, and only one-third of the agricultural land has year-round irrigation.

6.1.5 Weak Market Chain

There is oligopoly due to the presence of only a few large traders in the purchase of food grains from farmers, even if trade has expanded much faster due to remittance effects. Market manipulation issues emerge during harvest period. The implementation of regulations is weak. In vegetable sectors, government has promoted wholesale and collection centres, but they are only a few in the hills. Likewise, DDC milk collection is confined mostly to large pockets only.

6.1.6 Unstable Support Policy and Thinly Spreading of Resources

Support policies are unstable, and resources from public sector are thinly spread by covering many areas with small budget for short-term visibility due to political instability. This has led partly also to weak prioritization of projects, and there is unpreparedness in spending available budget. It is eroding absorption capacity of capital expenditure and adversely affecting the efficacy of implementation. The notion of food security being interpreted as food self-sufficiency that emerged after 2007/8 global world food crisis and assistance floating around this notion structured with minute interventions may have also contributed partly to such policy choices.

6.1.7 Increase in Fallow Land

Migration of labourers abroad has created shortage of labour in both hills and Terai, and farmers have to leave lands fallow. Traditional approach to farming is facing difficulty to cope up with fast-rising labour wage, which is growing at the real rate of 9% a year between 2008 and 2015.

6.1.8 Lack of Effective Packaging of Inputs and Pocket Development

Potential commodity pocket development lacks strategic approach for packaging of necessary infrastructure—irrigation, road from farm to market centre and rural electrification in sequential priority for fulfilling missing aspects and access to vital inputs (fertilizer, improved seeds, plant protection, etc.). The approach of covering everything everywhere leads to thinly spreading of resources making the implementation less effective.

6.1.9 Destruction of Agricultural Land for Residential Plotting

Tendency of the government and local bodies in constructing roads along river basins and soft plain areas for cost-effectiveness of construction and recent moves by banks in financing realtors in plotting and construction of residential housing along road corridors for financial soundness are destroying the crop areas, including irrigated lands. This is hindering commercialization move and food security in the country.

6.1.10 Weak Mechanization

Mechanization has been weak to fill up the gap of labour shortage in agriculture in rural areas. Likewise, mechanization technologies for smallholdings are less available in the country due to lack of effective promotional activities.

6.1.11 Weak Insurance System

The coverage of agricultural insurance is low. Agricultural production insured at present is very low at 0.9% AGDP. The constraints to agricultural insurance are the lack of risk-related data system, weak expertise in the insurers about the sector, lack of understanding of insurance system by farmers and weak promotional activities.

6.1.12 Inadequate Access to Credit

Access to longer-term credit is limited in agriculture. Available bank loans are mainly of short-term nature and confined more to commercial lending.

6.1.13 Weak Preparations for Utilizing International Trade Opportunities

Preparation of Nepal has been weak in exploiting advantageous position in international trade offered by China and India as neighbours, regional trade agreements such as SAFTA and BIMSTEC, European market, USA and the GSP under WTO. Sanitary and phytosanitary standards in the goods produced are weak, and production growth of export crops is expanding much slower than imports even in agricultural products.

6.2 Agro-industries

6.2.1 Weak Integration Between Industries and Farming

Except in a few cash crops (sugar cane, tea and coffee), agro-industrial processing is not linked to agricultural production pockets. Even in cash crops, the linkages are weak in terms of compliance.

6.2.2 Constraint to Longer-Term Credits

Access to longer-term credits to agro-enterprises is lacking. Commercial banks are involved mostly in short-term trade and hire—purchase schemes to minimize risks. They are less interested in long-term credits, due to weak governance, uncertainty in government policies and political instability in the country.

6.2.3 Fast Increase in Wage Rate and Shortage of Labour

Inadequate supply of industrial labour—both unskilled and semi-skilled—is a problem. Industrial labour wage is rising much faster leading to high cost of production.

6.2.4 Slow Development of Agro-industries

Emergence of new entrepreneurs has been slow, and the growth in agro-industrial sector is much lower than the production growth due to weak business environment including political instabilities.

6.2.5 Lack of Appropriate Technical Manpower Development

Manpower development is not well planned to cater to selective specialization of sectors with comparative advantage. While semi-skilled labourers needed in agro-processing are scarce in the country, even those who enter the job have fast turnovers as they leave for foreign countries after being trained for some time.

6.2.6 Low Quality and Lack of Assured Supply of Raw Materials

Good-quality raw materials are essential for quality products. Export of agro-industrial products is limited due to low quality of raw materials.

6.2.7 Weak Implementation of Government Policies

Instability in the government policies, ad hoc interventions in the market, labour issues and cumbersome regulations are often identified problems in developing agro-industries in Nepal.

7 Opportunities for Diversification, Conclusions and Recommendations

Nepal has distinct agro-ecological regions with varied climatic zones from tropical to perpetual snow, moderate rainfall and good soil structure. Various agricultural products such as cereals, horticultural crops and livestock are produced in the country. Importance of agriculture lies in its broad base for poverty alleviation and food security. There are huge unexploited potentials in the sector, which requires relatively low investment to tap these potentials due to low incremental capital ratio compared to other sectors. Despite low use of inputs, Nepalese agriculture has shown high growth performance of around 5% or higher in multiple years, particularly during good monsoon years even in the present situation of low investment in the sector. Between 1994 and 2015, annual growth of between 4.5 and 7% was achieved in 7 different years. This indicates that the sector does have the capacity to grow annually up to 7% with increased investments in irrigation, accessibility, adequate arrangements for input supply and favourable policy environment. However, the growth in the sector has not advanced basically due to (a) lack of investment, (b) short-sighted interventions, (c) lack of policy consistency and (d) weak prioritization and monitoring.

Nepal borders with two fast-growing most populous countries of the world, India and China. Though landlocked, it is also land-linked, as one-third of the world's population lives in those countries. Along with moderate rainfall, both hills and Terai (plain) have multiple potential sources for irrigation—surface water in Terai and hill basins, groundwater reserves in Terai and gravitational sprinkler irrigation in hill terrains. Agriculture has grown at around three per cent a year in the country. There is a good prospect for a higher growth in all major sectors of agriculture—field crops, horticulture and livestock, including high-value products like citrus, apples, nuts, spices, herbs, quality seeds, high-altitude cheese and off-season vegetables. Middle-class population is increasing fast in both neighbouring countries and in the region. Urban population growth in the country is more than 5% a year with emergence of multiple urban towns. As a result, marketing prospects are also high within the country. Remittance is providing resources for capital investment, which can be planned well for productive absorption.

The country has high prospects for agricultural development if she diversifies adequately from traditional agriculture to commercial agriculture and high-value crops. Agricultural commercialization, particularly in horticultural crops and livestock, also offers high prospects for employment growth. Major agricultural exports of Nepal are juice, jute goods, cardamom, cattle feed, ginger, herbs, Ayurvedic medicine and noodles to India, tanned skin and woollen carpet to China, carpets, garment, pashmina, and hides and skins to other countries, several of which have good prospects for expansion. Because of favourable climate, Nepal has comparative advantage in certain commodities like seeds, citrus, off-season vegetables, apple, sericulture, high-altitude yak cheese, herbs, Aurvedic medicines and hill-grown tea. These products have good market in SAARC region. Ilam tea has good market prospects in Europe and the Middle East. Production of cereals has prospect for exporting to Tibet and some other Asian countries. Products like high-quality rice, fresh vegetables, organic products and cut flowers can be marketed in Europe and Japan. Most of those products are already exported in small quantities by the private sector in those destinations. Selective promotions are needed.

Diversification for domestic market would be demand-driven. Due to fast-growing urban sector, changing consumption pattern and access to increased internal and external market, the prospect has further increased, compared to the past. There is good scope for expansion of cereals, cash crop production and related industries in Terai and vegetables, fruits and livestock-related products in hills and mountains. Such a strategy would also help in expanding trade links and economic integration between hills and Terai regions. There is considerable potential towards export-oriented food products like noodles, flavoured milk, yogurt, powdered milk, cheese, ketchup, fruit juice, jam, jellies and peanut butter. These could be exported to SAARC countries and abroad, as the Asian region is growing fast and people worldwide are being more conscious about natural/organic products. Production base in some commodities already exists, and some products and agro-industries would need support. Presently, agricultural export to India is two-thirds of the total, 3% to China and the rest to other countries. However, given high yearly total trade deficits (in 2015) of Rs. 436 billion with India and Rs. 98 billion with China, Nepal needs to target for more export to these countries in future.

The analysis shows that diversification is occurring in crops, livestock and agro-industries with strong internal demand. However, the pace of diversification is slow for various reasons. There are both potentials and constraints to faster rate of diversification. External environment for trade for Nepal is good due to duty-free and concession privileges in large neighbouring countries—China, India, USA and European Union. Nepal has not been able to take advantage of them due to production constraints, quality standard and sanitary/phytosanitary issues, and weak diplomatic efforts. Nepal being a small country having long open borders with large countries cannot have independent price policy and would need to behave as a price taker and explore diversification in agriculture based on comparative advantage from the regional perspective broadly and global perspective, selectively.

Nepal Trade Integration Strategy (NTIS) (2016) recognizes 15 potential priority export products for promotion such as cardamom, ginger, tea, medicinal and aromatic plants, leather, footwear, chyangra pashmina, knotted carpets, fruits and vegetable juices, lentil, instant noodles, wool products, honey and coffee. While they are important, it is necessary also to build future potentials based on emerging market signals and at the same time promote products to substitute fast-rising agricultural imports by taking broader perspective. Some import products like vegetables, fruits, rice, live animals, raw silk, fish, soya bean oil, processed dry foods and milk products could be targeted for import substitution to start with. These products would together make more than four times the current agricultural export. Foreign direct investment on such products would also help curtail import initially and would start being export commodities to the SAARC region, ultimately. Likewise, there is a good potential for community involvement in herb cultivation including agroforestry in the degraded forest areas of the country for export promotion of processed herbs and Ayurvedic medicines with appropriate branding. Initiating a managed timber plantation is a good possibility to replace current imports of wood products and timber. Thus, a broader view of looking at both export promotion and import substitution would be needed.

Agriculture diversification demands identification of appropriate commodity mix, policy and institutional reforms, establishing reliable linkage between the primary commodities and the industries, development of infrastructure including accessibility for market linkages and adequate support of research and extension. As Nepal has adopted liberal economy and democratic institutional process is being strengthened, it has to move from a broader strategic perspective of intervention. Nepal's physical and institutional constraints are many. Infrastructural facilities like roads, irrigation and rural electrification are poor. Majority of farmers are small-holders to take the risk of diversification. Crop insurance is still very low. Forward and back linkages with markets are weak. Research and extension supports are inadequate. Only about one-fifth of total farm holdings borrow agricultural credit, and among them only 37% borrow from institutional sources. Long-term credit is constrained for agro-industries and crops/commodities with long gestation period. A contractual land arrangement, which has good prospect for increasing size of farming, is very low. While there is shortage of labour in agriculture and land remains fallow in many areas, youth are not attracted to small-scale farming. The number of youth who leave for low-paid labour jobs abroad is almost close to the expected entry of youth in the job market of the country every year. There is lack of continuity in the government policy due to political instability. There is need for investments, but capital absorption capacity is eroding in public sector and monitoring is weak due to lack of elected local bodies, etc.

Nepal being a poor country, mobilizing large resources to support production enhancement is not easy. As it requires multi-sector interventions, support of one or two donors may not be practical and mobilization of multiple donors will be needed in strategic intervention areas like infrastructure and policy reform areas. Co-ordination for support is not easy as realized from the APP experience. The implementation of ADS has been started, and there is a need for intervention in key priority areas of commercialization and industrialization in agriculture. A pool-based funding in key interventions in high-priority national development agenda and joint monitoring will be more effective, as seen in some sectors.

In the context of strategic intervention for agricultural diversification, following are major suggestions based on the analysis. (i) Improve infrastructure and market development. (ii) Improve quality standards of agro-products and facilitate certification. (iii) Improve access to longer-term credits. (iv) Identify constraints and implement strategy for taking advantage of international trade opportunities. (v) Emphasize human development by targeting also agro-industries. (vi) Emphasize mechanization suitable for small farms. (vi) Promote institutional development for contract farming within the framework of property rights guaranteed by new constitution. (vii) Enhance linkage between production and industries by facilitating farm production contract system. (viii) Promote land-saving technology in crop farming by small farmers to utilize vertical spaces. (ix) Encourage migrant returnees in commercial farming with appropriate orientation facilitations. (x) Promote the targeted export promotion and import substitution of commodities with facilitation for product development. (xi) Discourage residential plotting and road construction in crop areas by introducing land use policy. (xii) Increase research on priority commodities of export and import substitution. (xiii) Develop production pockets by packaging hard and soft inputs based on prioritized sequential intervention for an effective impact on production growth. (xiv) Accelerate crop and livestock production insurance as a campaign. (xv) Mobilize Nepalese foreign missions in economic diplomacy including trade facilitation to utilize available opportunities. Appropriate actions on the above aspects will address major issues, promote agricultural diversification in Nepal and augment income and employment opportunities.

Annex

(See Tables 11, 12, 13, 14, 15, 16, 17, 18, 19 and 20).

Table 11 Performance of area, production and productivity of cash crops, 2000–15 (area '000 ha, production 000 Mt and yield Mt/ha)

Cash crops	Year	1999/00	2004/05	2009/10	2014/15	Annual growth rate% (2000–2005)	Annual growth rate% (2005–2010)	Annual growth rate% (2010–2015)	Annual growth rate% (2000–2015)
Sugar cane	Area	57.0	60.0	59.7	66.3	1.03	−0.11	2.13	1.01
	Production	2095.7	2381.3	2522.3	3077.3	2.59	1.16	4.06	2.59
	Yield	36.7	39.6	42.2	46.4	1.54	1.31	1.90	1.58
Oilseeds	Area	189.7	187.7	198.0	218.4	−0.21	1.08	1.98	0.95
	Production	125.0	138.0	155.3	192.5	2.00	2.39	4.39	2.92
	Yield	0.7	0.7	0.8	0.9	2.22	1.24	2.34	1.93
Tobacco	Area	4.3	3.0	2.1	1.7	−6.68	−7.45	−3.61	−5.93
	Production	3.9	3.0	2.1	2.2	−4.91	−7.10	1.13	−3.69
	Yield	0.9	1.0	1.0	1.3	1.85	0.53	4.85	2.39
Potato	Area	123.3	147.0	183.3	197.2	3.57	4.52	1.47	3.18
	Production	1196.0	1785.7	2483.3	2844.9	8.35	6.82	2.76	5.95
	Yield	9.7	12.1	13.5	14.5	4.62	2.20	1.40	2.73
Jute	Area	12.5	12.0	10.8	11.4	<0.88	−2.03	1.05	−0.63
	Production	15.6	17.2	14.4	16.3	2.06	−3.58	2.59	0.31
	Yield	1.3	1.4	1.3	1.4	2.44	−1.63	1.59	0.78
Total	Area	386.8	409.7	450.4	495.1	1.16	1.91	1.91	1.66

Source Statistical Information of Nepalese Agriculture (series), Ministry of Agriculture Development, Nepal

Table 12 Performance of area production and productivity of cereal crops, 2000–15 (area '000 ha, production 000 Mt and yield Mt/ha)

Cereals	Year	2000	2005	2010	2015	Annual growth rate% (2000–2005)	Annual growth rate% (2005–2010)	Annual growth rate% (2010–2015)	Annual growth rate% (2000–2015)
Paddy	Area	1541.7	1550.2	1511.2	1425.1	0.11	−0.51	−1.17	−0.52
	Production	3985.4	4318.3	4335.9	4711.6	1.62	0.08	1.68	1.12
	Yield	2.58	2.79	2.87	3.30	1.51	0.59	2.85	1.65
Maize	Area	815.3	845.0	885.8	900.9	0.72	0.95	0.34	0.67
	Production	1425.2	1680.2	1951.1	2220.0	3.35	3.04	2.62	3.00
	Yield	1.75	1.99	2.20	2.46	2.61	2.07	2.27	2.31
Millet	Area	262.4	259.70	268.06	268.68	−0.21	0.64	0.05	0.16
	Production	289.9	288.05	298.30	305.00	−0.13	0.70	0.45	0.34
	Yield	1.1	1.11	1.11	1.13	0.09	0.06	0.38	0.18
Wheat	Area	647.3	670.81	731.19	756.77	0.72	1.74	0.69	1.05
	Production	1142.6	1407.92	1548.74	1890.22	4.26	1.92	4.07	3.41
	Yield	1.8	2.10	2.11	2.50	3.53	0.13	3.39	2.34
Barley	Area	29.4	26.71	26.96	28.13	−1.91	0.19	0.86	−0.30
	Production	31.0	28.43	27.02	35.83	−1.74	−1.01	5.81	0.96
	Yield	1.1	1.09	1.00	1.27	0.55	−1.65	4.94	1.24
All cereals	Area	3296.2	3352.47	3423.23	3379.56	0.34	0.42	−0.26	0.17
	Production	6874.1	7722.86	8161.11	9162.64	2.36	1.11	2.34	1.93
	Yield	2.1	2.30	2.38	2.71	2.01	0.69	2.61	1.8

Source Statistical Information of Nepalese Agriculture (series), Ministry of Agriculture Development, Nepal

Table 13 Performance of area, production and productivity of cash crops, 2000–15 (area '000 ha, production 000 Mt and yield Mt/ha)

Cash crops	Year	1999/00	2004/05	2009/10	2014/15	Annual growth rate% (2000–2005)	Annual growth rate% (2005–2010)	Annual growth rate% (2010–2015)	Annual growth rate% (2000–2015)
Sugar cane	Area	57.0	60.0	59.7	66.3	1.03	−0.11	2.13	1.01
	Production	2095.7	2381.3	2522.3	3077.3	2.59	1.16	4.06	2.59
	Yield	36.7	39.6	42.2	46.4	1.54	1.31	1.90	1.58
Oilseeds	Area	189.7	187.7	198.0	218.4	−0.21	1.08	1.98	0.95
	Production	125.0	138.0	155.3	192.5	2.00	2.39	4.39	2.92
	Yield	0.7	0.7	0.8	0.9	2.22	1.24	2.34	1.93
Tobacco	Area	4.3	3.0	2.1	1.7	−6.68	−7.45	−3.61	−5.93
	Production	3.9	3.0	2.1	2.2	−4.91	−7.10	1.13	−3.69
	Yield	0.9	1.0	1.0	1.3	1.85	0.53	4.85	2.39
Potato	Area	123.3	147.0	183.3	197.2	3.57	4.52	1.47	3.18
	Production	1196.0	1785.7	2483.3	2844.9	8.35	6.82	2.76	5.95
	Yield	9.7	12.1	13.5	14.5	4.62	2.20	1.40	2.73
Jute	Area	12.5	12.0	10.8	11.4	−0.88	−2.03	1.05	−0.63
	Production	15.6	17.2	14.4	16.3	2.06	−3.58	2.59	0.31
	Yield	1.3	1.4	1.3	1.4	2.44	−1.63	1.59	0.78
Total	Area	386.8	409.7	450.4	495.1	1.16	1.91	1.91	1.66

Source Statistical Information of Nepalese Agriculture (series), Ministry of Agriculture Development, Nepal

Table 14 Performance of area, production and productivity of pulse crops, 2000–15 (area ha, production Mt and yield Mt/ha)

	1999/00	2004/05	2009/10	2014/15	Annual growth rate % (2000–05)	Annual growth rate % (2005–10)	Annual growth rate % (2010–15)	Annual growth rate % (2000–2015)
Area	306,526	315,459	322,373	327,569	0.58	0.43	0.32	0.44
Production	236,469	268,040	278,701	352,794	2.54	0.78	4.83	2.70
Yield	771.4	849.7	862.8	1077.0	1.95	0.31	4.53	2.25

Source Statistical Information of Nepalese Agriculture (series), Ministry of Agriculture Development, Nepal

Table 15 Performance of area, production and productivity of vegetable 2000–15, (area ha, production Mt and yield Mt/ha)

	1999/00	2004/05	2009/10	2014/15	Annual growth rate % (2000–05)	Annual growth rate % (2005–10)	Annual growth rate % (2010–15)	Annual growth rate % (2000–2015)
Area	148,790	181,080	234,785	250,150	4.01	5.33	1.28	3.52
Production	1,495,070	2,048,464	2,987,263	3,583,668	6.50	7.84	3.71	6.00
Yield	10,030	11,303	12,711	14,335	2.42	2.38	2.43	2.41

Source Statistical Information of Nepalese Agriculture (series), Ministry of Agriculture Development, Nepal

Table 16 Performance of area, production and productivity of fruits, 2000–15 (area ha, production Mt and yield Mt/ha)

Year	1999/00	2004/05	2009/10	2014/15	Annual growth rate % (2000–2005)	Annual growth rate % (2005–2010)	Annual growth rate % (2010–2015)	Annual growth rate % (2000–2015)
A. Citrus								
Total area	19,018	25,910	33,898	39,035	6.38	5.52	2.86	4.91
Productive area	11,277	14,606	22,903	25,261	5.31	9.41	1.98	5.52
Production	115,067	156,956	259,191	222,789	6.41	10.55	−2.98	4.50
Yield	10.2	10.7	11.3	8.8	1.05	1.04	−4.86	−0.96
B. Winter deciduous								
Total area	14,560	18,500	22,535	27,125	4.91	4.03	3.78	4.24
Productive area	10,169	11,150	12,573	16,849	1.86	2.43	6.03	3.42
Production	87,252	97,208	107,582	128,155	2.18	2.05	3.56	2.60
Yield	8.6	8.7	8.6	7.6	0.32	−0.37	−2.33	−0.80
C. Summer tropical								
Total area	36,490	44,903	50,889	84,127	4.24	2.53	10.58	5.73
Productive area	25,046	29,593	35,246	68,586	3.39	3.56	14.24	6.95
Production	245,015	298,715	340,199	641,034	4.04	2.63	13.51	6.62
Yield	9.8	10.1	9.7	9.3	0.63	−0.89	−0.65	−0.30
Total fruits								
Total area	67,494	89,312	107,322	150,387	5.76	3.74	6.98	5.49
Productive area	45,108	55,348	70,722	110,802	4.18	5.02	9.40	6.17
Production	456,013	552,879	706,972	992,703	3.93	5.04	7.02	5.32
Yield	10.1	10.0	10.0	9.0	−0.24	0.01	−2.17	−0.80

Source Statistical Information of Nepalese Agriculture (series), Ministry of Agriculture Development, Nepal

Table 17 Performance of area, production and productivity of specialty crops, 2000–2015

Specialty crops (area ha, production Mt)	2015	2010	2007	Annual growth rate % (2007–15)
1. Coffee				
Coffee area	2381	1650	1396	6.9
Coffee green bean production	464	308	271	7.0
2. Cardamom	2015	2010	2007	
Cardamom total area	16,043	14,001	13,227	2.4
Cardamom productive area	12,458	11,768	11,712	0.8
Production	5166	5232	6792	−3.4
3. Ginger				
Area	23,826	18,042	13,170	7.7
Production	242,547	210,790	160,576	5.3
4. Garlic				
Area	7119	5381	4806	5.0
Production	44,723	39,483	30,308	5.0
5. Turmeric	2015	2010	2007	
Area	7877	4161	3079	12.5
Production	71,812	37,926	25,399	13.9
6. Chilli				
Area	7680	6394	4780	6.1
Production	40,172	2679	15,569	12.6
7. Mulberry and cocoon production[a]	2014	2010	2005	
Area (ha)	1550	1300	825	8.2
Production	39	29	31	2.6
8. Tea[a]	2014	2010	2005	
Area (ha)	19,271	17,127	16,420	2.0
Production	21,394	16,608	15,168	4.4
9. Bee-keeping and honey production[a]	2014	2010	2005	
Bee hives (no)	170,000	140,000	130,000	3.4
Production	1650	1100	600	13.5
10. Mushroom[b]	2014	2010	2005	
Production	1675	1100	NA	8.8
Total area (excluding bee-keeping)	85,746	68,056	57,703	5.1

[a]Growth Rate 2005–14

[b]Growth rate 2008–14

Source Statistical Information of Nepalese Agriculture (series), Ministry of Agriculture Development, Nepal

Table 18 Sector productivities in livestock

Annual productivities per animal per year (milk, meat and wool: kg; egg: numbers per bird)					Annual growth rate (%)	
Animal	2000	2005	2010	2015	2000–2015	2010–2015
Cow milk	401.4	420.8	449.4	543.6	2.04	3.88
Buffalo milk	834.0	851.2	851.6	867.7	0.26	0.37
Buffalo meat	34.5	34.0	33.5	33.7	−0.17	0.08
Mutton (sheep)	3.4	3.4	3.4	3.4	0.02	0.06
Goat meat	5.8	5.8	5.6	5.9	0.12	1.06
Pig meat	16.7	16.6	16.0	16.7	0.02	0.87
Chicken meat	0.7	0.7	0.6	0.9	1.93	7.14
Duck meat	0.7	0.6	0.6	0.6	−1.05	0.07
Hen eggs	82.0	86.8	86.4	102.9	1.53	3.57
Duck eggs	73.2	74.3	76.5	75.5	0.21	−0.26
Wool	0.7	0.7	0.7	0.7	−0.01	−0.08

Source Statistical Information of Nepalese Agriculture (series), Ministry of Agriculture Development, Nepal

Table 19 Principal indicators of manufacturing establishments: 2001/2 and 2011/12

	No. of establishments		Value added						Annual growth rate % in value added		Annual growth rate % in capital	
			Amount (Rs. million)		As % of input value		Share by industry (%)		Nominal	Real[a]	Nominal	Real[a]
	2002	2012	2002	2012	2002	2012	2002	2012	2002–12	2002–12	2002–12	2002–12
Processing and preserving of meat	3	3	12.2	79.6	25.5	31.8	0.1	0.2	20.6	12.6	9.0	1.0
Processing and preserving of fruit and vegetables	3	7	32.2	78.2	35.2	34.6	0.2	0.2	9.3	1.3	36.7	28.7
Manufacture of vegetable and animal oils and fats	52	36	2502.9	1697.0	19.9	8.8	15.0	4.5	−3.8	−11.8	6.8	−1.2
Manufacture of dairy products	39	56	352.1	1701.5	15.8	36.0	2.1	4.5	17.1	9.1	9.8	1.8
Manufacture of grain mill products	316	575	903.0	5628.2	15.5	19.1	5.4	15.0	20.1	12.1	23.1	15.1
Manufacture of bakery products	110	112	319.1	880.7	33.4	39.3	1.9	2.3	10.7	2.7	20.1	12.1
Manufacture of sugar	41	54	781.8	972.7	39.3	22.9	4.7	2.6	2.2	−5.8	−2.0	−10.0
Manufacture of macaroni, noodles, couscous and similar farinaceous products	15	16	693.9	1242.1	37.5	27.4	4.1	3.3	6.0	−2.0	5.3	−2.7
Manufacture of other food products n. e. c	62	67	332.4	783.1	38.9	47.2	2.0	2.1	8.9	0.9	14.1	6.1

(continued)

Table 19 (continued)

	No. of establishments		Value added						Annual growth rate % in value added		Annual growth rate % in capital	
			Amount (Rs. million)		As % of input value		Share by industry (%)		Nominal	Real[a]	Nominal	Real[a]
	2002	2012	2002	2012	2002	2012	2002	2012	2002–12	2002–12	2002–12	2002–12
Manufacture of prepared animal feeds	32	40	249.8	1625.7	32.5	11.6	1.5	4.3	20.6	12.6	28.8	20.8
Distilling, rectifying, blending and manufacturing of alcoholic products	18	34	3283.5	7539.1	76.6	141.5	19.6	20.1	8.7	0.7	1.7	−6.3
Manufacture of tobacco products	25	30	4270.1	11,687.6	81.0	281.5	25.5	31.2	10.6	2.6	21.9	13.9
Manufacture of carpets and rugs	239	135	1582.2	692.9	46.9	74.4	9.5	1.8	−7.9	−15.9	5.7	−2.3
Manufacture of jute and jute products	14	0	697.4	0.0	39.2	0	4.2	0.0	−100.0	−108.0	−100.0	−108.0
Tanning and dressing of leather; dressing and dyeing of fur	11	8	236.7	157.1	31.8	15.8	1.4	0.4	−4.0	−12.0	−4.5	−12.5
Sawmilling and manufacture of wood products, builder's carpentry and related	463	709	476.7	2676.6	35.8	47.6	2.8	7.1	18.8	10.8	20.7	12.7

(continued)

Table 19 (continued)

	No. of establishments		Value added						Annual growth rate % in value added		Annual growth rate % in capital	
			Amount (Rs. million)		As % of input value		Share by industry (%)		Nominal	Real[a]	Nominal	Real[a]
	2002	2012	2002	2012	2002	2012	2002	2012	2002–12	2002–12	2002–12	2002–12
Manufacture of fertilizers and nitrogen compounds	2	5		36.0		34.0		0.1				
Manufacture of pesticides and other agrochemical products	1	3		13.6		62.3		0.0				
Manufacture of machinery for food, beverage and tobacco processing	Fresh entry	2		8.4		183.0	0.0	0.0				
Manufacture of agricultural and forestry machinery	Fresh entry	4		14.4		51.8	0.0	0.0				
Agro-industries	1446	1896	16,725.9	37,514.4	38	38.4	100.0	100.0	8.4	0.4	10.2	2.2
All industries	3213	4076	32,604.6	80,784.1	34.4	33.4			9.5	1.5	11.5	3.5
Share of agro-industries in all industries	45.0	46.5	51.3	46.5								

[a]After adjusting by GDP deflator (estimated annual inflation of 7.98 for 2002–12)
Source Estimation by Author; Source of basic data: CBS

Table 20 Urban consumer price index

Commodities and groups	Weights (%)	2005/6	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Overall index	100	100	105.9	113.0	127.2	139.4	152.5	165.4	181.7	198.2	212.5
Food and beverage	43.91	100	107.0	117.0	137.3	158.1	181.3	195.2	214.0	238.8	261.8
Cereals grains and their products	11.33	100	106.3	121.7	139.6	153.7	175.1	175.7	191.6	212.9	235.4
Legume varieties	1.84	100	117.3	133.2	165.7	208.8	193.0	192.9	217.0	227.6	267.7
Vegetables	5.52	100	111.5	119.9	133.4	160.7	217.0	269.6	285.0	343.4	364.1
Meat and fish	6.75	100	106.6	115.0	141.8	171.5	186.3	200.3	229.2	270.9	288.6
Milk products and egg	5.24	100	107.7	116.1	133.1	149.0	170.7	193.9	210.6	225.7	254.6
Ghee and oil	2.95	100	106.5	128.8	150.0	143.1	146.7	167.9	191.0	192.8	193.3
Fruits	2.08	100	106.1	110.6	128.4	154.7	184.7	216.0	229.5	260.9	296.7
Sugar and sweets	1.74	100	92.8	83.5	122.2	177.6	212.3	231.9	263.7	253.7	253.7
Spices	1.21	100	117.8	122.6	137.4	175.1	215.7	196.0	205.8	225.5	248.1
Soft drinks	1.24	100	103.7	107.8	128.6	152.6	168.5	176.0	195.4	200.3	207.7
Hard drinks	0.68	100	104.6	106.8	119.1	133.5	142.1	148.6	160.5	187.5	225.2
Tobacco products	0.41	100	106.7	116.1	135.2	152.1	172.7	191.4	217.8	258.8	325.2
Restaurant and hotel	2.92	100	103.3	110.6	136.5	164.2	189.7	212.3	237.5	262.6	291.1
Non-food and services	56.09	100	104.9	109.2	119.0	124.8	131.5	143.4	157.8	168.5	177.2
Clothing and footwear	7.19	100	103.5	107.0	116.0	124.8	141.4	162.3	182.0	202.2	222.3
Housing and utilities	20.3	100	105.6	111.7	121.0	124.9	134.1	142.3	157.4	165.4	168.0
Furnishing and household equipment	4.3	100	106.7	112.9	127.8	135.7	143.4	162.6	184.2	201.1	217.6
Health	3.47	100	102.8	108.6	114.0	117.8	122.7	128.3	137.0	147.1	155.1
Transport	5.34	100	108.7	111.2	129.7	123.6	136.1	157.3	174.4	183.7	186.1

(continued)

Table 20 (continued)

Commodities and groups	Weights (%)	2005/6	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Communication	2.82	100	100.0	100.0	100.1	100.1	89.5	82.2	80.5	80.9	81.0
Recreation and culture	2.46	100	102.8	107.2	114.6	123.0	120.1	129.4	140.1	149.4	158.7
Education	7.41	100	107.0	112.1	121.5	135.3	142.7	156.6	175.6	189.0	199.5
Miscellaneous goods and services	2.81	100	101.7	103.6	116.0	124.7	132.1	145.2	159.8	171.4	185.1

Source Basic Data from Central Bank Nepal; reconstructed by the author from multiple series by shifting the base year to 2006

References

AFND. (2007). Agriculture Diversification and small holders in South Asia.
APROSC. (1997). Evaluation and Impact Assessment of Third Small Farmer Development Project, Nepal.
CBS. (2011). Nepal Living Standard survey, Nepal.
CBS, National Account of Nepal (series), Nepal.
CBS. (1992/2002/2012). National Sample Census of Agriculture, Nepal.
CBS. (2011). Nepal Population and Housing Census: National Report, Nepal.
CBS, Statistical Pocket Book of Nepal, Series, Nepal.
CBS. (2002/212) Census of Manufacturing Establishments Nepal, Nepal.
Department of Custom. (2016). Nepal Trade Statistics, Nepal.
DOA. (2014). Cost of Production Year Book, Nepal.
DOA. (2015). Average Cost of Production and Gross Profit of Fruit Farming in Nepal, Nepal.
DoLIDAR. (2016). Annual Report, Nepal.
JMA/APROSC. (1995). Nepal Agriculture Perspective Plan, Nepal.
MOAD, Statistical Information on Nepalese Agriculture, (series), Nepal.
MOF, Economic Surveys, Series, Nepal.
MOF. (2016), Budget Speech 2016/17, Nepal.
MUD. (2015). National Urban Development Strategy, Nepal.
MI, Nepal Trade and Integration Strategy 2016.
NRB, Quarterly Economic Bulletin, Series, Nepal Rasta Bank (central bank), Nepal.
NPC, Thirteenth Plan (2013–16), Nepal.
NPC. (2016). Fourteenth Plan Approach Paper (20017–19), Nepal.
NPC. (2014). Development of Manufacturing Industries in Nepal Current State and Future Challenges, Nepal.
NRB, Quarterly Economic Bulletins, Series.
UNDP, 2014, Nepal Human Development Report, UND, Nep.

Chapter 13
Non-timber Forest Products (NTFP) and Agro-forestry Subsectors: Potential for Growth and Contribution in Agriculture Development

Madhav Bahadur Karki and Chhote Lal Chowdhary

Abstract The chapter describes the important role the non-timber forestry and agro-forestry sub-sectors play in Nepalese economy. Domestic consumption and export values of raw as well as processed non-timber forest products (NTFP) such as herbal medicine, aromatic oils, natural dye, fiber and nutrition supplements generated by these sub-sectors are on the rise. Agro-forestry is the mainstay of Nepal's mountain farming systems. Sub-sector-related policy, institutions and regulatory frameworks are carefully reviewed since they play a critical role in the healthy development of these sub-sectors. Gaps in policy and legal framework, implementation hurdles are preventing good potential for growth and their contribution in agriculture development.

1 Introduction

Non-timber forest product (NTFP) sub-sector that includes medicinal and aromatic plants (MAP), pharmaceuticals, nutraceuticals and medicinal food sub-sector is a multi-million dollar sub-sector in Nepal (Belchar et al. 2005; Dhungana and Bhattarai 2008; IUFRO 2012; NPC 2015). By its nature, the sub-sector is of cross-sector, multi-stakeholder and multi-disciplinary nature (Karki 2017; IUFRO 2012). Similarly, agro-forestry has a huge potential in Nepal's traditional farming systems (Amatya and Newman 1993). In recent years, it is gaining more importance since more emphasis is being given for climate resilient agriculture and sustainable food systems in agriculture development (Chan et al. 2015). Understanding and developing growth and development strategy for these rather complex sub-sectors is a challenging task. In fact, during the last twenty-five years, these sub-sectors have witnessed a

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G. Thapa et al. (eds.), *Agricultural Transformation in Nepal*,
https://doi.org/10.1007/978-981-32-9648-0_13

number of development and policy interventions (Banjade and Paudel 2008; Bhattarai and Karki 2010). Investment of various sizes and types has contributed to forest and biodiversity conservation and rural livelihoods (ANSAB 2011; Karki et al. 2004). However, there has been scarcely any comprehensive and systematic attempt to develop these sub-sectors taking a holistic approach of linking collection, production, consumption and marketing in a systematic supply and/or value chain combining the essence of both production and consumption patterns (Belcher et al. 2005). The first step in this direction was taken by the Government of Nepal in 2004 by announcing the NTFP policy (2004) which was developed to create an enabling and empowered institutional framework to promote the NTFP sub-sector in a systematic manner (Bhattarai and Karki 2010). It paved way to creating an apex body called Herbs and NTFP Coordination Committee (HNCC) chaired by the Minister. HNCC is a multi-disciplinary body which is empowered to take urgent and multi-sector policy decisions required to push the sector forward (Karki and Bhattarai 2010). Similarly agro-forestry policy development process has been ongoing with support from ICRAF (CCTN 2017). The process of developing NTFP sub-sector from the production to consumption system (PCS) perspective is a well-recognized strategy (Belcher et al. 2005). Due to the very nature, the sub-sector development strategy has to be a multi-sector, collaborative and dynamic system approach. There is a need for a dynamic NTFP and agro-forestry policy to drive the whole process in a coordinated manner and create an enabling environment in which policymakers, scientists, trade and business community, traditional knowledge holders, pharmaceutical, food and drug industries, NGOs and farmers' representatives can work together in a production, collection, cultivation, processing and marketing network. This chapter leads to this type of approach for the growth and development of the NTFP, MAP and agro-forestry sub-sectors in Nepal and discusses the need for policy reforms and institutional arrangements in each sub-sectors separately covering the entire gamut of conservation, cultivation, regulations, research needs, information and knowledge dissemination and marketing issues and solutions. Revitalization of these sub-sector strategies, revision of policy as per the new federal governance structures, and realignment of the sub-sectors with new global and regional imperatives and national priorities is necessary for achieving the result-based, time-bound and inclusive growth and development of NTFP and agro-forestry sub-sectors in Nepal (NEHHPA 2012; ANSAB 2011; IUFRO 2012; Karki 2017; ICIMOD 2019).

1.1 NTFP Sub-sector

Diverse types of non-wood or non-timber food, fiber, herbal medicine, aromatic and dye products harvested from both forest and non-forest areas are managed in wild or grown in agricultural land (Banjade and Paudel 2008; Karki 1995; Belchar et al. 2005). These products harvested from multi-purpose trees, shrubs and herbal plants are collectively called non-timber forest products or NTFP and contribute to the Nepalese economy and peoples' livelihoods in a significant manner (FNCCI-AEC/NEHHPA 2012; GIZ 2011a). Exact contribution of the NTFP sub-sector to Nepal's national economy is difficult to establish since different sources of data indicate different levels of contribution (MSFP 2014; FNCCI-AEC/NEHHPA 2012). This is mainly because available data and information are not consistent and refer to a wide range of wild extracted, domesticated, cultivated and processed goods or products. But it can be safely argued that NTFP sub-sector is a major source of rural employment and income for Nepalese farmers and a major source of revenue for the national and local economies (MSFP 2014; FNCCI-AEC/NEHHPA 2012; Karki 2012; Karki 2015). In terms of employment, ANSAB estimated that around 189,000 people work in the NTFP sub-sector (MSFP 2014). It is widely estimated that they draw between 15 and 50% of their household income from the sub-sector (APAARI/FAO 2013; Edwards 1996; MSFP 2014).

In terms of the volume and value of trade in NTFP, the Government of Nepal records indicate growing trend in formal export trade figures. The trade volume increased from 3350 tons in 1990 to 13,000 metric tons (MT) in 2010 (NPC 2011) and to more than 33,000 MT in 2012 (Karki 2012; MoFSC 2009). Similarly, there are large variations in value of the NTFP export trade from Nepal. For example, GoN (2009) as reported by Karki (2012) put the export earnings from NTFP in 2010 between USD 13 and 26 million. Subedi (2006) estimated 37% increase in annual value of NTFP trade between 1995 and 2002—around 5.5% growth per year. A study done by ANSAB (MSFP 2014) indicates that Nepal's NTFP export increased from US $2.76 million in 1992 to US $59 million in 2012. The study reported that the share of NTFPs in the total export value registered a growth of around 4% per annum doubling during between 1992 and 2002 (MSFP 2014). The data confirms the pattern of positive growth in Nepal's NTFP sector where numbers of NTFP-based traders and industries are also increasing each year (MSFP 2014). The above trend also reinforces the increasing economic, social and ecological importance of NTFPs (IUFRO 2012).

India is the most important market for Nepal's NTFPs especially the medicinal, aromatic and dye plants. Mostly raw but some semi-processed products are exported from Nepal (FNCCI-AEC/NEHHPA 2012; Karki 2012). Ghimire (2012) reported that Nepal also imports a huge amount of processed herbal products from India—mainly ayurvedic products. The import is growing at a rate of around 20% per annum. Over the years, both the volume and value of semi-processed and processed trade in NTFP products are increasing. Also growing are the essential oil industries that process various kinds of aromatic plants in Nepal (MSFP 2014). Different types of oils are extracted from more than 18 aromatic plants for export (Prakrit 2007; MSFP 2014). The main market destinations for Nepal's essential oils are Japan, the USA, Germany, Belgium and few other Asian and European countries. The other NTFPs exported are handicraft items whose value was about USD 3 million in 2004/2005 (Acharya 2006). The NTFPs thus are the major source of both export and employment in Nepal.

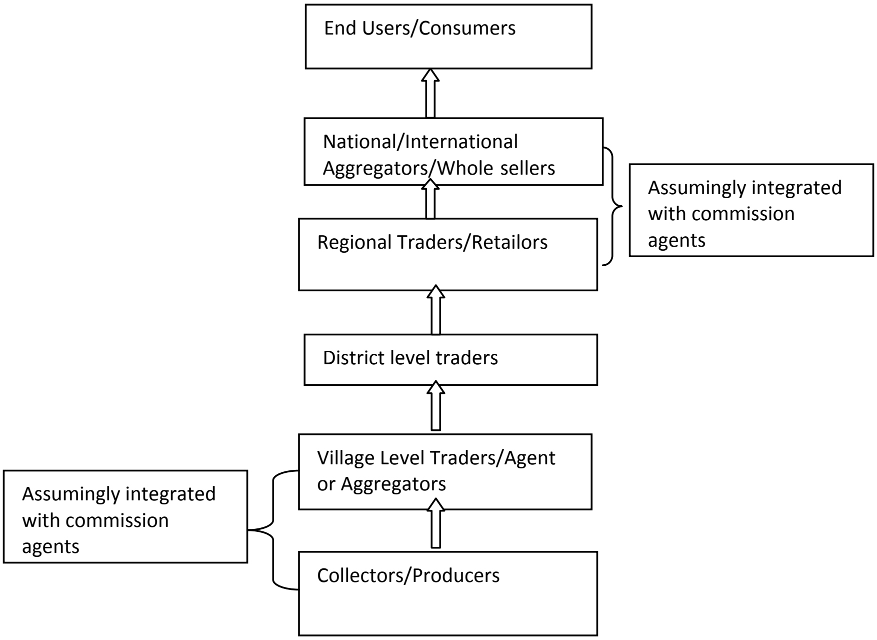

Fig. 1 Illustration of trade supply chain in NTFP/MAPs

The above description of the NTFP sub-sector indicates a huge potential for its growth especially in degraded forest and fallow agricultural lands. However, the sub-sector suffers from poor management of processing industries for value addition of especially high-value NTFPs such as herbal medicine and essential oils within the production pockets. A proper investment environment can create employment opportunity to local people reducing the heavy flow of youth migration to cities and foreign countries for jobs. This will also reduce poverty by providing income raising opportunities locally (GIZ 2015; IUFRO 2012).

The wide range of products managed under the NTFPs is classified under different trade names especially for export purpose. These are crude drugs, essential or aromatic oils (commonly grouped under medicinal and aromatic plants or MAPs), food (edible mushrooms and nuts), fibers (lokta argeli papers), processed drugs (ayurvedic, homeopathic and other traditional drugs), nutraceuticals, dietary products (food and nutrition supplements), bamboo and rattan products and minerals (FNCCI-AEC/NEHHPA 2012). Tea, coffee, honey and raw silk are the major AFPs. There is a wide range of stakeholders involved in the NTFP/MAP/AFP sub-sectors (Kalauni and Joshi 2018; Pandit and Thapa 2004). For example, in NTFPs alone the supply chain is spread across India and Nepal involving gatherers, cultivators, aggregators, processors, retailers and wholesalers. Figure 1 indicates the supply chain prevailing in Nepal's herbal sector. Various types of policies and programs are in existence for the development of NTFP/MAP sector in Nepal

(Choudhary and Bhattarai 2008) although their effectiveness and relevance in terms of sustainable development outcome are not well known (Karki et al. 2012; ANSAB 2011). It is generally believed that the policy formulation and implementation processes do not take into account the views of all the major stakeholders and key players involved in this sector, thereby resulting in their poor implementation and even poorer impacts. There are several policy and regulatory issues and administrative hurdles that discourage the small producers, primary processors, product manufacturers, entrepreneurs and small and micro-enterprises, investors and entrepreneurs (FNCCI-AEC/NEHHPA 2012).

1.2 MAP Sub-sector in Nepal

Nepal has rich medicinal and aromatic plants (MAPs) biodiversity—both wild and domesticated. Nepal is particularly well known for its rich endemic medicinal plant biodiversity found in wild (Bhattarai 1997; Bhattarai and Karki 2004). According to various authors and sources, there are between 700–1500 MAP species in Nepal (DFRS 1999; Joshi 2008; Bhattarai 1997; MoFSC 2009; Bhattarai and Karki 2010). A large number of Nepal's poor people especially indigenous and local communities living in the high mountain regions draw their livelihoods through gathering and sales of MAPs. The collection and sales of MAPs were estimated to have provided between 15 and 50% of the household income to the rural households as early as in the 1990s (Edward 1996; Bhattarai 1997; Subedi 2006). The contribution of MAP is increasing giving higher values than timber products to Nepalese economy (Acharya et al. 2015; Kalauni and Joshi 2018). Currently, majority of important MAP species are extracted unsustainably. However, a sustainable production, processing, marketing and consumption system has good potential to provide jobs and income to thousands of Nepalese people (Ghimire et al. 2016; Karki 2017). MAPs are high-value NTFP as well as grown as agro-forestry crops. Some of them provide high-value low-volume commodities that are most suitable for Nepal's mountainous terrain. As the herbal medicine sector is growing at least at the rate of 10% annually and import of herbal drugs into Nepal is increasing at the rate of 20% per year (Ghimire 2012), MAPs sub-sector has the largest potential among the NTFPs. This is because more than 75% of the people in Nepal use herbal drugs (Kalauni and Joshi 2018).

The commercial value of MAPs is also continuously increasing (Kalauni and Joshi 2018; Karki 2017). Nepal is estimated to export around 33,000 MT of MAP products with an annual revenue amount of around 19–60 million USD (MoFSC 2009). The export value increased from USD 27.49 million in 2005 to USD 60.09 million in 2014. Nepal on an average exported 13,230 MT worth USD 39.34 million per year equivalent of MAP products during the last 10 years (Kalauni and Joshi 2018) to more than 50 countries. While India tops the list in importing the largest quantity of MAPs, China is the most valuable market in terms of total export value. Certified organic products such as coffee command higher value in the export market (Karki 2004; IUFRO 2012). These figures clearly show that there is a tremendous potential of commercialization production, processing and export of MAPs which in turn can make good contribution to Nepalese economy.

Given the importance of conservation and sustainable use of natural products of MAPs, Nepal has prioritized 30 high-value MAPs and also banned collection, transportation and trade of about 20 rare, endangered and threatened (RET) species (www.floraofnepal.org, 2016). While wild harvesting has been a dominant source so far, in future cultivation of MAPs is expected to increase (Bhattarai and Karki 2010; Karki 2017). This is because there is widespread shortage of raw materials especially in the aromatic oil sector. Already, some farmers have taken up cultivation of MAPs such as *mentha, chamomite, citronella, lemongrass, palmarosa* and *French basil*. It is estimated that around 968 ha of agriculture land is already under these plants producing around 2752 MT of essential oil which shows an increase of 8% during the last 5 years. A study conducted by Forest Action, Nepal, reported that cultivation of MAPs in community-managed forest land gave thirteen times higher return than timber plantation (Ghimire et al. 2016). The area under MAPs in agriculture land is bound to grow in Nepal due to growing trend in farmers keeping their land fallow and increased attention to conservation of rare, endangered and threatened (RET) endemic species in wild. Nepal being a member of the Convention on International Trade in Endangered Species (CITES) has banned collection in wild, transportation and trade of more than 20 MAP species (MoFSC 2009). There are over 400 various preparations made from MAPs and are traded locally and internationally (Karki 2015). The standard supply chain of the MAP trade between Nepal and India is illustrated above in Fig. 1 (GFAR 2017).

Approximately 800 species of MAPs and non-timber forest products (NTFPs) are used for subsistence livelihoods and over 160 species for commercial trade (Karki et al. 2004; DoF 2008; GON 2009). The annual harvest and trade of commercial NTFPs from recorded sources is estimated to be 5373 metric tons with a value of NRs. 250 million (DoF 2008). Over 90% of the NTFPs exports are dispatched to India in crude forms, providing lesser benefits to local and national economy compared to its potential benefits if value-adding processing was done within the country (ANSAB and EWW 2000). However, Nepal lacks technical capability, finance and assured market for processed NTFP products. For example, non-timber forest products (NTFP) form secondary source of income in most parts of Nepal—it provides 35–50% total income of household in Karnali zone (Parajuli 2005; GIZ 2011). It is estimated that contribution of bamboo to total household income is 1–2% (Karki 1995). Bhattarai and Dhungana (2008) estimated that under scientific and intensive (e.g., multi-story cropping) forest management, Nepal's community forestry can be made more productive through NTFP, especially with MAP cultivation (Pyakurel and Baniya 2011). NTFP mixed forest yielded higher amount of incremental benefits than timber-based forest based on the data recorded over a period of 70 years. Another study (Forest Action, 2015) conducted in western Nepal indicated that cultivation of MAP species in community-managed forest land gave thirteen times higher return than timber plantation. In case of other NTFP species cultivation, bamboo and rattan planting provides four times higher return that timber planting in community forest land (Bhattarai and Dhungana 2008). According to an estimate by Bhattarai and Dhungana (2008), under an intensive forest management regime, community forests show promising potential through NTFP production. It shows significantly higher level of incremental benefits from NTFPs than from timber when managed intensively for seventy years. One study showed almost 13-fold incremental income through medicinal plants cultivation in community-managed forests compared to timber cultivation in Nepal. In case of NTFP cultivation and management (mainly rattan and bamboo), it is more than four times more profitable (Pyakurel and Baniya 2011; Bhattarai and Dhungana 2008).

1.2.1 Priority Medicinal and Aromatic Plants Species

The Department of Plant Resources (DPR) identified important MAPs and prioritized 30 MAP species for commercial and conservation purpose in 2002 for whole of Nepal. However, the prioritization is relatively more focused on research and development purpose. With the expanding and changing nature of global market, the list has to be updated regularly to incorporate high-value and highly traded MAPs like Yarsa Gumbo (Ophiocordyceps *sinensis*), Satuwa (*Paris polyphylla*), Ban Lasun (*Fritillaria cirrhosa*) and *Elaeocarpus sphaericus*. The Nepal Herbs and Herbal Products Association (NEHHPA 2016) has prioritized additional MAPs using three major criteria such as (a) highly traded MAPs/in terms of volume, (b) return to the producers and (c) host of other sub-criteria such as demand, product price, value addition potential, cultivation possibility, amount of harvestable parts, supply availability and length of the production cycle. Based on the above criteria, the following species are prioritized by NEHHPA: *Persea odoratissima*, nut of *Juglans regia*, *Cucurligo orchoides*, *Rubia manjith*, *Bergenia ciliata*, *Sapindus mukorossi*, *Berberis sp*, *Diploknema butyracea* as commercially promising NTFP species to include in the list. There is variation in prioritization of MAPs by different agencies since definition of MAPs and prioritization criteria are varying according to the perspectives of the agencies. Further revision is required from the set of criteria—research and development, commercial importance, market demand and economic importance.

NTFP/MAPs are prioritized considering the economic potentialities, i.e., traded value and volume, agro-ecology wise distribution, cultivation potential and value addition at local and national levels. Herbs and NTFP Coordination Committee (HNCC) has prioritized 30 species based on their economic values, conservation status and commercialization (AEC/FNCCI 2006). Parajuli (2005) set 17 criteria to select topmost commercial species for each of the three climatic zones of Nepal. NEHHPA has prioritized a list of 20 species including some exotic species like Mentha, chamomile, lemongrass, Dalchini, etc., according to agro-ecological and administrative regions of Nepal presented in Table 1. Table 2 presents the priority species of Nepal approved by the HNCC, Nepal (HNCC 2004; FNCCI-AEC/NEHHPA 2012).

Table 1 Prioritized NTFPs/MAP species according to eco-physiographic and administrative regions of Nepal (Credit FNCCI-AEC/NEHHPA 2012)

S. No.	Eco-physiographic regions	Districts	Species selected/ recommended
1	Far and mid-western hilly and high regions	Achham, Bajhang, Bajura, Doti, Dailekh, Jajarkot, Surkhet, Baitadi, Dadeldhura, Darchula	Lichen, Yarsagumbo, Ritha
2	Western mid-hills (hilly districts of Rapti and Lumbini)	Pyuthan, Rolpa, Rukum, Salyan, Lumbini: Arghakhanchi, Gulmi, Palpa	Lichens, Sugandhawal, Timur, Ritha, Chiuri, Sugandhakokila
3	Karnali region	Dolpa, Humla, Jumla, Kalikot and Mugu	Yarsagumbo, Kutki, Jatamansi
4	Western Tarai and lowlands (west of Dang)	Dang, Banke, Bardiya, Kailali and Kanchanpur	Sarpagandha, Mentha, Chamomile, Bael
5	Trans Himalayan region (Manang/Mustang region)	Manang and Mustang districts	Seabuckthorn, Jatamansi and Dhupi
6	Western mid-hilly regions (Kali Gandaki corridor)	All hilly district of now Gandaki Province—Baglung, Myagdi, Parbat, Kaski, Lamjung, Syangja, and Tanahu	Allo, Lokta, Satuwa, Dalchini, Lichens
7	Mid-Tarai and lowlands (Kapilvastu to Parsa)	Kapilvastu, Rupandehi, Nawalparasi, Chitwan, Parsa	Kurilo, Mentha, Chamomile, Lemongrass
8	Highlands of Gorkha, Dhading, Rasuwa, Sindhupalchowk and Dolakha	Rasuwa, Sindhupalchowk, Dolakha, Dhading and Gorkha	Jatamansi, Lokta, Dhupi
9	Central mid-hills	Hilly districts of Narayani, Bagmati and Janakpur zone—Bhaktapur, Dhading, Kathmandu, Kavrepalanchok, Lalitpur, Nuwakot, Rasuwa, Makwanpur, Sindhuli, and Ramechhap	Dhasingre, Satuwa, Lichens
10	Eastern Mid-hills	Hilly districts of Sagarmatha, Koshi and Mechi zone—Bhojpur, Dhankuta, Terhathum, Panchthar, Ilam, Khotang, Okhaldhunga and Udaypur	Chiraito, Lichens
11	Eastern Himalayas	Solukhumbu, Sankhuwasabha and Taplejung	Kutki, Chiraito, Dhupi
12	Eastern Tarai (Bara to Jhapa)	Jhapa, Morang, Sunsari, Dhanusa, Dolakha, Mahottari, Sarlahi, Saptari, Siraha, Bara and Rautahat	Pipla, Mentha, Lemon grass

Source NEHHPA 2012–16, NTFP/MAP Business Promotion Strategy

Table 2 List of 20 prioritized NTFPs/MAPs for economic development (in alphabetical order) (Credit: FNCCI-AEC/NEHHPA 2012)

S. No.	Local name of the plant	English	Scientific name	Region
1	Allo	Himalayan Nettle	*Gerardinia diversifolia*	Mid-hills
2	Chamomile	Chamomile	*Matricaria chamomilla*	Tarai (Central to Western)
3	Chirayito	Chireta)[a]	*Swertia chirayita*	Hills (Eastern, Western)
4	Dalchini	Nepalese Cinnamon)[a]	*Cinnamomum tamala*	Hills (Mid-Western)
5	Dhasingre	Wintergreen)[a]	*Gultheria fragratissima*	Hills (Central Nepal)
6	Jatamansi	Spikenard)[a]	*Nardostachys grandiflora*	High Hills (Mid-western to far-western)
7	Jhyau	Lichens)[a]	*Permellia spp*	High Hills
8	Kurilo	Asparagus)[a]	*Asparagus racemosus*	Siwalik (central to mid-western)
9	Kutki	Gentian)[a]	*Neopicrorhiza scorphularifolia*	High Hills (mid to far-western)
10	Lemon grass	Lemon Grass	*Cymbopogan genus*	Tarai
11	Lokta	Nepalese Paper Plant)	*Daphne papyracea*	Hills
12	Mentha	Mentha	*Mentha arvensis*	Tarai
13	Pipla	Long Pepper)[a]	*Piper longum*	Tarai
14	Ritha	Soapnut Tree)[a]	*Sapindus mukorossi*	Hills (mid- and far-western)
15	Sarpagandha	Serpentine)[a]	*Rauvolfia serpentina*	Tarai
16	Satuwa	Love Apple)	*Paris polyphylla*	Mid hills
17	Seabuckthorn	Seabuckthorn	*Hippophae spp*	Karnali region
18	Sugandhwal	True Valerian)[a]	*Valeriana jatamansi*	Western mid-hills
19	Timur	Prickly Ash, Nepal Pepper)[a]	*Zanthoxylum armatum*	Western mid-hills
20	Yarsagumba	(Caterpillar Fungus)[a]	*Cordyceps sinensis*	Karnali region

[a]Prioritized by HNCC, Department of Plant Resources, Government of Nepal
Source NTFP/MAPs Business Promotion Strategy, 2012, NEHHPA with modification

Among the NTFPs/MAPs, tejpat, timur, ritha, ginger, honey and large cardamom are extensively grown as agro-forestry crops in Nepal. Average annual export of large cardamom from Nepal is about 5959 MT (TEPC 2015). Although large cardamom has been one of the largest export agro-products from Nepal, because of limited value addition due to lack of modern processing and storage facility, it has been facing stagnant demand in the international market (NTIS 2016). It is estimated that close to 20,000 households are engaged in production, processing and marketing of timur (*Xanthoxylum aramatum*) in Nepal. The value chain of timur is estimated to generate around USD 1 million revenue to the government. However, collection and processing practice is primitive and the process is a hard drudgery to women, children and poor people as they use their traditional knowledge and tools to gather and process timur (Prakrit 2007; Karki 2004; MOA/SNV 2011).

1.3 Agro-Forestry Products (AFPs)

Ginger, honey, mushrooms, turmeric, sweet potato, and an array bean and pod crops and vegetables are grown understory in agriculture or shifting cultivation areas. These are collectively grouped under agro-forestry products or AFP. Nepal is the fourth largest producer of ginger with about 11.5% of the world's production (Roy 2010) and contributes 0.59% of the total national exports (TEPC 2015). Poor processing technologies hinder Nepal to compete in the international market and result in uncertainty of market (ANSAB 2011). Annual export of honey is about 529.3 MT (Pokhrel 2009) although domestic production in FY 2012/13 was 1625 MT. Production of honey is gradually increasing over the years, but the success has not translated itself into finding its niche in the international market due to its failure to meet stringent quality requirements. Trade data and figures indicate that Nepal is yet to succeed in marketing its honey to the European Union (EU) and even Indian markets despite rising demand for honey there. Poor quality and inadequate production of Nepalese honey have forced Nepal to rely mostly on Bangladesh for export (GIZ 2015). There are other avenues for expansion in AFP marketing. Farmers in the mid-hills of Nepal have long practiced tree farming using their rich farming system knowledge and practice of propagating and managing multi-purpose agro-forestry species grown in their farmland. For example, lapsi (*Choerospondias axillaris*), ritha (*Sapindus mukorossi*), tejpat (*Cinnamomum tamala*), these resources are gradually depleting in large tracts of fragile steep land in Nepalese mountains (Amatya 1993; Pandit and Thapa 2004; Rao et al. 2004).

2 Production to Consumption Processes in NTFP/MAP/AFP Sector

2.1 *Resource Extraction and Production*

Sustained yield-based production, efficient harvesting, minimizing post-harvest losses and stable marketing are the principal objectives of the NTFP/MAP/AFP sub-sectors. Since 90% of the MAPs are sourced from wild, unsustainable harvesting and use has become one of the major causes of biodiversity loss in this most important sub-sector of the NTFP sector (Bhattarai and Karki 2004). Proper management of harvest and post-harvest operations is the crucial stage of the long supply and value chain development and management of the NTFP/MAP/AFP sub-sector products as they have to add value at every next stage of production to consumption chain (ANSAB 2011). Ideally, well-managed NTFP business enterprise uses the principle of 'maximizing sustainable production and minimizing unsustainable costs.' This is the practice followed also in the sustainable management of forest resources. Therefore, good harvesting and good agriculture practices include sustainable harvesting and management NTFPs/MAPs/APs. Unlike timber management, the harvesting season for the NTFPs and MAPs is determined and followed on the basis of qualitative parameters predetermined for the end product of the constituents rather than the total biomass yield (Prajapati et al. 2006). Harvesting is done only on favorable days avoiding the risks of dew, rain or exceptionally high humidity. The containers used for harvested materials are to be kept clean to minimize waste. Care is taken to ensure freedom from the risks of cross-contamination by other species, weeds and such other extraneous matter. Cutting devices employed for harvesting are selected so as to minimize the contamination by soil particles. While harvesting, care is taken to avoid incidental and concurrent harvest of weeds (Karki 2004a; Prajapati et al. 2006).

2.2 *Processing and Management*

There are different stages of processing NTFPs especially MAPs undergo that include primary, secondary and tertiary processing: Primary processing includes washing and cleaning of freshly harvested materials by considering the retention of the target plant part. The procedure used ensures removal of soil particles adhering to the materials. Freshly harvested materials are stored in open, and the drying process is initiated in a continuum. Where necessary, the length of such storage is minimized and handled in a manner to prevent degradation or rotting. Processing yards or sites are kept clean, well ventilated, and have the facilities for protection against sunlight, dust, rain, rodents, insects and livestock (Prajapati et al. 2006). The drying procedure and the temperature employed for this purpose are kept in conformity with the quality needs of the NTFP/MAP produce (Karki 2004). In case of the AF products, the agronomic package of practices prescribes specific procedures for production to processing phase. Compliance of phytosanitary standards as prescribed by national and international regulations is followed to ensure quality. In high humidity conditions, it may be necessary to dry the produce under sun or through electrical drying facilities. Sorting procedure, if any, is ideally carried out after completion of drying phase and before the material is packed and stored for onward dispatching (Prajapati et al. 2006).

The selection of packaging material is based on the quality requirements and possible length of storage before consumption. It should be clean, dry and undamaged. Essential product description such as the product name, plant part, month and year of harvest and the name of farmer/farming agency must be legibly inscribed on every pack. If the material must be tested before, an appropriate label may be used indicating quality approval. While packaging, mechanical damages and undue compacting of the dried plant material that may result in undesirable quality changes are avoided. Care is taken to avoid overfilling of the containers. The storage area must be kept dry protected from insects and rodents and such other factors that may be detrimental to the quality of the product. Organic herbs, agro-forestry products and NTFPs must be stored separately from the non-organic products. When multiple commodities are handled in the same storage area, care must be taken to prevent product mix-up and cross-contamination. Plant materials having strong aromatic compounds should be kept at a reasonably good distance from others (Prajapati 2006; Karki 2004).

3 Challenges and Opportunities in NTFP/MAP/AP Sector Development

3.1 Overview

As described above, majority of Nepal's NTFPs/MAPs are exported to the Indian market, which has created dependency on Indian traders although Chinese traders are gradually entering the Nepalese herbs and herbal products market in recent years. There is also some trading between Nepal and Bangladesh especially in raw materials of selected herbs and vegetable seeds. Indian buyers however due to open border and proximity to major markets such as Delhi, Kanpur and Kolkata have monopoly and many times exploit the Nepalese producers and supplies by following an opaque system of trading wherein the real market price of the product is not given to suppliers (Dhungana and Bhattarai 2008; Pokharel et al. 2009). The NTFP trade is largely informal, and interventions that encourage NTFP trade and enterprise development are limited (ANSAB 2011). In addition, corruption and bribery is rampant in the national market, while international market is non-transparent, keeping the traders and entrepreneurs always at risk (Banjade and Poudel 2008). The Government of Nepal in April 2007 has made IEE and EIA mandatory for managing and handing over community forest larger than 200 ha and 500 ha, respectively (GON 2016). Therefore, there have inherent challenges and missed opportunities in the NTFP/MAP sector of Nepal ever since stepped efforts were made to develop the NTFP sector in Nepal. A SWOT analysis below provides a glimpse of not only challenges and opportunities but also threats and weaknesses of the sector (Karki/NMPB 2017).

3.2 SWOT Analysis of the NTFP/MAP Sector in Nepal

In order to have a comprehensive assessment of the sub-sector in terms of identifying internal strengths and weaknesses as well as identifying external opportunities and threats or limitations, a SWOT analysis is carried out, the result of which is shown in Table 3 (UK FCO 2012).

3.3 Challenges and Opportunities in Commercializing NTFPs/MAPs in Nepal

The high priority given to the NTFPs especially MAPs by the successive Government of Nepal during the last two decades is due to their significant contribution in rural livelihood and national economy as well-being a major source of raw materials in herbal medicine, primary health care, cosmetics, essential oils, nutraceuticals, fiber and handicraft products manufacturing. The herbal products and services market is increasing in both national and international levels with increasing value (Gauli and Hauser 2009). A wide range of stakeholders are involved in NTFP sub-sector in its conservation, management and commercialization. In spite of multiple players being involved in this sector and different promotional policies and programs implemented in the past many years for the development of NTFPs/MAPs sub-sector, the efforts have been largely ineffective, uncoordinated and often inefficient. Although the NTFP policy of 2004 is hailed as a milestone in the development of NTFP sub-sector in Nepal, its poor implementation and lack of human, financial and technical resources with the implementing agency—the DPR—have created more frustration, lack of coherence and poor response from the investors and promoters alike. The recent new Forest Policy and Forestry Strategy has addressed some of the policy gaps and created opportunities, but there remain major policy and regulatory issues and hurdles that need to be resolved to encourage the growth of small and medium enterprises in the NTFP/MAP sub-sector. Based on the information published by the FNCCI-AEC/NEHHPA (2012), major challenges faced by the NTFP and MAP sectors can be summarized below.

Table 3 SWOT Analysis of the NTFP/MAP Sector in Nepal

Level	Strength	Weakness	Threats	Opportunities
NTFP/MAP resource base	• Nepal is great reservoir of high-value NTFP/MAPs in the nature and great potential to captivate • Nepal has comparative and complimentary advantage in wild NTFP production (rich biodiversity, traditional practice, cheap labor and a large range of products) • Multiple stakeholders agenda for NTFP conservation, management and domestication practices scaled up	• Poor research on domestication of some high-value NTFPs/MAP that grows in natural habitat • Limited In situ and ex situ practices of the wild plants • Inaccessible commercial cultivation technology and lack of adequate skilled human resources	• Unsustainable extraction depletes the NTFP/MAP resources • External neighboring markets	• community based conservation practices are effective and can be widely replicated • Private land, communal and leased land are potential to scale up of domestication
Processing and Value addition	• Indigenous processing technology also recognized and adopted widely • Locally appropriate technologies are developed by domestic engineering companies	• Poor quality, volume, reliability, and certification arrangements for MAP products; • Unsustainable technologies and practices	• Uncertified processing technologies and products, difficult to recognize by international buyers	• Establishment of primary processing center in production pockets that are low capital based; secondary and tertiary processing done in near to big markets • Value addition at or near the raw material source is feasible in Nepal

(continued)

Table 3 (continued)

Level	Strength	Weakness	Threats	Opportunities
Market network and access	• Growing domestic and international demand, especially for MAP products • Diversification of products, wild production as organic product, high demand in national and international market	• Poor networks established with national and international business centers • Unstable supply from producers, quality not maintained regularly, adulteration (e.g., morchella, Yarsa gumbo etc.)	• Lack of buy back guarantee demotivates producers for long time	• Expanding domestic market (product diversification) • Global market demand for high quality essential/ aromatic oils increasing
Business environment	• High-value low-volume processed NTFP products with export potential is high	• Poor laboratory facilities forces traders to export raw drugs or rely on costly foreign laboratories for testing	• High dependence to export market creates vulnerability • Lack of capacity and skills to maintain quality, meet phytosanitary standards and remain competitive	• NTFP processing and value addition is a low investment and or easily financed
Business environment	• NTFPs are given high priority by the Forest, agriculture and local development policies and programs • NTFPs/MAPs production to marketing system creates green jobs and supports livelihoods	• Fluctuating market and price due to cartel ling and monopolistic behavior of wholesalers; • Poor transport and storage facilities resulting into heavy loss in quality (oxidization) and quantity (volatile nature) • Technical, financial and enterprise development (SMFE) support is lacking	• Changing and unpredictable regulatory mechanisms creates hurdles to the functioning of supply chain (lot of discretionary power) • High investment without proper enterprise and business development plans may result poor results	• Domestic markets for NTFP/MAPs is expanding and import substitution is possible • A number of donor supported projects are also supporting NTFPs • Foreign collaboration (FDI, JV) is possible as Nepalese herbs have unique selling points

a. *Bureaucratic and tedious process in registration of business*:
The current procedures to register and establish NTFP- and MAP-related business are rather discouraging. First of all, the enterprise has to be located within 3–5 km distance of the forest proposed for raw materials sourcing depending on the nature of the terrain of the location. Secondly, three agencies—Department of Forest; Department of Land Survey; and Department of Cottage Industries—have to approve the application. Yet, another disincentive is that the registration agency does not give the certificate of origin of the products produced by the enterprises, thus again exposing the industry to unnecessary direct and indirect taxation while transporting the processed products from factory to the markets;
b. *Species ban and environmental restrictions*:
A number of NTFP and MAP species fall under the Appendix 1 of the CITES. While the CITES provision allows undestructive harvesting of the Appendix 1 species, the government has put a ban on accessing these species, thus depriving the industry with some of the required raw material sources. Similarly, there is regulatory restriction or ban on export of certain species without processing. The definition of processing is rather vague, and some of the NTFP/MAP species (e.g., *Ophiocordyceps sinensis*) cannot be processed to meet the standard definition. The sticks can be only cleaned up and graded. There are also requirements to do IEE and EIA depending on the land conversion and raw material extraction plan of the enterprise. The requirements for IEE and EIA for setting up enterprises to be located within or around community forestry whose operational plan is approved by the government create extra hurdle to the community forestry user groups, investors and businesses to apply for NTFP/MAP industry as finding suitable forest is very difficult and IEE and EIA process is also bureaucratic.
c. *Transit or transport permit and short validity*:
The NTFP/MAP enterprises have to obtain transport permit from the Forest Department (FD) authorities; this process is rather cumbersome as all the declaration regarding source of origin, quantity and destination have to be provided. However, even with the FD permit, the consignments have to go through many police and local government check posts and pay both formal and informal fees and taxes. This makes the transaction cost of the product rather high, thus making the business unprofitable. General perception of the authorities is that all NTFP and MAP businesses do illegal collection and sale of products. Some unscrupulous individuals and businesses do engage in illegal and corrupt practices, but due to some bad elements, the entire NTFP business community is made to suffer. Also the Government of Nepal lacks standard accredited laboratory and equipment, thus making the phytosanitary certificates issued by the Government of Nepal unacceptable by other countries including India.
d. *Lack of universally acceptable product code*:
Export trade in NTFP requires that the traders use universal code to pass through international regulatory process such as border customs. These are called HS code. Currently, only a broad classification of NTFP and MAP has HS code #

3301. But in order to have optimum trade access and benefits (e.g., export tax and VAT exemption), all subcategories under the NTFP/MAP should have HS codes which the Government of Nepal has not been able to complete.

e. *Unscientific Royalty and Taxation Policy*:
Royalty and tax rates are fixed on the basis of ad hoc decision or historic rate which is unscientific. Rather, it needs to be a dynamic mechanism based on highly fluctuating NTFP product market price. Along with these mostly high and irrational royalty rates and taxes, the other informal taxes levied make the export price of the product less competitive in international market. This aspect discourages the exporters to venture into export business of the NTFP, and few enterprises actually can stay in the market. The most discouraging aspect of the royalty and taxation policy is that this is also applied to products coming from private forest and agriculture land. While agriculture products do not pay royalty, MAPs grown on agriculture land attract royalty.

f. *Distortion of policies and regulations in implementation and enforcement*:
In general, Nepal's Forest Policy and related rules and regulations are in favor of community forestry and NTFP cultivators. But vested interests are dominant while implementing the policy and enforcing the regulations. Different authorities interpret and apply policies and regulatory provisions differently mostly in a distorted manner, and unscrupulous private sector business also gets involved in corrupt practices, thus making the genuine NTFP/MAP enterprises suffer. For example, while the processed NTFP/MAP products exported from Nepal face unnecessary taxes and levies, the same types of products imported from neighboring countries are made duty-free; thus, Nepalese NTFP business becomes less and less competitive.

