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Constraints Faced by Farmers in Adapting to Climate Change in North Bihar

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HIGHLIGHTS

- Small and fragmented landholdings significantly restrict farmers' capacity to adapt to climate change.
- Lack of accuracy and untimely weather forecasts limits informed decision-making and hinders risk management efforts.
- High dependency on monsoon due to costly irrigation and lack of technical training increases vulnerability to climate variability.
- Financial constraints such as high input costs, delayed credit, and low savings reduce farmers' adaptive capacity and resilience.

ARTICLE INFO

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ABSTRACT

The study was conducted in 2025 in North Bihar to investigate the challenges faced by farmers in adapting to climate change. Districts Darbhanga and Sitamarhi were purposively chosen on the basis of high vulnerability to climate change. To analyze the constraints faced by farmers, 192 respondents were selected randomly from selected villages. Farmers were surveyed through personal interviews, and data were analyzed using Garrett's ranking technique to prioritize the constraints hindering adaptation to climate change. The constraints were divided into four categories, i.e., socio-personal constraints, institutional constraints, technical constraints, and financial constraints. The analysis revealed that socio-personal constraints, such as small size fragmented landholdings, and increasing labour scarcity, whereas institutional constraints such as lack of accurate and untimely information about weather forecast and poor extension service on climate risk management were major constraints faced by farmers in adapting to climate change in north Bihar. Furthermore, the highly dependent nature of farmers on the monsoon and the lack of training on climate-smart agriculture practices were ranked as major technical constraints, whereas the high cost of inputs and the non-availability of untimely inputs were financial constraints faced by farmers.

INTRODUCTION

In India, agriculture is one of the most significant economic sectors, providing food and a means of livelihood for about 60 per cent of the country's population. Agriculture and climate are mutually dependent. Climate change affects agriculture both directly and indirectly in India (Vijayabhinandana et al., 2022). Changes in cropping patterns, agricultural productivity, profitability, supply, and trade are only a few of the major economic impacts of climate change on agriculture. Due to rising temperatures, agricultural production is expected to decline by 2050 in the Himalaya region will lead to food insecurity (Bharat et al., 2022). In past years, it has been predicted that, with the rise in temperature by 2.5^{o}C to 4.9^{o}C, the yield of rice and wheat will drop by 32 to 40 per cent and 41 to 52 per cent, respectively (Chouksey et al., 2021). Despite the fact that climate change has happened globally, its effects frequently differ from region to region. Bihar is among the most climate-sensitive states in India because of its geographic location, unpredictable hydrometeorology, dense rural population, and poverty (Sattar et al., 2021). Due to the yearly floods in the northern part of Bihar and the droughts in the southern part, the state is particularly vulnerable to hydro-meteorological disasters.

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According to vulnerability analysis done by the Indian Council of Agricultural Research (ICAR) with the support of the National Innovation on Climate Resilience Agriculture (NICRA) programme, Bihar is most susceptible to the impacts of climate variation (Singh et al., 2024). Research report on national climate vulnerability assessment published by Department of Science and Technology in 2021, about 80 per cent (31 out of 38) district in Bihar are among top 25 per cent most vulnerable district in the country. According to available evidence, the vulnerability of Bihar' 's agriculture to climate change is likely to be more prominent in the future. Agriculture is the mainstay of the Bihar economy, employing 77 per cent of the workforce. Floods, heat waves, and other extreme weather conditions will have a detrimental effect on agricultural crops, cattle health, and productivity.

To cope with extreme weather, adaptation strategies are important. Adaptations are defined as adjustments in human or natural systems in response to real or anticipated climate stimuli, which moderately harm or exploit beneficial opportunities (IPCC, 2007). To deal with changing weather events, strategies for adaptation include adjusting planting dates, water-saving methods, prudent fertilizer management, etc. (Shanabhoga et al., 2020; Brar et al., 2020). Adapting to the changing climate presents a variety of constraints for farmers. They must overcome a variety of obstacles, including institutional ones like inadequate extension services and restricted credit availability, personal ones like low literacy and dispersed landholdings, and technical ones like ignorance of climate-smart practices. Their capacity to adapt is further hampered by weather-related problems such as inaccurate forecasts, shifting rainfall patterns, high input costs, and a lack of workers (Naik et al., 2022; Singh et al., 2023). This study highlights the major constraints face by the farmers in the study area.

