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Farmer's perception and adaptation strategies towards climate change in India

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Abstract

Climate change has emerged as a significant global challenge affecting agricultural sustainability and rural livelihoods. In India, where a large proportion of the population depends on agriculture, climatic variability poses serious threats to food security and economic stability. Farmers are increasingly experiencing changes in temperature patterns, irregular rainfall and frequent extreme weather events. Understanding farmer's perception of climate change and their adaptation strategies is essential for developing effective climate-resilient agricultural policies. The findings indicate that most farmers have observed rising temperatures, erratic rainfall patterns, delayed monsoon onset and increased drought frequency. In response, farmers adopt various adaptive practices such as crop diversification, adjustment of cropping calendars, adoption of improved crop varieties, and better water management practices. However, several constraints including limited access to information, financial barriers and inadequate technical support hinder effective adaptation. Strengthening agricultural extension services, improving access to climate information and promoting climate-smart agricultural technologies are essential for enhancing farmer's resilience to climate change.

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INTRODUCTION

Agriculture is one of the most important sectors of the Indian economy and provides livelihood support to a large proportion of the rural population. Despite its relatively smaller contribution to the national Gross Domestic Product (GDP), the agricultural sector remains essential for ensuring food security, employment generation, and rural development. Indian agriculture is largely dependent on monsoon rainfall, making it highly vulnerable to climatic variability.

Climate change has emerged as one of the most pressing environmental challenges affecting agricultural production worldwide. Increasing global temperatures, changing rainfall patterns, and the rising frequency of extreme weather events such as droughts, floods, and cyclones have significantly affected agricultural systems. According to the Intergovernmental Panel on Climate Change (IPCC), these climatic changes are expected to further intensify in the coming decades, posing serious risks to food production and rural livelihoods.

In India, climate variability has already resulted in irregular monsoon patterns, prolonged dry spells, and unpredictable weather conditions. These changes directly influence crop productivity, soil moisture availability, pest incidence, and livestock performance (Ratakonda, Dash, & Mishra, 2024). Studies have indicated that even a small increase in average temperature can reduce crop yields and increase production risks in many regions.

Farmers, as primary stakeholders in agricultural production, are often the first to observe changes in environmental conditions. Their perceptions of climate change influence their decisions regarding crop selection, farming practices, and risk management

strategies. Several studies have emphasized that farmer's awareness and perception of climate change play a significant role in determining their willingness to adopt adaptation strategies (Bhandari & Mishra, 2020; Sharma & Singh, 2024). Therefore, understanding farmer's perceptions and adaptation practices is essential for designing effective climate-resilient agricultural policies.

FARMER'S PERCEPTION OF CLIMATE CHANGE

Farmers across different regions of India have reported noticeable changes in climatic conditions over the past few decades. These observations include rising temperatures, irregular rainfall distribution, delayed monsoon onset, and an increased frequency of droughts and floods.

Research conducted in Rajasthan revealed that many farmers perceived a decline in rainfall and an increase in temperature, along with shifts in monsoon patterns (Dhaka, Chayal, & Poonia, 2010). Similarly, farmers in Punjab reported experiencing higher temperatures during both Kharif and Rabi seasons, which they believed negatively affected crop productivity (Kumar & Sidana, 2018).

In coastal Andhra Pradesh, farmers demonstrated high awareness of climate change, with a large proportion reporting increased temperatures and irregular rainfall patterns (Ratakonda et al., 2024). Farmers in Tamil Nadu also observed delayed monsoon onset and more frequent dry spells affecting crop cultivation (Dhanya & Ramachandran, 2015).

IMPACT OF CLIMATE CHANGE ON AGRICULTURAL PRODUCTIVITY

Climate change has substantial impacts on agricultural productivity and farm income. Rising temperatures and irregular rainfall patterns affect crop growth stages, soil moisture availability, and pest and disease dynamics.

Studies conducted in Punjab indicated that more than half of the farmers believed that climate variability had negatively affected crop yields and grain quality in crops such as wheat and paddy (Kumar & Sidana, 2018). Similarly, farmers in Andhra Pradesh reported increased weed infestation, heat stress on crops, and higher incidence of crop diseases due to changing climatic conditions (Ratakonda et al., 2024).

Extreme weather events such as floods, cyclones, and droughts further exacerbate agricultural losses. Coastal areas of Tamil Nadu frequently experience cyclonic storms that cause severe crop damage and economic losses to farmers (Dhanya & Ramachandran, 2015). Such climatic disturbances not only reduce crop productivity but also increase production costs and economic vulnerability of farming households. Climate-related risks also affect livestock productivity, water availability, and soil health. These factors collectively influence the sustainability of agricultural systems and the livelihoods of rural communities (Ngome & Nkemelang, 2024).