3.4 Barriers in Exports of MAPs and Essential Oils from Nepal

This section describes various internal as well as external constraints and hurdles to international trade (including non-tariff barriers) faced by medicinal and essential oil traders while engaging in the export of products to foreign markets. The analysis is based largely on the review of the literature related to the subject as well as consultations and discussions with relevant stakeholders.

3.4.1 Domestic Barriers

According to most stakeholders, the most important barriers in MAP trade are domestic in nature. There are a number of problems in MAP collection. As mentioned above, environmental impact assessment (EIA) and initial environmental examination (IEE) must be conducted for collections of more than 5 metric tons (MT). Stakeholders complain that this threshold for IEE/EIA has been established on a non-discriminatory basis and has to be done even for herbs that are abundant. Although the rationale behind the requirement to conduct IEE/EIA is environmental protection, the process is expensive, time consuming and with bureaucratic problems. Similarly, the release of permission letter that traders have to get from the District Forest Office (DFO) mandates that sale of collected items must be made within 21 days. If the sale period, due to unforeseen reasons, exceeds 21 days, another permission letter has to be acquired (FNCCI-AEC-NEHHPA 2012).

Similarly, when products are transported from their district of origin to the destination of export, forest range posts in each passing district have the authority to examine the items (Forest Regulation 21(2), 1995). This has increased the rent-seeking behavior among the officers working in those range posts. Similarly, Article 215 of the Local Self Governance Act permits District Development Committees (DDC) to levy taxes on NTFPs provided that such taxes are approved by the DDC Council. Consequently, along with indirect payments to range post officers, traders are also required to pay taxes to DDC offices. This has been a significant barrier in MAP trade (NEHHPA 2012).

Another pressing problem is the lack of distinction between MAPs collected from the wild and cultivated ones. As mentioned earlier, release letter from DFO is essential for transportation of MAPs. However, because some MAPs are cultivated too, the DFO does not issue release letters for them saying that they are not forest products and hence beyond their jurisdiction. When the District Agriculture Development Office is approached for the same, it denies issuing the letter stating that because the products cultivated are medicinal plants, it lies within the jurisdiction of the DFO and therefore it should issue the release letter. Therefore, many exporters are left with no choice but to transport such (cultivated) products without any release letter or official documents. That results in traders/exporters having to face hassles and make informal payments at range posts (Ghimire 2012).

Another problem relates to the stipulated condition in establishing an NTFP-based enterprise. The existing regulation does not permit establishment of an NTFP-based enterprise within 3 km of forest perimeter in Tarai and 5 km in the mountains of (AEC/NEHHPA 2012). Similarly, any new NTFP-based enterprise should acquire permission from three different agencies, viz. DFO, Land Survey Department and District Small and Cottage Industry Development Office (FNCCI-AEC/NEHHPA 2012).

Trade facilitation by Government of Nepal—within the border, at the border and beyond the border—is weak and cumbersome. It has been experienced by traders that transporting MAPs from the west to the east to export from Kakarvitta customs, an exporter has to get 36 stamps in his documents all along the way, which requires additional NRs. 500 to NRs. 5000 per stamp.

3.4.2 External barriers

There are a host of trade barriers that MAP exporters from Nepal have to face. While some of the barriers are general across all importing countries, some are country-specific. GIZ (2011a) highlights that although MAPs and essential oils have export potential in the world market; the potentialities have not been harnessed. Major export barriers are tariffs and non-tariffs, trade facilitation, quality and standards, intellectual property rights, EIA/IEE and research and development. Few countries have levied export tariff on essential oil and MAPs exported by Nepal. For example, tariff rates are imposed on MAPs by China (5.8%), Bangladesh (12%), Pakistan (5%), Republic of Korea (8%), Taiwan (0.4%) and Vietnam (5.4%). Similarly on essential oil, tariff rates vary by country—Brazil (10.8%), China (18.8%), Mexico (4.4%), Indonesia (5%) and UAE (5%). Even if export tariff rates are zero by some countries, duties and charges are imposed.

From an international trade perspective, product standards are mainly categorized into two groups, firstly, related to food safety and human, animal or plant life or health, covered by the SPS Agreement of the WTO, and secondly, related to processing and production methods, testing and certification procedures, packaging, marking and labeling, covered by the Agreement on Technical Barriers to Trade (TBT) of the WTO. These agreements encourage countries to use international standards as appropriate, but do not require them to change their levels of protection as a result of standardization, as long as their levels of protection have a scientific basis to prove the need. Nepal is weak in maintaining the standard.

Regarding the intellectual property right (IPR), traditional knowledge of communities is not protected by property right. Essential oil produced in Nepal, by default, is said to be organic, but lacks testing and certification.

3.4.3 Lack of regulation on quality

According to exporters, one of the primary reasons why Nepalese products do not find higher price in the international market is the lack of product quality. Common complaints are that chemical properties of Nepalese MAPs are extremely good, but because cultivators and collectors do not follow proper collection, storage and transportation measures, the final export products' quality suffers immensely. Because there is no mechanism in Nepal to ensure that GAP, good collection practices (GCP) and GMP are followed, proper harvesting, processing, packaging, storage and transportation procedures are not applied. This leads to loss of quality of MAPs at all stages, and therefore, the final products' value is compromised.

Quality here would mean the efficacy, safety and purity of the medicinal and aromatic plants.

Quality loss also occurs during checks and inspection of goods en route, as the packages are often opened, torn and mishandled in the process. This results in product pilferage and damage to the packaging of the exported materials. Such activities cost heavily on exporters since most MAPs are of high value and loss in their quality, even in small quantity, would incur heavy financial losses. Therefore, regulations related to quality maintenance at all stages from collection/harvesting to delivery/export are essential for Nepalese MAPs to fetch good price.

3.4.4 Lack of Effective Quality Assurance Mechanism

At present, the laboratory situated at DPR and the plant quarantine offices situated at various custom points of the country are responsible for assuring the quality of MAPs. Unfortunately, the quarantine posts are not equipped with qualified personnel and/or adequate equipment. As a result, exporters cannot assure the quality of products. Quality assurance certificate is necessary for customs clearance, but importing countries do not accept such certificates issued by Nepal‘s quarantine offices. According to stakeholders, there were cases where prevalence of fungus in some MAPs had led to consignments being canceled leading to significant losses. Furthermore, the lack of pest risk analysis (PRA) done on Nepalese plants has also hurt Nepalese MAP exports. Because most importing countries require PRA of specified plants being imported, it is necessary for Nepal to conduct PRA of such plants. However, as of yet, Nepal has not conducted PRA of any of its medicinal plants.

Another constraint is the absence of an accredited organic certification agency in Nepal. While organic certification is not a compulsion, certification can nevertheless increase the credibility of products and fetch higher prices. Unfortunately, Nepalese exporters have to acquire such certificates from international agencies bearing high costs. Organic certification can cost exporters as much as NRS 700,000 per annum, and therefore, only large exporters are able to afford organic certification.

3.4.5 Lack of Storage Facilities

Completing the entire export process for MAPs often takes a long time (because of problems like PFA certification in India and quarantine clearance in China, which are discussed below), it is vital that proper warehousing and cold chain facilities are developed at/close to custom points from where MAPs are exported in huge quantities. Unfortunately, appropriate storage facilities are lacking both in Nepalgunj as well as the Tatopani border—the two important customs points for exports of Nepal‘s MAPs. During cases of protracted litigation, disputes and quality tests, the products cannot be stored well, which may deteriorate their value or render them completely useless. It also increases the idle time of transport and raises transport costs. A respondent reported that there was an instance in the past when total consignment of Chiraito was lost due to the lack of proper storage facility at Tatopani customs point.

4 Current Policy, Legal and Regulatory Framework

4.1 Overlapping and Contradictory Nature of Policies

There are various policies and legal frameworks governing the NTFP/MAP sector in Nepal covering the major aspects of conservation, development, enterprise promotion, inland trade and export. Sectoral policies and legal framework such as Master Plan for the Forestry Sector, 1988; Forest Policy, 2015 and NTFP Policy, 2004; Forest Act 1993 (amendment, 1999), Forest Regulations 1995 (and its amendments 1999, 2002 & 2005), Community Forestry Directives, 1995 (and its amendment 1999), and Guidelines for Community Forestry Development Program 2008 (revised) directly influence the conservation, management and utilization of NTFPs. Cross-sectoral laws and policies such as the Industrial Enterprise Act 1992, the Company Act 1997, the Cooperative Act 1992, the Income Tax Act 2002, the Value-Added Tax Act 1996, the Environment Protection Act 1997, the Environment Protection Rules 1997, etc., affect NTFP/MAP/AFP-based enterprise development and trade. Among these policies and laws, there exist many overlaps, contradictions and sometimes enabling features. Only few of these administrative and legal instruments have positive implications and a more direct impact on the overall development of NTFPs/MAPs sector and associated enterprise development in Nepal. These policies and laws along with their major features are presented in Table 4.

The multiplicity of regulations and administrative procedures mean efficiency of export is reduced as exporters need to obtain a collection permit, transport permit, certificate of origin and certificate of identification (involving CITES clearance) from various agencies of the government as follows (NEHHPA 2012):

- Collection permit given by District Forest Office (DFO)/Community Forest User Group (CFUG)
- Royalty payment collected by DFO/CFUG
- Issue (transit) permit given by DFO
- Local taxes collected by District Development Committee (DDC)
- Certificate of origin FNCCI/Nepal Chamber of Commerce (NCC).

Table 4 Various policies and laws related to NTFP/MAPs in Nepal (NEHHPA 2012; Ghimire 2012; MSFP 2014)

Sectoral	Cross-sectoral
• Private Forest Nationalization Act (1957) • Master Plan for the Forestry Sector (1988) • Forest Act (1993) • Forest Regulation (1995) • Community Forestry Directive (1995) • Collaborative Forest Management Guidelines (2003) • NTFP, Herbs and Herbal Development Policy (2004) • Community Forestry Guideline (2008)	• The Industrial Enterprise Act (1992) • The Company Act (1997) • The Cooperative Act (1992) • The Income Tax Act (2002) • The Value-Added Tax Act (1996) • Environment Protection Act (1997) • Environment Protection Rules (1997) • Local Self-Governance Act (1999) • Food Act (1966) • ++10th Five-year Plan

4.2 Regulatory Provisions and Enforcement Mechanisms

Nepal's forest acts, regulations and plans in general support the forestry sector growth and development especially development of NTFPs. Master Plan for the Forestry Sector 1988 was the first such comprehensive plan that envisaged sustainable conservation, management and enterprise development of NTFP/MAPs (Parajuli 2005). The Ministry of Forest and Soil Conservation (MoFSC) is the major public sector agency to administer the conservation and management of forests, NTFPs and biodiversity of Nepal. For the purpose of conservation, management and research, the Department of Plant Resources (DPR) is leading under the MoFSC, whereas the Herbal Products and Processing Company Limited (HPPCL) is a parastatal or a semi-government company to utilize and process the NTFP/MAPs. The Forest Enterprise Division has been created in the MoFSC to develop forestry and NTFP enterprises. However, the Department of Forest executes the conservation and development of forests and NTFPs through its district and range offices throughout the country (Parajuli 2005; GoN 2009, 2016).

4.3 Key Policy Issues

There are mainly four (4) policy and institutional issues in the NTFP/MAP/AFP sectors—some are specific, and others are general (APAARI/FAO 2013; NPC 2015; FNCCI-AEC/NEHHPA 2012). They are described below:

a. *Enterprise registration and establishment*:
   The restrictions such as the establishment of enterprises requiring to be located within the 3–5 km range of raw materials source should be amended and decided based on the rationale from the perspective of transparent, participatory

and profitable supply and value chain change management. Similarly, given the huge investment potentials from cooperatives, NTFP/MAP enterprise registered as cooperatives should also be incorporated as business and issued the certificate of origin (CO) products. Most of the environmental examinations as provisioned by IEE are already there in the operational plan of the community forest. So, the provision of IEE requirement in the case enterprises to be located within the community forestry area should be removed and only the provision of EIA kept in case required by law.

b. *Removal of unnecessary hurdles, trade/export barriers*:
The transport or transit permit (TP) issued by DFO and its validity period needs to be based on the duration the consignment needs to reach the destinations depending on the terrain and road quality. The multiple checkpoints en route should not require for the consignment that display valid TP and are sealed with the authorized government logos. The current requirements by traders to obtain approvals from different authorities should be replaced by one-window or one-stop paper work preferably at customs point. Economy diplomacy of the Government of Nepal should include promotion of NTFP/MAP trade and quality and brand promotion-related awareness campaign and training at all levels need to be undertaken. All illegal traders and black marketeers should be severely punished. Internationally accredited laboratory should be established both in public and private sectors so that the dependence on foreign laboratory is eliminated. MAP/NTFP trade issues especially non-tariff barriers created by major importing countries should be regularly brought in bilateral negotiations and talks at both political and official levels. Some of the other issues of importance are: certificate of origin, lengthy quarantine procedures, and requirement of HS codes. Especially with India and China, more export points with quarantine and other required facilities should be set up at the high NTFP/MAP productions zones such as mid- and far-western Nepal. The Government of Nepal (GoN) should also make clear-cut least contradictory and overlapping NTFP/MAP policy and regulatory framework that is based on the national reality and international requirements (e.g., HS code for all major export items). Wisely crafted carrot and stick policy should follow by rewarding clean business and punishing the unscrupulous traders and vested interests.

c. *Reform Royalty and Taxation Policy*:
Royalty rates should be based on commonly acceptable scientific criteria such as phenology, availability, market price and fluctuating price of individual products. For example, traded species of orchids should be clearly identified, and royalty has to be determined according to the species, i.e., the trade volume, availability, phenology, regeneration capacity not on the basis of generic trade name of Orchid. Multi-stakeholder consultations including with scientists and NTFP/MAP trade experts should be the basis to reform the royalty rates in a logical and rational manner. Double and triple and informal taxation should be eliminated as these create major disincentive to entrepreneurs, businesses and investors. Equating with agriculture sector, current charging of royalty to NTFP/

MAP products grown in agriculture land should be stopped. Digital registration cards should be issued to identify the NTFP/MAP products originating from private forests/farmland.

d. *Bans and Restrictions of Species*:
The policy for banning of MAP species for collection, cultivation, processing and export needs to be rationalized. If conservation is the purpose, the objective can be met as per the CBD convention through sustainable use and fair and equitable benefit sharing. Some of the commercially valuable NTFPs such as Panchaule, fruit husk of Okhar and Lichens that are currently banned can be harvested non-destructively, and the stock managed sustainably. Since Nepal's open border and weak enforcement capacity cannot implement the ban effectively, it is better to enforce sustainable cultivation, harvesting, wastage minimization and processing for maximum value addition within country which can achieve the same objective. For example, the current ban on Panchaule should be lifted for domestic consumption and royalty for the same should be reduced. The term 'processing' needs to be defined scientifically by the government based on expert opinion and the experience of neighboring countries since current definition is vague and implementable (NEHHPA 2012, 2016).

5 Policy and Regulatory Framework for Growth-Led NTFP/MAP/AFP Sector

5.1 Need and Vision of a Vibrant NTFP/MAP/AFP Sector in Nepal

The NTFP policy reform is long overdue in Nepal since the existing policy is already more than 12 years old. Besides, the country has undergone major governance changes with federalized structure under which local village and town councils have been given more authority to manage their natural resources. Along with the reformed three-tier policy at centre, province and local levels, suitable regulatory and enforcement mechanisms have to be also developed. New policy has to have a blend of conservation, cultivation and marketing to provide continuity of the current emphasis on conservation by enhanced emphasis on trade and marketing for economic development especially in rural areas. The interconnected benefits of conservation and cultivation have implications for the economic well-being, social stability and the survival of the diverse cultures in the region. The goods and services provided by NTFP/MAPs can support livelihoods of millions of Nepalese people who are dependent on forest ecosystem goods and services for their livelihoods. While the conservation and sustainable use is important, livelihoods improvement has to be managed simultaneously to incentivize conservation.

The traditional use of these diverse resources not only reflects a diverse resource-use pattern, but also ways of maintaining livelihoods of people dependent on their ecosystems.

The long-term vision of the NTFPs/MAPs/AFP sector development is to see a commercially viable and vibrant sector contributing to the overall economic development of Nepal in which private and business sectors play a leading role. The governments at different levels play the role of facilitators. Having a conducive policy and regulatory environment is the main requirement for attracting private sector investment. Trade diversification, sales and export promotion of NTFP/MAP/AFP products in both domestic and foreign markets require a new strategy. Besides, the value addition of the products within the country through primary and secondary processing, proactive promotion of Nepalese products based on its geographic location should also be considered in the future strategy of the development of the NTFP, MAP and agro-forestry.

Given the wide altitudinal and climatic variation and ecological diversity of Nepal, it is prudent to promote diversified product development along with economic potential and opportunity. Nepal needs to have strategy to promote different types of NTFP/MAP species based on comparative and competitive advantages. It is argued that products can be selected based on their biological availability on the principle of one-agro-ecological zone having priority for one MAP product or ‘one ecological zone-one MAP product’. The Ministry of Agriculture Development (MoAD) already has experience in promoting one village one product (OVOP) in the area of AFP. In NTFP/MAP sector, the same policy can be adopted by selecting ecologically similar areas and prioritizing one commercially high-potential product. After a successful commercialization during pilot phase, scaling out can be initiated. For selecting the agro-ecological zone-wise NTFP/MAP promotion, the policy can use the existing classification of twelve ecological regions and 20 priority species as proposed by the Department of Plant Resources (DPR) for the balanced growth and development of NTFPs/MAPs sub-sector in Nepal (NEHHPA 2012; NTIS 2016).

5.2 Purpose of the New Policy Reform

The main purpose of the new policy reform should be to develop NTFP/MAP/AFP sector policy applicable to the new federal structure of Nepal with proper vision, mission, strategy, action plans and implementation modalities. The aim is to develop a participatory and multi-disciplinary policy by involving major stakeholders especially democratically elected decision makers, conservation scientists, traders, exporters and manufacturers and community development professionals. The goal is to utilize Nepal’s comparative and complementary advantages in the field of NTFP/MAP/AFP sector for drawing maximum economic benefit. Research scientists, forestry professionals, development workers, business leaders, traditional healers and academicians in Nepal have long recognized that unsustainable use of biological resources, especially medicinal plants, has rarely benefited the economic development of the country as well as the local livelihoods. It is therefore necessary to first and foremost put in a policy that can give greater attention to develop NTFP/MAP sub-sector in a holistic and long-term basis to ensure sustainable harvesting, production and use of the scarce natural resources. Such a policy should focus on an integrated development of the NTFP sector by fully utilizing both the growing domestic and international market potential. The policy has to protect access and benefit rights of the people and the intellectual property rights of the local NTFP collectors, MAP-based health service providers and AFP producers who are the custodians of these natural and agriculture products and traditional practices that support their livelihood, health and well-being.

5.3 Role of Private Sector

Recognizing the vital role of private sector in attracting investment and promoting the growth and development of the NTFP/MAP/AFP sector, the following policy directions are recommended:

- *Developing a favorable environment for private sector investment*: Develop mechanisms and a favorable environment for investment by the private sector on priority NTFPs/MAPs and agri-products;
- *Processing and value addition*: Many NTFP/MAP processing centers are operating with traditional and outdated processing technologies that have always increased the production costs discouraging new individual as well as community investors in NTFP enterprises; also, most of these facilities are away from the raw material production areas which increase the cost of supply to the producers and decrease the revenue. There is therefore a need to introduce modern processing technologies and to establish processing facilities close to production areas.
- *Implement one-region one-product (OROP) scheme*: Implementation of this potentially good strategy should be based on the proper understanding of Nepal's unique geography and NTFP/MAP distribution, The OROP should be designed based on the different nature of NTFP/MAP production potential in different ecological regions of Nepal. NTFPs/MAPs need to be developed by promoting both wild collection and cultivation if the OROP policy is to succeed. For example, far- and mid-western development regions (now Karnali and Sudur Paschim provinces) have more than one product that can be commercially promoted. So the definition of the region should be based on NTFP/MAP ecology not political boundary.
- *Promoting business partnership*: Various types of partnership arrangements among the forest-based enterprises (FBEs) should be promoted to better capture the value within the FBE chain by introducing profit- and/or risk-sharing mechanisms and improved supply and value additions and providing better access to information and technical, business and financial services.

- *Trained human resources*: Many enterprises are found dependent on foreign skilled workers pointing to the need to train local human resources especially on newer and efficient technologies.

5.4 Importance of Inter-sectoral Collaboration

Recognizing the cross-sectoral role of NTFPs, the concerned ministries need to develop an inter-sectoral and overarching policy and legal framework that can drive the whole process in a production to consumption and marketing system (PCMS) or value chain model taking a dynamic and sustainable approach. Such an approach has to embrace the principle of sustainable wild harvesting, commercial cultivation based on FAO-prescribed good agriculture cultivation practices (GACP), good wild harvesting practices (GWHP), continuous training and capacity building program for sustainable utilization of NTFP/MAP and constant policy and institutional support. The GoN has given a high priority for the conservation and development of medicinal and aromatic plants. But there is a need for enabling policy and well-designed plans and programs to translate models into realistic conservation and development practices. Also, among the concerned ministries especially forestry, agriculture, commerce and industry including small and medium industries, there is a need for launching collaborative and joint initiatives to promote NTFP/MAPs involving entrepreneurs, enterprises, NGOs and local governments in partnership, and joint-venture manner (Karki 2004b).

There is a need for a systematic approach to enhance the contribution of MAP sub-sector that is driven by a comprehensive national policy. Such an approach has to be multi-stakeholder and multi-disciplinary and should ideally involve the following steps: (a) formulation of cross-sector policy, preparation of long-term strategy, development of short- and medium-term action plans, implementation of policy actions especially simplification of regulations, and streamlining of enforcement measures to promote growth, development and export markets. The PCMS approach described above requires that policymakers and resources managers properly understand the status of the NTFP/MAPs/AFPs in the country that all stakeholders participate in decision making and, through public–private–NGO partnerships, undertake effective and result-oriented implementation to resolve emerging issues and challenges. Finally, policymakers and development agencies need to be constantly updated with latest information and knowledge—including indigenous and traditional knowledge—regarding the changing role of our ecosystems especially forest and grassland ecosystem for keeping strategic balance between demand and production and collectively work for sustainable production, consumption and marketing of MAPs in the country.

6 Conclusions and Recommendations

6.1 Conclusions

NTFP/MAP is one of the sub-sectors of forestry sector in Nepal. Similarly, agro-forestry is a sub-sector of agriculture sector. Although the NTFP sub-sector contributes around 12% of the total revenue earned by the forestry sector, its management and utilization is still not business-oriented. There are numerous stakeholders involved and players dominated by interest groups ranging from community-based forest enterprises (CBEF), forest users federations, community-based organizations (CBOs), forestry and agriculture commodity associations and traders' and business associations. While the knowledge and skill of private entrepreneurs and traders from private sector are specialized, producers' knowledge and skills are of general nature. There are apex bodies such as Nepal Herbs and Herbal Products Association (NEHHPA); Fruit and Vegetable Marketing Associations, etc. However, these apex associations are facing challenges to strengthen these organizations as strong business promoters. This is because NTFP/MAP as well as agro-forestry business is the concern of various government institutions and policies, thus resulting in overlapping policies and regulations. Advocacy and lobby by NGOs, CBOs and commodity associations with government institutions for removing policy hurdles, contradictions and irregularities are not producing desired results due to weak advocacy capacity of these organizations. Perhaps, a more collaborative work undertaken collectively by organizations with similar objectives with support from development partners and civil societies might yield better results. Most of the member-based associations of entrepreneurs are operating in the diverse geographical locations and therefore are struggling for survival due to lack of institutional and infrastructure support.

NTFP/MAPs and agro-products such as essential oils are among the most important export commodities of Nepal. Besides earning foreign currency, their socio-economic impact, mostly in some of the poorest regions of the country, in terms of employment generation, is also high. However, this sector has been facing a number of hurdles due to which its anticipated benefits have not been realized. For example, due to unsustainable collection practices, many of the important and valuable MAPs are gradually disappearing from Nepalese forests. Non-compliance of the GACP and good manufacturing practices (GMP) has also resulted in loss of international markets for Nepalese MAPs and essential oils. Similarly, high transaction cost in the domestic movement of these products due to formal and informal taxation systems is a major problem faced by traders and movers engaged this sector. A major shortcoming regarding Nepal‘s inability to benefit the most from the NTFP/MAP/AFP sector has been the lack of transparency in government's enforcement mechanisms, lack of quality and standards in production system, inadequate value addition and relying more on trade in raw materials than in finished products.

Despite rich diversity of NTFP/MAP/AFP products, Nepal has not been able to benefit from the domestic consumption and export trade of these products. While there is an upward trend in the demand for natural food and medicine products and natural healing and health services, Nepal's production of medicinal products, organic food, essential oils and traditional health service growth is almost at a stagnant stage. Therefore, while it is essential to ensure the quality of its products to realize more benefits, it is also important to ensure a stable international market for these products to provide impetus to the domestic industry to utilize the country's NTFPs/MAPs optimally and turn them into high-value-added products.

6.2 Recommendations

Recognizing the vital role played by NTFP/MAP/AFPs in providing food, medicine and well-being security of vast percentage of Nepalese population, Nepal's policymakers should recognize the need to conserve, sustainably use and responsibly commercialize the country's rich terrestrial and agro-biodiversity resources. There is an urgent need to develop and enforce globally recognized guidelines on good agricultural and collection practices (GACP) in production and harvesting of all products in this sector. This will help ensure produce quality raw materials facilitating national, regional and global acceptance of Nepalese natural products. Since the participation of local communities is essential in biodiversity conservation, different kinds of local stakeholder groups such as forest users' federation (FECOFUN), NTFP/MAP commodity associations, entrepreneurs and community-based forestry enterprises engaged in local value addition and primary processing need to be vigorously supported and nurtured. This will ensure the institutional strengthening of the upstream producers, aggregators and processors on the MAP supply value chains and improve the monetary value of the entire PCMC and product value chains. The cluster-based enterprise development approach is highly suitable for NTFP/MAP/AFPs commercialization as it saves cost by sharing facilities and creating complementarities and synergies. If supported with proper and adequate investment, the NTFP/MAP cluster can generate huge number of green jobs and promote green growth strategies yielding triple dividends of poverty reduction, local economy development and environment conservation besides generating several indirect benefits such as improved human and environment health (UNEP 2012). This will need farmer group and forestry users' community based value chain development programs so as to ensure transparency, accountability and equity in the commercialization process.

The NTFP/MAP/AFP sub-sectors lack a centralized and comprehensive database which acts as barrier to enter these products into the FAO's commodity list (HS code). Therefore, the Government of Nepal should engage the relevant agencies such as Forest Survey and Research Department (FSRD), NARC, NEHHPA and HNCC/DPR in accelerating the development of HS codes for all the categories and subcategories of the NTFP/MAP products exported at least in the member countries of the SAARC. There is also a good potential of developing Nepalese brand of the NTFP/MAP products based on geographic area indication or cultural heritage-based labeling strategies. Commercial value of these products and market appeal can be substantially enhanced if Nepal can brand its products wisely using exotic and unique icons such as the names of famous Himalayan peaks, Lord Buddha's birth place and others with Nepalese tradition, culture, spirituality and beliefs. These traits, however, need to be made acceptable to the regional and global markets for which internationally recognized but affordable certification system that recognizes organic produce of assured quality through good agriculture and collection practices (GACP), socially responsible and ethical production system by using good manufacturing practices (GMP) and good laboratory practices (GLP) needs to be followed by Nepalese companies and traders. GACP, GLP, GMP and organic certifications therefore must be instituted at national levels by creating internationally accredited laboratories within the country, which will facilitate the greater market access by Nepalese products in regional and global trade in agri-products. Regular and meaningful exchange of knowledge, information and experiences related to trade along with good practices of handling project implementation and regulatory procedures for sustainable production and commercialization need to be promoted in the country. This will help in development of national commodity value chains and stimulate growth and development of the sector. Sustainable commercialization will not be possible without a transparent and functional regulatory mechanism that ensures sustainable extraction and enforces GACP, GMP and GLP, thus assuring biosafety, ethical trading, including quality assurance and inclusive market-oriented development.

There is an urgent need to develop and sustain regional cooperation among SAARC countries in achieving sustainable conservation, commercialization, and compilation and protection of NTFP/MAP-based indigenous, traditional, and local knowledge and practices some of which might have high commercial values. Member countries could develop and implement national initiatives, but eventually the sensitive information related to IPR protection, R&D, product development, and price-related information should be shared among the business fraternity of all the member countries. In this context, the recently unveiled FEDMAPs can play a major role in consolidating and sharing the knowledge, material and the production and processing technologies as also recommended by the recently concluded APAARI/FAO conference on MAPs in the Asia-Pacific region (ICIMOD 2019; APAARI/FAO 2013).

Proper development of instruments and mechanisms for financial support and technology transfer is critical since public investment in MAP conservation and poverty reduction is needed where private sector usually does not invest. In this context, the role of SAARC Development Fund (SFD), especially its social window, should be tapped to fund national and regional MAP projects. Such projects can generate new knowledge and promote exchange through research network eventually helping SARRC level trade and commerce.

Annex: Organizations and Institutions Involved in NTFP/MAP Sub-sector

There are wide ranges of government, private sector and civil societies involved in sustainable development and management of NTFP/MAP in Nepal.

Government agencies

- Ministry of Forest and Soil Conservation (MoFSC): Ministry of Forest and Soil Conservation plays role for policy and guideline formulation, revision of royalty rate, banning and uplifting of NTFPs, declaration of NTFP pocket area, enabling environment for overall development of NTFP/MAP sub-sector. Recently, the Forest Enterprise Division facilitates for establishment of forestry and NTFP enterprise development.
- Department of Plant Resources (DPR): DPR conducts and provides services in the field of research and development of plant resources in Nepal. DPR is responsible for conservation of endangered MAPs, conduct research activities, prioritization of NTFPs/MAPs, conservation of germplasm, documentation of indigenous knowledge, processing of NTFPs. The Department is now developing the quality standards (QS), and Good Agricultural and Collection Practices (GACP) of various important MAPs. By now it has prepared the QS and GACP of jatamasi, sarpagandha, timur, tejpat, kurilo, chiraito, and is working on few others.
- Department of Forest (DoF): Through district-level offices, the DoF provides services on NTFPs such as nursery development, technical feedback, and the collection and transportation permits. DoF executes policies, disseminates status of collection of NTFPs, regulates.

Private sectors

- Federation of Nepalese Chamber of Commerce and Industry (FNCCI)/ Agro-Enterprise Center (AEC): FNCCI through Agro Enterprise Center and Forestry Enterprise Division (FED) promotes commercialization of forest based including NTFP industries and trade.
- Herbs Production and Processing Company Limited (HPPCL): HPPCL leads conservation, processing and enterprise development of MAPs.
- Dabur Nepal: Dabur has been involved in identification of most important medicinal plants for cultivation in Nepal, along with the most suitable climatic areas for cultivation, establishment of protocols and procedures for Greenhouse propagation and field cultivation.
- Chaudhary Biosis: Biosis has established domestications sites of essential oils in various districts and market the essential oil to foreign countries.

NGO, INGOs/civil societies

- International Center for Integrated Mountain Development (ICIMOD): ICIMOD works for livelihood enhancement through value chain development of NTFP/MAP enterprises in mountain area, and disseminates lessons learning.
- Asia Network for Sustainable Agriculture Bio-resources (ANSAB): Conducts evidence based advocacy through field based research, value chain development, management information system (MIS), and knowledge management.
- Micro-Enterprise Development Program (MEDEP): Develops entrepreneurship of pro-poor groups, supports for establishment of enterprises, developing marketing linkages between producers and buyers, institutional development and strengthening of entrepreneurs.
- International Union for Nature Conservation (IUCN): Conservation, assessment and prioritization of NTFPs/MAPs for livelihood of rural people
- Germany's Gessellschaft fur Internationale Zusammenarbeit (GIZ): Value chain development of MAPs, enterprise and marketing development, capacity building of producers, processors and networks.
- Federation of Community Forestry Users Nepal (FECOFUN): through Community Forest User Groups, incorporate conservation, management and utilization procedure in the forest operational plan (FOP), provides financial supports to CFUG members to start their enterprises.
- Likewise, Jaributi Association of Nepal (JABAN), NEHHPA, Handmade Paper Association (HANDPASS) are actively involved.

References

Acharya, D. (2006). Nepali Hate Kagajko Antarik Bazaar: Ek Charcha. Smarika (Chhaithu Barshik Sadharan Sabha 2062 BS. Nepal Hate Kagaj Sangh, Kathmandu, Nepal. (in Nepali).

Acharya, R. P., Dahal, S., Kunwar, R. M., Sharma, R., & Baral, S. (2015). Medicinal and aromatics plants in a far western Nepal: A sustainable livelihoods analysis. Hartmann & Weipert: Biodiversität und Naturausstattung im Himalaya V. - Erfurt 2015. https://www.researchgate.net/publication/299676190.

AEC/FNCCI. (2006). Compilation and prioritization of ten important NTFPs of Nepal for commercial promotion through private sector investment. Kathmandu: Agro Enterprise Centre and Federation of Nepalese Chambers of Commerce and Industry (FNCCI).

Amatya, S. M., & Newman, S. M. (1993). Agroforestry in Nepal: Research and practice. *Agroforestry Systems, 21,* 215–222. https://doi.org/10.1007/BF00705241.

ANSAB & EWW. (2000). *Enterprise development for natural products*. Kathmandu, Nepal: ANSAB.

ANSAB. (2011). *Value Chain/Market Analysis of the Ginger Sub-sector in Nepal*. A study report of ANSAB for USAID Nepal.

APAARI/FAO. (2013). *Proceeding and Recommendation of the Expert Consultation on Promotion of Medicinal and Aromatic Plants in Asia Pacific Region*; Bangkok, Thailand, December 2–3, 2013. Organized by the FAO Regional Office and the Asia Pacific Association of Agriculture Research Institute (APAARI).

Banjade, M. N., & Paudel, N. S. (2008). Economic potential of non-timber forest products in Nepal: Myth or reality? *Journal of Forest and Livelihood, 7*(1), 36–48.

Belcher, B., Perez, M. R., & Achdiawan, R. (2005). Global pattern and trends in the use and management of commercial NTFPs: Implications for livelihoods and conservation. *World Development, 33*(9), 1435–1452.

Bhattarai, N. K. (1997). Biodiversity-people interface in Nepal, Medicinal Plants for Forest Conservation and Health Care. *FAO, UN, Rome, and Italy*: *NWFP Bulletin, 11*.

Bhattarai, N., & Karki, M. (2004). Medicinal and aromatic plants ethnobotany and conservation status. In J. Burley, J. Evans, & J. Youngquist (Eds.), *Encyclopedia of Forest Sciences* (pp. 523–532). UK: Academic Press.

Bhattarai, N., & Karki, M. (2010). Medicinal and other useful plants and sustainable development in the Asia Pacific region: Present scenario, challenges and way forward. *Asia-Pacific Mountain Courier, 11*(1), 1–6.

Chan, C., Pradhan, A., & Reed, B. F. (2015). Economic potential of conservation agriculture production systems (CAPS) for tribal farmers in the hill region of Nepal. *Conservation agriculture in subsistence farming*: *Case studies from South Asia and beyond* (pp. 133–154).

Choudhary, D., & Bhattarai, N. (2008). Organic production and certification of MAPs: Experience of MAPPA. In P. Chaudhary, K. Aryal, & D. Tharu (Eds.), *Proceedings of International Workshop on Opportunities and Challenges of Organic Production and Marketing in South Asia* (pp. 95–103). Kathmandu, Nepal: Permaculture Group and Ministry of Agriculture and Cooperatives.

CTCN. (2017). *CTCN in Nepal: Developing National Agroforestry Policy*. World Agroforestry Centre. November 29, 2017. https://www.ctc-n.org/news/ctcn-nepal-developing-national-agroforestry-policy.

DFRS. (1999). Forest and shrub cover of Nepal, 1994. Kathmandu: Department of Forest Research and Survey, Government of Nepal.

DoF. (2008). *Hamro Ban*. Department of Forests, Ministry of Forests and Soil Conservation, Government of Nepal. http://www.floraofnepal.org. Cited on January 3, 2017.

Dhungana, S. P., & Bhattarai, R. C. (2008). Exploring economic and market dimensions of forestry sector in Nepal. *Journal of Forest and Livelihood, 7*(1), 58–69.

Edwards, M. D. (1996). The trade in non-timber forest products from Nepal. *Mountain Research and Development*, *16*(4), 383–394. International Mountain Society. https://doi.org/10.2307/3673988, https://www.jstor.org/stable/3673988, pp. 12.

FNCCI-AEC/NEHHPA. (2012). NTFPs/MAPs Business Promotion Strategy (2012–2016) From Private Sector Perspective. Authors: Dipesh Pyakurel and Bhesh Raj Oli; Consultants, BARDAN—Regenerating the Earth for People; Teku, Kathmandu, Nepal.

Gauli, K., & Hauser, M. (2009). *Pro-poor commercial management of non-timber forest products in Nepal's community forest user groups: Factors for success*. Mountain Research and Development (MRD); An International, peer-reviewed open access journal published by the International Mountain Society (IMS). www.mrd-journal.org.

GFAR. (2017). Medicinal and aromatic plants association of India. https://sites.google.com/site/mapaindiaorg/Home. India; Geographic scope: Global; Original Link: http://www.agriprofiles.net/node/130897.

Ghimire, P. (2012). *International trade of medicinal and aromatic plants (MAPS) and essential oils from Nepal*. Nitisar: South Asian Watch on Trade, Economics, and Environment.

Ghimire, S. K., Awasthi, B. et al. (2016). Export of medicinal and aromatic plant materials from Nepal. *Journal of Plant Science, 10*, 24–32. ISSN 1726-6858; Central Department of Botany, Tribhuvan University; file:///C:/Users/DELL-PC/Downloads/Ghimireetal.2016ExportofMAPsfromNepal.pdf.

GIZ. (2011a). Medicinal and aromatic plants: Poverty impact assessment of proposed trade support measures in Nepal's MAPs sector. Kathmandu: GIZ.

GIZ. (2011b). *Promoting exports of medicinal and aromatic plants (MAPs) and essential oils from Nepal*. A report. GIZ, 2011, Kathmandu.

GIZ. (2015). *Nepalese Honey: Potential and challenges in export*. A report. GIZ, 2015, Kathmandu.

GoN. (2009). Nepal Forestry Outlook Study. Asia-Pacific Forestry Sector Outlook Study II. Ministry of Forests and Soil Conservation. Working Paper No APFSOSII/WP/2009/05. Agriculture Organization of the United Nations Regional Office for Asia and the Pacific, Bangkok, 8 pp.

GoN. (2016). Environmental Protection Regulation BS 2054 and amendment 2nd amendment in 2069, 3rd amendment in 2070 and 4th and 5th amendment.

HNCC. (2004). (2061 BS). Jadibuti Awam Gair Kastha Ban Paidawar Bikas Niti (NTFP Policy). GoN/MoFSC/DPR/HNCC. Department of Plant Resources, Government of Nepal.

IUFRO. (2012). Enhancing the contribution of nontimber forest products in supporting green economy and sustainable development in mountain countries. Keynote Paper (KN04); Authors: M. B. Karki, Nirmal Bhattarai; presented in 2012 IUFRO Conference Division 5: Forest Products Conference; 8–13 July 12—Estoril Congress Centre, Lisbon, Portugal. https://www.iufro.org/fileadmin/material/publications/proceedings-archive/50000-estoril12.pdf.

ICIMOD. (2019). *The Hindu Kush Himalaya Assessment*. Springer, Nature, 2019. International Centre for Integrated Mountain Development (ICIMOD), Kathmandu, Nepal.

Joshi, A. (2008). Medicinal and aromatic plants in Nepal: Approach, strategies and interventions for subsector promotion. Kathmandu: GIZ/Private Sector Promotion-Rural Finance Nepal (PSP-RUFIN).

Kalauni, D., & Joshi, A. (2018). Status of medicinal and aromatic plant (MAPs) and socio-economic influence in Nepalese livelihood—a review research article. *ACTA Scientific Agriculture*, *2*(9). ISSN 2581-365X.

Karki, M. B. (2017). *Challenges, opportunities and trade-offs in commercialization of medicinal and aromatic plants in South Asia Region*. Invited paper presented at the workshop on current challenges and recommendations; Government of India; New Delhi, India. https://www.academia.edu/12863952/CHALLENGES_OPPORTUNITIES_AND_TRADE-OFFS_IN_COMMERCIALIZATION_OF_MEDICINAL_AND_AROMATIC_PLANTS_IN_SOUTH_ASIA_REGION?auto=download.

Karki, M. B. (1995). *National Bamboo and Rattan Information Database, Nepal*. Pokhara: Tribhuvan University, Institute of Forestry.

Karki, M. (2004a). Certification and marketing strategies for sustainable commercialisation of medicinal and aromatic plants in South Asia. (Rotorua, New Zealand: IUFRO All Division 5 Conference on Forest Products, 2003).

Karki, M. (2004b). Institutional development process in medicinal plants sector: A case study of Nepal. In Y. Y. Thomas & M. Karki (Eds.), *Proceedings of wise practices in sustainable management of himalayan medicinal plants* (Kathmandu: People and Plants International and International Development Research Centre).

Karki, M., Tiwari, B. K., Badoni, A. K., & Bhattarai, N. K. (2004). Creating livelihoods-enhancing and biodiversity-rich production systems based on medicinal and aromatic plants: Preliminary lessons from South Asia (Chiang Mai, Thailand: Third world congress on medicinal and aromatic plants for human welfare, 2004).

Karki, M. (2012). Sustainable mountain development 1992, 2012, and beyond: Rio + 20 assessment report for the Hindu Kush Himalaya Region, a joint publication of ICIMOD, Kathmandu and the Swiss Development Cooperation (Kathmandu: International Centre for Integrated Mountain Development, 2011).

Karki, M. (2015). Challenges, opportunities and trade off in commercialization of medicinal and aromatic plants in South Asia Region (www.Academia.edu).

MOA/SNV. (2011). Value Chain Analysis of Timur. High Value Agriculture Project in Hills and Mountain Area (HVAP), Ministry of Agriculture Development/SNV. IFAD Project.

MoFSC. (2009). Nepal fourth national report to the Convention on Biological Diversity. Kathmandu: Ministry of Forest and Soil Conservation, Government of Nepal.

Multi Stakeholder Forestry Programme (MSFP). (2014). Services Support Unit (SSU), Forestry Complex, Babarmahal, Nepal. www.msfp.org.np.

NEHPPA. (2012). NTFP/MAP Business Promotion Strategy (2012–2016): From Private Sector Perspective. FNCCI-AEC/ FNCCI, Kathmandu, Nepal.

NEHPPA. (2016). *Nepal Herbs and Herbal Products Association, Strategic Plan 2016–2020, Organizational strategic Perspective*. AEC/FNCCI, Kathmandu, Nepal.

NPC. (2011). *Three year plan approach paper (2010/11–2012/13)*. Government of Nepal, National Planning Commission.

NPC. (2015). *Nature conservation national strategic framework for sustainable development 2015 to 2030*. Government of Nepal, National Planning Commission, Singha Durbar Kathmandu, p. 144.

NTIS. (2016). *Nepal Trade Integration Strategy 2016*. GON, MOC, Kathmandu.

Pandit, B. H., & Thapa, G. B. (2004). Poverty and resource degradation in the mountains of Nepal. *Society and Natural Resources, 17,* 1–16.

Parajuli, D. (2005). Potentiality in Enterprise Development of Nepalese MAPs and other NTFPs: A call for multidimensional investment. *Synthesis of Seminar Preparation and Discussions during First National Trade Show and Seminar on Herbs, Herbal Products and Spices*. November 12–14, 2005. Nepalganj. Sahakarya Project, Canadian Center for International Studied and Cooperation (CECI) Kathmandu. 2005, pp. 22–24.

Pokhrel, S. (2009). Comparative benefits of beekeeping enterprise in Nepal. *The Journal of Agriculture and Environment,* 10, June 2010. http://www.nepjol.info/index.php/AEJ/article/viewFile/2129/1960.

Prajapati, N. D., Purohit, S. S., Sharma, A. K., & Tarun, K. (2006). *A handbook of medicinal plants*: *A complete source book*. ISBN: 817754134X (Bibliographic Information: Pages: lxxx +928+134 colour plates). www.vedicbooks.net.

Prakrit. (2007). Sugandhit Tel Niryatma Dekhiyika Samasyaharu (Problems in aromatic oil export), (in Nepali), Prakrit. 3/1: 9–15 (2007).

Pyakurel, D., & Baniya, A. (2011). *NTFPs*: *Impetus for conservation and livelihood support in Nepal, a reference book on ecology, conservation, product development and economic analysis of selected NTFPs of Langtang area in the sacred Himalayan landscape*. Kathmandu: World Wildlife Fund Nepal.

Rao, M. R., Palada, M. C., & Becker, B. N. (2004). Medicinal and aromatic plants in agro-forestry systems. *Agroforestry Systems, 61,* 107–122.

Roy, R. (2010). Contribution of NTFPs to livelihoods in Upper Humla, Nepal. Bangkok: Asian Institute of Technology, School of Environment, Resources and Development.

Subedi, B. P. (2006). Linking plant based enterprises to conservation in Nepal. New Delhi: Adroit Publications.

Trade and Export Promotion Center (TEPC). (2015). Ministry of Commerce, Foreign Trade Statistics of Nepal, Kathmandu, Nepal.

UK FCO. (2012). Country profile Nepal. Figures quoted are International monetary fund estimates. www.fco.gov.uk/en/travel-and-livingabroad/travel-advice-by-country/country-profile/asia-oceania/nepal?profile=economy. Accessed 22 March 2012.

UNEP. (2012). Green economy sectoral study: BioTrade – Harnessing the potential for transitioning to a green economy – The case of medicinal and aromatic plants in Nepal.

Chapter 14
Impact of Migration and Remittances on Agriculture: A Micro–Macro-analysis

Amina Maharjan and Beatrice Knerr

Abstract The chapter reviews the impact of migration and remittances on crop yields, labour use in agriculture, land use, as well as macro-level impacts (impact on tradeables and non-tradeables, grain imports, etc.). It also makes policy recommendations for the use of remittances for productive investment in agriculture, particularly food production.

1 Introduction

Migration and labour mobility are traditional livelihood strategies among the Nepalese people, in particular for smallholder families. Nepal is still an essentially agrarian economy, with the agricultural sector contributing 34% to its gross domestic product (World Bank 2017) and engaging an estimated 73% of its labour force according to Nepal's latest labour force survey (CBS, 201X). In the twenty-first century, Nepal's agriculture still has remained essentially subsistence-oriented, and it is increasingly challenged by the impact of climate change, which disproportionately affects mountain agriculture and gives a further push to out-migration (IPCC 2013). With increasing globalization, economic liberalization and the fast development of road infrastructure and communication technologies, even people in most remote villages are now connected to the outside world and thus have become aware of the life beyond their restricted communities, resulting in higher aspirations, particularly among the youth. Also, with the monetarized economy penetrating each corner of the country, maintaining a decent life without cash income has become difficult. Hence, alternative income sources, in addition to subsistence farming, are increasingly necessary. However, under the conditions of sluggish industrial growth,

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G. Thapa et al. (eds.), *Agricultural Transformation in Nepal*,
https://doi.org/10.1007/978-981-32-9648-0_14

local opportunities for earning cash income can hardly be found in the countryside, and people are often left with little choice than to leave their villages, for urban centres in the country or foreign destinations. Once migration has started off in a community, it usually accelerates over time with the strengthening of trans-local social networks (Maharjan 2010).

Nepal's population census records the absent population since 1961. It remained below 3.5% of the total population until 2001 and then showed a fast rise to 7.3% in 2011; i.e. it has more than doubled within one decade. At the same time, the destinations diversified significantly. While in 1981 India hosted more than 90% of Nepal's international migrants, this share had dropped to just 38% in 2011 (CBS 2014). Migration to India has been mostly seasonal, and due to the long land border between both countries share and an arrangement of free movement of people between them, migration to there can be entirely informal. Migration of low-skilled workers—who constitute the vast majority of Nepal's international migrants—to other countries usually lasts for two to three years, and it requires lengthy processes to organize it, which makes it more expensive. At the same time, the returns from such migration are also higher, yet, which in turn contributes to facilitate internal migration: with increased household revenues, parts of or whole families leave the villages for nearby urbanized centres to find more favourable living conditions and better education opportunities for their children (Sunam and Goutam 2015; Poertner et al. 2011).

The increasing out-migration of labour force from and inflow of remittances to rural areas has significant implications for the agriculture sector, via changes in the availability of labour, the gender division of work, decision-making processes, investments, continuation of subsistence farming and ultimately the capacity of the households to perform farming activities. This occurs in the middle of a fragile agricultural sector, dominated by subsistence farming, where commercial farming is restricted by land fragmentation; rough geophysical conditions; insufficient and unreliable availability of inputs; inadequate access to capital and credits; the absence of irrigation facilities; poor access to modern technologies; and lack of technical support (USAID 2017). Our focus in this chapter is to investigate the implications that migration and remittances have on the agriculture sector at the micro- as well as macro-level. By this, we go beyond the level of case studies—of which an increasing number is available and provides valuable, although sketchy and scattered information—and include the impact on the macro-level of economic development.

2 Impact of Migration and Remittances on the Farm Level: Facts and State of Research

The impact of out-migration on Nepal's farm sector works via two interrelated ways: the outflow of labour force and the inflow of remittances. Usually, in the framework of economic analysis with regard to remittances, financial transfers are in the foreground, but also remittances of human and social capital are relevant and increasingly coming into the focus. Yet, our paper will largely concentrate on financial remittances as the most influential ones in the present context but occasionally we will also refer to other forms where appropriate.

With the growing number of people migrating from Nepal to other countries, providing net financial benefits to the workers, remittances are received by their left-behind households and thus Nepal's economy as a whole has also expanded. Over the early twenty-first century, remittances have become a major source of income to many households, and the country's major source of foreign exchange. Between 2000 and 2015, their flow increased from 111 million US$ to almost seven billion US$, pushing the share of remittances in the country's gross domestic product steeply upwards (see Fig. 1) and exerting a deep influence on its economic and social development. According to Nepal Living Standards Survey (NLSS) of FY 2010/11, 55.8% of the households received remittances, including two-thirds of those in Terai and half of those in the hill and mountain regions, at an average amount of NPR 80,436 p.a.[1] per household (NLSS 2011), with more than 80% coming from abroad. The question of how these international remittances influence poverty, food production, labour allocation and farm investment, especially among smallholder families, has been investigated via household-level case studies by numerous authors, with mixed results. In this section, we present the outcomes of several of the studies (including those by the authors).

One of the major negative consequences of labour out-migration for agricultural production probably is the loss of labour force, depending on the individual farm situation. Labour requirements in agriculture are seasonal in nature, implying higher demand during planting and harvesting periods, and lower requirements in between. In Nepal, widespread labour shortages, particularly in peak seasons, are reported nationwide, entailing delays in planting, neglect of intercultural operations (weeding, hoeing, etc.), declining land productivity and abandonment of farming. It also influences the wage rates. The NLSS 2010/11 reports that the agricultural sector's share in national wage employment decreased from 53% in 1995/96 to 35% in 2010/11 while the nominal daily wages in the agricultural sector increased by more than the fourfold (from NPR 40 to NPR 170) whereby the rate of wage increases has been higher for male than for female workers (CBS 2011). This national trend is confirmed by various case studies such as Sunam and Goutam (2015), and it is attributed to the boosting out-migration of males.

Since 2001, massive out-migration of rural youth has dramatically changed the rural landscape, in particular in the mid-hills of Nepal (Paudel and Adhikari 2010; Adhikari and Hobley 2011). A meso-level study by Paudel et al. (2016) in the Koshi River basin reported a reduction in cropland in the basin by more than 9000 ha between 1992 and 2010, emphasizing international labour migration as one of the decisive factors contributing to reduction in cropped land.

[1]The exchange rate between the NPR and US$ (buying of US$) was 100 NPR for 9.25 US$ in October 2016.

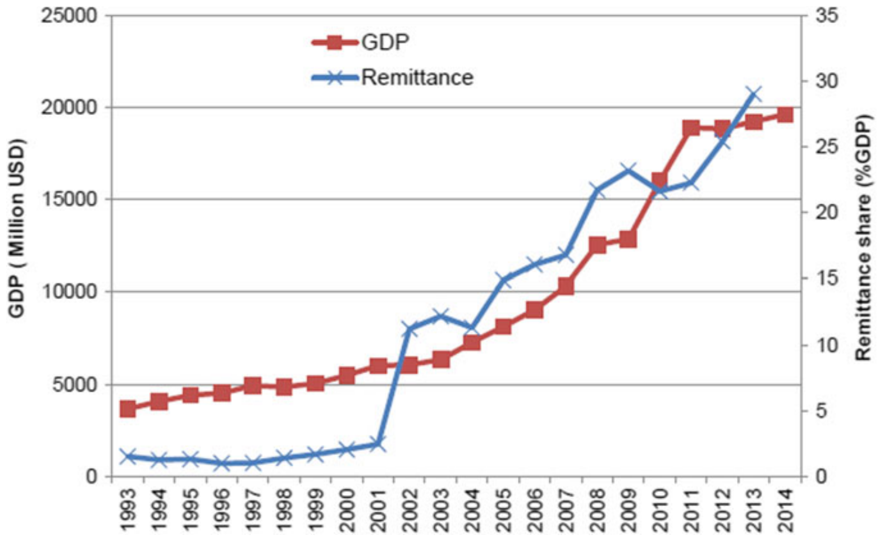

Fig. 1 Remittances inflow to Nepal and share of gross domestic product. Source: Based on World Bank (2016)

Similarly, a study in Jhapa district conducted by IOM and submitted to FAO 2010, found that 30–35% of the total arable land either remained fallow or was occupied by plotting land for housing as a result of rapid urbanization. Similarly, Paudel et al. (2014) when investigating four mid-hill districts found that 18% of the total arable land was abandoned in Kavre, 28% in Lamjung, 378% in Parbat and 19% in Pyuthan which is almost the double of the findings of earlier studies conducted in different locations of the region (Malla 1992; Khanal 2002; Khanal and Watanabe 2006). In another study, Jaquet et al. (2015) reported that due to the high level of male out-migration in the hills of Kaski district almost 22% of the cropland area had been abandoned, indicating a lack of incentives to transform subsistence to commercial farms. Similar results are reported by Fox (2016), Pandey et al. (2016) and Gautam et al. (2004).

Khanal and Watanabe (2006) found that the increasing trend of out-migration has reduced the agricultural labour force, also through less involvement of children in farm work as migrant families allocate a higher priority to their education as compared to their contribution to household and family work (Maharjan et al. 2012; Nepal 2013). Child labour on farms is still a common phenomenon in Nepal, particularly in livestock caring, where often the children are responsible for feeding, watering and grazing. But with increased remittances, parents tend to reduce children's labour duties and instead prefer their offspring to concentrate on their studies. Removal of children from farm and household work is positive for their future income earning capacities and for overall human capital formation in the country, but it has short-term negative implication on the households' labour availability, as the work formerly done by children is now taken up by elders or not carried out at all, and thus may depress the livestock and farming capacities.

Nepal's population census of 2011 reports that 87% of the country's absentees are men (CBS 2012), thus skewing the gendered labour availability at household as well as community level (Adhikari and Hobley 2011; Maharjan et al. 2012). So, even for hiring external farm labour, usually more women are available than men, leading to a feminization of agricultural work with a negative impact on specific operations, which—because of advantages of physical strength or due to tradition —, are performed rather by male household members, such as ploughing. Although, as shown in Maharjan et al.'s (2012) study, there is a gradual change in the gendered farm labour division, taboos attached to certain types of work such as ploughing still persist. Nevertheless, male out-migration has enhanced the overall responsibilities of women in farming, as indicated by the fact that the number of female-headed households has significantly grown between the two population censuses of 2001 and 2011. This, however, is not matched by women's access to information, technology, finance and competencies, resulting in feelings of being more burdened by the new situation rather than empowered (Maharjan et al. 2012; Gartaula et al. 2012). Altogether, investigations about additional workloads of women in migrant households show mixed results, whereas Gartaula et al. (2012) report that migration has added to their workload, and Maharjan et al. (2012) from their study in Syangja and Baitadi report that this is contingent on the amount of remittances received by the household, with the workload declining with increasing amounts of remittances received.

Other studies are pointing to investment of remittances into the farm sector, particularly for purchasing land. Regmi and Tisdel (2002), studying a group of Nepalese rural-to-urban migrants from Dhanusha district (Terai), found that remittances were spent primarily on household expenditures, education of relatives and financing farm assets. Within the three years prior to the investigation, 28% of the remittance-recipient households had purchased land, while just 13% of the non-recipient households had done so. A majority of the receiving households reported that they had bought it for agricultural purposes, in contrast to the often-found perception that such households spend the received remittances on purchasing "*ghaderi*", i.e. small plots exclusively designed for building a house. Similar results are reported by Sunam and McCarthy (2016) in their study in Sunsari district (Terai) where about 40% of the migrant households who previously had been landless had used remittances to purchase farmland for food production. A study by Nepal Rastra Bank (2012) also found that households experienced a substantial rise in farm income after having started to receive remittances, indicating that they increased their landholding, invested in productivity-enhancing technologies or assets, and/or embarked on producing cash crops. In this context, it is important to note that the information about households' investment into farmland as such does not allow drawing conclusion about the implications for total agricultural production, respectively food supply, in the whole country; for that purpose it would be necessary to know details about the former holders' production on that land.

Studies investigating the impact of migration and remittances on food production have also found mixed result. Based on cross-sectional national household data, Tuladhar et al. (2014) revealed a negative effect of out-migration on farm yields, and that—in spite of increased incomes—remittance-receiving farm households did not demonstrated improvements in agricultural productivity. They thus point to two important trends: first, migration tends to adversely affect farm yields by stiffening labour shortages in the sector; secondly, remittance-receiving households are hardly inclined to spend them on productivity-enhancing agricultural investments. Also, Maharjan et al. (2013) found that the loss of labour force by out-migration is not compensated by farm investment out of remittances; instead, they revealed an overall negative impact on crop production.[2] Yet at the same time, there was a positive impact on livestock husbandry which could be explained by the fact that in Nepal livestock is considered as a comparatively liquid form of capital that can be sold for cash when this is necessary to meet basic requirements of the households. Similarly, a study conducted by the International Water Management Institute (2014) in the highly fertile Indrawati and Pankhu sub-basins (both in the Hill region) showed mixed results with regards to the of impact of migration on food production. In Pankhu, located in Okhaldhunga district, in spite of high rates of out-migration the overall agricultural productivity was significantly higher than in the rest of the communities, whereas in Indrawati agriculture was largely neglected. Both sub-basins have canal and pond irrigation facilities, but the willingness of the remaining family and household members in maintaining the irrigation infrastructure were different. In Pankhu, there was a general interest to maintain agricultural infrastructure but in Indrawati the community's engagement was highly divided. The report concludes that the interest in and the impact on agriculture, in addition to the migration decision also depend on the presence of agricultural infrastructure, the profitability of farming, the availability of other economic options, the social cohesion and other factors. For instance in one of the study sites, in spite of high out-migration, the community stick together in its interest to invest in maintaining the agricultural infrastructure.

Financial and social remittances earned from migration if invested in new technologies and innovation can improve the household economy through a more profitable farming system. Thus, they can potentially support agricultural development in rural economies, in particular since, as a result of the migration experience with other cultures and new technologies, migrant households tend to be more open to innovative changes (Firdaus et al. 2010). For example, a study by Pandit and Paudel (2014) in Chitwan (Terai) demonstrates that the adoption of novel agricultural technologies increases with the amount of remittances received. Similarly, another study conducted in Chitwan Valley (Terai) by Bhandari and Ghimire (2016) revealed a positive relation between agricultural mechanization,

[2]Similar results of investment behaviour of remittance-receiving households in South Asian migration pockets have been observed by Pohle (2014) in the Indian state of Kerala, by Khan (2007) in Pakistan and others.

particularly tractor use, and individual out-migration, independent of variations in communities, households and individual-level factors which influence migration. One of the most obvious impacts of out-migration is the loss of farm labour, which might be substituted by mechanization, studies that farm households adopt enhanced mechanization to overcome the migration-induced labour shortages.

Gartaula et al. (2014) in their study in Jhapa district (Terai), which is highly fertile and suitable for rice cultivation, found a direct relationship between remittances and the introduction of lift irrigation through electric water pumps. Remittance-receiving households had invested in pump irrigation allowing them two rice harvests per year instead of only summer rice. ADB (2014) using a cross-sectional data set of NLSS (2011) found that the use of chemical fertilizers tends to be higher among migrant than non-migrant households, suggesting that either remittances were utilized to buy chemical fertilizers or they released other financial resources which could then be used for that purpose.

Anecdotal evidence shows investment of remittances in small-scale commercial agriculture. In the peri-urban areas of Kathmandu Valley, since the mid-2000s, commercial farming activities are generally expanding. According to the authors' personal communications, returned migrants, who in their host countries had been working in the farm sector, particularly in Israel and South Korea, have brought back technologies used there and on that basis started up their own commercial livestock and vegetable cultivation.

As reported by the World Bank (2013), based on interviews among 303 returned migrants, just 43% have either invested in existing businesses or started new ones. Returnees turned out to be more likely to invest remittances brought back with them on starting a new business, whereas remittances sent home during the migrant's absence are rather invested in already existing businesses. Maharjan et al. (forthcoming) also deduct similar findings in their study about the re-integration of returnees into the village economy. Still, both studies recognize that remittances have the potential to encourage entrepreneurship at the household level by providing start-up capital. World Bank (2006) data on Nepal show a positive relationship between the inflow of remittances and business ownership: almost half of the youth surveyed either had invested in a business (new or already existing) or were at least considering it.

In her impressive study among migrants' households in the mountains of Nepal, Wasti (2017) found that, although almost all of the surveyed households were involved in some form of agriculture and/or livestock keeping, only 17% had invested remittances for such purposes. Moreover, the share spent on that decreased with increasing remittances received. The greatest hindrance to investments, as expressed by the households was the obligation to pay back the loans which they had taken for financing the migration of their household member. The major farm investments undertaken were on fertilizers, tools and improved seed varieties for staple crops and commercial vegetable farming. Expenditures on livestock were mostly for cattle, goats and poultry feed, and on shelter constructions.

Adhikari and Hobley (2011) in their study among farmer in Khotang (hill) showed that remittances help to shift from subsistence maize-based farming to cash crops such as cardamom, vegetables or tomatoes as remittances serve as co-insurance against the risks of such a transition. They also found that farmers closer to the market centres tended more to invest their remittances into small-scale commercial livestock than those further away.

In addition to financial remittances, labour migrants may bring significant new knowledge and social remittances in terms of ideas, practices, mindsets, attitudes, norms of behaviour and experiences from their host countries (Mohamoud and Fréchaut 2006) which can potentially support investment in education, land and small business.

Nepal is highly dependent on cereal imports from its neighbouring countries for covering its requirements including traditional cereals such as maize and millet. They reach new records every year. While on the one hand food imports are increasing, on the other hand the share of farm income in total household income has dropped from 61% in FY 1995/96 to 28% in FY 2010/11 (CBS 2011). Among the factors causing this trend is the declining engagement of young people in smallholder farming. In fact, the major regions of origin of international migrants are in the country's "cereal basket", the Terai district. Large number of younger men opting for labour migration rather than smallholder farming has resulted in large areas of land-falling fallow. A study conducted by ADB (2014) suggests that for each additional labour migrant leaving the farm household a loss of about 163 kg of paddy occurs. In fact, monetary productivity of farm work hardly compete with the wages paid in other sectors of the economy and even less with what a person can earn abroad.

Based on the micro-level studies, various ways of influence of migration and remittances on farming decisions and practices at household level have been highlighted. But from this moderate number of farm-level studies—although they demonstrate robust results—it is difficult to get a clear picture about the impact of migration on food production as the findings are context-specific and partly contradictory. Moreover, secondary effects of labour out-migration and remittances are completely neglected in such studies. So, as mentioned above, land purchases by migrants' households might enhance the food production of their respective farm, but at the same time it probably reduces the food output of the selling household, whereby the net effect remains open. Moreover, multiplier effects of remittance spending which might vary considerably depending on the expenditure categories are not captured by single-household considerations. Thus, in order to better understand the overall impact, a macro-level investigations are required. This is shown in the following section.

3 Impacts at the Macro-level

Overall, the implications of Nepal's remittance boom on the macro-level development are not well understood, although a number of studies have dealt with economy-wide growth effects in the country (Sapkota 2013). Even less is known about the macro-level impact of remittances on the agricultural sector, although it accounts for one-third of the country's gross domestic product.

Our macro-level impact assessment is grounded in the Dutch Disease model which in its basic ideas focuses on the implications which a large-scale inflow of foreign exchange into sectors exporting natural resources and raw material (i.e. goods which are not processed domestically) bears on the receiving economy mainly via exchange rate effects (Ismail 2010). This situation is quite similar to the "export" of labour force and the associated inflow of foreign exchange in the form of remittances. In this case, too, foreign exchange is flooding the country without inducing direct forward or backward linkages and, in addition, it is associated with an outflow of labour force which—as shown in the previous section of our paper—diminishes the country's productive resources and may lead to growing labour scarcity and upward pressure on wage rates. In fact, such a development has been evidenced in numerous low-income countries receiving considerable amounts of foreign exchange from international labour migrants (see Knerr 1997, 2008), including in particular South Asian countries (Knerr 1990).

The effects of remittances on the development of the agricultural sector occur through the *spending effects* and the *foreign exchange effect*. Through the spending effect, the remittance-receiving households' additional purchasing power is directed towards various product groups which for our purpose are categorized into non-agricultural products, agricultural tradeables and agricultural non-tradeables. This includes the direct spending (first round spending) by remittance-receiving households as well as the indirect spending (second and later round spending) by those who receive the migrant families' money. As Nepal is a low-income country, it can be expected that a significant share of the additional income received is spent on food, i.e. agricultural products, while still "Engel's law may hold (saying that income elasticity of demand for agricultural products is declining with increasing income).

At the same time, with the inflow of remittances" in form of, an exchange rate effect occurs: the exchange rate of the domestic currency tends to appreciate as the demand for it increases. This makes domestic products more expensive as compared to imports and also more expensive on the world market where, as a result, they lose competitiveness, giving imports an advantage on the domestic market and exports a disadvantage abroad.

Moreover, the real exchange rate—i.e. the relationship between the prices of non-tradeables and those of tradeables—in the remittance-receiving country declines, shifting the economy into a production structure skewing in favour of non-tradeables as—not being confronted with foreign competition—this sector draws productive resources out of the tradeable sectors which are faced with stagnating or declining demand. This effect can be aggravated by increasing out-migration of labour which leads to tighter labour scarcity and increasing production costs, making imports even more competitive and exports less competitive on the world market.[3]

[3]For the Nepalese economy as a whole, Dutch disease effects caused by remittances were considered by Sapkota (2013).

We will test the hypotheses deduced from this model that (a) the demand for imported agricultural tradeables is positively related to the inflow of remittances; (b) the production of domestic agricultural tradeables is negatively related to remittances; (c) the domestic production of agricultural non-tradeables is positively related to the inflow of remittances.

For that purpose, we ran double-log regressions, providing information about the percentage change of the dependent variables in reaction to a one-per cent change of the independent variables. As dependent variables, we chose various agricultural products (domestic and imports, in quantitative and value terms) as explained in detail below, and as independent variables the inflow of remittances (indicating at the same time the outflow of migrant labour), and as control variable the inflow of foreign exchange by foreign aid as another major source of foreign exchange in Nepal's economy. The analysis was done using the software package Stata. We applied the Breusch–Pagan/Cook–Weisberg test for detecting heteroskedasticity and could not find any hints to it. Also, by applying the Wooldridge test, we did not find any hints to collinearity, except for slight collinearities with regard to the multiple impact on agricultural production with time lag 1 (with vif = 10.99) and time lag 2 (with vif = 11.04) (Table 1), but they are small enough to not cause problems for our analysis.

