Chapter 1
Agriculture, Food, and Nutritional Security: An Overview

Rukhsana and Asraful Alam

Abstract Priority in developing countries is achieving food and nutritional security (FNS). A flexible global food system, and one of the critical routes to achieving better FNS, requires the reorganization of relevant policies. Among them, policies and strategies related to the creation and adaptation of technologies, innovations, and their associated institutional adjustments are significant factors to counteract the complex and growing challenges of the global food system. During the last decades, food and nutritional security (FNS) has developed greatly in practice. This overview provides some basic information about current understanding on agriculture, food, and nutritional security. It introduces the concepts of food and nutritional security and separately introduces the part of this book. It focuses on the overview of agriculture, food, and nutritional security worldwide, followed by a more detailed analysis along various dimensions of food security, such as food availability, food utilization, and sustainability in food supplies and access to food. This observation emphasizes the interdisciplinary nature of food insecurity concerns, which have to be addressed through an effective cross-sectoral approach.

Keywords Food and nutritional security · Developing countries and agriculture

1.1 Introduction

Agriculture plays a central role in food availability and accessibility, income, livelihoods, and sharing to the overall economy (World Bank 2007) and is thus a major factor in efforts to improve food and nutritional security. The development of the agricultural sector is particularly important for reducing poverty in developing

Rukhsana
Department of Geography, Aliah University, Kolkata, West Bengal, India

A. Alam (✉)
Department of Geography, Serampore Girls' College, University of Calcutta, Hooghly, West Bengal, India

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countries, where a large proportion of GDP is generated by small shareholders within the primary sector. For example, agricultural development has been shown to be four times more effective at reducing poverty relative to development in other regions, and increasing smallholder agricultural productivity has a positive impact on both urban and rural populations in three ways: for consumers, low food prices; for producers, high income; and for the rest of the economy, manifold increase in economic growth as a result of increased demand for other goods and services (FAO 2004). Agriculture is diverse and full of contradictions. In 2012, an estimated 1.3 billion (19%) of the world's 7.1 billion people were directly engaged in farming, but agriculture (including the relatively small hunting/fishing and forestry sectors) accounted for only 2.8% of total income (World Bank 2012). However, most farmers in the world today are to be found in middle- and low-income countries, where the agricultural income constitutes a large proportion of national income and employment.

The significant increase in global food production over the last four decades has been a major achievement, but they have also caused serious environmental problems. These contain the cumulative effects of salinization on land productivity and soil erosion, pesticide hazards and chemical fertilizer, desertification, and accelerated conversion of crops to nonagricultural uses. Large-scale industrial agriculture is also the cause of genetic degradation, species loss, and wildlife habitat erosion; over 4000 plant and animal species are endangered by agricultural intensification (FAO 2010). Improvement of the industrial livestock sector is an essential part of sustainable food security (FAO 2010). From various studies, it is found that much improvement has been made to minimize the poverty and hunger and to improve food and nutritional security. Improvement in productivity and technological advancement has shared to more efficient resource utilization and better food security. But major concerns remain. Seven hundred ninety-five million people still endure from hunger, and more than two billion people suffer from micronutrient deficiency. In addition, global food security may be threatened, due to increasing pressure on natural resources and climate change, both of which threaten the sustainability of large-scale food systems. If the current trend continues, planetary boundaries may cross well.

Despite the many successes of development worldwide, including major advances in food production, the persistence and scale of world hunger are astounding. As per latest State of Food Security and Nutrition in the World report (FAO 2019), more than 820 million people endure from daily hunger, and this number has been increasing gradually over the last 3 years. And nearly two billion people face some form of food insecurity—no access to safe, nutritious, and adequate food. Women, children, and indigenous groups are particularly vulnerable to starvation. Under nutrition, the world is also facing an increasing risk of overweight and obesity, growing rapidly in all world regions and assuming epidemic proportions. Hunger remains a silent emergency—drawing attention primarily when a large number of people die during a sensational and highly visible famine. In contrast, chronic hunger remains in the headlines. As the world struggles to accomplish better developmental outcomes in the face of climate disruption, the political, economic,

and social implications of this silent emergency are enormous. Hunger and food insecurity are the products of a complex set of factors, including climate-related triggers (such as droughts, floods, cyclones), often exacerbated by economic tightness and conflict.