ADAPTATION STRATEGIES ADOPTED BY FARMERS

Farmers have adopted various strategies to cope with the adverse impacts of climate change. These strategies are often based on farmer's local knowledge, past experiences, and available resources.

Adjustment of Cropping Calendar

One of the most common adaptation practices adopted by farmers is modifying sowing and harvesting dates in response to changing rainfall patterns. By adjusting cropping calendars, farmers attempt to minimize the risks associated with droughts or excessive rainfall during sensitive crop growth stages.

Crop Diversification

Crop diversification is another widely practiced strategy for reducing climate-related risks. Farmers cultivate multiple crops such as pulses, vegetables, and short-duration varieties to reduce dependency on a single crop and ensure stable income.

Adoption of Improved Agricultural Technologies

Technological interventions such as laser land leveling, improved irrigation systems, and conservation agriculture practices have also been adopted by farmers to improve water use efficiency and enhance crop productivity (Kumar & Sidana, 2018).

Integrated Farming Systems

Integrated farming systems that combine crop cultivation with livestock, poultry, or fisheries provide farmers with diversified sources of income. This approach helps reduce economic risks associated with crop failure.

Water Management Practices

Efficient water management practices such as rainwater harvesting, drip irrigation, and farm ponds are increasingly adopted to address water scarcity and improve irrigation efficiency.

The promotion of climate-smart agricultural practices has been recognized as an effective approach for enhancing resilience in agricultural systems. Farmers with better access to training, information, and institutional support are more likely to adopt such technologies (Ikendi et al., 2024; Kumar et al., 2025).

Table 1: Adoption Rate of Adaptation Strategies in Punjab (n=200) (Source: Kumar & Sidana, 2018)

Strategy	Number of Respondents	Adoption Percentage (%)
Laser Leveling of Field	60	30.0%
Irrigation Improvement	54	27.0%
Change in Crop Variety	43	21.5%
Zero Till Wheat	17	8.5%
Direct Seeded Rice (DSR)	15	7.5%
No Adaptation	65	32.5%

Barriers to Climate Change Adaptation

Despite the availability of adaptation strategies, several constraints limit farmer's ability to effectively respond to climate change. One of the major barriers is the lack of awareness and technical knowledge regarding climate-resilient agricultural practices. Many farmers do not receive adequate information about improved technologies due to limited extension services.

Financial constraints also restrict farmers from investing in modern agricultural technologies. The high cost of inputs, limited access to institutional credit, and inadequate financial support schemes make it difficult for small and marginal farmers to adopt adaptation measures. Additionally, crop insurance schemes are often underutilized due to complex procedures and lack of awareness. Institutional limitations such as poor infrastructure, inadequate irrigation facilities, and limited market access further hinder farmer's ability to adapt effectively.

Determinants Influencing Farmer's Adaptation Decisions

The adoption of climate adaptation strategies is influenced by several socio-economic and institutional factors. Education level, farming experience, farm size, and access to extension services significantly influence farmer's perception and decision-making processes.

Educated farmers are generally more capable of understanding climate information and adopting improved technologies. Similarly, farmers with greater farming experience tend to have better knowledge of climatic patterns and risk management practices. Access to extension services and climate information also plays a crucial role in encouraging farmers to adopt innovative agricultural practices. Studies have shown that socio-economic characteristics such as education, income level, and access to information significantly influence farmer's climate adaptation behavior (Singh et al., 2023).

Policy Implications

Strengthening farmer's resilience to climate change requires coordinated policy interventions at multiple levels. Agricultural extension services should be strengthened to enhance farmer's access to climate-related information and training programs. Regular awareness campaigns, field demonstrations, and capacity-building programs can improve farmer's understanding of climate-resilient technologies.

Governments should also improve financial support mechanisms by providing accessible credit facilities, subsidies for climate-smart technologies, and effective crop insurance schemes. Investment in water conservation infrastructure such as farm ponds, check dams, and micro-irrigation systems can help farmers manage water scarcity more effectively. Furthermore, improved weather forecasting systems and early warning mechanisms can enable farmers to make timely decisions regarding crop planning and farm management.

CONCLUSION

Farmers across India are increasingly aware of changes in climatic conditions, including rising temperatures, irregular rainfall patterns, and the increasing frequency of extreme weather events. These climatic changes significantly affect agricultural productivity and the livelihoods of rural communities. In response, farmers adopt several adaptive strategies such as adjusting cropping calendars, diversifying crops, improving water management practices, and integrating livestock with crop production.

However, the effectiveness of these strategies is often constrained by financial limitations, lack of technical knowledge, and inadequate institutional support. Strengthening agricultural extension services, improving access to climate information, and promoting climate-smart agricultural technologies are essential to enhance farmer's adaptive capacity. A coordinated approach involving policymakers, researchers, and extension agencies is required to build a resilient agricultural system capable of addressing the challenges posed by climate change.

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