We use cereals as indicator for agricultural tradeable products and as proxies for non-tradeable agricultural products a composite index vegetable and—for lack of immediate data—the import of animal feed as indicator for meat production. We further assumed that Nepal effects its foreign trade in terms of US$ and that also remittances enter the country in terms of US$, and so we can base our calculations related to remittances, exchange rate effects and foreign trade in US$.

Table 1 shows the double-log regression output of two sets of equations which measure the impact of Nepal's main sources of foreign exchange (remittances, export of goods and services, development aid and foreign debts) on total gross domestic product and on total agricultural production, in the same period as well as with time lags of one and two years. Obviously, as expected, remittances have a significantly positive impact on the country's overall economic growth, which is still strongly felt two years after the respective inflow. Regressing on agricultural production shows a slightly positive but still significant impact in the period of the remittances inflow with an elasticity of 5.8% (i.e. a 10% increase in remittances brings about 6% of growth for the agricultural sector); afterwards, no positive effect is demonstrated at all.

Disaggregating the agricultural sector in order to assess Dutch disease effects shows a different picture (see Fig. 2): Nepal's grain imports surge with the inflow of remittances and almost parallel to them in most of the years, while the domestic production of domestic tradeables declines and that of non-tradeables increases with the inflow of remittances. These results support our hypotheses as deduced from the Dutch disease model.

Table 1 Impact of workers' remittances on the Nepalese economy—elasticities with respect to workers' remittances

Dependent variable	Time lag	Independent variables				R^2
		Remittance	Export of goods and services	Development assistance and aid	Foreign debts	
Gross domestic product	0	0.214*** (6.800)	0.775*** (3.660)	−0.335 (−1.43)	−0.499 (−1.790)	0.97
	1	0.214*** (7.230)	0.810*** (4.08)	−0.174 (−0.800)	−0.373 (−1.430)	0.97
	2	0.219*** (8.600)	0.878*** (5.130)	−0.074 (−0.390)	−0.254 (−1.130)	0.98
Total agricultural production	0	0.059** (2.79)	0.074 (0.44)	0.140 (0.880)	−0.950*** (−4.750)	0.98
	1	0.027 (1.140)	0.200 (1.060)	−0.084 (−0.470)	−1.121*** (−4.970)	0.97
	2	0.007 (0.190)	0.173 (0.600)	−0.050 (−0.180)	−1.104*** (−3.230)	0.94

***Significant at the 0.01 level. **Significant at the 0.05 level. *Significant at the 0.10 level
1. Definitions of the aggregates used can be found at World Bank (2017). Data. Metadata Glossary. http://databank.worldbank.org/data/glossarymetadata/source/3690/concepts/series
2. Figures in parentheses indicate t-test results
Source Authors' calculations with data from World Bank (2016)

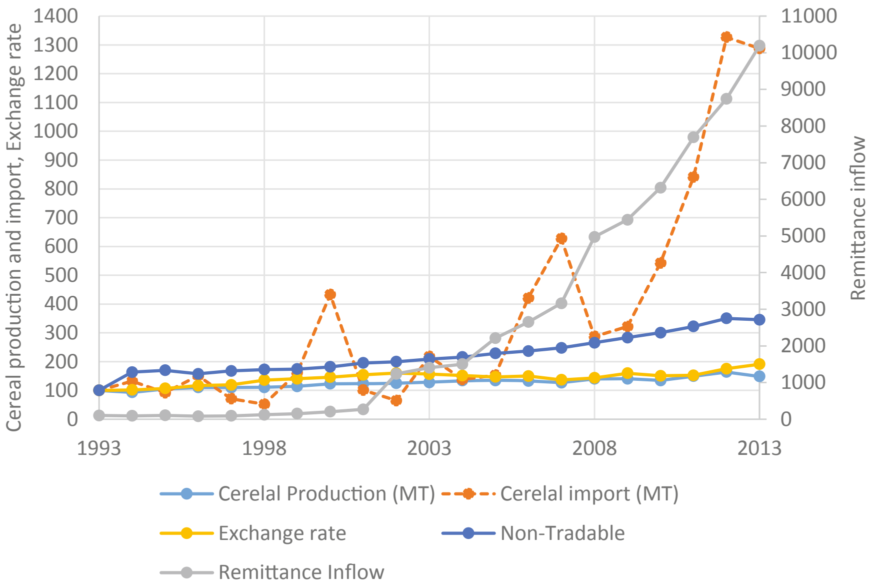

Fig. 2 Remittances inflow, exchange rate, cereal production and imports, and production of non-tradeables in Nepal (indexed by 1993 = 100)

Tables 2, 3, 4 and 5 show the results of our regression analysis related to hypotheses (a) to (c).[4]

Table 2 shows the results of the test if the demand for imported agricultural tradeables is positively related to the inflow of remittances, by focusing on the country's major staple food imports maize, rice/paddy, potato and wheat. All of the coefficients support our hypothesis, although with a different strength with regard to different time lags. Maize shows a highly significant coefficient of 2.47 in period 0, and a significant one of 1.5 after a one-year time lag, while the lower coefficient of 1.23 after two periods is not significant. Also, R^2 is declining from 85% in period 0 to 24% in the lagged period 2. The significant reaction of rice/paddy imports to the inflow is lower and restricted to period 0, with an elasticity coefficient of just 0.73 and an R^2 of only 0.46. Potato imports, in contrast, are highly significantly related to remittance inflows in the first two periods (with 0.86 and 1.09), while wheat imports—surprisingly—show a significant reaction only after two periods, and this is a negative one (-1.45). At the same time, wheat imports are the only category, which shows a significant relation with the inflow of foreign aid, which takes place in period 0.

The relatively high and significant reaction of maize imports (value) should be ascribed to its increasing use in poultry and other animal feed (which at the same time could be interpreted as an indicator for the expansion of the non-tradeable category "meat" for which no reliable database has been available).

In contrast to import values, the import quantities display less significant coefficients. What is striking in this context, however, are the significanty contrasting results for maize imports after a one-year time lag: while the import values show a positive coefficient of 1.508, the import quantities display a negative one of −3.015 which could point to a strongly price-enhancing effect of additional demand for maize. The seemingly contradictory outcomes become clearer when considering them in the context of the development of international (corn) prices: they are closely related to the international production of biofuels which—in turn—are partly determined by the oil prices. Over the period considered, both energy prices have strongly increased, pulling the corn prices with them (Wisner 2009, 2014), although they plunged again for some time in late 2013 (see USDA 2016).

Potato imports react highly significant in periods one and two (value) and period three (quantity). This is to be considered together with the reaction of potato production (quantities) (Table 4), which is highly significant for all laged periods, with an overall R^2 of more than 90%. This is explained by the fact that potato is an important cash crop in Nepal, giving it characteristics of a non-tradeable, and hence domestic demand and supply are expected to strongly react to the inflow of

[4]We had tried "population growth" as instrumental variable, but the instrumentation gave an F value <5 in most of the cases. In the regression result, the population (log of total population) did not show up with any usable result. The F test result is quite low 2.05. Hence, with this information, in most of the case the results are the same.

Table 2 Import values and remittances

Dependent variables	Lag period	Remittance	ODA[a]	Constant	R^2
Maize (corn)	Period (0)	2.476*** (7.16)	−0.860 (−0.42)	9.229 (0.29)	0.85
	Period (1)	1.508** (2.25)	1.488 (0.38)	−25.220 (−0.41)	0.39
	Period (2)	1.237 (1.77)	−2.069 (−0.5)	31.662 (0.49)	0.24
Rice/paddy	Period (0)	0.738** (2.8)	0.046 (0.03)	2.081 (0.09)	0.46
	Period (1)	0.087 (0.25)	1.176 (0.57)	−13.815 (−0.43)	0.049
	Period (2)	0.326 (1.04)	0.399 (0.22)	−2.363 (−0.08)	0.12
Potato	Period (0)	0.859*** (4.67)	−0.751 (−0.7)	12.899 (0.76)	0.69
	Period (1)	1.099*** (5.42)	−1.187 (−1)	18.826 (1.01)	0.75
	Period (2)	0.467 (1.34)	0.426 (0.21)	−4.846 (−0.15)	0.18
Wheat	Period (0)	−0.361 (−0.57)	−8.586** (−2.31)	138.258** (2.37)	0.42
	Period (1)	−0.996 (−1.71)	−4.887 (−1.43)	81.544 (1.53)	0.42
	Period (2)	−1.455** (−2.38)	−2.669 (−0.75)	48.067 (0.86)	0.45

Database for remittances and official development assistance from World Bank (2016); database for agricultural products from FAO (2016)
Source Authors' calculations
[a]Net official development assistance

remittances. Without credit constraints which might be eased by the inflow of remittances, farmers would be motivated and will tend to venture more into potato cultivation rather than wheat, rice or maize, crops which (considering the overall transportation costs and perishability) are under stronger competition from the world market. Yet, due to comparatively high production requirements in terms of fertilizer, frequent agronomical operations and labour, farmers need some capital in advance for potato production.

The production of domestic agricultural tradeables is negatively related to remittances. Wheat production reacts highly significantly negative to the inflow of remittances, which is in line with the fact that wheat is tradeable and the international wheat market is well established.

Table 3 Import quantities and remittances

Dependent variables (import quantity)	Lag period	Remittances		ODA[a]		Constant	R^2
		Period (0)		Period (0)			
Maize (corn)	Period (0)	1.690** (2.53)		−2.750 (−1.41)		60.288 (2.23)	0.945
	Period (1)	−3.015** (−3.15)		−1.075 (−0.39)		−37.653 (−0.97)	0.884
Rice/paddy	Period (0)	−0.325 (−0.55)		1.034 (0.6)		−6.622 (−0.27)	0.696
	Period (1)	−0.340 (−0.48)		1.868 (0.91)		−59.118* (−2.07)	0.523
	Period (2)	1.773*** (5.12)		3.255** (3.23)		−41.578 (−2.96)	0.861
Potatoes	Period (0)	0.180 (0.4)		−0.720 (−0.54)		31.316 (1.69)	0.783
	Period (1)	−0.188 (−0.5)		−3.436** (−3.12)		45.986** (3)	0.893
Wheat	Period (0)	−0.359 (−0.17)		−5.630 (−0.92)		111.91 (1.32)	0.182
	Period (1)	−1.365 (−1.07)		−8.490* (−2.28)		155.51 (3)	0.608

Database for remittances and official development assistance from World Bank (2016); database for agricultural products from FAO (2016)
Source Authors' calculations
[a]Net official development assistance

The reaction of fresh vegetable[5] production in terms of quantity—an essentially non-tradeable category—strongly supports our hypothesis, with highly significant coefficients of more than 0.2 and R^2s of around 80% in all lag periods. This does not apply to the production value, however, most probably due to a weak data basis with regard to vegetable prices.

Referring to the other non-tradeable categories, the import of corn (used as animal feed) could be considered as an indicator of significantly increasing meat production in reaction to the inflow of remittances.[6] The relatively high and significant reaction of maize may be ascribed to its increasing use in poultry feed and other animal feed (which at the same time could be interpreted as an indicator for the expansion of the non-tradeable category "meat" for which there is no reliable database available).

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[5]Data are from FAO, the composition of this category is not specified in detail. This data row was the only officially available one and complete data set retrievable for our purpose.

[6]Another important non-tradeable category to include into the analysis would have been fresh milk. However, no reliable data rows were available for that.

Table 4 Production value of non-tradeables and indicators of non-tradeables, domestic production of staple food and remittances

Dependent variables (production value)	Lag period	Remittance	ODA[a]	Constant	R^2
Fresh vegetables	Period (0)	0.002 (0.06)	0.511** (2.23)	1.939 (0.52)	0.281
	Period (1)	0.005 (0.18)	0.085 (0.37)	8.474** (2.24)	0.0084
	Period (2)	0.034 (1.74)	0.146 (0.92)	7.092** (2.72)	0.16
Potato	Period (0)	0.074* (1.82)	0.509 (1.55)	0.625 (0.12)	0.197
	Period (1)	0.067 (1.62)	0.318 (0.95)	3.687 (0.67)	0.143
	Period (2)	0.047 (1.01)	0.277 (0.74)	4.681 (0.77)	0.065
Wheat	Period (0)	−0.108*** (−3.53)	0.260 (1.05)	7.136* (1.76)	0.58
	Period (1)	−0.094*** (−3.59)	0.412** (1.96)	4.611 (1.33)	0.65
	Period (2)	−0.091*** (−3.38)	0.310 (1.43)	6.161 (1.74)	0.59
Rice/paddy	Period (0)	−0.192*** (−4.38)	0.376 (1.07)	7.770 (1.34)	0.67
	Period (1)	−0.169*** (−3.82)	0.261 (0.73)	9.236 (1.58)	0.59
	Period (2)	−0.128*** (−3.16)	0.730** (2.26)	1.395 (0.26)	0.64

Database for remittances and official development assistance from World Bank (2016); database for agricultural products from FAO (2016)
Source Authors' calculations
[a]Net official development assistance

4 Conclusions and Policy Recommendations

A key challenge for Nepal as a highly remittance-dependent and at the same time food-importing low-income agrarian economy is to attract productivity-enhancing investments into the farm sector, whereby remittances entering directly into smallholder households have a high priority on the policy agenda of the government as well as for international development organizations and non-government organizations concerned with the country's poverty alleviation and food security. At the same time, investment in farm is considered as a way out of large-scale unemployment and hence out-migration of young people. In 2016, the UN, for example, complained that a "too small" share of the remittances has been spent for investment in productive sectors could create avenues for breaking the migration

Table 5 Remittances and domestic production quantities

Dependent variables (production quantities)	Lag period	Remittances	ODA[a]	Constant	R^2
Fresh vegetable	Period (0)	0.226*** (10.9)	0.129 (0.69)	8.844** (2.86)	0.8875
	Period (1)	0.219*** (9.78)	0.071 (0.35)	9.826*** (2.94)	0.8656
	Period (2)	0.208*** (8.86)	0.072 (0.34)	9.943** (2.85)	0.8407
Potatoes	Period (0)	0.264*** (14.74)	−0.072 (−0.45)	11.208*** (4.21)	0.9383
	Period (1)	0.271*** (14.17)	−0.025 (−0.14)	10.273*** (3.61)	0.9327
	Period (2)	0.273*** (12.9)	−0.074 (−0.39)	10.956*** (3.48)	0.9209
Wheat	Period (0)	0.126*** (10.34)	−0.198** (−1.79)	15.210*** (8.34)	0.8927
	Period (1)	0.133*** (9.52)	−0.124 (−0.98)	13.895*** (6.69)	0.8696
	Period (2)	0.136*** (9.87)	−0.233** (−1.87)	15.534*** (7.57)	0.8849
Rice/paddy	Period (0)	0.040*** (3.79)	−0.199** (−2.1)	17.747*** (11.41)	0.6181
	Period (1)	0.048*** (4.06)	−0.353*** (−3.3)	20.031*** (11.38)	0.7085
	Period (2)	0.056*** (5.05)	−0.171 (−1.71)	17.014*** (10.33)	0.6977

Database for remittances and official development assistance from World Bank (2016); database for agricultural products from FAO (2016)
Source Authors' calculations
[a]Net official development assistance

cycle and contribute to stimulate Nepal's economy (UN 2016). At the same time, it is demonstrated that the inflow of remittances is conveying important growth effects on the economy, and significantly contributes to poverty reduction. Our survey of household-level case studies as well as macro-level investigation shows, however, that also adverse drawbacks in terms of decline of production and deformation of the agricultural sector prevail which might particularly bear out their adverse consequences in the longer term.

Various localized studies have arrived at mixed results with regard to the impact of migration on the agricultural sector. Considering the details, some general trends can be carved out yet. In particular, it becomes obvious that the younger generation is less and less inclined to engage in subsistence farming. Mainly, two circumstances shown in our investigation are supporting this trend: first, attractive payments abroad, and secondly the loss of competitiveness of domestically produced agricultural tradeables. On the other hand, where there is an enabling environment, including roads, markets and financial funds, people perceive farming as an attractive income-generating venture. This is particularly true with regard to non-tradeable products,[7] such as meat and fresh vegetables, which, in addition to being under less pressure from the world market, also enjoy a comparatively high-income elasticity of domestic demand which bears out in a growing remittance economy. Hence, even at a small scale, farmers chose to produce commercial cash crops such as vegetable as well as livestock rather than cereal crops.

Though in the short-run migration and the ensuing remittances help improve the food security requirements of individual households (Maharjan et al. 2010), their long-term positive impact on food security is questionable, on the household as well as on the national level. Being mostly a mountainous country with fragile road infrastructure, high dependence on food imports for meeting the population's food security could be a challenge. For an agrarian economy leaving arable land resources underutilized—which is a frequent consequence in migrants' households—may imply adverse implications for long-term food security.

Obviously, large-scale remittance inflow triggers a distorted structure of the agricultural sector, biased towards non-tradeable products. The domestic production of tradeable crops—which in fact constitute the major basic staple food in the country) tends to decline due to a loss of competitiveness twoards growing imports as the sector is prone to Dutch disease symptoms. Yet, in spite of the noticeable long-term risks to which Nepal's remittance-dependent and skewed economy is exposed, it is hardly possible to sterilize the negative exchange rate effects remittances bear on the competitiveness of domestic tradeables. For Nepal as a WTO member it is difficult to impede imports by imposing tariff for making them more expensive and less competitive on the domestic market. Also, supporting the domestic production by state subsidies is not practical for a low-income country like Nepal with a huge farming population. In addition to being dependent on remittances for gaining foreign exchange, the country is becoming increasingly reliant on food imports which eat up a considerable part of these gains of foreign exchange. Against that background, the government, as well as foreign donors, should make strong efforts to strengthen the domestic sector's competitiveness in particular by productivity-enhancing programs, such as the introduction of modern production technologies, extension services and training of farmers, focusing on the output of staple food, in particular cereals, as well as high-value cash crops, in particular non-tradeables, like fruits, vegetables and animal products which in some areas of Nepal have a comparative advantage in production, and meet farmers' interest to invest in such production segments. As the production of these commodities usually is labour-intensive and labour shortage is a wide-spread effect of migration, selective mechanization, like small tractors and irrigation facilities, would deserve special attention for that purpose. Also, male out-migration changes the gender roles and responsibilities with women playing an increasingly important

[7]Including products which are relatively difficult and/or expensive to trade under the given circumstances.

role in agriculture. Therefore, promoting technologies that mitigate women's workload burden, as well as policies their access to credits and inputs would be useful. However, for channelling remittances into farm investments, interventions into the agricultural sector alone are not sufficient. In addition, there is an urgent need for interventions to make labour migration more beneficial to the migrant households. This could be achieved, for example by increasing the returns via skills trainings as pathways to higher wages, so that the migrant households could accumulate higher savings and invest them in productive activities, particularly in the agriculture sector.

References

Asian Development Bank (ADB). (2014). Effects of migration and remittance income on Nepal's agriculture yield. South Asia working paper series No. 27. Manila.

Adhikari, J., & Hobley, M. (2011). Everyone is leaving—Who will sow our fields? The Effects of Migration from Khotang District to the Gulf and Malaysia. *Swiss Agency for Development and Cooperation (SDC) Nepal and Helvetas Swiss Intercooperation.* Kathmandu.

Bhandari, P., & Ghimire, D. (2016). Rural agricultural change and individual out-migration. *Rural Sociology, 81*(4), 572–600. https://doi.org/10.1111/ruso.12106.

CBS. (2011). Nepal living standard survey 2010/11. Central Bureau of Statistics, National Planning Commission Secretariat, Government of Nepal, Kathmandu, Nepal.

CBS. (2012). National population and housing census 2011. Central Bureau of Statistics, National Planning Commission Secretariat, Government of Nepal, Kathmandu, Nepal.

CBS. (2014). Population monograph of Nepal 2014 – volume II (Social demography). Central Bureau of Statistics, National Planning Commission Secretariat, Government of Nepal, Kathmandu, Nepal.

Firdaus, G., & Ahmad, A. (2010). Exploring diversity among farmers in adoption of agricultural innovation and options for smallholder farming system. A case study of Ambedkar Nager District of UP. *International Research Journal of Applied and Basic Sciences, 1*(1), 25–36.

Food and Agricultural Organization of the United Nations (FAO). (2016). FAOSTAT. Country Indicators. Nepal. http://www.fao.org/faostat/en/#country/149 .

Fox J. (2016). Community forestry, labor migration and agrarian change in a Nepali village 1980 to 2010. *The Journal of Peasant Studies*. https://doi.org/10.1080/03066150.2016.1246436.

Gartaula, H. N., Chaudhary, P., & Khadka, K. (2014). Land redistribution and reutilization in the context of migration in rural Nepal. *Land, 3,* 541–556. https://doi.org/10.3390/land3030541.

Gartaula, H. N., Niehof, A., & Visser, L. (2012). Shifting perceptions of food security and land in the context of labour out-migration in rural Nepal. *Food Security, 4*(2), 181–194.

Gautam, A. P., Shivakoti, G. P., & Webb, E. L. (2004). Forest cover change, physiography, local economy, and institutions in a mountain watershed in Nepal. *Environmental Management, 33* (1), 48–61.

Intergovernmental Panel on Climate Change (IPCC). (2013). Climate change 2013: The physical science basis. In T. F. Stocker, D. Qin, G.-K. Plattner, M. Tignor, S. K. Allen, J. Boschung, et al. (Eds.), *Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (p. 1535). Cambridge, United Kingdom/New York, NY, USA: Cambridge University Press.

International Water Management Institute (IWMI). (2014). Climate change, out-migration and agrarian stress: The potential for upscaling small-scale water storage in Nepal. IWMI Research Report 159. Colombo, Sri Lanka.

Jaquet, S., Schwilch, G., Hartung-Hofmann, F., Adhikari, A., Sudmeier-Rieux, K., Shrestha, G., et al. (2015). Does outmigration lead to land degradation? Labour shortage and land management in a western Nepal watershed. *Applied Geography, 62*(62), 157–170.

Ismail, K., (2010). The structural manifestation of the 'Dutch Disease': The case of oil exporting countries. *International Monetary Fund (IMF)*, Working Paper WP/10/103. Washington.

Khan Azhar, I. A. (2007). *Overseas migration and its impacts on the families left behind in Pakistan*. Kassel, Germany.

Khanal, N. R. (2002). *Land use and land cover dynamics in the Himalaya: A case study of the Madi Watershed, Western Development Region, Nepal*. Ph.D. thesis. Kathmandu: Tribhuvan University.

Khanal, N. R., & Watanabe, T. (2006). Abandonment of agricultural land and its consequences: A case study in the Sikles Area, Gandaki Basin, Nepal Himalaya. *Mountain Research and Development, 26*(1), 32–40.

Knerr, B. (1990). Labour export from South Asia: Another case of the 'Dutch Disease'? In G. Borsa (Ed.), *The Indian Ocean* (pp. 248–315). New Delhi.

Knerr, B. (1997). *Labour migration from developing countries. Macro-economic impacts and policy interventions*. Kassel.

Knerr, B., (2008): Rücküberweisungen: Gefahren für die langfristige Entwicklung der Empfängerländer. In *Heinrich-Böll-Stiftung*. DOSSIER Migration & Entwicklung. Berlin. http://www.diversity-boell.de/web/migration/46_1907.asp.

Maharjan, A. (2010). *Labour out migration and its impact on farm families in the Mid Hills of Nepal*. Weikersheim, Germany.

Maharjan, A., Siegfried, B., & Knerr, B. (2013). International migration, remittances and subsistence farming: Evidence from Nepal. *International Migration Review*. https://doi.org/10.1111/j.1468-2435.2012.00767.x.

Maharjan, A., Bauer, S., & Knerr, B. (2012). Do rural women who stay behind benefit from male out-migration? A case study in the Hills of Nepal. *Gender, Technology and Development, 16* (1), 95–123.

Malla, Y. B. (1992). *The changing role of the forest resource in the hills of Nepal*. Ph.D. Thesis. Canberra, Australia: Australian National University.

Mohamoud, A. A., & Fréchaut, M. (2006). Social remittances of the African Diasporas in Europe, North–South Centre of the Council of Europe.

Nepal, R. (2013). *Remittances and livelihood strategies: A case study in eastern Nepal*. Kassel, Germany.

Nepal Rastra Bank (NRB). (2012). *Impact evaluation of remittances: A case study of Dhanusha District*. Kathmandu: Nepal Rastra Bank.

Paudel, B., Gao, J., Zhang, Y., Wu, X., Li, S., & Yan, J. (2016). Changes in cropland status and their driving factors in the Koshi River basin of the Central Himalayas, Nepal. *Sustainability, 8,* 933. https://doi.org/10.3390/su8090933.

Pandey, D., Heyojoo, B. P., & Shahi, H. (2016). Drivers and dynamics of land use land cover in Ambung VDC of Tehrathum district, Nepal. *Banko Janakari, 26*(1), 90–96.

Pandit, M., & Poudel, K. (2014). Effect of remittance on intensity of agricultural technology adoption in Nepal. Selected paper prepared for presentation at the Southern Agricultural Economics Association 2014 Annual Meeting, Dallas, USA.

Poertner, E., Junginger, M., & Müller-Böker, U. (2011). Migration in far west Nepal: Intergenerational linkages between internal and international migration of rural-to-urban migrants. *Critical Asian Studies, 43*(1), 23–47.

Pohle, A. (2014). *Remittances, farm investments, land use, and water consumption: Interdependencies in Kerala, India*. Kassel, Germany.

Regmi, G., & Tisdell, C. (2002). Remitting behaviour of Nepalese rural-to-urban migrants: Implications for theory and policy. *Journal of Development Studies, 38*(3), 76–94.

Sapkota, C. (2013). Remittances in Nepal: Boon or bane? *The Journal of Development Studies*, *43* (10), 1316–1331.

Sunam, R. K., & Goutam K. R. (2015). Agrarian future(s) of rural Nepal: Revitalizing peasant agriculture? *HIMALAYA 35*(1). https://digitalcommons.macalester.edu/himalaya/vol35/iss1/12
Sunam, R. K., & McCarthy, J. F. (2016). Reconsidering the links between poverty, international labour migration, and agrarian change: Critical insights from Nepal. *The Journal of Peasant Studies, 43*(1).
Tamang, S., Paudel, K. P., & Shrestha, K. K. (2014). Feminization of agriculture and its implications for food security in rural Nepal. *Journal of Forest and Livelihood*, *12*(1).
Tuladhar, R., Sapkota, C., & Adhikari, N. (2014): Effects of migration and remittance income on Nepal's agriculture yield. *Asian Development Bank*. South Asia Working Paper Series no. 27. Manila.
United States Agency for International Development (USAID). (2017). *Nepal. Agriculture and Food Security*. https://www.usaid.gov/nepal/agriculture-and-food-security.
United States Department of Agriculture. (USDA), (2016). Grains: World markets and trade. Washington. http://www.thefarmsite.com/reports/contents/grain.pdf.
Wasti, K. (2017). Remittances and long-term livelihood security in the mountains of Nepal. In B. Knerr (Ed.), *International labour migration and livelihood security in Nepal: Considering the household level 22*. International Labour Migration Series, Kassel.
Wisner, R. (2009). Corn, ethanol and crude oil prices relationships—Implications for the biofuels industry. *Agricultural Marketing Resources Center, Iowa State University*. http://www.agmrc.org/renewable-energy/ethanol/corn-ethanol-and-crude-oil-prices-relationships-implications-for-the-biofuels-industry/.
Wisner, R. (2014). Ethanol, gasoline, crude oil and corn prices: Are the relationships changing? *Agricultural Marketing Resources Center, Iowa State University*. http://www.agmrc.org/renewable-energy/ethanol/ethanol-gasoline-crude-oil-and-corn-prices-are-the-relationships-changing/.
World Bank Group Nepal. (2013). *Migration and entrepreneurship in Nepal with a focus on youth: An initial analysis*. Kathmandu.
World Bank. (2006). *Global economic prospects: Economic implication of remittances and migration*. Washington, D.C.
World Bank. (2016). *Statistics. Economy and growth*. Nepal. http://data.worldbank.org/topic/economy-and-growth?locations=NP.
World Bank. (2017). *Data. Metadata Glossary*. http://databank.worldbank.org/data/glossarymetadata/source/3690/concepts/series.

Part IV
Agricultural Trade and Marketing

Chapter 15
Trends, Structure and Drivers of Nepal's Agricultural Trade

Ramesh Sharma

Abstract This chapter analyses the trends and structure of agricultural trade in general and with India, in particular, and discusses the drivers of recent trends in agricultural trade. It presents the results of Nepal's trade competitiveness and export potential based on trade data and recommends a number of measures to respond to trade-related issues. The study depicts a high comparative advantage for most of the exported agricultural items from Nepal with almost perfect complementarity in the agricultural export profiles of both India and Nepal. However, Nepal's export potential in the Indian market is not very encouraging, and in most cases, the binding constraint to trade potential of Nepal is its limited export capacity and not the lack of opportunities in the Indian market.

Abbreviations

(Agricultural Trade Chapter)

ADS	Agricultural Development Strategy (Nepal)
ATF	Agreement on Trade Facilitation (WTO)
CBS	Central Bureau of Statistics (Nepal)
CIF	Cost Insurance and Freight
CoO	Country of origin
CTH	Change in tariff heading
FoB	Free on Board
GNDI	Gross National Disposable Income
GoI	Government of India
GoN	Government of Nepal
HS	Harmonized System
ICBT	Informal Cross-border Trade
IGC	Intergovernmental Committee (SAFTA)
IGSC	Intergovernmental Subcommittee (SAFTA)
ITP	Indicative Trade Potential

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G. Thapa et al. (eds.), *Agricultural Transformation in Nepal*,
https://doi.org/10.1007/978-981-32-9648-0_15

LDC	Least-developed country
MoAD	Ministry of Agricultural Development
MoCS	Ministry of Commerce and Supplies
MRA	Mutual Recognition Agreements
MT	Metric ton
NLSS	Nepal Living Standards Survey
NOM	Non-originating materials
NRB	Nepal Rastra Bank
NTB	Non-tariff barrier
NTIS	Nepal Trade Integration Strategy
NTM	Non-tariff measure
p.a.	Per annum
PTM	Para-tariff measure
RCA	Revealed Comparative Advantage
RoO	Rules of origin
RoW	Rest of the world
SAARC	South Asian Association for Regional Cooperation
SAFTA	South Asian Free Trade Area (SAFTA)
SARSO	South Asian Regional Standards Organization
SL	Sensitive list
SPS	Sanitary and Phytosanitary (WTO)
TBT	Technical Barriers to Trade (WTO)
TCI	Trade Complementarity Index
TEPC	Trade and Export Promotion Centre (Nepal)
TLP	Tariff Liberalization Program (SAFTA)
$	US dollar

1 Introduction

The ultimate objective of Nepal's trade policy as articulated in official documents is to enhance the contribution of trade to economic growth and poverty reduction. Other stated goals include strengthening backward and forward linkages of trade with domestic productive sectors and promoting diverse and value added exports. Likewise, in line with market-led economic policies, trade policy will be liberal and based on the principle of comparative advantage.

The current state of Nepal's trade, both agricultural and non-agricultural, is not considered healthy and is positioned well short to attaining the above goals. Based on literature and government documents (GoN 2015; WTO 2012), the main problems or issues may be listed as follows: (i) surging agricultural imports in recent years, breaking with the past trend; (ii) slow growth in exports; (iii) as a result, escalating trade deficits; (iv) very high product concentration of exports;

(v) very high concentration of trade with only one partner which is not considered healthy; and (vi) low value addition of most exports and weak backward and forward linkages to the rest of the economy in the case of manufactured products exported.

This chapter assesses the state of Nepal's agricultural trade in general and with India in particular. Accordingly, it covers 4–5 topics that are central to the narrative. The chapter is organized as follows. Following this introduction, Sect. 2 analyses trends and structure of agricultural trade. Section 3 summarizes the framework or agreements governing current trade, namely Nepal–India Treaty of Trade and South Asia Free Trade Agreement (SAFTA). With these backgrounds, Sect. 4 analyses five categories of likely drivers of recent trends in agricultural trade. Section 5 presents the results of Nepal's trade competitiveness and export potential as revealed by trade data. Section 6 concludes. The chapter draws heavily from a longer report on this subject (Sharma et al. 2017).

2 Nepal's Agricultural Trade: Trends and Structure

The first part of this section reviews longer-term *trends* in Nepal's agricultural trade based on aggregated data published by the Nepal Rastra Bank (NRB). This is followed by an analysis of the *structure* of trade based on highly disaggregated trade data available from the Trade and Export Promotion Centre (TEPC).

2.1 Longer-term Trends in Agricultural Trade,[1] 1991–2016[2]

2.1.1 Trends in Agricultural Exports

Figure 1 shows trends in Nepal's agricultural exports to India and to rest of the world (RoW). To India, the following four trends may be noted. First, during 1991–97, exports were essentially flat within a small range of $21–$33 million per year ($ refers to US dollar), with a mean of $26 million. Second, starting in 1998, exports surged for five years until 2002, reaching a peak of $155 million, which

[1]Unless otherwise stated explicitly, the words trade, exports and imports used in this chapter refer to agricultural trade, exports and imports. Where the total also includes non-agricultural trade, this is explicitly stated.

[2]The NRB publishes trade data by SITC numbers. For this section, agricultural trade is defined as the sum of the SITC numbers 0, 1 and 4, the rest being non-agriculture. The data are for fiscal years (July/June). For ease of presentation, unless otherwise stated, fiscal years are written as single years as follows: 1991 for 1990/91, 1992 for 1991/92 and so on.

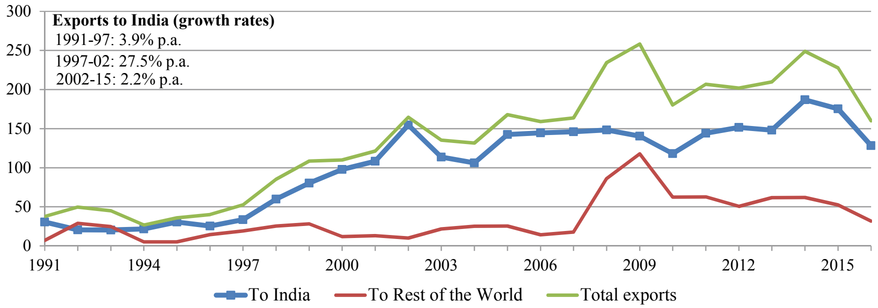

Fig. 1 Trends in Nepal's agricultural exports, 1991–2016 (million \$). *Source* NRB trade data. 1991 refers to fiscal year 1990/91 and so on. Average annual growth rates are trend growth rates computed by regressing the logarithms of the trade value on time trend

translates into a 28% per annum (p.a.) growth rate during 1997–2002.[3] In 25 years since 1991, this was the only period when exports to India increased significantly and steadily. *Vanaspati ghee* (hydrogenated vegetable oil) played crucial role in this export surge. Third, for the next 11 years until 2013, exports were essentially flat within a range of \$100–150 million per year with a mean of \$138 million. And fourth, for the first time, exports crossed the \$150 million mark and reached \$187 million in 2014, but dipping to \$175 million in 2015. In 2016, exports fell further by 27% to \$128 million, due to combined effects of earthquakes, political disruptions and trade embargo. Exports to the RoW also suffered markedly, declining by 15% in 2015 and by a further 40% in 2016.

Just one product, *Vanaspati ghee*, dominated trends in total agricultural exports to India for several years beginning in 1998, but its role started to decline from 2002 and eventually faded out by 2008. There is a consensus that the main driver of the phenomenal growth of *Vanaspati ghee* after 1997 was the liberal provisions in the 1996 Nepal–India Treaty of Trade, notably no export quotas and no requirement for country of origin certificate. The share of this product fell to 37% on average during 2003–08, to 22% by 2008 and faded out from the picture. As its role ended, total exports did not slump but remained stable, as the graph shows, because a range of other products grew to offset the declines, which was a positive development as product diversification widened. These products included cardamoms, noodles, fruit juices and animal feeds.

As for exports to the *RoW*, there was a fairly modest growth during 1991–07, from about \$12 million in early 1990s to about \$20 million during 2004–06. Exports then surged for two years, by almost 5 times in 2008 and further in 2009, after which exports fell and stabilized from 2010 onwards, averaging \$60 million per year during 2010–14, but sliding further in 2015 and 2016.

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[3]Unless otherwise stated, all growth rates reported in this section are average annual growth rates, estimated by regressing the logarithms of the variable on time trend using data for all years covered.

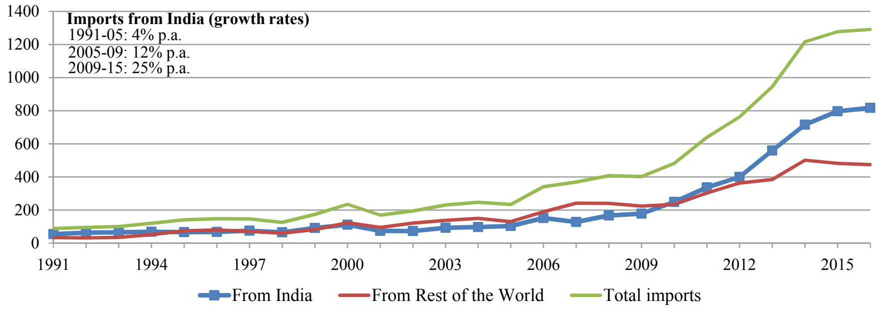

Fig. 2 Trends in Nepal's agricultural imports, 1991–2016 (million $). *Source* NRB trade data. 1991 refers to fiscal year 1990/91 and so on. Average annual growth rates are trend growth rates computed by regressing the logarithms of the trade values on time trend

2.1.2 Trends in Agricultural Imports

Figure 2 shows trends in Nepal's agricultural imports. From India, three distinct phases may be noted. First, imports grew steadily but slowly during 1991–2005, taking 15 years for imports to cross the $100 million mark in 2005 (with one exception in 2000) from just over $60 million in the early 1990s, the growth rate being just 4% p.a. Second, imports grew fairly strongly (12% p.a.) during 2005–09, from about $100 million to $178 million in just four years. Third, 2010 marked the beginning of a new phase of surging imports. The value of imports from India in 2015, at $797 million, was 4.5 times the value in 2009 (trend growth rate of 25% p. a. during 2009–15). Thus, the escalation of imports from India is a very recent phenomenon. Why this break with the past trend now and what are its drivers? This is the focus of Sect. 4. The structure of imports in Sect. 2.2 also sheds some light to this query.

Unlike from India, imports from the RoW also surged after 2010 although imports were rising steadily for several years (growth rate averaged 11% p.a. during 1991–05, versus 4% p.a. for imports from India). Imports from the RoW increased faster in 2006 and 2007 but stabilized for the next three years, and surged from 2011, one year after that from India, with a growth rate of 15% p.a. during 2010–15, still markedly lower than that from India (25% p.a.). Thus, overall, the main message is that Nepal's escalation of agricultural imports is a recent phenomenon and this is taking place for imports from both India and the RoW, although much more strongly from India. There was a notable impact of earthquakes, political disruptions and trade embargo during 2015 and 2016. The rapid growth of imports during 2010–2014 decelerated considerably in 2015 and especially in 2016.

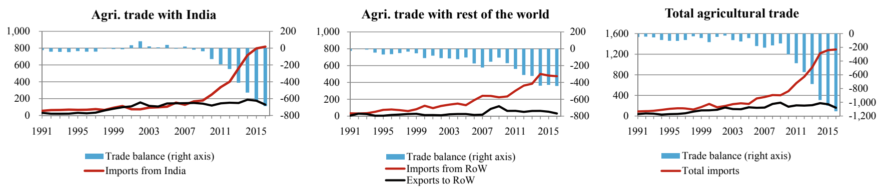

Fig. 3 Trends in agricultural trade balance, 1991–2016 (million $). *Source* NRB trade data. 1991 refers to fiscal year 1990/91 and so on

2.1.3 Agricultural Trade Balance

Figure 3 shows trends in agricultural trade balance with India and the RoW. With India, the surging deficits are only a recent phenomenon, while previously there were even trade surpluses for six years, from 2001 to 2005 and 2007. In contrast, the deficits with the RoW were always negative and growing steadily since around 1999, with edible oils playing an increasingly dominant role in recent years. India's share in the total deficits was high during the first half of the 1990s (about 60% on average) but dropped to lower levels after that until recently when it reached high levels, averaging 57% during 2013–15.

2.2 The Structure of Nepal's Agricultural Trade[4]

This section complements the longer-term assessment by focusing on the structure of agricultural trade based on the analysis of highly disaggregated data from TEPC. It reviews the composition of trade, growth rates in value and volume terms and asks what specific products drove the trends. At the time of undertaking this analysis, the TEPC's disaggregated data were available in public domain for five years only, 2009–2013, which should be adequate for understanding the structure of trade.

2.2.1 The Structure of Agricultural Exports

Table 1 presents summary statistics for 15 top ranked export products which together accounted for 95% of all agricultural exports to India and 90% to the RoW. India's share in the total was 74% for the 15 products together and over 90% for 10 of them. Thus, barring a few products for which India's share is small (e.g. lentils, plants, bovine meat, chewing tobacco and *dalmott, papad,* etc.), an analysis of

[4]Unlike with the NRB data used above which were for fiscal years, the TEPC data used in this subsection are for calendar years.

Table 1 Structure of Nepal's agricultural exports, 2009–2013

HS No.	Products	Total exports to world, average 2011–2013			Exports to India, average 2011–2013		Growth rates of exports to world 2009–2013 (% p.a.)		
		Value million $	% share in total	Volume 000 MT	Value million $	Share in all exports (%)	Value	Volume	Price
The big 4: cardamom, lentils, tea and ginger		**99**	**44**	**–**	**69**	**70**	**−0.3**		**–**
090830	Cardamoms	42	19	5.1	41	100	26	−11	36
071340	Lentils	28	12	23.9	1	3	−29	−29	0.02
090210-40	Tea	21	9	10.1	18	88	6	4	2
091010	Ginger	9	4	35.4	9	100	17	12	6
Plants/forest products/ herbs		**23**	**10**	**–**	**15**	**65**	**−8**	–	–
121190/91	Plants and parts of plants	13	6	7.8	5	38	8	−0.4	9
1401-04	Forest/ vegetative products	11	5	9.5	10	98	−21	−2	−19
Manufactured products		**78**	**35**	**–**	**60**	**77**	**12**	–	–
2009	Fruit juices total	39	18	55.7	39	100	13	11	3
1902	Noodles/pasta	8	4	5.9	5	64	−11	−7	−4
2304/05/06	Oilcakes	8	4	36.1	8	99	0	−2	2
0202	Bovine meat, frozen	5	2	2.9	0	9	–	–	–
230103/07-09	Feeds, brans, residues	5	2	19.8	2	51	1	−14	15
210690	Dalmott, papad, pachak, etc.	4	2	1.7	1	22	19	5	14

(continued)

Table 1 (continued)

HS No.	Products	Total exports to world, average 2011–2013			Exports to India, average 2011–2013		Growth rates of exports to world 2009–2013 (% p.a.)		
		Value million $	% share in total	Volume 000 MT	Value million $	Share in all exports (%)	Value	Volume	Price
2403	Pipe, chewing tobaccos	4	2	1.0	0.1	2	203	197	7
151590	Fixed vegetable fats/oils	2	1	2.3	2	99	−6	−9	3
040590	Fats/oils from milk	2	1	0.5	2	100	4	−3	7
080290	**Betel nuts**	**10**	**4**	**8.7**	**10**	**100**	**−5**	**−18**	**14**
	Sum of the above	210	94	–	154	74	3.7	–	–
	Rest of agriculture	14	6	–	7	52	−4.3	–	–
	All agriculture (HS 1-24)	224	100	–	162	72	3.1	–	–

Note Some products (such as juices, oilcakes, and brans/feeds) are aggregated for being like products, not shown in the table: (i) the listed products amount to 96% of total exports to India; (ii) the rate of growth of total value of exports to India was 8% p.a. during 2009–13; and (iii) growth rates per annum are trend rates computed by regressing the logarithms of the trade values on time trend

Source Author, based on the TEPC data

Nepal's total agricultural exports essentially amounts to the same thing as an analysis of exports to India.

As a first insight, note the very narrow *product concentration*, one of the several ills noted at the outset. As just said, 15 products together accounted for as high as about 94% of all agricultural exports, and just three products (cardamoms, fruit juices and lentils) to the world and two to India (cardamoms and fruit juices) made up 50% of the total. Further, of about 200 agricultural tariff lines at the 4-digit level of the Harmonized System (HS), only about 37% of the lines on average during 2009–13 had nonzero exports to India, but mostly at insignificant levels (the corresponding nonzero lines were 47% for exports to the RoW).

What follows highlights the product structure of exports. For a better exposition of the results, the top 15 products are grouped into four categories.

The big four—cardamoms, lentils, tea and ginger—These are Nepal's star export products, also identified as being so in Nepal Trade Integration Strategy (NTIS) 2010 and 2016 (GoN/NTIS 2010, 2016). Their combined share was about 43% of all agricultural exports to India and 48% to the RoW. The growth rate for their aggregate value during 2009–13 was negative 0.3% p.a., mainly due to the negative growth of 29% p.a. for lentils, whose exports fell markedly from about 50,000 MT in 2009 to 13,000 MT in 2013. This comes as somewhat surprising because production grew by 3.5% p.a. during 2010–15. Excluding lentils, exports of the other three products together grew by 18% p.a. in value terms with positive growth in volume for tea and ginger and negative for cardamoms. Cardamom exports declined from about 10,000 MT in 2009 to just over 5000 MT in 2013 (growth rate of −11% p.a.), although there was a more than doubling of the value of exports in five years, $20 to $48 million, as export prices surged by 36% p.a. Tea exports have been almost stagnant.

Manufactured products—miscellaneous manufactured products made up 35% of all agricultural exports, with India's share of 88%. Of the total exports to India, 65% was various fruit juices, 13% oilcakes, 9% noodles and about 4% each of brans/ feeds, oils and fats, etc. Juice exports increased fairly strongly at 11% p.a. in volume terms. Juices are also distinct from other products in that most if not all came from the industry with Indian investment. Instant noodles are another big item, with India's share in total exports of 64% in value and 81% in volume terms. During 2009–13, noodles export to India declined while this surged to the RoW (27% p.a. growth for volume and 20% p.a. for value). Oilcakes ranked third among manufactured products, almost all to India, which was somewhat puzzling as Nepal imported $46 million worth of oilcakes in 2011–13 (below) as well as because Nepal is largely deficit in oilseeds and grains, while the domestic meat industry is growing rapidly.

Forest/vegetative products, medicinal plants/herbs—These products, also prioritized by NTIS, include a wide range of forest-based medicinal plants, herbs and oils. The export value of *medicinal plants* (HS 121190)[5] and *forest/vegetative products* (HS 1401–1404)[6] together was $23 million in 2011–13, with 65% exported to India. The famed *yarchagumba* (HS12119010) is a big item within medicinal plants with a 14% share. There is a perception that significant volumes of these products are exported to India informally (unrecorded) and processed in India with a part that exported to the RoW. If so, the recorded export data underestimate this trade markedly (Sharma 2017). Exports to the RoW have been impressive, with 43% p.a. growth in volume terms, albeit from a smaller base.

Other prominent exports—betel nuts and bovine meat—Nepal's exports of betel nuts to India in large volumes have been controversial, with India claiming that much of the exports could be third-country product deflected to India. Nepal indeed imported large amounts of betel nuts from third countries (discussed below). Nepal exporting bovine (buffaloes) meat (HS020230) is a recent phenomenon, with exports rising rapidly during 2009–13. India's share in Nepal's total exports was 30% in 2011, 56% in 2012 and 67% in 2013. During 2009–13, bovine meat was sold to eight countries, with Thailand's share in the total of 61%, followed by Vietnam (27%), Lao PDR (12%) and India (1%). Bovine exports from India itself have been growing rapidly, but it is not clear if Nepal's industry is linked in some way to the Indian industry and trade. This is worth exploring as there could be some synergy for further growth of this industry in Nepal.

2.2.2 The Structure of Agricultural Imports

Key statistics are summarized in Table 2 with agricultural imports grouped under seven product categories for better exposition of the results. The summary results show a number of features of import structure. One, 56% of Nepal's imports of $1012 million during 2011–13 were from India. Two, imports increased rapidly during 2009–13, at the rate of 27% p.a. from India and 11% p.a. from RoW (19% p.a. overall). Three, imports were highly concentrated, with cereals and oilseeds complex (oilseeds, oils and cakes) together making up 53% of all imports during 2009–13. Four, a rough regrouping of all imports shows that about 77% were food products and 23% feeds and raw materials. And five, the last three

[5]The full product description for HS 121190 is "Plants and parts of plants (including seeds and fruits) of a kind used primarily in perfumery in pharmacy or for insecticidal or similar purposes". This includes a wide range of products, with a typical list being Amala, Atis, Chiraito, Dalchini, Gucchi, Jatamansi, Jhyau, Kutki, Pipla, Ritha, Sugandhawal and Timur. A table in an ITC study shows the following as the top five traded species based on the royalty collected: ritha (Sapindus mukorossi) 34% of total, timur (Zanthoxylum armatum) 22%, lichen (Parmelia sps.) 20%, pawan ko bokra (Persea sps.) 18% and chiraito (Swertia chirayita) 7%.

[6]Forest/vegetative products include many items. In 2013, *khayaar* accounted for 50% of the total, followed by *kattha* (40%) and *rudraksha* (4%). Others in small amounts were skin of Argel, *soapnut* and *amriso* (broom). In 2012, 98% of the total was *khayaar* and 2% *rudraksha*.

Table 2 Structure of Nepal's agricultural imports, 2009–2013

HS No.	Products	Total imports from world, average 2011–2013			Imports from India, average 2011–2013		Growth rates of import from world 2009–2013 (% p.a.)		
		Value million $	% share in total	Volume 000 MT	Value million $	Share in all imports (%)	Value	Volume	Price
	Cereals	**190**	**19**	**599**	**180**	**95**	**49**	**36**	**13**
1006	Rice	117	12	326	112	96	52	39	13
1005	Maize	51	5	209	49	96	47	26	21
1001/1101	Wheat and flour	11	1	42	11	100	138	126	12
HS10-11	Other cereals	10	1	21	7	72	14	15	−1
	Oilseeds, oils and cakes	**349**	**34**	**–**	**116**	**33**	**14**	**–**	**–**
1201/05/07	Oilseeds	85	8	142	68	81	18	10	8
1507-15	Edible oils	218	22	188	2	1	12	3	9
2304/05/06	Oil cakes	46	5	90	46	100	20	5	15
	Fruits and vegetables	**119**	**12**	**–**	**74**	**62**	**20**	**–**	**–**
0713	Dried vegs. (peas)	39	4	69	11	29	10	−2	13
0701	Potatoes	29	3	174	29	100	39	34	5
0703	Onions and garlic	20	2	84	16	80	18	8	10
0808	Apples and pears	15	1	51	4	27	24	17	7
HS0803-14	Other fruits[a]	12	1	75	10	90	48	53	−6
	Other foods, spices and food preparations	**153**	**15**	**–**	**98**	**64**	**16**	**–**	**–**
0904/09/10	Spices[b]	32	3	32	19	60	25	1	24
1905	Bread, biscuits, wafers	17	2	11	15	84	21	−46	67
1701	Sugar	15	2	30	9	61	4	−4	7
2106	Dalmott, paan, bhujiya	13	1	6	8	62	16	11	5

(continued)

Table 2 (continued)

HS No.	Products	Total imports from world, average 2011–2013			Imports from India, average 2011–2013		Growth rates of import from world 2009–2013 (% p.a.)		
		Value million $	% share in total	Volume 000 MT	Value million $	Share in all imports (%)	Value	Volume	Price
1704	Sugar confectionery	13	1	6	10	80	22	16	6
0104	Live sheep/goats	12	1	1	12	100	33	18	14
2202	Non-alcoh. beverages	11	1	12	1	9	37	28	9
2208	Spirits, liqueurs	11	1	1	3.8	36	10	6	4
0402	Milk and cream	10	1	9	8	83	−8	2	−10
1806	Choc. and choc preprtn.	10	1	2	6	67	19	10	9
2101-05	Miscell. food preprns.	9	1	4	6	59	11	1	10
080290	**Betel nuts**	**37**	**4**	**54**	**2**	**6**	**−2**	**−18**	**16**
	Raw materials	**94**	**9**	**–**	**62**	**66**	**16**	**–**	**–**
21069040	Juice pulps/concentrates	25	2	7	4	16	25	33	−8
2401	Tobacco unmanufactured	23	2	7	23	100	−2	−8	6
23	Feeds/brans/residues	23	2	32	13	58	24	10	14
1901/2207	Malt and ethyl alcohol	23	2	12	21	91	21	21	0.3
	Sum 6 subgroups	943	93	–	533	57	19	–	–
	Sum remaining imports	69	7	–	37	53	20	–	–
	All agri (HS 1 to 24)	1012	100	–	570	56	19	–	–
	All food products	774	77	–	417	54	21	–	–
	All feeds/raw mat.[c]	237	23	–	153	64	14	–	–

[a]Other fruits include citrus (35% of other fruits), mango/pineapple (19%), grapes (18%) and others (28%)
[b]Spices include peppers (47% of the total), cumin/coriander (33%) and ginger/saffron (20%)
[c]Feeds/raw materials are assumed to be the following: sub-category raw materials, oilcakes, betel nuts, half of maize and half of the remaining 7% imports other than those in the seven subgroups
Growth rates per annum are trend rates computed by regressing the logarithms of the trade values on time trend
Source Author, based on the data from TEPC

columns show that imports of most products grew fairly rapidly, both in value and volume terms. What follows highlights the main results.

Cereals—Cereals, sourced almost fully from India, made up 19% of all agricultural imports during 2011–13, with rice alone being 62% of all cereals. The data show phenomenal increases during 2009–13, with trend growth rates among the highest for major products (in volume terms, 39% p.a. for rice, 26% p.a. for maize and 126% p.a. for wheat and flour). Growth rates in value terms were higher by 12–20% points as import prices also surged. Cereals also accounted for between 35 and 68% of the annual increases in agricultural import bills from India between 2009 and 2013.

These trends showing Nepal facing serious imbalances between the demand for and domestic supply of cereals are somewhat inconsistent with two other developments. One is that the share of cereals in the food consumption basket has been declining over time, by 18.4% between 2006 and 2016 (source: Chapter on Agricultural Diversification in Nepal). Two, cereal production has been growing at 2% p.a. between 2000 and 2015, about the same rate as the population growth rate. These point to the possibility of some data issues, both trade and production. More research is needed to reconcile this matter. One strand of investigation should be in understanding the types of cereals that are being imported and their final use, for example, Basmati-type rice for urban consumers, maize for animal feeds, wheat for bakery products, etc. The other strand would be better understanding of the nature and scale of informal trade.

Oilseeds, edible oils and oilcakes—Total imports of these three products amounted to $349 million during 2011–13, 34% of all imports. India's share in the total was only 33% because most edible oils are sourced from the RoW. *Oilseeds* are ranked top third imported product after edible oils and rice, with all three major oilseeds (soybeans, mustard and rape/colza) individually appearing among Nepal's top 10 import products. Import growth was very high, 10% p.a. for volume and 18% p.a. for value. *Edible oils* as a group are Nepal's top ranked import, more than cereals, with 99% sourced from the RoW as India bans the export of edible oils. *Oilcakes* accounted for 5% of the total agricultural imports, all from India, and rising strongly. Large imports of oilcakes and animal feeds point to strong demand for feedstuffs to cater to Nepal's expanding livestock industry.

Imports of *fruits and vegetables* more than doubled during 2009–13, with 62% sourced from India, with dried vegetables, mostly peas, making up about 40% of the total for vegetables, followed by potatoes (31%), and onions and garlic (21%). Imports of potatoes grew rapidly, by over four times in volume and six times in value terms between 2009 and 2013, despite the fact that Nepal has been implementing large potatoes development programs for the past 3–4 decades. Most onions come from India, while bulk of the garlic is sourced from China. The data show large fluctuations in garlic imports, which tend to support a perception that a good part of the imports might have been deflected to India (Sharma 2017).

Other foods, spices and prepared foods include a range of prominent foods most of which can be associated with increasing urbanization, changing taste and income growth. On a positive note, these foods can be manufactured in Nepal and imports substituted to some extent, unlike primary agricultural products whose growth is constrained by land and further growth has to come from higher yields, whose potential exist for most crops given low yields currently (ADS 2015). Overall, at $153 million in 2011–13 and growing at the rate of 16% p.a., the market for these foods is both large and growing.

Trade in *betel nuts* (HS 080290) has been controversial, with India complaining, including in bilateral official meetings, that much of the exports to India are deflected trade. Export volumes vary widely from year to year which could indicate that unrecorded exports to India might be high. The data on Nepal's exports to India based on the Nepalese and Indian sources diverge markedly for some years but were also fairly close for others, with the Indian data showing larger exports from Nepal ($62 million in five years in the Indian data and $45 million in the Nepalese data) (Sharma 2017).

Raw materials and feeds, including oilcakes, are estimated to be just over 20% of Nepal's total agricultural imports (last row in the table). These imports play important role in sustaining industries in Nepal, such as the meat industry, as well as export-oriented industries. For example, Nepal exported in 2011–13 some $39 million worth of fruit juices, at the same time importing $25 million worth of pulps and concentrates. The large imports of malt and tobacco similarly support Nepal's beer and tobacco industry. Discussions on Nepal's trade deficit often miss the point that a large part of the imports also sustains domestic industry and exports.

So, in summary, what were the main contributors to the surges in imports during 2009–13? These were, in order: rice, edible oils, oilseeds, maize and onions/potatoes. Their contributions vary from year to year. For example, rice accounted for 44% of the annual change in total import bill in 2012 but 17% in 2010 and only 3–5% in 2011 and 2013. Edible oils contributed the most in both 2010 and 2011, and markedly so in 2012, but its share declined in 2013. Overall, it was food products that contributed the most to recent import surges. These include both basic foods such as rice and edible oils but also a diverse range of prepared foods that are associated with urbanization, income growth and change in food habits. An analysis of the likely drivers of the demand growth and the state of their supply response is the subject of Sect. 4.

3 Trade Agreements—The Framework for Agricultural Trade

Trade agreements provide the legal framework for conducting trade among nations. For Nepal, with 60–70% of agricultural trade with India, the Nepal–India Treaty of Trade (in short, Treaty) remains the most important framework. A significant share of the remaining trade with the RoW benefits from preferential access provided to Nepal as a LDC by various countries. In contrast, very little trade takes place with SAARC countries other than India. But SAFTA is of potential significance for

Nepal and so needs to be taken seriously. Accordingly, this subsection discusses key provisions under the Treaty and SAFTA.

3.1 Nepal–India Treaty of Trade

The current Treaty, signed in 2009 and renewed in 2016, was a continuation of the 1991 Treaty renewed with amendments and revisions in 1996 and 2002. The most important, and long-standing, provisions of the Treaty are the basic trading rules for agricultural and non-agricultural products. For primary products as defined in the Treaty (mostly agriculture and forestry sub-sectors), Article IV provides for full exemption for both parties from customs duty and other restrictions. For manufactured products, Article V provides favourable access by India to Nepal, on a non-reciprocal basis, subject to meeting country of origin requirements. Most of the rest of the provisions in the Protocols and Annexes concern details, exemptions and exceptions to key provisions. What follows summarizes very briefly some provisions that are of significance for Nepal's agricultural trade (more details in Sharma et al. 2017).

The 2009 Treaty contained, for the first time, a potentially valuable provision that states that both parties shall recognize Sanitary and Phytosanitary (SPS) certificate issued by the other party, subject to assessments of certification capability and meeting mandatory requirements of the importing party. This, the mutual recognition agreement (MRA), was a long-standing request of Nepal. Two, a new provision provides for joint meetings of customs and quarantine/food officers and other stakeholders of the two countries right at the spot in borders to resolve non-tariff barriers (NTBs) and trade facilitation issues involving *perishable* agricultural and forest-based products. While in the past also officers from both sides met informally to resolve problems, the new provision provided for those meetings formally. Three, India agreed to consider Nepal's request for relaxation of import restrictions of canalized goods, i.e. whose imports by India are restricted to public agencies or are prohibited, which could be useful for Nepal's exports of food products. Four, four more land border routes were added for trade, as well as for the first time four international airports connected by direct flights, potentially benefitting Nepal's exports. And five, the establishment of the Intergovernmental Committee (IGC) at the Secretary level and the Intergovernmental Subcommittee (IGSC) at the Joint-Secretary level have been valuable for resolving issues and facilitating trade.

Furthermore, a new provision provides for India to consider relaxing exports of its "essential goods" to Nepal in the form of specific annual quotas, if and when Nepal needs and makes a request. These are mostly products that receive subsidies in India and so exports are regulated or prohibited (e.g. cereals, edible oils, sugar, fertilizers). The provision thus reassures Nepal's food security during periods of critical supply shortages. The Treaty also called upon Nepal to be sensitive to India's trade concerns, notably the deflection of third-country products to India through Nepal as well as to prevent unauthorized imports by Nepal of goods whose exports are restricted by India.

Rules and provisions by themselves do not often change how business is conducted on the ground, i.e. at the border posts. Many trade hassles at the borders occur despite good intentions in the rules book. Moreover, some provisions are conditional, such as Nepal upgrading its certification capacity or Nepal making specific requests to India for assistance. For all these reasons, Nepal, as the main potential beneficiary, should be proactive in taking initiatives towards implementing the provisions. Nepal should also generate evidence on difficulties being faced, such as those related to NTBs and trade facilitation, so that complaints made are evidence-based. This work should also pinpoint how specific trade rules are being violated.

3.2 The SAFTA

The core provisions on trade in goods of the SAFTA include: (i) a Tariff Liberalization Program (TLP); (ii) sensitive list; (iii) rules of origin; (iv) provisions on NTBs; and (v) institutions for product standards and harmonization.

As of 2016, most provisions of the *TLP* have been implemented in stages, and so ordinary tariffs in SAFTA are now fairly low. The TLP had called for bringing all tariffs, with the exception of the sensitive lines, to a 0–5% range, as well as to eliminate quantitative restrictions on those products. As regards *sensitive list* (SL), Members are free under SAFTA rules to designate any number of products as sensitive. There is a trend since 2006 of Members voluntarily shortening the SL. India stands out in slashing the SL for LDCs to just 25 tariff lines, a 95% reduction from the earlier list. The data show that, as of end-2015 and for all Members combined, 33% of all sensitive lines were agricultural products in the case of the LDCs and 22% for non-LDCs (Sharma et al. 2017).

Rules of origin (RoO) attract a great deal of attention in all trade agreements in view of their significance for determining eligible trade. The preferential RoO offered by India to Nepal under the Treaty and under SAFTA (in this case as a LDC) is highly liberal, with maximum foreign content of 70% of the f.o.b. value plus a change in tariff heading (Table 3).

Non-tariff Barriers (NTBs), called Non-tariff Measures and Para-tariff Measures (NTMs/PTMs) in SAFTA, are addressed through some provisions. One is the formation of a SAFTA Committee of Experts (COE) with a subgroup that receives notifications from Members on trade barriers facing them. These are compiled and scrutinized for their conformity with the WTO provisions, and recommendations made to Members for resolution. But the committee lacks teeth—SAFTA is silent on Members' obligations with regards to the recommendation. Some years back, under this provision, Pakistan, Bangladesh and Nepal notified about 60 NTMs/PTMs that they faced in accessing the Indian market. The notifications covered issues on SPS and TBT measures, customs procedures, licences and quotas,

Table 3 India's general rules of origin under various trade agreements, 2015

Agreement	Original criteria for contracting parties	Regional/bilateral cumulation
SAFTA	(i) Max. NOMs: 60% of FOB value for non-LDCs; 65% for Sri Lanka and 70% for LDCs, and	(i) At least 50% regional materials + VA, subject to $\geq$20% local content + VA in exporting country, and
	(ii) CTH at 4-digit HS level	(ii) CTH at 4-digit HS level
	(iii) For some products, product-specific RoO	
India's bilateral agreements		
Nepal	NOMs (excl. India's) $\leq$70% of FOB value and CTH at 4-digit HS	India's materials not counted as NOMs
Sri Lanka	Max. NOMs (excl. India's) $\leq$65% and CTH at 4-digit HS	Aggregate VA $\geq$35% of FOB, with $\geq$25% in Sri Lanka and $\geq$10% in India; and CTH at 4-digit HS
Bhutan	Not applicable (no RoO)	Not applicable (no RoO)
Afghanistan	50% of FOB value and CTH at 4-digit HS	40% of FOB value, subject to 30% domestic content and CTH at 4-digit HS
LDCs	Max. NOMs of 70% of FOB value plus CTH at 4-digit HS	Materials from India considered originating, but not from other LDCs

Note Rules of origin are not covered under the India–Bhutan preferential trade agreement
Source Based on Table 3.2 of WTO (2015) (India's Trade Policy Review) and other sources

para-tariffs, infrastructures, interstate movement of goods and so on. No information is posted anywhere as regards the progress made in resolving the issues.

The establishment of the South Asian Regional Standards Organization (SARSO) as an institution for enhancing coordination and cooperation among SAARC Members for standardization and conformity assessment is potentially of immense significance for boosting regional trade. SARSO became operational in early 2014 and has been active in developing standards for products and practices in its five of work: food and agricultural products; jute, textile and leather; building materials; chemicals and chemical products; and electrical and electronic products. Most successful regional trade bodies have mechanisms to facilitate the adoption of two key instruments: (i) formulation of common standards and processes, e.g. risk analysis; and (ii) MRAs. In South Asia, SARSO could be the institution for that. This requires Members to trust and empower the body.

One question often asked in studies on regional trade in South Asia is the *significance of SAFTA* given the bilateral trade agreements among Members? For example, what is the added value of SAFTA for Nepal over and above the bilateral Treaty? One view, e.g. Ratna and Sidhu (2007), is that SAFTA falls well short of the favourable concessions that bilateral agreements currently provide and hence very little trade takes place under SAFTA terms. Some analysts hold that SAFTA remains weak precisely because of the attractiveness of the bilateral agreements, and thus, one way to strengthen SAFTA would be to terminate the bilaterals, or, as this may not be practical politically, to continually make SAFTA more attractive (Islam 2010). This question is also raised at times in Nepal as India's trade concessions to LDCs are increasingly becoming highly attractive vis-à-vis the bilateral Treaty. There is a need for some analysis of this issue, i.e. to understand the relative merits of the bilateral treaty and SAFTA.

4 Drivers of Agricultural Trade with India and the Rest of the World

The ills inflicting the state of Nepal's agricultural trade were identified at the beginning of this chapter as follows: (i) surging imports in recent years, breaking with the past trend; (ii) slow growth in exports; (iii) as a result, escalating trade deficits; (iv) high concentration of export products; and (v) high concentration of trade with only one partner, India. This subsection discusses likely underlying reasons for, or drivers of, these trends. These are grouped into five categories: (i) demand surge; (ii) supply response and trade competitiveness; (iii) access to export markets; (iv) NTBs; and (v) statistics. For space reason, the discussion is succinct; indeed, some of the drivers deserve separate studies (see Sharma et al. 2017 for details).

4.1 High Demand for Foodstuffs Due to Income Growth and Urbanization

There is a broad consensus in literature that the growth of disposable income due to remittances is a major driver of the soaring demand for foodstuffs in Nepal, leading to soaring imports of foods and raw materials. The data show that both per capita GDP and per capita Gross National Disposable Income (GNDI), which includes remittances, increased much faster in recent years, by 4.5% p.a. during 2008–2015, which was 40% higher than the 3.3% p.a. growth during 2001–2007. Nepal's GDP data by expenditure also show that private expenditure on food grew by 3% p.a. in constant prices in the second period, 72% higher than the 1.8% p.a. growth in the first period.

Incomes from remittance also tend to spread more evenly across households. The 2011 Nepal Living Standards Survey (NLSS) shows that 56% of the households in Nepal received remittances during 2010/11 compared to 32% in 2003 (a 75% increase). This share must have increased further since 2011. Remittance income is also credited for the much improved income distribution—the Gini coefficient of income inequality fell from 0.41 in 2003/04 to 0.33 in 2010/11. Thus, overall, all indications are that there have been large increases in disposable incomes in the second period, incomes that were also shared more evenly, boosting consumption expenditures, including on food. The trade data show that besides basic foodstuffs such as cereals, oils, sugar and fruits, there were also rapid increases in imports of processed and convenience foods whose demand is driven by urbanization and changing food habits.

Import surges in the face of overall demand growth are indications of inadequate supply response of the domestic agriculture. It is difficult to empirically determine the relative contributions of these two drivers to import growth. There is a dearth of analyses on the demand for various foods and feeds at disaggregated levels and the drivers of those demands. Such studies could indicate where the demand pressure is high and where demand is leading to imports because supply response has lagged.

4.2 Supply Response and Trade Competitiveness

The two relevant sub-sectors whose supply response matters for agricultural trade are agricultural production and agro-industry. The performance of these two sub-sectors also determines the pace of growth of exports. There is also a general perception that Nepal is losing out on competitiveness vis-à-vis India due to high levels of support and subsidies to Indian agriculture. What follows discusses these two topics, namely the state of Nepal's agriculture and agro-industry and India's role in Nepal's trade competitiveness.

4.2.1 The State of the Agriculture Sub-sector

The general perception in Nepal is that agriculture has been in disarray for various reasons which include the decade-long insurgency, political instability, inadequate public spending on agriculture and large-scale outmigration of youths. Are recent production trends consistent with this view? The data do not show that the sector is in disarray although production growth must be inadequate to meet the high demand, leading to soaring imports.

For agriculture as a whole, agricultural GDP (AGDP) grew fairly steadily since 2001, averaging 3.2% p.a. in constant prices during 2001–15. This rate of growth is not out of line with those in many other countries, e.g. in South Asia, 4.4% for Bangladesh, 3.7% for India, 3.1% for Pakistan and 3.8% for Sri Lanka (the target in Nepal's Agricultural Development Strategy or ADS is 5% p.a.). The data also show that the growth rate has been fairly steady since 2001 (3.2% p.a. during 2001–09 and 3.1% p.a. during 2010–15), which means that the recent surges in imports are not necessarily due to a slowing down of the sector.

The data on output growth of most food products also do not support the view that agriculture has slowed down, with the exception of some export crops. Figure 4 shows that production growth rates were positive for 16 of the 17 products, cardamoms being the exception, and also mostly positive on a per capita basis, two exceptions being paddy and cardamoms. Output growth was impressive for the other six food crops shown, with growth rates in recent years of 4% p.a. or more for pulses and fruits, and 3–4% p.a. for oilseeds, sugarcane and vegetables.

Likewise, three of the four export crops had production growth rates of over 2% in the second period but much higher earlier.

