Building Climate Resilient Agriculture and Enhancing Grassroot-Level Adaptive Capacity in the Semiarid Tropics of India: Indicative Policies for Action

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Abstract

Climate change has been recognized as a potential threat to livelihood of the poor farmers in the marginal agricultural productive environment especially in the semiarid tropics of India. The impacts may vary spatially, and the rural poor are more challenged of its impacts. Initiatives at national level are underway to address the consequences especially rural and agriculture. The research initiative coordinated by the International Crops Research Institute for the semiarid tropics (ICRISAT) tracked the climate change impacts, adaptation strategies, and constraints at the households' level through a rigorous quantitative and qualitative analysis in the semiarid tropics of India. This explorative exercise identified challenges and opportunities towards climate resilience through recommendations and policy directive for action. This chapter comprehends the policy needs that emerged from the regional study in identifying the impacts and constraints to effective adaptation by climate change. This evidence-based indicative policy stresses the need to channelize resources effectively in enhancing the grassroot-level resilience to climate change.

Keywords

Climate-resilient agriculture • Policies • Local-level adaptation • Resource management

Introduction

The 4th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) provides the latest situation and outlook on the science, impacts, and potential measures to address climate change (IPCC 2007). However, the state of knowledge available at the global level is far from being comprehensive and holistic. There has been a strong focus on the different scales of understanding beyond regional and subregional levels (INCCA 2010). In response to the growing awareness of governments worldwide, including those from developing countries, "early action" plans

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are expected to strengthen confidence, capacity, knowledge, and experience to focus on enhancing resilience of the system particularly local level agricultural production systems against climatic risks. The research agenda on enhancing climate resilience in agriculture with a considerable focus on the microlevel understanding of impacts, opportunities, and constraints are crucial.

The climate resilient agriculture should evolve from science-based solutions and pro-poor approaches that enable agricultural systems to effectively deal with the climate-related challenges so that the poor and the most vulnerable farmers in the semiarid regions are benefitted. Contributing to this global effort, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) together with five countries in Asia implemented a project entitled "Vulnerability to Climate Change: Adaptation Strategies and Layers of Resilience" supported by the Asian Development Bank (ADB). This research identified and prioritized regions most at risk and agricultural adaptation and mitigation strategies at microlevel as an integral part of agricultural development in the most vulnerable areas. Research activities were designed and undertaken with a goal to improve innovations in agricultural institutions, crop and resource management, social capital, and social networks (Adger 2003) in the target countries. The research activities generated valuable output in the form of useful information repository to inform policy decisions on critical issues affecting the future of agriculture and livelihoods in the target domain and valid information with policy and livelihood impacts. To achieve these impacts, the research activities should implement a robust approach with reliable and in-depth understanding with an optimal set of key information that should be undertaken. This will pitch for enhanced information from different components of analysis, argumentation, and advocacy (Adger and Vincent 2005; Kelly and Adger 2000).

Ensuring sufficient food for the ever-increasing global population through improved productivity and increased resource use efficiency continues to be a key challenge throughout this century. Since competition for natural resources like water and land is increasing, catapulted by the risks of climate-related impacts on agriculture, the challenge appears to be even more daunting (Shiferaw and Bantilan 2004). With the pressure to produce more from shrinking natural resources under climate uncertainties, the agricultural production systems are also to be environment friendly and climate neutral by minimizing carbon emissions. Indeed this is a daunting task. To achieve this task of paving the way for a "climate smart agriculture," several measures must be taken, including enabling policies, institutions and infrastructure in place, and farm communities better informed and empowered with necessary resources. As a response to impacts of climatic extremes and the initiatives to tackle the expected impacts, countries including India have come up with strategies and plans, e.g., India (NATCOM 2009; NAPCC 2008). However, these strategies and plans are not properly oriented to cater the regional or local specific needs that are critical to the agriculture and rural sector. In India, there are timely initiatives from the government understanding the magnitude of impact by climate change, for example, national communications to the UNFCCC, National Action Plan on Climate Change (NAPCC), and other related projects (Table 1).

