

Institutional Policy Framework to Mitigate the Climate Change Risks in Agriculture: A Study in Cooch Behar District, West Bengal

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Abstract

Agriculture is facing many challenges as a result of climate change, particularly in less developed areas such as Cooch Behar District (West Bengal). This study assesses the current institutional and policy environment for mitigating climate-related agricultural risk. Specifically, the study looks at the impact of flooding, waterlogging, erratic rainfall and soils on agriculture and rural livelihoods. Agricultural risk mitigation strategies have been established at both the national and state levels (e.g. through national/state agricultural policies, irrigation schemes, crop insurance and climate resilient agricultural programmes). However, due to poor coordination, limited awareness, inadequate extension support and lack of access to finance or technology, many of these initiatives have been ineffective. Local institutions are critical in facilitating linkages between farmers and government assistance, and include Panchayati Raj Institutions, cooperatives and self-help/self-directed groups. This study recommends that institutions be strengthened, that greater emphasis be placed on coordination and cooperation, and that climate-smart agricultural practices be promoted to support sustainable development. Ultimately, an inclusive policy environment is needed in order to build resilience in agriculture and support rural livelihoods.

Keywords: Climate Change, Agriculture, Policy Framework, Climate-Smart Agriculture.

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INTRODUCTION

One of the biggest environmental challenges facing the planet is climate change; this is one of the most significant global issues affecting the environment and will have considerable effects on agricultural systems, especially in developing countries such as India. Agriculture has many links with climate variables (e.g., precipitation, temperature). Therefore, agricultural production is highly sensitive to climate changes, such as temperature variations, changes in precipitation patterns and an increase in extreme weather events (e.g., floods, droughts, cyclones), all of which present increasing risks to agricultural productivity, food security and rural livelihoods (IPCC, 2022; FAO, 2016). Agricultural systems predominantly provide livelihoods for smallholders and marginal farmers who typically have limited capacity to adapt to these climate change impacts and will be especially hard hit (Morton, 2007; Hallegatte *et al*, 2016). In the specific case of India, the vulnerability

of agricultural systems to climate change will be heightened by their dependence on the monsoon and high prevalence of rain-fed systems. Research has already shown that agriculture has been affected by climate variability through significant decreases in yields, lack of water for crop irrigation and decreasing soil fertility across different agro-climatic zones in India (Lobell *et al*, 2011; MoEFCC, 2014). The eastern region of India, including the state of West Bengal, is highly prone to flooding, riverbank erosion, and waterlogging, making it more prone to the impacts of climate changes. Within the eastern region of India is Cooch Behar District, which is located in the floodplain of three major river systems (Torsa, Dharla and Teesta) and is highly sensitive to climate; farmers in this district suffer from disruptions to farming operations due to climatic stresses, crop damage and loss of livelihood on a frequent basis (Ghosh & Mistri, 2020).

The Growing challenges of climate change have made it increasingly important to establish Institutional and policy frameworks that will shape climate resilient development of agriculture. At the national level, the Government of India has begun many Policy initiatives aimed at enhancing adaptive capacity through Climate Resilient Technologies and promoting sustainable resource management, among other things; this includes the NAPCC and also the NMSA (Government of India, 2008; Ministry of Agriculture and Farmers Welfare, 2018). The national policies outline how to incorporate and promote Climate Change Adaptation into Agricultural Planning (i.e.; crop diversification, efficient use of water, improved soil health). At the state level, West Bengal has developed the SAPCC, which outlines the Strategies and Actions for Mitigation of Climate Change Risks affecting agriculture. The SAPCC has been designed to enhance agricultural productivity through sustainable agricultural practices and initiatives, strengthen Irrigation Infrastructure and provide access to Climate Information Services (Government of West Bengal, 2012). Productivity has seen major increases through resilient agricultural practices. Resilient areas experience greater yield stability and higher beneficial results, while marginalized areas are more affected by climate. Several centrally-sponsored schemes complement these policies by providing additional Support and Resources to Farmers; some examples include PMKSY and PMFBY which are intended to Improve the Efficiency of Water Use and Offer Financial Protection to Farmers for Crop Losses (Reddy *et al.*, 2016).