Did output growth rates of crops decelerate during recent years when food imports surged? On the whole, this does not seem to be the case as Fig. 4 shows—output growth rates were higher in the second period for 11 of the 17 products, which include cereals (due to a large turnaround for paddy) but also wheat and maize which grew steadily throughout the entire period. Other food products such as pulses, oilseeds, sugarcane and fruits also performed better in the second period. Two exceptions were potatoes and vegetables both of which also saw massive imports. For livestock products, except for milk, the performance was better in the second period. In contrast to this improved performance for food products, export crops fared badly in the second period, except for lentils. Thus, Nepal's sluggish growth in agricultural exports is consistent with worsened production trends but not so for the import-substituting food sub-sector.

4.2.2 The State of Agro-industry/Manufacturing

Manufacturing products made up about 35% of all agricultural exports during 2011–13 (Sect. 2). About 50% of Nepal's manufacturing output is estimated to be agricultural products, including forest-based industry, and thus, the state of manufacturing matters greatly for agricultural export performance. The performance of the manufacturing sector has worsened, with its share in Nepal's GDP falling to a very low level of 6% in 2015, perhaps one of the lowest in the world. Aside from the share, manufacturing GDP itself increased by just NPR 10 billion in constant prices in 14 years, or from $38 to $48 billion between 2001 and 2015. Both the indicators point to serious difficulties facing the sub-sector. It is possible, but highly unlikely, that the agro-industrial sub-sector could be performing better than the rest of the manufacturing, but data breakdown is not available.

A detailed analysis by the Central Bureau of Statistics (CBS) of the sub-sector based on data from Nepal's four censuses of manufacturing establishments (1997, 2002, 2007 and 2012) summarizes the state of the sub-sector as follows (CBS 2014):

- Very little structural change over the census years
- Very little change in diversification over the census years
- Substantial declines over time of the value added to output ratios
- A continuous decline in total factor productivity (TFP)

All these indicators point to serious structural problems. The CBS study also presents the results of a survey of perceptions of entrepreneurs on bottlenecks

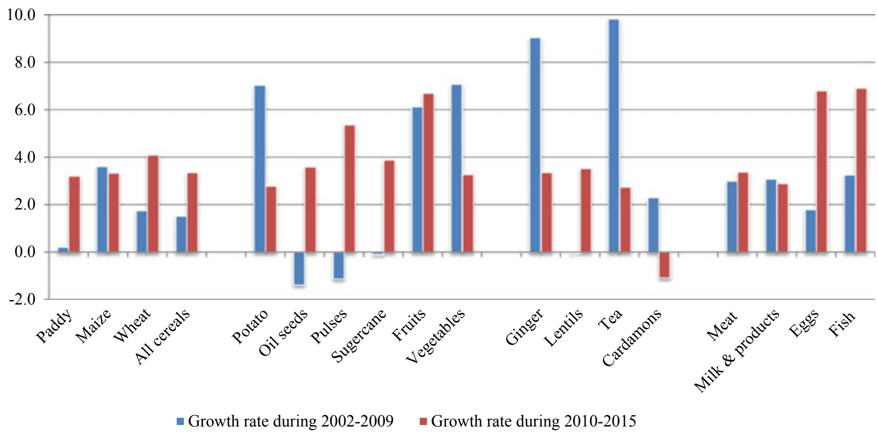

Fig. 4 Average annual growth rates of outputs of major crops and livestock products. (1) All cereals include millet and barley also, with paddy counted in rice equivalent (using a conversion factor of 0.65). Growth rates are trend rates estimated by regressing the log of the variable concerned on time trend, including all the years covered. For six crops in the group with potato and four livestock products, the series begin in 2005 (hence, the growth rates are for 2005–09 and 2010–15). *Source* Author, based on MoAD statistics

facing the sector that show electricity, labour problems such as frequent strikes, and shortages of skilled workers as top concerns.

4.2.3 Competitiveness in Production and Trade Vis-à-Vis India

This issue attracts considerable attention in Nepal, the general perception being that Nepal is losing out on this with the result that the state of agricultural trade has gone from bad to worse. High levels of support and subsidies to agriculture by the Indian government are often seen as the reason for the erosion of competitiveness, prompting calls for matching subsidies in Nepal as well. What follows assesses these questions based on reviews of: (i) trends in gaps in crop productivity between Nepal and India as one proxy for relative competitiveness; and (ii) likely effects of the Indian support and subsidy on Nepal's agriculture and trade.

Gaps in crop yields between India and Nepal, and their trends, are reviewed in Sharma et al. (2017) for selected food and non-food crops that are also traded between the two countries. The 11 products covered were Nepal's top three export products (tea, ginger and lentils), one potential export product (coffee), three principle cereals (rice, maize and wheat), and four other prominent foods (potatoes, sugar, pulses, and oilseeds). Growth rates of yields (in MT/hectare) were compared for two periods, the 1990s and 2000s. The main findings were as follows (details in Sharma et al. 2017).

First, for most years covered, India's average yield rates were higher than Nepal's for 9 of the 11 products covered, the two exceptions being lentils and ginger. Second, while yield rates were mostly higher in India, their growth rates were decelerating for several products with the result that yield gaps between India and Nepal were narrowing. Third, the decomposition of the production growth into contributions of area and yield showed that Nepal's performance markedly improved in the 2000s (that is, increased contributions of yield) and was generally superior to India's performance on this ground during the same period. Thus, the overall picture for Nepal's comparative performance on crop productivity is not as negative as is often perceived. Yields are still higher in India across the board but the gaps are narrowing, and this is occurring despite much higher level of support and subsidies to the Indian agriculture. Unlike these other crops, import substitution is more difficult for vegetables and fruits. For vegetables, the gap between potential and current yield is relatively small [17 MT/hectare versus 12.8 MT/hectare, according to the ADS (GoN/ADS 2015)], which means area has to expand markedly. For fruits, yields have been declining in recent years, which imply that more needs to be done on research, saplings and input delivery.

The second and related question asked above was the likely negative effects on the Nepalese agriculture and trade competitiveness of India's policies, and agricultural support and subsidies, with the general perception in Nepal that the effects are negative. Even Nepal's ADS has addressed this issue briefly, stating that there is some basis to claim that Indian products outcompete Nepalese products in Nepal's market, particularly cereals and horticultural products. The ADS calls for strengthening Nepal's ability to identify harmful import surges and to take counteracting measures. It also suggested a review of the provision on free trade in primary agriculture under bilateral Treaty and to explore the possibility of excluding cereals and horticultural products from the provision.

Indian agriculture benefits from a number of factors that confer it a competitive edge relative to farming in Nepal. These include availability of more advanced agricultural technologies from its public and private research system, better infrastructure such as roads and irrigation and economies of scale in production and manufacturing. The overall level of public support and subsidy is also higher. All these contribute to lower cost of production and competitive edge. On top of this, consumer subsidies lower the price of a number of food products. It is generally felt in Nepal that part of these subsidized food products find their way into Nepal and depress farm prices. While India regulates or restricts the export of these "essential goods", informal trade is believed to be substantial (Karmacharya 2010; Sharma 2017), one driver being the export restriction itself. There is thus some basis to claim that while Indian agricultural products have a general competitive advantage across the board, the situation is particularly marked in the case of these "essential goods". There is however no evidence on the magnitude of such effects for different products, and it could be worthwhile to undertake studies on this subject, as called for by the ADS also.

As regards products currently exported by Nepal to India (e.g. cardamoms, ginger, tea, other vegetative products, medicinal plants, etc.), these are not India's "food security" products and are not subject to restrictive trade interventions (other than NTBs) nor do they receive substantive subsidies in a manner that has negative impact on Nepal's export competitiveness. Moreover, the data show that India's recent performance on trends in crop yields of these products is not any better than Nepal's is. In this sense, Nepal's current basket of exports reflects natural comparative advantage in trade with India. If exports of these products are not growing, as recent data show, it could be because of the slowdown in production, or for quality and NTB reasons, but very unlikely due to the Indian trade policy or subsidies.

4.3 Access to Export Markets

Changes in market access terms often have an impact on trade flow. As an example, the surge in Nepal's exports of *Vanaspati ghee* to India was due to favourable access terms in 1996 Nepal–India Trade Treaty, as was the reason for the collapse of this trade following the removal of these concessions in the 2002 Treaty. Could changes in market access terms explain part of the recent surge in Nepal's imports from India and the weak export performance?

As regards Nepal's imports, there does not seem to be any such relation because the 2009 Treaty continued the same access provisions to India as existed for a long time. The same could be said for Nepal's imports from the RoW. Market access terms have been improving under SAFTA, due to tariff reduction program and shorter sensitive lists, but these have not triggered Nepal's imports from SAARC countries other than India. So, overall, a change in market access could not be a reason for recent surges in imports.

As for Nepal's agricultural exports, access terms to India under the bilateral treaty have not changed fundamentally since at least 2002, aside from some small changes such as additional border posts for trade. No significant change has taken place on NTBs also as some new reform measures included in the 2009 Treaty are yet to be implemented (see section on trade agreements and NTBs). With SAARC countries other than India, there have been improvements in access terms, as said above, but these have not spurred exports. As regards the RoW markets, preferential access terms have improved on tariffs and quotas but the situation on NTBs is unlikely to have improved. According to World Economic Forum's *Global Enabling Trade Report 2012* (WEF 2012), Nepal ranked 5th from top out of 132 countries in foreign market access index, better than Bangladesh (9th), Sri Lanka (77th), Pakistan (81st) and India (88th). The index is based on the level of protection facing exports in the destination market and is computed with two measures, tariffs faced and margin of preference. It does not include NTBs, which if included would have altered the rankings considerably as LDCs face many NTBs. This is good news for Nepal in general and also for attracting FDI. India and China, for example, do not have the highly favourable access terms to the RoW markets as

Nepal does, which could be an incentive for them to invest in Nepal for exports to the RoW.

In the meantime, margin of preference for Nepal's exports to India has been eroding over the years as India increasingly liberalized its import regime. More recently, India has granted duty-free quota-free access to most LDCs, further reducing the margins for Nepal and competitive edge. Overall, thus, there is some basis to claim that access terms have not improved much for the Nepalese agricultural products, which would be consistent with the sluggish rate of growth of Nepal's exports. There are no studies on the magnitude of these losses of the preferential margins and how various products are affected, but such studies would be useful to clarify this issue.

4.4 Non-tariff Barriers Facing Nepalese Agricultural Exports

There is a consensus that as ordinary tariffs and other restrictions are reduced to low levels or eliminated for most products, the NTBs remain one major constraint to trade expansion. For this reason, there are many studies on this subject. Three studies in particular provide detailed accounts of the NTBs facing Nepal's exports to India: the two NTIS reports (GoN/NTIS 2010, 2016) and Sharma et al. (2014). In addition, Sharma and Shrestha (2011) provide useful insights for medicinal plants and essential oils.

The two NTIS reports provide an assessment of prominent NTBs facing several export products. Thus, exports of *ginger* suffer periodically when India insists on post-entry laboratory tests in India to verify compliance with India's phytosanitary requirements, as happened twice in 2016 itself. Exports of *honey* to the European Union (EU) have suffered from SPS-related requirements, namely that Nepal demonstrates an effective national residue surveillance plan and testing laboratory that conforms to EU's accreditation requirements. As for *lentils*, the issue is again one of trust by India on Nepal's phytosanitary certification. *Tea* exports have also suffered from phytosanitary requirements, including certification of tests for soil, plant diseases and agrochemicals. *Cardamoms* also suffer from most of these weaknesses. Moreover, most countries have not as yet prescribed specifications for large cardamoms, nor has the FAO/WHO Codex formulated specific standards for large cardamoms. For *medicinal plants, forest products, herbs and essential oils*, the main issue has been the limited listing of products in India's Plant Quarantine Order while Nepal exports many more. While listed products are allowed with a phytosanitary certificate issued by Nepal, testing requirements are stringent for those not listed.

Based on these and other assessments, a number of suggestions have been made on NTBs, notably in SPS areas. The NTIS analyses acknowledge that many of the SPS-related requirements imposed by importing countries are in fact consistent with the SPS Agreement and implemented in a non-discriminatory manner, that is, also required for domestic producers. This shifts the burden of compliance to mainly Nepal.

Required responses are broadly of two types. First, as most problems related to safety and quality of the products have their roots in "poor" practices throughout the value chain (production, collection, post-harvest and processing stages), the appropriate response is to adopt globally accepted "good" practices, such as food agricultural practices, good manufacturing practices, etc. Poor practices are systemic and not commodity-specific. This is the domain of research, extension and education, as well as of incentives and penalties. The second category of responses is upgrading the capacity of laboratories and institutions to undertake tests so that the certification issued by Nepal is accepted. Action is needed in a number of areas such as formulating new standards, obtaining accreditation, capacity for risk analysis and traceability, third-party certification and reforms in institutions and legislative fronts.

The Nepal–India Trade Treaty provides for recognizing SPS certificates issued by the exporting country, subject to meeting the required capacity for certification and to products meeting the mandatory requirement of the importing country. Nepal has been working to meet the requirements for testing and certification to meet India's requirements but there is still some distance to go. Trade facilitation measures on the ground, including extra measures for perishable products, are also addressed in the Treaty, but it takes effort from both sides to implement them on the ground.

Finally, there are *some other drivers of trade competition* worth noting. One is the general perception that the Nepalese rupee is overvalued vis-à-vis the Indian rupee due to gaps in inflation. Some estimates available show overvaluation, but there is no consensus on by how much. The ADS has called for a review of the policy of pegged exchange rate with India and its impact on the agricultural sector. Somewhat related, the ADS also called for identifying and reducing pro-manufacturing bias in tariff structure as this creates an anti-export bias. A third factor identified for the erosion of competitiveness is rapid growth in wage rates, both in agriculture and elsewhere, without accompanied by productivity growth. The data from the Nepal Rastra Bank show rapid increases in wage indices in recent years: for overall wage index, a growth rate 10% p.a. during 2005–09 and 15% p.a. during 2010–15, with 11% p.a. and 16% p.a. for agricultural labour, and 9% p.a. and 15% p.a. for industrial labour, respectively, for the first and second periods. Thus, overall, a number of indicators seem to point to an erosion of competition in recent years, which could have a role in the import surge and sluggish growth of exports.

4.5 Reliability of Trade Statistics—"Mirror" Data and Informal Trade

The accuracy of trade data, as well as production statistics, is frequently raised in literature and seminars on trade, commodity balances and food policy. Two particular reasons for questioning Nepal's trade data with India are presumed large unrecorded or informal cross-border trade (ICBT) due to porous borders, and free trade in agriculture which tends to reduce the incentive on the part of the customs offices to record all trade that passes through the customs. The specific question asked here is whether and to what extent the ICBT might shed light on recent trends in Nepal's trade with India. The discussion is based on two sources of information: (i) mirror data, that is Nepal's trade data as recorded in the Indian data; and (ii) estimates of informal trade.

4.5.1 Nepal's Trade with India According to the Indian Data

"Mirror data", i.e. trade data from a trade partner, could be useful for verifying the accuracy of trade data of the partner country. Although the two sources rarely converge for reasons such as different valuations, CIF in one case and FOB in the other, they should show similar trends. Between 2004 and 2009, when Nepal's imports were growing relatively slowly, both sources showed similar values for Nepal's imports. But the differences widen considerably after 2009. During 2010–2016, Nepal's total import from India was \$554 million per year as per the Nepal data but only \$453 million per year as per the Indian data (India's exports to Nepal), or a difference of \$100 million per year on average (Sharma 2017). Both sources agree that Nepal's imports surged after 2010, breaking with the past trend.

Mirror data tend to vary by types of products. For example, the Indian data show markedly lower exports of products that are declared by India as "essential goods" and their exports regulated or restricted. For 2010–2016, the value of Nepal's imports of a number of such products (total for urea, rice, wheat, pulses, sugar, live buffalo and live goat) was 1.8 times higher as per Nepal's data than that recorded in the Indian export data (\$242 million versus \$134 million per year). It seems that either the Indian customs do not record a large part of this trade because these are officially restricted or that large volumes of these products are imported into Nepal through borders where there are Nepalese but not the Indian customs.

As regards Nepal's agricultural exports, the Indian source consistently shows lower values. Between 2004 and 2009, when Nepal's exports were essentially flat, the average value was \$101 million as per the Indian data and \$138 million in Nepal's data. But the difference narrowed considerably to just 11% during 2010–2014 (with Indian data showing lower values) when Nepal's exports were growing fairly strongly.

Thus, overall, the Indian source markedly underestimated the value of Nepal's trade with India. Based on the Indian data, Nepal's agricultural imports from India between 2009 and 2014 would have been 25% lower on average while exports to India would have been 11% lower, which means smaller trade deficits. This means that the Indian data do neither fully provide further insights to validate Nepal's soaring imports in recent years nor point to the possibility that Nepal's exports might have been higher than recorded by Nepal.

4.5.2 Unrecorded or Informal Cross-Border Trade (ICBT) with India

Despite widespread interest, evidence on ICBT with India is poor. Some estimates for agriculture for the year 2009 are available in a study commissioned by FAO for the MoAD (Karmacharya 2010). It estimated that the total value of informal imports by Nepal of 27 agricultural products was $693 million in 2009, which was *seven* times more than the value of recorded, official imports of those products ($96 million). Informal imports were high for rice, sugar, edible oils, oilseeds, pulses, fish, spices and powder milk. As regards exports to India, the estimates were made for 14 products which were identified as prominent products for ICBT. Eight of these were notable for informality. The total value of informal exports of these eight products was $130 million, which was ***five*** times the value of recorded exports ($25 million). The prominent products were hides and skins/leather, garlic, apple, ginger, betel nuts and large cardamoms and jute/jute products.

No similar study is available for recent years. One 2017 study sought to identify products with relatively large ICBT and to assess the likely scale, nature and drivers of this trade based on recent trade data, views expressed in official Nepal–India trade meetings, literature, media stories, and anecdotes of traders and officials (Sharma 2017). It grouped products into three categories based on different drivers of this trade: (i) products unauthorized under Nepal–India Trade Treaty for exports to India because they do not meet country of origin (CoO) requirement, mainly alleged to be third-country products (e.g. betel nuts, garlic, apples and ginger); (ii) products unauthorized under the Treaty for imports into Nepal without India's permission because the goods are subject to export regulation by India (under Essential Commodities Act) (e.g. fertilizers, rice and wheat, pulses, sugar, edible oils); and (iii) products that Nepal can export freely under the Treaty but informal trade continues to be attractive as formal trade faces sanitary, phytosanitary and other trade facilitation-related difficulties.

The main driver of the ICBT for the first category was tariff differential—India's high applied tariffs versus none if exported via Nepal with a certificate of country of origin (CoO). This, the CoO, was the main loophole for this trade which is illegal under the Treaty. Exports of these products are at times disrupted as India bans or tightens imports when trade deflection is suspected, thus hurting genuine trade as well. For category 2 products, the main driver is price gaps on account of India's consumer subsidies to those products, which is why India has to regulate their exports. The mirror data show large gaps in such products. When these gaps are high and exceed the cost of trading informally, it is but natural that the scale of informal trade rises. The third category of products includes most other agricultural and forest-based products exported from Nepal which meet the CoO test but face a range of NTBs, notably related to phytosanitary and trade facilitation (as summarized in Sect. 4.4). The main issue is that these products face the *risk* of trade disruption, often unannounced, as quarantine certificates issued from Nepal could be easily questioned.

Does ICBT explain part of the trends in Nepal's recent trade with India? One conjecture would be Nepal's imports soared in recent years because a big share of the large informal imports became formal since around 2010. This argument, however, does not seem plausible because for such large shifts to occur, there has to be substantive changes in the drivers of the ICBT, such as elimination of the NTBs, substantive cuts in red tape and transaction costs associated with formal trade, change in some provisions in the trade agreement and so on. None of this has happened. As regards exports, there is some basis to hold that a substantial share of Nepal's agricultural goods, especially fresh agricultural and forest-based products, continues to be exported informally as barriers to trading formally, especially those related to phytosanitary and trade facilitation measures, have not come down notably in recent years.

5 Nepal's Trade Competitiveness and Export Potential as Revealed by Trade Data

The availability of detailed trade statistics at the product level has enabled trade analysts to use a variety of indices for analysing the structure of trade and prospects for growth. This section reviews latest estimates of three such measures: (i) Revealed Comparative Advantage (RCA); (ii) Nepal's trade complementarity with India; and (iii) Nepal's export potentials in the Indian market.

The main results are as follows (see Sharma et al. 2017 for detailed results). First, the average RCA values[7] for 2011–2013 exceeded one (that is, had comparative advantage) for all 23 agricultural export products covered, with high values for most products including all of Nepal's top exports. Furthermore, the RCA values trended positively during 2009–13 for 15 of the 23 products, which include six of the top 10 exports, with high growth rates for cardamoms, juice mixtures, orange juice and ginger. This is an indication of improvements in global comparative advantage. Second, the analysis of the *Trade Complementarity Index* (TCI), which measures the degree to which the export pattern of one country matches the import pattern of another, showed that agricultural export profile of Nepal matches

[7]The RCA is a measure of a country's relative advantage or disadvantage in a specific industry as evidenced by trade flows and is measured as a ratio of two trade shares. The numerator is the share of a country's total export of a given commodity (for example, ginger) in that country's total exports of all goods. The denominator is the share of the total world export of the same commodity (that is, ginger) in total world exports. For a product to possess global comparative advantage, the RCA value should exceed one.

almost perfectly with the import profile of India, with an average TCI of 87% (TCI values range between 0 and 100%, the latter indicating perfect complementarity) during 2011–13, indicating excellent prospects for Nepal's exports. The same was the case for India's agricultural exports to Nepal (TCI of 90%). This is in contrast to non-agricultural products for which Nepal's export profile matches poorly with India's import profile (TCI of 16%), while India's export profile matches much better with Nepal's import profile (TCI of 40%).

The third index, *Indicative Trade Potential* (ITP), measures export potential, additional to what is currently exported, in a target market. The ITP is computed by comparing the size of the market of the importing country with export capacity of the exporting country, with one of the two settings the limit to trade for a product at any given time. The results show fairly small *additional* agricultural export potential for Nepal in the Indian market, only about $49 million only during 2011–13. Moreover, trade potential was limited to fairly few products (lentils, medicinal plants and food preparations). These results are not encouraging. The reason for the low ITP was that, for most products, the binding constraint to trade potential during 2009–2013 was Nepal's export capacity and not the Indian market, i.e. India had absorbed all that Nepal could export and thus there was little additional room left, given Nepal's export capacity. The data also showed steady decline in agricultural ITP in the Indian market as India absorbed more and more of Nepal's exports.

6 Summary and Conclusions

The state of Nepal's agricultural trade is not healthy as most indicators of trends and structure show: escalating imports, slow growth in exports dominated by low value added products, surging trade deficits and very narrow product and export market concentration. The analysis of the drivers of trade showed that agriculture, especially the much larger import-competing food sub-sector, has grown reasonably well in recent years but clearly inadequate to meet the surging demand for foodstuffs, hence the escalating imports. In contrast, the export crop sub-sector has not been performing as well while agro-industry (manufacturing) has been shrinking and in a state of disarray. The business environment for industry has worsened, largely due to systemic failures in infrastructure and governance. As regards trade-specific drivers such as the provisions in Nepal's trade agreements, preferential access to export markets and the incidence of trade barriers, the situation might not have improved but also have not worsened, and thus, the worsening of the trade indicators in recent years is unlikely to be related to these trade-specific drivers.

Given that the main fault line is the inadequacy of supply to respond to demand growth, solutions have to be found in vibrant and dynamic agricultural and agro-industrial sub-sectors. For agriculture, the Agricultural Development Strategy (ADS) provides the framework. The ADS has projected that in 20 years, with full implementation, agricultural exports should increase by *eight* times to reach

$2000 million, which, together with large-scale import substitution, would turn agricultural trade balance positive to the tune of $690 million. Nepal is also projected to be surplus in food grains by 0–5%. As for agro-industry, this sub-sector suffers from a number of systemic ills that will improve only slowly. On a positive note, there is now in Nepal a large and rapidly growing market for a variety of processed foods for the manufacturing sub-sector to seize and grow.

As for trade-specific issues, the two main challenges are on NTBs and trade facilitation. The primary responsibility for responding to the issues rests on Nepal. On NTBs, three categories of responses are identified: (i) promoting good practices in production and throughout the value chains, through research, extension and education, as well as through incentives and penalties; (ii) investing substantially to upgrade the capacity of laboratories and institutions to undertake required tests for export certification; and (iii) generating through studies evidence on NTBs facing Nepal's exports, including the scale of losses, reasons for NTBs, as well as their compliance with WTO rules. This information should be put into public domain so that there is a common understanding of the problems and also used as evidence for pressing reforms through formal meetings with trading partners. The new WTO Agreement on Trade Facilitation (ATF) is promising in addressing some of the long-standing difficulties facing Nepal, including transiting goods across the borders and trade in perishable products. The ATF is also useful for improving some provisions on SPS-related issues.

Although very little trade takes place currently under SAFTA, it could be a valuable framework for trade and investment, notably for resolving NTBs and difficulties related to trade facilitation, because there are certain issues that are best resolved at the regional level. SARSO, the regional body for standards, could be the main forum for addressing this issue. Nepal needs to be proactive in advocating the strengthening SARSO. Nepal could also explore the pros and cons of broadening SARSO's mandate to also cover various NTBs and trade facilitation.

Towards responding to various issues discussed in this chapter, what follows is a list of activities that could be initiated by the Government of Nepal:

- The Ministry of Commerce and Supplies (MoCS) could launch a multi-year program involving stakeholders under which all cases of the NTBs facing Nepal are documented, their scientific and legal status clarified and the damage done quantified, and this information made available in the public domain. Such evidence is crucial not only for effective trade negotiations but also for generating public pressure for reform.
- This initiative on generating evidence on NTBs beyond the border should be complemented with a substantive work program on promoting good practices in production and throughout the supply chain and upgrading of the capacity of laboratories and institutions to undertake test required for export certification.
- Also related to NTBs, the MoCS could launch a work program on the new WTO Agreement on Trade Facilitation. The scope of this work should include both implementing the agreement by Nepal and also monitoring and analysing how effectively various provisions are being implemented by Nepal's main trading

partners such as India and China. The analysis would be valuable for traders but also for official meetings and negotiations.

- The Ministry of Agricultural Development (MoAD) and MoCS could jointly commission a study to generate evidence on the claim that free trade in primary agriculture is undermining the competitiveness of Nepal's food sub-sector. This could also address the claim that Nepal might be better off with SAFTA-type free trade with a sensitive list of food products than with free trade without product exception and full reciprocity as under the Nepal–India Trade Treaty.
- Towards implementing Nepal's new trade policy and NTIS, MoAD or/and MoCS could establish a web site dedicated to the agricultural products listed in NTIS and populated with valuable information such as statistics, government support and subsidies, export markets and prices and links to related studies.

References

CBS. (2014). *Development of manufacturing industries in Nepal: Current state and future challenges*. Kathmandu: CBS. http://cbs.gov.np/image/data/Manufacturing/Development%20of%20Manufacturing%20Industries%20in%20Nepal,%202014/Devlopment-of-manufacturing-industries-in-Nepal.pdf.

GoN. (2015). *Trade Policy 2015, Ministry of Commerce and Supplies*. Government of Nepal.

GoN/ADS. (2015). *Agriculture development strategy: 2015–203*. Ministry of Agricultural Development, Government of Nepal. Kathmandu, Nepal. http://www.moad.gov.np/en/.

GoN/NTIS. (2010). *Nepal trade integration strategy 2010—Executive summary and action matrix, Ministry of Commerce and Supplies, Government of Nepal*. Kathmandu. http://www.mocs.gov.np/uploads/NTIS%202010%20exe%20sum%20160610.pdf.

GoN/NTIS. (2016). *Nepal trade integration strategy*: *Executive summary and action matrix*. Kathmandu: Government of Nepal, Ministry of Commerce. www.moc.gov.np/uploads/Strategy/NTIS%202016.pdf.

Islam, Md. R. (2010). Constraints of the agreement on South Asian free trade area and SAARC agreement on trade in services militating against sub-regional trade proliferation in South Asia. *Brigham Young University International Law and Management Review, 7*(1), Article 2.http://digitalcommons.law.byu.edu/ilmr/vol7/iss1/2.

Karmacharya, B. (2010). *A study on cross-border informal trade between Nepal and India on selected agricultural commodities*. Study commissioned by FAO. Kathmandu: NCDR (National Council for Development Research).

Ratna, R. S., & Sidhu, G. (2007). *Making SAFTA a success: The role of India*. Paper prepared for CUTS International, Jaipur. www.cuts-citee.org/pdf/RREPORT08-AP-03.pdf.

Sharma, R. (2017). *The scale and drivers of informal trade in agricultural products across the Nepal–India borders*. Paper prepared for the SAARC Agricultural Trade Forum, Organized by SAARC Agriculture Centre and FAO, May 22–23, 2017, Dhaka, Bangladesh.

Sharma, P., & Shrestha, N. (2011). *Promoting exports of medicinal and aromatic plants (Maps) and essential oils from Nepal*. Study for WTO/EIF Support Programme. Kathmandu: SAWTEE. http://www.sawtee.org/Research_Reports/R2011-04.pdf.

Sharma, B. P., Adhikari, S. R., Bhusal, T. P., Pande, B., Bhattarai, K., Adhikari, D. B., & Dahal, A. R. (2014). *An assessment of export barriers of Nepalese products to India*. Study commissioned by Research Department Nepal Rastra Bank. Department of Economics, Patan Multiple Campus, Tribhuvan University.

Sharma, R., Kumar, A., & Joshi, P. K. (2017). Nepal–India agricultural trade: Trends, issues, and Prospects. Policy Reform Initiative Project (PRIP)-Nepal Report 3, IFPRI.

WEF. (2012). *The global enabling trade report 2012: Reducing supply chain barriers*. World Economic Forum. http://www3.weforum.org/docs/GETR/2012/GlobalEnablingTrade_Report.pdf.

WTO. (2012). *Trade policy review: Nepal—Report by Nepal*. https://www.wto.org/english/tratop_e/tpr_e/tp357_e.htm.

WTO. (2015). *Trade policy review: India—Report by the Secretariat*. https://www.wto.org/english/tratop_e/tpr_e/s313_e.pdf.

Chapter 16
Agricultural Marketing and High-Value Chains: Enhanced Role for Private Sector Towards Value Chain Integration

Rajendra Adhikari

Abstract This chapter reviews the existing government policies and programmes on high-value chain development and by using a case study, demonstrates how value chains can benefit different stakeholders of agri-food systems. It then draws policy implications and recommendations on areas of immediate focus and further research. It suggests that value chain upgradation and integration into global value chain can spur positive impact on the economy as well as on the livelihood of the people dependent on agriculture and therefore all efforts need to be made to develop efficient value chains in agriculture.

Acronyms

ACIAR	Australian Centre for International Agricultural Research
ADB	Asian Development Bank
APP	Agriculture Perspective Plan
APROSC	Agriculture Project Service Centre
CADP	Commercial Agriculture Development Project
CEAPRED	Centre for Environmental and Agricultural Policy Research, Extension and Development
DANIDA	Danish International Development Agency
DFID	Department for International Development
EU	European Union
FAO	Food and Agriculture Organisation
GON	Government of Nepal
GTZ	German Agency for Technical Cooperation
HVAP	High-value Agriculture Project
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
JICA	Japan International Cooperation Agency
MOAC	Ministry of Agriculture and Cooperatives

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G. Thapa et al. (eds.), *Agricultural Transformation in Nepal*,
https://doi.org/10.1007/978-981-32-9648-0_16

Nepal-SIMI	Nepal Smallholder Irrigation Market Initiative
NPC	National Planning Commission
PACT	Project for Agriculture Commercialization and Trade
RFID	Radio Frequency Identification Device
RISMFP	Raising incomes of small and medium farmers' project
SDC	Swiss Agency for Development and Cooperation
SNV	SNV Netherlands Development Organisation
UK	United Kingdom
UNIDO	United Nations Industrial Development Organization
USA	United States of America
USAID	United States Agency for International Development
VADEP	Value Chain Development Program
VC	Value chain
VCA	Value chain analysis
WFP	World Food Program

1 Introduction

Over many years, Nepalese agriculture has experienced a public-sector-led development. The typical support in agriculture from the public sector, including the support from the development partners, has mostly been focused on increasing agricultural production. In the government's own agricultural development programs, farmers have been almost always the target beneficiaries and the focus has been on building their production capabilities (MOAC 2004; NPC 2011). Even market development interventions were designed to provide supports to farmers. Similarly, various donor-funded programs such as the Block Production, Farming Systems Research and Extension, Integrated Pest Management and Integrated Rural Development programs all adopted a farmer-oriented research and extension approach (FAO 2010). Despite a gap in the production and post-production support, some positive outcomes have emerged in high-value commodity sub-sectors such as coffee, tea, fresh vegetables, poultry, fruits, ginger and cardamom that have recorded a steady expansion of the number of farm units, areas and productions. A new cohort of high-end farmers and agribusinesses, which are more capable and resourceful than the majority of other smallholder farmers, are emerging in these high-value commodity sub-sectors.

Yet, these programs from government and development partners have been unable to translate the resources and efforts into a performance that transforms the whole agriculture sector (NPC 2002). This has largely been attributed to market side constraints such as inadequate marketing infrastructure and facilities, poor integration of farmers with markets, low level of post-production value additions and supply which is unresponsive to market demand (ANZDEC 2002; Blaikie et al. 2002).

Besides these industry-wide constraints, continuously decreasing share of farmers in consumers' expenditure is a typical challenge realized at the farm level, which has made the production agriculture a low-return endeavour. The problems are more prominent in high-value commodities such as tea, coffee, vegetables and fruits (Thapaliya 2006; NPC 2010). The dynamics of their competitions have shifted from domestic levels to international levels. Various underlying social, political and economic factors are responsible for this situation. Evidence abounds that solutions to most of these problems with economic roots do not lie solely within the public sector mechanism.

This is both a challenge and an opportunity for the cohort of emerging high-end farmers and agribusinesses that emanates at a time when globalization is driving greater integration between production and markets, technology is enabling this to happen more efficiently and effectively, and consumerism is providing clearer demand signals to producers (Dunne and Collins 2004; Humphrey 2006). Some authors (Reardon et al. 2003, 2009; Weatherspoon and Reardon 2003; Vorley et al. 2007; Timmer 2009; Hazell et al. 2010) have already warned that farmers unable to integrate with markets could be marginalized under new levels of global competition. Responding to these requirements and opportunities is not straightforward, particularly for a developing country, due to small quantities of production, limited resources, actors in the agri-food industry operating independently of each other and isolation of farmers from market signals.

These opportunities, constraints and challenges have prompted stakeholders to redefine their agricultural development approaches towards the whole-of-chain development and management perspectives (Swinnen and Maertens 2007; Byerlee et al. 2009; Humphrey and Navas-Aleman 2010; Helmsing and Vellema 2011; Hospes and Clancy 2011), which are increasingly being referred to as value chain (VC) approaches (Collins 2009; Taylor and Fearne 2009; Cattaneo et al. 2010; Folke et al. 2010; Webber and Labaste 2010; Gómez et al. 2011; Fearne et al. 2012; Soosay et al. 2012). Agri-food industry development in Nepal is not immune to these emerging trends and, therefore, has responded by adopting VC as a new agricultural development approach. VC approach is hailed as one of the successful ways to enhance farmers' access to markets and bring all actors of the chain as an integrated whole close to consumers.

For major development actors, the VC approach has been an emerging development paradigm over past decades in the agri-food industry of various developing countries. In Nepal, the VC approach to agri-food industry development has been introduced by government and development partners (ANZDEC 2003a) since early-2000, underscoring the importance of supporting all actors, including farmers, in agri-food chains. The Nepalese government is currently implementing major agricultural projects with support from development partners such as the World Bank, the Asian Development Bank (ADB) and the International Fund for Agricultural Development (IFAD), all of which promote VCs in some way in their development approaches (CADP 2011; MOAC 2011; RISMFP 2011; HVAP 2012; PACT 2012; ADB 2011). Other development partners[1] working with the government have also applied a similar approach.

The Nepalese government acknowledges VC approach as a means to achieve its broader societal goal of private sector development (GON 2015) by increasing the efficiency and effectiveness of the existing food systems, improving collaborations among chain actors and enhancing the competitiveness of the value chains (GON 2015). At the same time, this approach has remained largely within the confinement of the public-sector-led agricultural development initiatives. This approach of agri-food industry development only represents one facet of multitudes of applications of the VC principles in the agri-food industry, described in Sect. 3. Each of these facets requires different conditions and pathways to succeed. Fortunately, VC allows both the public and the private sector to apply the concept in agri-food industry, albeit through different pathways.

Elsewhere, this approach is central to private sector development objective of bilateral and multilateral development partners, international non-governmental organizations and United Nations agencies (UNIDO 2009). VC has also been used by government and development stakeholders as an agribusiness development model. In 2015, the Government of Nepal formulated Agriculture Development Strategy (2015–2035), which identifies VC management as one of the four flagship areas for the agribusiness development in the country. Formulation of Agriculture Development Strategy (2015–2035) is an opportunity to transform the Nepalese agriculture with a shift towards a more advanced role for the private sector in the VC development. This is a high time to complement the government's VC approach of development by the private sectors' adoption of the VC strategy. The global trend of consumerism and business actors' response to it through the development of VCs (Boehlje 1999; Swinnen and Maertens 2007; Byerlee et al. 2009) implies that VC has become a vehicle for private sector to achieving the competitive advantage through the creation and delivery of consumer value (Taylor 2005; Fearne et al. 2012).

Advancing the private sector as a champion of VC development requires a fundamental shift in the mindset, both in public and private sectors, towards adopting VC as a business strategy. On issues related to the business, roles and responsibilities of the government and the development actors shift from championing to facilitating. The leadership role rests on the private sector. Exploring and sharing the Nepalese experiences of VC development so far might be useful to operationalize this fundamental shift from welfare-oriented development approach to market-oriented business approach as demanded by the Nepalese Agriculture Development Strategy (2015–2035).

[1]For example, such as USAID, SNV Netherlands Development Organisation (SNV), and Centre for Environmental and Agricultural Policy Research, Extension and Development (CEAPRED), and Nepal Smallholder Irrigation Market Initiative (Nepal-SIMI), DANIDA.

2 Purpose

The main purpose of this chapter is to argue that private sector can and should adopt VC development as a business strategy as a complement to the public sector's VC development initiatives. It uses economic rationale and market-side opportunities as the bases for the argument. Using reviews and a case study, it examines the conditions and benefits of advancing VC as a business strategy in the Nepalese context.

The remainder of the chapter is structured in seven sections. The next section provides a conceptual background on the meaning and typology of the VCs in the agri-food context, which is followed by a review of the existing policies and programs of the government of Nepal on VC development. It then, using a case study, demonstrates how VC can benefit actors and stakeholders of agri-food systems. Discussion and conclusions follow the analysis of the case study results. Finally, the chapter draws policy implications and makes recommendations on areas of immediate focus and further research.

3 Value Chain: Meaning and Typology Definition

Adhikari (2013) defines a value chain as a relationship-based governance structure focused on value-creating activities of a product or service from its conception to consumption to efficiently and effectively deliver value as defined by the consumers. In a VC, consumer value is the guiding force. VCs are developed and managed with the objective of delivering attributes that consumers value (Zokaei and Simons 2006). Since consumers are the ultimate determiners of what constitutes a value in a product (Zeithaml 1988), the locus of power in business is moving from producers to consumers (Gereffi 2001; Hines et al. 2004). Therefore, an understanding of markets where consumers manifest their behaviour is central in VC development and management.

4 Typology of Value Chains

A multitude of evidence suggesting greater competitiveness achieved through the VC integration underscores the rising popularity of the approach. Based on the champion, scale and coverage of the VC development initiatives in agri-food industry, VCs can be categorized into three groups: (1) Global VC; (2) Industry VC; and (3) Enterprise VC.

1. ***Global VC***

The process of globalization has compelled and enabled actors in the agri-food industry to be integrated into chains beyond their national boundaries (Kaplinsky

2000; Gereffi et al. 2001). The objective of global VC is to link retailers in developed countries with producers in underdeveloped countries. "Rules of the game" for VC are set by the leading business institutions (Gibbon 2001, 60). Global VCs are involved in the redistribution of value among actors, policy environments and the role of power and governance in the redistribution process (Kaplinsky 2000; Gereffi et al. 2001; Gereffi 2001). These are the VCs where export-oriented domestic production can be linked. Issues such as creating an enabling policy environment for international customers by developing certifications and quality standards, regulating contract laws, facilitating domestic producers through negotiations and arbitrations, developing freights and aerial infrastructure and supporting the promotion of national brands through economic diplomacy are the intervention areas through which the government can facilitate the integration of domestic actors into the global VCs. There are many examples (such as in Box 1) that smallholder farmers from developing countries have been benefitted by upgrading into the global VCs.

Box 1: Global value chain: Case of UK-Africa horticultural product chains
UK-Africa horticultural product chains are examples of global value chains. Driven by powerful retailers in the UK, these chains link affluent consumers in the UK with fragmented and diverse producers in Kenya. With increasing demand from consumers for quality and diversity of horticultural produce, retailers faced increased pressure to establish closer relationships with a small number of actors in tightly structured chains. Management of these chains spanned two continents, requiring a concentration of upstream actors, resulting in structural changes in the upstream economy. Upstream actors benefitted through market assurance and higher profits. At the same time, these actors had to meet high product quality standards. Integration of actors into these global chains also impacted on the nature of the industries, both upstream and downstream (Based on Dolan 2004).

2. ***Industry VC***

Industry VC can be compared to the sectoral approach of development. Donor organizations such as the World Bank, ADB, the Australian Centre for International Agricultural Research (ACIAR), United States Agency for International Development (USAID), Department for International Development (DFID), United Nations Industrial Development Organization (UNIDO) and German Agency for Technical Cooperation (GTZ), SNV have used this approach to develop the overall agri-food industry (for example, M4P 2008; Folke et al. 2010; Shrestha 2010; Webber and Labaste 2010; Collins and Iqbal 2011). In this approach, macro-level objectives of a country and the donors guide the VC development interventions. The ultimate goal of VCs in this approach is to achieve broader societal objectives such as poverty reduction (M4P 2008), rural industry development (Collins and Iqbal 2011), promoting economic development (GTZ 2007), mainly by achieving agricultural industry competitiveness (Ruth 2008). The VC development interventions in this approach are more focused on markets, in general, developing linkages between the horizontally integrated producers and market-actors and enhancing the VC capability of actors in chains to establish those linkages. The public sector agencies directly support these actors. Once these actors achieve a certain level of capabilities and establish rapports with potential partners, they would be expected to engage in the enterprise or global VCs (refer to Box2 for an example).

Box 2: Industry value chain: the case of the Pakistan mango industry
Pakistan is the sixth largest mango exporter in the world (Collins and Iqbal 2011). The industry is also the second-largest fruit industry in Pakistan (Mehdi 2012), growing delicious varieties of mangoes which are exported to countries in Gulf region, as well as Europe, including the UK, which is the largest European importer of Pakistani mangoes (Collins and Iqbal 2011). Despite having promising varieties and consumers in affluent economies, Pakistan receives the lowest price for mangoes on the world export markets (Mehdi 2012). In 2006, the Australian Centre for International Agricultural Research funded a project, "Improving the supply chain performance of the mango industry in Pakistan" which adopted a whole-of-chain approach to development. The project started with a scoping study to identify developmental opportunities and barriers, and followed up with postharvest, market and consumer research to develop chain-based interventions for industry development. Export markets in China and the UK were targeted with fruit from the project's demonstration chains that adopted improved practices. The project was value-chain-based as signals from consumers were identified and chain development interventions were based on chain actors understanding those signals. Although pilot scale, the export chains demonstrated implementability of the model in practice. This is an example of a value chain perspective being applied as an agricultural development approach by development partners.

3. ***Enterprise VC***

The objective of enterprise VC is to achieve efficiency through the improvement in existing chain processes and effectiveness through redesign of targeted consumer-focused VCs (Zokaei and Simons 2006). This approach emphasizes the consumer value dimension in chain upgrading (Lim-Camacho et al. 2006; Collins

2009). This approach acknowledges that consumers are the ultimate arbitrator of value (Grunert et al. 2005; Humphrey 2006; Bonney et al. 2007; Collins and Dunne 2002; Collins 2010; Taylor and Fearne 2009; Fearne 2009) in VCs. These VCs mostly subscribe to high-end consumers who are willing to pay a premium price for the attributes they pursued (refer to Box 3 for an example).

Box 3: Enterprise level value chains: Houston's farm-fresh salad value chain

A fresh salad value chain from Tasmania is an example of an enterprise-level value chain. Houston's Farm was involved in the production of green salad as a commodity in a highly competitive market niche. With little value addition downstream of the chain, the firm was under intense pressure to reduce costs to remain competitive. The introduction of an innovative value chain management approach, which began with a consumer survey of more than 700 shoppers at leading retail outlets, enabled consumer value perspectives on Huston's product attributes to be identified. A value-added product in the form of cut and bagged salad was developed as a result. A small number of actors in the value chain jointly identified improvement opportunities in terms of creating or adding value and reducing waste, resulting in improved performance of the chain and co-innovation of new products with attributes attractive to a major segment of green salad consumers in the market. The chain was championed by a lead firm, Houston's Farm, and intervention in chain management was guided by a consumer value perspective and a focus on collaboration among small numbers of upstream and downstream actors (Based on Bonney et al. 2007).

Table 1 compares the three different types of value chains in terms of their nature, focus and characteristics.

In essence, literature within the stream of VC development highlights that a whole-of-chain approach is being increasingly used in the agri-food industry. While industry VCs take a sectoral perspective and is largely a public-sector-driven development approach, enterprise and global VCs are private-sector-driven business strategies. Enterprise VC operationalizes the concept at the microlevel. The global VC extends the concept of microlevel enterprise VC across the physical boundary of the country to international domain. In all cases, understanding market and consumer value is becoming the guiding construct, which is at the heart of the VC principles.

At the same time, VCs' related initiatives have a different focus. Each of the three dominant categories of VCs has its own focus and priorities. They have been championed by different actors or stakeholders and have different aims. Policy and programme level interventions related to VC development need to appreciate these differences.

Table 1 Typology of value chains: nature, characteristic and focus

Factors	Industry VC	Global VC	Local VC
Coverage/ Scope	Sectoral development	Export market	Domestic high-end market
Primary focus	Commodity market (Domestic)	International market	Niche market or consumers
Championship	Government or development actors	Multinational company	Supermarket or corporate agribusinesses,
Policy requirement	Sectoral priority, research and development, innovation, direct subsidies and incentives	Macroeconomic stability, arbitration, laboratories and accreditation for quality standards and certification, contract laws and foreign investment, no non-tariff barriers, processing industries	Logistics, national quality standards, certificates and enforcement, market research and information systems
Market development focus	Hardware market infrastructure, farmer markets; infrastructure, input and technological support	Logistics and information software, labelling, freight and aerial transport services and infrastructure, international expo and trade fairs, value-adding processes	Logistics (refrigerated van, RFID tags), postharvest processing, storage, VC development fund
Nature of integration	Increasing the capability of actors at different nodes (horizontal integration, vertical coordination)	Horizontal integration (among producers for economies of scale) and vertical functional integration (for value addition)	Vertical collaboration (between niche producers, retailers and consumers) and horizontal coordination among producers)
Related commodities	High-value, high-volume	High-value, low-volume, value-added or processed	High-value highly-perishable
Examples	All commodities	Tea, Apple, Medicinal and Aromatic Plants, Cardamom, Coffee, citrus (mandarin/ orange)	Dairy, poultry, goat, local pig, vegetables, fruits

Source Author’s compilation

5 Value Chain Enabling Policies and Programs in Nepal

The government facilitates development processes through its policies. This section presents a review of government agricultural policies with reference to the promotion of VC development in Nepal and the uptake of the development initiative by the public and the private sector.

The Agriculture Perspective Plan (APP) (1995–2014) has been an overarching policy document for Nepalese agricultural development for the past two decades (APROSC 1995). Although this plan has encouraged a coordinated approach to agricultural development in Nepal, there is no explicit reference in the document to VC approaches. On the other hand, the policy advocates an enabling environment that encourages more private sector investment and involvement by development partners in agri-food industry development, which is consistent with the VC approach.

The Tenth Plan (2002–2007), which was based on the APP, adopts a strategy of commercialization of agriculture and market development and identifies programs that link high-value commodities to markets (NPC 2002). This plan acknowledges a need to find an alternative approach to agricultural development:

> Different alternatives will be explored and analysed to identify competitive edge of national products and support needed for increase in production by analysing national and international market situation (p. 162).

This opened up opportunities to introduce VC approach in the development of the agri-food industry. In 2004, the National Agriculture Policy was promulgated. To make the policy operational, the Agribusiness Promotion Policy was formulated in 2006. Both of these policies promoted linkages between production and markets.

After the inception of the Commercial Agriculture Development Project (CADP) in 2003, VC development became a policy buzzword in Nepalese agricultural development and commercialization forums. The objective of the project was "to establish a network of innovative and competitive value chains" (ANZDEC 2003a, p.1). The VC approach was the basic methodological framework for the project implementation (ANZDEC 2003a, b). The project, which was funded by ADB, became effective in 2007. The project supported the VC analysis of ten agricultural commodities to guide the development of competitive commodity VCs.

The Three-Year Interim Plan (2007–2010) which followed the Tenth Plan, without explicitly referring to the VC approach, promoted adoption of VC approach in agricultural programs (NPC 2007):

> Help will be provided from the available resources to the demand and necessity of all the stakeholders (producers, processors and business persons) to make the agriculture produce more qualitative and competitive by commercialising it, according to the national and international demand (p. 41).

A World Bank funded Project on Agriculture Commercialization and Trade soon followed CADP (effective from 2009) with a similar conceptual approach. The development objective of the project was to improve the competitiveness of smallholder farmers and the agribusiness sector in selected commodities VCs (PACT 2012). Similarly, the High-value Agriculture Project was launched in 2010 with the support from International Fund for Agricultural Development. The project acclaims "development of pro-poor value chains" as its dominant-intervention approach (HVAP 2012, p.1).

More recently, the Three-Year Plan (2011–13) explicitly acknowledged the adoption of VC approach in the development of agri-food industry (NPC 2011). The plan aims for greater involvement of development partners in agri-food industry development.

By this time, in accordance with these plan and policy documents, the National Planning Commission began issuing directives for the implementation of a VC approach through the guidelines of Ministry of Agricultural Development to the local authorities on formulating annual programs for agricultural development:

> Formulate value chain-based agricultural programs based on findings of consultations among stakeholders in value chains and actors in markets in order to increase agri-food production and facilitate easy marketing.[2]

Meanwhile, the Ministry of Agricultural Development kept implementing donor-funded agriculture megaprojects which were taking a VC approach. In the meantime, the Nepalese government formulated the Agricultural Development Strategy in 2015 with the support of 13 different development partners[3] led by ADB (GON 2015). This strategy explicitly accepted VC development as a vehicle to private sector development in the Nepalese agriculture. It outlines VC Development Programme as one of the four flagship programmes in agriculture to drive commercialization of the sector. It identified and analysed 20 commodities as the potential commodity to develop competitive VCs in the country. Strategy related to this programme is to prioritize a limited number of VCs in the first five years of strategy implementation. The strategy appreciates government's important roles in providing a facilitating policy environment, structural set-up to steer/guide VC development, market infrastructure development, capacity building of agriculture extension and development workers and supporting the private sector initiatives in agriculture. It suggests to establishing the VC development fund that private sector actors can leverage and build upon. The Agriculture Development Strategy states:

> …Differently from other value chain interventions in Nepal, the VADEP [Value Chain Development Program] will have the following innovative features: i) will be looking at and developing all the stages of the value chain, from seeds to final products, from production to processing, from market infrastructure to access roads and connectivity, from postharvest technology to quality assurance and exports; ii) will strengthen linkages among associations of farmers, traders, processors, input providers and other value chain actors in order to ensure effective investment; iii) will aim at replication and linkages beyond the

[2] Translated from Nepali.

[3] IFAD, European Union (EU), FAO, Swiss Agency for Development and Cooperation (SDC), Japan International Cooperation Agency (JICA), World Food Program (WFP), USAID, Danish International Development Agency (DANIDA), DFID and the World Bank.

> district and achieve national impact; and iv) will work not only with one district or department but across districts and departments (GON 2015, p.163).

This is a strong policy shift from farmer-centred, production-oriented development focus of the ministry to a whole-of-chain focus and production plus post-production orientation in policy and development.

The recent agricultural projects and policy initiatives highlight that development partners and the Nepalese government were attaching top priority to the VC approach of agricultural development. The Nepalese Agriculture Development Strategy (2015–2035) reinforces the commitment of Government of Nepal to use the approach to developing the private-sector-led agri-food chains.

Although there is no formal review of the effectiveness of the VC approach in the agri-food industry of Nepal, an evaluation of CADP and PACT gives a proxy picture of its adoption by the private sector. Some positive impacts were generated by these projects which include development of public infrastructure such as markets, roads, irrigation, processing and logistics facilities; strengthening farmer and agribusiness networks and multi-stakeholder platforms; leveraging private sector investment in the agri-food industry; and creation of a policy environment that promotes VC development. There were increasing awareness and willingness of the actors towards the VC approach but very few numbers of integrated VCs in practice. Important lessons were also drawn from the implementation of these projects. These lessons comprise public sector actors cannot champion the VC development process and smallholder farmers were not ready and capable enough to guide the VC process. Further, price and value signals from markets and consumers were not effectively transcended to producers, trust-based relationships were not fully established among actors, VC-based infrastructure were inadequate and powerful downstream actors were keen to appropriate more value from others. These lessons, on one hand, necessitated championing role of the private sector in VC development. On the other hand, public sector actors also have strong roles for the facilitation of private sector, investment in public goods and regulation of market failures.

While donor-funded agriculture projects are increasingly uptaking the VC approaches (CADP 2011; MOAC 2011; RISMFP 2011; HVAP 2012; PACT 2012; ADB 2011; ANZDEC 2003a), development programs funded by the government's own resources are still taking conventional farmer-centred, production-oriented approach (MOAC 2011). It shows that barriers exist which constraint the government to fully translate VC experiences from the donor-funded projects into regular programs. Inadequate human resources and research and extension capabilities both in the public and private sector to support the value chain initiatives of the private sector are the critical barriers. VC requires innovativeness, consumer orientation, agility and entrepreneurship within the private sector actors. Adoption of pluralistic extension approach and promotion of private-sector research and extension would have addressed the constraint. Other critical barrier was one size fits all policy of grant financing employed by these projects. Majority of the smallholder and marginalized farmers were least benefitted out of the grants because, firstly, free-ride grants could never be enough for all and, secondly, a large chunk of the grants were appropriated by already capable actors of the industry. Collaboration with financial institutions to promote value chain financing could have leveraged further resources in the banking sector and helped the project to reach out to more beneficiaries and create a level playing field for all from the public resources. The challenge for the government, nevertheless, is now to justify that VC development is not a policy rhetoric but an approach with the promise of a real change in practice. The government and the development partners together have made efforts to promote policies such as contract farming, agricultural insurance and result-based incentive mechanism that were supportive of VC development.

Using a case study as an example, following sections describe the economic rationale for private sector actors to adopt the VC as a business strategy and present how an understanding of consumers and integrating into VCs benefits all stakeholders, including consumers, chain actors and the public sector agencies.

6 Case Study: Fresh Vegetable (Tomato) Value Chains

This section analyses a fresh vegetable local VCs (tomato) and consumers' categories and preferences to which the chain caters. The objective of the analysis is to identify VC upgrading opportunities that can benefit both the chain actors and the consumers. The fresh tomato chains used in this study originate from production sites in Kavre and ends at retail sites in Kathmandu. Actors of these chains include farmers, commission agents, wholesalers (including a wholesaler-cum-supermarket supplier) and retailers through whom the product flows to consumers. Stakeholders comprise service providers and government and development partner organizations. The primary data used in this analysis were collected between April and September 2010. The primary sources of data included walking-through the-chain method of observations and semi-structured interviews, a survey of shoppers/consumers, focus group discussions with consumers and producers, and a workshop with chain actors and stakeholders. The secondary sources of data included policy documents as well as the industry and government reports. The qualitative data were analysed using computer-assisted qualitative data analysis software (Nvivo 9), and the survey data were analysed using assessment of consumer value preferences and segmentation technique.

7 Research Methods

Using the market intercept survey responses of 395 farmers, the chapter analyses preferences of consumers of tomato based on various product attributes. Tomato is marketed as a commodity product in Kathmandu. Specific to the nature of a commodity product, price has been the primary driver of the competition in the market. The objective of the consumer research was to explore consumer

Table 2 Taxonomy of variables used in the analysis

Attribute	Search	Experience	Credence	Attribute
Intrinsic	Colour	Shelf life	Pesticide residue	Natural
	Freshness	Cooking quality	Production location	
	Size	Taste	Organic production	
	Ripeness			
	Presence of peduncle			
	Pest-free			
Extrinsic	Price			Negotiable
	Packaging		Traceability	Augmented
	Pack size			
	Shopping location			
	Display in shop			

preferences which can then be used to inform the VC improvement in the existing supply chains. Eighteen products and process-based attributes were used in the analysis. These attributes include 12 intrinsic and 6 extrinsic product attributes; 11 search, 3 experience and 4 credence attributes; and 12 natural, 1 negotiable, and 5 augmented attributes, as outlined in Table 2.

8 Results

Consumers' attitude and perception towards these 18 variables were measured on a five-point rating scale of very important, important, less important, unimportant and neutral. A value ladder (Fig. 1) is drawn from the mean score of responses on these attributes to understand the relative importance of various attributes to the consumers of tomato in Kathmandu. Mean scores of all consumers' responses for these 18 variables show that 10 variables are above a mean of 2.5. Freshness received the highest average mean value which infers that it is the most sought attribute throughout the samples. Little more than 94% of respondents rated freshness as an important attribute. In contrast, pack size received the least mean score in terms of importance as perceived by the respondents. Around 90% of consumers did not attach any importance to it. Data from observation and the focus group discussions among other sets of consumers support this result on freshness and pack size. Out of the six retail outlets sampled, packaged tomatoes were sold only in the supermarket —a possible explanation for such low mean score. Price was still an important driver of the consumer value.

Interpreting the results from the aggregated responses of the consumers gives a broad picture of the relative importance of various attributes among the heterogeneous samples. However, from strategic viewpoint of value chain development, an in-depth analysis of various segments of consumers and their value preferences is

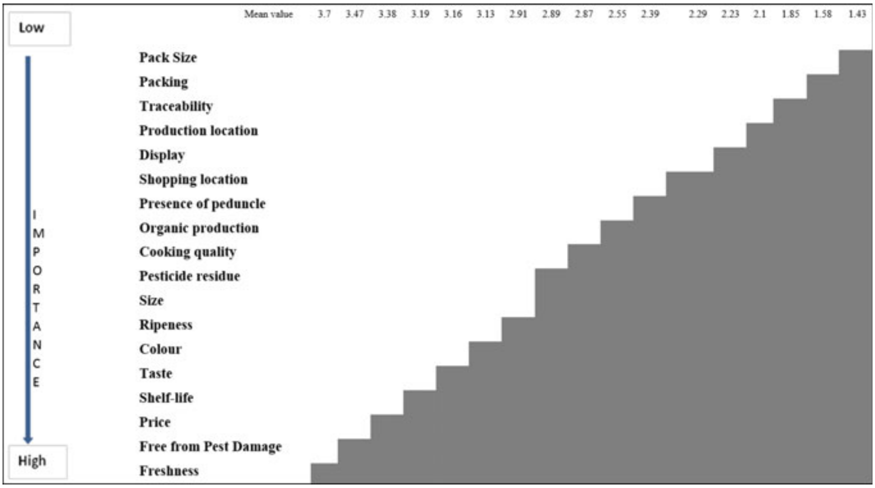

Fig. 1 Value attribute ladder for Nepalese tomato consumer. *Source* Author's calculation

considered essential. For example, the attributes that have a low mean score value (such as pack size) may not necessarily be the least important attributes for convenience-seeking consumers of a supermarket (or niche) market. Therefore, the data were analysed further using a cluster analytical technique to examine if consumers of tomato in Kathmandu can be differentiated based on their value preferences and behaviour. The analysis used consumers' preferences to the various attributes of tomatoes as the basis of segmentation. The analysis resulted in four distinctly different segments of consumers in terms of their value preferences towards the product- and process-related attributes in the seemingly heterogeneous market of tomato in Kathmandu. Table 3 outlines the nature of the value preference for each segment of consumers and their underlying socio-demographic profile. (For detail description, please refer Adhikari et al. 2012).

Although tomatoes were being marketed as a commodity with very little product differentiation in Kathmandu, results identified four distinct segments of consumers. The largest segment (about 40%) of consumers placed high importance on credence attributes[4] and least importance on price. These consumers value premium products over price. They were the high-value segment of consumers as shown by their socio-economic profile. Most of them represented consumers of high-income bracket and were educated. They had the preference to shop at the supermarkets or trusted retail shops. Rest (60%) of the consumers demonstrated characteristics that were mostly consistent with the commodity market.

[4]Such as freshness, freedom from residues, organic production and traceability.

Table 3 Segments of tomato consumers in Kathmandu

Characteristics	Cluster 1	Cluster 2	Cluster 3	Cluster 4
Size (n = 394)	40% (n = 157)	13% (n = 50)	31% (n = 122)	16% (n = 65)
Attributes with high mean	Credence attributes such as organic, production location, freshness and traceability	Price and shopping location	Price	None
Above-average mean	All attributes except packaging	Physical (Ripeness, pest-free, display in shop)	Physical attributes (colour, size, ripeness)	Second on peduncle, traceability, organic
Lowest mean	Price	Pesticide residue	Traceability and organic production	External and physical attributes
Preferred Buying location	Supermarket, Corner Shop	Wholesale/ local vegetable market	Local vegetable market/ wholesale	Pedestrian market/ street vendor
Income bracket	High income	Low income	Middle income	Low income
Education	Educated	Less educated	Less educated	Self-literate

A tag cloud,[5] shown in Fig. 2 was developed based on interview responses of farmers to show their understanding of consumer value preferences. It shows that most of the farmers possessed a false perception that consumers of their product would prefer colour and appearance. While that may be true with other consumers, farmers' perception contrasted to the actual preferences of high-value segments of consumers who value credence attributes more than physical attributes. This misalignment in the understanding between producers and consumers on the value preferences is one of the reasons for actors to integrate into VC and harvest the benefits arising from the willingness of the high-value consumers to pay the premium price for the assurance of the credence attributes.

[5]Figure 2—Bigger the size of the text in the cloud, the more the attribute (represented by the text) is preferred among farmers.

Fig. 2 Farmers' perception of consumer value

9 Value Chain Analysis

Next, an analysis of the chains that deliver the product to these consumers was conducted using a value chain analysis (VCA) framework. Value chain analysis is a diagnostic tool widely used to build, upgrade or manage chains (Boehlje 1999) and implement a whole-of-chain approach in businesses. The tool assesses the structures and processes of the chain and identifies leverage points for improvement across firms involved from production to consumption (Taylor 2005). The tool is fundamental to VC upgrading. The analysis maps the chain to explore how effectively and efficiently the chain delivers the product to the consumers. It assesses structure, process (activities) and the level of relationship and information flow among the actors through which the product flows. Based on the analysis, a VC map of the chain, as outlined in Fig. 3, was drawn.

The map illustrates the structure of the chain. The chain covers less than 50 km distance. However, by the time the product reaches the consumers, it passes through at least three levels of actors after the farm gate, namely commission agents who offer logistics, wholesalers who offer market space and retailers who interact with consumers. The longer the chain is, in terms of the number of actors, the slower will be the agility and more complex becomes the chain governance and relationship management. That makes the chain processes less efficient in information flow and weak in responsiveness.

The map also outlines chain processes (major activities under each actor) and the level of information flow and the relationship among the actors. The activities were classified as value adding, necessary-but-not-value adding and waste activities. According to Collins et al. (2015), value-adding activities result directly in attributes that the consumer values and will pay for; necessary activities are unavoidable under the existing supply processes but not make a product more valuable; and wasteful activities are unnecessary or redundant activities that can be eliminated or reduced.

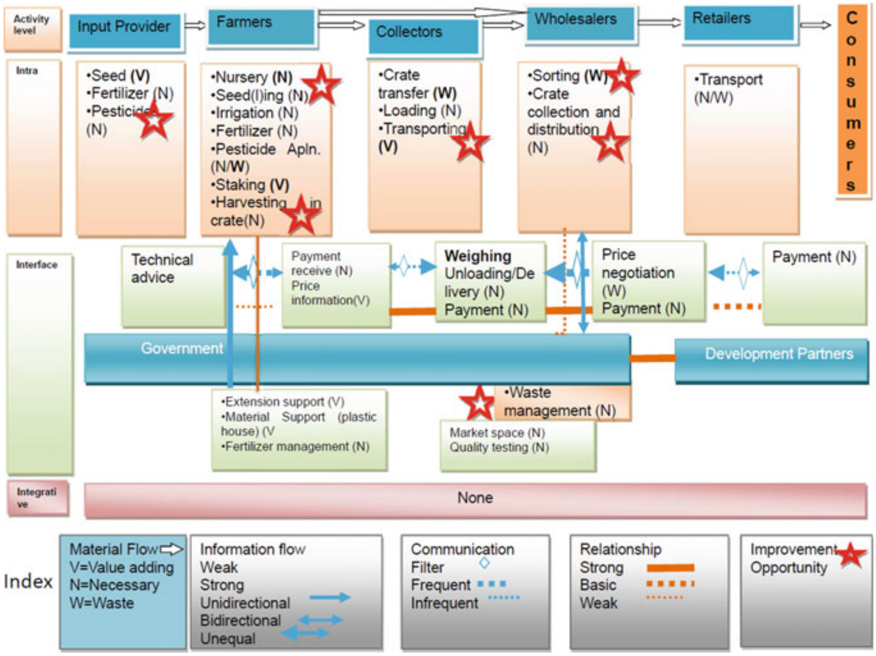

Fig. 3 Value chain map of a fresh tomato chain (Kavre-Kathmandu). *Source* Author's analysis of the chain. *Note* Intra-activities refer to activities performed by an actor within its domain. Interface activities refer to activities performed at supplier–customer interface. Integrative activities refer to activities performed collaboratively by various actors of the chain

The VC analysis of the processes demonstrated that a majority of the product value was created at the farmer level. Farmers' processes were adequate enough to guarantee most of the credence attributes that the high-value segments of consumers valued. However, processes of downstream actors, such as pooling and aggregating tomatoes with differentiated attributes at the collection centres and wholesale markets, contributed to the loss of various credence attributes in the product. Further, subsequent actors in these chains had not been able to add significant value to the product. In the case study chains, actors other than farmers could only create activities that were necessary-but-not-value-adding or that could be classified as waste. Interestingly, stakeholders' efforts were also non-value adding. In some instances, their support mechanism such as government policy or regulations[6] had rather contributed to waste activities. This shows that the existing structure of chains and their associated processes had low compliance with the demand of the high-value consumers. The whole chain functions and processes were operated as if they only meant to serve the consumers who transact at the commodity market

[6]Traffic regulation that does not allow the movement of the supply vehicles during certain time of the day.

mainly on the basis of price, but not quality. Even the supermarkets were sourcing their product of agri-food line from the wet markets, which had no product differentiation based on the credence attributes. Supermarket added value to the product by packing the tomatoes in a small plastic bag, for which majority of the consumers placed least preference. Collaboration among these actors was non-existent, and communication and relationships were not strong with the producers that primarily contribute to product value.

10 Discussion

The review in Sect. 4 shows that the Nepalese government's current agricultural development policies subscribe the development of agri-food VCs in Nepal. However, the evidence also reveals that VC development initiative in Nepal has overly focused on the industry VC development and less emphasis has been given to promote the other types of VCs—the global VCs and enterprise VCs.

An indicator of a successful uptake of VC strategy is that capable actors in the private sector lead coherent chain processes that deliver differentiated products/services, aligning with the expectation of different segments of markets or consumers. In the Nepalese context, there were not adequate instances to demonstrate that private sector had adopted the approach fully. For example, supermarkets have emerged as the drivers of these VCs globally. In Kathmandu, however, supermarkets were still sourcing their agricultural product lines largely from the wet markets. Similarly, tea is an established export-oriented commodity in Nepal. Still more than 90% of the tea exported from Nepal ends up in the commodity market of India without any traceability or recognition of the place from where the product originates (Basnett and Pandey 2014). These instances exemplify the lack of VC integration at the agribusiness level in Nepal. It also shows that supports from the government and development partners to VC development have yet to be cascaded through to the private-sector-led adoption.

Evidence from the case study supports the argument that upgrading into VCs benefits both the chain actors and consumers. The consumer research shows that around 40% of the consumers in a seeming commodity market of fresh vegetable in Kathmandu value credence attributes over price. These are the attributes that can only be assured through a closely coordinated or collaborative chains that are agile and responsive to the market demand.

At the time when the number of supermarkets with fresh vegetables in their product line has grown steadily, the situation that such a high-value retail outlets are not integrated into VCs is a strong case for a change. This is in contrast to the usual trend where supermarkets have led the VC development initiative in most emerging economies (Reardon et al. 2003, 2009; Timmer 2009). Value chain integration is more important to these high-end retail markets as their brand image would be damaged if an agri-food product with no traceability caused a food-borne disease incident.

The VC map also shows that most of the improvement opportunities in the chains exist within the business processes of the actors themselves. Because government's policies and programs (availability of VC grants) are favourable and improvement is possible from within, it is a high time for a capable private sector actor to step up and lead the enterprise-level VC development initiative. An integration into the chain can allow the non-value-adding actors in the chain, such as wholesalers or commission agents, to focus their efforts on the wet market improving the benefit to all—farmers, chain leaders and consumers.

Such an integration (in this case, a direct linkage between producers or their representatives with supermarkets or logistic operators) could also benefit the public sector and the general public. It releases the pressure to an already stretched market infrastructure in Kathmandu. It reduces the volume of transaction in the wet markets, minimizes the level of wastage during transportation and in wet markets, reduces the food miles consequently increasing the product shelf life, also ensuring traceability and co-innovation.

Most importantly, none of these activities needs a massive industry re-structuring or a huge amount of support from the government or development partners. It is more about achieving the chain-level partnership and process efficiencies within farm or agribusinesses. VC development initiatives from the government and development partners so far have developed a cohort of farmers and agribusinesses possessed with adequate resources and capabilities to undertake these responsibilities. It is an opportune moment for these private sector actors to assume the role of champion of the process of VC upgrading. It can be argued that agribusinesses unable to internalize enterprise VC in their functions and processes cannot effectively be integrated into global VC because the same fundamental principle of VC applies in both the contexts.

