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Climate Change and Risk Management in Indian Agriculture

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Introduction

Climate change has emerged as a big threat to the sustainable development of agriculture, food and nutrition security, and livelihoods of millions of smallholder farmers. An increase of 1.5°C in the temperature is predicted to severely affect crop yields and food supplies, human and animal health, and ecosystem services. Towards the end of this century, India's surface temperature under the moderate greenhouse representative concentration pathway (RCP) 4.5 is expected to increase by 1.57°C over its level in 2019.

In this background, a paper on "Climate Change and Risk Management in Indian Agriculture" has been published under the *'Research and Policy series'* which analyses different approaches used for estimation and predictions of climate change impact on various crops for different time periods, geographies, crop seasons and climatic conditions majorly in terms of yield loss. Further, the study analyses how different management strategies such as crop diversification, irrigation, stress-tolerant seeds, agronomic management, crop insurance, social safety nets, etc, reduces the risk and sensitivity to climate change. It identifies several research gaps that must be addressed considering the predicted rise in the frequency of extreme climate events in plausible future climatic scenarios. At the end, the study gives a way forward for designing and implementing effective policies in making agriculture resilient to climate change.

II. Major Findings

1. From 1950 to 2010, India's average surface temperature increased by 0.11°C per decade, and it is predicted to increase further in the plausible future climate scenarios. Even under the RCP 4.51 — the moderate greenhouse concentration pathway — by 2099, India's average surface temperature is expected to be 1.57°C higher over its current level (i.e., in 2019), and under the RCP 8.5, it will be higher by 4.36°C .
2. Series of experiments demonstrated that climate change negatively impacted yields of most field crops. By 2040, under the RCP4.5, the yield of wheat is expected to be 9% less, irrigated rice 12%, maize 18%, mustard 12% and potato 13%. In addition, a 1.0°C rise in the mean temperature could reduce wheat, soybean, mustard, groundnut, and potato yields in the range of 3% to 7%. By 2099, if the mean temperature were to rise by 2.5°C-4.9°C, the damages would be in the range of 10%-40%. However, studies have also come out with evidence of mixed impact of climate change on crop yields depending on the geographical locations.
3. In India, more than two-thirds of the geographical area is exposed to droughts, with a probability of 35% occurrence at the national level, varying from 20% in the dry-humid regions to 40% or more in the arid regions. A 10-days delay in the onset of monsoon from its normal date of arrival could potentially reduce yields of rainy season crops by 1.6%-5%, and of post-rainy season crops by 1.1%-1.9%.
4. Studies have reported a substantial reduction in the household income and consumption expenditure due to the negative rainfall shocks. In India, in a drought year, the household income was less by 25%-60%, and the head-count poverty was higher by 12%-33%.
5. Climate change impacts animal husbandry, directly as well as indirectly. According to an estimate, by 2050 the climate change may reduce India's milk production by 15 million tonnes. In the Trans and Upper Gangetic plains, the heat stress would cause a loss of milk production worth Rs.24 billion by 2039. Poultry production is also highly vulnerable to heat stress and an increase in temperature from 31.6°C to 37.9°C would decrease feed consumption by 36% and egg production by 7.5%.
6. As per the study done by Birthal et al. (2021), risk mitigation is widely adopted strategy — more than three-fourths of the farm households adopts it and is followed by risk coping (34%) and risk transfer (10%) strategies. Among risk mitigation strategies, the most common is the ownership of livestock, with 62% of households adopting this approach, while owning non-farm businesses and cultivating horticultural crops are also utilized, albeit by relatively smaller proportions at 5.35% and 31.27%, respectively. In terms of risk coping strategies, guaranteed employment through MGNREGA is embraced by

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13% of households, and remittances, out-migration, and livestock sales are used by smaller percentages of households, ranging from 4.26% to 10.61%.

III. Policy Implications

1. There is a critical need for enhanced coordination and decentralisation of administrative management. To effectively address climate risks, policies should prioritize improving local capacity through information and resource transfer, empowering communities and local governments in adaptation planning, fostering mechanisms for information sharing among decision-makers at various levels, and ensuring greater accountability of local decision-makers to their constituents. Additionally, the involvement of village-level institutions, such as panchayats, is crucial for effective coordination and successful implementation of climate adaptation initiatives, bridging the gap between macro-level policies and micro-level realities.
2. Emphasis should also be given on coordinated approach across various government ministries and departments. With numerous schemes related to climate change adaptation, pooling finances and resources can enhance efficiency, sustainability, and inclusiveness. For example, integrating the efforts of schemes like MGNREGA with climate adaptation options presents an opportunity to harness complementarities and maximize the impact of these programmes, ultimately leading to more effective climate resilience and rural development.
3. There is need for enhancing farmers' access to credit to manage production risks and adopt climate-smart practices. To achieve this, public policies should promote the integration of climate-smart principles into agricultural policies. This can involve providing subsidized and collateral-free loans to small-scale producers contingent upon the implementation of climate-smart agricultural practices. Customized climate financial products should be developed to cater to the specific needs of farmers, incentivizing investments in on-farm infrastructure and technologies that enhance climate resilience in the agri-food system.
4. Agriculture research agenda needs to be re-oriented to prioritize breeding stress-tolerant crop varieties and climate-smart practices. To achieve this, several policy initiatives need to be taken up.
    a. There is a need for increased financial allocation to agricultural research considering the attractive returns on investment in developing climate-resilient technologies. Currently, agricultural research in India is underinvested, receiving only 0.4% of agricultural GVA, which falls significantly short of the levels seen in developed countries (2%-2.5%).
    b. Initiatives like the National Innovations on Climate Resilient Agriculture (NICRA) have demonstrated success in evolving climate-resilient technologies, but there's a clear need for scaling up technology demonstrations to address the emerging threats of climate change in agriculture.
    c. There is limited understanding of climate change effects on high-value agriculture and insufficient research on the influence of changing rainfall patterns, heat stress, and natural resource quality. Additionally, the potential shifts in crop preferences and land use under future climate scenarios need to be adequately explored.
    d. There is a notable lack of research on the downstream transmission of climate risks in agricultural supply chains, hindering comprehensive strategies for managing these challenges.
5. Information and communication technology (ICT) would be playing an important role in enhancing climate resilience for farmers in rural India. With 277 million internet users in rural areas and 20 million subscribers to SMS advisories, there is a significant opportunity to leverage ICT for disseminating weather forecasts and climate-smart practices. Notably, the adoption of agromet services has the potential to reduce cultivation costs by approximately 25% and increase net returns by 83%. To capitalize on this, fostering public-private partnerships to create localized digital platforms for climate services and advisories is essential. These platforms should prioritize improved context-specific content and timely delivery to effectively address the needs of farmers in the face of climate change.

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