According to multiple studies there are numerous policies in place as well as programs that provide assistance, but many of these continue to be ineffective. Reasons for this include institutional fragmentation or difficulties coordinating between agencies. Farmers often don't have the extension services available to allow them to do so or do not understand what is available (Birkmann *et al.*, 2013 & Agrawal, 2008). The use of top-down policy interventions does not afford enough consideration to either socio-economic conditions or ecology, leading to a lack of relevance at a grassroots level (Meadowcroft, 2009). At the same time as we have mentioned beforehand, local institutions provide a link between creating policies and implementing those policies on the ground. Institutions such as Panchayati Raj Institutions (PRIs) and Agricultural Extension Services, cooperatives and self-help groups are essential in disseminating information, providing access to resources and helping to create or promote adaptive practices for farmers. With sufficient institutional support; farmers have a much greater ability to respond to climate change and develop sustainable agricultural practices (Smit & Wandel, 2006 & Agrawal & Perrin, 2009). In places like Cooch Behar District where there is the continued use of these institutions; they will be key in addressing localised climate challenges and creating resilient agricultural systems.

With agriculture being increasingly vulnerable to the impacts of climate change and the importance of institutions and policies to deal with the impact of climate change risks; it is timely and necessary for a focused study of the Institutional and Policy Framework (IPF) in Cooch Behar District. This type of study will give a comprehensive view of how policies at the national and state level are implemented at the district level; the gaps in coordination within institutions; and assess how effective current interventions have been. In addition, it will provide insight into the role of local government, stakeholder engagement, and policy integration in the creation of climate-resilient agricultural economies. Thus, this study will examine the IPF to see how it affects climate change risks within the agricultural sector; specifically in relation to Cooch Behar District. By assessing how IPF interacts with policy efforts, institutional mechanisms and the realities of local communities, the study will help shape a more coherent, integrated, and effective strategy for climate-resilient agricultural development in vulnerable areas. As such, the IPF provides the foundational basis of mitigation and adaptation strategies for climate change in the agricultural sector, particularly in vulnerable areas such as the Cooch Behar District. Given that Cooch Behar District is highly affected by floods, unpredictable precipitation patterns and saline-affected Soil; institutions from local governing bodies to federal agencies and policy instruments have a crucial role to play in promoting climate-resilient agricultural development. The subsequent sections of this report will provide an analytical perspective of the major functions performed by the IPF, using supporting academic references.

OBJECTIVES OF THE STUDY

This research explores how the framework of institutions and policies can limit agricultural risks associated with climate change at the Cooch Behar District in West Bengal. There are several objectives for conducting this research:

1. To review the existing institutional structures those have been created to decrease the risk of climate change in the agricultural sector.
2. To evaluate the effectiveness of policy implementation at the grassroots level through looking at outreach, access, and farmer participation.

RESEARCH METHODOLOGY

1. Research Methodology: The study is designed to collect descriptive and analytical data regarding the policies and institutions that have been established to address climate change risk through agriculture. This includes examining the policy framework in order to understand both its structure and the functionality of the policy at the community level.

2. Location: Cooch Behar District in West Bengal includes extensive areas of agriculture that experience frequent flooding, water logging and have significant soil moisture and erosion problems. These factors make the Cooch Behar District an appropriate study area for the research.

3. Data Collection: a) Primary Data: Primary data is collected through the use of a field survey with structured questionnaires administered to farmers in Cooch Behar District. In addition, interviews and discussions are conducted with agricultural officers, extension workers, and representatives from Panchayati Raj Institutions to develop an understanding of the functioning of the institution in order to better understand the context of the research study. b) Secondary Data: Secondary data is obtained from sources such as government reports, research reports, and national and international publications in order to understand the broader context and policy framework for the study.

4. Sampling: A multistage sampling method will be used to select the research participants. A list of blocks and villages will be generated from the census data to identify possible blocks and villages to survey. Random sampling will be used to select the farmers, with emphasis on small and marginal farmers because they represent populations most vulnerable to the risks of climate change.

5. Data Collection Tools: The research collected data through the use of structured questionnaires, interview schedules, and focus group discussions, which provided data that could be analyzed quantitatively with respect to institutional support for climate-resilient agriculture and qualitatively with respect to awareness of climate change policy and local adaptation. Each of these tools provided the research with information that could be analyzed to provide farm-level information on farmers' responses to these factors.

6. Analytical Techniques: The quantitative data that were obtained by these three tools were analyzed using a range of descriptive statistical techniques (i.e., percentages, averages), examining these farmers' responses. The qualitative data that were obtained from these tools were analyzed using two approaches i.e., thematic and comparative approaches.