11 Conclusion

Although VC is a private-sector-led development construct, the government or development partners have been the champions so far in Nepal. VC development initiative in Nepal has mostly been one-dimensional as the focus of the initiative is on industry VC development. A shift is required both at government and private sectors to diversify the approach from industry level to more microlevel approach, which not only encourages the private sector development but also ensures government initiative focus on areas of high need and high impact. Uptake of enterprise and global VCs is required to cascade the effects of industry VC development initiative of the public sector into private sector. For this, a complementarity between public and private sector is warranted. While the private sector can target high-value segments of the consumers, the public sector can continue servicing the rest of the actors and consumers. Public sector can also invest more in market research to generate adequate scientific knowledge about diversified markets and high-value consumers as an incentive to drive private sectors towards value chain integration and upgrading.

Value chain is neither a panacea to all problems of poor agricultural performance (Dunne 2001) nor applicable in all contexts. However, integrating into VCs, where feasible, addresses most of the market-side constraints faced by the Nepalese agri-food sector. Effectively exploiting the opportunities of VCs depends on whether actors are ready, capable and committed enough to embark on the journey of VC. The private sector actors, who are capable and engaged in high-value agri-food commodities, should now step up to develop their own VCs and serve niche consumer segments. Allowing the actors capable enough to integrate into local or global VC in activities that only matters to the commodity markets is a missed opportunity. Private sector's increased participation in the domestic enterprise VCs would encourage VC orientation/thinking across the sector that may help to translate the practices and experiences into the global VC.

12 Policy Implications and Recommendations

This chapter identifies that, in general, overarching policy framework related to VC development is adequate. At the same time, it identifies following specific areas where VC-related working policies are to be developed or refined. These areas are:

- A policy that implements an incentive structure to reward actors in the local VCs who develop close and direct collaboration between producers and logistic providers or retailers.
- Policies and programs related to VC development are rather silent on facilitating global VC integration. A separate policy may be required with regard to the global VC development of export-oriented commodities. Such policy should at least focus on how the Himalayan image of the country can be promoted to augment clean, fresh, natural and by default organic attributes of the Nepalese products.
- The policy on global VC should also be linked with developing intermodal freight hubs and upgrading strategic aerial connections with the countries/cities of global VC interest. Nepalese diplomatic missions have already subscribed to economic diplomacy, now is the time to demonstrate that policy into action.
- The nature of interventions for different types of VCs is different. A clear targeting strategy is required to support actors in each type of VCs.
- Since objective knowledge about markets and consumers guides the whole chain development process, government and development partners should now collaborate with the private sector in activities that assure a clear understanding and communication of the nuances of markets, consumers, their characteristics and value preferences.
- To that effect, pluralistic approach in research and extension should be promoted.

- Collaboration with financial institutions to promote value chain financing should be adopted.
- Food safety and quality plays an important role in the successful implementation of high-value projects. In agri-food VCs, these credence attributes can only be ensured through effective collaboration among actors from production to consumption. Therefore, policies that promote and incentivize food safety and quality should be promoted to catalyse agri-food VC development.
- Since the trust-based relationships that hold the VCs were largely absent across many chains, the VC cannot be a panacea for all the problems faced by the Nepalese farmers. In circumstances where trust is absent or power inequalities result in unfair value appropriation, contract farming which has stronger regulatory binding feature can be an alternative to VCs. Kumar et al. (2016a, b) demonstrated that, even in the arms-length relationships and unequal power regime, contract farming can increase the productivity and profit, improve production practices such as food safety measures and reduce the cost of production, provided the smallholders' participation is ensured. Paralleling the benefits of VC integration, contract farming can also enhance market access to farmers even in geographically remote locations (Kumar et al. 2016a).

13 Future Research Areas

Recent studies on the export potentials of high-value commodities like tea, coffee, cardamom, ginger and medicinal and aromatic plants suggest that Nepalese export-oriented crops are being traded in the international markets without significant value addition and differentiation. Nepal's pristine image stemmed from its natural capital, its proximity to huge neighbouring and emerging Asian markets, and the low cost of labour is a pulling factor that can attract global VC champions towards the Nepalese agri-food products. Evidences suggest that the upgrading and integrating into global VCs can spur positive impact on the economy as well as on the livelihood of the people dependant on agriculture. Future research and policies need to emphasize on upgrading Nepal's agri-food actors into global VCs.

References

ADB (Asian Development Bank). (2011). *Nepal: High mountain agribusiness and livelihood improvement project, Report and recommendation of the President to the Board of Directors*. http://www.adb.org/sites/default/files/projdocs/2011/37292-04-nep-rrp.pdf. Accessed August 24, 2012.

Adhikari, R. P. (2013). *Developing agri-food industry in Nepal: A value chain management perspective.* Ph.D., School of Agriculture and Food Sciences, The University of Queensland, Australia.

Adhikari, R. P., Collins, R., & Sun, X. (2012). Segmenting consumers to inform agrifood value chain development in Nepal. *International Food and Agribusiness Management Review, 15*(4), 93–114.

ANZDEC (ANZDEC Limited). (2002). *Nepal agriculture sector performance review*. Kathmandu: Prepared for Ministry of Agriculture and Co-operatives, Nepal and Asian Development Bank.

ANZDEC. (2003a). *Nepal commercial agriculture development project*, *final report*. Kathmandu: Prepared for Government of Nepal and Asian Development Bank.

ANZDEC. (2003b). *Nepal commercial agriculture development project*, *inception report*. Kathmandu: Prepared for Government of Nepal and Asian Development Bank.

APROSC (Agriculture Project Service Centre). (1995). *Nepal agriculture perspective plan.* Kathmandu: Prepared for National Planning Commission Nepal and Asian Development Bank.

Basnett, Y., & Pandey, P. R. (2014*). Industrialization and global value chain participation: An examination of constraints faced by the private sector in Nepal*. In Asian Development Bank Economics Working Paper Series.

Blaikie, P., Cameron, J., & Seddon, D. (2002). Understanding 20 years of change in west-central Nepal: Continuity and change in lives and ideas. *World Development, 30*(7), 1255–1270.

Boehlje, M. (1999). Structural changes in the agricultural industries: How do we measure, analyze and understand them? *American Journal of Agricultural Economics, 81*(5), 1028–1041.

Bonney, L., Clark, R., Collins, R., & Fearne, A. (2007). From serendipity to sustainable competitive advantage: Insights from Houston's farm and their journey of co-innovation. *Supply Chain Management: An International Journal, 12*(6), 395–399.

Byerlee, D., de Janvry, A., & Sadoulet, E. (2009). Agriculture for development: Toward a new paradigm. *Annual Review of Resource Economics, 1*(1), 15–31. https://doi.org/10.1146/annurev.resource.050708.144239.

CADP (Commercial Agriculture Development Project). (2011). *Annual progress report*. Edited by Commercial Agriculture Development Project. Kathmandu: Commercial Agriculture Development Project.

Cattaneo, O., Gereffi, G., & Staritz, C. (Eds.). (2010). *Global value chains in a post crisis world a development perspective*. Washington, DC.: The World Bank.

Collins, R. (2009). Value chain management and postharvest handling: Partners in competitiveness. In W. J. Florkowski, R. L. Shewfelt, B. Brueckner, & S. E. Prussia (Eds.), *Postharvest handling: A systems approach* (pp. 107–128). Burlington, USA: Academic Press.

Collins, R. (2010). Postharvest science and value chain management: Using the virtuous value cycle to define common ground. *Acta Horticulturae, 880,* 67–74.

Collins, R., & Dunne, T. (2002). *Agribusiness supply chains: Learning from others, CD-ROM: Department of agriculture*. Canberra: Fisheries and Forestry.

Collins, R., & Iqbal, M. (2011). Integrating postharvest, marketing and supply chain systems for sustainable industry development: The Pakistan mango industry as work-in-progress. *Acta Horticulturae, 895,* 91–97.

Collins, R., Dent, B., & Bonney, L. B. (2015). *A guide to value-chain analysis and development for overseas development assistance projects*. Canberra: Australian Centre for International Agricultural Research.

Dolan, C. S. (2004). On farm and packhouse: Employment at the bottom of a global value chain. *Rural Sociology, 69*(1), 99–126.

Dunne, A. J. (2001). Supply chain management: Fad, panacea or opportunity? *Australasian Agribusiness Perspectives, 48.* Accessed March 10, 2010.

Dunne, A. J., & Collins, R. J. (2004). The marketing of food and fiber products: Evolution and revolution. In K. Rickert (Ed.), *Emerging challenges for farming systems* (pp. 39–52). Kingston, ACT: Rural Industries Research and Development Corporation.

FAO (Food and Agriculture Organization). (2010). *Agriculture extension services delivery system in Nepal*. In ftp://ftp.fao.org/TC/CPF/Country%20NMTPF/Nepal/AgExtServDelSysNepal.pdf. Accessed October 12, 2012.

Fearne, A. (2009). *Sustainable food and wine value chains*. Adelaide: Government of South Australia.

Fearne, A., Martinez, M. G., & Dent, B. (2012). Dimensions of sustainable value chains: Implications for value chain analysis. *Supply Chain Management: An International Journal, 17*(6), 575–581. https://doi.org/10.1108/13598541211269193.

Folke, L., Riisgaard, L., & Ponte, S. (2010). *Agro-food value chain interventions in Asia and the Pacific: A review and analysis of case studies*. Danish Institute for International Studies commissioned by UNIDO and IFAD.

Gereffi, G. (2001). Beyond the producer-driven/buyer-driven dichotomy the evolution of global value chains in the internet era. *IDS Bulletin, 32*(3), 30–40. https://doi.org/10.1111/j.1759-5436.2001.mp32003004.x.

Gereffi, G., Humphrey, J., Kaplinsky, R., & Sturgeon, T. J. (2001). Introduction: Globalisation, value chains and development. *IDS Bulletin, 32*(3), 1–8.

Gibbon, P. (2001). Agro-commodity chains an introduction. *IDS Bulletin, 32*(3), 60–68. https://doi.org/10.1111/j.1759-5436.2001.mp32003007.x.

Gómez, M. I., Barrett, C. B., Buck, L. E., De Groote, H., Ferris, S., Gao, H. O., et al. (2011). Research principles for developing country food value chains. *Science, 332*(6034), 1154–1155. https://doi.org/10.1126/science.1202543.

GON (Government of Nepal). (2015). *Agriculture development strategy (2015–2035)*. Edited by Ministry of Agricultural Development. Kathmandu: Government of Nepal.

Grunert, K. G., Jeppesen, L. F., Jespersen, K. R., Sonne, A.-M., Hansen, K., Trondsen, T., et al. (2005). Market orientation of value chains: A conceptual framework based on four case studies from the food industry. *European Journal of Marketing, 39*(5/6), 428–455.

GTZ (German Agency for Technical Cooperation). (2007). *Value links manual—The methodology of value chain promotion*. Accessed January 15, 2010.

Hazell, P., Poulton, C., Wiggins, S., & Dorward, A. (2010). The future of small farms: Trajectories and policy priorities. *World Development, 38*(10), 1349–1361. https://doi.org/10.1016/j.worlddev.2009.06.012.

Helmsing, A. H. J. B., & Vellema, S. (Eds.). (2011). *Value chains, social inclusion, and economic development: Contrasting theories and realities.* Routledge: Routledge Studies in Development Economics.

Hines, P., Holweg, M., & Rich, N. (2004). Learning to evolve: A review of contemporary lean thinking. *International Journal of Operations & Production Management, 24*(10), 994–1011. https://doi.org/10.1108/01443570410558049.

Hospes, O., & Clancy, J. (2011). Unpacking the discourse on social inclusion in value chains. In S. Vellema & A. H. J. Helmsing (Eds.), *Value Chains, Social Inclusion, and Economic Development: Contrasting Theories and Realities.* Routledge: Routledge Studies in Development Economics.

Humphrey, J. (2006). Policy implications of trends in agribusiness value chains. *The European Journal of Development Research, 18*(4), 572–592.

Humphrey, J., & Navas-Aleman, L. (2010). Value chains, donor interventions and poverty reduction: A review of donor practice. In *Research Report*: Institute of Development Studies.

HVAP (High Value Agriculture Project). (2012). *Project approach/modality*. High Value Agriculture Project. http://www.hvap.gov.np/content.php?id=105. Accessed September 24, 2012.

Kaplinsky, R. (2000). Globalisation and unequalisation: What can be learned from value chain analysis? *Journal of Development Studies, 37*(2), 117–146.

Kumar, A., Roy, D., Tripathi, G., Joshi, P. K., & Adhikari, R. P. (2016a). *Can contract farming increase farmers' income and enhance adoption of food safety practices? Evidence from remote areas of Nepal*. IFPRI discussion paper *01524.*

Kumar, A., Roy, D., Tripathi, G., Joshi, P. K., & Adhikari, R. P. (2016b). *Contracting by small farmers in commodities with export potential: Assessing farm profits of lentil growers in Nepal*. IFPRI discussion paper 01533.

Lim-Camacho, L., Dunne, T., & Firrell, C. (2006). The Backhousia project: A value chain alliance for an Australian native cut flower to Japan. *Acta Horticulturae, 699,* 269–275.

M4P (Market for Poor). (2008). *Making value chains work better for the poor: A toolbook for practitioners of value chain analysis, version 3*. Making Markets Work Better for the Poor (M4P) project, UK, Department for International Development, Agricultural Development International. http://www.valuechains4poor.org/file/V4P%20Toolbook%20v3%20Final%20lowres.pdf. Accessed October 4, 2012

Mehdi, M. (2012). *Evaluating the effectiveness of a 'whole of chain approach' in rural industry development in developing countries: A case of Pakistan mango industry*. Australia: The University of Queensland.

MOAC (Ministry of Agriculture and Co-operatives). (2004). *National agricultural policy 2004*. Kathmandu: Ministry of Agriculture and Co-operatives, Nepal.

MOAC. (2011). *Annual progress report* (*Nepali*). Edited by Ministry of Agriculture and Coopeatives. Kathmandu: Ministry of Agriculture and Cooperatives.

NPC (National Planning Commission). (2002). *Tenth plan*. Kathmandu: National Planning Commission, Nepal.

NPC. (2007). *Three Year Interim Plan*. Kathmandu: National Planning Commission, Nepal.

NPC. (2010). *Three Year Plan Approach Paper (2010/11–2012/13)*. Kathmandu: National Planning Commission, Nepal.

NPC. (2011). *Three Year Plan*. Kathmandu: National Planning Commission, Nepal.

PACT (Project on Agriculture Commercialization and Trade). (2012). *Overview*. Project for Agriculture Commercialization and Trade. http://www.pact.gov.np/?option=cms&cms_id=353632303237&sid=353637333237. Accessed September 24, 2012

Reardon, T., Barrett, C. B., Berdegué, J. A., & Swinnen, J. F. M. (2009). Agrifood industry transformation and small farmers in developing countries. *World Development, 37*(11), 1717–1727.

Reardon, T., Timmer, C. P., Barrett, C. B., & Berdegue, J. (2003). The rise of supermarkets in Africa, Asia, and Latin America. *American Journal of Agricultural Economics, 85*(5), 1140–1146.

RISMFP. (2011). *Raising incomes of small and medium farmers project* (*RISMFP*). Government of Nepal, Department of Agriculture. http://www.rismfp.gov.np/. Accessed November 25, 2012.

Ruth, C. (2008). *Value chain framework* (briefing paper). USAID.

Shrestha, S. (2010). *Special evaluation study on support to agriculture value chains development for inclusive growth*. Manila: Asian Development Bank.

Soosay, C., Fearne, A., & Dent, B. (2012). Sustainable value chain analysis—A case study of Oxford Landing from "vine to dine". *Supply Chain Management: An International Journal, 17*(1), 68–77.

Swinnen, J. F. M., & Maertens, M. (2007). Globalization, privatization, and vertical coordination in food value chains in developing and transition countries. *Agricultural Economics, 37,* 89–102. https://doi.org/10.1111/j.1574-0862.2007.00237.x.

Taylor, D. H. (2005). Value chain analysis: An approach to supply chain improvement in agri-food chains. *International Journal of Physical Distribution & Logistics Management, 35*(10), 744–761.

Taylor, D. H., & Fearne, A. (2009). Demand management in fresh food value chains: A framework for analysis and improvement. *Supply Chain Management: An International Journal, 14*(5), 379–392. https://doi.org/10.1108/13598540910980297.

Thapaliya, J. N. (2006). *Constraints and approaches for developing market access and vertical linkages in high value agriculture*. In Policy Paper 16. Kathmandu: Ministry of Finance.

Timmer, C. P. (2009). Do supermarkets change the food policy agenda? *World Development, 37*(11), 1812–1819. https://doi.org/10.1016/j.worlddev.2008.08.022.

UNIDO (United Nations Industrial Development Organization). (2009). *Agro-value chain analysis and development the UNIDO approach*. Vienna: United Nations Industrial Development Organisation.

Vorley, W., Fearne, A., & Ray, D. (Eds.). (2007). *Regoverning markets: A place for small-scale producers in modern agrifood chains?*. Aldershot, England; Burlington, VT: Gower.

Weatherspoon, D. D., & Reardon, T. (2003). The rise of supermarkets in Africa: Implications for agrifood systems and the rural poor. *Development Policy Review, 21*(3), 333–355. https://doi.org/10.1111/1467-7679.00214.

Webber, C. M., & Labaste, P. (2010). *Building competitiveness in Africa's agriculture: A guide to value chain concepts and applications*. *Agriculture and rural development*. Washington, DC: The World Bank

Zeithaml, V. A. (1988). Consumer perceptions of price, quality, and value: A means-end model and synthesis of evidence. *The Journal of Marketing, 52*(3), 2–22.

Zokaei, A. K., & Simons, D. W. (2006). Value chain analysis in consumer focus improvement: A case study of the UK red meat industry. *International Journal of Logistics Management, 17*(2), 141–162.

Part V
Agricultural Trade and Marketing

Chapter 17
Agrarian Relations, Institutions, and Land Reform in Nepal

Jagannath Adhikari

Abstract The chapter analyzes the main issues related to access to land and poverty, landownership distribution, access to land for women and the indigenous peoples, landlessness and lack of viable landholdings, land rentals, tenancy rights, and fallow land. It reviews existing laws and policies on land and land rights, land reform in the context of smallholder agriculture, and land administration. It also draws lessons for Nepal from the experiences of other countries in land reform. Finally, it makes policy recommendations to enhance the access to the landless and marginal farmers to land and also to improve access to vital infrastructure such as farm roads and irrigation, technical support system, marketing, and land consolidation, which are vital for agricultural productivity enhancement and income increases.

Acronyms

ADB	Asian Development Bank
BS	Bikram Sambat (Nepali year)
CARP	Comprehensive Agrarian Reform Program
CBS	Central Bureau of Statistics
CSRC	Community Self-Reliance Centre
DFID	Department for International Development
DoLIA	Department of Land Information and Archive
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GLOF	Glacial Lake Outburst Flood
GoN	Government of Nepal
IDS	Integrated Development Study
IFAD	International Fund for Agriculture Development
IPs	Indigenous Peoples
LFUG	Leasehold Forest Users Group

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G. Thapa et al. (eds.), *Agricultural Transformation in Nepal*,
https://doi.org/10.1007/978-981-32-9648-0_17

MLRM	Ministry of Land Reform and Management
NA	Not Available
NGO	Non-Governmental Agency
NLSS	Nepal Living Standard Survey
UNDP	United Nations Development Program
WTO	World Trade Organization

1 Understanding Nepal's Agrarian Relations and Its Transformation

Nepal's agrarian economy has been a subject of debate among the development theorists, politicians, and policy makers. While some still regard that precapitalist modes of production are dominant in rural Nepal (Bhattarai 2003; Blaikie et al. 1980 [2001]), where much of farming is done, others regard Nepal moving into capitalism as state-landlordism is over by now (Mishra 2014). Globalization that has taken place intensively since the 1990s has led to rapid changes in agrarian structure, especially in the relation between landowners and tenants. As the rural areas are deeply integrated with global capitalist market with contemporary processes like out-migration and climate change, tenants are now less dependent on landowners (Sugden 2016). This change has implications for land and agrarian reform even in countries like Nepal. Accordingly, conventional nature of agrarian relations as well as contemporary issues affecting such relations is to be understood for effective land reform policies. These intellectual debates are linked to the type of land reform required—like whether it is important to have radical land reform[1] or other market-driven land reform[2] with support from the government. This paper examines these relations and issues and draws implications for future land reform measures in Nepal.

While this paper does not dwell on theoretical debates on modes of production and on which mode of production exists in Nepal, it is informed by the fact that in

[1]Radical land reform, here, refers to a practice of fixing a ceiling on landownership and state taking the control of excess land without paying the price for the land, and then freely distributing the land to the needy people like landless or marginal farmers or farm laborers. It is assumed, here, that 'land' is a part of natural capital to which everyone has free access and only the state is the owner.

[2]This included programs like land bank which would facilitate the linkage between willing sellers of land (generally landowner) and willing buyers of land (landless and marginal farmers, farm laborers), tenure reform, incremental taxation on land to discourage large holdings, land consolidation, and the like. Nepal had a 'land bank' program until 2006, but this was discontinued, as there was a claim that it helped just to buy the land of large landowners at higher prices who were after all prepared to sell land in the market at lower prices. But, again, afterward, there were suggestions to have a land bank, which would connect land sellers and land buyers to be supported by the government's subsidy and the price to be fixed by the government's agencies based on market survey.

Nepal's agrarian atlas, one finds a continuum of farms between the two extremes formed by precapitalist mode of production and capitalist mode of production, and that no farm, or individual farm family, just belongs to one of these two modes. Moreover, there is also a tendency for individuals to occupy different position in multiple livelihood strategies at the same time. This certainly calls for analysis of various resources to identify a person's dependence on land. Accordingly, apart from landownership patterns, one has to look into labor contracts,[3] contracts for land cultivation, and the new ways of getting benefits from modern capitalist sector (like migration and remittances) and diversifying the economy. In recent times, there are also changes in the way rights are defined and understood. Agrarian relations in Nepal do not mean individual landownership only but also common ownership defined by community and traditional norms like indigenous people's rights to resources and gender-based rights. These will be discussed in this paper as they have implications for policies in the use of land, land reform, and other policies that help to maximize food production with adequate attention to social justice. In fact, high production (efficiency) and social justice (like access to land, fair farm wages, and fulfillment of other rights) go hand in hand.

2 Availability and Access to Land[4]: Its Importance as a Means of Production or Other Sources of Power?

Despite changes in rural economic structure mainly due to migration out of rural areas and injection of remittances,[5] land has remained a vital resource for the livelihood of rural population of Nepal. Moreover, land still has other values too—it defines one's social and economic position and status in society and bestows political and symbolic power. Studies of economic history of Nepal clearly show that 'land' was the main basis for the political power in Nepal, and the ruling class used 'land' and 'land tax' to sustain their position in power hierarchy in what can be called state-landlordism (Regmi 1978, 1988, 1999). This remained until 1950, and its remnants are still seen in the structure of landownership pattern. But in the past

[3]Like bondage, unfree labor, and imperfect labor market where there is no perfect information about the work, wage rates, and no willing buyer and willing supplier of labor.

[4]In rural areas, especially in Nepal, a household uses different types of lands and they all are interrelated. These lands could be farmland, forestland, pastureland, wasteland, and the like. Moreover, as these land types can be functional in relation to one another, it is necessary to understand that it is difficult to separate them. Therefore, these all types of land are to be covered here, but the focus is on farmland.

[5]Remittance in Nepal is equivalent to 29.2% of the GDP, which is more or less equal (including the remittances coming from informal sources) to contribution of agricultural sector (33% of GDP). Nepal Living Standard Survey Reports reveal a significant increase in the proportion of households receiving remittances (23.4% in 1993/94 to 31.9% in 2003/04 and 55.8% in 2010/11). The volume of remittances each household received was Rs. 15,160 in 1993/94, Rs. 34,698 in 2003/04, and Rs. 80,436 in 2010/11 (CBS 2013).

three decades, there has been major shift in the landholding patterns and the purpose for which land is owned or held. In recent times, land has become more of an investment property, especially in urban and semi-urban areas and market centers. As a result, powerful and wealthy people still cling on their land even though they do not cultivate the land themselves. The land grabbing in the form of buying the land for speculation purpose and plotting land (for housing purpose) has thus increased. There are repercussions of this tendency on agricultural production, absentee landlordism, food security, and poverty, and access to land for the poorer and landless families.

The varied way land can be used, and has been used, in Nepal, makes the concept of access to land or land rights/tenure complicated. A common way to understand tenure or tenure rights is through what is defined in legal system of the country (*kanuni-hak*) or what is generally practiced by people traditionally (*chalan*), which still has influence even though this influence is declining. In some cases, these two also overlap giving a situation called legal plurality. In fact in rural areas, the plurality is seen more often in the use of resources—land, forest, pasture, and water. The access to land (or land rights) also needs to be understood as 'bundle' of rights (legal rights, traditional rights, use rights, etc.)—some rights are held in common, some individually, and some can be broken, and some cannot be broken and divided or passed on to others (Riddle 1987: 2). Land rights/tenure, even though it consists of many types of rights, gives people option or opportunity to benefit or use the land. These options and opportunities to benefit or use the land are considered here as access to land (see also Bruce 1989).

2.1 Access to Land and Poverty

In rural areas, poverty is still determined by access to land and landownership. As shown in Table 1, poverty is high among the households having less than 1 ha land. It is interesting to observe that poverty rate is slightly less among the landless households (2010–11) than the marginal farmers, those having less than 0.2 ha of land. But, in general, average landholding per household is just 0.7 ha, and this has been consistently declining, as discussed below.

Table 1 also reveals that poverty rate has drastically reduced in the land categories of 1–2 ha and 'more than 2 ha' as compared to the national average for rural areas. It is also to be reckoned that proportion of population in larger land categories has been declining rapidly. Especially, the proportion of population in the land category 'more than 2 ha' declined by almost 70% in the last 15 years. There is an increase in 'landless households' and in the lower middle land-class (0.2–1 ha group).

Looking at Tables 1 and 2, one can conclude that poverty is very high among the 'agricultural wageworker' or 'landless farmworkers', where poverty is as high as 47%. In general, people engaged in farming are poorer as compared to others. Therefore, farmers having less than 1 ha land and those engaged in farming as

Table 1 Poverty measurement by landownership in Nepal, 1995–96, 2003–04 and 2010–11 (rural areas only)

Landholding (ha)	Poverty head count rate				Distribution of population			
	1995–96	2003–04	2010–11	Change (%) 1995–96 to 2010–11	1995–96	2003–04	2010–11	Change (%) 1995–96 to 2010–11
Landless	NA	NA	28.5	–	NA	NA	13	–
<0.2	48	39	32	−33.3	21	22	18	−14.3
0.2–1	45	38	29.6	−34.2	42	47	49	16.7
1–2	39	27	20.1	−48.5	21	20	15	−28.6
>2	39	24	7.1	−81.8	16	11	4.9	−69.4
Total	43.3	34.6	27.4	−36.7	100	100	100	–

CBS, World Bank, DFID and ADB (2006): Resiliency amidst conflict. Poverty assessment in Nepal 1995–96 and 2003–04. Page 14; CBS (2013). Poverty in Nepal page 9, Table 10

Table 2 Occupation of the family head and poverty rate

Occupation categories	Poverty rate (%)	Share of the group on total population (%)
Self-employed		
Agriculture	27.2	51.0
Industry-production	22.4	4.2
Trade/business	13.2	7.9
Service	19.6	2.6
Wages		
Agriculture	47.0	3.4
Other professional sector	5.6	3.3
Others	28.3	14.5
Extended economic activities	31.6	4.7
Unemployed	26.7	0.4
Inactive	16.6	8.0
Nepal	25.2	100.0

Source CBS (2013). Poverty in Nepal, page 8, Table 9

wageworkers, represent the poorer population and they comprise about 55% of the population. Since 82% of households in Nepal have less than 1 ha land, they contain many poorer households of the country.

2.2 *Availability and Access to Land*

Nepal is a land-scarce country in terms of availability of cultivable land. Only about 21% of the land is cultivated and there is not much scope to increase the flat or terraced land for field crop production. However, a different type of farming, forest farming, is possible in a larger area. About 40% of the land area is covered by forest, and about a fifth of this forest is managed as community forests. Government (present constitution 2015) has stipulated that at least 40% of the area will be covered by forests. Apart from the agricultural land, which is held as private ownership, all other lands (almost 80%) are still owned by the government. There are few community-owned landholdings too. Here, only the privately owned land is discussed.

'Ownership' and 'tenancy' practices are the main ways through which farmers gain access to land. In Nepal, ownership is obtained mainly through 'inheritance.' It is reported that 85% of the land is obtained through inheritance (CBS, World Bank, DFID, and ADB 2006). The other ways to gain access to land are various tenancy practices and customary practices. Customary practices are more common on common property like forest and pastures. Government's distribution of land is also one way to gain access to land. But it has benefitted a very small segment of the population to gain access to land.

A brief picture of land distribution situation in the past 50 years has been presented in Table 3. From the table, one can find the following conclusions:

1. Table shows that the number of holdings has been increasing, and it has increased by 2.5 times in the last 50 years. The increase in holding number has been higher than the population growth rate, even though it is the primary cause. There are other factors too for the fragmentation of landholdings.

Table 3 Availability of land in Nepal in the last 50 years (1961–2011)

Category	Census year					
	1961/62	1971/72	1981/82	1991/92	2001/2002	2011/12
Total holdings (000)	1540	1721.2	2194	2736.1	3364.10	3831.1
Increase (%)		11.77	27.47	24.71	22.95	13.9
Holdings with land (000)	1518	1707.3	2185.7	2703.9	3337.4	3715.6
Increase/decrease (%)		12.5	28	23.7	23.4	11.3
Holdings with no land (000)	22	13.9	8.2	32.1	26.7	115.6
Increase/decrease (%)		−36.8	−41	291.5	−16.8	333.0
Holdings with land:						
Area of holdings (000 ha)	1685.4	1654	2463.7	2597.4	2654	2522.6
Increase/decrease (%)		−1.86	48.95	5.43	2.18	−5.0
Average holding size (ha)	1.11	0.97	1.13	0.96	0.8	0.68
Increase/decrease (%)		−12.61	16.49	−15.04	−17.16	−15.0
Number of parcels (000)	10,318.2	12,282.5	9516.4	10,806.2	10,987.40	12,096.4
Increase/decrease (%)		19.04	−22.52	13.55	1.68	10.1
Average parcel/holding	6.8	7.2	4.4	4	3.3	3.2
Increase/decrease (%)		5.88	−38.89	−9.09	−17.5	−3.0
Average parcel size (ha)	0.16	0.13	0.26	0.24	0.24	0.21
Increase/decrease (%)		−18.75	100	−7.69	0	12.5

Source CBS, World Bank, DFID and ADB (2006) and Agriculture Census Report 2013. Data is computed from these sources

2. Average holding size in 2011/12 was 0.68 ha, which reduced by almost half in the last 50 years.
3. Land fragmentation is rapidly growing with increase in the number of parcels and reduced size of the parcels. Such a small size of a parcel requires a lot of cooperation among the neighbors to go for intensive cultivation.

2.3 Distribution of Land (Ownership Distribution)

Distribution of land in the country is shown in Table 4. It shows the area of land available in different land categories and households in those categories. It is clear that land concentration has been declining and that there is a small proportion of landholdings that are big. For example, by 2011, only 0.7% of the holdings were bigger than 4 ha and they constituted only 5.39% of the total land. The holdings larger than 2 ha constituted only 23.38% of the land in 2011—reduced from about 61% in 1961. But 2 ha is not considered a big size for commercial farming. Accordingly, not much land can be obtained from the land ceilings for redistribution unless the ceiling is fixed at 2 ha or less. Given this reality, a report stated about a decade ago based on NLSS II study (2003–04):

> Average land holdings have been decreasing rapidly, falling 25% between 1995/96 to 2003/04; from 0.88 ha to 0.66 ha.[6] The decline has been larger in the upper tail of the distribution (for example median fell 9%), resulting in a drop in the land Gini from 0.65 to 0.60 (if landless households are excluded as in agricultural census, it would come to 0.52 in 2003/04). Only 0.5% of rural households owned more than 6 ha. The share of landless households increased from 15% to 16% (CBS, World Bank, DFID and ADB 2006: 68).

It is very likely that landholding size might have further declined by 2016—due to population growth and division of land among the potential inheritors, and from the fear that larger landholdings will be confiscated through radical land reform. This fear is still there among the larger landholders. It was one reason for the faster rate of division of larger landholdings.

2.4 Access to Land for Women and Indigenous Peoples

Even though there is a rising trend in women's ownership of land, still not many women own the land. In 2001, women (main farmer in the house) owned only about 8% of holdings, and now in 2011, 19% of heads are women farmers. Even though the Constitution of Nepal guarantees equal rights to inheritance for son and daughter, this has not been seen in practice. There are a few policies (e.g.,

[6]The data on average landholding size is slightly different from one study to another.

Table 4 Percentage distribution of number and area of landholdings by size of holding 1961–2011

Landholding	1961		1971		1981		1991		2001		2011	
Categories	Holdings	Area	Holdings	Area	Holdings	Area	Holdings	Area	Holdings	Area	Holdings	Area
Marginal farmers (less than 0.2 ha)	56.2	11.9	62.7	13.8	50.3	6.6	16.2	1.9	18.2	2.4	21.6	3.5
Small farmers (0.2–1.0 ha)	18.8	12.2	14.9	12.1	16.3	10.8	53.3	28.6	85.6	48.8	58.3	43.2
Medium farmers (1–2 ha)	11.9	15.4	11.1	17.3	17.3	19.9	19.6	27.6	17.6	29.8	14.7	29.7
Large farmers (more than 2 ha)	7.8	60.6	11.3	56.9	16.1	62.7	11	41.9	7.5	31.3	5.2	23.6
Total	100	100	100	100.1	100	100	100.1	100	100	100	100	100
Concentron index		0.64		0.63		0.65		0.52		0.49		0.44

Source CBS (2006) and Agriculture Census 2011 exemption in tax if land is purchased in women's name) that have also helped to increase the women's ownership of land. Women constitute a large portion of the economically active population engaged in agriculture, both as farmers and as farmworkers, and play a crucial role in insuring household food security, despite enjoying very limited rights to land (Adhikari 2009). Feminization of agriculture, especially agricultural work (as ownership pattern has not changed much), is a common feature in the country. On average, women own only 5.42% of the land area, even though they own about 8.07% of the landholdings, which indicate that landholdings owned by women are of smaller size. Ownership of property by development regions clearly shows that as one moves from east to west, the share of women on land declines significantly. Therefore, from this, one may conclude that if the region is socioeconomically developed, women's access to land also improves. There is also a variation in women's landownership across ethnic groups/caste groups. For example, some ethnic groups, especially Tibeto-Burman groups, have more egalitarian inheritance practices and do pass on land to daughters (e.g., Watkins 1996). But as discussed later, all ethnic groups or indigenous peoples do not have such traditions. Especially, ethnic groups of Tarai do not have the liberal ownership rights for women as seen in some of the hill ethnic groups.

Apart from the ownership of land by women, there are also questions as to how far women play important decision-making role in the use of resources owned by their husbands as well as by them. In other words, it is important to know how far the land rights enjoyed by women, even though it is already less, is effective land rights, i.e., socially and legally recognized for every type of use they desire.

In case of indigenous groups, the ownership of land differs from one group to another. There are marginal farmers among them in most of the cases, but a few indigenous peoples also own relatively larger piece of land. This can be seen in Table 5.

2.5 Problem of Landlessness and Lack of Viable Holdings

It is clear that landlessness has become a serious problem even though information/data about landlessness is fuzzy and is complicated by the politics of landlessness.[7] Landlessness, though predominately a rural phenomenon, has also become an urban phenomenon. The problem of squatter settlement is now one of the urban issues in most municipalities. NLSS third report states that 21% of households are landless

[7] About 24.5% households are landless and 7% households semi-landless, owing less than 0.2 acres (UNDP 2004). According to CRSC, there are 1.02 million landless families and additional 450 thousands (0.45 million) *Jotaha* or *Hali* families, i.e., those who plow other's land usually on annual (Haliya—Reading Material-5, pp. 1–2, not dated). As early as 1994, *Badal Commission on Land Reform had estimated that about* 500,000 people were completely landless in the early 1990s.

Table 5 Access of indigenous peoples to land (percentage distribution of household owning self-operated land by farm size and ethnicity, 2001)

Ethnicity/caste	Landless	Semi-landless	Marginal cultivators	Small cultivators	Medium cultivators	Large cultivators	Total households
Santhal, Jhangad, Kisan, Munda	58.46	4.91	10.44	7.07	18.26	0.87	16,910
Raute, Kusbodiya, Kusunda	46.12	6.12	20.41	15.51	11.43	0.41	245
Rajbansi, Gangain, Dhimal, Mache	45.78	6.12	10.89	9.09	24.73	3.39	33,597
Dhanuk	34.04	7.79	25.66	14.2	10.67	7.65	32,290
Sherpa, Bote, Walung	32.4	3.81	20.45	18.27	23.02	2.04	35,731
Raji	31.64	15.07	28.91	14.22	9.81	0.33	15,005
Gurung	26.85	6.36	30.53	21.5	14.35	0.41	110,574
Tharu	22.83	6.36	17.93	15.65	34.34	2.79	235,500
Danuwar, Bhujel, Pahari, Baramu, Adivasi/*janajati*	20.04	10.59	32.84	20.28	15.73	0.51	72,715
Rai	20.04	4.89	24.97	24.24	25.04	0.76	125,297
Tamang	16.69	6.93	31.29	26.73	18.03	0.32	239,755
Limbu	15.83	4.57	27.06	25	26.82	0.91	67,916
Magar	14.41	5.88	33.33	26.53	19.21	0.63	296,313
Caste groups							
Tarai Dalits	43.98	9.89	26.19	11.3	8.3	0.34	231,880
Hill Dalits	15.32	15.24	44.55	17.25	7.41	0.24	308,796
Nepal	24.44	6.98	27.59	20.15	19.67	1.17	4,174,374

Semi-landless (<0.2 acre), Marginal cultivators (0.21–1.00 acres), Small cultivators (1.01–2.00 acres), Medium cultivators (2.01–10.00 acres), Large cultivators (10.1+ acres)
Source UNDP (2004: 176)

(CBS 2013—see Table 1). Landlessness is more pervasive among the Dalit families, particularly Terai Dalit families.

The other types of land-deprived groups include permanent farmworkers, daily workers (*khetalas*), and periodic and semi-attached workers, such as *Haliyas (working as ploughman), Charuwas and Gothalas (looking after the animals), and Kamlaris (girl of generally 9–17 years working in other's house)*. The problem in these labor types is that it is highly informal and there is no fixed wage rate. Usually, women workers get low wage than males. It is estimated that there are about 0.3 million *Halis* (Haliyas) in Nepal, 60,000 of them only in far west region.[8] There is also a problem with Ukhada cultivators, i.e., those cultivating Ukhada land, i.e., public land cultivated on behalf of landlords. There are 5000 of them who have no rights on this land.

2.6 Access to Land: Land Renting Magnitude and Practices

2011 Agricultural Census shows that there are different types of land tenure practices. But an overwhelming proportion of landholdings is owner-cultivated. About 85% of holdings (and 80% of the land area) are cultivated by the owners themselves. The other 15% of the holdings are rented out or 20% of the land is rented out—that could be cultivated (rented-in) by other landowners or by others having no land (computed based on Table 2 of Report on Agriculture Census 2011).

Only about 1.2% of the landholdings and 1.1% of the total land area are cultivated purely on rental basis (one rental tenure). On the other hand, 13.8% of the landholdings and 19% of the total land area are under 'more than one tenure,' which suggests that a large majority of land renters already have some land (owner-cultivator) (Computed based on Report on Agriculture Census 2011, Table 2).

Of the total landholdings rented out, 56% (covering 68.2% of rented land area) were rented based on fixed share on production—popularly known as 'share-cropping.' About 10.5% of the holdings (9.0% of the area) were rented under fixed payment of money, 8.6% (10.9% area) fixed amount of production, 1.5% (0.6%) in exchange for services, 19.5% (9.7% land area) mortgaged, and 3.9% (1.6% area) in other ways (computed based on Table 2a, b, Report on Agriculture Census 2011). The practice of renting land by paying fixed amount of money has been growing. Accordingly, the role of cash money in paying rent seemed to have increased.

[8]CRSC (nd). Haliya. Reading Material-5. pp. 1–2.

2.7 Tenancy Rights and Tenants (Mohi)

Tenancy rights have been very complicated and are major factors impacting productivity of land and social justice. This has also become a political issue. The 1964 Land Act—which still is the major law regulating the ownership and use of land—had initially reserved the rights of the tenants (defined tenants as persons or families cultivating the land other than their own under certain conditions, and tenancy right means legal rights of the cultivators over the land that they cultivate), but its fourth amendment in 2053 BS (1996) removed 'dual ownership' over the land. This type of ownership was considered not permissive for investment from the landowners. Accordingly, 'tenants' were given six months' time to prove their tenancy, i.e., submitting receipts proving that the tenants were paying in cash or handing over *kut*, minimum share of production to the landlords. Only then, they were given the rights, i.e., one half of the land they cultivated. After this six months time, the tenancy right was abolished. However, this new legal provision was not brought to the public attention, systematically denying tenants the opportunity to register their tenancy claims over land. Moreover, there were many tenants who did not have proof of their tenancy. As a result, they were not able to register their claim. Guthi Sansthan Ain (Act), 2033 (1977 AD) recognizes the tenants' right to Guthi land (i.e., trust land) in its first amendment (2041 BS–1985), but the legal provisions have not been implemented properly.

The main contentious issue with regard to land reform has been the tenants' rights. Neither all tenants have been registered nor have those registered got their share of land. Moreover, data on tenants varies widely, and according to Agricultural Census reports (2001), there are not many tenants as about 86% of the landholdings are owner-cultivated, and many of the tenants are also owners of the lands. There are very few pure tenants—depending solely on rented land.[9]

2.8 Fallow Land

Even though the 2001 Sample Agricultural Census mentions that 10,720 ha (of the total cultivated 2,654,037 ha) land is fallow, there is a growing concern that a lot more land is lying fallow, especially those owned by absentee landlords. CRSC reports that about 20% of the cultivated land has remained fallow. According to their reports, 2,968,017 ha land has been cultivated and 986,898 ha has remained

[9]However, there is other data that counters the government's agriculture census reports. In 1985, according to a study carried out by IDS, 31% of farm families were tenants—10.8% registered and 22.3% nonregistered (IDS 1985). According to Badal Commission, there were 0.56 million tenant farmers in 1994, 20% farm families were tenants, and total land area cultivated by them was about 12% of the cultivable land. At that time, the registered tenants were 370,127, of which 72% lived in the Terai, 24% in Kathmandu valley, and 4% in the hills. According to Nepal Living Standard Survey II (2003–04), 31% farmers (about one million farm families) work as tenants.

fallow (CSRC 2004). But it is difficult to define what a fallow land is and how these statistics have been generated. However, in the last decade, the tendency of fallowing the land has grown, especially in the hills and mountains and in Terai around the cities and market centers (for plotting the land). Various microlevel studies have pointed out this. The main cause of abandoning the cultivation of land is migration of young males to work in Gulf, Malaysia, India, and other countries. Again it is difficult to exactly tell how much land has remained fallow. A study in four districts (Kavre, Parbat, Lamjung, and Pyuthan) revealed that abandoned agricultural land ranged from 17.9 to 36.8% of the cultivated land. It is almost double than the earlier studies conducted about a decade ago. Parbat and Lamjung districts had higher proportion of abandoned land. The reason for such abandonment is migration for foreign employment and plotting of the land near the city and market area and access to alternative sources of income (Paudel et al. 2014). It is also interesting to note from this study that poor households abandoned 50% of their land, middle-income households 16%, rich 18%, and ultra-poor 17% (page 16). As poor households did not find their landholding viable, they switched to other sources of income. But for ultra-poor, migration and other opportunities were not accessible, and thus, they were forced to cultivate the land. The tendency to fallow the farmland because of migration has also been highlighted in other studies (see Adhikari and Hobley 2015).

It is also interesting to note that because of migration and abandonment of land, the terms and conditions for renting land—whether sharecropping or fixed rent—have moved in favor of tenants. Now, tenants have started demanding terms and conditions in their favor and are paying low rent (product or cash) and are also getting supports from landowners in the form of seeds, fertilizers, and other inputs and sharing of the cost of plowing the land. Because of these demands of the tenants, landowners have started abandoning the land (see Adhikari and Hobley 2012, 2015; Adhikari 2010).

The fear that tenants will claim the tenancy rights is one of the reasons landowners who are not able to cultivate the land by themselves keep the land fallow. This is despite the law that there will be no 'double tenure' on land. But still then there is fear from the politics of land reform. It is not that landowners do not want to rent out the land. They are willing to rent out with minimum rent or even without the rent. But the fear of legal tenure right has prevented them from renting out. In places where, this fear is minimum because of the social condition (e.g., Gurung villages in Kaski district), many migrant Gurungs have rented out their land without seeking any rent. Abandonment of land because of this fear has two consequences—it has led to decline in overall production, and it has also prevented tenants to cultivate the land on rental basis (Adhikari 2010). This has created a new challenge to devise a policy. So, now, land reform policy, it is argued, should aim at reforming the land tenure to provide high share of production/income to the tenant (like 80–90% of the production) but not the ownership rights to land. As the cost of farming has increased, tenants deserve higher share in production and guaranteed rights of cultivation until they are willing to do so.

There is another tendency emerging regarding agrarian relations in Nepal. Now, the factor determining the sharecropping, or cultivation on rental basis, is not the landownership (as in the past), but access to other income sources, mainly foreign labor migration. Now, in rural Nepal, one can see small farmers renting out their land if their family member(s) are in foreign employment. Similarly, one can also see middle-scale farmers renting in other's land if they are not able to access such employment opportunities. These new emerging tendencies have implications for land reform policies.

2.9 Commonland and Its Uses

Apart from private land, which is mainly used for farming and which forms the main basis of landownership in Nepal, there are also common lands. As a matter of fact, government owns about 80% of the common land, and community owns a small part of it (also called 'public land'). Some of these lands are also suitable for farming in traditional sense, i.e., for field crops. But a significant part of the land owned by government in the form of forest/pasture can also be used for producing food. In every village, there are some types of common land, which are used as pastures for public purpose. There is no data about the extent of these types of land. In some places, these lands are used for developing community forests or leasehold forests.

There is about 1.7 million ha of pastureland in Nepal, of which about 1 million ha (66.6%) is located in the mountains, 4.3% in the middle hills, and 32.1% ha in the hills. Pasture has mainly been used as community property and its use in high mountains was dictated by local traditions. But government regulations have nationalized it. In high mountains, they are still used as community property. These pastures have also been important for people who move according to seasons with their livestocks.

Forestland is another category of land. Forests are important as they could help in producing food as well as supporting farmlands. From management perspective as provisioned in recent laws, acts, and policies, it has the following types of forests: national forests (government-managed forest, protected forests, community forests, leasehold forest, and religious forest) and private forest. About 40% of the area of the country is under the forest. Community forestry in Nepal has become a functional and integrated part of many communities with over 18,000 recognized community forests legally managing over some 20% of the forested land. Forest Act 1993 and Forest Policy 2000 recognize the Community Forest User Groups as legal bodies capable of owning the land/forest. However, there is still controversy about the ownership status over the community forestland. Leasehold forestry is another management regime, which is targeted specifically in helping the poorer households and individuals, particularly women among them. Groups of poorest people are allocated degraded forest on a long-term tenure basis for producing animal fodder, fruit trees, and nontimber products. The main target of leasehold forestry is to reduce rural poverty and restore environment in the middle hills by promoting fodder grasses and livestock raising (Box 1). About 18.33% of the land surface of Nepal is devoted to protected areas—national parks, conservation areas, and wildlife reserves. At present, there are about 18 protected areas, and eleven national parks also have buffer zones. There are a few innovations in these resource management practices like allocating specific area to poorer and disadvantaged people to manage and use resources within the buffer zones.

Box 1: Leasehold forestry in Nepal

The goal of the Leasehold Forestry and Livestock Production Project, implemented by the Government of Nepal with support from the International Fund for Agricultural Development (IFAD) was to reduce poverty and restore environments in the middle hills by offering on long-term lease small plots of degraded, public forest land to groups of the poorest rural households. The project participants rehabilitated the land by banning grazing and by stall-feeding their livestock, as well as by cultivating fodder grasses, fruit trees, and other plants provided by the project. The leases gave them long-term land tenure and along with it, the incentive to regenerate, protect, and manage the degraded forest areas they were using, while offering them benefits in terms of improved livelihoods. Selection of households was on the basis of their poverty status.

In the second phase of the project (2005–2014), a total of 20,450 ha of forest area were handed over to 40,638 households belonging to 4101 leasehold forestry user groups (LFUGs), with an average leasehold forestry area per household of 0.5 ha. The project provided two mature female goats of locally adapted breed to each member of LFUG and a breeding buck to each LFUG.

The project brought about significant economic and social empowerment of LFUG members. There was both an increase in income and a diversification of sources of income. The growing sources of income were all related to the increased fodder available from intensive management. Households increased their holdings of animals and sales of milk and other animal products. The shift from grazing to stall feeding, in turn, had an impact of women's and children's time use. Women saved up to two and half hours per day, time that they then used either in other productive activities or for leisure. Children, who often had to take the animals for grazing, were able to go to school. 97% of LFUGs were engaged in savings and credit schemes.

Leasehold forestry is a form of land reform in which forest land was redistributed from state to community/individual membership. The forest right is a user right and not a right to sell or sublease. By not allowing the right to sell the asset, stress is placed on the income that can be sustainably extracted from the forest. Sustainability is enhanced since the lease for a long-term (40 years). Land reforms have usually ignored women. But leasehold forestry explicitly brought women into the picture as designated members of LFUGs. Both as primary members and as managing committee members, women became key players. This improved their self-esteem and increased household well-being (IFAD 2003). What is novel about this initiative is that it was introduced as a project and then adopted as a national policy.

Source Thapa (2016)

3 Laws and Policies on Land and Land Rights

Several laws and policies have been enacted to regulate or govern various types of lands in Nepal.[10] Of these, Land Act 1964 is directly related to land use and management, and to agricultural production and food security. This Act was developed to guide the land reform program, which was implemented in the mid-1960s. It also has some features on land use and management. But this Act was seen primarily as the one to reduce landholding by fixing a maximum ceiling on landownership and to provide land tenure rights for those who cultivate others' land. The fourth amendment (1997) of the Land Act 1964 made the provision of termination of rights of unregistered tenants (who were not able to register within given time) (Table 6).

There are questions as to the effectiveness of the past land reform programs. Most claim that land reform program enacted in the mid-1960s was not able to take over the excess land (above the ceiling), but was effective in providing land tenure rights. Apart from implementation problems, these programs also did not receive much political support. By now, there is not much land to gain by fixing the ceiling over landownership as sizes of family landholding have become smaller.

From time to time, government has initiated different programs to promote access of disadvantaged communities to land. Some of the examples are:

- Exemption of 25% registration fee if the land is registered in the name of women. This policy seems to have brought significant change in increasing the

[10]These include Land Acquisition Act 1977, Land Act 1964, Birta Abolition Act 1959, Land Revenue Act 1977, Trust Corporation (Guthi) Act 1976, Land Survey and Measurement Act 1963, Range Land Nationalization Act, 1974. Similarly, Forest Act 1993 and Forest Regulations 2000 are important Acts to govern forestland.

Table 6 Land ceiling proposed by government at different times (Land Act 1964 and its revision in 2001)

1964 Act				Revised ceiling by Deuwa government in 2001
S. No.	Category of areas	Ceiling provision	Additional areas provided for housing	
1	All hills/ mountain areas	80 Ropani (4.07 ha)	16 Ropani (0.8 ha)	70 + 5 rop (3.75 ha)
2	Kathmandu Valley	50 Ropani (2.54 ha)	8 Ropani (0.4 ha)	25 + 5 rop (1.5 ha)
3	Tarai and inner Tarai	25 Bighas (16.93 ha)	3 Bighas (2.30 ha)	10 + 5 bigha (7.43 ha)

Source Adhikari (2009)

buying of land in women's name. This also indicates that soft policies like tax (to encourage or discourage) can work effectively.

- Implementation of leasehold forestry to increase access of poor and marginalized people in the land resources (however, a persistent and loud criticism is the intention to provide poor quality land, for which marginal people have to invest huge resources to make it quality land. This is not possible for poor people),
- Buffer zone program in national parks—to improve access to land for indigenous peoples living nearby the park.
- Land bank (this has been discontinued as discussed above).
- Land to freed Kamaiyas (bonded laborers)—this has been a successful program, even though it is not complete yet as some Kamaiyas are still to get land.
- Rehabilitation of freed Haliyas (plowmen)—this program is under implementation.

After the 2006s comprehensive peace agreement with the Maoist party, there was pressure to initiate land reform program in Nepal, as it was one of the agendas of the agreement. Nepal Government then formed two commissions for this purpose—in 2008 and 2009. These commissions have made various recommendations, and some of them are not implementable in strict sense as there is no land for redistribution. There are also a few controversies regarding whether to pay landowners to acquire the land above the ceiling. The fixation of land ceiling and the payment for the land above the ceiling have been very controversial politically and practically. Accordingly, these issues have not been resolved yet. Government has also formed a new High-Level Squatters Committee to settle the issue of resettlement of squatters.

4 Land Reform in the Context of Smallholder Agriculture

The data on landownership and its distribution shows that Nepal's agrarian terrain is composed of mainly small landholders. On average, a family farm's landholding is 0.7 ha, and there are only a tiny proportion of landowners whose land area exceeds 3 ha, and most of the landowners are cultivators themselves. Moreover, all of land a family has (i.e., 0.7 ha) is not cultivable land, as a part of this area is occupied by terrace bunds, trees, fodder grasses, and trees. Implementing land reform, especially redistributive land reform, in this context is extremely difficult.

Until now, redistributive land reform (which comes to mind of a Nepali citizen when land reform is talked about) has been proposed on the assumption that there is higher crop intensity or yield (production per unit area) in smaller landholdings. Accordingly, small farms were considered efficient than the bigger farms. But when small farms are not able to provide full employment and full food security, people have started searching other alternatives neglecting the farms. As discussed above, land abandonment in the middle hills was highest among the small farms than the medium or the large farms. This is because, for smaller farmers, land did not contribute much to their livelihood and thus they started giving less priority to farming in search for other alternative livelihood strategies. But they still keep the land, as land is also a security.

There has been a long-standing debate about the efficiency of small farms versus large farms. Early studies, mainly from South Asian countries, showed an inverse relationship between farm size and land productivity (Sen 1962; Bardhan 1973; Lipton 2009). In many developing countries, the inverse farm size-productivity relationship has been a major justification for redistributive land reform. If small farms are more productive than large farms, then distributing more land from large farms to small farms would lead to productivity gains and economic growth. In the case of Nepal, the evidence is mixed.

A study conducted in the middle hills of Nepal in 2007 supported inverse relationship between farm size and output per hectare (Thapa 2007). Total cash input use and labor hours per hectare were found to be higher on small farms. In contrast, another study of farms in Nawal Parasi district of Nepal's Tarai region in 1985/86 found no significant relationship between farm size and productivity (Tiwari 1990). It showed that productivity of farms depended on geoclimatic, sociocultural, and structural factors. In Nepal's case, the farm size has already become too small to be viable. So, any policy to further reduce this will discourage farmers to get involved in farming as a viable profession. It is seen that for generating surplus and getting more income from market, larger farms are necessary as there is economy of scale too. Now, with the out-migration of young people from farming and rapidly increasing wage rates, farmers are not able to cultivate the land properly. In such context, mechanization of farms is also recommended; however, it is also debatable whether this is a viable option in Nepal's terrain, especially in the hills. In Terai, mechanization with the use of small machines could be an option, which calls for consolidation of parcels of a landholding. This all calls for ways of land reform without reducing the landholding sizes and with emphasis on land consolidation and security of tenure. Of course, it needs to be recognized that availability of other infrastructure like, and irrigation, and other services are equally important to produce more, and make smallholder farming an option too. In countries like China and India, these types of infrastructure have helped in increasing production even in smallholdings.

Despite the tendency of fallowing the land in rural areas, cash crop cultivation in locations close to urban areas or to market centers has been found to be profitable for small farmers. Accordingly, practice of bringing poorer households in group and leasing common lands for them to cultivate cash crops like vegetables have been practiced especially from the support of non-governmental organizations. These cultivations take place in small areas, but generate significant income. A few examples of leasing common ponds for fish culture for poorer households are also seen in Terai region of the country. Accordingly, production of high value crop/product requiring less land could be a viable option for small farmers to engage in farming.

5 Land Administration and Information System

As a part of an institution to deal with land, land administration has been central. Moreover, this has a long history and was the backbone of the politics and ruling class. This was partly because of the fact that land revenue was the sole source for the state's finance and land administration. Prior to 1950, the land administration was revenue centric and only provisions were made regarding land taxes, their assessment methods, and modalities of collecting the revenue. Land Reform Act 1964 was brought to abolish traditional and feudal way of collecting revenue.

The land administration and recording system or land information system used by the government is still traditional. It is not aimed at improving the people's access to land. Land records are largely paper-based, written in old style. It is extremely cumbersome to find them when needed. This leads to corruption, as people have to pay extra to find their records. Moreover, records are extremely inaccurate. This is one of the reasons for large numbers of conflicts and court cases related to land. More than 60% cases in every type of court are related to land disputes. As the records are inaccurate, the verdicts are also arbitrary and this inaccurate information gives an opportunity to make corruption. Because of the storage problem and records being in paper form, they deteriorate and could be damaged in events of disasters like destruction of offices during insurgency.

The land recording system and the official process are extremely cumbersome. As a result, clients cannot get the services from the office easily. They need to hire *lekhandas* (writers), who will help in filling the forms or writing the applications and in approaching the officials. Without the help of *lekhandas*, it is extremely difficult to locate the documents and complete the official process. It is also because of the lack of information that land reform could not be implemented properly in the mid-1960s. At that time, cadastral survey was just started. The cadastral survey maps are now available but they are also inaccurate in most cases.

Security of landownership is extremely important. It has also been the main objective of land administration. But the poor land information system does not make the land administration a capable one. It also means that government is losing a significant amount of taxes and revenue, which could be invested in land itself.

Currently, land administration is done through the Ministry of Land Reform and Management (MLRM). Under it, they have Land Revenue Department and Department of Land Information and Archives (DOLIA). The ministry has a plan to modernize the administration and land recording system. They have also started computerized land recording system. But this has not been adopted except for one or two trials. There are several contentious issues regarding the rights and responsibilities of MLRM and its departments. There are questions as to its mandatory roles. How this institution links with institutions both at higher level or the lower level is also important. The use of technology for generating and recording the land information and providing services is important, which could also reduce corruption. Similarly, the process of land administration needs to be simplified.

6 Contemporary Issues Related to Access to Land

Contemporary issues like globalization and integration of world economy, growing land grabbing or commercial pressure on farmland, climate change, and foreign direct investment on land have also been affecting the use, management, and governance of land. Intensity of globalization has increased in recent times with Nepal's accession to WTO. Its impacts are seen in the form of foreign labor migration, remittances, and fallowing of farmlands. It will also have an influence on food imports and FDI on land, and thus on the production of crops and ownership of land by foreign companies within the country.

The direct impact of globalization is seen in the control of land directly by the foreign companies or the corporate world making land less available for the poor people. However, in the case of Nepal, this has not been seen as a significant issue, because of land-lockedness and relatively less developed transport and communication infrastructure.

Climate change is also impacting the use and management of land. Nepal is one of the countries in the world to have been greatly affected by climate change. The extreme weather and resultant disasters like drought, floods, GLOF, and landslides will have consequences on the availability and productivity of land. It is also possible that the increase in rainfall and temperature will make some land in the Himalayan region, which was hither to uncultivable, to become cultivable. But the diseases and pest associated with climate change will make farming in such lands difficult.

7 Experience of Other Countries in Land Reform

Land reform has been experimented in about two dozens countries in Asia from the late 1940s. There were several reasons or triggering factors for this, which varied from country to country. In general, both economic and sociopolitical causes led to these land reform programs. As self-sufficiency economic strategy was pursued with focus on agriculture, food production was emphasized. The social justice issues, which also entailed the reduction in the power of landed elites (for example, in Japan), were also the triggering factors for land reform. As with the triggering factors, there was also variation in the types of and reform programs. In some countries, especially in communist countries like China and Vietnam, state led the land reform and land was brought under state control without paying compensation to the landowners. This state's land was then operated by the commune/co-operatives. Private ownership on land was dismantled. However, China was not able to produce enough food to feed the growing population. There was a severe famine in 1960–1963, which led to food shortages and death of millions of people. In 1978, realizing the weak performance of collective agriculture in many areas of the country, China introduced the Household Responsibility System in which parcels of collective land were allocated to farm households. By 1982, more than 90% of the country's farmland had been distributed to more than 160 million farm households (Bruce and Li 2009). The shift to household farming, together with reforms in the government's procurement system for agricultural produce, better seeds for rice farmers, and investment in irrigation, led to big increases in food production and poverty reduction.

In Vietnam, the reform process known as Doi Moi, introduced in 1988 led to the dismantling of collectives and land-use rights were assigned to farmers, agricultural markets were liberalized, and wider economic reforms were implemented (Kirk and Tuan 2009). These reforms supported farmers to intensify rice production, diversify into new crops such as coffee and cashew, and improve the quality of food they produced. In countries like Japan, South Korea, and Taiwan land was given to households under the policy of 'land to the tiller,' and landowners from whom land was obtained were given compensation. The land reform in these countries was relatively successful.

South Asian governments, especially India and Pakistan, implemented land reforms to remove the vestiges of colonialism. Initially, these reforms were aimed at removing the zamindar system and recognition of land tillers as the actual owners of the land. They also aimed at tenancy reforms, imposition of land ceilings, and redistribution of private surplus lands and state lands. However, the implementation was ineffective at most, and, patchy if few successful cases. In India, there was some success in land reform in West Bengal and Kerala states, where peasant's income increased. Operation Barga in West Bengal implemented in 1978 has been considered as successful, though controversial, in securing the tenancy rights of the Bargadars (sharecroppers). It helped in preventing sharecropping from forced eviction by landowners. It also guaranteed that the Bargadars would receive a fair share of the crop—75% if the bargadar provided the nonlabor inputs (Dasgupta 2011). This program led to the legal empowerment of sharecroppers. But, later on, it was also reported that industrial development was hampered in these states because of the land reform. Land reform programs were rather less successful in Bangladesh and Pakistan where military rulers controlled the government for most of the time. This class of rulers also controlled the land.

After a long struggle by peasants in Philippines, land reform became government's agenda following the 1986 revolution. The 1988 Comprehensive Agrarian Reform Program (CARP) was the main land reform program and there are contested claims about its effectiveness even though it was able to give use rights of land to a large number of peasants. Land ceiling was fixed at 5 ha and all land above this ceiling had to be confiscated by the state for redistribution to people. It outlawed sharecropping practice in favor of leasehold (fixed rental) arrangements. In recent times, Philippines has adopted market-led land reform under the support of World Bank and has also taken seriously the question of Indigenous Peoples' (IPs) land rights.

Land rights to IPs have also been carried out effectively in South American countries. In Brazil, land reform attracted government's attention after Luiz Inácio da Silva ('Lula') of the Workers Party won the presidency in 2002. But, again, land reform program was not implemented effectively. Rather, Brazil is known for other programs like 'zero hunger' and 'food sovereignty.' These are also the concepts that are applied in Nepal nowadays, at least in policy arenas.

How far the experiences of these countries are useful to Nepal is hard to answer. Nepal's unique historical and socioeconomic context does not match with that of others. Therefore, Nepal should look more into its unique situation to devise the strategies of land reform. However, there are some lessons worthy of consideration:

- The experiences of China and Vietnam show that in addition to land reform, other economic measures such as government-supported procurement system for agricultural produce, supply of better seeds, investment in irrigation, liberalization of agricultural markets, etc. are crucial for productivity enhancement and poverty reduction.
- The experiences of countries like India, China, and Vietnam show that for a successful farm size transition (increase in size of holdings), there is a need for structural transformation of not only the rural economy but also the nonrural economy because it requires a large movement of farm population to rural towns and cities through migration. Farm size expansion is taking place in Punjab state of India and in the Mekong delta of Vietnam, where farm population is declining due to out-migration of landless workers and small farmers, who are induced to urban areas due to increased job opportunities (Otsuka 2015).
- Results based on studies conducted in China, India, Indonesia, and Vietnam indicate that the inefficiency of small farms increases with increases in rural wage rates and that there is an emerging advantage of large farms (Otsuka et al. 2013; Yamauchi 2014; Zhang et al. 2016; Deininger et al. 2015; Wang et al. 2014). Also, it is difficult for small farms to integrate into modern value chains,

to adapt to climate change, and to deal with market volatility and other risks. Small farms face another important development challenge—it is difficult to provide adequate levels of income to attract young, well-educated and innovative farmers.

8 Major Findings and Recommendations

1. Land distribution in Nepal has remained skewed due to historical reasons mainly the distribution of land by state to elites, but landholding sizes have become small. There is virtually not much land in larger landholdings, as their number has become very small. Therefore, it will be difficult to increase efficiency in production if landholding sizes are further reduced through land policies (like fixing of upper ceiling of landownership per household as 2 ha). As the experience of other countries in Asia shows the efficiency of small farms decreases in the face of rising rural wage rates, they are unable to provide adequate levels of income to attract young farmers, and face several other challenges. Lack of land, cultivation of land by owners themselves in most cases, and smallholdings, and smaller number of absentee landlords mean that there is not much scope to gain from radical redistributive land reform. Therefore, other ways to increase the access of poor and marginal farmers to land are to be found out. Leasehold forestry provides an example of innovative ways of enhancing access of the landless and marginal farmers to productive resources.
2. The tendency to migrate for work is growing, especially from the lower middle class and middle class. As a result, availability of land for leasing/renting has increased and so is the relaxation in rental terms and conditions. This has helped to some extent the poor households who could not take benefits from the new opportunities like migration. It is seen that proper policy on land tenure—giving more share of production to tenants (like 80–90% of production) and tenure security would make more land available for renting as landowners will be willing to rent out if they do not fear about tenants claiming the landownership title.
3. In semiurban areas, investment from large businesspersons on land for the purpose of land speculation and housing is also seen. This tendency might increase the landlessness in future and reduce food production. This trend is to be discouraged. Moreover, an appropriate plan for land use and strict compliance mechanism has to be developed to reduce haphazard settlement developments in prime farmlands.
4. Marginal indigenous peoples, women, and Dalits are the groups, which still own less land and lack access to land. But they are the ones who are involved in farming and in the management and collection of natural resources. At present, some state policies are favorable toward them. For example, there is tax

concession if the land is bought/registered in the women's name. The surplus land that is generated from the buying of land above the ceiling is to be distributed to landless Dalits and marginal indigenous people. But still, the situation of Dalits, women, and marginal indigenous peoples is precarious and more favorable policies are required, which also need to be implemented effectively.

5. New land reform should also encompass the issues like vital infrastructure (e.g., roads and irrigation and technical support system, marketing facilities) and land consolidation. Fragmented landholdings have not been helping in maximizing the use of services and machines (mechanization).
6. Common properties are very important for improving the access to land and natural resources for the poor and marginalized groups. It is because of the existence of these resources that landless people can take up the occupations like goat raising, livestock raising, home enterprises like weaving, bamboo basket making, collecting fruits and vegetables from the forest, and the like. The program of the NGOs like taking (leasing) a small plot of land and giving it for cultivation to poor families has also been possible because of the existence of the common property. The leasehold forestry program, which gives land to poor households on a group basis, has also been possible because of the availability of common land/property.
7. Land administration and information system are also very traditional and obstructive of the activities aimed at improving access to land for the poor. As a result, there is a lot of corruption and delay in providing justice to the rights-holders. Therefore, capacity of the land administration (including the human resources) and information system should be improved and the process simplified.
8. The new contemporary developments like climate change and globalization also seem to have impacts on access to land. Nepal until now has not benefited much from foreign direct investment (FDI), but globalization, in the form the opportunities to go to foreign countries for work and earn remittances, has direct bearing on land. It has some positive impacts also because it has helped in providing access to land to the rural poor. As a result, the terms and conditions of leasing the land are increasingly relaxed in favor of tenants. Climate change is also expected to bring many adverse impacts on access to land. Even though FDI is not an issue now, government needs to have proactive policy on this also. It is suggested that FDI that has adverse impact on the livelihood of local people should not be encouraged.
9. Some of the soft policies can also work to improve the access to land, for example—giving concession on tax if the land is registered in women's name. This has helped in improving the 'ownership' of land in women's name, but it does not solely mean that it indicates the effective control that is emphasized here. But increasing the ownership of land in women's name is certainly a step ahead. Similarly, progressive land tax could discourage people to have large landholdings. This could lead to availability of cheaper lands for the poor and marginal farmers, who also need government support (like subsidized loan) to buy the land.

References

Adhikari, J., & Hobley, M. (2012). *Every one is leaving, who will sow the seeds. A study of the impact of migration to Gulf States and Malaysia on the livelihoods of Khotang District, Nepal*. Swiss Development Corporation/Swiss Embassy, Kathmandu and Nepal Institute of Development Studies.

Adhikari, J., & Hobley, M. (2015). Everyone is leaving, who will sow our fields'. Impact of migration to Gulf countries and Malaysia in Khotang and Udaypur districts of Nepal. *Himalaya, The Journal of the Association for Nepal and Himalayan Studies in US, 35*(1), 11–23.

Adhikari, J. (2009). *Land reform in Nepal: Problems and prospects*. Kathmandu: ActionAid Nepal and NIDS.

Adhikari, J. (2010). Access to land and social inclusion in the context of high mobility in Nepal. In K. Stokke & M. D. Manandhar (Eds.), *State and society: Social exclusion and inclusion in Nepal* (pp. 91–130). Kathmandu: Mandala Book Point.

Bardhan, P. (1973). Size, productivity, and returns to scale: An analysis of farm level data in Indian agriculture. *Journal of Political Science, 81*(6), 1370–1386.

Bhattarai, B. (2003). *The nature of underdevelopment and regional structure of Nepal*. New Delhi: Adroit Publisher.

Blaikie, P., Cameron, J., & Seddon, D. (1980) [2001]. *Nepal in crisis: Growth and stagnation at the periphery: Revised and enlarged edition*. New Delhi: Adroit Publishers.

Bruce, J. W. (1989). *Community forestry: Rapid appraisal of trees and land tenure*. Rome: FAO (Community Forestry Note 5).

Bruce, J., & Li, Z. (2009). Crossing the river while feeling the rocks: Land-tenure reform in China. In D. Spielman & R. Pandya-Lorch (Eds.), *Millions fed: Proven successes in agricultural development*. Washington, DC: IFPRI.

CBS (Central Bureau of Statistics), World Bank, DFID, & ADB. (2006). *Resilience amidst the conflict*. Kathmandu: CBS and World Bank.

CBS. (2006). *Monograph. Agricultural census 2001–2002*. Kathmandu: CBS.

CBS. (2013). *NLSS III report.* Kathmandu, Nepal.