The Government of India has several policy decisions on the anvil and enabled that reduce risks and enhance the adaptive capacity of the most vulnerable sectors and groups including that of farming community (Fig. 1). These efforts are primarily driven by the objective of sustainable livelihoods and poverty alleviation. According to the latest information on the governmental initiatives undertaken and/or already existing, those are primarily aimed to mainstream as adaptation components in the country. There exist seven major initiatives that include crop improvement and research, poverty alleviation and livelihood preservation, health improvement and prevention of diseases, forest conservation, disaster management, risk financing, and drought proofing and flood control. These initiatives have

Table 1 National initiatives on climate change resilience

Submitted first national communication to UNFCCC in 2004 and second national communication in 2012
National Action Plan on Climate Change (NAPCC) was released in 2008. It identifies eight missions in the area of solar energy, enhanced energy efficiency, sustainable agriculture, sustainable habitat, water, Himalayan ecosystem, increasing forest cover, and strategic knowledge on climate change
ICAR has launched a major project entitled National Initiative on Climate Resilient Agriculture (NICRA) during 2010–2011 in the 11th national plan in conjunction with the proposed NAPCC
To achieve coherence between strategies and action at national and state level. State-level action plan on climate change (SAPCC) was drafted to enable to address existing and future climate risks and vulnerability. 14 out of 28 states have drafted SAPCC, and further planning is underway towards implementation

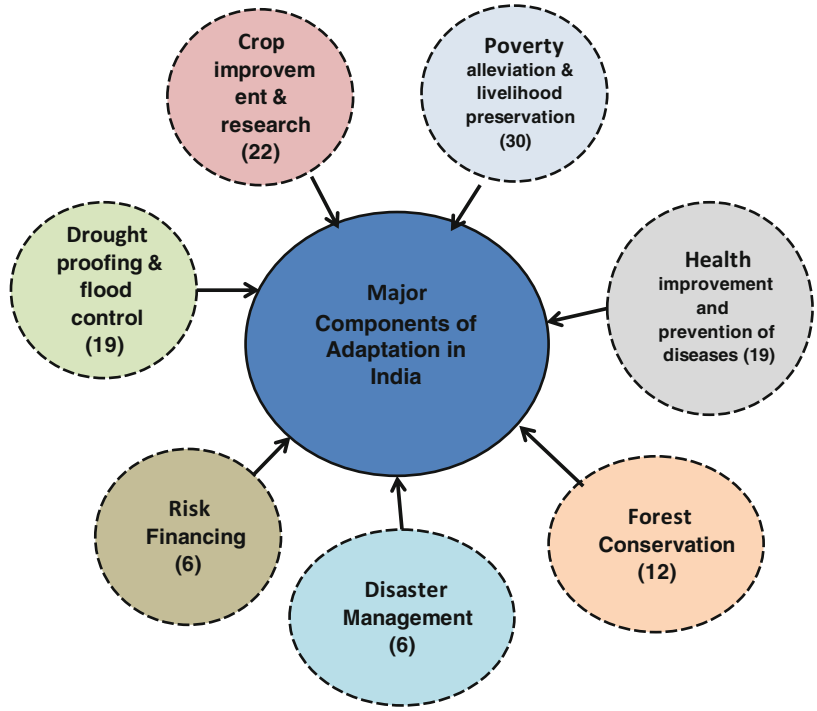

Fig. 1 Major components of adaptation planning in India (Source: GOI (2013). *Parenthesis indicates number of schemes identified under each category)

components of natural resource management, socioeconomic support program, agricultural development program, and other allied programs aimed for strengthening the adaptive capacity of farmers. In total, the schemes are around 100, and most of the schemes are in crop improvement and research and poverty alleviation and livelihood preservation.