7. Framework of Analysis: The analysis of the data collected from tools mentioned above was based on the following four elements of institutional policy: 1) Policy formulation; 2) Institutional coordination; 3) Access to services; and 4) Adoption of climate-resilient agricultural practices. This framework provided the research with a comprehensive understanding of how policies and institutions operate at the local level.

RESULTS AND DISCUSSION



Figure I: Conceptual Framework

Explanation of Framework from Fig.-I: The article's structural framework outlines how climate change-related risk and response mechanisms connect or work together among agricultural systems, policy, and institutions. The initial development of this framework identifies the major climate variables that are considered stressors to agricultural productivity, including temperature variability, unpredictable rainfall, floods, and droughts. These stressors contribute to the agricultural outcome of crop yield, economic stability, and overall food security for the farmers that produce food for the population. After identifying the climate risks impacting agriculture at the farm level, the next aspect of this framework integrates the response of institutional, policy, and governmental entities to climate-related risk through their respective institutional mechanisms, including governmental agencies, local governmental bodies, and agricultural extension services. Policy mechanisms (both national and state level) are identified as the tools that provide guidance for adaptation and mitigation initiatives for the agricultural industry. Important types of interventions include irrigation programs, crop insurance policies, climate-resilient seed programs, and technology transfer initiatives. The framework depicts the interaction of institutions and farmers as a reciprocal or bi-directional relationship where effectiveness is determined by the level of awareness, access to, and the degree of implementation of these mechanisms. Socio-economic characteristics such as educational attainment, landholding size, and available resources influence how farmers respond to climate-related risk. The framework also highlights the use of feedback loops, where the outcomes of policy interventions and institutional entities are used to modify future policies and strengthen institutional effectiveness. Ultimately, the framework presents a comprehensive model that links together the relationship between climate change-related risk, the agricultural effects of climate change on farmers, the agricultural institutions supporting farmers' success, and the agricultural policy actions necessary for achieving sustainable agricultural resilience among the most vulnerable populations across all of the geographic regions of the world.

INSTITUTIONAL POLICY FRAMEWORK

1. Formulation of Policy and Strategically Planning: Climate adaptation policies must be formulated at both national and state levels in order to integrate climate change into agricultural planning; Examples include Climate-Smart Agriculture (CSA) policies which seek to improve productivity/resilience/mitigative outcomes within a single policy framework. These policies provide guidelines for adapting farm systems to climate variability along with ensuring food security (Khan *et al.*, 2022). The policy initiatives in West Bengal regarding irrigation schemes and climate resilient agricultural programs exemplify the requirement of coordination to achieve planned targets. Through effective coordination of these policy initiatives, resources can be allocated

appropriately and sustainably utilized, while also promoting diversification of crops that are best suited to typical agronomic and climatic conditions.

2. Coordination and Governances among

Institutions: Properly coordinating between multiple institutions is vital when mitigating the effects of climate-related risks; institutions such as governmental agencies, research institutes, extension service organizations and local self governing bodies each play unique roles that must work in conjunction in order for them to fulfill their respective mandates effectively and efficiently. Institutional frameworks will provide a mechanism for vertical (i.e., national - state - district) and horizontal (i.e., intra-departmental) coordination to improve harmonization of policy implementation and procedures used to deliver services to relevant stakeholders. Research has shown that effective institutional arrangements will enhance the adoption of climate-smart technologies by providing greater access to information and service delivery through enhanced knowledge dissemination (Patra & Babu, 2023). For example, in Cooch Behar, effective coordination among Panchayat Raj Institutions (PRIs), departments of agriculture and climate-related agencies is required for localized planning and execution of these climate-smart technologies.

3. Climate-Smart Agriculture (CSA) Promotion:

Institutions play an important role in promoting Climate-Smart Agricultural (CSA) methods through the provision of sustainable agriculture programs. CSA has 3 main goals: 1. Improving Productivity, 2. Building Resilience, and 3. Decreasing Greenhouse Gases (Drishti IAS, 2023). Institutions facilitate the dissemination of best practices by providing support for: • Climate-Resilient Crops • Conservation Agriculture • Integrated Agricultural Systems • Agro-Forestry and Water Conservation. In West Bengal, the use of Krishi Vigyan Kendras (KVKs) and Climate-Smart Agricultural (CSA) Village Models are also helping to transfer these technologies to the farmers.