Dasgupta, R. (2011). *Operation Barga: An exercise in legal empowerment? A qualitative study of sharecroppers (‘bargadar’) and landowners in a West Bengal village*. A Master's thesis submitted at Sociology Department of Lund University, Netherlands.

Deininger, K., Jin, S., Liu, Y., & Singh, S. (2015). *Labor market performance and the farm size-productivity relationship in rural India*. Paper presented at the International conference of agricultural economists: Agriculture in an interconnected world. Universita degli di Milano, August 8–14, 2015, Milan, Italy.

IFAD. (2003). *Review of leasehold forestry project*. Rome: IFAD.

Integrated Development Systems (IDS). (1985). *Rural landlessness in Nepal*. Kathmandu.

Kirk, M., & Tuan, N. (2009). Exiting from collective agriculture: land-tenure reform in Vietnam. In D. Spielman and R. Pandya-Lorch (Eds.), *Millions fed: Proven successes in agricultural development*. Washington, DC: IFPRI.

Lipton, M. (2009). *Land reform in developing countries: Property rights and property wrongs*. London: Routledge.

Mishra, C. (2014). *Nepal and capitalism*. The Kathmandu Post. June 10, 2014. p. 4. http://kathmandupost.ekantipur.com/news/2014-06-10/nepal-and-capitalism.html.

Otsuka, K. (2015). *The future of small farms in Asia*. Paper presented at the International Association of Agricultural Economists, 2015 Conference, August 9–14, 2015, Milan.

Otsuka, K. (2013). Food insecurity, income inequality, and the changing comparative advantage in world agriculture. *Agricultural Economics, 44,* 7–18.

Paudel, K., Tamang, S., & Shrestha, K. K. (2014). Transforming land and livelihoods: Analysis of agricultural land abandonment in the mid hills of Nepal. *Journal of Forest and Livelihood, 12*(1), 11–19.

Regmi, M. C. (1978). *Land tenure and taxation in Nepal*. Kathmandu: Ratna Pustak Bhandar.

Regmi, M. C. (1988). *An economic history of Nepal*. New Delhi: Nath Publishing House.

Regmi, M. C. (1999) [1977]. *Land ownership in Nepal*. New Delhi: Adroit Publisher.

Riddell, J. C. (1987). Land tenure and agro-forestry: A regional overview. In J. B. Raintree (Ed.), *Land, trees and tenure* (pp. 1–16). Nairobi/Madison, USA: Land Tenure Center/University of Wisconsin.

Sen, A. (1962). An aspect of Indian agriculture. *Economic Weekly*, Annual Number, February 1962.

Sugden, F. (2016). A mode of production flux: The transformation and reproduction of rural class relations in lowland Nepal and North Bihar. *Dialectical Anthropology*, 1–33. https://doi.org/10.1007/s10624-016-9436-3.

Thapa, S. (2007). *The relationship between farm size and productivity: Empirical evidence from the Nepalese mid-hills*. Paper prepared for presentation at the XXII National Conference of Labour Economics, Napoli, September 13–14, 2007.

Thapa, G. (2016). *Land markets in Asia: A synthesis of issues, lessons and policy implications*. A background paper for APR's outlook report, APR, IFAD.

Tiwari, B. (1990). *Farm Size and Productivity in Nepalese Agriculture: A Case Study of Nawal Parasi District*. Research Report Series No. 9, HMG Ministry of Agriculture—Winrock International—Policy Analysis in Agriculture and Related Resource Management, Kathmandu.

UNDP. (2004). *Human development report of Nepal*. Kathmandu: UNDP.

Wang, X., Yamauchi, F., Otsuka, K., & Huang, J. (2014). *Wage Growth, Landholding and Machine Services in China*. Unpublished manuscript, Center for Chinese Agricultural Policy and the World Bank.

Watkins, J. C. (1996). *Spirited women: Gender, religion and cultural identity in the Nepal Himalaya*. New York: Columbia University Press.

Yamauchi, F. (2014). *Wage growth, landholding and mechanization in agriculture: Evidence from Indonesia*. Policy Research Working Paper No. 6789, World Bank.

Zhang, W., et al. (2016). Closing yield gaps in China by empowering smallholder farmers. *Nature, 537*(7622), 671–674.

Chapter 18
Agricultural Credit and Insurance in Nepal: Coverage, Issues, and Opportunities

Nara Hari Dhakal

1 Introduction

1.1 Background

A majority of Nepalese population lives in rural areas and agriculture is their primary occupation. Growth in gross domestic product (GDP) and development of Nepalese economy mainly depend on growth and development of agriculture sector as most of the Nepalese industries are agriculture-based and export sector is dominated by commodities. The sector has important role to increase farmer's purchasing power. The sector has pivotal role to promote off-farm and on-farm employment opportunities as well as maintaining price stability. Since the 1980s, share of the agricultural GDP has been declining from two third in 1980 to less than one third in 2017, but dependence of economically active population in the sector reduced from 93% in early eighties to slightly over 60% in 2017.[1] Growth in agriculture sector is sluggish over the last 30 years as a result agricultural production becoming insufficient to feed growing population. Agricultural import, like import of other commodities, has been increasing over time. This trend has drawn the attentions of planners, policy makers, bilateral and multilateral agencies working in Nepalese agricultural sector.

Experiences from agricultural advanced countries around the world reveal that the adoption of improved agricultural practices is the necessary conditions for agricultural growth and development. More specifically, this requires the cumulative efforts on increased intensity on the use of modern agricultural inputs, innovations through research and development, and enabling infrastructure such as

[1]Ministry of Finance. 2017. "Economic Survey 2017/18, Singha Darbar, Kathmandu, Nepal.

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G. Thapa et al. (eds.), *Agricultural Transformation in Nepal*,
https://doi.org/10.1007/978-981-32-9648-0_18

irrigation, agricultural road, market networks, storage, processing, and packaging facilities, agricultural finance. These infrastructures are instrumental to improve and achieve technical efficiency. The sufficient condition for agricultural development is behavioral changes among farmers to adopt capital intensive improved farming technologies. Nepalese farmers are predominately either marginal or small and are characterized by low propensity to save and increase investment in agricultural sector is not their priority. Further, agricultural sector is characterized by high risk and uncertainties on production productivity and prices. In this context, in order to enable farmers to adopt improved farming technologies with increase confidence to cope with prevailing risk and uncertainties, agricultural credit and insurance are the essential services to build farmers' confidence to adopt modern agricultural technologies to realize shift on agricultural production through higher productivity.

Experiences from agriculturally advanced countries revealed that properly designed and packaged agricultural credit and insurance services are demanded by small and marginal farmers for their survival to medium to larger farmers to enhance their income and developing entrepreneurship. Agricultural credit and insurance services are required by farmers to fulfill their cash and safety net requirement; purchase of farm inputs such as seeds, machinery, pesticides, labor, irrigation, and cope with emerging risks and uncertainties. Further, availability of credit and insurance services enables farmers to enhance their purchasing power and affordability to buy quality seeds and fertilizers and improve crop output and increase adoption of farming technologies by increasing their risk-bearing capacities.

Distribution of bank, finance, and insurance services in rural area is highly skewed, and they have inadequate financial sources to purchase quality seeds, fertilizer, pesticides, and machinery, etc. Therefore, credit has become the basic needs of marginal and small farmers. Hence, since mid-fifties, there has been increased concern from all the stakeholders to enhance frontier of agricultural credit and insurance services. Several policy measures and strategies are devised and implemented to promote agricultural credit and insurance services over the decades, but there have been marginal improvements on access to agricultural credit and insurance services. Furthermore, agricultural insurance is a very recent phenomenon, even less than a decade in Nepal.

Nepalese agricultural credit system consists of informal and formal sources of credit supply. While the informal sources include friends, relatives, commission agents, traders, private moneylenders, community-based savings, and credit groups, etc., the formal sources consist of banks and financial institutions (BFIs), financial cooperatives, and small farmers' cooperatives limited covering the whole length, breadth, depth, scope, cost, and variety of outreach. Nepalese planners and policy makers have taken it granted that access to agricultural credit and insurance is an essential service that affects agricultural productivity and research and development in agricultural sector need to establish causality with productivity growth. Further, there is consensus among agricultural planners and policy makers that intensification in agricultural operations requires guaranteed access to affordable agricultural credit and insurance services.

To date, efforts to promote agricultural credit and insurance services to large majority of farmers have been focused on enhancing supply-side capacity and directing financial and insurance service providers to expand credit and insurance services in agricultural sector. Such efforts were effective to substitute the services extended by the moneylenders, relieves, business persons, and traders leading to improved availability of credit and insurance services, increased investment, and improved agricultural outputs. There are evidences that input effect of access to agricultural credit and insurance is visible on increase on fertilizer use and promote private investment in machines and livestock, but output effect/yield effect is yet to be seen.

Box 1: Chronology of agricultural finance in Nepal

S. No.	Year	Event
	Prior to 1990: subsidized direct credit, experiment, trials and errors	
1	1956	Establishment of first cooperative and start of cooperative
2	1968	Establishment of Agriculture Development Bank, Nepal
3	1974	Directed Credit Program (priority sector)
4	1975	Small Farmer Development Program
5	1981	Production Credit for Rural Women Program
6	1982	Cottage and Small Industries Project
7	1985	Lead Bank Scheme
8	1987	Institution development program for SFDB (GIZ)
	1990–2000: expansion, trials, action, reflection, and action	
1	1990	Rural Self Reliance Fund
2	1992	Cooperative Act 1992
3	1993	Microcredit Project for Women
4	1992–96	Establishment of five Regional Rural Development Banks
5	1993	Grameen replication by NGOs (Nirdhan and CSD)
6	1993	Small Farmer Cooperatives Limited
7	1995	Development Bank Act 1995
8	1998	Rural Microfinance Development Centre
9	1998	Transformation of NGO into MFDB (Nirdhan)
10	1999	Act for NGO involved on Financial Intermediation 1999
	2001 onwards:	
1	2001	Small Farmer Development Bank
2	2001	Transformation of NGO into financial intermediary NGO
3	2002–2005	Expansion on number of FI-NGOs
4	2006	Banks and Financial Institution Act 2006
5	2001–2010	Expansion on number of Commercial Banks, Development
6	2012–2015	Expansion on number of Microfinance Development Banks
7	2010	Merger and acquisition
8	2010	Government renewed focus on expanding agricultural finance
9	2014	Merger of five Grameen Bikas Bank

Agricultural lending started with the establishment of three state-owned commercial banks, namely Agricultural Development Bank, Nepal (ADBN), Nepal

Bank Limited, and Rastriya Bank in sixties, and gained momentum on the aftermath of financial liberalization in the 1980s and 1990s on opening of banks and financial institutions by Nepalese private sector and foreign joint-venture banks. Bank branches were opened in different parts of rural and urban areas of Nepal primarily in those areas without bank branches and potential for their viable operation designated as un-banked locations. With the financial liberalization initiatives, many of the bank branches were closed, right sized, and ADBN was transformed into a full-fledged commercial bank: Agricultural Development Bank Limited. With the transformation of ADBN into ADBL, there has been gradual shrinkage in access to agricultural finance, especially in remote rural areas. Further, mainstream insurance companies were not attracted in promoting agricultural insurance services until 2012.

Since 2010, there has been gradual policy shift among regulators and policy makers to engage BFIs and commercial insurance companies to expand access to credit and insurance services in agricultural sector. Since then, BFIs are gradually increasing their financial services in agricultural and rural sector. Nepal Insurance Board (NIB) for the first time in the history showed demonstrated interest on expanding agricultural insurance in rural areas. In collaboration with Government of Nepal (GON), NIB introduced Crop and Livestock Insurance Directives (CLID) in 2013. This directive made a mandatory provision to insurance companies develop and implement commercial agricultural insurance products and services to promote agricultural production and productivity. According to CLID, all the Nepalese non-life insurance companies are obliged to design and implement agricultural insurance products suitable to farming communities in general and marginal and small farmers in particular. NIB also issued the guidelines for insurance product design for mainstream insurance companies and requires these companies design agricultural insurance products and submit their products to NIB for review. Insurance companies can sell their policy to the farmers only upon approval from NIB.

The GON established Deposit Insurance and Credit Guarantee Corporation (DICGC) in 1987 which was renamed as Deposit and Credit Guarantee Fund (DCGF) in 2016. DCGF offers livestock insurance service to farmers borrowing under priority sector and/or deprived sector lending scheme to safeguard micro-loans extended by banks and financial institutions (BFIs), financial intermediary non-government organizations (FI-NGOs), and financial cooperatives since its inception in 1987. There had been notable ups and downs on amount of loans guaranteed with change in GON's mandates and priorities. Regulated by NRB, DCGF charges 8% premium on loan guarantee, and GON subsidizes 50% of total premium. The service officers by DCGF are separated from that of the mainstream insurance companies.

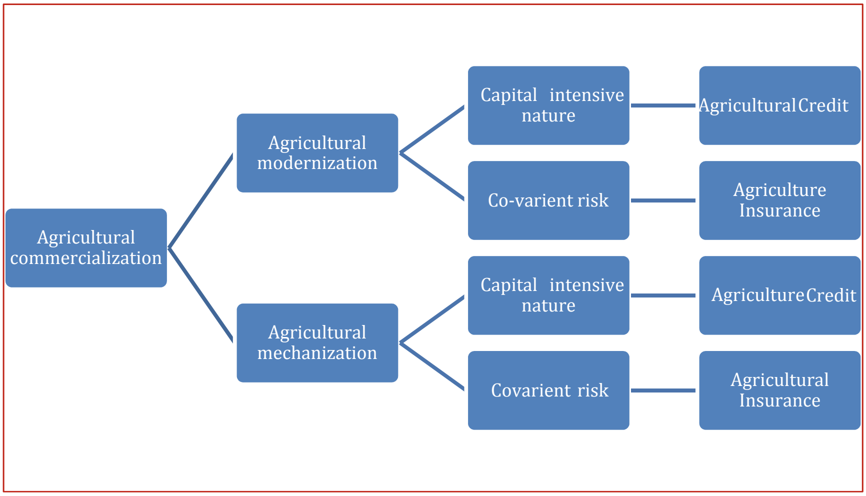
In the past, Nepal has implemented a number of innovative agricultural credit projects to expand the outreach of financial services to marginalized groups such as women and small farmers. These include Small Farmer Development Project (SFDP), Production Credit to Rural Women (PCRW), Small Farmer Cooperatives Limited (SFCL), and many others (Refer Box 1 for details). But because of supply led nature of these schemes, program like SFDB and PCRW failed but Small Farmers Cooperatives

Limited (SFCL) emerged with notable institutional transformation coupled with wholesale financing from Small Farmer Development Bank (SFDB).

There exist enormous opportunities to expand agricultural credit and insurance services in rural areas. However, there are numbers of issues and challenges impeding momentum to expand boundary of agricultural credit and insurance services. These issues and challenges need to be identified and analyzed to understand impediments to expand agricultural credit and insurance services. Major scope of this paper lies at assessing the coverage, issues, and opportunities on promoting agricultural credit and insurance services in Nepal.

1.2 *Conceptual Framework*

Agricultural development through modernization and mechanization of farming systems is must for agricultural commercialization. This requires farming communities to invest on latest agricultural technologies and farm machineries. Access to agricultural credit is required to enable farmers to be part of agricultural modernization and mechanization initiatives to manage required incremental farm investment. Improved access to agricultural finance has added significance for agricultural modernization and mechanization in country like Nepal where over 60% farmers are marginal and small endowed with fragmented landholdings. This is compounded by low marginal propensity to save resulting in inadequate sufficient owned-equity. Surrounded by these realities, these groups of farmers are compelled to resort to external borrowings to modernize and mechanize their farming system. Further, agriculture is a risky business compounded by both price and quantity/output risks. On the absence of access to reliable, trustworthy, and affordable agricultural insurance services, these farmers lack confidence to invest on agricultural modernization and mechanization and actively participate in agricultural commercialization process.



Both institutional and non-institutional sources of credit coexist in Nepal and farming households rely on both sources to fulfill their agricultural credit needs. In general, credit is not available to farmers from institutional/formal sources on time and at reasonable rates. In this situation, they are compelled either to depend on non-institutional/informal lenders or give up their participation on agricultural commercialization process. Demand for agricultural credit for subsistence farmers is low and non-institutional/informal lenders remained sources to meet their credit needs. Introduction of Green Revolution technologies diffused number of capital-intensive technologies to bring changes in cropping patterns in farming system and farmers' credit needs increased at a geometric rate and formal/ institutional sources of credit emerged as major players during the diffuse of those technologies. This was the era when the transformation of subsistence cropping to commercial cropping started. BFIs, including microfinance institutions (MFIs), saw business opportunities on this process and come up with different financing technologies, products, and services to meet farmers' financing needs and demand.

Public support was also diverted in agricultural sector to motivate farmers adopt green revolution technologies in the form of subsidy on agricultural inputs, interest rate, insurance premium, and other forms. On the other hand, BFIs designed and extended different agricultural credit products and services to farmers including different value chain finance products for short, medium, and long term. Performances of agricultural credit service delivery are mixed with banks gradually interested in agricultural finance owing to diverse problem on maintaining portfolio quality and burden to government due to increased input subsidy.

On the other hand, insurance companies have capacity constraint. Design and administration of diverse agricultural insurance products that is attractive to farmers and beneficial to insurance companies are not straightforward and require expertise from different fronts. Existence of diverse insurance infrastructures is requisite for promoting agricultural insurance service to farmers in remote rural areas.

Access to agricultural credit and insurance services is a necessary condition of agricultural modernization and mechanization leading to eventual agricultural commercialization. Despite significant efforts of the public sector institutions and BFIs, edge of agricultural credit and insurance sector has not been expanded as desired. Despite that there are tireless efforts from public sector, there is shortage of agriculture credit and insurance[2] services in relation to its demand by farming communities. In most cases, such an un-met demand has been met from informal sector as a way forward of emerging compulsion.

[2]Access to insurance service is also equally important for agriculture commercialization and development. There has been some effort to enhance access to insurance services, but performance on promoting access to insurance services has been very much limited.

1.3 Rationale and Scope of the Study

At present, all the stakeholders are concerned over ensuring food security and maintaining sustainability on agricultural sector. This has however been challenged as a consequence of decline in farm profit due to declining production and productivity on agricultural sector. In most cases, farmers are at distress due to both natural (flood, drought, crop failure due to prevalence of pests and diseases, etc.) and human-made (debt burden, low return from production due to inefficient marketing and unavailability of resources, higher cost of production due to use of traditional technologies) factors. It is evident that stakeholders have virtually no control over the natural factors, but those emerging from human-made factors could be mitigated through proper management and control. Enhanced access to agricultural credit and insurance services could be instrumental to reduce farmer's distresses emerging from both natural and human-made factors.

Promotion of agricultural credit and insurance has potentials to achieve twin goals of (i) uplifting socioeconomic situation and standard of living of marginal and small farmers (poverty reduction) and (ii) increasing production and productivity of agricultural products (import substitution and export promotion). This will create the foundation for the broad-based economic growth and lead to increase rate of GDP growth while creating foundation for sustainable development. In this context, promotion of agricultural credit and insurance is a necessity and not luxury but aspects related to reasons for using non-institutional sources of agricultural credit and insurance is still under-researched. In light of the above, this chapter is an attempt to analyze and present coverage, issues and opportunities pertaining to enhancing access to agriculture credit and insurance at a single place. In this chapter, relevant issues are reviewed, classified, and presented based on several themes.

1.4 Objectives of the Chapter

This chapter aims at reviewing the coverage, issues, and opportunities of the agricultural credit and insurance in Nepal. The specific objectives of this study are the following.

- Review the government policies on agricultural credit and insurance.
- Estimate the coverage of the agricultural credit and insurance.
- Identify the issues and opportunities for expanding agricultural credit and insurance services.

1.5 Organization of the Chapter

This chapter is organized into six sections. After this introductory section, Sect. 2 reviews the government policy on agricultural credit and insurance in Nepal while Sect. 3 estimates the coverage of the agricultural credit and insurance in Nepal. Section 4 identifies issues for expanding agricultural credit and insurance services, while Sect. 5 provides an overview of the opportunities for expanding agricultural credit and insurance services. The chapter concludes with summary and recommendations in Sect. 6.

2 Government Policies on Agricultural Credit and Insurance

Agricultural growth and development is prerequisite to achieve the objective of poverty reduction through broad-based economic growth. Access to agricultural credit and insurance services is required to promote agricultural growth and achieve food security and employment generation goals. Agriculture and agro-based value-added services can potentially play key role on achieving Nepal's commitment to Sustainable Development Goals (SDGs).[3] Despite these potentials, promoting access to agricultural finance to meet growing demand of agricultural investment capital and providing access to credit and insurance to marginal and small farmers appeared to be a daunting task.

Agricultural credit and insurance are essential services. On the absence of these services, agricultural commercialization is less likely. Agricultural production and productivity growth targets required to feed growing population and employment generation there-off is less likely to be achieved in the absence of enhanced farmers' confidence due to access to agricultural credit and insurance services.

The requirement of finance in agricultural sector is enormous. Due to very low propensity to save, very few marginal and small farmers have own capital for agricultural investment and they require access to agricultural credit to enable them adopt new technologies. Their cash flow situation is highly uneven, concentrated into 2–3 months of the year. Most of them lack skill to smoothen their cash flow situation. Access to agricultural credit enables them to smoothen erratic cash flow situation and advantageously use borrowed fund to purchase seeds, fertilizers, irrigation, machinery, etc. Explicitly or implicitly, they are in demand for agricultural credit from any available sources.

Innovations in technology and agricultural markets are required to break many supply-side constraints on promoting agricultural credit and insurance. Promotion of agricultural credit and insurance requires an assessment of risk, costs/distribution

[3]It includes 17 goals with 169 targets on a broad range of sustainable development issues for post-2015 till 2030.

channels, bankable opportunities, product diversification, and provision of right products to right people. The GON has acknowledged the importance of these factors while framing policies and strategies for expanding frontier of agricultural credit and insurance services in rural areas.

2.1 Operating Environment for Agricultural Credit and Insurance

Supply of agricultural credit in Nepal is governed by Bank and Financial Institution Act 2006, Act for NGOs involved in Financial Intermediation 1999, Cooperative Act 1992, and Annual Monetary Policy of the NRB. Likewise, the Insurance Act 2049 B.S. (1992) and Insurance Regulation 2049 B.S. (1993) govern the promotion of agricultural insurance services in Nepal.

Diversity of BFIs and insurance companies, high level of interest of NGOs and INGOs, bilateral and multilateral agencies supporting supply of agricultural credit, and insurance; many trials, inadequate documentation, alignment and harmonization on policy processes; and many promoters in accessible areas but few or no practitioners in remote areas are characteristic features of agricultural credit and insurance in Nepal. Deprived sector lending requirements, policies to encourage banks to open more branches outside Kathmandu valley, incentives for enhancing the outreach of agricultural credit to reach the unreached, and policy to license MFI with head office in nine most remote areas, introduction of CLID 2013 by NIB, premium subsidy of 50% initially which increased to 75% later, and allocation of 73 districts @ 3–5 districts to each of the 17 non-life insurance companies are some of the government efforts in expanding the edge of agricultural credit and insurance services in Nepal.

Nepalese BFIs have tried seven different lending modalities. These modalities are individual lending, Grameen-type lending, solidarity group lending, village banks, village savings and loan association schemes, financial cooperatives, and self-reliance groups. On the other hand, insurance companies have used agents to expand their services. These methodologies are specialized in extending individual and/or highly specialized financing to their clients. BFIs adopting these methodologies have attained saturation to expand agricultural credit and demands innovation on lending methodologies.

National Insurance Board (NIB)/Beema Samiti (BS) is the regulator for insurance sector. Pursuant to prevailing Insurance Act and Insurance Regulation, life and non-life insurance service providers are segregated with clear demarcation on related prudential norms, good governance standards, and operating rules. In connection with agricultural insurance and micro-insurance, since 2017, Regulatory Framework Promotion of Pro-poor Insurance Markets in Asia (RFPI) has been working in collaboration with NIB.

As of July 2017, there are a total of 26 insurance companies (17 non-life and 9 life) in Nepal. There is one re-insurance company. Of these insurance companies, there are one each state-owned life and non-life insurance company. All the non-life insurance companies, except the state-owned non-life company, offer livestock insurance and crop insurance[4] product. The re-insurance company provides re-insurance services.

Except for credit life insurance services initiated by MFIs and cooperatives to protect their credit portfolio, regulated Nepalese insurers do not offer any other micro-insurance products as of July 2017. This was mainly due to the absence of micro-insurance regulations. It is expected that to a great extent, the newly implemented Micro Insurance Directives 2071 and two life micro-insurance products recently developed for them by NIB will be instrumental to overcome contemporary issues inherent to these services.

2.2 Government Policies on Agricultural Credit

2.2.1 General Policies

In general, government policies on agricultural credit are provision on Bank and Financial Institution Act 2006, Act for NGOs involved in Financial Intermediation 1999, and Cooperative Act 1991, Financial Sector Development Strategy, and Annual Monetary Policy. Government had policy to provide financing facility at 6% to BFIs providing loans up to NRs. 10 million to entrepreneurs aged between 21 and 45 in agriculture sector. The fiscal policy of the current year has increased ceiling further. In order to promote agriculture led-rural development, GON endorsed the objectives of Nepal Agricultural Development Strategy such as reducing rural poverty to 10% through large investment in agricultural sector.

2.2.2 Fiscal Policy 2074/75 (2017/18)

Fiscal policy of the GON is providing direction on agricultural credit on annual basis. Fiscal policy 2074/75 (2018/19) has the provisions to promote agricultural credit and insurance by subsidizing up to 75% of total premium on agricultural insurance and promote easy accessibility of agricultural credit and insurance services to marginal and small farmers. The policy increased interest subsidy to 5% on agriculture and livestock credit and removed thresholds of Rs. 10 million set for agricultural credit under interest subsidy. Policy provision was made to extend agricultural credit against collateral of agricultural crops and fix minimum price of

[4]The state-owned insurance company, Rastriya Bima Sansthan, does not offer any agricultural insurance or micro-insurance products.

main crops, like paddy, wheat, maize, and sugarcane before plantation. To strengthen the cooperative sector, the policy put in place the submission of amendment proposal on the Cooperative Act in the Legislature-Parliament and establishes a separate structural institution to monitor and regulate the SACCOS.

2.2.3 Monetary Policy 2074/75 (2017/18)

Monetary policy 2074/75 (2017/18) has provided greater emphasis on increasing access to agricultural credit to farmers and youth. Important policy provisions of the monetary policy 2074/75 (2017/18) are outlined hereunder.

- Refinance facility for agricultural loan: The monetary policy 2074/75 (2017/18) has provided continuity to general refinance rate at 4% to loans extended to commercial agriculture such as fruit crops including banana, vegetable farming, livestock, fisheries, hydro, and other productive sectors with the purpose of supporting overall economic growth.
- Special refinance facility for agricultural loan: In case of export promoting enterprises such as ostrich farming, cardamom farming, and honey, special refinance facility will be provided at 1% of amount equivalent to total value of such export.
- Loan to productive sector: Monetary policy has provided continuity to the mandatory requirement of extending 20% of the total loan in productive sectors. Also, provision of BFI requiring extending the loan in agriculture and energy sector from 12 to 15% of the total loan portfolio by the end of July 2017 has been made. Similarly, continuity has been provided to the policy provision to development banks and finance companies to maintain the rate at 15% and 12% respectively.
- SME desk: BFIs should enhance the effectiveness of the "SME" desk setup to assist the missing middle people to have continued access to finance through additional and effective follow-up and supervision.
- Seed capital to youth: Pursuant to the provision of the fiscal policy in FY 2074/75 (2017/18), BFIs will be encouraged to provide additional financial support to the entrepreneurial youth receiving "Seed Capital" out of the Challenge Fund. Loan extended under this arrangement will be counted as a deprived sector credit.
- Deprived sector lending: The policy did not change the requirements of commercial banks, development banks, and finance companies on deprived sector lending. However, mandatory provision of 2% of total portfolio to be financed by the commercial banks directly has been withdrawn.
- Collateral: The policy made provision of accounting up to Rs. 1.0 million loan extended by the BFIs against the collateral of the commercial agricultural project under deprived sector lending has been made.
- Ceiling of the microfinance loan: This has been increased significantly.

2.2.4 Agricultural Credit for the Youth

Monetary policy 2074/75 (2017/18) states that under the agricultural credit policy for the youth, BFIs have extended the loans to 2342 youth at 6% interest rate and volume of the loan disbursed has been estimated at Rs. 1990 million, and average loan size has been estimated at Rs. 0.85 million. The GON has not rated it to be a satisfactory performance. Pursuant to this, the GON has reduced the interest rate for extending agricultural credit for the youth to 5%, and impact of this policy support on extending agricultural credit to be youth is yet to be seen.

2.2.5 Deprived Sector Lending Scheme

Since 1991/92, GON introduced deprived sector lending (DLS) scheme, wherein BFIs are required to finance certain percentage of their loan portfolio in deprived sectors. To start with, the scheme was confined among commercial banks, wherein commercial banks are required to extend 3% of their loan portfolio in deprived sectors. The scope of DLS was expanded to development banks and finance companies gradually since 2005, and percentage of total loan portfolio to be financed in deprived sectors was also increased to 5%, 4.5%, and 4% to commercial banks, development banks, and financial companies, respectively, in the monetary policy of 2014/15. Monetary policy 2074/75 (2017/18) did not change this requirement and made a mandatory provision for commercial banks to finance at least 2% of total portfolio in DLS directly. This was major paradigm shift to encourage commercial banks to downscale their operation.

2.3 Government Policy on Agricultural Insurance

Considering that insurance services in general and agricultural insurance in particular have had limited reach among rural households, the GON is currently providing 75% subsidy on insurance premiums for agricultural insurance to encourage farmers to buy the policy and has allocated NPR 120 million in the fiscal year 2074/75 (2017/18) toward this.

In 2013, the NIB issued Crop, Livestock and Poultry Insurance Directive (CLID) and pursuant to this directive, it endorsed four agricultural insurance products (crop, livestock, birds, and fish). There are several other agricultural insurance products or insurance like products implemented by Deposit and Credit Insurance Fund, MFIs, cooperatives, and self-help groups. The NIB board approved Micro-insurance Directive (DMID) in April 2014, and it is currently at the implementation phase.

In addition to private insurance agents, the NIB authorizes insurance companies to use MFIs/NGOs/cooperatives as distribution channels to implement their insurance policies. The NIB has yet to draft the policy to utilize alternative distribution channels, such as development banks, suppliers of fertilizers or seeds or pesticides or insecticides, utility companies, chain stores, retail outlets, foreign remittance payment networks, cell phone airtime providers, and SIM card as distribution channels, as agents. There are several potential partners available to be the distribution channels. Involvement of these organisations would make a substantial impact on reducing the cost of agricultural insurance service delivery.

History of implementing the livestock insurance in Nepal dates back to 1987, and there is high interest of mainstream insurance companies to extend livestock insurance services. In contrast, there is a shortage of crop insurance services. Though regulated crop insurance started in January 2013, very few mainstream insurance companies have shown interest in this business and their coverage is minimum.

The GON has been providing premium subsidy to policyholders in agriculture and livestock insurance since June 2013. Initially, the subsidy was 50% and this was raised to 75% in August 2014. The maximum sum insured per person/entity for this subsidy program is NPR 10 million. Tax (VAT) of 13% is applicable in premium paid up to July 2015. Tax (VAT) was waived in agri-insurance premium from FY 2015/16 with the continuation of 75% premium subsidy.

Despite that GON has been providing subsidy on agriculture credit and insurance to expand the outreach of smallholders, with the pace of support expanding at a rapid pace, the landscape of agricultural credit and insurance has not been changed notably.[5] The scheme was implemented adopting traditional banking and insurance service delivery modalities, confining at primary production level and was ineffective to upgrade smallholder's ability to participate in higher value chain. Modern value chain finance instruments, such as warehouse receipt, invoice discount, receivable finance, leasing, contract farming, lead firm farming, weather-based index, are yet to be scaled up in Nepalese agricultural credit and insurance arena.

3 Agricultural Credit and Insurance: Coverage

3.1 Overview

Promoting agricultural credit and insurance remained one of the major policy initiatives in Nepal since 2010. Despite several policy interventions to expand access to agricultural credit and insurance services, access of these services is confined among few commercial farmers in accessible areas. Compared to pre-harvest finance, agricultural credit and insurance services are extended in post-harvest activities such as agricultural processing, commodity traders, milling houses. The

[5]There has not been any effort to assess the impact of to assess the relevance, efficiency, effectiveness, impact, and sustainability of the subsidy to agricultural credit and insurance scheme, particularly on smallholder's ability to participate in high value chains.

pace of commercialization of agricultural activities has not matched with the spirit of government policy. This is specifically so in the inaccessible hills and mountain and accessible inner part of Terai region. The eventual result has been low level of access to agricultural credit and insurance services in inaccessible hills and mountains compared to accessible areas. Moreover, coverage of crop insurance is lower than livestock insurance due to low level of commercialization of crop sector coupled with small size of holding and inadequate enabling agricultural infrastructures.

3.2 *Coverage of Agricultural Credit in Nepal*

3.2.1 Access to Agricultural Credit

As of July 2017, agricultural credit is extended by 30 commercial banks, 68 development banks, 45 finance companies, 43 microfinance development banks, 27 financial intermediary NGOs, over 550 small farmers' cooperatives, over 14,000 financial cooperatives, 6000 agricultural cooperatives, 4000 multipurpose cooperatives, and 1700 dairy cooperatives. The number of financial service providers has been increasing in recent years.

In addition, informal groups on savings and credit, production, marketing, etc., promoted by government and non-government sectors are other important actors that are acting as an entry point for financial services for most low-income people, mainly to farmers especially in inaccessible rural areas. There are areas where such types of community-based financial service providers have an important role to meet agricultural credit need of farmers in some isolated pockets which is not attractive for the mainstream financial service providers to operate.

Though microfinance has proved to be a successful approach in providing credit to rural poor, mainly for non-agricultural activities, there are several challenges in designing microfinance product suitable for farmers. From 2012/13, there have been many initiatives to design innovative new product suitable for smallholders to promote seasonal agriculture. MFI has extended products and services to promote seasonal agriculture, but the delivery of these services could not be diversified beyond traditional methods of direct financing to clients. This, the landscape of agricultural finance could not be change notably.

3.2.2 Effectiveness of the Deprived Sector Lending Scheme

DLS is another important tool that the GON and NRB have used for promoting agricultural finance, but this scheme has mixed impact on extending access to agricultural credit in rural and remote areas. BFIs have met the DLS requirements by two modalities: directly and through MFIs. Because of the excess liquidity available, MFIs have not used funds thus received for retail lending. Review of financial statement of 20 MFIs for FY 2015/16 and subsequent discussion with their chief executive officers and other management-level staff revealed that 20% of the amount of DSL borrowing was used for parking[6]: 50% in rural and emerging market town areas and 30% in urban areas. Of the total lending extended in rural and emerging market town areas, 80% are used for promoting agriculture-based income generating/micro-enterprise activities. This implies that about 40% of DLS fund received by MFIs are used for promoting access to agricultural credit.

Some BFIs (Mega Bank, Bank of Kathmandu, NMB Bank, Global IME Bank, Muktinath Bikas Bank, Kamana Bikas Bank, OM Bikas Bank, etc.) have started retail lending by themselves to comply with DLS requirement, and consultation with these BFIs revealed that on an average 70% of their retail lending are used for micro, agricultural, and rural finance, of which about 70% are used for promoting agricultural business. This implies that about 42% of the DLS requirement directly mobilized by BFIs is used for promoting access to agricultural credit.

Access to agricultural credit under DLS is highly scattered and is not visible due to inadequate systematic approach to production pocket area development and market linkages. Promotion of systematic access to agricultural credit using suitable and viable value chain finance modality has potential to demonstrate the impact of the scheme on agriculture development.

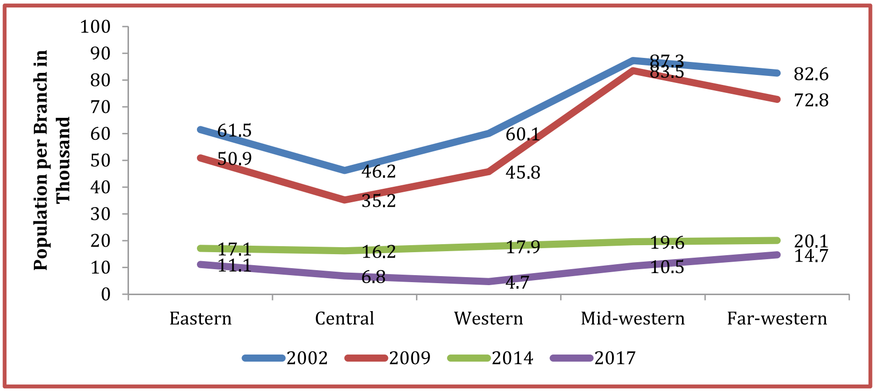
To sum up, agricultural financing policy for the BFIs including DLS is yet to be effective to extend access to agricultural credit. Government's efforts to make commercial banks responsive to extend 10% of their total loan portfolio on production (agriculture) sector are one step positive on promoting medium and large-scale investment in agriculture sector. There are several caveats on implementation front. Interest of BFIs has been skewed toward promoting post-harvest finance against pre-harvest finance. Policies and environment to generate enthusiasm among BFIs to be part of pre-harvesting financing are yet to be cultivated. They still see a lot of risk behind pre-harvest finance. Existence of properly designed and workable risk-sharing mechanism is a prerequisite to promote pre-harvesting finance by Nepalese BFIs. Agricultural insurance simply may not work, and it requires promoting buyback guarantee and function risk coverage at different tier of production process

3.2.3 Regional Distribution of Branches of BFIs

In general, BFIs have decentralized operation, and operate through branch offices in different parts of the country. The distribution of the bank branches across the nation's five regions is highly uneven. There is more number of branch offices in eastern, central, and western regions compared to mid-western and far-western regions. The population per bank branch in eastern, central, and western regions

[6]Deposit in other commercial banks as short-term fixed deposit.

significantly decreased from 61.5, 46.2, and 60.1 thousand per commercial bank branch in 2002 to 50.9, 35.2, and 45.8 thousand, respectively, in 2009.[7] This has been further reduced to 11.1 thousand, 6.8 thousand, 4.7 thousand, 10.5 thousand, and 14.7 thousand, respectively, in eastern, central, western, mid-western, and far-western regions in 2017.



Region-wise distribution of population per branch of commercial banks. *Source* Calculation based on data from: (i) quarterly economic bulletin of NRB for bank branches (ii) and statistical pocketbook of CBS for population

The close examination of the information presented in above graph suggests that there has been notable improvement in financial deepening in those development regions which have comparatively easier geography, better road connectivity, and more urban areas. This implies that growing number of commercial bank branches is not geographically balanced. Owner have tendency to open bank branches in developed and accessible areas against under developed and inaccessible areas. Further, it has been found that there is positive correlation between access to agricultural credit and distribution of BFIs' branches which has implications on expanding access to agricultural credit as well.

3.3 Current Financing Policies

As mentioned earlier, NRB has directed commercial banks, development banks, and finance companies to lend 20% of their total loan portfolio in productive sector and 10% of the loan portfolio should go in agriculture sector. Against this lending target of 10% on agriculture sectors, commercial banks and development bank have

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[7]This represents a growth of 20.8, 31.3, and 31.2%, respectively.

Table 1 Performance on agricultural credit disbursement (2009–2015)

Year	Portfolio of commercial bank			Portfolio of development bank			Total portfolio		
	Agriculture	Total	% of total	Agriculture	Total	% of total	Agriculture	Total	% of total
2009	13,259	389,045	3.4	–	–	–	13,259	389,045	3.4
2010	14,313	458,069	3.1	–	–	–	14,313	458,069	3.1
2011	13,921	513,664	2.7	–	–	–	13,921	513,664	2.7
2012	24,544	604,457	4.1	–	–	–	24,544	604,457	4.1
2013	31,013	748,178	4.1	–	–	–	31,013	748,178	4.1
2014	40,302	902,162	4.5	8,624	161,804	5.3	48,927	1,063,966	4.6
2015	50,736	1,103,151	4.6	12,384	194,685	6.4	63,120	1,297,836	4.9

Source NRB (2015), Bank and financial statistics (Mid-July 2015)

Table 2 Percent of total loans in agricultural sub-sectors, 2015

S. No.	Agriculture sub-sectors	% total loans
1	Agriculture and forestry	4.03
2	Fishery related	0.10
3	Agriculture-related machinery and tools	0.07
4	Fertilizers	0.12
5	Seeds	0.01
6	Animal and poultry products	0.24
7	Agro-product storage	0.13
8	Processing of tea, coffee, ginger, and fruits, and primary processing of domestic products	0.20
Total		4.90

Source Nepal Rastra Bank unpublished data

lent 4.6 and 6.4% of their loans and advances in agricultural sector in 2014/15. Table 1 provides information of performance of agricultural credit (2009–2015) of the commercial banks and development banks.

Ratio of agriculture portfolio to total portfolio of the commercial banks ranges between 1.19% (Nepal Bangladesh Bank) and 25.64 (Agricultural Development Bank) with an average of 4.6% in 2015. On the other hand, similar ratio for development banks ranges between 0.81 (Narayani Development Bank) and 31.32% (Muktinath Development Bank) with an average of 6.36% (Table 2).

Discussion with leading BFIs revealed that majority of their loans to agriculture sector are in processing sector such as rice and lentil mills, tea and coffee processing, sugar, poultry, animal feeds, fishery, dairy products, cold storage, compost fertiliser. Production loans are nominal. Banks have yet to come up with pre-harvest financing products. They would finance in agriculture sector if there were demand for loans from viable businesses. As majority of agriculture production is for subsistence, there has been very low demand for loans from production sector involving medium- and large-scale investments. If an appropriate conducive environment is created through policy adjustments and support is provided through technical assistance, as discussed above, agriculture entrepreneurs would be more motivated to invest in the production at commercial scale; there will be demand for commercial loans and banks can be expected to lend.

3.3.1 Emerging Trends

The GON has recognized agriculture sector as one of national priority sectors (consequently, NRB has included it in its mandate) and with the gradual expansion of scope of the services in the Nepalese farm sector, an increasing trend in banks' lending and investment in agriculture can be seen. While lending of 4.9% of their total loans and advances in agriculture sector by BFIs is encouraging, an important point to note is that most of these investments have been made in post-harvest side of agriculture where lending risks for BFI are low or none, and investments in pre-harvesting still remain a challenge. Additionally, high dependence of economically active labor force on agriculture, contribution of agriculture sector in national economy, and potentials for poverty reduction through the promotion of broad-based and inclusive economic growth, the current disbursement of 4.9% of total outstanding loan portfolio in agriculture sector by the BFIs is not encouraging. There is a clear requirement to increase investment in pre-harvest activities. Such a shift on lending priorities has further potentials to promote agriculture-based small-, medium-, and large-scale enterprises.

Based on these facts and data, it is seen that although BFIs lending to the sector have been gradually increasing over the years, what has been witnessed and confirmed by consultation with BFI is the inadequate more appropriate and farm-friendly policies and tools to facilitate graduation from subsistence to commercial farming. Further, a major challenge for transition to a commercially successful agriculture sector lies at inability to motivate commercial financing in pre-harvesting activities. Meanwhile, a few innovative value chain financing models such as warehouse receipt, invoice discount, receivable finance, leasing have been introduced in promoting agricultural credit, but their feasibility to scale up in other parts of the country is yet to be seen.

3.3.2 Agricultural Finance and Remittance

With increased number of migrant workers, there has been gradual growth in remittance flow, and it is likely to grow in the future. But migrant workers and their families have used remittance primarily for consumption purpose. If the current trend of remittance led and dominated higher consumption continues to take a major share, hard-earned money by migrants abroad will not be productively utilized and cannot contribute to economic growth and development. Productive use of remittance calls for systematic effort to divert remittances and requires initiative from government to encourage investments, generate employment, and expedite national economic growth.

Despite that many households in rural area receive significant amounts of remittance as a result of migration of rural youth to foreign countries, and there exists a potential to link this resource for agriculture and rural development by linking remittance receivers and senders with financial institutions, these potentialities have not been fully utilized. Initiatives of productive use of remittance are confined at channelizing remittance through formal channel (bank-based and/or wire-based) and concerned effort to further channel it to productive us is yet to be started.

3.4 Coverage of Agricultural Insurance in Nepal

3.4.1 Development of Agricultural Insurance in Nepal

Large-scale agricultural production ventures are lacking in Nepal due to risk factors such as poor market access and fear of potential losses. Many farmers are still sticking to the small-scale traditional mode of their work because they are unwilling to take larger risks. Farming for mere livelihood on small plots of land has remained a safer option, but such an approach does not encourage agriculture as a commercial venture. The national budget statements have been reiterating the need of commercial development of agriculture to reap more lucrative returns from the sector. Such a slogan is natural for an agriculture-based country like Nepal. But it is difficult to achieve the desired goal in this direction unless major hindering factors are identified and appropriately addressed.

Agricultural commercialization requires large investment in capital, land, human resources, and other inputs. However, this sector is full of potential risks. Hearing the news reports of crops being destroyed by hailstorms when they were ready for harvest is quite common. Natural disasters like floods and landslides can cause massive crop losses. Agricultural pests and crop diseases also bring unexpected losses. Due to impact of climate change, there has been unexpected shift in weather patterns. This requires change in the calendar of tilling, agro nursery, plantation, and harvesting to suit the changed pattern. New seed varieties may also be needed. There are rising phenomena of prolonged droughts, excessive or poor rains, and more windstorms. Good irrigation facilities are lacking, with increased incidences of droughts, late or inadequate monsoon rains proving to be disastrous. All these factors increase risks and potential losses to the farmers. Livestock farmers are also not immune from potential risks. Outbreak of cattle diseases is causing losses of millions overnight. Agriculture insurance can provide the right solution to these risk factors and provide enabling environment for commercial agriculture development.

Nepalese insurance companies did not sell insurance services to a significant scale for livestock and crops till 2012. After the issuance of the "Crop and Livestock/Poultry Insurance Directive (CLID) 2013" by NIB to encourage BFIs to develop commercial agricultural insurance products and services, mainstream insurance companies started selling agriculture insurance policies to the farmers. CLID makes it mandatory for all non-life insurance companies to offer agricultural (crop and livestock) insurance. It provided guidelines for product design. Further, the directive also authorized insurance companies to design and submit their own agricultural insurance products for NIB's approval. The directive issues by NIB include six insurance products, namely paddy, vegetables, potato, poultry (chicken and duck), fruits (orange and junar), and livestock (cattle, buffalo, goat, and pig). In order to properly implement the agricultural insurance, ensure inclusive and nationwide coverage, NIB has assigned 73[8] out of 75 districts to mainstream insurance companies @ 3 to 5 districts per companies to sale their agricultural insurance policies. Each insurance company is required to establish at least one agri-insurance branch in rural areas. The issuance of CLID by NIB facilitated the insurers to sell insurance products on vegetables, fruits, cereals, and livestock.

Crop Insurance

Crop insurance is primarily meant to cover the potential losses on crop production due to price and quantity risk emancipating due to change in production conditions. As per CLID, crop insurance covers production cost incurred till the field crops/horticultural crops are ready to harvest. This includes cost involved in the purchase of seedlings and fertilizers, and labor charge, among others. The minimum land requirement for insurance was half ropani (2738 sq. ft. = 254.50 sq. m) in the hills and one katha (3559 sq. ft = 330.85 sq. m) in the plain areas. It has estimated all the production cost that a farmer incurs till the field crops or horticultural crops are harvested. The types of the crop specified in the CLID are (i) vegetables, fruits, paddy and (ii) other crops with prior approval of NIB (the regulator). The type of damages covered by the policy includes: (i) fire, lightning; (ii) earthquake; (iii) flood, inundation, drought, landslide; (iv) storm, hailstorm, frost, snowfall; (v) accidental external means; and (vi) damage by disease/illness or insects. On the other hand, the policy excludes (i) damage by carelessness; (ii) destruction by government authority; (iii) theft; (iv) sale of land; (v) war and warlike risks; and (vi) nuclear arms, waste radioactivity. The CLID has provided process for filing claim and claim settlements.

Livestock Insurance

Livestock insurance under CLID covers cows, oxen, buffalos, yaks, sheep, goat, pig, chicken, swan, and ducks. The policy was launched to provide coverage of domesticated animals and birds such as buffalos, cows, goats, sheep, pigs, chickens, and others. In 2017, NIB issues separate directives to include bee, ostrich, and mushroom as well. Maximum values of insurance for improved breeds of dairy cow and buffalo are Rs. 150,000 and Rs. 125,000, respectively. Similarly, sum insured for water buffalo and ox raised for reproductive purpose was fixed at Rs. 70,000, while insurance coverage for water buffalo and oxen used for transportation purpose was fixed at Rs. 40,000. Likewise, amount insured for sheep and goat raised for meat production cannot exceed Rs. 8000, while maximum insurance coverage for different types of chicken and duck was fixed at Rs. 1200 and Rs. 700,

[8]Two districts (Kathmandu and Bhaktapur) were not assigned to any mainstream insurance companies.

respectively. Claim payment for livestock is 90% of the amount insured in case of death and 50% of the amount insured in case of permanent total disablement.[9] Deaths not reported within three days, and missing livestock and theft are excluded from claim process. Coverage and exclusion conductions that apply for livestock insurance are same as in crop insurance. The CLID has provided process for filing claim and claim settlements.

Premium Rate

There has been varying premium rate for crop and livestock. In case of commercial poultry farming, annual premium rate is 6%. For other crops and livestock, farmers can buy insurance policies by paying a premium of 5% and the policy agents can charge the commission of up to 15%. But, if the insurant buys the policies in a group or by being a member then 15% discount is provided. GON has provided subsidy on premium,[10] at 50% to start within 2013. Since the utilization of subsidy is extremely low despite concerted efforts of the insurance companies to increase the outreach of agricultural insurance services. Usually, the insurance policy is brought for a period of one year. But in case the insured plant, animal, or fowl has a life span of less than a year, then the premium amount are calculated based on production cycle. The CLID directs claim settlement process to be wrapped up within 30 days of first reporting of the event. Agri-insurance volume has increased following the increase in subsidy to 75% in 2014/15. Under the agricultural insurance framework, insurers and customers will bear 90% and 10% of the actual loss, respectively.[11]

Experiences and Progress

Progress on agricultural insurance provided by NIB reveals that very few (almost negligible) policies were issued in FY 2012/13 because the agricultural insurance was new; premium rates were high without subsidy; and period was 6 months. Total amount of insurance was Rs. 625,404,614, and subsidized premium was NRs. 17.024,512. There was no re-insurance support, and the policy was sold and started with co-insurance. There has been notable increase on insurance policy sale after FY 2013/14 (Table 3).

[9]Permanent total disablement is the situation in which insured cattle results in permanent and total incapacity to function in a capacity and purpose in which it is domesticated.

[10]Subsidy in premium by GoN (i) FY 2012/13: Nil; (ii) FY 2013/14: 50%; (iii) FY 2014/15: 75% (contd. in FY 2015/16). GON allocated subsidy; (i) FY 2012/13 (2069/70): Nil; (ii) FY 2013/14 (2070/71): 130 million; (iii) FY 2014/15 (2071/72): 60 million + 50 million; (iv) FY 2015/16 (2072/73): 120 million; and.

[11]kaflebishal.blogspot.com.

Table 3 Status of crop and livestock insurance (FY 2012/13–2016/17)

Fiscal year	Sum insured		Premium		Subsidized premium		Claim paid	
	Crop	Animal and fisheries	Crop	Animal and fisheries	Crop	Animal and fisheries	Crop	Animal and fisheries
2012/13	15,222,744	610,181,870	0	0	427,658	16,596,854	0	0
2013/14	146,955,001	3,039,878,894	0	0	6,225,541	114,348,193	1,741,482	59,908,698
2014/15	438,721,001	5,599,691,224	21,633,998	192,833,312	1,741,482	192,833,312	9,739,898	149,842,980
2015/16	776,283,131	8,468,778,684	38,588,225	387,336,479	28,941,169	290,502,360	25,263,190	230,606,104
2016/17	614,028,152	12,608,560,873	29,611,153	544,487,685	23,899,907	408,365,763	23,899,907	292,384,361

Source Nepal insurance board, crop and livestock insurance data summary FY 2012/13–FY 2016/17

Table 4 Progress on FY 2014/15: company-wise total premium (Rs.)

S. No.	Company	Total premium	Percentage
1	NLG Insurance	58,918,803	27.47
2	Shikhar Insurance	18,917,051	8.82
3	Siddhartha Insurance	15,718,054	7.33
4	Lumbini Insurance	8,831,640	4.12
5	Nepal Insurance	8,148,985	3.80
6	Sagarmatha Insurance	7,110,084	3.32
7	United Insurance	4,893,897	2.28
8	Himalayan General Insurance	3,898,094	1.82
9	Everest Insurance	3,214,950	1.50
10	Alliance (Prabhu) Insurance	3,104,760	1.45
11	Prudential Insurance	3,048,713	1.42
12	Premium Insurance	2,857,602	1.33
13	Neco Insurance	1,906,410	0.89
14	The Oriental Insurance	699,188	0.33
15	National Insurance	62,150	0.03
16	Rastriya Beema Co.	176,725	0.08
17	Others	72,960,204	34.02
	Total	214,467,310	100.00

Source Nepal Insurance Board 2016
Note Other refers to agricultural insurance done through DCGF, ADBL, and SFDB

In FY 2013/14, policy was sold for livestock, poultry, fish, and crop with an insured amount of Rs. 3,186,833,895; subsidized premium of Rs. 120,573,734 with a total claim of NRs. 61,650,180. Likewise, in FY 2014/15, policy was also sold for livestock, poultry, fish, and crop with an insured amount of NRs. 6,038,412,224; with total premium collection NRs. 214,467,310; subsidized premium of NRs. 194,574,794 and total claim of NRs. 159,582,874/–. Progress on insurance has been increasing gradually in recent years. Proportion of claim paid to total amount of premium collected was 51.1%, 39.0%, 34.3%, and 31.4%, respectively. This implies that proportion of claim paid to total amount of premium collected has been declining over time, leading to increased experiences of the insurance service providers on agricultural insurance.

Insurance company-wise progress on total premium collection (NRs.) in FY 2014/15 is provided in Table 4. This information implies that NLG Insurance, Shikhar Insurance, Siddhartha Insurance, and others including ADBL, DCGF, and SFDB have over 77% share in agricultural insurance market in Nepal. The devastating earthquakes in April and May last year and Indian blockade caused a severe impact on the insurance industry and further implications on agricultural insurance as well.

Agricultural insurance got momentum after the NIB issued directives for the insurers, which implied that they mandatorily design insurance products to address

Table 5 Loan guarantee by DCGF as of Mid-July 2018

Program type	Mid-July 2018
Micro-finance and deprived sector credit guarantee	10,126.22
Agricultural credit guarantee	1444.82
SME credit guarantee	809.56
Livestock guarantee	324.13
Total	12,704.73

Source Deposit insurance and credit guarantee fund, 2018

the areas specified by the regulator and assigned 3–5 districts for each of the commercial insurer to work with. The NIB has been running publicity campaigns, including interactions with selected farmers, and interaction with farmers and other stakeholders in several places. Similarly, the insurance companies are also expanding their network and starting publicity campaign. The agricultural insurance would further receive a fillip as there was increased awareness about the product.

Deposit and Credit Guarantee Fund in Agricultural Insurance

The government-owned Deposit and Credit Guarantee Fund (DCGF) was offering livestock insurance in the form of guarantee since 1987. DCGF partial credit guarantees backstop loans to small borrowers of BFIs, MFDBs, FI-NGOs, and savings and credit cooperatives (SACCOs) societies. DCGF charges 0.6–1% of premium depending on the type of loan, and the GON subsidizes 50% of the total premium. DCGF has provided guarantee to (i) microfinance and deprived sector loan, (ii) agricultural loan, (iii) SME loan, and (iv) livestock loan. The uptake and buy-in of the scheme are still slow by the BFIs. Amount of loan guaranteed by DCGF was Rs. 12,704.73 million as of mid-July 2018 (Table 5).

3.5 Assessment of the Coverage of Agricultural Credit and Insurance in Nepal

Though institutional finance in agricultural sector began in the mid-1950s, even after 60 years of experiences, there has not been significant improvement in lending methodology, appraisal technology, and in risk-sharing mechanism in agricultural credit. Agricultural insurance has a more recent start. Due to the government's agricultural credit and insurance policies and programs, repeated emphasis, and renewed thrust on promoting access to agricultural credit and insurance since 2010, there has been a gradual improvement in enhancing access to these services in different parts of the country.

Table 6 Number and area of holdings and number of holdings reporting access to agricultural credit (2011/12)

S. No.	Total area of holding	Total		Holdings with status of agricultural credit	
		Holdings (No)	Area (ha)	Without access	With access
1	Landless	115,538	3119	95,778	19,760
2	0.01–0.20 ha	817,506	88,239	673,170	144,336
3	0.21–1.00 ha	2,153,525	1,091,781	1,668,213	485,312
4	1.01–2.00 ha	548,974	749,810	417,088	131,886
5	>2.01 ha	195,550	592,691	140,923	54,627
	Total	3,831,093	2,525,640	2,995,172	835,921
	Access to agricultural finance				21.82

Source National Sample Census of Agriculture, 2011/12

3.5.1 Expanding the Frontier of Agricultural Credit

State-owned commercial banks, few regional-level development banks, MFIs, financial intermediary (FI) NGOs, and financial cooperatives (savings and credit, agricultural, and multipurpose) are the main suppliers of agricultural credit in Nepal, with private commercial banks, most of the development banks, and finance companies having a limited role. In general, the outreach of agricultural credit from commercial banks, development banks, and finance companies is confined among few farmers; that of MFIs and FI-NGOs are concentrated in areas with road access, and financial cooperatives have greater depth and breadth of outreach even in inaccessible hills and mountains but with limited quality (Table 6).

National Sample Census of Agriculture (NSCA) 2011/12 revealed that there are about 22% holdings in the country with access to agricultural credit. This implies that despite significant number of BFIs, cooperatives, and informal sources, larger section of the farm holdings is without access to agricultural finance.

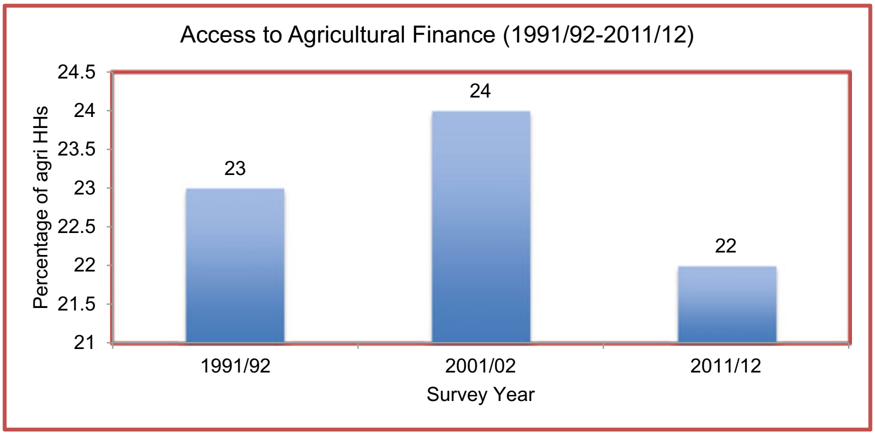
NSCA reveals that farm holdings have accessed agricultural finance from cooperatives, ADB/N, other BFIs, farmers' groups, women's groups, relatives, and other sources. A majority (about 35%) has accessed agricultural finance from relatives; with cooperatives, ADB/N and women's groups have notable share. As anticipated, proportions of households with larger holdings have better access to agricultural finance than the smaller holdings (Table 7).

Comparison of previous NSCA findings revealed that increase in number of BFIs, cooperatives, and informal groups has not been translated into corresponding increase in access to agricultural finance among farm holdings. These surveys revealed that the share of agricultural households taking loans to finance farming operations has decreased over time. The proportion has been fluctuating between 22 and 24%. It was 23% in 1991/92, which increased to 24% in 2001/02 and decreased to 22% in 2011/12.

Table 7 Sources of agricultural credit for farm households (2011/12)

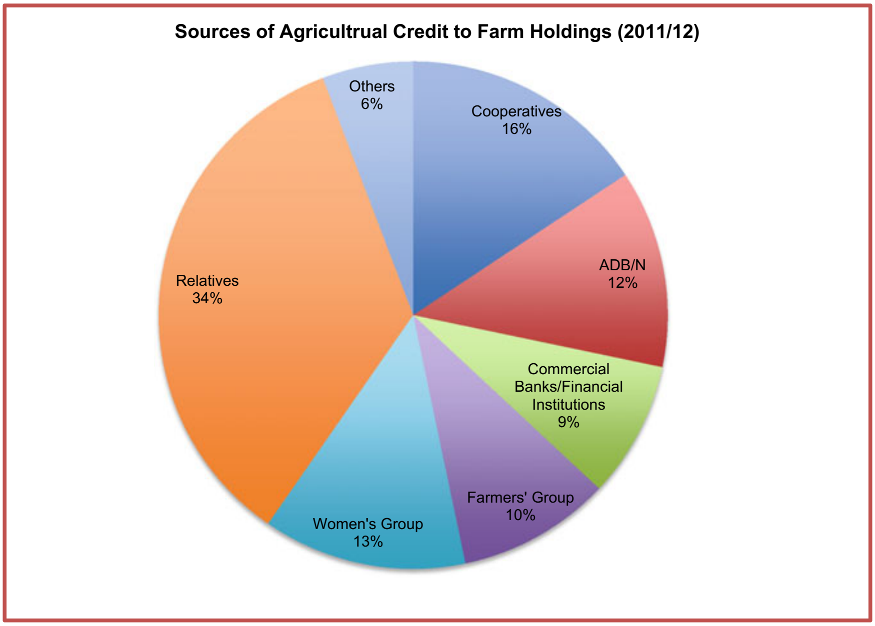
S. No.	Total area of holding	Total holdings (No)	Holdings with access to agricultural finance by source								Access (%)
			Cooperatives	ADB/N	Other BFIs	Farmers' groups	Women's groups	Relatives	Others	Total	
1	Landless	115,538	2140	1339	2,685	1736	2944	7206	1710	19,760	17.1
2	0.01–0.20 ha	817,506	19,934	8657	13,735	13,963	22,992	56,481	8574	144,336	22
3	0.21–1.00 ha	2,153,525	79,303	48,981	38,713	48,714	66,232	175,003	28,366	485,312	13.6
4	1.01–2.00 ha	548,974	20,817	25,901	12,345	13,436	13,174	39,743	6470	131,886	20.7
5	>2.01 ha	195,550	8844	20,550	5,064	3553	2879	10,553	3184	54,627	22
	Total	3,831,093	131,038	105,428	72,542	81,402	108,221	288,986	48,304	835,921	21.8
			15.68	12.61	8.68	9.74	12.95	34.57	5.78	100.00	

Source National Sample Census of Agriculture, 2011/12



Source National Sample Census of Agriculture, 1991/92, 2001/02, and 2011/12

Agricultural credit was accessed by farmers both from formal and informal sources. However, non-institutional or informal sources are the main source of loans for agricultural activities.



Source National Sample Census of Agriculture, 2011/12

Though the frontier of agricultural credit is gradually expanding, the proportion of farm households with access to agricultural credit has not increased yet as envisaged.

3.5.2 Expanding the Frontier of Agricultural Insurance

Many Nepalese farmers are not covered by insurance schemes yet, though the trend of getting insured is on rise lately. Agricultural insurance policy is a new thing for Nepal as the scheme was launched only six years back. According to information obtained from NIB, the insured amount in agricultural insurance has been increasing gradually over time. The NIB policy of allocating 3–5 districts for each mainstream insurance company to extend agricultural insurance services is quite effective to expand the breadth of insurance services in all 73 districts except Kathmandu and Lalitpur districts. However, compared to livestock insurance, expansion of crop insurance has remained slow despite government offering 75% premium subsidy. The slow growth in sale of agricultural insurance policy was attributed to inadequate technical human resources and poor distribution channels. The information provided by NIB revealed that livestock insurance accounted for 85% of agriculture insurance since the start of insurance scheme in FY 2012/13. The low rate of expansion of crop insurance has been mainly due to inadequate technical human resources to calculate premium and losses and declining farmers' motivation on agricultural commercialization. NIB sources revealed that a total of 700 insurance agents and over 100 para-veterinarians are mobilized for extending agriculture insurance services. The insurance companies have yet to mobilize the agronomist on expanding insurance business.

The farmers started taking the scheme seriously only after the GON increased the subsidy on crop insurance premium to 75 from 50% two years ago. Losses the farmers faced due to the April 25 earthquake further prompted them to go for the insurance scheme, and the trend has been on the rise.[12] Government officials and lawmakers stressed on the need to create enabling environment for agricultural commercialization such as introducing a pricing mechanism for agricultural products, irrigation facilities, market infrastructure, and other logistics supplies for effective implementation of farm insurance. Further, there has been increased realization to introduce integrated programs to promote commercial agriculture. Despite increased budgetary provisions and high acknowledgment by all the stakeholders including development partners, government failed to demonstrate and deliver the services as expected by farmers at large.

Consultation with the Ministry of Agriculture and its departments on agriculture and livestock services revealed the absence of service delivery network of the agricultural insurance service providers in rural areas impeded the government's target to

[12]In FY 2014/15, government has allocated Rs. 120 million for the farm insurance subsidy. As of now, the policies worth Rs. 1.51 billion have been issued. Premiums worth Rs. 72.6 million have so far been collected, while the insurers have settled claims of Rs. 21.6 million.

boost agro insurance to the needy farmers. The demand for insurance for dairy products quadrupeds and poultry farming has a notable growth since 2000; however, farmers were unable to get agriculture insurance service owning to increased focus of the insurers on urban and sub-urban areas. At present, it is costly for the mainstream insurance service providers to start service delivery outlets in rural areas and there is a need to explore alternatives to meet this need. One such option could be allowing Nepalese MFIs and cooperatives to work as an agent of the mainstream insurance companies for selling the agricultural insurance services, especially these institutions should be permitted to work as insurance agents. NIB has realized the potentials of this alternative, and they have drafted and forwarded a bill on amendments to the concerned laws to the MOF, which includes provision to allow MFIs and cooperatives to work as insurers/agent of insurance company. Such provisions will potentially expand the current breadth of the outreach of agricultural insurance services in rural areas.

4 Issues in Agricultural Credit and Insurance

4.1 Overview

According to NSCA, informal sources dominate credit, while financial cooperatives lead among formal sources. Farm holdings have accessed credit primarily from relatives (at 34%), followed by financial cooperatives, and women groups. Agricultural credit access from ADBL is also significant. Unsurprisingly, the proportion of households with larger holdings has better access to agricultural finance than the smaller holdings. Majority of farmers live in inaccessible areas, unattractive to traditional microcredit and insurance service providers for business expansion.

Prior to 2005, ADBL was specialized state-owned financial institutions for agricultural financing, and with the reform of ADBL as a commercial bank, it gradually diverted its loan portfolio to industry, commerce, trade, auto, hire purchase, etc., at the cost of agricultural finance. Exposure of ADBL on agricultural sector was 22% in March 2019. Since 2009, Sana Kisan Laghubitta Bittiya Sanstha Ltd. has emerged as one of the specialized financial institutions for agricultural financing, and as of March 2019, their total exposure was Rs. 19,076.99 millions and over 95% of this loan was used in agricultural sector. Other financial institutions such as Muktinath Bikas Bank, Nirdhan Utthan Laghubitta Bittiya Sanstha, Chhimek Laghubitta Bittiya Sanstha are gradually expanding their exposure on agricultural sector in recent years.

Agricultural activities are characterized by high risk and uncertainties characterized by factors such as output and price risks, seasonality in demand and erratic labor and capital requirements emancipating due to droughts, floods, pests, or diseases which is beyond the control of farmers. Banks and financial institutions have limited hedging capacity due to their limited capacity of spread those risks and adopt the risk mitigation measures.

4.2 Issues in Agricultural Credit

Packages of practices involved for the production of various agricultural activities are quite peculiar compared to other non-agricultural activities. They are characterized by long gestation period with both working capital loan and fixed investment loan requiring at varying time, slow turn over, both output and price risks, etc. Primarily, diverse nature of flow of capital, loan terms, low and uncertain rate of returns, etc., are the main issues confronting lenders in enhancing access to agricultural credit. The issue is more serious among marginal and poor farmers who are either technically or geographically excluded by the institutional credit delivery methodologies of the mainstream financial service providers.

In order to promote access to agricultural credit, BFIs need to adjust their typical micro-enterprise loans products to suit fundamentals of agricultural activities discussed above. Because cash outflows for inputs, capital, and some labor occur at the beginning of the crop season and cash inflows occur primarily at harvest time, agricultural loans often require loan principal to be paid at maturity rather than throughout the loan period. Interest may also be paid at maturity, at the beginning of the loan, or periodically either at fixed or flexible intervals throughout loan period. This is contrary to commonly adopted lending practices of the BFIs.

Due to special nature of agricultural activities and agro-based enterprises, there are several barriers to expanding agricultural credit to farm households. These barriers are (i) high delivery cost, proximity; (ii) weak farming practices and farmers; (iii) inadequate banking technology; (iv) collateral; (v) exogenous risks; (vi) government intervention; and (vii) weak collaboration with farmers. Thus, enhancing access to agricultural finance needs to tackle these issues carefully.

4.2.1 High Delivery Cost, Proximity

There are issues such as distance, isolated, and dispersed populations and poor road and energy infrastructure that make access to agricultural credit unattractive. They lack comparative advantage of operating in remote rural areas as it is difficult and expensive for BFIs to open branches in rural areas and to serve and monitor clients. They are characterized by working in urban areas and in relatively larger market and offer clients individual loans, savings accounts, and payment transactions. They lack potentials of providing services to the farmers in remote and inaccessible areas.

4.2.2 Weak Farming Practices and Farmers

Adoption of agricultural farming practices by farmers is very weak. Mechanization is at an infancy stage. Improved agricultural inputs and seeds are not available on time. Agricultural infrastructure such as irrigation, storage, agricultural road, marketing system either does not exist or insufficient. All these have resulted in weak farming practices. Average size of holding is small to initiate commercial agricultural practices. Collaborative farming is not common practices. All these have made mission of the BFIs to expand agricultural credit unattractive.

4.2.3 Inadequate Banking Technology

BFIs located in urban areas lack good knowledge of agriculture, and they have developed standard financial products that do not respond to its specificities, because agriculture is not the only lending activities to these institutions. They lack capability to analyzing farming household with typically mixed farms and many activities and many unknown factors. They also lack workforce with hand-on experiences on agricultural lending. They lack financial service products that take into account the specificity of agriculture, such as seasonality in payment, e.g., only after the harvest, or a lengthy investment period without cash flow for long gestation products, such as fruit trees or heifer cows. They are not properly positioned to design credit repayment proposals that match farming reality.