The government schemes that currently exist target region/groups that are in need (Table 2). For example, for the agriculture sector, the currently existing schemes include drought proofing measures; promoting zero tillage practices; developing drought-resistant varieties; promoting crop diversification (Walker and Ryan 1990); promoting on-farm water-efficient technologies, farmer credit, and loan system to improve at local level; promoting national agricultural insurance scheme; and encouraging resource-conserving technologies (RCTs) for enhancing input use efficiency and crop productivity. Similarly, in the water resource sector, it includes integrated water resource management strategy, the national water policy, schemes for revival of diverse and community-based irrigation systems and soil and water conservation, managing drought through early warning, flood mapping, appropriate drought protection measures, and schemes for reducing the

Table 2 Major government initiatives and programs in agriculture and water resources sector in India

Agriculture	Water resources
Drought proofing measures	Integrated water resources management strategy
Promoting zero tillage practices	The National Water Policy (2002)
Developing drought-resistant varieties	Revival of diverse and community-based irrigation systems, soil and water conservation, etc.
Promoting crop diversification	Technological management of drought through early warning, flood mapping, etc.
Promoting on-farm water-efficient technologies	Appropriate drought protection measures
Farmer credit and loan system	Reducing the water requirement of crops and developing crops that are less dependent on water through application of biotechnology
Promoting the national agricultural insurance scheme	Encouraging resource-conserving technologies for crop production

Source: Ray (2010)

water requirement of crops that are less water dependent through application of biotechnology and other sophisticated sciences.

These programs are being implemented; however, how far these initiatives have real impact is always unrealized. Several studies including the one from our research stressed the need for a downstream approach to have maximum impact with greater efficiency.

Microlevel Constraints and Barriers to Adaptation

Studies on semiarid tropics of India as the domain conducted by ICRISAT were successful in augmenting improved understanding of the climate challenge influencing the changes in cropping patterns, crop yields, structures of income and employment, and adaptation-coping strategies of the rural poor in semiarid tropic (SAT) villages; the best practices and institutional innovations for mitigating the effects of climate change and other related shocks; and strategies to address socioeconomic problems relating to changing weather patterns and availability of a range of initiatives for their alleviation. Attempt was made to pull together the entire aspects for action. The following list is indicative and is neither exhaustive nor specific. The idea is to suggest policies/strategies to create an enabling environment for the farmers in SAT India to address climate variability-related socioeconomic problems. The illustrative policies are grouped into three subheads: (a) policies and strategies to minimize climate change impacts; (b) tools, technologies, and infrastructure for climate smart agriculture; and (c) financing and forging partnership for transformational change (Bantilan et al. 2012).

Policies and Strategies to Minimize Climate Change Impacts

It is very important that all initiatives to address adaptation and mitigation to climate change must be integrated with government policies that address agriculture, food production (Klein et al. 2005), and livelihood. This will ensure effective mainstreaming. The measures identified should be sustainable based on location specificity and adaptation gains:

- *Integration of climate change initiatives (such as NAPAs,[1] NAPCC,[2] NICRA,[3] NDMA,[4] etc.) with the national agricultural policies/programs (food security, disaster management, natural resource conservation technology adoption, livelihood enhancement, etc.) to*

[1] National Adaptation Programs of Action identifies priority activities that respond to their urgent and immediate needs to climate change by which further delay would increase vulnerability and/or costs in the future.

[2] National Action Plan on Climate Change.

[3] National Initiatives for Climate Resilient Agriculture.

[4] National Disaster Management Authority.

encourage rural communities to engage and adopt the proposed adaptation measures to address climate change impacts.

Response to climatic shock may not be efficient, but identifying these and work towards improving their capacity to adopt these during the time of climatic extremes (Eriksen et al. 2011). There is a need to implement measures that will enable farmers to invest in mitigation and adaptation measures (short duration varieties, soil and water conservation technologies, crop management practices, replenishing the feed, and fodder management). An example can be to encourage farmers by giving subsidies on interest on loans for implementing adaptation measures. Subsidized weather-based crop insurance crop insurance are a measure to tackle the climate risks associated with extreme weather events such as drought in the region. Development of strong collective initiatives such as cooperative movements will improve economic status and help in facing climate shocks.