METHODOLOGY

The study was carried out in North Bihar's Darbhanga and Sitamarhi districts, which were purposively chosen on the basis of high vulnerability to climate change according to vulnerability analysis done by ICAR with the support of NICRA programme. In the second stage, the Alinagar and Hanuman-nagar block of Darbhanga district and Dumra and Riga block of Sitamarhi district were selected by random sampling technique for the study. From each selected block, four villages were selected using a random sampling technique making a total of 16 villages.

To analyze the constraints faced by farmers in adapting the climate change 12 respondents were selected randomly, from each village constituting a total sample size of 192. The constraints were classified as personal, institutional, technical and financial based on the review of literature. From the listed constraints, respondents were asked to give higher ranks to the most severe one and last rank to the least severe one. Among the various methodologies as suggested by Gupta et al., (2020), ranking of constraints was done with the help of Henry Garrett's Ranking Technique. For this, the percent position of each rank is calculated with the help of following formula:

Percent position = $100 (R_{ij} - 0.5) / N_j$

Where, R_{ij} = Rank given for the i^{th} variable by j^{th} respondent, N_j = Number of variable ranked by j^{th} respondents

With the help of Garrett's table given by Garrett and Woodworth (1969), the percent position estimated is converted into scores. Then for each constraint, the score of each individual was summed up and divided by total number of respondents for each constraint to get mean value. The constraint with the highest mean value was the most important one and ranked I.

RESULTS

The data from Table 1 shows that among the personal constraints, 'small size fragmented land holdings' was ranked 'I' with a Garrett score of 65.34, followed by 'Increasing labour scarcity' was ranked 'II' with a Garrett score of 58.14, 'Inadequate knowledge about climate change coping strategies' was ranked 'III', and inability to take risk was ranked 'IV' with a Garrett score of 56.25 and 52.74, respectively

Among the institutional constraints as perceived by the respondents, 'Lack of accurate and untimely information about weather forecast and climate change' was the most significant constraint (61.09). 'Poor extension service on climate risk management' ranked 'II' with a Garrett score of 59.89, followed by 'Lack of market access' was ranked 'III' with a Garrett score of 54.20 and 'Lack of support from line departments' was found to be the least important institutional constraint (51.45).

It is evident from Table 1 that among technical constraints faced by farmers in adapting to climate change, 'highly dependent on monsoon' was ranked 'I' with a Garrett score of 61.07. 'Lack of technical know-how on climate change', 'High cost of irrigation facilities' and 'Poor reliability of climate forecast' were ranked 'II',

Table 1. Constraints faced by the farmers in adapting to climate change

Constraints	Garrett Score	Rank
Personal constraint		
Small size fragmented landholdings	65.38	I
Inadequate knowledge about climate change coping strategies	56.25	III
Increasing labour scarcity	58.14	II
Inability to take risk	52.74	IV
Institutional constraint		
Poor extension service on climate risk management	59.89	II
Lack of accurate and untimely information about weather forecast and climate change	61.09	I
Lack of Market access	54.20	III
Lack of support from line department	51.45	IV
Technical constraints		
Highly dependent on Monsoon	61.07	I
High cost of irrigation facilities	56.53	III
Lack of training on climate smart agriculture practices	58.13	II
Poor reliability of climate forecast	51.32	IV
Financial constraints		
High cost of inputs	68.15	I
Short of savings	38.65	IV
Non-availability of untimely inputs (seeds, pesticides, fertilizers, etc.)	45.41	II
Delay in sanctioning credit	42.67	III

'III' and 'IV' with a Garrett score of 58.13,56.53. and 51.32, respectively.

It is indicated from Table 1 that 'High cost of inputs' was ranked the most severe financial constraint ranked 'I' with a Garrett score of 68.15, followed by 'Non-availability of untimely inputs' was ranked 'II' with a Garrett score of 45.41, 'Delay in sanctioning credit' and 'Short of savings' were ranked as 'III' and 'IV' financial constraints in adapting to a changing climate, with a Garrett score of 42.67 and 38.65, respectively.