BFIs' branch office has high initial setup cost, and they cannot wait long to start small and operate small for initial few years. Their lack business linkages with their clients and their staff lack expertise to collect the types and volume of information required for agricultural lending. Most BFIs have yet to acknowledge significance of group lending methodologies such as involving farmers' associations and involving technical operators through value chain finance. On the absence of local presence, they will have challenges to know their clients and personal identification is a major issue. Getting clients' credit history will be an arduous task to these institutions. Most BFIs lack aptitudes and expertises to work with farmers which are resource intensive while the return will be lower.

4.2.4 Collateral

BFIs believe in traditional physical collateral, and they have yet to invent several collateral substitutes that enable small-scale entrepreneurs to have access to finance for their enterprise. Group lending, character-based lending, savings linked lending, use of cosigners, etc., are some of the collateral substitutes which Nepalese BFIs except MFIs are not familiar. Reliance with traditional collateral has been main issue to the BFIs to promote access to agricultural finance to marginal and small farmers living in areas with poor physical infrastructures.

4.2.5 Exogenous Risks

Agricultural system is exposed to various shocks emancipating from climate change, unpredictable weather conditions, natural catastrophes such as droughts, floods, incidence of pest and diseases, etc. Immediate effect of these risks has been evident in terms of highly variable production outcomes from agricultural activities. In addition, there are other production risks as a result of price risks, credit risks, technological risks, and institutional risks. All these made agriculture as a vulnerable business leading to inadequate attraction among BFIs to adopt it as an specialized lending business alternative. This calls for design and implementation of functional risk management system including informal (adoption of low-risk (cash) crops, crop diversification, diversification of income sources) as well as formal (agricultural insurance, minimum support price system, and contract (buyback guarantee) farming. There is no tangible and systematic to mitigate exogenous risks.

4.2.6 Government Intervention

Promoting access to agricultural (rural) credit either through state agricultural banks or through directed credit programs facilitated by commercial financial institutions was one of the popular government interventions in Nepal. Despite that these programs have had an immediate effect on growth and the development of targeted agricultural sub-sector, such schemes include the features of high administrative cost and subsidized interest rates. In addition, government often treats these loans as grants, resulting in a culture of non-repayment. Because of the subsidized features and soft terms, such an initiative drive-out private sector activity taking place in the area. Eventual consequences have been the absence of long-term sustainability of the initiative leading to leaving agricultural sector and rural areas with even less access to agricultural credit services.

4.2.7 Weak Collaboration with Farmers

BFIs have very weak collaboration with farmers. It has been strengthened over time. The relationship between BFIs and farmers could not be brought close, and this has further complicated due to the adoption of the individual lending methodologies. They lack understanding on availability of farm inputs, selling products, and creating mutually owned companies that operate within the value chain. Weak collaboration of the BFIs with farmers has decreased farmers' bargaining position with BFIs and traders.

4.3 Issues in Agricultural Insurance

Agricultural insurance by the mainstream insurance companies is relatively new phenomenon. Agents need to face several issues while implementing the new products. These issues can be pointed out as institutional, technical, operational, geo-climatic, diversity in risk exposure, inadequate trustworthiness, and high operating cost. Political instability and uncertainty also hinder the new business. Potential policy holders lack experiences on formal insurance, lack understanding on the concept of insurance, terms and conditions of contract, premium and benefits of purchasing of a policy. Demand-side preparation is very low due to low level of agricultural insurance literacy.

Moral hazard in agricultural insurance is very high, and the cost of verifying a claim is very expensive. It is hard to determine whether the losses are due to factors outside of the farmer's control or the farmer did not do his best to get a good harvest by using quality inputs like seeds and fertilizers and appropriate timing of planting. The insurance companies have difficulties evaluating the risk attached to crop production.

There are two approaches to pay out in crop insurance: input cost basis and yield basis. While farmers prefer "yield basis" pay-outs, NIB has directed mainstream insurance companies to adopt pay-out based on "input cost." Proper implementation of the agricultural insurance scheme requires systematic assessment of input costs of different crops. This depends on capacity to systematically assess the input cost of the crop insured which is lacking with most mainstream insurance companies and agent level. Further, some of the terms and conditions imposed by NIB (insured threat, capping on sum insured, and commission rate) jeopardize the efficiency of insurance service provider. Re-insurance companies operating in Nepal do not offer re-insurance coverage for agricultural insurance. All these have resulted in difficulties on achieving economic of scale and restricted the breadth of the outreach of agricultural insurance services in Nepal.

CLID is the only policy provision for implementing agricultural insurance in Nepal, and this is insufficient and needs further improvement to effectively implement and monitor agricultural insurance services. Rules and regulations required for agricultural insurance either do not exists or insufficient and requires immediate enactment. NIB lacks expertise on aspects such as actuary, statisticians, underwriters, risk analysts, and loss assessors of agricultural insurance.

Mainstream insurance companies lack distribution networks in rural areas. They need to relay with agents to sale agricultural insurance to rural farmers. Communication to remote areas is expensive and time consuming. Varying nature of agricultural products as well as risks attached to insurance products according to climate and topography has further complicated the process. CLID has yet to recognize these variations and realities. Uniform premium and compensation packages designed in CLID require immediate revision based on diversity on climate, topography, and other weather parameters.

Proper implementation of livestock insurance required livestock accident and mortality policy or table for livestock deaths and such information is not available at present. The risks to be covered under CLID are almost comprehensive, thereby making compliance a challenge. Some of the risks covered are catastrophic nature, exposing insurance service providers toward huge claim which potentially damages the insurer financially in the absence of re-insurance facility. Due to low insurance literacy, most farmers have perception that the schemes are overwhelmingly complicated, difficult to understand, and lack confidence on clam settlement.

Despite that community-based livestock insurance is not a recent initiative in Nepal, livestock insurance as such is a new activity for mainstream insurance service providers. Before 2013, none of these companies were involved in this sector and they lack expertise on agricultural risk management. However, claims data and risk experience of DICGC are available for them and can be used to assess the risk involved. The insurers see livestock insurance as a more valuable product and easier to monitor than crops.

On the other hand, crop insurance is very new in Nepal. There are no community-based experiences. Before CLID, a few MFIs, cooperatives, and seed suppliers offered informal crop insurance to few farmers in a very limited scale and there had been insufficient focus to bring commercial operators under their ambient. Consequence has been inadequate appreciable progress on crop insurance. The breadth of the outreach of the two mainstream insurance service providers that started offering crop insurance services after the issues of CLID has less than 100 policyholders.

Against above backdrop and challenges in implementing agricultural insurance, the issues in implementing agricultural insurance are categorized at three levels: (i) institutional- or regulation-related issues, (ii) operational-level issues, and (iii) local-level issues.

Institutional-level issues: Mechanism of agricultural insurance is yet at an infancy stage. Pilot testing has been completed and call for framing the governing rules and regulations. The directive itself is insufficient to address the issues governing the implementation of agricultural insurance. This calls for developing capacity of NIB to formulate governing rules and regulations as well as recruiting workforce with expertise on actuary, statistics, underwriting, risk analysis, and loss assessment. Against the market for agricultural insurance of 22 million people, current outreach has been 1.3 million people, which is very low (5.9%). On the absence of sales distribution network in rural area and re-insurance provision for catastrophe loss, commercial insurers are not ready to sell agriculture insurance in the present condition.

Operational-level issues: Most of the farmers are insurance illiterate and unaware of advantage and function of insurance. Agricultural products are highly diversified, with location-, geography-, and topography-specific variations. So the designing of agricultural insurance products needs more information and skill. There is an inadequate accurate time-series animal mortality data and crop production loss or damage data which is not available readily. In the absence of these data, the basis to establish technical premium rates is non-existent. Thus, most of the operation parameters of agricultural insurance have to be fixed on an ad hoc basis.

Local-level issues: There is high transaction cost both on-demand and supply sides. On the supply side, insurers need to bear excessively high administrative costs to deal with farmers located in remote and scattered geographical settings. Frequent visits for pre-inspection and assessing crop or livestock losses on an individual farmer basis are hardly possible from cost and benefits point of view. On the demand side, farmers' inadequate knowledge about the norms and principles of insurance, inadequate utmost good faith may hinder the implementation of agricultural insurance in an effective way. They are not used to the claim settlement process required by agricultural insurance system, requiring significant administrative work, which act as dis-incentive and de-motivation to farmers in buying the insurance policy.

5 Opportunities for Agricultural Credit and Insurance

5.1 Opportunities in Agricultural Credit

5.1.1 Un-met Demand for Agricultural Credit

Findings of the NSCA 2011/12 reveal that about 41.8% of agricultural households reported the need for agricultural credit, and these findings are summarized in Table 8.

Findings of the NSCA 2011/12 also revealed that landholders of Nepal are in need of the loan primarily to start livestock/poultry farming and to purchase agricultural inputs. Table 9 summarizes the information on the main purpose of agricultural loan among needy households.

The above information reveals that there is more financing need/demand for livestock/poultry sector, followed by agricultural inputs, and irrigation. The finding implies that there is tremendous demand for extending agricultural credit.

5.1.2 Very High Agricultural Financing Need

Based on the crop, livestock and microenterprise model budget prepared for each of the farm size categorize, financial need of these groups were estimated. The average loan need of these groups ranged between Rs. 190 thousand and Rs. 4980 thousand with an weighted average of Rs. 1124 thousand. Based on this calculation, total agricultural financing need is estimated at Rs. 1,799,720,295 thousand (Table 10).

Table 8 Need for agricultural credit in Nepal (2011/12)

S. No.	Total area of holding	Total		Holdings reporting need for agricultural loan	Percent
		Holdings (No)	Area (ha)		
1	Landless	115,538	3119	41,273	35.72
2	0.01–0.20 ha	817,506	88,239	283,570	34.69
3	0.21–1.00 ha	2,153,525	1,091,781	930,723	43.22
4	1.01–2.00 ha	548,974	749,810	249,638	45.47
5	>2.01 ha	195,550	592,691	95,663	48.92
	Total	3,831,093	2,525,640	1,600,867	41.79

Source National Sample Census of Agriculture, 2011/12

Table 9 Main purpose of loan for needy households with agricultural credit need in Nepal (2011/12)

S. No.	Total area of holding	Main purpose of loan of HHs with agricultural credit need (no. of holdings)							Total households	% of Total
		Agricultural Inputs	Irrigation	Agricultural implements	Livestock/poultry farming	Fishery	Other	Total		
1	Landless	902	596	439	36,373	229	2734	41,273	115,538	35.72
2	0.01–0.20 ha	46,898	29,516	8,730	170,506	2710	25,212	283,572	817,506	34.69
3	0.21–1.00 ha	223,799	162,771	42,544	425,689	10,362	65,557	930,722	2,153,525	43.22
4	1.01–2.00 ha	77,341	55,244	18,664	77,204	3801	17,384	249,638	548,974	45.47
5	>2.01 ha	33,864	20,031	14,312	18,513	1907	7035	95,662	195,550	48.92
	Total	382,804	268,158	84,689	728,285	19,009	117,922	1,600,867	3,831,093	41.79
	Percent of total	23.91	16.75	5.29	45.49	1.19	7.37	100.00		

Source National Sample Census of Agriculture, 2011/12

Table 10 Estimated agricultural need for agricultural credit (2018/19)

Total area of holding	Total		Holdings reporting need for agricultural loan	Average loan need (Rs. '000)	Total agricultural loan need (Rs. '000)
	Holdings (No)	Area (ha)			
Landless	115,538	3119	41,273	190	7,841,870
0.01–0.20 ha	817,506	88,239	283,570	495	140,367,150
0.21–1.00 ha	2,153,525	1,091,781	930,723	875	814,382,625
1.01–2.00 ha	548,974	749,810	249,638	1445	360,726,910
>2.01 ha	195,550	592,691	95,663	4980	476,401,740
Total	3,831,093	2,525,640	1,600,867	1124	1,799,720,295

Note Estimated using NASC data and estimated crop, livestock, and enterprise budget

Based on consultations with farmers, loan pricing is not the most pressing concern instead of other loan features such as loan term, repayment structure, collateral and access to reliable and quality non-financial (e.g., technology, raw materials, technical advice, marketing, and processing) services. Farmers self-report that they are not sensitive to pricing of financial products but are many concerns on aspects such as access to quality or reliable irrigation facility, access to market, storage facility and selling price of their produce. They are also concerned about inadequate technical advice on biological processes that help to mitigate against potential losses and are willing to pay for such services.

5.1.3 Promoting Agribusiness Financing

While different value chain finance models have evolved around the world, demonstrating the potential in agribusiness, BFIs are still following traditional financing policies, methods, and mechanisms, which have showed only marginal improvements. BFIs remain reluctant to lend in the agricultural sector as they perceive the risk of default to be high. Additionally, BFI's knowledge in the sector is limited along with the scarcity of skilled human resources required to identify and monitor such investments. With some effort on harnessing emerging potentials, there exist opportunities to promote agribusiness financing.

Under the banking sector, at present the most common agribusiness financing products are working capital finances such as overdrafts and demand loans for meeting working capital requirements of businesses. These loans are mostly revolving in nature and are provided against mortgage over real estate collaterals and personal guarantees of business owners in addition to hypothecation over stocks and receivables. However, lately in partnership with development initiatives, BFIs have innovated three major structured agribusiness financing models in order to meet post-harvest working capital requirements namely financing against warehouse receipts, invoice discounting, and loans against assignment of receivables. These models are running relatively successfully, and there exist opportunities to expand these models on a wider scale as a risk-sharing mechanism.

5.1.4 Replicating the Emerging Best Practices' Models Elsewhere

At present, most agriculture-dependent developing countries are making the switch from subsistence farming to medium- and large-scale commercial farming, and several innovative financing models to improve investment in agriculture have emerged world over. Of those, the ones that may be particularly relevant to the Nepalese agriculture sector are factoring, channel financing, savings account linked input finance, and value chain finance with input suppliers. Status of use of the other innovative approaches like mobile banking/digital finance/branchless banking is at an infancy stage. There are over 1000 branchless banking outlets in different parts of the country, but these outlets are not operating properly. Especially, continuity and sustainability of the branchless banking outlets are doubtful. There exist opportunities that BFIs can learn and replicate these model in Nepal.[13]

To sum up, through opportunities in agricultural credit exist for increasing outreach by BFIs, but there are challenges of expanding outreach to women, poorest of the poor, and disadvantaged groups, adoption of traditional banking system could help least to harness these opportunities. Alternative innovations such as partnership with member-based organizations, value chain finance, and use of ICT-based access to finance technology are required to address these challenges.

5.2 Opportunities in Agricultural Insurance

Insurance penetration and density in Nepal are the lowest among Asian countries. In 2014/15, it was less that 3%, whereas in India and China it was 8.9 and 6.6%, respectively (NIB 2016). The insurance density in Nepal was $7.9 compared to $52.2 in India and $93.6 in China. These figures show that there is a good opportunity for insurers to sell any types of insurance products in the existing market.

Neighboring countries in South Asia have more than two decades' long experience in agricultural insurance, which can be easily shared and the best suitable model replicated in local context. Evolving mass communication, exposure of the youth in international job markets and increasing trend of education and literacy, gradual road access to rural area are some factors that create good insurance environment. Financial inclusion is gradually increasing through massive activities of MFIs, financial cooperatives, and multiple activities of thousands of NGOs.

The Department of Meteorology has rich data on rainfall and weather, which is useful to design the insurance products. Introducing of modern technology, access of telephone, mobile, Internet, and use of remote sensing technology in remote area,

[13]ADB and White Lotus Centre (2016), "Medium and Large-Scale Investment in Agriculture in Nepal Opportunities, Challenges and Way Forward" Kathmandu, Nepal.

availability of resources, training and interactive forum for insurance are external factors to create conducive environment for agricultural insurance.

There has been greater policy support in agricultural insurance sector in recent years, but the off-take of agricultural insurance is still very low. With the support of existing community-based groups and networks involved in the agriculture and finance sector, there are some informal agricultural insurance schemes in place, but they have very limited scope and scale. Further, insurance products targeting value chain players in different emerging sectors are yet to be developed, with a very limited experience. There are greater opportunities to promote insurance products targeting value chain players.

Access to agricultural and micro-insurance services to marginal and small farmers promotes financial inclusion and will be instrumental on achieving sustainability of poverty reduction initiative. In the context, community-based livestock insurance scheme has achieved localized success as a risk mitigation tool and they are much that mainstream insurance companies can learn from this initiative. On the other hand, key stakeholders have limited knowledge on demand for crop insurance and its implementation management. On the demand side, farmers lack confidence on agricultural insurance due to their limited insurance literacy knowledge. Additionally, the regulator (NIB) lacks capacity to develop enabling environment to accommodate agricultural insurance as a new line of business as well as supervise agricultural insurance implementation by mainstream insurance service providers.

To sum up, there are tremendous opportunities to all stakeholders to promote agricultural insurance and much need to be done to harness those potentialities. More specifically, opportunities in agricultural insurance exist for increasing outreach by mainstream insurance companies. This however requires development of qualified technical human resources, work-out support mechanism for reinsurance, introduce weather based coverage, channel government support on insurance infrastructure development such as technical support, weather data etc., innovation on identification using microchips, and strengthen distribution channels through cooperatives, MFIs, and cost sharing on premium and loss. On the absence of these fundamentals, the above opportunities could not be harnessed.

6 Conclusions and Recommendations

6.1 Conclusions

Nepalese BFIs lend a disproportionately lower portfolio share to agriculture compared to the sector's share of GDP. Financial inclusion of commercially oriented farmers and agricultural SMEs through expended agricultural credit and insurance services is critical to achieve national priority of accelerating the transformation to a more commercialized agriculture sector set out in Nepal Agriculture Development

Strategies (2015–2035). While there are several structural challenges on promoting agricultural finance, there is significant space for policy interventions to increase financial solutions to the sector.

Nepalese agricultural credit and insurance services are highly subsidized. It is characterized by interest/premium subsidy. Global and regional practice implies that performance on implementation of subsidized agricultural credit and insurance scheme is not satisfactory. Nepal is not an exception. The agricultural credit and insurance subsidy policy have undermined the sector performance.

Increasing access to and improving the quality of agricultural credit and insurance services across all target market segments are constrained by inadequate required capacity of the macro-, meso-, and micro-level service providers and preparedness of the clients at demand side. At present, there are inadequate strategies to develop the capacity retail service providers, marginal and small farmers, and regulators/policy makers.

Nepalese BFIs lack clear understanding of the complexities involved for increasing agricultural credit specifically in rural areas. They are still adopting traditional approaches to agricultural lending; a continuation of approaches and strategies adopted almost four decades back by ADBL. This is partly due to several challenges inherent to the supply of the agricultural credit. BFIs engaged in agricultural finance need to tackle several specific challenges related to new product development, product diversification, client education, marketing, and implementation management.

There exist policy framework for promoting access to agricultural credit and insurance services in Nepal. The framework is often criticized on ground of its inability to expend the breadth of agricultural credit and insurance services to marginal and small farmers. Act, rules, directives, and guidelines formulated within the policy framework have failed to stimulate micro-level investments of BFIs and insurance service providers in agricultural credit and insurance services specifically to marginal and poor farmers. The policy framework and under-laying act, rules, directives, and guidelines failed to embrace both demand and supply constraints.

Agricultural credit is insufficient and unevenly distributed across geography and production activities. Credit flows are unevenly distributed, with bulk of finance directed to post-harvest finance compared to pre-harvest finance. Though agricultural businesses, particularly those involved in producing field crops, are intensive users of credit, limited numbers of marginal and small farmers have used agricultural credit due to their low-risk-bearing capacity and BFIs seeing them as high credit risk.

Agricultural insurance services have very low level of penetration. Mainstream insurance service providers are more confident on livestock insurance than crop insurance services. These service providers lack workforce with expertise on actuary, statistics, underwriting, risk analysis, and loss assessment. All these have a direct bearing on low levels of exposure of these companies. Investing on market research, product development, and marketing is quite uncommon among them. This has implications on prevailing low levels of understanding of insurance, misconceptions around the very concept of insurance, and distrust of insurance companies among target farmers. This calls for design and implementation of consumer education among them prepared based on proper market research and implementation of market-led approaches to new product development.

Agricultural credit and insurance services are dominated by traditional strategies to service delivery, and there is dearth of innovative institutions that promote innovative approaches to products' design and service delivery. This is lacking in Nepalese agricultural credit and insurance sector. Further, the level of use of ICT is either marginal or none on agricultural credit and insurance service delivery. The use of mobile and SMS banking technology is uncommon. Continuity and sustainability of lately introduced branchless banking technology are often doubtful and under-utilized in most cases.

Agricultural value chain finance (AVCF) is not very popular among Nepalese BFIs. This is primarily attributable to the absence of clear cut policy framework on AVCF, the absence of SMEs in AVCF, scale economy on production, fragmented market place and longer but small production corridors. Marginal and small farmers lack collateral, and almost all the BFIs have taken them as a credit risk. Their low propensity to save limited their ability to pay even subsidized insurance premium which is major barrier to entry to them. Further, agriculture insurance is not sufficient and accessible to real agri-businesses. Agricultural credit and insurance services are concentrated in accessible areas, and these service providers are reluctant to extend the services in remote and rural areas due to inadequate information and infrastructure. Majority of marginal and small farmers are yet to be brought under the ambit of agricultural credit and insurance service delivery.

6.2 Recommendations

In the context of inherent ineffectiveness and inefficiency of interest subsidy policy on agricultural credit and premium subsidy on agricultural insurance services, there is a need to review and expand the scope of interest rate subsidy on agricultural credit for the youth and premium subsidy on agriculture insurance scheme to make these policy initiatives more inclusive and broad based.

Promotion of agricultural credit and insurance requires strengthening the sector. It should be guided by both short-term and long-term strategies. The short-term strategies should consist of initiatives on developing the capacity of macro-, meso-, and micro-level institutions to identify institutional needs and scope of operation to promote agricultural credit and insurance services. On the other hand, the long-term strategies need to revolve around determining client-centered approaches for packaging technical training and learning forums that impart latest approaches in product development, outreach and delivery, and best practices and lessons learned from around the region.

Decentralized service delivery mechanisms on extending agricultural credit and insurance services require concerted efforts to develop industry-level knowledge at service delivery networks and/or agent level. More specifically, the implementation capacity of branch-level leadership and management including relationship managers and credit officers should be enhanced. They should have clarity on knot and bolts of agricultural credit and insurance products and services offered by their institutions.

Issue of reaching un-banked and under-banked farmers means financial deepening and diversification of products and services in accessible areas and expanding full-fledged financial services in inaccessible remote hills and mountain areas. In cognizance to existing stock of financial infrastructure, reaching un-banked and under-banked is a feasible preposition, but this requires concerted efforts on design and delivery of financial services from all the stakeholders engaged on enhancing access to agricultural finance for all through understanding of client need and development of products and services, enhance the capacity of institutions engaged on agricultural credit and insurance service delivery, and revisit of their service delivery methodology.

Agricultural credit and insurance technology need to be modernized, and the use of innovative institutions that promote innovative products needs to be encouraged. The level of use of ICT should be increased with full-fledged promotion of mobile, SMS, and branchless banking technologies. These require enabling regulatory and policy framework.

Some of the AVCF currently implemented as pilot such as invoice discount, warehouse receipt finance, receivable finance, leasing, lead firm finance, contracting are subject to close scrutiny to document the lessons learned and best practices. GON should come up with required policy reform to adopt and implement these AVCF modalities by Nepalese BFI.

References

ADB and White Lotus Centre. (2016). *Medium and large-scale investment in agriculture in Nepal opportunities, challenges and way forward*. Kathmandu, Nepal.

Central Bureau of Statistics. (2012). *National sample census of agriculture, 2011/12*. http://cbs.gov.np/image/data/Agriculture/National%20Level/NATIONAL%20REPORT%202011_12.pdf.

Ghimire, R., & Kumar, P. (2014). *Agricultural insurance products in Nepal*. Varanasi: Banaras Hindu University.

Gashayie, A., & Singh, M. (2015). *Agricultural finance constraints and innovative models experience for Ethiopia: Empirical evidence from developing countries*. www.iiste.org. http://www.iiste.org/Journals/index.php/RJFA/article/viewFile/21590/22438.

Interim Report. (2015). Agriculture Sector Development Program Interim Report. ADB.

Innovative Agricultural Finance Models, International Finance Corporation (2012, November). http://www.ifc.org/wps/wcm/connect/55301b804ebc5f379f86bf45b400a808/Innovative+Agricultural+SME+Finance+Models.pdf?MOD=AJPERES. (Apr. 2016).

Ministry of Agriculture development. (2015). *Nepal agricultural sector development strategies* (*2015–2035*). Singhadarbar, Kathmandu, Nepal. http://www.dls.gov.np/uploads/files/ADS%20Final.pdf.

Ministry of Finance. (2018a). *Economic survey*. Singhadarbar, Kathmandu, Nepal. https://www.mof.gov.np/uploads/document/file/for%20web_Economic%20Survey%202075%20Full%20Final%20for%20WEB%20_20180914091500.pdf.

Ministry of Finance. (2018b). *Budget Speech 2018/19*. Singhadarbar, Kathmandu, Nepal. https://www.mof.gov.np/uploads/document/file/speech_english_20180715091522.pdf.

Nepal Critical Development Constraints. (2009). *Country diagnostic studies* (pp. 78–79). http://www.adb.org/sites/default/files/publication/28933/main-report.pdf.

Nepal Rastra Bank. (2018a). *Statistics of banks and financial institutions in Nepal.* Baluwatar, Kathmandu, Nepal. https://www.nrb.org.np/bfr/statistics/cms_pdf/Asar_2075.pdf.

Nepal Rastra Bank. (2018b). *Monetary Policy 2018/19*. Baluwatar, Kathmandu, Nepal. https://www.nrb.org.np/ofg/monetary_policy/Monetary_Policy_(in_English)–2018–19_(Full_Text)-new.pdf.

Chapter 19
Nepal's Changing Governance Structure and Implications for Agricultural Development

Jordan Kyle and Danielle Resnick

Abstract The chapter deals with the implications of Nepal's new constitution, particularly federalism, on broad agricultural policy planning as well as on agricultural research and extension. It evaluates how constitutional reforms will shape three key issues in governing the agriculture sector—authority, autonomy, and accountability. Using comparative cases, it offers policy options relevant to these three aspects of governance. This chapter also draws lessons for Nepal from the experiences of other countries such as Indonesia, Kenya, Malaysia, and South Africa.

Acronyms

ADS	Agricultural Development Strategy
AIATs	Assessment Institutes for Agricultural Technology (Indonesia)
CAESC	Community Based Agricultural Extension Service Centers
CPN	Communist Party of Nepal
CTEVT	Council for Technical Education and Vocational Training
DADOs	District Agricultural Development Officers
DAFF	Department of Agriculture, Forestry and Fisheries (South Africa)
DDCs	District Development Committees
DFRS	Department of Forest Research and Survey
DLOs	District Livestock Officers
GDP	Gross Domestic Product
GoN	Government of Nepal

Sections in this chapter draw from the authors' IFPRI Discussion Paper 1589.

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G. Thapa et al. (eds.), *Agricultural Transformation in Nepal*,
https://doi.org/10.1007/978-981-32-9648-0_19

IAARD	Indonesian Agency for Agricultural Research and Development (Indonesia)
ICAR	Indian Council for Agricultural Research (India)
KVKs	Krishi Vigyan Kendras (India)
LSGA	Local Self-Governance Act
MARDI	Malaysian Agricultural Research and Development Institute (Malaysia)
MECs	Members of the Executive Council (South Africa)
MFSC	Ministry of Forest and Soil Conservation
MinMECs	Ministers and Members of Provincial Executive Committees (South Africa)
MoLD	Ministry of Livestock Development
MLRM	Ministry of Land Reform and Management
MoAD	Ministry of Agricultural Development
MoCPA	Ministry of Cooperatives and Poverty Alleviation
MoE	Ministry of Energy
MOF	Ministry of Finance
MoFALD	Ministry of Federal Affairs and Local Development
MoFSC	Ministry of Forestry and Soil Conservation
MoGA	Ministry of General Administration
MoI	Ministry of Irrigation
NARC	Nepal Agricultural Research Council
NARI	National Agricultural Research Institute
NASRI	National Animal Science Research Institute
NAST	Nepal Academy of Science and Technology
NPC	National Planning Commission
PDA	Provincial Department of Agriculture (South Africa)
Pemandu	Performance Management and Delivery Unit (Malaysia)
PSC	Public Service Commission
R&D	Research and Development
SALGA	South African Local Governance Association (South Africa)
TU	Tribhuvan University

1 Introduction

Constitutional reforms in post-conflict or fragile countries are often intended to address underlying weaknesses in governance structures that may have contributed to the onset of violence and perceptions of marginalization by certain segments of the population. Federalism, in particular, is viewed as a way of enhancing local autonomy and increasing popular points of access into the political sphere in countries with extremely diverse populations and a history of communal conflict. Federalism is a form of government in which power is constitutionally divided between national and subnational governments, which have equal status within the constitution. Key characteristics of federal states include subnational governments that contribute to decision making over policy, have power over taxing and spending, and operate autonomously from the national government in many policy domains (Ziblatt 2006). Adopting a federalist structure has widespread consequences not only for conflict management but also for broader public administration and the quality of service delivery, including agricultural, education, and health services.

This chapter focuses on the implications of federalism for Nepal, with a specific focus on the agricultural sector. In September 2015, Nepal's elected parliamentary body, known as the Constituent Assembly, passed a new Constitution. Among many other notable provisions, a key objective of the Constitution is to transform Nepal into a "federal, democratic, republican country" in the next two years.[1] This reform represents the culmination of a more than twenty-year political process. In 1990, a people's movement restored multiparty parliamentary government with the king as the head of state and the prime minister as head of government. A series of coalition governments ensued until 1996 when the Communist Party of Nepal-Maoist (CPN-Maoist) launched an insurgency. A central claim of the Maoists was that the centralized and unitary nature of successive Nepalese governments had exacerbated inequality and failed to address the needs of local people (Boex 2012a). A decade later, the government signed a Comprehensive Peace Accord with the Maoists, and an interim constitution was promulgated in 2007. The interim constitution committed to transforming Nepal from a unitary to federal system in order to redress government centralization and end discrimination. The 2015 (2072) Constitution then provided concrete details about how exactly to implement the federal state project.

Although a transition to a federal system has vast implications across a broad range of sectors, we focus specifically here on agriculture for a number of reasons. First, agriculture is the primary livelihood for two-thirds of the Nepali population, and it contributes one-third of the country's GDP and over half of its exports (WDI 2015). Second, the current governance landscape of the agricultural sector is already quite complex. In part, the sector presents governance challenges because rural livelihoods are quite distinct across the country's three broad agro-ecological zones, known as the terai, mid-hills, and mountains. In addition, multiple ministries oversee interventions in the sector. The Ministry of Agricultural Development (MoAD) is the main ministry in charge of the sector but other relevant ministries include the Ministry of Livestock Development (MoLD), the Ministry of Irrigation (MOI), the Ministry of Land Reform and Management (MLRM), the Ministry of Forestry and Soil Conservation (MOFSC), Ministry of Cooperatives and Poverty Alleviation (MOCPA), the Ministry of Federal Affairs and Local Development (MoFALD), the Ministry of Energy (MoE), and the Ministry of Finance (MOF) (see Quinn and Gupta 2013). Thirdly, it is worthwhile to focus on the agricultural sector because the government of Nepal recently committed to a set of ambitious agricultural development goals, guided by the Agricultural Development Strategy (ADS).

In accordance with the shift to federalism, the 2072 Constitution outlines significant changes for the governance of the agricultural sector. Currently, the agricultural

[1]See Part 7, Sect. 74.

sector in Nepal is devolved in theory but not in practice, with appointed, rather than elected, local government bodies exercising relatively little authority or autonomy over many aspects of budgeting and employment. The 2072 Constitution, by contrast, stipulates that "agricultural and livestock development" (Schedule 6) will be a provincial power and "agriculture and animal husbandry, agro-products management, animal health, and cooperatives" (Schedule 8) will be local powers. In addition, "agriculture" is included in the list of concurrent powers of federation, province, and local level (Schedule 9). Moreover, the Constitution stipulates that executive power at the local level will be vested in either a village executive or municipal executive, which will be overseen by either an elected village chairperson or municipal mayor, respectively. This deviates from the current situation where local government is largely deconcentrated from the Ministry of Federal Affairs and Local Government (MoFALD) and overseen by appointed local development officers.

Consequently, the Constitution has two clear implications for the governance of the agricultural sector: (1) authority and autonomy for various agricultural and livestock activities will be devolved from MoAD in Kathmandu to the seven anticipated provincial governments as well as newly constituted local bodies and (2) those new local bodies will be overseen by elected rather than appointed executives who will be able to determine their own policy priorities. However, exactly how authority will be devolved and over which domains remain unresolved because "agriculture" is listed as a concurrent function across all tiers of government in the Constitution.

In this chapter, we focus specifically on implications of this major constitutional shift on broad agricultural policy planning as well as on agricultural research and extension. We adopt a holistic perspective that draws linkages from the current fiscal, administrative, and policy contexts to potential changes, challenges, and opportunities for the sector in a federal Nepal. In doing so, we evaluate how constitutional reforms will shape three broad issues in governing the agricultural sector: authority, autonomy, and accountability. Using case studies from other federal or devolved contexts, such as Indonesia, India, Kenya, Malaysia, and South Africa, we show why these issues are important and distill lessons for Nepal. Methodologically, the chapter draws on interviews conducted in early 2016 with more than two dozen stakeholders within government ministries, civil society, and the donor community as well as various secondary resources. In addition, surveys were conducted with 50 District Agricultural Development Officers (DADOs) and 50 District Livestock Officers (DLOs) drawn from 50 randomly selected districts across all development regions, all proposed new provinces, and all agro-ecological zones (see Appendix Fig. 2) to gain an in-depth understanding of the current landscape of governance challenges at the local level, which is the level of government that will become the new locus of policymaking in a federal Nepal.[2]

[2]Although the local body units may be changed through the Constitutional reform process, it is nonetheless the case that policy planning and implementation will increasingly be under the purview of local rather than federal governments, and it is important to understand local capacities and constraints.

The next section provides an overview of key concepts relevant to devolution and federalism and elaborates on the current status of decentralization within Nepal. Subsequently, we examine the major differences for the governance of the agricultural sector entailed by the new Constitution. We then focus more specifically on implications of restructuring for agricultural research and extension. Finally, the comparative cases are presented to offer policy options relevant to authority, autonomy, and accountability. The final section concludes.

2 Decentralization in Nepal

The Constitution lays out a period of two years for Nepal to transition from its current status as a unitary state with deconcentrated local units to a devolved, federal state. Devolution is the most extensive form of decentralization while deconcentration is the most limited form. Under deconcentration, local branch offices carry responsibility for policy implementation but report upward to the central government, which typically retains authority over decision making, hiring and firing personnel, and budgeting. Under devolution, by contrast, local bureaucracies gain authority over the policy process and report to democratically elected local governments rather than to the central government. Truly devolving authority is a complicated governance process and attention needs to be accorded to balancing the goals of promoting genuine popular participation and subnational engagement in the policy process without sacrificing policy coherence and direction.[3] We discuss this difficult balance through the lens of the three main objectives of devolution that are outlined in Table 1.

The first issue is delineating clear authority. Devolution involves redistributing authority over administrative functions across tiers of government. In any system where authority is not concentrated in a single tier of government, there is the potential for overlapping and unclear authorities. Thus, a strong legal framework is needed to delineate and clarify responsibilities. A second objective is to match the *de jure* authority given to local governments with de facto autonomy (see Yilmaz et al. 2010). Such autonomy involves according lower tiers of government discretion over the use of fiscal resources and the power to fire and hire employees as well as to issue rewards and sanctions for employee performance. Third, devolution requires attention to accountability, which means that citizens must have a means of holding subnational governments responsible for performance in the areas for which they have been accorded authority (see Cheema and Rondinelli 2007; Kathyola and Job 2011). Typically, elections are the most fundamental way of allowing citizens to either sanction or reward local governments for their performance. Authority, autonomy, and accountability are interconnected: if local

[3] State structure does not necessary map neatly onto degree of decentralization. In other words, federal states can still be oriented towards deconcentration while unitary states can be devolved.

Table 1 Key issues for devolved government

Objectives	Implications
Authority	Clear delineation of responsibilities across tiers within a legal framework
Autonomy	Adequate control over fiscal and human resources to fulfill responsibilities
Accountability	Flows of information and mechanisms for rewards/sanctions both vertically (between citizens and governments and between tiers of government) and horizontally (across ministries and actors engaging in complimentary activities)

Source Authors' compilation

governments have authority over a policy domain without real autonomy, then accountability is misaligned, with civil servants accountable to central governments rather than local ones, undercutting local incentives for efficiency and responsiveness (Azfar et al. 2001; Lankina 2008).

By bringing more actors with independent areas of authority into the policy process, devolution can introduce problems of coordination, including between ministries at each tier of government and between local governments and the central government. When authority is devolved, achieving any kind of goal that is larger than the boundaries of a given local government unit requires coordination among autonomous bodies. Greater accountability can ease coordination challenges by making coordination in the interests of subnational governments and civil servants employed at the subnational level. Overlooking any of these objectives—authority, autonomy, and accountability—risks undermining the devolution process more broadly.

Nepal's anticipated shift to a devolved, federal structure in a manner that addresses these three objectives will represent a stark change from its existing unitary and relatively deconcentrated structure. Currently, there are 75 district development committees (DDCs) with an average population of approximately 300,000 each. At the sub-district level, there are 217 municipalities and 3157 village development committees (VDCs) with the latter having an average population that is, on average, less than 6000 residents. Following the creation of a high-level decentralization coordination committee in 1996, the Local Self-Governance Act (LSGA) was enacted in 1999. The LSGA is widely viewed as a landmark piece of legislation that accorded greater responsibilities to these subnational structures. In particular, local bodies were charged with setting development priorities, allocating budgets, and monitoring the implementation of local development projects (Carter Center 2014).[4] The LSGA also stipulated that VDC committees consist of 11 elected representatives, including a chairperson, vice-chairperson, and nine ward chairpersons, as well as two nominated members. A civil servant is appointed by the central government to serve as VDC administrator (UNDP 2014). To improve transparency, accountability, and public participation, the government was supposed to devolve authority in three sectors to these elected local bodies: health, education, and agriculture and livestock extension.

[4]"Local bodies" is the collective term to refer to DDCS, VDCs, municipalities, and wards.

Yet, in practice, the government has remained quite unitary. By 2000, civil conflict had affected about half of the 75 districts, predominantly in rural areas. Insurgents often targeted VDC offices, causing elected officials to flee their villages (Carter Center 2014). Consequently, in 2002, the government decided that it was not possible to hold new local elections and instead allowed the terms to expire of those officials who were elected in 1998. Therefore, for the last 14 years, local governments effectively have been run by civil servants appointed by MoFALD. Even within the avowedly devolved sectors, line agency officials were assigned to carry out policy implementation within the DDCs (GoN 2006). In the agricultural sector, these include District Agricultural Development Officers (DADOs) and District Livestock Officers (DLOs). In fact, the deconcentrated nature of these civil servants' responsibilities was reflected in the DADO and DLO survey. Specifically, 80% of DADOs and DLOs answered that their primary responsibility is to implement MoAD and MoLD programs to fulfill national development goals rather than helping farmers in their districts to address local problems.

Another key component of the LGSA was the requirement that all local bodies formulate annual and five-year development plans based on citizen input. The fourteen-point planning process provides the guidelines for a participatory planning, budgeting, and monitoring process. This process requires both downward communication from line ministries, MoFALD, and the National Planning Commission (NPC) to local bodies on annual budget ceilings and spending guidelines as well as upward communication from the grassroots level on local development plans up to local bodies and, ultimately, to the NPC.

However, local governments currently lack autonomy over both fiscal and human resources. As of 2013, only 8% of total government expenditures occurred at the local level within local bodies, exclusive of expenditures by deconcentrated government ministries (GoN 2015b). In addition, most revenues within local bodies are from intergovernmental transfers rather than own-sourced revenues. Local bodies also lack autonomy to set tax rates or bases, and they generally do not have mechanisms to enforce payment of local taxation. In the 2012/2013 fiscal year, own-source revenue constituted only 13% of total local body revenue (World Bank 2014a). The budgets of DADOs, DLOs, and other sectoral district officers come from their respective central line offices, although they must be approved first by the appointed DDC head before dispersal (Root 2014). Expenditures that are for "devolved" sectoral services are included in the budget and the country's Red Books as spending for the relevant ministry rather than as grants to local bodies (Boex 2012a).

DADOs and DLOs also lack the autonomy to handle human resources at a local level. Two-thirds of DADOs and DLOs report that they can take no action beyond writing a letter in an employee's file when an employee is performing poorly. They also cannot do much to improve employee performance or technical capacity. Several DADOs mentioned wishing that they had more opportunities to set incentives for good performance and to participate in developing training curricula to ensure a better match between technical abilities and local needs.

3 Implications of Federalism for Nepal's Agricultural Sector

The 2072 Constitution aims to transform this current deconcentrated structure through federalism (GoN 2015a). Most fundamentally, the Constitution stipulates the creation of seven provinces that will replace the current five development regions. While the current 75 districts will remain, they will be the administrative unit for parliamentary constituencies rather than the unit for local government administration.[5] Instead, local level government will be represented by approximately 1000 village or municipal development councils.

Moreover, the Constitution authorizes different tiers of government to assume control over different policy areas. However, it is not yet entirely clears what the enumerated powers mean for agricultural policy. According to Schedule 5, only a few functions are reserved exclusively for the federal government, including major irrigations projects, national ecology and forestry management, land use policy, water use policy, and quarantine. Enumerated powers for provinces within the agricultural sector include provincial-level environmental and forest management and agriculture and livestock development (Schedule 6). Scientific research is listed as a concurrent power of provinces and federal government (Schedule 7). Local-level governments are given exclusive power over farming and livestock, agriculture production management, livestock health, local roads, local irrigation projects, and management and control of agricultural extension (Schedule 8). However, agriculture as a whole is also listed as a concurrent function of federal, provincial, and local governments (Schedule 9), leaving relatively open which tier of government may ultimately gain authority over different aspects of agricultural policy.

Table 2 below describes the primary responsibilities in governing the agricultural sector and the government tier given primary authority for the particular responsibility. Many of the responsibilities are officially allocated across multiple tiers of government, which leaves unclear where certain powers should lie. There is particular ambiguity over agricultural research, food safety, environmental protection and conservation, and agricultural education. Typically, when there are concurrent functions, the principle of subsidiarity prevails, which means that the lowest government tier that is capable of performing the function should be given the mandate to do so.

As highlighted by Table 3, the new Constitution stipulates that local governments should be elected rather than appointed and delineates responsibilities at all levels of government (i.e., national, provincial, and local). However, with the strong possibility of overlapping mandates across levels of government, attention will need to be given to both horizontal and vertical coordination mechanisms. Moreover, consideration will be needed to ensure adequate capacity at the local level since staff will be now hired and fired locally rather than centrally.

[5]See Schedule 4.

Table 2 Schedule of powers across tiers of government within agricultural sector according to the 2072 constitution

Responsibilities	Government tier allocated authority
Regulatory services	
Food safety	Federal, Provinces
Plant quarantine	Federal
Livestock quarantine	Federal
Seed safety	*Unspecified*
Research and development	Federal, Province
Agricultural education	*Unspecified*
Agricultural and livestock extension	Local
Environmental Protection and Conservation	
Soil health	Federal, Province, Local
Forests	Federal, Province, Local
Water use	Federal, Province, Local
Land use, land tenure, land reform	Federal, Province
Irrigation	Federal, Province, Local
Rural infrastructure	Federal, Province, Local

Source Compiled by the authors based on the 2072 Constitution

Table 3 Institutional changes for agriculture envisioned by the constitution

Characteristic	Prior to 2072 Constitution	After 2072 Constitution[a]
Units of government	National, development regions (5), districts (75), VDCs (3915) and municipalities (58)	National government, federal provinces (7), districts (75), local bodies (amalgam of current VDCs and municipalities)
Administration of local bodies	Appointments by MoFALD of officials to administer local bodies	Elections at the national, provincial, and local (VDC and municipality) levels District boundaries will be retained for parliamentary constituencies
Responsibility for agricultural functions	Agricultural policy development at national level and implementation at subnational level Agricultural and livestock extension deconcentrated to DDCs through DADOs and DLOs	Agricultural policy development and implementation at *both* national and subnational levels Agricultural and livestock extension devolved to subnational government
Agricultural expenditures	Line ministries (MoAD and MLD) transfer resources to district staff via the DDC DDCs are given a block grant for agricultural spending	Local government has greater autonomy over budgeting for, and spending on, agricultural priorities
Staffing	Civil service staff at the national, provincial, and district level recruited through the National Public Service Commission	Civil service staff at the provincial and local levels will be recruited through a Provincial Public Service Commission while those at the federal level will continue to be recruited by the National Public Service Commission

Source Authors' compilation
[a]These are proposed changes that have not yet necessarily been implemented

4 Agricultural Research and Extension

4.1 Background Context

We focus here on how the anticipated changes reviewed above will specifically affect the current management of Nepal's agricultural research and extension services. In any country, agricultural research and extension systems are fundamental to improved agricultural productivity by helping farmers to make informed decisions about the availability and appropriateness of adopting new technologies. In Nepal, the public extension system is jointly managed by the Department of Agriculture in MoAD and the Department of Livestock Services in the Ministry of Livestock Development (MoLD). In the education system, extension is also provided by the Council for Technical Education and Vocational Training (CTEVT) and Tribhuvan University (TU).

With the LSGA, agricultural extension services were, in theory, devolved to the districts.[6] In order to access extension services, an individual must be a member of a farmers' group and registered with a DADO. According to Suvedi and McNamara (2012), approximately 22,000 farmers' groups and more than 1500 dairy cooperatives exist. Sometimes DADOs also provide training to input sellers who are then expected to pass on technical services to their farmer customers, thereby enhancing the value-added of their inputs. DADOs may also support seed producer groups, monitor seed quality, and distribute seed subsidies. In addition, DADOs along with DDCs and VDCs may help construct or oversee the management of markets where farmers sell their output (Root 2014). Extension services from the DLO focus on educating farmers on best practices for livestock production and animal health, artificial insemination services, poultry management, forage and fodder crops, and preventing diseases among farm animals (Suvedi and McNamara Suvedi et al. 2012).

However, there are a number of concerns with the current system. First, the availability of extension services is relatively uneven across the country with agricultural service centers less accessible in poorer areas (see CBS 2011). Second, districts lack the man power to adequately deliver services. For a country that remains relatively dependent on public sector extension services, Nepal has comparatively a few public extension agents, as indicated by the high number of agricultural workers served by one extension officer (i.e., a ratio of 1 for every 3837 agricultural sector workers).[7] In part, this is because staff vacancies are not filled in a timely fashion. On average, DADOs and DLOs report that 16% of total positions in their districts were vacant at the time of the survey, with some reporting that as

[6]In practice, however, as noted above, accountability, authority, and autonomy over extension services remain primarily with the central government.

[7]Calculated from data from Swanson and Davis (2014), World Development Indicators, and Food Security Portal (http://www.foodsecurityportal.org/).

many as 40% of positions are vacant. In all, 85% of DADOs and DLOs state that they do not have enough technical staff to deliver services.

Third, even when positions are filled, technical staff often lacks adequate training, with 65% of DADOs and DLOs arguing that existing agricultural education programs do not prepare staff to provide services and almost all arguing that more on-the-job training opportunities are needed to raise capacity. Many DADOs and DLOs also raised lack of transportation funding and infrastructure as a major constraint to providing services. Lack of local capacity severely strains the ability of DADOs and DLOs to fulfill basic job functions. In interviews, DADOs and DLOs claimed that they "are struggling," "are hardly managing," and "are working with whatever we have." One DADO succinctly stated the key problem with local policy implementation: "at the central level, there is more staff and fewer programs, while at the local level it is exactly the opposite."

Agricultural research in Nepal is equally constrained. In the domain of research, the main government agency is the Nepal Agricultural Research Council (NARC), the Nepal Academy of Science and Technology (NAST), and the Department of Forest Research and Survey (DFRS). While NARC is institutionally under the MoAD, NAST, and DFRS are administered by the Ministry of Science and Technology and the Ministry of Forest and Soil Conservation (MFSC), respectively. Since NARC accounts for approximately 70% of the country's agricultural research capacity and receives approximately 75% of its funding from the government of Nepal, it is the main focus here (NARC 2016; Rahija et al. 2011).

With a broad mandate, focusing on livestock, crops, aquaculture, and natural resources, among other things, NARC was established in 1991 under the Nepal Agricultural Research Council Act and intended to be an autonomous body (NARC Act 1992). It represents one of the key stakeholder organizations involved in helping to formulate government agricultural policies and operates two research institutes, the National Agricultural Research Institute (NARI) and the National Animal Science Research Institute (NASRI). There are currently 61 research centers under NARC in Nepal, as well as research stations in different parts of the country to cater to Nepal's main agro-ecological zones and development regions. In addition, there are more than a dozen research stations for specific commodities.

Yet, the links between research and extension are relatively weak, with Suvedi and McNamara (2012) observing that findings on the latest technologies or improved farm practices, are not communicated to farmers in a timely manner. One key reason for this is insufficient human capacity in both extension and research. Nepal has one of the lowest ratios globally of full-time equivalent researchers per agricultural worker, ranking on par with highly agrarian economies in Africa such as Burkina Faso and Malawi.[8] As of 2016, only 600 out of 1300 positions could be filled.[9] Rahija et al. (2011) claim that the difficult entrance exam is one of the

[8]See Agricultural Science and Technology Indicators (ASTI), available at http://www.asti.cgiar.org/.

[9]Interview with NARC, Kathmandu, January 13, 2016.

reasons why critical posts remain vacant. Currently, NARC conducts its own recruitment rather than applicants going through the Public Service Commission (PSC), which typically is responsible for recruitment into the government.[10] Another challenge is that younger, junior scientists typically only have a BSc while older researchers have PhDs but are constrained by NARC's low retirement age (60 years old). As more researchers retire, there is a growing gap in expertise within the organization (see Rahija et al. 2011).

In addition to the entrance exam undermining the number of full-time equivalent staff employed by NARC, another challenge is retaining existing employees. Without a guaranteed pension and no extra remuneration for researchers, vis-à-vis extension officers, NARC finds many of its employees deciding instead to move to extension work or finding jobs overseas. According to Stads (2015), salary levels at NARC are one-half to one-tenth of those offered by the private sector or NGOs, and a PhD qualification does not impact salary levels for those pursuing a career in agricultural R&D. A survey of motivations among NARC researchers found that promotion opportunities and performance-based evaluations would help to incentivize them. Under the current status quo, everyone receives the same salary (see Stads 2015).

Collectively, this results in inadequate levels of research, with over 80% of DADOs and DLOs stating that there is not enough research on crop and livestock, respectively, which are important in their districts. Moreover, there is evidence of weak communication between NARC and extension agents over local demand for research and over the output of existing research efforts. This appears to be particularly problematic for livestock research, with numerous DLOs reporting a wish for more responsiveness in researching livestock disease in a timely fashion. Furthermore, nearly two-thirds of DADOs and DLOs report that their staff lacks the technical capacity to use existing agricultural research. Weak links between research and extension are exacerbated by policies that prevent civil servants from developing area-specific expertise. Agricultural extension officers are frequently transferred between locations, preventing them from forming long-term relationships with farmers, building trust, and developing area-specific expertise. Similarly, DADOs and DLOs themselves are frequently transferred between locations, with 30% of surveyed DADOs and DLOs serving for less than two years in their current district.

4.2 Implications of Constitutional Reforms

How will these existing challenges be ameliorated or exacerbated by Nepal's transition to a federal country? We discuss potential changes through the framework of authority, autonomy, and accountability.

[10]Ibid.

4.2.1 Authority

With respect to authority, the Constitution clearly specifies that agricultural extension will be an exclusive responsibility of local government. In this way, there should be no ambiguity created by concurrent functions with other levels of government. Even before the Constitution was passed, the ADS, which aims to guide the government's agricultural development strategy between 2015 and 2035, envisioned devolving responsibility for agricultural extension services to the local level. Specifically, ADS proposes establishing Community Agricultural Extension Service Centers (CAESCs) in each VDC, to be governed by representatives from local communities (GoN 2013: 89). Thus, the directive of the Constitution to devolve authority to local governments is very much in line with the strategic vision for the sector.

However, the new Constitution plans to retain extension workers as civil servants who will be recruited under a provincial-level PSC.[11] This should help reduce the degree to which agents are rotated geographically by limiting their rotations within provinces rather than across the entire country. Yet, this could potentially hamper the autonomy of the new sub-provincial local governments since they will have Constitutional authority over-extension but may be unable to exercise effective oversight of, and demand responsiveness from extension agents who have been hired at the provincial level.

Beyond concerns about the distribution of authority, subnational governments may lack the capacity to fulfill the responsibility of that authority. This is a concern for new provincial governments seeking to recruit and retain capable extension agents, and would likely be even more challenging if smaller, local governments were required to recruit extension agents, as suggested by ADS. Therefore, decentralized public extension will need to be complemented with an expansion of Nepal's existing pluralistic extension system to ease capacity constraints. Beyond the public sector, private sector providers of extension services include agrovets, traders, processors, consultants, and contractors. They play an active role in offering improved seed, pesticides, and artificial insemination for livestock, among other services (Suvedi and McNamara 2012). Likewise, there are more than 5000 NGOs that provide extension services to farmers and community groups, including CEAPRED Nepal and PLAN Nepal (Sharma 2011). However, given Nepal's difficult terrain, non-public extension service providers can face some of the same difficulties in reaching remote beneficiaries as their public sector counterparts.

For agricultural research, there is greater legislative ambiguity over authority because the Constitution stipulates "Scientific research, science and technology and human resources development" will be a concurrent power of the federation and the new provincial governments.[12] On the one hand, this provides some leeway for NARC to determine which functions that it currently performs are most appropriate

[11]Interview with NARC, Kathmandu, January 13, 2016.

[12]See 2015 Constitution, Schedule 7.

at the national level and which should be decentralized. On the other hand, ADS lays out a vision for a much more decentralized research system. In theory, due to economies of scale and high costs of agricultural research, Byerlee and Traxler (2001) argue for the centralization of research that is broadly applicable across a given territory or country, such as crop improvement activities that apply across diverse agro-systems. In Nepal, for instance, this would be with respect to widely grown crops such as rice, potato, and citrus. Yet, for research with local relevance due to location-specific nature of crop cultivation or livestock management, there should be decentralized research activities.

In concrete terms, operationalizing this approach would involve having a national research institute with a central mandate and research institutes in each province. One concern is the ability to find sufficient staff and resources to establish so many subnational institutes, especially given that seven provinces have been proposed at the time of writing. Another concern is how such a decentralized system will be financed. Byerlee and Alex (1998) note that federal funding is typically used to support agricultural research since provincial and local governments do not have incentive to finance research with interjurisdictional spillovers. However, where the benefits are more localized due to the specificity of the research, subnational governments typically need to help with the fiscal burden. Yet, as noted earlier, subnational governments struggle to raise sufficient local revenue. As one interviewee noted with regards to NARC, “Right now, there are effectively 14 research stations and many of these are dysfunctional and have a high cost to the treasury.”[13]

4.2.2 Autonomy

Because authority over-extension is clearly specified within the Constitution as the purview of local governments, local autonomy over-extension services should, in theory, follow. However, as noted above, provincial PSCs retain authority over hiring extension officers, and it is not yet clear whether local governments will have the ability to reward and sanction employees for good and poor performance, respectively. The ability to set local salary scales and incentives may be essential to ensuring continuity of extension services through the transition. In a unitary system, federal employees can be transferred to more remote and often less desirable locations to ensure that all areas retain services. Under a devolved system, local governments in remote areas may need to utilize higher salary scales and bonuses to attract talent. Notably, half of DADOs and DLOs say they are concerned about the prospect of moving to an undesirable location as a result of the new federal structure.

As local governments gain budgetary autonomy, there is reason to be concerned that local governments will dedicate even fewer resources toward agricultural

[13]Interview with CEAPRED, Kathmandu, January 14, 2016.

development than today. Local planning for the DDC and VDC block grants offers insights into how local spending priorities might be reflected in local budgets once local governments have greater autonomy. The federal government currently earmarks 15% of these block grants for spending on agricultural development, but 63% of DADOs in the survey sample report that not enough agricultural projects are planned locally to meet the earmark.[14] Even among those areas that do locally plan agricultural projects, half report that the projects are really spending in other sectors disguised as agricultural spending, e.g. building roads.[15] This suggests that as local bodies have more autonomy over planning, local government budgets could increasingly diverge from national priorities, particularly in agriculture.

With respect to NARC, autonomy is a longstanding issue, and the new Constitution offers a window of opportunity to finally address it. Since research is inherently different from other aspects of agricultural policy, it requires specialized staff and the pursuit of "lumpy" investments in infrastructure that are essential for experimental work. Consequently, national agricultural research organizations should have greater autonomy in choosing their board and chief executive officer, defining their research agenda and administrative procedures, managing personnel and finances, and pursuing international collaboration (Byerlee and Alex 1998). While the NARC Act of 1991 stipulated that NARC should be autonomous, this has not happened in practice (see Stads 2015). For instance, autonomy is hampered by having the Minister of Agriculture chair the NARC executive council; with one of the world's highest turnovers of agricultural ministers over the last decade, this has resulted in frequent changes in NARC leadership.[16]

One of the few areas of existing autonomy is NARC's control over recruitment. Yet, the new Constitution stipulates that all entities receiving at least 50% of government funding, which includes NARC, should have staff recruited through the national public service commission (PSC).[17] There are possible benefits to standardizing the recruitment process, such as limiting political interference in the selection and promotion of NARC staff and potentially setting a standardized payscale that is currently higher than what NARC offers. However, this lack of autonomy in recruitment could also limit NARC's ability to identify talented researchers with specialized experience and to offer unique incentives to retain highly qualified employees.

[14]This is consistent with a report by Inlogos (2009), which found that only 2.5% of VDC block grant resources were used to fund agricultural and irrigation projects.

[15]This is not necessarily a bad thing, as spending on rural roads is one of the most productive public expenditures in Nepal (Dillon et al. 2008).

[16]Nepal has had 16 Ministers of Agriculture between 2001 and 2015.

[17]Interview with NARC, Kathmandu, January 13, 2016.

4.2.3 Accountability

Perhaps, one of the largest changes under the new Constitution is with respect to accountability. Under the current deconcentrated setting, extension agents are accountable to the central MoAD or MoLD.[18] Under the new Constitution, by contrast, there is a potential for greater bottom-up accountability to elected local leaders rather than to the line ministries in Kathmandu.[19] In theory, greater bottom-up accountability enables citizens to hold local governments responsible for the quality of extension services, and this in turn, incentivizes local governments to hold extension workers accountable for providing good quality services that meet local needs. In this way, extension could be better targeted to farmers' needs in a particular agro-ecological or regional area. This accountability is only effective, however, if local governments are also contributing financially to extension activities (see Swanson and Rajalahti 2010) and if farmers are adequately pressuring local governments over the quality of extension services.

It is unclear how these new accountability relationships will shape extension services. On the one hand, DADOs and DLOs report that local politicians and the general politicization of their local staff present formidable challenges to policy implementation today. Despite the lack of local elections, local party officials are prevalent throughout Nepal and are heavily involved in policy planning: 80% of DADOs and DLOs report meeting with local party officials at least twice per month. In qualitative interviews, numerous DADOs and DLOs stated that they face "high political pressure" and "political interference" with their work and that their staff is highly involved in local political organization in ways that make it more difficult to execute policy, with staff "hold[ing] political grudges." In other words, DADOs and DLOs are currently managing relationships with local officials from many political parties, none of whom has been formally elected as a representative of the local citizens. Holding local elections will increase the accountability of these local political officials to citizens and may reduce the number of parties that local civil servants have to manage. On the other hand, especially during the early years of introducing local elections while political parties are vying for local support, politicization of local policy planning, and of civil servants could increase.

The Constitution could potentially further worsen opportunities for coordination between research and extension since, going forward, these two domains will be under the authority of different levels of government. Even if decentralized research stations may improve ties to local extension agents, it will be important that the different lines of accountability anticipated in the new structure (i.e., upward accountability from research stations to NARC and downward from extension agents to elected local governments) do not further exacerbate existing weak ties.

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[18]Interview with CEAPRED, Kathmandu, January 14, 2016.

[19]Suvedi and McNamara (2012) note that the lack of elected local leaders for the last decade has severely undermined the ability of extension agents to be responsive to farmers' needs.

This will be especially true if elected parties at the provincial and local levels are different from those governing at the federal level, possibly creating difficulties with the chain of command and collaboration.

5 Nepal's Federal Restructuring in Comparative Perspective

In order to identify options to guide MoAD's restructuring in the wake of the new Constitution, we review the experiences of other developing countries that have organized their agricultural sector across multiple tiers of government. Figure 1 highlights five relevant countries for comparison, which were chosen because they are either federal countries or unitary but highly decentralized countries.[20] The motivation for federalism or greater devolution in these countries was either the end of colonial rule (India and Malaysia), transitions to democracy (Indonesia and South Africa), or political violence (Kenya). Collectively, these cases offer useful insights regarding how to address the challenges of authority, autonomy, and accountability within a devolved context.

5.1 Authority

In all five countries, authority over the agricultural sector is distributed across multiple tiers of government, i.e., it is not concentrated solely at the federal level. However, the transition process proved complicated. For instance, to avoid overwhelming local government and interrupting service delivery, the Kenyan government was recommended to transfer only some agricultural activities to the 47 new counties that were created in the wake of the country's 2010 constitutional reform (World Bank 2012). When such advice was ignored and authority in multiple functions was transferred simultaneously, the national treasury was unable to transfer concomitant funding for county governments to implement agricultural programs as anticipated (World Bank 2014b).

By contrast, one of the most important elements in Indonesia's shift from a highly centralized to a highly decentralized state was that it set up opportunities for mid-course corrections and reevaluations of the decentralization process down the line. A period of 10 years was designated as a "review period" for the decentralization laws, and the government remained flexible about making changes to address flaws in the original design. This time horizon was selected in order for the

[20]Notably, the classification of country cases into state "types" is subject to interpretation since they often have features that commensurate with both types.

Contribution of Agriculture to GDP	Type of Country	
	Federal *(Year of legislation)*	Unitary *(Year of legislation)*
High (>30% of GDP)	Nepal (2015)	Kenya (2010)
Low (<30% of GDP)	India (1950), Malaysia (1957) South Africa (1996)	Indonesia (1999)

Fig. 1 Selected case study countries. *Source* Compiled by the authors. Agriculture as a share of GDP is from the World Development Indicators (WDI)

government to retain flexibility to revise what did not work while also allowing the new structure sufficient time to work before revising (Bennet 2010).

Consequently, when and where MoAD has latitude, it should advocate for a staged transition whereby functions at the subnational level are initially transferred very gradually, and it should resist the temptation to invert the balance in staff and responsibilities too quickly in order to show "progress" at reform.

Similarly, even when constitutional provisions outline authority at multiple tiers of government, establishing an administrative presence at all levels should be gradual if capacity is constrained. This is extremely relevant to agricultural research, which will be a concurrent function in a federal Nepal. There may be pressure to display capacity that matches the authority given to the provincial level over agricultural research. However, a useful alternative model is offered by Malaysia where the Malaysian Agricultural Research and Development Institute (MARDI) focused on targeting agro-ecological zones rather than creating a research institute in every state.

5.2 *Autonomy*

As noted earlier, *de jure* authority over a policy area should be complemented with de facto autonomy over budgetary and human resources. However, a common challenge observed across the country cases is that subnational governments receive authority without autonomy. For example, in India, despite the fact that social and economic planning are concurrent functions of state and federal governments, the federal government exerts a great deal of influence over development strategies due to the imbalance in revenue and expenditure authorities between state and federal governments. In essence, state governments pursue the central government's development strategies because the central government earmarks intergovernmental fiscal transfers for particular development initiatives, curtailing states' autonomy to pursue local development initiatives.[21]

Even if autonomy is granted, it can result in unintended consequences for development policy more broadly and agriculture in particular. For example, providing subnational governments with greater autonomy over taxing and spending is, as noted earlier, essential for achieving effective devolution. However, it can lead to unintended consequences for the agricultural sector. In Kenya, devolution has resulted in a majority of rural counties introducing local cess charges that target agricultural activities, particularly coffee, tea, and livestock. Since these charges are not coordinated among counties, they have often resulted in traders paying more than once and raising transaction costs in agriculture and livestock farming that undermine the attractiveness of the sector and hinder expansion into high-value agribusiness opportunities (see World Bank 2014b). A similar outcome occurred in the wake of Indonesia's decentralization where local governments faced pressure to generate own-source revenues. The agricultural sector was particularly hard hit by the proliferation in local tax laws, with every district imposing its own set of levies and tariffs on agricultural goods passing through its borders. These interregional tariffs and levies diminished incentives to produce agricultural surplus (see Sumarto et al. 2004).

Another unintended consequence of greater subnational autonomy over agricultural governance observed across the cases has been a reduction in budgetary support for agricultural extension. For example in South Africa, extension is financed by the provincial departments of agriculture (PDAs) and the districts, but it remains highly understaffed due to the retention of "supernumeraries," i.e., staff who are unnecessary but inherited from the apartheid era system. In Indonesia, resources for agricultural extension dropped dramatically in the wake of decentralization, when local governments became responsible for providing the budget for extension services. In the district of Cianjur in West Java, for example, spending on agricultural extension services dropped by 88% after decentralization, and about two-thirds of districts closed agricultural service centers altogether (World Bank 2007). Commitment to agriculture did not begin to recover until 2006, when the government established national service delivery standards and provided central government resources to fund the new delivery standards (World Bank 2007). These examples suggest that MoAD, in conjunction with MoFALD, will need to consider whether to retain earmarked funding for agriculture in order to ensure that agricultural services remain funded or whether to allow local government sufficient fiscal autonomy to determine their own spending priorities, even if agriculture is not among them.

On the other hand, a key insight from these countries is the need to respect subnational autonomy by avoiding imposing a uniform organizational structure on

[21]Significantly, in 2015, India began implementing a broad fiscal reform to devolve a 10% point increase in tax revenues to states (*Power to the States* 2015).

subnational departments of agriculture. Indeed, one benefit of devolving authority is that state governments can allocate resources to the areas that they see as the highest priority. For instance, in South Africa, the national ministry that oversees agriculture is the Department of Agriculture, Forestry and Fisheries (DAFF). Every province also has a PDA, which varies significantly in the services that they provide. Similarly, in the wake of Kenya's new Constitution, each of the 47 new counties now has a department of agriculture depending on the agro-ecological zone. For example in rural Narok county, there is equivalent attention to agriculture, livestock, and fisheries while in Nairobi county, which houses the capital city, the department also includes urban agriculture and food security divisions. Particularly in contexts where budgets and capacity are limited, as in Nepal, enabling subnational governments to decide which services are most useful to suit the local context can avoid the costly policy of replicating uniform structures across every subnational unit.

As noted earlier, agricultural research represents a special case with respect to autonomy due to the need for specialized staff and scientific policies driven by technical concerns rather than political preferences. In Kenya, Malaysia, and South Africa, the head of the country's research council is appointed by the minister of agriculture or the national executive for a defined and renewable term and must meet a minimum level of qualifications. For example, in the South African case, the chair often is a university professor. Nepal could likewise consider this approach to end the process of having the MoAD minister chair the NARC executive council. In terms of personnel, NARC's recruitment autonomy will be stifled by the need to recruit through the PSC under the new Constitution. However, one alternative is that the PSC establishes a specialized recruitment exam focused specifically on agricultural science, like in India.

Finally, granting *de jure* authority to subnational governments over policy areas once controlled by the central government raises new challenges about how to staff and to motivate the civil service. Any type of public sector reform generates a large degree of uncertainty among civil servants, especially if very little information on the process is communicated to them in advance. Implementing federalism can be especially unsettling because, despite the espoused goals of giving citizens greater voice and bringing government closer to the people, civil servants may still enjoy the benefits and status associated working with the federal administration than in provinces or remote local governments. As already noted, a federal structure, local governments will need to recruit and retain staff to serve in remote areas, often without the prospect of later being transferred to a more desirable location. In Nepal, the transition process may be even further complicated by the country's relatively strong civil service unions.

A useful case is Indonesia, where 2.4 million civil servants were transferred from the center to local government units in wake of its decentralization reforms (Bennet 2010). Central government civil servants working in regions were given the option to either stay in the region in which they were currently employed or to return to their home districts. This limited flexibility in staffing policy helped civil servants to accept their change in status from central government to local government employees. In Nepal, a similar option could be considered since 35% of DADOs/DLOs either have no preference about where they serve or would like to continue on in their current district and an additional 25% would like to serve closer to their own home districts. However, Nepal should anticipate significant challenges in retaining civil servants in remote districts: none of the DADOs/DLOs in mountain districts report wanting to continue to serve in those areas, with all reporting wanting to serve closer to the capital, in the hill region, or closer to where they were born. Greater consideration should be given to providing top-up pay to encourage agents to go to more remote areas of the provinces.[22]

Autonomy over human resource policy involves not only the ability to recruit and retain staff at the local level, but also the ability to motivate staff to provide high-quality services at the local level. In Nepal, a major question is how to incentivize research and extension staff to improve communication and linkages. It will be important that the restructuring does not worsen this situation since research will occur at the federal and provincial levels while extension is devolved to the local level. Institutional mechanisms and mandated job requirements can be useful in strengthening these linkages. Both Malaysia and South Africa provide examples of the mandated requirements approach whereby extension workers need to spend a share of their time learning about new technologies at regular intervals in order to retain their qualifications as extension officers.

India and Indonesia offer two examples of the institutional mechanisms approach. The Indian Council for Agricultural Research (ICAR) established Krishi Vigyan Kendras (KVKs), or agricultural extension centers, in 1974. These KVKs are frontline researchers who conduct tests on farmers' fields and provide critical inputs, such as seeds and fertilizer. Indonesia's Assessment Institutes for Agricultural Technology (AIATs) offers another approach. Specifically, Indonesia's Agency for Agricultural Research and Development (IAARD) undertakes research and pass along their findings to Assessment Institutes for Agricultural Technology (AIATs) in each province for testing. Having AIATs close to the areas that they serve enables each AIAT to adapt technologies to fit the area that they are serving (Stads et al. 2007). Further, by concentrating AIATs at the provincial level, which is also responsible for training for agricultural extension workers, this ensures that agricultural research and agricultural extension are closely linked and integrated into a single structure.