- *Prioritizing regions of climate change vulnerability in arid and semiarid tropics; preparation and implementation of comprehensive district-wise (local level) agriculture and livelihood contingency plans*[5] *of actions for effectively managing the climate risk.*

From meso-level data analysis, the regions vulnerable to long-term climate change need to be identified. Regional crop-contingency plans, i.e., district-wise, which will be a response to anticipated climate change developed on an annual basis, with sufficient flexibility. In all study countries, regional-level plans exist, and identifying vulnerable sectors and regions is a prerequisite.

- *Encourage crop and livelihood diversification*[6] *and ensure rural income flow; managing the common property resources (ponds, wells, tanks, grazing land, etc.) judiciously by community participation enabling long-term sustainability.*

Increasing dry spells in the wet seasons, delayed monsoons, and other climate change-related effects require tailoring a location-specific cropping calendar and developing suitable crop management techniques through research and interaction with the farmers. The farming income is not considered sufficient to cover the increasing risks due to uncertainty and variability in rainfall and occurrences of extreme events like droughts, floods, etc. Farmers are increasingly looking for diversification to high-value crops and other income-generating enterprises from traditional agriculture to cushion the risk associated with agricultural production and income loss. Farmers need an enabling environment that creates or assists in innovation by the farmers to diversify their income sources. This could be achieved through rural developmental agencies. Hence, revamping of rural developmental agencies such as SFDA[7] and DRDA[8] focused towards small farmers in India, policies on sustainable development, livestock production, irrigation and fisheries, and aqua cultural development. In India, evoking the focus of these rural development agencies to farm and nonfarm evenly is a must.

- *Support to implement pasture conservation and better feed and fodder management*[9] *approaches for improved productivity of livestock, fisheries, poultry, and other enterprises.*

There is a need to improve feed and fodder management approaches to enhance fodder quality and availability for improved livestock productivity. Cereal-based systems particularly coarse cereals are slowly being replaced with other cash crops in villages of SAT India. As a result the availability of dry fodder to feed the

[5] Includes state-/district-level contingency plans, disaster management plans, and other reliefs.

[6] Enable opportunities to diversify more into high-value crops, livestock and other nonfarm income sources.

[7] Small Farmer Development Agency.

[8] District level Rural Development Agency.

[9] Programs/schemes on dairy development, development of small ruminants, fodder and feed development, livestock entrepreneur programs, etc. In India, the concerns of demand for fodder and pasture are on the 12th plan call for rehabilitation of pasture and fodder resource in the country.

livestock population has become an issue. Options for improved fodder management and availability will ensure a healthy development of livestock sector in the villages which will further help the farmers to diversify their income options. There are several livestock/poultry/fisheries programs at state/district/national level officially being implemented in the regions; however, the time has come to relook the impacts of these programs and policies on livelihood and ensuring better effectiveness and efficiency.

- *Ensure equitability in access of government support/relief programs such as Antyodaya*[10] *program, food security programs in India, etc. These programs focus on food security, agricultural and enterprise subsidies, rural finances, poverty reduction programs, technology adoption support, etc.*

All groups of farmers must be able to get loans under easy conditions. This will enable small and disadvantaged farmers to implement adaptation measures to address climate change. This is true only if there is no recurrence of drought in this period. In reality droughts recur in the time span, and many of these farmers fall into perpetual debt traps. Access to finance on easy terms and highly subsidized interest will help them come out of the debts.

Support in terms of subsidies must be given for choosing adaptation measures and innovative technologies to address climate change impacts as well as productivity-improving measures of watersheds, integrated water, and nutrient management options for efficient use of resources like land, water, etc., as well as any other inputs. This is mainly because farmers in vulnerable areas do not have any social safety nets and require support to sustain and continue crop production. Easy access to support mechanisms like government interventions in terms of knowledge flow and/or financing options might help.