Food security exists when all people, at all times, have physical and economic access to adequate, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life (1996 World Food Summit Plan of Action, UN FAO; FAO 1998). India can attain food security only through measured active steps with population of 1.35 billion. The United Nations Declaration of Human Rights states that "everyone has the right to an adequate standard of living for the health and well-being of himself and his family, including food" and mandatory food as a human right. A flexible global One of the important routes to achieving the food system and better food and nutritional security (FNS) is the need for recombination of relevant policies. Among them, policies related with the adoption, knowledge, creation, and adaptation of technologies and innovations (Juma and Yee-Cheong 2005) are key factors for countering the complex and developing challenges of the global food system.

Food and nutritional security is essential to leading a healthy and productive life and for socioeconomic development. The system of food production and consumption has wrought human society and the environment for millennia (Desor 2017). Food insecurity historically refers to a decrease in overall regional, national, or global food supplies compared to requirements. However, by some groups increasing inadequate food intake, the term has recently been applied at a local, household, community, or individual level (Foster 1992). In addition, the term has been used beyond the notion of food supply, which contains the elements of access (Sen 1981), vulnerability (Watts and Bohle 1993), and sustainability (Chambers 1989; Maxwell 1995).

Food security is attained when it is ensured that "all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life" (FAO 2000). Food is essential to maintain life and growth of people to drink and eat food which results; safe and clean water is a vital part of food commodities. The need to also include nutrition in food security developed over time. The focus of nutrition links care practices and aspects of health services and healthy environments to this definition and concept. It is intended to be more accurately termed "nutritional security," which can be defined as an adequate nutritional status in terms of protein, energy, vitamins, and minerals for all household members at all times (Quisumbing et al. 1995, 12).

The FAO estimates that a total of 925 million people were undernourished in 2010, compared to the 2009 figure of 1.023 billion. This decline is largely due to a more favorable economic environment in developing countries and a decline in both international and domestic food prices since 2008. However, 2010 estimates were higher than they were before the 2008–2009 food and economic crisis. In addition, the recent increase in food prices, if it persists, will create additional barriers to further reduce hunger. The fact that nearly a billion people are still hungry due to the

recent food and financial crisis largely points to a deep structural problem that confers the ability to achieve internationally agreed goals on hunger reduction and supports (FAO 2010).

Global FNS has a history of more than 50 years and has been developed through a sequence of definitions and paradigms including "Food for Development" in 1960, "Food Assurance" in 1970, "Broadened Food Security" in 1980, "Freedom from Hunger and Malnutrition" in 1990, and "Food and Nutrition for Poverty Reduction and Development" in 2000. The concept of "safe, adequate, and appropriate supply of food for all" was accepted internationally in Hot Spring Conference on Food and Agriculture in 1943, in which bilateral agencies from donor countries such as the United States or Canada Was made in the 1950s and abroad began to dispose of its agricultural surplus goods. In the 1960s, when it was accepted that food aid could be an obstacle to developing self-sufficiency, the concept of food for development was introduced and institutionalized. The creation of the World Food Programme (WFP) in 1963 is a prime example.

During 1972–1974, food crisis marked a dramatic turn from the previous era of food abundance of contributor countries to highly volatile food supplies and prices on the world market. As a result, food security insurance schemes that assured international access to physical food supplies were developed in the 1970s. Improved food safety assurance was to be achieved through better coordination between donor organizations and agencies and through food availability monitoring in recipient countries. In the 1980s, following the success of the Green Revolution, which helped increase food production (food availability), it was recognized that food emergencies and even famines were not the cause of the catastrophic shortages in food production, because there was a sharp decline in purchasing power. Therefore, food security was broadened to include both physical and economic access to food supplies. In this decade, the role of women in poverty alleviation and development was promoted. In the 1990s, concrete plans were defined to reduce at least hunger and malnutrition. In addition, the human right to adequate food and nutrition was reaffirmed internationally and by committed national governments to a more active role. Finally, international public support from donor agencies reduced food aid for crisis management and prevention. In the 2000s, the reduction of hunger and malnutrition has been seen in terms of overall development, poverty reduction, and attainment of the Millennium Development Goals (SCN 2004).