Each of these models bear similarities to the idea of Community Agricultural Extension Service Centers proposed in the ADS (p. 89) and could be promising in Nepal, as nearly 70% of DADOs/DLOs report wishing they could get local staff involved in adaptive testing in the field. However, it is important to bear in mind that two institutional characteristics have been key to AIATs' success: (1) provincial-level autonomy over agricultural research and education that has

[22]We were informed that this incentive system was considered in the early 2000s. However, the profiles of extension staff found they were predominantly from a small group of districts where technical and vocational education centers were located and therefore would not have sufficient expertise to go to different areas.

enabled provinces to adapt research to meet local needs and (2) strong commitment from the federal government for the institutions, including providing funding and assistance with coordination between AIATs. Similar commitments would be important to ensure its success in Nepal, particularly the provision of long-term funding.

5.3 Accountability

Greater autonomy for provincial and local governments implies that there should also be greater vertical accountability, between citizens and their local governments, for both good and bad performance. For instance, early indications from Kenya's reform suggest that devolution has notably strengthened vertical accountability due to the high level of autonomy accorded to county governors (see Cheeseman et al. 2016).[23] Yet, with a dispersion of autonomous actors responsible for agricultural policy and services, lines of accountability across different government entities can be easily muddled.

To address these challenges, some options include service delivery units and performance contracts, which have been successful in setting national-level development priorities and developing metrics by which to measure successful service delivery within the priority areas. This in turn helps ministries to identify and address bottlenecks in policy implementation. A key part of the success has been creating metrics for successful service delivery beyond just "budget received" and "budget executed" and receiving frequent updates on these priority metrics so that bottlenecks can be addressed in real time. For each priority policy, a "responsible" ministry, department, or level of government can be identified that is held accountable for policy successes and failures.

One example is Malaysia's Performance Management and Delivery Unit (PEMANDU). Established in 2009, the main innovation of Pemandu is that performance targets themselves, rather than just the public servants charged with pursuing them, are constantly subject to review and revision. Civil servants from across all government ministries are regularly brought together in "laboratory" sessions to brainstorm solutions and to identify and review targets. At the end of the laboratory sessions, participants and ministry representatives signed cooperative agreements committing to initiatives and action steps. However, after the outcomes and performance indicators have been agreed upon, they are subject to constant review and revision (Sabel and Jordan 2015).

At the same time, greater autonomy for subnational governments will create challenges for policy coordination. Overcoming these challenges will require strong mechanisms of horizontal accountability between federal and provincial

[23]For some caveats on corruption, please see http://www.oxfordbusinessgroup.com/news/kenya-devolution-still-evolving.

governments, between provincial governments, and across ministries involved in the agricultural sector. Importantly, these mechanisms should not undermine the autonomy of local governments.

In terms of coordinating between and among tiers of government within the agricultural sector, at least two approaches are common. One approach includes utilizing service delivery units to bring together multiple actors and ministries around a single goal. A second approach is demonstrated by South Africa. Following the Intergovernmental Relations Act in 2005, the President's Coordinating Council was created which includes the president, deputy president, key national level ministers, premiers of the nine provinces, and representatives of the South African Local Governance Association (SALGA). The aim is to ensure implementation of national policies and legislation and to ensure that national, provincial, and local development strategies are well aligned and complementary. In addition, there is a National Intergovernmental Forum, known as "MinMECs," whereby national ministers meet with the Ministerial Executive Councils (MECs) of the provinces (i.e., provincial cabinets) and SALGA. These MinMECs are critical for ensuring coherence *within* sectors across all levels. Horizontally, there are also Premiers' Forums that focus on cooperation specifically across the provinces while the District Intergovernmental Forums and Intermunicipality Forums do the same at the local levels (Dickovick 2005; Maseru 2008).

In Nepal, a key area of horizontal accountability and coordination will be with respect to extension. Even though extension will be primarily a local-level function, it is important to ensure coordination across tiers so that extension workers have equivalent training across the country. Following the South African model, the local government at the VDC level could actually implement extension services and liaise with other frontline service workers relevant to agriculture. At the federal level, the Directorate of Agricultural Extension within MoAD could focus exclusively on developing standards, policies, and accreditation for extension workers. Provincial agricultural departments could focus on training extension workers, facilitate information sharing among them, and coordinate VDC level activities. On the latter, the Indian model of using district-level extension plans to create a state-level extension plan, which in turn becomes the basis for training extension workers, would be a viable option in the case of Nepal.

6 Conclusion

Nepal's small size and limited resources pose a number of challenges for its transition to a federal country. At the same time, this institutional transition offers a unique opportunity to address existing weaknesses in the current policy process and institutional structure, including within the agricultural sector. This chapter highlighted critical concerns and options for MoAD and MoLD going forward, especially with respect to agricultural policy planning, agricultural research, and agricultural extension. The chapter aimed to adopt a holistic approach that accounts for the concerns of MoAD and MoLD while illustrating the broader administrative, fiscal, and policy process context in which decisions related to the agriculture sector will henceforth operate. Since Nepal is embarking on a pathway that has already been well trodden by other countries, we drew on the experiences of India, Indonesia, Kenya, Malaysia, and South Africa to highlight institutional innovations that could be adopted or pitfalls to avoid.

Notwithstanding the value of a comparative perspective, Nepal is considerably smaller than most countries that have adopted a federal structure, both in terms of population and in terms of land area. Globally, countries with a federal structure, on average, have a population of around 130 million and a land area of over 3 million square kilometers, compared to Nepal's population of roughly 20 million and land area of less than 150,000 square kilometers.[24] Thus, in adapting lessons from other countries with a federal structure, it is important to adjust structures and institutions by Nepal's relatively smaller population and land area. For example, while India maintains state-level agricultural recruitment boards to handle recruitment and screening for agricultural technicians, Nepal's smaller size makes such an institution less feasible (and less necessary) at the state level.

Moreover, the new Constitution appears to favor bypassing the district level for service delivery functions at the local level in favor of the VDCs, which will be re-amalgamated from their current 3200 to approximately 1000. VDCs in Nepal are numerous, fragmented, and often have low administrative capacity. By way of comparison, the average third-tier local government unit in Indonesia governs a population of nearly half a million people (Booth 2014) compared to an average of 6000 households living within a VDC in Nepal. In Kenya, the Government amalgamated more than 100 local authorities into the new 47 counties. For Nepal, it will be critical that the need to reach local citizens and provide equitable representation in government is balance with lessons of scale economies for efficient delivery of services. Giving responsibilities to local government units that exceed their capacity risks undermining public support for decentralization as a whole and the legitimacy of the new local government units.

Despite these caveats, Nepal's strong history with local governance will facilitate its adaptation to the new federal structure. During the past decade, Nepal has institutionalized the fourteen-point planning process, which has provided citizens with experience and capacity to participate in public fora on local development, to plan projects, and to monitor their outcomes. Experience of more than decade with planning local agricultural development projects has given citizens experience with articulating demands for local agricultural development priorities. This was exemplified by the highly participatory process surrounding the crafting of the recent agricultural development strategy as well. Thus, Nepal's strong history with participatory planning will make the transition into a federal system with more

[24] Authors' calculations using World Development Indicators 2015.

demand-based agricultural services easier than if these institutional frameworks and processes had not existed.

Acknowledgements Authors are very grateful to the many officials, researchers, donors, and civil society organizations in Nepal that helped inform this report. A special thanks to the US Agency for International Development (USAID) for extending financial support to conduct this study through the policy reform initiatives project in Nepal and to P. K. Joshi and Anjani Kumar for supporting our involvement in this study. We are also extremely grateful to Madhab Karkee, who provided invaluable assistance in facilitating interviews in Kathmandu and providing feedback on previous iterations of the study. We further thank the Institute for Integrated Development Studies (IIDS) in Kathmandu for collecting the DADO/DLO survey data, particularly Bishnu Pant, Ram Khadka, and Anuj Bhandari. The survey could not has been conducted without the support of the Ministry of Agricultural Development and the Ministry of Livestock Development in Nepal. The authors are also grateful to Jane Lole for assisting with the secondary country case studies. All errors remain authors' own.

Appendix

(See Fig. 2).

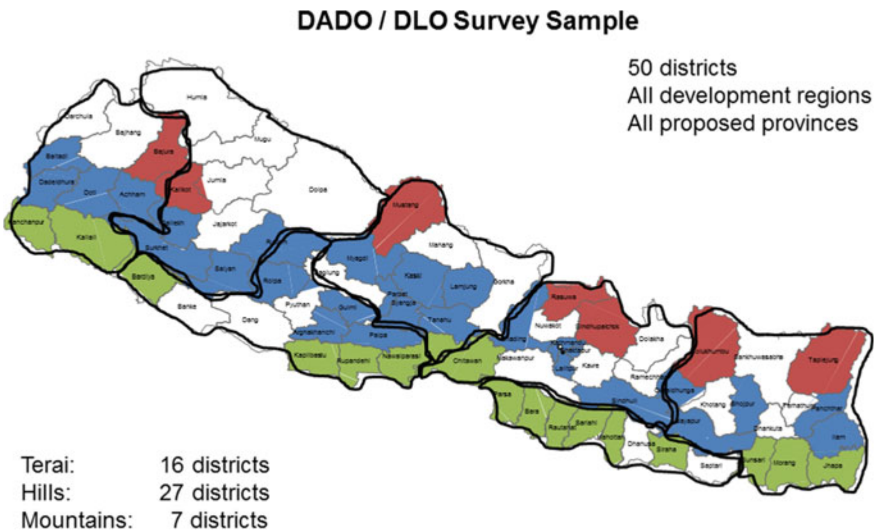

Fig. 2 DADO/DLO survey sample. *Source* Authors' compilation. *Notes* Black lines provide a rough indication of the provincial boundaries as set forth in the January 2016 Constitutional amendment. However, these boundaries were still under consideration as of the writing of this chapter

References

Azfar, O., Kahkonen, S., & Meager, P. (2001). *Conditions for effective decentralized governance: A synthesis of research findings*. Working Paper No. 256. College Park, MD: Center for Institutional Reform and the Informal Sector, University of Maryland.

Bajagai, Y. S. (2012). Food safety regulation in Nepal and issues in the regulation of meat safety. In G. Dawadi, K. P. Rai, & B. M. Adhikari, (Eds.), *National Conference on Food Science and Technology* (*Food Conference-2012*) (pp. 90–97). 10–11 August, 2012, Kathmandu, Nepal.

Bennet, R. (2010). Decentralizing authority after Suharto: Indonesia's 'big bang', 1998-2010. *Innovations for successful societies.* Princeton, NJ: Princeton University.

Boex, J. (2012a). *Review of the criteria and grant allocation formulas for block grants to DDCs and VDCs in Nepal*. Washington, DC: The Urban Institute, Center on International Development and Governance.

Boex, J. (2012b). *Toward a federal constitution in Nepal: What is the future role and structure of local governments? IDG Policy Brief*. Washington, DC: The Urban Institute.

Booth, A. (2014). Before the 'big bang': Decentralization debates and practice in Indonesia, 1949–99. In Hal Hill (Ed.), *Regional dynamics in a decentralized Indonesia*. Singapore: Institute of Southeast Asia Studies Publishing.

Byerlee, D., & Traxler, G. (2001). The role of technology spillovers and economies of size in the efficient design of agricultural research systems (Chapter 9). In J. Alston, P. Pardey, & M. Taylor (Eds.), *Agriculture science policy: Changing global agendas*. Washington, DC: IFPRI.

Byerlee, D., & Alex, G. (1998). *Strengthening national agricultural research systems: Issues and good practice*. Washington, DC: World Bank.

Carter Center. (2014). *Local governance in Nepal: Public participation and perception*. Atlanta, GA: The Carter Center.

Central Bureau of Statistics (CBS), Federal Democratic Republic of Nepal. (2011). NEPAL small area estimation of poverty, 2011 (summary and major findings). Retrieved August 5, 2013, from http://cbs.gov.np/wp-content/uploads/2013/06/Small%20Area%20Estimates%20of%20Poverty,%202011.pdf.

Cheema, G. S., & Rondinelli, D. (2007). From government decentralization to decentralized governance. In G. S. Cheema & D. Rondinelli (Eds.), *Decentralizing governance: Emerging concepts and practices*. Cambridge, MA/Washington, DC: Harvard University/Brookings Institution Press.

Cheeseman, N., Lynch, G., & Willis, J. (2016). Decentralization in Kenya: The Governance of Governors. *The Journal of Modern African Studies, 54*(1), 1–35.

Dickovick, T. (2005). The measure and mismeasure of decentralization: Subnational autonomy in Senegal and South Africa. *Journal of Modern African Studies, 43*(2), 183–210.

Dillon, A., Sharma, M., & Zhang, X. (2008). *Nepal agriculture public expenditure review*. Washington, DC: International Food Policy Research Institute.

Government of Nepal (GoN). (1999). Local Self-Governance Act 1999 (LSGA).

Government of Nepal (GoN). (2006). *An assessment of the implementation of the Tenth Plan/PRSP*. Kathmandu, Nepal: National Planning Commission Secretariat.

Government of Nepal (GoN). (2013). *Agricultural Development Strategy (ADS): 2015-2035*. Kathmandu, Nepal: Ministry of Agricultural Development.

Government of Nepal (GoN). (2015a). *Constitution of Nepal. September 20, 2015 (2072.6.3).* Kathmandu, Nepal.

Government of Nepal (GoN) (2015b). *Public Expenditure and Financial Accountability (PEFA) Assessment: Nepal PFM Performance Assessment II.* Kathmandu, Nepal: Ministry of Finance and Public Expenditure and Financial Accountability Secretariat.

Inlogos. (2009). *Assessment of village development committee governance and the use of block grants*. Kathmandu: Ministry of Local Development and United Nations Development Programme.

Kathyola, J., & Job, O. (Eds.). (2011). *Decentralisation in commonwealth Africa: Experiences from Botswana, Cameroon, Ghana, Mozambique, and Tanzania*. London, UK: Commonwealth Secretariat.

Lankina, T. (2008). *Cross-cutting literature review on the drivers of local council accountability and performance*. Social Development Working Paper No. 112. Washington, DC: World Bank.

Maseru, J. (2008). *UCLG Country Profiles: Republic of South Africa*. Barcelona, Spain: United Cities and Local Governance (UCLG).

Nepal Agricultural Research Council Act, 2048. (1992). *Kathmandu, Nepal: Law Commission of Nepal*. Available at: https://extwprlegs1.fao.org/docs/pdf/nep100289.pdf (Accessed October 5, 2016).

Nepal Agricultural Research Council (NARC). (2016). *NARC-ACIAR partnership: Past, present, and ways ahead*. Kathmandu, Nepal: NARC.

Power to the states: Making fiscal transfers work for better health. Washington, DC: Center for Global Development and Accountability Initiative, Centre for Policy Research. Available at http://www.cprindia.org/sites/default/files/policy-briefs/India-fiscal-transfers-CGD-working-group-report_0.pdf.

Quinn, D., & Ramananda, P. G. (2013). Institutional architecture for food security policy change: Nepal. Washington, DC: USAID.

Rahija, M., Shrestha, H., Stads, G. J., & Bhujel, Ram Bahadur. (2011). *Nepal: Recent developments in public agricultural research, Agricultural Science and Technology Indicators (ASTI) country note*. Kathmandu/Washington, DC: NARC/IFPRI.

Root, C. (2014). *Agricultural service responsiveness in Nepal*. Research Triangle Park, NC: RTI Press.

Sabel, C., & Jordan, J. (2015). Doing, learning, being: Some lessons learned from Malaysia's National Transformation Program. *Competitive Industries and Innovation Program*. World Bank. Available at http://www2.law.columbia.edu/sabel/papers/CS-LSJ–DLB%20Malaysia%20PEMANDU–Final-190115.pdf.

Sharma, N. K. (2011). *National agriculture extension system in Nepal: An analysis of the system diversity*. Country Paper Submitted to SAARC Agriculture Centre. Dhaka, Bangladesh.

Stads, G. J. (2015). *Taking stock of agricultural R&D capacity and investment in Nepal*. Presented at Regional Workshop on Agricultural Transformation, Challenges and Opportunities in South Asia. Kathmandu, Nepal, February 13–14.

Stads, G. J., Haryono, & Nurjayanti, S. (2007). Agricultural R&D in Indonesia: Policy, Investments, and Institutional Profile. *ASTI: Agricultural Science & Technology Indicators*. Washington, DC: IFPRI.

Sumarto, S., Suryahadi, A., & Arifianto, A. (2004). Governance and poverty reduction: Evidence from Newly-decentralized Indonesia. *SMERU Research Institute Working Paper*. Available at https://www.researchgate.net/profile/Sudarno_Sumarto/publication/4811349_Governance_and_Poverty_Reduction_Evidence_from_Newly_Decentralized_Indonesia/links/0c96051a514ce4e652000000.pdf.

Suvedi, M., & McNamara, P. (2012). *Strengthening the pluralistic agricultural extension system in Nepal.* Monitoring Extension and Advisory Services (MEAS).

Swanson, B., & Davis, K. (2014). *Status of agricultural extension and rural advisory services worldwide: Summary report*. Global Forum for Rural Advisory Services: Lindau, Switzerland.

Swanson, B., & Rajalahti, R. (2010). *Strengthening agricultural extension and advisory systems: Procedures for assessing, transforming, and evaluating extension systems*. Washington, DC: World Bank.

United Nations Development Program (UNDP). (2014). *Annual Report 2014: UNDP in Nepal.* New York, NY: UNDP.

World Bank. (2014a). *Nepal: Local Service Delivery in Nepal.* Report No. 87922-NP. Washington, DC: World Bank.

World Bank. (2014b). *The evolution of Kenya's devolution: What's working well, what could work better*. Information Note for World Bank Staff. Washington, DC: World Bank.

World Bank. (2012). *Devolution without Disruption: Pathways to a successful new Kenya*. Washington, DC: World Bank.

World Bank. (2007). *Agricultural extension services in Indonesia: New approaches and emerging issues.* Jakarta, Indonesia: World Bank. Available at http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2010/03/23/000333038_20100323010352/Rendered/PDF/384680ESW0Whit10Box345622B01PUBLIC1.pdf.

World Development Indicators Database. *World Bank*. https://databank.worldbank.org/source/world-development-indicators

Yilmaz, S., Beris, Y., & Serrano-Berthet, R. (2010). Linking local government discretion and accountability in decentralisation. *Development Policy Review, 28*(3), 259–293.

Ziblatt, D. (2006). *Structuring the state: The formation of Italy and Germany and the puzzle of federalism*. Princeton, NJ: Princeton University Press.

Part VI
The Policy Agenda

Chapter 20
Concluding Chapter: The Policy Agenda

Ganesh Thapa, Anjani Kumar and P. K. Joshi

Abstract Chapter 1 briefly reviewed the performance of the agriculture sector in Nepal and identified the new sets of challenges and emerging opportunities for this sector. This chapter summarizes the conclusions that can be drawn from the various chapters on some of these issues and presents policy options for the future of Nepal's agriculture.

Chapter 1 briefly reviewed the performance of the agriculture sector in Nepal and identified the new sets of challenges and emerging opportunities for this sector. This chapter summarizes the conclusions that can be drawn from the various chapters on some of these issues and presents policy options for the future of Nepal's agriculture.

In the following section, we present the major findings of the various chapters of this book on some of the important macro-issues affecting the agriculture sector.

1 Macro-issues in Agriculture

1.1 Structural Transformation and Agriculture

Agriculture is the largest sector of the Nepalese economy, as it contributes around one-third of the value added and accounts for 64% of employment. As in other developing countries, agriculture is important not just for economic growth but also

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G. Thapa et al. (eds.), *Agricultural Transformation in Nepal*,
https://doi.org/10.1007/978-981-32-9648-0_20

for poverty reduction. Poverty elasticity with respect to agricultural value added is almost twice as large as the corresponding elasticity with respect to GDP (Chap. 3). Therefore, growth in this sector's productivity is critical to enhancing aggregate economic growth and equity.

Nepal exhibits a unique pattern of structural transformation that differs from what most other countries have experienced, in which the process of structural transformation involves a manufacturing hump as resources move away from agriculture into manufacturing before declining (Chap. 2). In the case of Nepal, as agriculture shrinks, manufacturing peaks prematurely before declining. The move away from agriculture represents more of a transient, back-and-forth shift than a lasting transformation towards services, which, in turn, comprises of both high and low productivity sectors. The value added from agriculture now is exceeded by the service sector, significantly driven by remittances sent by migrant workers who, in the absence of overseas employment opportunities, might have remained in the subsistence agricultural sector. Remittances have sustained economic activities in the service sector.

All sectors in the economy are stagnant in terms of sectoral value added, reflecting poor performance in the productivity of the labour force. The same cohort of unskilled or semi-skilled workers appears to be circulating among the agriculture sector, overseas employment or informal services. A mere shift of resources or value added from one sector to another sector has not translated into better economic performance, and overall output growth has not exceeded 5% in real terms over the past 20 years. The traditional dominance of agriculture and a significant inflow of remittances, in an otherwise stagnant economy, can explain this pattern of declining poverty, low inequality and the lack of job-creating growth.

An area where Nepal's experience is similar to that of other Asian countries is in the gradual fragmentation of landholdings. While the prominence of agriculture is declining, the number of farms is increasing, and the average farm size is decreasing. This indicates that the rate of exit from agriculture is slow. This implies that the productivity gap between the agricultural and non-agricultural sectors and the incomes of farmers and non-farmers are likely to diverge.

1.2 Performance of the Agriculture Sector

As highlighted in Chap. 1, the performance of agriculture sector in Nepal has been poor, particularly since 1995. The agricultural gross domestic product (AGDP) growth as well as cereal yields in Nepal has been lower than in neighbouring countries. As a result, much of the increase in agricultural incomes between 2004 and 2011 has come from gains in prices and not yields (World Bank 2013). The total factor productivity (TFP) growth in Nepal's agriculture in the last three decades has been the lowest in South Asia, and the TFP growth rate has declined over time during this period. The main factor for low agricultural productivity growth has been the low level of technical change and technical efficiency (World Bank 2017).

Over time, Nepal's agriculture has become less competitive in both domestic and export markets. The country's net imports of agricultural commodities have risen consistently, both of staples such as rice, wheat, maize and potatoes and of high-value foods like vegetables and fruits. Chapter 15 shows that cereal imports increased dramatically during 2009–2013, with trend growth rates of 39% per year for rice, 26% for maize and 126% for wheat. During this period, the imports of fruits and vegetables doubled.

The main causes of low productivity in agriculture sector, particularly cereals have been low rates of adoption of improved technology due to subsistence farming, low access to appropriate technology, limited availability of production inputs and limited investment in the agriculture sector (GON 2015). The armed conflict between 1996 and 2006 and a long political transition after 2006 also had an adverse effect on the sector. Several agricultural policies were formulated following the implementation of the Agricultural Perspective Plan (APP) in 1996. However, the implementation of such policies has been ineffective due to the lack of supporting legislation and resources for implementation. Institutional capacity including human resources has also been inadequate for effective implementation of projects and programmes.

2 Agricultural Productivity Growth and Its Drivers

2.1 Seed

Agricultural productivity enhancement is dependent on farmers' access to production inputs, among which quality seed is critical. However, Chap. 8 shows that the current seed system in Nepal is inefficient to ensure farmers' access to quality seeds of wide range of choice varieties suited to diverse production systems. The seed value chain starting from genetic resource management, variety development and maintenance is often poorly integrated with commercial seed multiplication and marketing chains resulting in lack of sustained flow and farm level deployment of choice variety seeds.

In Nepal, informal seed system dominates in which the bulk of seed requirement of farmers is met through on-farm saving of seed by farmers or through local distribution channels such as exchanges between farmers, community sharing systems and local markets. The formal seed system is in its infancy with the dominance of public sector in varietal development, release and source seed production with an increasing role of the private sector in seed multiplication and marketing. Community-based seed producer groups and community seed banks are also evolving as an important partner in meeting the seed requirements of farmers.

Although the role of private sector is evolving and increasing gradually in recent years, their capacity is still weak to function as the key value chain promoter for dynamic seed sector development (Chap. 8). There is a poor integration of variety development and maintenance process and institution with seed multiplication and marketing chains resulting in poor popularization and dissemination of newly developed varieties. Consequently, farmers' uptake and adoption of newly released varieties are low.

Moreover, the capacity of national agencies and stakeholders is weak in implementation and enforcement of existing seed policies to assure supply of quality seeds of choice varieties. Therefore, the process of variety development, release and multiplication and dissemination of quality seeds of farmers preferred varieties is slow.

2.2 Fertilizer

Although the use of fertilizer has increased in Nepal in the last few decades, its intensity of use has been low from the international standard. Increasing fertilizer use is critical for agricultural productivity enhancement in the country, where land is one of the scarce resources that farmers own. Chapter 9 investigates the recent trends in chemical fertilizer use in Nepal and offers key insights that can partly fill current knowledge gap. The Terai and the Hills/Mountains have experienced diverging patterns in fertilizer use growths particularly in the last 10 or 20 years. During this period, both Terai and Hills/Mountains zones have seen reductions in real chemical fertilizer price, relative to the food price. Chemical fertilizer use in the Terai had grown considerably partly in response to such reduction in chemical fertilizer price, but it has stagnated in the Hills/Mountains as the demand has remained irresponsive to price.

The stagnation of chemical fertilizer use growth in the Hills/Mountains is consistent with the patterns in hilly, mountainous countries around the world, where organic manure, relative to chemical fertilizer, has remained an important source of soil nutrients. In the Nepal Hills/Mountains, a balanced promotion of chemical fertilizer and organic fertilizer (manure) may be important, drawing lessons from other countries. At the same time, the trends of chemical fertilizer use growth in the Terai, which accounts for the majority of farmland in Nepal, has also exhibited important patterns that have implications on agricultural transformation in Nepal, including, among others, the future of smallholders.

The evidence from Chap. 9 indicates that the recent growth of chemical fertilizer use in the Terai has been led by substantial growth of uses among relatively larger farms. While various market factors can potentially explain such pattern, the growing returns to intensive chemical fertilizer among relatively larger farms compared to smaller farms seem one of the primary factors. Such growths in returns to intensive chemical fertilizer use are partly enabled by the growing tractor adoptions through custom-hiring service that has contributed to the overall increases in returns to scale in agricultural production. Such technical advantages among relatively larger farms might have given them better bargaining power over smaller farms for sharecropping/land rental. While lower chemical fertilizer price currently leads to land transfer from larger farms to smaller farms through sharecropping or rental, a significant share of the gains from low price accrues to greater livestock production among relatively larger farms, potentially through increased supply of fodder from tenants.

Policy implications/recommendations: Chapter 9's findings have important implications for the government's efforts for promoting more intensive chemical fertilizer use in the country. The effects of reduced chemical fertilizer price are likely to differ across farm sizes and depend on interrelationships between crop and livestock, land transactions that farms are engaged in and other external factors like growing mechanization. Lowering chemical fertilizer price with the aim of supporting smallholders may not always benefit them sufficiently, both in the Terai and the Hills/Mountains. Other more effective direct supports for smallholders may be necessary. At the same time, lowering chemical fertilizer prices can complement the growth of larger, more commercial farm households, particularly in the Terai. Altogether, fertilizer policy in Nepal should be designed within the broader framework of longer-term agricultural sector strategies for hilly/mountainous regions and the future of smallholder farmers.

2.3 Mechanization

Agricultural mechanization has grown steadily in Nepal in response to growing farm-power needs which have been driven by increasing agricultural intensifications and rising labour costs driven by non-farm sector growth, out-migration or education levels, among others. The adoptions of various modern agricultural machineries have started rising, particularly in the Terai zone.

Chapter 10 assessed the overall trends of mechanization (tractors, threshers and pumps) in Nepal, determinants of their adoption and their impacts on household incomes and agricultural productions. The econometric results show that the adoption of tractors and pumps leads to significant increases in per capita agricultural incomes. The adoption of tractors or threshers leads to increases in areas cultivated, intensive uses of chemical fertilizer and irrigation. In addition, because of such intensifications in land uses and other potentially labour—using inputs, and production increases, the adoption of machines generally leads to increased uses of labour. Another important result is that mechanization does not lead to labour displacement, although the overall effects on agricultural labour also depend on how the trends in rising wages lead to the change in overall agricultural households.

Tractor use was found to lead to agricultural income increases through land expansion, while pump use led to increases through increased revenues per area cultivated. While these effects on agricultural practices do not seem to lead to significant changes in overall household incomes, they may lead to greater changes in outcomes in the long run. The positive effects on agricultural incomes are still important since it provides greater returns to farmland, one of the main productive resources of the agricultural households. It provides rural households more options to raise household incomes in the long run.

Policy implications/recommendations. The government's policies and plans promoted only labour intensive technologies up until 2014. However, the agriculture sector started to face labour shortages, agricultural wage rates raised beginning in the early 2000s due to increasing migration of rural youth for employment in cities and abroad. This had encouraged farmers to adopt agricultural mechanization, particularly tractors, threshers and pumps, mostly in the Tarai. Lately, the government has also started to promote mechanization through the provision of subsidy. In 2014, the MOAD approved Agricultural Mechanization Subsidy Directives 2070 for distributing subsidy through the Department of Agricultural Engineering. In 2015, the ADS acknowledged agricultural mechanization as one of the priority areas. Because of the low level of mechanization in the country and its potential positive impact on agricultural productivity, the government should provide support to farmers to adopt mechanical technologies.

The analyses of the determinants of adoptions help identify strategies that can accelerate agricultural mechanization in the country (Chap. 10). Support for educational development facilitates the adoption and intensive use of various machines, particularly tractors and pumps. Consolidation of lowland farm through improved farm land sales/purchase market may facilitate mechanization. The government can facilitate consolidation of land by promoting the development of more active land rental markets. However, as Chap. 17 shows land owners are reluctant to rent out land due to fears that they may lose land rights are eventually taken by those renting in the land. Part of such inefficiency may be overcome by the mechanization technologies themselves; economies of scale enabled by mechanization technologies can give greater bargaining powers to larger farms that can now offer higher rental prices to smallholder land owners. However, more formal land policies, such as granting stronger land tenure rights to land owners and strengthening enforcement may further facilitate land rental transactions.

Lastly, improved electricity access may facilitate the ownership of pump. Certain crops, such as maize and lentils are not necessarily positively associated with mechanization through tractors, threshers or pumps. Therefore, balanced promotions of these crops must be designed. Alternatively, research and development in mechanization applicable to these crops may further induce mechanization growth.

Lastly, access to mechanization services may be affected by the proximity to machine owners (possibly due to limited mobility of large agricultural machines). Therefore, identifying the areas with high potentials and appropriately supporting the growths of private owners of machines is important in improving the accessibility to services by potential users. Evidence elsewhere suggests that government should not handpick such owners but rather focus on supporting the natural growths of efficient private owners.

2.4 Agricultural Research and Extension

One of the important factors for low agricultural productivity growth in Nepal is the inadequate access of farmers to demand-driven agricultural technologies and extension services. The institutional capacity (manpower, infrastructure, funds and other resources) of Nepal Agricultural Research Council (NARC), the main government agency with a mandate for agricultural technology generation, is inadequate to address the diverse technological and service demands of farmers, entrepreneurs and industries (Chap. 11). Also, there is no mechanism of functional integration of public and private sectors in priority setting, programme planning, implementation, monitoring and up-scaling for sustainable impacts.

The level of funding for agricultural research in Nepal has averaged about 0.28% of agricultural GDP, which is significantly lower than the globally recommended level of 1% of AGDP for a well-functioning research system. Although NARC's funding has increased in recent years, the actual research cost constitutes only 16% of total budget. About a third of agricultural research budget goes for food crops with horticulture, livestock, non-timber forest products and fisheries receiving significantly less budget. In horticulture, livestock and fisheries, dearth of qualified human resource is also a binding constraint. Also, the focus of research is primarily on production aspects, with limited research on post-harvest, quality and mechanization.

In the recent years, the country is gradually moving from a public sector dominated to a pluralistic agricultural extension service system. As a result, several donor-funded projects, I/NGOs, the university system and private seed and feed companies are contributing to extension efforts. There are several concerns with the current agricultural extension system. First, the availability of extension services is relatively uneven across the country, with agricultural service centres less accessible in poorer areas (Chap. 19). Second, district extension offices lack the manpower to adequately deliver services. Third, even when positions are filled, technical staff often lacks adequate training. Fourth, there is inadequate technical capacity in the areas of agribusiness, climate change mitigation and adaptation, post-harvest and processing technologies and inadequate initiatives to promote public–private partnership in extension due to the lack of robust policies and mechanisms. Fifth, functional coordination and linkages among extension service providers are weak to support farmers and other clients.

When Nepal's new constitution adopted in September 2015 is fully implemented, it will have major consequences on the functioning of the agricultural research and extension systems. Under the new constitution, agricultural research is listed as a concurrent power of both the provincial and federal governments (Chap. 19). However, the local governments will have exclusive authority over agricultural and livestock extension. At the same time, the overall agriculture sector is listed as a concurrent function of all three levels of governments. This has led to a high degree of uncertainty about the final authority of different levels of governments over different aspects of agricultural development.

Policy implications/recommendations: In order to improve the performance of Nepal's agricultural research and extension system, it is crucial to strengthen both public and private institutions and actors with proactive policies and programme interventions for functional participation and linkages. The government's commitment to promote pluralism in agriculture R&D with enabling policies, funding and capacity building is vital for sustainable impacts. The implementation of ADS recommendations to reform and strengthen research and extension systems, and promote linkages among actors, service providers and key stakeholders in Nepal's federal system will be critical for bringing the anticipated outcomes. Some policy and programme recommendations are as follows (Chap. 11).

In order to strengthen agricultural research, NARC's funding should be increased from the current level of 0.27 of AGDP to 0.5–1.0% of AGDP over five years in line with UN recommendations. NARC should be made more autonomous and accountable to reforms and strengthen its capacity. NARC should take proactive initiatives to functionally integrate new actors (universities, DOF, private institutes and NGOs) in research system through enabling policies and mechanism. A bottom-up planning process needs to be institutionalized. The national research network of institutions and programmes should be strengthened to cater to present needs and opportunities with required human resources and funding.

NARC should take on new initiatives, such as climate-smart production and management technologies and services. It should promote collaboration with international and regional R&D institutions (IARCs, SAARC countries and China) to benefit from their vast research products and skills. This will boost technology access and save time and costs.

In the area of agricultural extension, explicit policies and guidelines should be developed for promoting pluralistic model of extension though coordination and networking with public-private institutions. Technical capacity building and funding support should be provided to public sector extension agencies and CAESCs by the federal, provincial and local governments to create needed momentum in agricultural development at the grassroots level.

Provincial governments should promote private extension service providers through capacity building and incentives to contribute in areas of commercial agriculture, inputs supply, agribusiness and industries where the clientele are willing to share the cost of services as well. The government should promote youth and women in agriculture and related agribusiness through more enabling policies, funding, incentives and capacity building.

3 Emerging Challenges

3.1 Climate Change

Chapter 6 shows that climate change has potential to lower the effectiveness of development interventions across the country, with impacts on food production and availability of resources including water and energy. Communities dependent on agriculture are frequently exposed to a variety of climate extremes. Among them, floods, landslides and droughts are particularly regular phenomena in Nepal. The rainfall patterns have become erratic, and a decreasing annual trend has been noted in different parts of the country.

Various analyses of the potential impacts of climate change show that small farmers will be the most vulnerable segment of the society, as they tend to own fewer assets including land, earn lower income, have lower levels of education and lower access to community and government services. The ecosystems on which they rely are increasingly degraded, and their access to appropriate agricultural land and forest resources is declining. Many small and marginal farmers produce on marginal rainfed land that is affected by increased water scarcity and erosion.

Although Nepal has formulated several national and sectoral policies (e.g. Climate Change Policy 2011, Forest Policy 2015, Irrigation Policy 2014, Agricultural Development Strategy 2015) to address climate change impacts, these are not well integrated and are subject to overlaps and duplication. The government has taken steps to implement adaptation measures that are consistent with the Climate Change Policy 2011, the National Adaptation Programme of Action 2010 and the National Framework on Local Adaptation Plan for Action 2011. Many institutions in the country are implementing climate change adaptation and mitigation-related programmes and projects. These include the introduction of stress-tolerant crop varieties, integrated plan nutrient management, on-farm water management, organic farming, etc. However, most of these programmes/projects have limited coverage and are scattered too thinly with limited impact.

Policy implications/recommendations. In order to avoid the duplication of efforts and thinly spreading of resources across many institutions and across geographic areas, there is a need to consolidate similar activities under a single programme head and delineating the institutions to implement specific activities, which will also facilitate monitoring and tracking of implementation. The government has already begun immediate and urgent responses to climate change through NAPA in the country. However, there is a need to initiate medium to long-term response measures through the National Adaptation Programme (NAP) in order to integrate climate change adaptation measures into medium and long-term national planning processes. It implies identifying entry points for adaptation planning in agricultural and natural resources management and taking action to strengthen country systems to improve management of the risks and opportunities of climate change.

Policy responses to climate change should identify and support scaling up of known best practices and technologies for the farmers. It is also necessary to develop technologies suitable to diverse ecosystem and need of different categories of farmers and enhance the capacity of stakeholders and service providers at policy and program implementation level. For technology development, it is important to identify, document, test and disseminate local knowledge and alternative practices and to facilitate the process of building bridges between local and scientific knowledge.

Smallholder farmers find it hard to adopt many climate change adaptation and mitigation-related agricultural technologies and practices, as they do not have adequate funds to pay for significant establishment and maintenance costs. Therefore, the climate finance programmes should focus on improving livelihoods and incomes so that smallholder farmers can invest in climate-resilient and sustainable agriculture. In order to reduce the vulnerability of small farmers to climate-related risks, the government should implement programmes to improve their access to credit and also develop rural infrastructures such as irrigation canals and rural roads.

3.2 Governance Challenges

Nepal's small size and limited resources pose a number of challenges for its transition to a federal country. At the same time, this institutional transition offers a unique opportunity to address existing weaknesses in the current policy process and institutional structure, including within the agricultural sector. Drawing on the experiences of India, Indonesia, Kenya, Malaysia and South Africa, Chap. 19 highlights critical concerns and options for MoAD and MoLD going forward, especially with respect to agricultural policy planning, agricultural research and agricultural extension. This chapter also highlights institutional arrangements that Nepal can adopt based on other countries' experiences.

Other countries in the world that have adopted federal structure are much larger than Nepal in terms of population and land area. Therefore, in drawing lessons from such countries, it is important to consider Nepal's relatively small land area and population.

Policy implications/recommendations: Thus, in adapting lessons from other countries with a federal structure, it is important to adjust structures and institutions by Nepal's relatively smaller population and land area. For example, while India maintains state-level agricultural recruitment boards to handle recruitment and screening for agricultural technicians, Nepal's smaller size makes such an institution less feasible (and less necessary) at the state level.

Moreover, the new Constitution appears to favour bypassing the district level for service delivery functions at the local level in favour of the VDCs, which will be re-amalgamated from their current 3200 to approximately 1000. VDCs in Nepal are numerous, fragmented and often have low administrative capacity. By way of comparison, the average third-tier local government unit in Indonesia governs a population of nearly half a million people (Booth 2014) compared to an average of 6000 households living within a VDC in Nepal. In Kenya, the Government amalgamated more than 100 local authorities into the new 47 counties.

For Nepal, it will be critical that the need to reach local citizens and provide equitable representation in government is balanced with lessons of scale economies for efficient delivery of services. Giving responsibilities to local government units that exceed their capacity risks undermining public support for decentralization as a whole and the legitimacy of the new local government units.

3.3 Migration-Led Challenges

Based on a review of several studies in different parts of the country, Chap. 14 lists a number of challenges that out-migration of youth from rural areas pose to the agriculture sector. Large-scale out-migration of youth from rural areas since 2001 has adversely affected agricultural production through three inter-related effects. First, the shortage of agricultural labour has affected labour-intensive agricultural operations such as planting and harvesting thus lowering agricultural yields. Second, with increased remittances, these families can afford to send their children to schools. The removal of children from farm work is positive for their future, but it has short-term negative implication on the household's labour availability. Labour shortage has also led to rise on agricultural wages leading to higher costs of production and reduction in competitiveness of agriculture, particularly in hills and mountains. Third, shortage of labour has led to abandonment of crop land in many parts of the country resulting in production losses.

Men constitute the bulk of migrants in rural areas of Nepal (Chap. 14). This has led to the feminization of agricultural work with a negative impact on specific farm operations such as land preparation and excessive work burden on women. On the positive side, large-scale male out-migration has enhanced the responsibilities of women in farming as shown by the significant increase in the number of female-headed households over time. However, women's access to information, technology and finance has not significantly improved, which has left women more burdened than empowered.

In Nepal, only a small share of remittances is being spent in the country for investment in productive sectors including agriculture. Available studies show that the rural youth is less inclined to engage in subsistence farming, particularly cereals production. Based on an econometric study, Chap. 14 confirms this trend through which the country is losing competitiveness in domestically produced agricultural tradeables such as cereals. On the other hand, in areas where farmers have access to roads, markets and financial resources, they are taking. Although in the short run, migration and resulting remittances help in improving food security of individual households, it may have adverse effects on food security in the long-term due to increasing dependence on imports of food grains.

Policy implications/recommendations. Chapter 14 shows that the large-scale inflow of remittances, through exchange rate effects, triggers a distorted structure of agriculture sector, in which tradeable products (basic food stuffs), tend to be produced less domestically but are rather imported as this sub-sector loses competitiveness against the world market supply. As a result, the country is becoming increasingly dependent on food imports. Therefore, the government and development partners should strengthen the domestic sector's competitiveness in the production of staple food through productivity-enhancing programmes, such as development of rural infrastructure (irrigation, rural roads, etc.) and the introduction of improved production technologies, extension and support services (e.g. rural finance).

Many parts of Nepal have a comparative advantage in the production of high-value commodities, particularly non-tradeables, such as fruits, vegetables and livestock products. Farmers are also keen to invest in such commodities, benefitting from the financial and social remittances. However, the production of these commodities typically is labour-intensive, and labour shortages are the most direct effect of migration. Therefore, selective mechanization, such as small tractors and pump irrigation needs to be promoted. Also, male out-migration changes the gender roles and responsibilities with women playing an increasingly important role in agriculture. Thus, promotion of technologies that mitigate women's work burden, as well as policies enhancing women's access to credits and inputs, would be needed. However, for channelling remittances into farm investments, interventions into the agricultural sector alone are not sufficient. There is also a need for interventions to make migration more beneficial to the migrant households. This can be done through the reduction of costs of migration and increasing the returns, via skills trainings, so that the migrant households can save more and invest these savings in productive sectors, including agriculture sector.

3.4 Agricultural Trade

Nepal's agricultural trade has several challenges—escalating imports, slow growth in exports dominated by low value-added products, surging trade deficits and very narrow product and export market concentration (Chap. 15). Average agricultural imports during 2011–2013 were US-$1012 million compared to agricultural exports of US-$224 million. Imports increased rapidly during 2009–2013, both from India and rest of the world. Cereals and oilseeds together made up 53% of all agricultural imports during this period. Imports of fruits and vegetables also more than doubled during the same period, with 62% sourced from India. Agricultural exports declined in 2015 and 2016 from a high of 2014 due to the combined effects of earthquakes, political disruptions and trade embargo.

The analysis of the drivers of trade shows that agriculture, particularly the much larger import-competing food-sub-sector, has grown reasonably well in recent years but domestic production is inadequate to meet the surging demand for foodstuffs, hence the escalating imports. This raises the issue of raising the productivity of food commodities in the country to improve the food and nutrition security of people.

The export crops sub-sector has not been performing as well while agro-industry (manufacturing) has been shrinking and in a state of disarray. The business environment for industry has worsened, largely due to systemic failures in infrastructure and governance. As regards trade-specific drivers such as the provisions in Nepal's trade agreements, preferential access to export markets and the incidence of trade barriers, the situation might not have improved but also have not worsened, and thus the worsening of the trade indicators in recent years is unlikely to be related to these trade-specific drivers.

Policy recommendations. In order to address the inadequacy of food supply to respond to demand growth in the country, solutions have to be found in vibrant and dynamic agricultural and agro-industrial sub-sectors. The agro-industry sub-sector suffers from a number of systemic problems. On a positive note, there is now in Nepal a large and rapidly growing market for a variety of processed foods for the manufacturing sub-sector to seize the opportunity and grow.

With respect to the trade-specific issues, the two main challenges are on non-tariff barriers (NTBs) and trade facilitation. The primary responsibility for responding to the issues rests on Nepal. On NTBs, three categories of recommendations are: (i) promoting good practices in production and throughout the value chains, through research, extension and education, as well as through incentives and penalties; (ii) investing substantially to upgrade the capacity of laboratories and institutions to undertake required tests for export certification and (iii) generating through studies evidence on NTBs facing Nepal's exports, including the scale of losses, reasons for NTBs, as well as their compliance with WTO rules. This information should be put into public domain so that there is a common understanding of the problems and also used as evidence for pressing reforms through formal meetings with trading partners. The new WTO Agreement on Trade Facilitation (ATF) is promising in addressing some of the long-standing difficulties facing Nepal, including transiting goods across the borders and trade in perishable products. The ATF is also useful for improving some provisions on SPS-related issues.

Although very little trade takes place currently under the South Asia Free Trade Agreement (SAFTA), it could be a valuable framework for trade and investment, notably for resolving NTBs and difficulties related to trade facilitation, because there are certain issues that are best resolved at the regional level. SARSO, the regional body for standards, could be the main forum for addressing this issue. Nepal needs to be pro-active in advocating the strengthening SARSO. Nepal could also explore the pros and cons of broadening SARSO's mandate to also cover various NTBs and trade facilitation.

4 Emerging Opportunities

Several new opportunities have arisen in the country in recent years, which have the potential of generating significant income increases for farmers through increased production of high-value crops and forestry products. This section discusses some of these emerging opportunities.

4.1 Shift in Food Consumption Patterns/Dietary Diversity

Food consumption has shown an increasing trend in Nepal except for cereals (Chap. 4). Between 1995 and 2011, calorie consumption has increased in all three geographic areas—mountains, hills, and Tarai. The annual per capita consumption of cereals declined by about 8% during this period, whereas the per capita consumption of other food items (pulses, milk, vegetables, fruits, meat, eggs and fish) increased significantly.

Another important trend has been a gradual diversification of food basket from a cereal-dominated one to a mix of high-value commodities. The consumers are gradually moving away from low-cost calories food to high-cost calorie food items and have diversified the dietary pattern towards livestock, fisheries and horticultural products that they can afford due to rise in their incomes, life-style changes, urbanization, etc. Chapter 7 shows that this trend will continue in the future.

Several socio-economic factors have influenced the household level dietary diversification in the country. Household income, family size and urbanization are all positively related with dietary diversification (Chap. 4). Likewise, households with high non-farm income and better access to safe drinking water and sanitation consume more diverse diets. More diverse diets lead to a reduction in stunting and underweight among young children. Findings of this chapter show that Dalit and Janjati children are likely to be more stunted and underweight compared to children belonging to higher castes.

Food price inflation may lead to under-nourishment, as people increase the consumption of cereals and reduce the consumption of high-value commodities in response to high food prices. If higher food prices continue for long, the dietary pattern will shift towards cereal-dominated diet with consumers experiencing the deficit of quality food and nutrients in Nepal. High and sustained food prices also slow down or even reverse the progress made on poverty reduction as food accounts for a large share of household expenditure in the country (Chap. 5).

During the period of global food price crisis (mid-2008 to late 2009), food inflation surged to an average of 20% in the country. Since 2008, food inflation has become a more important contributor to the overall inflation than non-food inflation, which is in contrast to the 1992–2007 period when non-food inflation contributed more to the overall inflation average. Among the different food items, vegetable inflation was the highest (20%) during this period, followed by fruits (16%), pulses (13%) whereas cereals inflation was only 11%.

Policy implications/recommendations: In order to achieve self-reliance in food production, Nepal needs to make greater efforts to increase production through higher public investment in infrastructure (irrigation, rural roads, electrification, etc.) and rapid spread of modern technology with improved food production practices (Chap. 7). These policies will help in maintaining the balance between domestic production and increasing demand for food. Resources need to be augmented for investment in research, extension, infrastructure development and introducing new technologies.

The food basket in Nepal will continue to diversify with increasing consumption of milk, fruits, vegetables, meat, poultry products and fish. Consequently, the demand for horticultural, livestock, poultry and fishery products will rise considerably in the coming years. In view of this, the government should implement programmes to increase the production of high-value food in order to contain food price inflation. Higher food prices will have a negative effect on nutritional level, as consumers will shift from more nutritious food to cereals. Therefore, the government should re-think the current focus on cereals and should strengthen the policies to promote dietary diversity by promoting high-value agriculture (Chap. 4).

Given the close linkages of food markets in Nepal with those of India, Indian prices will continue to be one of the main drivers of price stability in Nepal as well as occasional surges, as documented in Chap. 5. On the positive side, pursuit of price stability has been a long-standing goal of Indian price policy and Nepal has benefitted from price stability in India including during the global food crisis in 2008. Although Nepal has limited ability to counter unwanted price ripples from India, there are a few measures that Nepal can take to contain food inflation. For example, the government can incentivize investments in cold storage and farm retail market infrastructure, given that vegetable prices have been the major contributor to food inflation (Chap. 5). Effective market information and early warning systems also help reduce price instability. There is a need for more data analysis on food prices to understand the drivers of occasional surges and slumps. Currently, official publications provide comprehensive data on inflation but they do little to analyze the data to identify drivers of price changes.

The government should implement policies to promote women's education, given the important role of mother's education in reducing stunting, wasting and underweight among children (Chap. 4). Also, policies in support of Dalits and Janjatis should be implemented, given that children belonging to these groups have higher likelihood of stunted and underweight children. The government should also help these people to earn income from diverse sources, given that households with higher share of non-farm income consume more diverse food.

4.2 Agricultural Diversification

Changes in food consumption pattern are important factors in stimulating agricultural diversification in Nepal. The changes in the share of different agricultural sub-sectors in the gross value of agricultural output show that agricultural diversification is taking place in Nepal. The share of food grains in AGDP declined from 36.4% in 2001 to 30% in 2015 (Chap. 12). In contrast, the combined share of horticultural crops (fruits and vegetables), cash crops, livestock and fisheries increased from 56.8 to 63.6% during this period. Impressive growth was recorded in the production of horticultural crops and fisheries. Although the overall share of livestock declined slightly, the production of chicken meat, cow milk and eggs grew rapidly. Similarly, the area under coffee, ginger, garlic, turmeric and chilly increased significantly during the same period.

Distinct agro-ecological zones with varied micro-climates offer good prospects for the production of such commodities in the country. There are also huge potentials for the export of such commodities to neighbouring countries and elsewhere in the world. However, there are many physical and institutional constraints to agricultural diversification. Rural infrastructure like roads, irrigation and rural electrification are poor. Although the majority of small farmers cannot take the risk of diversification, crop insurance coverage is still very low. Forward and back linkages with markets are weak. Research and extension supports are inadequate. Long-term credit is constrained for agro industries and crops/commodities with long gestation period. While there is shortage of labour in agriculture and land remains fallow in many areas, youth are not attracted to small-scale farming. There is lack of continuity in the government policy due to political instability. There is need for investments, but capital absorption capacity is eroding in public sector and monitoring is weak due lack of elected local bodies, etc.

Policy implications/recommendations. In order the accelerate the pace of agricultural diversification, the government needs to take measures including, policy and institutional reforms, establishing reliable linkages between the production of primary commodities and the agro-processing industries, development of infrastructure including accessibility for market linkages and adequate support for research and extension.

Support from multiple donors will be needed in strategic intervention areas like infrastructure development and policy reform. Co-ordination of donor support is not easy as realized from the APP experience. The implementation of ADS has been started and there is a need for intervention in key priority areas of commercialization and industrialization in agriculture. A pool based funding in key interventions in high priority national development agenda and joint monitoring will be more effective, as seen in some sectors.

In the context of strategic intervention for agricultural diversification, important areas for policy and programme support include improving infrastructure and market development, improving quality standards of agro products and facilitating certification, improving access of farmers and agro-entrepreneurs to longer-term credits, identifying constraints and implementing strategies for taking advantage of international trade opportunities, promoting institutional development for contract farming within the framework of existing property rights, enhancing linkages between commodity production and agro-industries, encouraging migrant returnees in commercial farming with appropriate support.

4.3 High-Value Chains

Despite the emphasis of the Nepal government's past agricultural development programmes on production support for farmers but inadequate support for post-production activities, high-value commodities such as coffee, tea, fresh vegetables, poultry, fruits, ginger, and cardamom have recorded a steady expansion in area and production. The value chain (VC) approach to agri-food industry development has been introduced by the government and development partners since early 2000, underscoring the importance of supporting all actors, including farmers and the private sector in agri-food chains (Chap. 16). The government acknowledges VC approach as a means to promote private sector development by increasing the efficiency and effectiveness of the existing food systems, improving collaborations among chain actors and enhancing the competitiveness of the value chains. The ADS (2015–2035) has identified VC development programme as one of the four flagship programmes in agriculture to drive commercialization of the sector.

Although agricultural projects funded by development partners are increasingly taking up the VC approaches, development programmes funded by the government's own resources are still taking conventional farmer-centred, production-oriented approach. This shows that barriers exist which constrain the government to fully translate VC experiences from the donor-funded projects into regular programmes. Inadequate human resources and research and extension capabilities both in the public and private sectors to support the value chain initiatives of the private sector is the critical barrier.

Available evidence reveals that VC development initiatives in Nepal have overly focused on the industry VC development and less emphasis has been given to promote the global VCs and enterprise VCs. The support from the government and development partners for VC development has not yet cascaded through to the private sector-led adoption.

Policy implications/recommendations. In Nepal, a shift is needed both at government and private sector levels to diversify the VC approach from the industry level to more micro level. This will not only encourage the private sector development but also will ensure government initiatives' focus on areas of high need and high impact. For this, complementarity between public and private sector is required. While the private sector can target high-value segments of the consumers, the public sector can continue servicing the rest of the actors and consumers. Public sector can also invest more in market research to generate adequate scientific knowledge about diversified markets and high-value consumers as an incentive to drive private sectors towards value chain integration and upgrading.

The private sector actors, who are capable and engaged in high-value agrifood commodities, should now step up to develop their own VCs and serve niche consumer segments. Allowing the actors capable enough to integrate into local or global VC in activities that only matters to the commodity markets is a missed opportunity. Private sector's increased participation in the domestic enterprise VCs would encourage VC orientation/thinking across the sector that may help to translate the practices and experiences into the global VC.

Current policies and programmes related to VC development in Nepal do not facilitate global VC integration. Therefore, a separate policy may be required with regard to global VC development for export-oriented commodities. Such a policy can utilize the Himalayan image of the country to promote natural and by default organic attributes of the Nepalese products. The policy on global VC should also be linked with developing intermodal freight hubs and upgrading strategic aerial connections with the countries/cities of global VC interest.

Since food safety and quality play an important role in the successful implementation of high-value products, effective collaboration should be promoted among actors from production through to consumption. Policies that promote and incentivize food safety and quality should be promoted to catalyze agrifood VC development.

4.4 Non-farm Diversification

4.4.1 NTFPs/MAPs/Agro-Forestry

In many remote areas of the country, NTFP/MAPs and agro-forestry products constitute an important source of income and employment for the poor. These products are also important export items. However, the development of this sector faces a number of hurdles. Due to unsustainable collection practices, many of the important and valuable MAPs are gradually disappearing from Nepalese forests. Non-compliance of the good agriculture cultivation practices (GACP) and good manufacturing practices (GMP) has also resulted in loss of international markets for Nepalese MAPs and essential oils. Similarly, high transaction costs in the domestic movement of these products due to formal and informal taxation systems is a major problem faced by traders and movers engaged in this sector. A major shortcoming regarding Nepal's inability to benefit the most from the NTFP/MAP/AFP sector has been the lack of transparency in government's enforcement mechanisms, lack of quality and standards in production system, inadequate value addition, and relying more on trade in raw materials than in finished products.

While there is an upward trend in the demand for natural food and medicine products and natural healing and health services, Nepal's production of medicinal products, organic food, essential oils and traditional health service growth is almost at a stagnant stage. Therefore, while it is essential to ensure the quality of its products to realize more benefits, it is also important to ensure a stable international market for these products to provide impetus to the domestic industry to utilize the country‘s NTFPs/MAPs optimally and turn them into high-value added products.

Policy recommendations: Nepal’s policy makers should recognize the need to conserve, sustainably use and responsibly commercialize the country’s rich terrestrial and agro-biodiversity resources. There is an urgent need to develop and enforce globally recognized guidelines on good agricultural and collection practices (GACP) in production and harvesting of all products in this sector. This will help ensure produce quality raw materials facilitating national, regional and global acceptance of Nepalese natural products.

Since the participation of local communities is essential in biodiversity conservation, different kinds of local stakeholder groups such as forest users’ federation (FECOFUN), NTFP/MAP commodity associations, entrepreneurs and community-based forestry enterprises engaged in local value addition and primary processing need to be vigorously supported and nurtured. This will ensure the institutional strengthening of the upstream producers, aggregators and processors on the MAP supply value chains and improve the monetary value of the entire PCMC and product value chains.

Proper development of instruments and mechanisms for financial support and technology transfer is critical since public investment in MAP conservation and poverty reduction is needed where private sector usually do not invest. In this context, the role of SAARC Development Fund (SFD), especially its social window should be tapped to fund national and regional MAPs projects. Such projects can generate new knowledge and promote exchange through research network eventually helping SARRC level trade and commerce.

4.4.2 Remittances

Financial and social remittances earned by migrants can increase household incomes through a more profitable agricultural system if remittances are invested in new technologies. Migrants can also contribute to agricultural development based on their experiences and exposure to new technologies abroad and they tend to be open to innovative ideas. Several studies conducted in different parts of Nepal have shown positive association between remittances and adoption of new technologies (Chap. 14). Remittances have helped farmers transform from subsistence crop-based farming to cash crops such as cardamom, vegetables as remittances act as a co-insurance against the risks of such a transition. Framers closer to market centres tended more to invest their remittances in small-scale commercial livestock than those further away.

Remittance receiving households were found to have invested in agricultural mechanization, particularly tractor use to overcome the labour shortage effect of out-migration. They also invest in pump irrigation, which allows them to grow two rice crops a year instead of only monsoon rice. There is also evidence of investment of remittances by migrants in small-scale commercial agriculture in peri-urban areas of Kathmandu and other accessible areas of the country. Migrants, who are their host countries had worked in agriculture, have brought back technologies used in these countries and have started their own commercial livestock and horticultural farming.

Policy implications/recommendations: Currently, only a small proportion of the remittances is being invested in sectors of the economy that can generate employment and income and thus contribute to the national economy. A key challenge for Nepal as a highly remittance-dependent and at the same time food-importing low-income agrarian economy is to attract productivity-enhancing investments into the farm sector. Developing appropriate strategies to facilitate such investments should be a high priority in the policy agenda of the government as well as for international development organizations and non-government organizations. One important measure would be to make migration more beneficial to the migrant households by reducing the cost of migration and increasing returns via skills trainings, so that the migrant households can save more and invest these savings in productive sectors, including agriculture sector.

Male out-migration changes the gender roles and responsibilities with women playing an increasingly important role in agriculture. Therefore, there is a need to promote technologies that mitigate women's work burden, as well as policies enhancing women's access to credit and production inputs.

5 Institutions and Governance

5.1 Agrarian Reform

Access to land is a major issue for many households in the country (Chap. 17). It is estimated that a quarter of total households in Nepal are landless and of the land-owning households, about 80% own less than 1 ha. Although land concentration has been declining over time, land distribution is still highly skewed. There are two important trends with respect to access to land—a secular decline in average farm size, and rapid growth in land fragmentation with increase in the number of holdings. Tenancy rights are very complicated in Nepal and are a major factor impacting productivity of land and social justice. Although the 1964 Land Act reserved the rights of the tenants, its 4th amendment in 1996 removed dual ownership over land. However, the tenants were not able to register their tenancy claims, as they were not aware of the new law. Those tenants, who have been registered, have also not received their share of land.

Because of migration and abandonment of land, the terms and conditions for renting land, whether sharecropping or fixed rent, have moved in favour of tenants. As a result, tenants are paying lower rents (produce or cash), and are also getting support from landowners in the form of seeds, fertilizer, other inputs and sharing of cost of land preparation. Because of these demands, some landowners have started to abandon the land. The fear that tenants will claim the tenancy rights is one of the reasons why landowners keep the land fallow if they cannot cultivate the land themselves. This has led to a decline in overall production, and it has prevented tenants from cultivating the land on rental basis.

The tendency to migrate for work is growing, especially from the lower middle class and middle class. As a result, availability of land for leasing/renting has increased and so is the relaxation in rental terms and conditions. This has helped to some extent the poor households who could not take benefits from the new opportunities like migration.

Small farmers in Nepal find it difficult to grow high-value crops and earn higher profits. They also have difficulty in adapting to climate-related risks and are more vulnerable to market price volatility and other risks.

Policy implications/recommendations: Lack of potential new land, cultivation of land by owners themselves in most cases, and smallholdings, and small number of absentee landlords mean that there is not much scope to gain from radical redistributive land reform in Nepal. Therefore, other ways to increase the access of poor and marginal farmers to land are to be found out. Possible measures include promoting tenancy reforms, land consolidation and enhancing access of the landless to public land including forests. A new policy on land tenure should be formulated—giving a higher share of production to tenants. Enhanced tenure security would make more land available for renting, as landowners would be willing to rent out land if they do not fear about tenants claiming the land ownership title.

In recent years, in many areas of rural Nepal, small farmers are renting out their land if their family members are in foreign employment, as they can cultivate the land due to labour shortages, etc. Medium farmers who are not able to access such foreign employment opportunities rent-in such land to expand their operations. This phenomenon has the potential of contributing to land consolidation and make farming an attractive business.

Potentials exist for the government to enhance the access of the landless and marginal farmers to land by expanding the access to common property resources such as forests and community grazing land. The leasehold forestry programme provides an example of innovative ways of enhancing access of the landless and marginal farmers to productive resources (Chap. 17). The leases give poor rural households long-term land tenure and along with it incentive to protect and manage the forest area and benefit in terms of improved livelihoods by raising small livestock and growing fodder crops. Marginalized groups such as indigenous peoples, women and Dalits have limited access to land. More favourable policies need to be implemented effectively to enhance their access to land.

5.2 Agricultural Credit and Insurance

Access to agricultural credit and insurance can increase agricultural productivity, minimize the negative impact of climate change and promote agriculture sector in developing resilience among the farming households to cope with shocks. In order to transform the agriculture sector as envisaged in different policy priorities including the ADS, investments in agriculture sector need to be increased significantly through innovative agricultural credit and insurance schemes.

Despite the efforts of the bank and financial institutions (BFIs), cooperatives, non-governmental organizations and other actors, only one-fifth of farm holdings in the country have access to agricultural credit, and this proportion has not changed between 1991/92 and 2011/12 (Chap. 18). The coverage of agricultural insurance is minimal in Nepal, as the agricultural insurance policy was introduced only three years ago.

Although the government has been providing subsidy on agricultural credit and insurance to expand outreach to smallholders, most credit schemes have not to enhance smallholders' ability to participate in high-value chains. Microfinance has proved to be a successful approach in the country in providing credit to rural poor mainly for non-agricultural activities. However, there are several challenges in designing financial products, which are suitable for farmers. Although BFIs' lending to agriculture is gradually increasing, there is a lack of appropriate farm-friendly policies and tools to facilitate graduation from subsistence to commercial farming. A major challenge is the inability to motivate commercial financing in pre-harvesting activities because of their perception of high default risks. Another important challenge has been to link increasing remittance flows in rural areas for agriculture and rural development by linking remittance receivers and senders with financial institutions.

Policy implications/recommendations: There is a need to encourage investments in pre-harvesting activities, which currently is not attractive to investors due to the higher risks involved as compared to post-harvesting, agro-processing and mechanization (Chap. 18). Such upstream investments in the value-chain also need innovative and well-conceived agribusiness plans that are attractive to financial institutions. However, attracting innovative entrepreneurship to the agriculture sector requires right efforts from the government and development partners to develop schemes for increasing investments. Such joint investments further motivate investments from the private sector and can go a long way in helping agribusiness entrepreneurs to benefit from reduced costs and increased productivity contributing to better economies of scale.

The coverage of agricultural insurance is minimal in Nepal. The Crop and Livestock Insurance Directives 2013 have opened the door to commercial insurers to start agricultural insurance schemes. The directive can be improved further for the effective implementation and monitoring of the scheme. There is no provision of obligation to commercial insurers to sell the minimum policies per year to socially backward and economically deprived community. The directives also need to cover the insurance schemes run by NGOs, cooperatives and other non-insurance institutions.

The insurance scheme, in the long run, can be an effective tool for poverty reduction and financial inclusion. Subsidy is essential for low-income groups in the long term but in the short run, most of the farmers need to be encouraged to participate in insurance through the incentives of certain percentage of premium subsidy.

5.3 Governance Related Opportunities

The armed conflict between 1996 and 2006 had enormous adverse effects on the agriculture sector through agricultural labour shortages due to large-scale out-migration from rural areas, land abandonment and reduced investment and economic activities in rural areas. The long political transition following the conflict led to political instability and poor implementation of policies and programmes including the long-term Agricultural Perspective Plan 1996. During this period, both public and private investment in agricultural declined.

The turbulent period of conflict and political transition is finally ending in the country with the gradual implementation of the new constitution, including the recent local level elections and forthcoming provincial and national level elections. The nascent political stability is presenting significant opportunities for higher public and private investment in the agriculture sector. The potential investment of increasing levels of remittances also represents a big potential for the agriculture sector, particularly in the area of high-value commodities.

Although local governments in Nepal suffer from low administrative capacity and other constraints, the country's long experience in local governance should help in adapting to the new federal structure. During the past decade, Nepal has institutionalized the fourteen point planning process, which has empowered citizens to participate in public fora on local development, to plan projects and to monitor their outcomes. This has enabled the local people to articulate demands for local agricultural development priorities. This was demonstrated by the highly participatory process followed in formulating the recent Agricultural Development Strategy.

6 Conclusions

In Nepal, agriculture sector's productivity growth is crucial for the overall GDP growth, as it is the largest sector of the economy. It is also well established that agriculture is important for poverty reduction in the country. However, agricultural productivity growth in the last two decades has been low and highly volatile from year to year. Many factors have contributed to the poor performance of agriculture, including inadequate delivery of technologies and support services to farmers, armed conflict, labour shortages in rural areas, political instability and limited investment in agriculture both from public and private sectors. As a result, Nepal's agriculture has become less competitive both in domestic and export markers. The country is increasingly becoming a net food importer, both of staples and high-value foods.

In order to address the long-term food and nutrition security challenge and to benefit from its comparative advantages, Nepal needs to adopt a *two-pronged approach*. The *first* would be to enhance the growth rate of domestic cereals production in order to reduce increasing dependence on imports. In order to increase food production to meet increasing demand, there is a need to increase public investment in infrastructure (irrigation, rural roads, electrification, etc.) and rapid spread of modern technology with improved food production practices.

In order to enhance the capacity of Nepal's agricultural research and extension system in delivering demand-driven technologies and extension services, the government's commitment to promote pluralism in agriculture research and extension with enabling policies, funding and capacity building is vital for sustainable impacts. Provincial governments should promote private extension service providers through capacity building and incentives to contribute in areas of commercial agriculture, inputs supply, agribusiness and industries where the clientele are willing to share the cost of services as well.

The *second* part of the strategy would be to promote agricultural diversification through the production of high-value commodities such as horticultural products, dairy and livestock products with the dual objectives of nutritional security and increasing farmers' incomes. In recent years, factors like rising incomes, urbanization and increasing demand for more nutritious food have led to an increasing consumption of such high-value commodities. This dietary diversification is having a positive impact in reducing malnutrition among children. Increasing demand for high-value commodities is also creating income-enhancing opportunities for farmers, including smallholders. In some of these commodities, the value chain approach to agri-food industry development has been introduced by the government and development partners, underscoring the importance of supporting all actors, including farmers and the private sector in agri-food chains.

In order the accelerate the pace of agricultural diversification, the government needs to provide policy support for improving infrastructure (markets, agro-processing facilities, etc.), improving quality standards of agro products and facilitating certification, improving access to longer-term credits, promoting institutional development for contract farming within the framework of property rights, enhancing linkages between commodity production and agro-industries and encouraging migrant returnees in commercial farming with appropriate support. A separate policy may be needed with regard to global VC development for export-oriented commodities. Such a policy should also be linked with developing intermodal freight hubs and upgrading strategic aerial connections with the countries/cities of global VC interest. Policies that promote and incentivize food safety and quality should also be developed to promote agrifood VC development.

NTFP/MAPs and agro-forestry products are an important source of income and employment for many smallholders and other rural poor in remote areas. They also constitute important export commodities of Nepal. In order to address the challenges that this sector faces, the government should promote good agricultural and collection practices in the production and harvest of these products; strengthen the participation of local communities in local value addition and primary processing and develop a transparent and functional regulatory mechanism that ensures sustainable extraction, biosafety, ethical trading, quality assurance and inclusive market-oriented development.

A key challenge for Nepal is to channel remittance flows for productivity-enhancing investments in agriculture and rural development, as only a small proportion of such flows is invested in productive sectors. It is also important to make migration more beneficial to the migrant households by reducing the cost of migration and increasing the returns via skills training. As male out-migration increases women's responsibilities and work burden, the government and development partners should promote technologies to mitigate women's burden as well as implement policies to enhance women's access to credit and production inputs.

Many smallholder farmers face constraints in accessing capital and markets, which limit their ability to climate-smart agricultural technologies and practices and raise their income. Hence, the government and development partners must provide support to small farmers to invest in climate-smart agricultural technologies and practices. In order to help farmers to cope with climate-related risks, it is important to implement policies that enhance the economic viability of smallholder farming. Such policies relate to the provision of credit and improvement of agricultural roads, irrigation channels and agricultural markets.

As the country moves towards a federal political system, there will both challenges and opportunities in governance. On the one hand, the country's small size and limited resources pose a number of challenges for its transition to a federal country. On the other hand, this institutional transition offers a unique opportunity to address existing weaknesses in the current policy process and institutional structure, including within the agriculture. It could be the case that agricultural productivity can be expedited by provincial and local governments who take greater ownership of public investments. On the other hand, fragmenting of jurisdictions, in the absence of cooperative federalism, could stunt prospects for attaining economies of scale and securing productivity gains in agriculture.

References

Booth, A. (2014). Before the big bang: Decentralization debate and practice in Indonesia, 1949-99. In H. Hill (Ed.), *Regional dynamics in a decentralized Indonesia*. Singapore: Institute of Southeast Asia Studies Publishing.

Government of Nepal (GON). (2015). *Agricultural development strategy 2015-2035*. Kathmandu, Nepal: Ministry of Agricultural Development.

World Bank. (2013). *Nepal: Poverty diagnostics: 1965-96 to 2010-11, bigger strides in post conflict poverty reduction? unpublished Manuscript*. Washington, DC: World Bank.

World Bank. (2017). *Nepal country economic memorandum—climbing higher: Toward a middle-income Nepal*. May 2017. Washington, DC: World Bank.