- *Strengthen and empower the final beneficiary, i.e., farmers, to make them meaningful partners. Supplement their traditional/experiential knowledge with valid scientific knowhow and technology options, engage them more meaningfully in climate information management systems, provide incentives to farmers to adopt natural resource conservation measures, and support to improve the existing indigenous technologies that are eco-friendly.*

Although the farmers had a wealth of information and experience in dealing with climate change variability and the harsh realities of moisture stress, they were still lacking in knowledge on accessing information and taking optimum use of services provided by the governments. Often they are unaware of their entitlements, reliefs on offer, and other government support programs and thus fall prey to ignorance and consequences of extreme climate conditions. In vulnerable areas, farmers also lacked social capital and the organizational capabilities. They are often passive suppliers of information to the state and research establishments, but not integrated as valuable and active stakeholders in the climate change debates or intervention programs. The concept of "climate change schools" could have sufficient potential for sharing information and knowledge (indigenous knowledge). The weather data collected at local levels once synthesized centrally must go back to the farmers as useful outputs, so that they can and are assisted to make effective use of inferences drawn. The study also calls for strengthening extension program and institutionalizing effective mechanism of information dissemination through Agricultural Technology Centre (KVK,[11] ATMAs[12] in India) in every block/mandal/sub-country level.

- *Prioritize investment in training officials, extension, and local development workers to make them more effective change agents in assisting farmers and strengthening*

[10] Schemes under the program included land allotment, agriculture and land development, animal husbandry, village and cottage industries, wage employment, old age pension, housing subsidy, etc.

[11] Krishi Vigyan Kendra is a district-level institution engaged in transfer of latest agricultural technologies to the end users for bridging the gap between production and productivity.

[12] Agricultural Technology Management Agencies addresses the constraints faced by extension system.

institutions to improve climate adaptation capacity at local levels.

Officials responsible for the farmers' socio-economic well-being may be educated on climate change and mitigation through a series of awareness programs. Such programs may be conducted at the village level, and required incentives need to be provided. To illustrate, it is observed that the common property resources (CPRs) like grazing lands have degraded over the last several decades due to lack of collective action in managing them. It will be appropriate for extension officials to educate the farmers on low moisture availability in their ecosystem and ways to mitigate. It is essential to emphasize on capacity building for the government employees dealing with farmers problems in particular and agriculture in general. The lack of needed competitiveness in understanding climate change-related implications and experience is highly recommended for the region. Moreover, various stakeholders involved in nation building through agriculture development are not well aware about global policies, decisions, and other related information.

Tools, Technologies, and Infrastructure for "Climate Smart Agriculture"

- *Increasing the density of weather observatories, establishing rain gauges at village level, and enabling access and efficient management of weather-related information (remote sensing and GIS) and repository.*

Weather especially rainfall is variable across the regions. Analysis of single-station data may not represent the accurate climate resources. Microlevel weather data analysis showed a decreasing trend in the rainfall compared to the positive trends at a district level. This feature was observed in two selective project locations in India. Village-level rainfall observations are important in characterizing the environment at microlevel. Therefore, there is a need to increase the density of network of weather stations for better interpretation of variability of weather parameters and for accurate planning for improved and sustainable agricultural production. Droughts and flash floods are common in the Asian countries. In the event of increased frequencies of extreme weather events, agricultural production gets affected considerably. The best way to reduce the impact is to prepare the farmer well in advance to manage the situation in order to minimize the losses. Weather-based agro-advisories benefit the farming community in ensuring effective agricultural operations. In spite of best efforts to alert the farmers, extreme weather events often cause huge losses subjecting the farmer to extreme hardships. To save the farmer from the weather hazards, weather insurance is quite beneficial. To cope with disasters such as typhoons, flash foods, or droughts, identification of geographical boundaries for such events followed by preparation of regional crop-contingency plans must be put in place. These will form ready-reckoners to meet out any eventuality. They should be prepared to meet out the year-to-year variability. Modern tools such as "remote sensing and GIS" should provide an excellent opportunity to analyze spatial land use and land cover changes to climate change. There have been initiatives[13] from the government on this front in the study countries to improve the infrastructure and database on climate information and to use advanced methods.