"Food and nutritional security is achieved if a person has enough food (quantity, quality, safety, socio-cultural acceptance) available and accessible at all times to lead a healthy and active life." This definition combines food and nutritional security and emphasizes many aspects, namely, availability, access, and use of food. Food security developed from the "Freedom from Hunger" in the 1940s to a broader concept in four dimensions including availability of food, accessibility to food, utilization, and stability. Nutritional security evolved in the 1970s from a "multisectoral nutrition planning" approach and UNICEF conceptual framework with three determinants, i.e., access to adequate food, hygiene and health, and care and feeding practices Marzella w. 2013.

Food security is the fundamental foundation of the right to adequate food, which was adopted by the Food and Agriculture Organization (FAO) Council in the 127th session held in November 2004. In that session, governments had agreed to some voluntary guidelines so that they could cooperate in this direction. For the recognition of the economic, social, and cultural rights to food and the right to food, it is recommended to pursue some practical work during the coming decade. In October 2012, the FAO's "Committee on World Food Security" endeavored to define food and nutritional security as the condition when all people at all times have physical, social, and economic access to food, safe and adequate, and it is supported by adequate sanitation, health services, and care environments, which allow for quality and to meet their dietary needs and food preferences to stay healthy and active (FAO 2012). Inadequate food insecurity is a condition where calorie intake is less than the minimum dietary energy requirement (Jones et al. 2013).

Nutritional security exists when food security, coupled with a hygienic environment, adequate health services, and proper care and feeding practices, ensures a healthy life for its household members (Shakir 2006a). The undernourishment measures aspects of food safety and is present when energy intake is less than the minimum dietary energy requirement, which is the amount of energy required for light activity and the minimum acceptable for attained height (Food and Agricultural Organization of The United Nations (FAO) 2009) is the weight. Although undernourishment is based on national-level data, it can be used as a substitute for food consumption in circumstances where regional- or household-level data is not available. It varies from country to country and year to year depending on the gender and age composition of the population. Undernutrition is present when inadequate food intake and repeated infections result in one or more of the following including low weight for age, low vision for age (blurred), thin for height (wasted), and vitamin-deficient and/or functionally deficient in minerals (micronutrient malnutrition). Malnutrition is a broad term that refers to poor nutrition in all forms. Malnutrition is caused by a complex collection of factors including dietary deficiency (deficiency in energy, protein, and micronutrients, overeating, or imbalanced eating), infection, and sociocultural factors. Malnutrition includes underweight as well as overweight and obesity (Shakir 2006a).

"Food security exists when all people, at all times, have physical and economic access to adequate and safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (World Food Summit 1996). There are four dimensions to food security: availability, access, utilization, and stability (FAO 2008b). Food availability refers to the physical availability of sufficient levels of food in a particular area. Cultural suitability of food is also an important aspect as dissimilar cultures have different food preferences (Jones et al. 2013; Hussain and Routray 2012). Access to food refers to physical and economic access to food. Food use refers to food quality, absorption, and safety, supported by a sufficient health status. Food availability, access, and use ensure food stability throughout the year and over a long period of time.

The concept of food security also needs to be unstated from both national and domestic standpoint. Although national food security is significant as providing a

basis, it cannot guarantee domestic food security. It is therefore important that every household and every member within it has safe, nutritionally sufficient, and culturally suitable food available (Gillespie and Mason 1991). Hunger and food insecurity may exist at the domestic level even when there is sufficient food at the national level. Food security is a multidimensional concept involving (a) physical availability, including food production, stocks, and reserves on multiple scales; (b) physical and economic access, which depends on purchasing power, income, food prices, transportation, and market infrastructure; (c) the use of food, or the ability to absorb nutrition according to health, dietary diversity, and intra-household distribution; and (d) timely food supply stability and accessibility in cases of weather variability, price fluctuations, and other transitory shocks or periodic stresses (FAO 2008a).

