Azadi Ka Amrit Mahotsav

POLICY BRIEF 48

Managing Climate Risks in Indian Agriculture What do We Need to Know?

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Climate change, in its extreme forms like droughts, floods, cyclones, heat waves, and cold waves, has considerable potential to damage agricultural productivity and food supplies, especially in tropical developing countries[1]. In India, between 1901 and 2018, the average surface temperature rose by 0.7°C. By the end of the twenty-first century, the average surface temperature under the intermediate greenhouse gas emission scenario RCP4.5 is likely to be 2.4°C higher than its average for 1976-2005. The quantum of rainfall may not change much, but its distributional pattern is likely to alter significantly. The rising temperature will be accompanied by the increasing frequency and intensity of extreme climatic events.

These plausible future climate scenarios forewarn us that climate change, in the absence of appropriate mitigation and adaptation strategies, will severely impact agricultural productivity and food supplies, which, in turn, will exacerbate the problems of food insecurity, malnutrition, and hunger.

Some Stylized Facts[2]

- In the past four decades, in India, the frequency of climatic shocks, i.e., droughts, floods, heat waves, and cold waves, has increased considerably, slowing down the productivity growth of agriculture by about one-fourth.
- Different climatic shocks differentially impact agricultural productivity growth. Droughts cause more damage to it, followed by heat waves, floods, and cold waves.
- Climate change disproportionally affects the populations and geographies. The poor and agrarian states are more affected by climate change.
- Agricultural activities, including the farming of crops, animals, and fishes, respond differently to a climatic shock or different climatic shocks because of the differences in their inherent genetic potential to withstand climate stress.
- The adverse effect of climatic shocks on agricultural productivity growth has accentuated, despite the use of mitigation and adaptation measures.
- Farmers face multiple climate risks, and many times more than one risk simultaneously; hence they also use more than one mitigation/ adaptation measure at a time.

What do We Need to Know?

Climate Change Impacts

- Most assessments of climate change impacts have centered on staple foodgrains, ignoring high-value crops (vegetables, fruits, spices,

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[1] Ortiz-Bobea, A., Ault, T.R., Carrillo, C.M., Chambers, R.G., & Lobell, D.B. (2021). Anthropogenic climate change has slowed global agricultural productivity growth. Nature Climate Change 11, 306–312. https://doi.org/10.1038/s41558-021-01000-1.

[2] Birthal, P.S., Hazrana, J., Negi, D.S., & Bhan, S.C. (2021). Climate change and land-use in Indian agriculture. Land Use Policy 109, https://doi.org/10.1016/j.landusepol.2021.105652.

plantations and flowers), animal husbandry, poultry, and aquaculture. Currently, high-value commodities account for about 55% of the value of agricultural output and contribute significantly to farmers' incomes and agricultural growth, and to the reduction in rural poverty, inequality, and malnutrition.

- Climate change predictions suggest no significant change in the quantum of rainfall but a shift in its temporal and spatial distribution. However, our understanding of the impacts of the timings of precipitation, say deviation in the arrival of monsoon at a location from its expected arrival date or the concentration of heavy rains on a few days, on the crop yields is imperfect. Alternatively, not much is known 'how the early-, mid-, and late-season droughts impact the crop performance'. Similarly, the heat stress has emerged a significant threat to agriculture, especially the post-rainy season crops, but there is a lack of evidence on its impact at different crop growth stages.

- India receives around 85% of its annual rainfall from the southwest monsoon, extending from June to September. Farmers in several parts of the country grow crops on residual soil moisture on account of the receding monsoon. Yet, we know little about the impact of the receding monsoon on the yields of post-rainy season crops.

- Quality of the natural resources, i.e., soils and groundwater, does matter in shaping the impacts of climate change. But, our understanding of how the quality of natural resources moderates the harmful effects of climate change on agricultural productivity is limited.

- In predicting the impacts of climate change on agricultural production, it is often assumed that the existing cropping patterns will persist in the future too. This is a restrictive assumption. Crops differ in their water and temperature requirements and, therefore, in their responses to climate change. The possibility of a change in their comparative advantage, in terms of yields and profits, due to the changes in climate, consumption patterns, and government policies (e.g., input subsidy and output price support) cannot be ruled out. From the perspective of crop planning, it is imperative to know how the climate change will influence the intra-regional and inter-regional shifts in the cropping patterns.

- Climate change impacts have been studied mainly upstream of the supply chain. While the probability of transmission of its impact downstream the chain is quite significant. Put it differently, risks upstream of the chain can significantly influence the efficiency and sustainability of chain segments. Volatility in domestic supplies, exports, and consumer prices reflects such a transmission. However, our understanding of the process of risk transmission along the supply chain, and its economic impacts on different chain activities is imperfect.

- Climate variables are often spatially dependent, meaning climate change at a location, besides impacting the performance of agriculture and its social and economic outcomes at that location, may also affect its performance and outcomes in the neighborhood through the spatial spillovers. Our understanding of the cross-border effects of climate change on agriculture, agricultural supply chains, prices, food security, poverty, and nutrition is extremely limited.

Risk Management Strategies

- Farmers, based on the past anomalies in rainfall and temperature, use several traditional mitigation and adaptation measures to avoid the harmful effects of climatic shocks on agriculture. The role of such measures in mitigating risks is well documented[3], but the empirical evidence of their impacts on crop choices and crop yields is insufficient to draw creditable conclusions

[3] Jodha, N.S., Singh, N.P., & Bantilan, M.C.S. (2012). Enhancing Farmers' Adaptation to Climate Change in Arid and Semi-Arid Agriculture of India: Evidences from Indigenous Practices. Working Paper Series No. 32, International Crops Research Institute for the Semi-Arid Tropics, Patancheru 502 324, Andhra Pradesh, India.

regarding their mainstreaming in the agricultural development agenda.