4. Capacity Building and Agricultural Extension:

Extension Services and Capacity Building programs are other important functions of the institutional framework of agricultural development. Extension institutions serve as intermediaries between research agencies and farmers; therefore they facilitate the transfer of knowledge, skills and/or innovations to farmers. Evidence-based research demonstrates that farmers who have access to extension services also have an increased likelihood of adopting climate-resilient technologies (Kumar *et al.*, 2022). Extension training programs, farmer field schools and public education programs assist farmers in understanding climate-related risks and the type of adaptation methods to adopt. In Cooch Behar District and similar locations, there is a need to strengthen public extension systems to address issues related to low levels

of awareness, traditional farming practices and limited access to scientific information.

5. Financial Support, Credit Access, and Subsidy Mechanisms: Financial support, including loans, grants and insurance, through public and private financial institutions and policies are essential in providing the credit, grants and insurance mechanisms to farmers. Some climate-resilient technologies require significant amounts of capital to implement; therefore, the vast majority of small and marginal farmers would not be able to afford them without the assistance of an institution. Research has shown that the availability of loans, grants and financial incentives play a significant role in farmers adopting CSA technologies (Kumar *et al.*, 2022). Institutional innovations such as streamlined loan delivery systems, and micro-finance systems provide a farmer with the ability to invest in climate-resilient agriculture. In Cooch Behar, a flood-prone area in India, the establishment and implementation of risk mitigation instruments such as crop insurance and disaster compensation systems have provided farmers with ways to protect themselves from financial losses due to extreme weather events.

6. Research/Innovation/Technology Development: There are many institutions engaged in the development of climate-resilient agricultural technologies and practices, including agricultural universities, agricultural research institutes and innovation/technology/knowledge transfer institutions. These climate-resilient technologies/practices include drought-tolerant seed varieties, flood-tolerant seed varieties, and precision agriculture technologies. Through pilot studies, field demonstrations, and public private partnerships, policy frameworks have created structures to facilitate the practice of implementing the results from research in a practical activity. Technological innovations such as GIS, remote sensing, and AI decision-support systems are becoming more widely used to improve adaptive capacity for climate-smart agriculture.

7. Infrastructure Development & Resource Management: The role of institutional policies in the construction of rural infrastructure required for climate-resilient agriculture is critical. Agricultural infrastructure includes but is not limited to irrigation systems, drainage networks, storage facilities, and transport networks. Areas prone to flooding or waterlogging (e.g., Cooch Behar) must invest in irrigation and drainage infrastructure to limit crop losses and stabilize agricultural production. Additionally, policies that promote water efficiency (e.g., micro-irrigation and rainwater harvesting) support enhancements to the resilience of agriculture (Khan *et al.*, 2022).

8. Regulatory/Environmental Governance: The institutional framework fulfills regulatory functions by regulating land use, water management, and chemical

inputs through the enforcement of environmental laws and standards. Environmental regulations deter resource degradation while enforcing sustainable farming practices. Examples of policies that promote climate-resilient agriculture include reduced application of synthetic fertilizers, increased sustainable agriculture via organic methods, and conservation of biodiversity through institutional measures that promote compliance at all levels of government.

9. Risk Management/Disaster Preparedness: It is the role of institutions to develop early warning systems, disaster preparedness plans, and contingency plans to manage climate-related risks (floods, droughts, and cyclones). In Cooch Behar, an area frequently impacted by flooding, institutional forecasting and delivery of real-time advisories and emergency response assistance for farmers are key factors in managing crop loss. Early warning systems also allow farmers to make strategic decisions about how and when to plant their crops or irrigate them based upon the weather.

10. Inclusion, Community Participation and Social Support: An institutional framework's primary function is to promote inclusive development through the active participation of local communities, marginal farmers and other vulnerable groups in decision-making processes. Participatory methods of developing climate adaptation strategies can improve and enhance their effectiveness, as well as their sustainability. Local institutional arrangements such as Panchayats (village councils) and farmer cooperatives play a vital role in enhancing the ability of local people to adapt to climate change by providing opportunities for the sharing of information and knowledge, and for working collaboratively with others. By developing and implementing policies which are inclusive, all individuals will have an equal opportunity to access resources, technology and financial assistance, thus improving their ability to withstand climate change at the grassroots level.

11. Monitoring, Evaluating and Providing Policy Feedback: Institutions of all types have responsibilities to monitor and evaluate the efficacy of climate-related policies and programs at all levels. Monitoring and evaluation provide for constant assessment of gaps in implementation, tracking achievement of intended outcomes and ensuring that policy design is sound and evidence-based. In providing for evidence-based policy development, adaptation strategies will remain responsive and adaptable as the climate continues to change. Through effective feedback mechanisms, policy-makers will be better able to adjust programmes in order to achieve more positive results over time (Patra & Babu, 2023).