DISCUSSION

The multifaceted constraints were identified in the adaptability of farmers to climate change in North Bihar through survey data and farmers' insights. Farmers have small and fragmented land holdings due to the nuclear family and low annual income. Singh et al., (2015) in their study in Bihar reveal that small and scattered land holdings reduce economies of scale, limit access to credit, and challenging to adapt various coping measures to climate change. Labour scarcity hinders farmers' climate adaptation by limiting their ability to implement resilient practices, adopt new technologies, and respond to climate related shocks (Ashoka et al., 2022). Adequate knowledge about climate change coping strategies enables farmers to implement adaptive measures, ultimately supporting farmers' livelihood and food security (Ghanghas et al., 2015; Chouksey et al., 2020; Mishra et al., 2024).

Inaccurate weather forecast hinders farmers' climate adaptability, causing crop losses and poor decision-making. Untimely and precise forecasts enable informed choices, reducing risks and enhancing resilience to climate change. Similarly, in the study by Shelar et al., (2022), access to reliable weather data is crucial for farmers to manage climate related challenges and ensure sustainable agricultural practices. Poor extension services on climate risk management can hinder farmers' ability to adapt to climate change leading to increased vulnerability to climate-related shocks and stresses. As reported by Shanbhoga et al., (2023), the improvement of field extension services, especially on climate risk management, can improve farmers' ability to adapt to climate related innovations. In the study of Roy et al., (2023) in Bihar reports that unfavorable weather circumstances like droughts and floods can destroy crops, reduce the appropriate supply of agricultural products, and eventually affect the selling of agricultural commodities. Furthermore, unstable demand and low prices can discourage farmers from investing in sustainable practices, exacerbating their vulnerability to climate change. Lack of support from the line department in Bihar is due to a shortage of officials, staff, and lack of unity of command on officers of the line department (Singh et al., 2015). Support from line departments can significantly enhance farmers' capacity for climate adaptation by providing essential services such as extension, technical assistance and input supply.

In study done under the Central Research Institute for Dryland Agriculture on Promising Climate Resilient Technologies for Bihar (Singh et al, 2024) reported that 60 per cent to 70 per cent of agriculture is highly dependent on rainfall. The erratic monsoon is responsible for making Bihar agriculture particularly vulnerable to fluctuations in monsoon patterns (Singh et al., 2014). Saha et al., (2019) & Mishra et al., (2024) highlight the need for specialized training programmes and found that farmers who receive regular training faced fewer problems in adopting climate smart agricultural practices. Unavailability of water storage structures makes farmers more dependent on monsoon. This can lead to reduced crop yields, decreased productivity, and financial strain, ultimately limiting their ability to invest in climate-resilient practices. Unawareness of the farmers about the shift in meteorological circumstances and poor reliability on weather forecasts can lead to poor planning and decision-making, making farmers more vulnerable to crop damage or loss, and decreased productivity (RaviKumar et al., 2015; Adhikari et al., 2022; Kumar et al., 2023).

In the study of Namdeo et al., (2023), the high cost of inputs encountered by farmers was the major constraint in adapting climate-resilient practices. The high cost of agricultural inputs such as seeds, fertilizers, equipment, and untimely unavailability can limit farmers' ability to invest in climate-resilient practices and technologies, making them more vulnerable to climate-related shocks. The problems of agricultural finance are manifold and complex. Farmers face the problem of credit non-availability in time, document expense, expensive procedure, and high rate of interest (Subramanian et al., 2017). Delayed credit can hinder farmers' ability to adapt to changing climate conditions, ultimately affecting their productivity, income and resilience. A lack of savings can significantly affect farmers to invest in climate-resilient practices, new technologies, or essential inputs that can improve productivity, making it challenging to sustain their livelihoods and respond to emerging challenges (Naik et al., 2022).

CONCLUSION

The study highlights the multifaceted challenges faced by cultivators in North Bihar in adjusting to climate shifts. These challenges are interrelated and call for a holistic and multi-level response. Addressing these challenges requires integrated efforts such as strengthening extension services, promoting climate-resilient farming practices, improving weather forecasting systems, and ensuring untimely access to inputs and credit. Moreover, policy interventions that prioritize smallholder farmers, invest in rural infrastructure, and integrate local knowledge with scientific innovations are crucial for long-term sustainability. Empowering cultivators through training and institutional support is essential to enhance their ability to cope with climatic variability and secure sustainable agricultural livelihoods.

DECLARATIONS

Ethics approval and informed consent: Informed consent was sought from the farmer respondents during the course of the research.

Conflict of interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The authors declare that during the preparation of this work, thoroughly reviewed, revised, and edited the content as needed. The authors take full responsibility for the final content of this publication.

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