- Farmers face multiple risks; and they adopt several measures for their mitigation. Climate-smart agriculture is now a buzzword in the literature, suggesting a blending of the scientific innovations with mitigation and adaptation measures that farmers have been following traditionally. It is argued that combining the modern and traditional mitigation, coping, and transfer measures can charter a sustainable path for agricultural development. However, little is known about the costs and benefits of implementing different adaptation measures. Essentially, the question that merits attention is: Does the joint adoption of modern and traditional risk management practices provide a higher payoff than any of the measures implemented in isolation?

- How do risk-coping measures from outside agriculture influence farmers' risk management decisions? Examples include the subsidized foodgrains from the Public Distribution System (PDS) and the guaranteed wage employment under the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA). These programs are being implemented on a large scale to help rural people smoothen their consumption. Nonetheless, such programs can positively or negatively influence the adoption of risk management strategies. Still, there is little empirical evidence of their influence on farmers' risk behavior, i.e., adoption of risk management strategies and their impacts on agricultural productivity.

- Over time, there has been a significant expansion of infrastructure for generating climate data, their compilation, collation, and processing for weather forecasts, and delivery of agro-met services. Nonetheless, little is known about their uptake by farmers and their impact on agricultural performance.

- Crop insurance is an essential means to manage production risk. However, its uptake remains low because of several social, personal, behavioral, economic, and institutional factors. A farmer will adopt insurance if he expects to be better off. And at the same time, he also evaluates the gains from its adoption relative to other mitigating strategies like crop diversification, stress-tolerant seeds, and supplemental irrigation. However, there is little evidence of the net benefits of crop insurance vis-à-vis other adaptation measures.

- India has considerable heterogeneity in agro-climatic conditions, giving rise to significant differences in cropping patterns and crop yields, farmers' exposure to risks, and risk management strategies. Therefore, there is a need for understanding risks and their management strategies across the agro-ecological landscape.

Policies and Institutions

- There is a disconnect between macro-economic policies and ground realities, leading to an imperfect understanding of the nature and intensity of risk, risk transmission mechanisms from upstream to downstream of the agricultural supply chains, and the efforts required at different administrative or geographical levels, from households to state, in implementing the risk management strategies[4]. Coordination among different organizations at different administrative levels may empower farming communities and local institutions in adaptation planning and implementation; improve their adaptive capacity through an enhanced flow of technical information and finances; and improve accountability of the decision-makers at different administrative levels.

- The Central and State governments have been implementing several agricultural and rural development programs through their various ministries and departments. Many of these,

[4] Birthal, P.S., Hazrana, J. & Negi, D.S. (2019). A multilevel analysis of drought risk in India agriculture: Implications for managing risk at different geographical levels. Climatic Change 157, 499-513.

directly or indirectly, are related to climate change adaptation and mitigation[5]. But, there is a lack of synergy among different organizations for adaptation planning and implementation, leading to a thin spread of financial, technical, and human resources; hence poor returns on the investment. How can different programs being implemented by different agencies be mainstreamed in agricultural risk management planning? Can a convergence among different departments lead to higher resource use efficiency or saving of resources?

- Credit, by alleviating the liquidity constraints on the investment and purchase of inputs by farmers, can play an important role in improving the productivity of agriculture and its resilience to climate change. Evidence indicates that credit helps preserve agricultural productivity[6]. It is, therefore, essential to identify the channels through which credit influences the resilience of agriculture. It is also important to know about the synergy between the long-term credit for capital expenses and the short-term credit for operational costs. Given the predictions of a growing climate crisis, the need for adaptation finance cannot be undermined.

- Agricultural research plays a crucial role in sustainable improvements in agricultural productivity. Evidence indicates attractive rates of returns on the investment in breeding for climate resilience[7]. India's agricultural research system has traditionally emphasized breeding for higher yields, ignoring their stability traits. Emerging changes in climate demand a re-orientation of the agricultural research agenda, emphasizing conservation of natural resources and breeding for stress tolerance. The stress-tolerant seeds act as insurance. These are easy to produce, multiply and distribute, are less costly than several other adaptation measures, for example, irrigation, and relieve pressure on the scarce water resources.

Conclusion

Climate change is now a reality, significantly impacting the agriculture and agriculture-based livelihood of millions of smallholders that dominate Indian agriculture. A sound understanding of the likely changes in climate and their impacts on different agricultural activities, especially high-value crops, animal husbandry, poultry, and aquaculture, across the agro-ecological landscape; and of the risk-mitigating potential of existing and potential adaptation measures in terms of their economic feasibility, is critical to:

- designing contemporary risk management strategies encompassing scientific innovations and traditional adaptation measures,

- strengthening coordination of local institutions with higher administrative levels for a better flow of technical and financial resources for regional and local adaptation planning and implementation, and

- improving accountability of the decision-makers at different administrative layers.

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[5] Singh, N.P., Anand, B., Singh, S., & Khan, A. (2019). Mainstreaming climate adaptation in Indian rural development agenda: a micro-macro convergence. Climate Risk Management 24, 30-41.

[6] Narayanan, S. (2016). The productivity of agricultural credit in India. Agricultural Economics 47 (4), 399-409.

[7] Mottaleb, K.A., Rejesus, R.M, Mohanty, S. & Li, Tao. (2017). Benefits of the development and dissemination of climate-smart rice: Ex ante impact assessment of drought-tolerant rice in South Asia. Mitigation and Adaptation Strategies for Global Change 22, 879-901.

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