- *Institutionalize continuous mechanism to collect and collate microlevel information (climate, crops, socioeconomic, natural resources, etc.) and efficiently transmit to be used as an input in formalizing macro-level policies.*

Most of the macro-level policies are formulated with inputs from aggregated level. The aggregated information and existing microlevel information could be highly diverse. There is a pressing need of having microlevel information on climate, crops, socioeconomics, natural resources, governance, trends, efficiencies, etc., especially in the context of

[13] In India, the Indian Meteorological Department (IMD) and the Allied Department are greatly involved in enhancing weather information by improving weather station density across the country.

climate change issues. Microlevel information needs to be collected and collated to be accessed and used by various national/regional, governmental/nongovernmental, and other developmental agencies for efficient planning.

- *Blending of farmers' traditional/indigenous knowledge on resource conservation, coping strategies, etc., with advanced technological interventions (varieties, crop management, community resource conservation, rainwater harvesting, storage, etc.) for coping against climate change and associated stress.*

Farmers have inherited the knowledge of managing and understanding the climate through their ancestors. Hence, there is a need to utilize this ancient wisdom[14] along with modern knowhow. For effective utilization of the modern technologies, combining traditional knowledge may improve the reliability and acceptability.

- *Encourage investment in research and development of locally adaptable crops, management practices, input sources, etc., decision support systems (DSS), and models for analyzing the impacts of climate change and mitigation strategies in the semiarid tropics in view of future climate scenarios.*

With the changes in and increasing variability of weather patterns, and introduction of new crops and varieties, the pest and disease behavior is likely to be altered in any given location. There is a need to identify such location and crop-specific pest and disease incidence and approaches to manage such situations that developed. For example, in Maharashtra (India), introduction of sugarcane in Shirapur and soybean in Kanzara and improved and short duration pigeon pea in Kalman villages brought in new diseases and pests that needed different management practices from the normal. Improved on-farm water harvesting and water conservation measures are useful in rainfed agriculture; similarly, improved technologies like drip irrigation and precision timing of irrigation will reduce the risk associated with the variability of rainfall (Rockstrom et al. 2010; Lundqvist and Falkenmark 2010; Barron et al. 2010). Incorporating organic matter or mulching to increase the water holding capacity of soils, in situ water storage using different devices is a time-tested measure adopted by farmers in cover cropping, mulching, composting, etc. The different techniques adopted by farmers in the region provide an array of options for field validation in other countries and subsequent adoption.

- *Encourage adoption of location-specific conservation techniques (cover cropping, in situ moisture conservation, rainwater harvesting, groundwater recharge techniques, locally adapted cropping mixture, etc.) for water-efficient agriculture and demonstration of these available technologies[15] in the farmers' field.*

Incentives or support must be given for choosing adaptation measures and innovative technologies to address climate change impacts as well as productivity-improving measures for efficient use of resources like land, water, etc. as well as any other inputs. For example, modern technology and external support by government in India helped the farmers in many villages to harvest groundwater through agro wells and tube wells. In the recent decades, there has been a rapid, uncontrolled expansion in the number of tube wells in many villages resulting in the receding of the groundwater table. Such "tragedy of the commons" should be avoided through collective action, regulation by external agencies, or systems of incentives and disincentives. The ground situation is sometimes aggravated due to low levels of education of farmers. Thus improving the knowledge of farmers may be a first step before adopting other measures. This calls for sensitivity to local socioeconomic contexts when addressing mitigatory measures.

- *Managing climate risks effectively through weather-based agro-advisories and*

[14] On weather prediction, water conservation and storage, and cultivation practices, viz., organic farming, natural pesticides, etc.