1.2 Climate and Agricultural Productivity

Agriculture is the economic sector most susceptible to climate change. Climate characteristics that have the most direct impact on agricultural productivity include increases in temperature, changes in frequency and intensity of rainfall, and extreme weather events and increased CO_2 levels available for photosynthesis. Agriculture mostly depends on climate change (Mendelsohn and Dinar 2009); the choice of the optimal crops and planting and harvesting times depends directly on the weather conditions prevailing in every region. The imminent climate change due to the increase in greenhouse gases will have a direct impact on agricultural productivity and production and, as a result, on farmers' incomes. Climate change is happening very fast; compared to the gradual change in temperature during the last ice age, it has been 5.0 °C lower in today's temperature (Duncan 2009). The predictions of the current century reflect the urgency of the case. Therefore, urgent actions are needed to mitigate the effects of climate change as well as the adoption of climate change mitigation measures by the agricultural sector.

Since climate affects production and current findings suggest that climate change can positively or negatively alter crop yields (IPCC 2007), it is not a big leap to hypothesize that increased productivity may be influenced by climate change. For example, climate change depicted in the IPCC (2007) is a possible explanation for the decline in the rate of increase in productivity of agriculture (Pardey et al. 2007).

According to the most widely considered climate change scenario (A2), as per recent estimate of the impact of climate change on agricultural productivity, global food production is not threatened by expected climate change, unlike previous forecasts (IPCC 2007). However, due to climate change, the regional agricultural productivity gap will increase the percentage of world population which will become more vulnerable to hunger. The recent estimates from the IPCC forecast state that there will be both positive and negative impacts in agricultural productivity based on climate change and type of farming (IPCC 2007). Thus, there will be different effects at regional, national, and international levels. However, losses in the arid tropical regions of the world can be expected through international trade (European

Commission 2009). Increasing atmospheric concentration of CO_2 will positively impact agricultural productivity (Taub 2010).

The growth rate of agricultural production is usually measured by the recital of food and non-food production. The agricultural product of food production from these two is more important for two reasons. First, it provides the basis for subsistence by offering basic foods, and second, it is the only cluster of agricultural produce where Green Revolution was first introduced. Its importance has also increased due to the establishment of the World Trade Organization (WTO) in 1995, and hence in the present study, we will focus our attention on production (Sharma 2005).

1.3 Changes and Trend of Cropping Pattern and Food Security

The concept of food security is based on three main pillars including availability of food, access to food, and sustainability of food. Agriculture is a creator of food using available natural resources, containing water, soil, and weather resources. Food production and availability, as well as reduced food insecurity, can be achieved by increasing the efficiency of using the said resources. To assist meet the world demand for food, many crops must be put into practice, namely, technology and gradual harvest. Intercropping technology can achieve all of the above benefits. In addition, a consistent crop production can have many benefits, such as improving and maintaining soil fertility, as well as increasing farmers' income (Sheha et al. 2014). Both solutions occur when land is limited; thus intensive harvesting can adequately utilize available water and labor (Gallaher 2009). Intercropping provides year-to-year ground cover, or at least longer than monoculture, to protect the soil from erosion (Gebru 2015). By growing more than one crop at a time on a single farm, farmers achieve maximum water use efficiency and maintain soil fertility, where the soil profile has high roots. In today's world, cereal grains have been considered a major component of the human diet for thousands of years and have played a vital role in shaping human civilization. Around the world, wheat, rice, and corn, and to a lesser extent, millet and sorbet, are important staples for the daily survival of millions. More than 50% of the world's daily calorie intake is taken directly from cereal consumption. Most grains used for human food are bran (pericarp), and some are milled to remove bran and germs, mainly to meet consumers' sensory expectations (Awika 2011).