LIMITATIONS OF THE STUDY

1. Limits on geography – The results of the study are based on the information collected from the Cooch Behar District, and the research findings represent only this

geographical area with no expectation that they can be generalized to other geographical areas that have different agroclimatic conditions than those in the Cooch Behar District.

2. Limits on data availability - Our ability to have reliable and updated data at the district level is limited, which will negatively impact how well we can analyze the research findings.

3. Sample size and representation issues - Due to time and other constraints, the size of our samples, which constitute the population of farmer respondents, was limited; therefore we do not have enough samples to adequately represent all categories of farmers.

4. Recall Bias - Most of the data collected from farmer respondents are based on their own past experiences and memories; therefore, it is possible that the answers provided will contain recall bias.

5. Barriers to accessing institutional records - Lack of access to some government personnel and institutional records will limit how much detail we can provide about the implementation process of policies.

6. Dynamic nature of climate change – Climate change is a dynamic force, and as a result, the consequences of this phenomenon will continue to evolve and may evolve different once and in ways beyond the scope of the research study.

7. Measurement problems in assessing the effectiveness of policies implemented – Our research does not provide adequate measures of the real successes of the political scientists and policymakers implementing the policies analyzed in our research because we do not have a means of measuring what the success or effectiveness of the implemented policy is.

CONCLUSION

Various institutions work together to help farmers deal with climate change-related challenges and risks in agriculture. These include developing favorable policies, organizing the different agencies working together on climate change, providing access to financial resources, developing new technologies, developing systems and infrastructure to help farmers adapt to climate change, and providing opportunities for the community to participate in climate resilience building. In Cooch Behar (a district with a high probability of natural disasters), the success of farmers' ability to adapt to climate change depends on the effectiveness of the institutional and policy framework. Therefore, improving institutional capacity, improving policy coherence, and implementing more farmer-focused interventions will be important to improve Cooch Behar's agricultural system's resilience.

The findings clearly demonstrate that many of the policies intended to support farmer adaptation are limited by the institutional and organizational constraints of the implementing agencies. In addition to the lack of coordination between/among the implementing agencies, fragmentation of implementing agencies, lack of integration of climate change-related considerations in

agriculture planning and the top-down approach of many policy implementing agencies have also created challenges for implementing these policies effectively in a poor and vulnerable region such as Cooch Behar. In addition to inadequate extension services, barriers to farmers' learning about climate-resilient agricultural practices have included: limited time to adopt adaptive practices; insufficient knowledge about adaptive agricultural practices; difficulties in obtaining relevant, timely climate-related information; and inadequate means of receiving or accessing financial credit for investment in adaptive agricultural practices.

The study highlights the critical role of local institutions in building climate-resilient communities through agricultural activities. Local institutions such as the Panchayati Raj Institutions, agricultural extension agencies, cooperatives, and self-help groups act as important intermediaries between the policy framework for adapting to climate change and the farming community. By reinforcing these institutions, we will improve knowledge dissemination, facilitate access to credit/technology/information and support the adoption of community-focused climate-resilient programming. In relation to Cooch Behar District, improving localized capacity of institutions and developing participatory governance systems will be key to addressing specific agro-ecological issues such as flood management, soil degradation and water logging.

Additionally, this research indicates that there is a need for a more comprehensive and equitable approach to formulating policies. Cooperation between national, state, and municipal governments is critical to achieving climate risk mitigation within agriculture. Furthermore, agricultural policies must be aligned with other policies in various regions (e.g., water, agriculture, and rural development) to achieve climate risk mitigation in the region. As a result, inclusion of Indigenous Knowledge Systems (IKS), promotion of climate-smart agriculture practices, and involvement of farmers in the policy-making process will improve the relevance and sustainability of policy interventions aimed at achieving climate risk mitigation. In summary, while the institutional and policy framework for climate change risk mitigation in Cooch Behar District is structured well, its overall success depends primarily on the efficiencies of implementation, coordination between governmental bodies, and adaptability to local conditions. It is essential to strengthen grassroots organizations, enhance policy consistency, and encourage participatory methods in order to achieve an agricultural system that is capable of withstanding climate change-related shocks. As such, this study contributes to the discourse on climate governance and provides a pathway toward developing local, scalable, and sustainable climate change adaptation strategies in regions highly susceptible to adverse climate conditions.

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