[15] Support in soil and water conservation, soil health, irrigation, fertilizer, etc.

developing equally accessible innovative weather insurance products.[16]

In the event of increased frequencies of extreme weather events, agricultural production gets affected considerably. The best way to reduce the impact is to prepare the farmer well in advance to manage the situation in order to minimize the losses. Weather-based agro-advisories come in a big way to benefit the farming community on timely agricultural operations. In spite of the best efforts to alert the farmers, extreme weather events often cause huge losses subjecting the farmer to extreme hardships, and weather insurance can be an effective strategy to offset the losses. In order to prepare the weather insurance products for different agro-climatic regions, research efforts on crop-weather relations need to be strengthened.

- *Harnessing nonconventional energy*[17] *sources in agriculture and other allied sectors.*

The use of nonconventional sources of energy, such as biofuels, solar energy, and wind power in agricultural operations, is very limited where there are more effective state interventions, with high levels of adoption in the rural area. In order to reduce the GHG emissions from the different sources, more research is required to estimate the emission levels and on measures to restore the balance.

Financing and Partnerships for Transformational Change

- *Enabling environment to attract public and private finances to invest in "climate smart agriculture"*

Increasing the level of state financing for promoting climate smart agriculture is a priority, considering the long-term goals of minimizing food insecurity, reducing carbon emissions, and mitigating climate change effects. Public investment in the field of agriculture research and development must be increased. The focus should be to invest in tools and technologies as well as policies. For example, the National Initiative for Climate Resilient Agriculture (NICRA) is a major research and capacity-building national project launched by the Government of India and ICAR to develop location-specific tools and technologies and capacity building.

- *Encouraging the role of the nongovernmental organizations and public and philanthropic organizations for enhancing adaptation preparedness among the local community*

Along with the government efforts, NGOs are also important for the development of the rural community. There is a need to generate partnerships between public funding and financing from foundations and charitable private institutions for investment into smart agriculture promotion (Vermeulen et al. 2012; Vogel et al. 2007). Many NGO and other research organizations funded by various societies and trusts have been doing commendable job in various sectors. Their involvement in conducting research to manage climate change threats may be encouraged, and enabling environment must be created.

- *Forging international/regional partnerships for developing tools and technologies adaptable to suit local requirement through pooling finance and intellectual resources*

International partnerships among neighboring countries that share similar ecosystems as well as similar agricultural practices might be useful in sharing financial and intellectual resources to develop appropriate adaptation tools and technologies.[18] The technologies generated at

[16] Weather-based insurance schemes, government support through subsidies on premium. When weather indices differ from the guaranteed indices of major crops, a payment equal to the deviation/shortfall is payable to all insured farmers.

[17] The progressing demand and initiatives by the respective governments are existing. These are well highlighted in the related policies and strategies, national action plans, etc.

[18] Drought, flood and salt tolerance varieties, robust methodologies to predict climate change impacts, resource conservation technologies, innovative safety nets, etc.

various locations in the world may be collected and identified for its suitability to other regions. The SAARC[19] is a potential platform for cooperation and exchange of tools, technologies, skills, finance, and other related resources to combat climate change and enhance resilience in India.

Conclusion

Future adaptation and/or agriculture policies should explicitly draw on the evidence-based grassroots level insights and should create enabling environment overcoming the constraints at the grassroots. In order to design efficient and effective adaptation and mitigation strategies, there is a prior need to know the impacts of climate change and locate existing knowledge on climate change, including local practices and indigenous knowledge. The overarching recommendation is to diagnose and understand farmers' adaptation strategies to climate variability and change with special focus on the dynamics of adaptations, implying search for and promoting approaches and options to harness the opportunities in the changing economic, technological, and institutional opportunities at microlevel, which should even exceed what farmers have been practicing in the subsistence-oriented, locally focused contexts in the present. Dynamism, diversity, and flexibility are essential for enhancement and reorientation of the capacities of the farmers and fostering enabling environment among the rural communities, though institutional arrangements and innovations are in dire need. Future policies and actions should be devised from evidence-based information on climate change impacts and implication at the household and community level.

[19] South Asian Association for Regional Cooperation (SAARC) with an objective of providing promotion of economic and social progress and cultural development within the South Asia region.

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