Today, cereal grains are the most important source of calories for most of the world's population. Developing countries are more dependent on grain for needs than developed countries. Approximately 60% of calories in developing countries are derived directly from cereals, with more than 80% of the value in the poorest countries. In comparison, about 30% of calories in the developed world are derived directly from grains. However, even in these more wealthy societies that rely less on

direct grain consumption, grains are the most important foods, as they supply most of the nutrients for livestock that make up a large portion of the diet in these regions (Anon 2003). The three most important food crops in the world are rice, wheat, and maize (maize). These three cereal grains directly contribute more than half of all calories consumed by humans. In addition, other small grains such as sorghum and millet are major contributors to overall calorie intake in some regions of the world, particularly in the semiarid parts of Africa and India. For example, sorbet and millet contribute up to 85% of daily calories in Burkina Faso and Niger. A large part of cereal grain production (especially corn, barley, sorbet, and oats) also goes to livestock feeds, thus contributing indirectly to human nutrition (FAO 2014). The three most edible foods in the world are rice, wheat, and maize (maize) crops which directly share more than half of all calories consumed by people. In addition, other small grains such as sorghum and millet are major contributors to overall calorie intake in some regions of the world, particularly in the semiarid parts of Africa and India. A large part of cereal grain production (especially corn, barley, sorbet, and oats) also goes to livestock feeds, thus contributing indirectly to human nutrition (FAO 2014).

1.4 Food and Nutritional Security for Sustainable Development

Food security exists when all people, at all times, have physical and economic access to adequate, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life (FAO 1998). The World Food Summit, after much deliberation, promised to reduce the number of malnourished people during 1996, compared to 2015. Sixth report on humanity was "malnourished" by the United Nations Food and Agriculture Organization (UNFAO) on June 19, 2009, after 12 years (UNFAO 1999). Severe shortages in food supplies and huge increases in the prices of basic food items were identified as the primary cause of malnutrition (Timmer 2010). The final report released by UNFAO on the timeframe interval for achieving the Millennium Development Goals in 2015 indicated that the proportion of undernourished people in developing regions has fallen by almost half since 1990, down from 23.3% in 1990–1992 to 12.9% in 2014–2016 (UN Report 2015). Despite such a claim, the World Food Price Index was found to be higher from 201.4 in 2008 to 229.9 in 2011, and it was 163.5 in October 2018. Food prices remain volatile over the years, and India, the world's highest exporter of rice, grapples still with food insecurity (Pogge 2015). The promise made in 1996 has been resumed as one of the Sustainable Development Goals (SDGs) to be achieved by the year 2030 (UN 1996). New policies and regulatory measures were designed to achieve the goal of zero hunger. It is worth considering whether this goal-shifting will help solve the hunger problem or at least make it manageable for countries like India.

Despite numerous developmental successes around the world, including major strides in food production, the persistence and scale of world hunger are astonishing. According to the latest State of Food Security and Nutrition in the World report (FAO 2019), more than 820 million people suffer from daily hunger, and this number has been slowly increasing in the past 3 years. And almost two billion people face some form of food insecurity—i.e., without access to safe, nutritious, and sufficient food. Women, children, and indigenous groups remain particularly vulnerable to hunger. In addition to undernutrition, the world is also facing the growing threat of overweight and obesity, which continue to rise fast in all world regions and are assuming epidemic proportions. Increasing food production to meet growing demands is a major global challenge, particularly in a population-dense and poor South Asia, where smallholder agriculture is dominant (Fischer et al. 2009). Sustainable intensification has been widely proposed as an important agricultural development policy goal (Godfray et al. 2010). Availability, access, and adequacy are recurring concerns when developing policies to achieve "zero hunger." Climate change and land boundaries are also emerging as important factors that increase the problem of food insecurity globally. In particular, "[i] is likely to intensify the debate about the preservation of seeds and plant diversity due to food insecurity, which mandates licensing provisions used to provide access to life-saving drugs in developing countries Refuel for life" (Leidwein 2011).

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