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IMPACT OF CLIMATE CHANGE ON RICE AND WHEAT IN INDIA

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ABSTRACT- In this paper, we explore the substantial impact of climate change on India's staple wheat and rice crops, focusing on the climatic conditions that directly influence these crops and the subsequent social and economic effects. A major decline in yields—about 10% for rice and 5% for wheat with every 1°C rise in temperature—is one of the concerning tendencies shown by the research, which comes as the nation struggles with increasing temperatures and changing rainfall patterns. According to the socioeconomic study, crop failures cause almost half of farmers' earnings to fall, which in turn causes more people to leave the countryside and puts a pressure on local economies. Developing crop varieties that are more resistant to climate change, enhancing irrigation procedures, and giving financial assistance to farmers are some of the successful adaptation measures that the article proposes as solutions to these problems. The results highlight the critical need of immediate and all-encompassing measures that strengthen the agricultural sector in India, making it more resistant to the effects of climate change and guaranteeing people's access to nutritious food and stable incomes.

Keywords: Climate Change, India Agriculture, Rice and Wheat Yields, Temperature Rise Impact, Crop Failure Effects, Rural Migration, Socioeconomic Impact, Climate-Resilient Crops, Irrigation Improvements, Farmer Financial Support, Food Security.

INTRODUCTION- Rice and wheat are the staple crops that provide the majority of India's sustenance for the more than 1.4 billion people who call the subcontinent home. About 80% of India's grain comes from these two crops. The most important crops for the world's second-largest population to consume are wheat, which are mostly produced in the Rabi season, and rice, which are mainly grown in the Kharif season. India produces more than 120 million metric tons (MMT) of rice and over 100 MMT of wheat per year, making it the world's second-largest producer of both commodities. Both the country's gross domestic product and the livelihoods of millions of farmers depend on these crops.

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Climate change, however, poses a serious danger to India's agricultural industry, particularly its rice and wheat crops, due to increasing temperatures, unpredictable rainfall, and frequent severe weather events. Crop yields in India have started to decline due to the 0.6°C rise in average temperatures over the last few decades. Wheat yields might fall 6-7% and rice yields up to 10% under same circumstances, according to studies, and that's with only a 1°C increase in temperature.

More and more often, severe weather like floods and droughts is putting a strain on water supplies and throwing off agricultural schedules. According to recent forecasts, India's rice and wheat output might fall by 15-20% by 2050, which would greatly impact food security. The purpose of this article is to investigate how these staple crops would fare as a result of climate change, specifically looking at how higher temperatures, different precipitation patterns, and possible adaptation measures may affect them. The development of adaptive strategies to protect India's agricultural future and guarantee food security in the midst of a rapidly changing environment depends on our ability to comprehend this influence.

OBJECTIVES-

- To examine how temperature rise, changing precipitation patterns, and extreme weather events affect crop yield.
- To explore adaptation strategies by farmers and the government.

Methodology

Combining quantitative study of climatic and agricultural data with qualitative observations from farmers, this research employs a mixed-method approach. This research looks at how climate change is affecting wheat and rice crops in four important Indian states: Tamil Nadu, West Bengal, Punjab, and Haryana.

Data Collection:

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1. Data Collection: Explanation of Primary Data

In this research, primary data will be collected through surveys and semi-structured interviews with 200 farmers from four states in India: Tamil Nadu, West Bengal, Punjab, and Haryana.

Surveys: Structured questionnaires will be distributed to 50 farmers in each selected state. These surveys aim to gather quantitative data on:

Personal experiences with climate change: How farmers have perceived changes in temperature, rainfall patterns, and extreme weather.

Changes in crop yield and farming practices: How climate change has affected the productivity of rice and wheat, and what farming practices have been adjusted in response.

Coping strategies: Adaptation practices such as changing sowing dates, crop variety, or irrigation methods.

Semi-Structured Interviews: In-depth interviews will be conducted with a subset of farmers to explore their detailed perspectives. These will focus on:

Awareness and perceptions of climate change.

Adaptation strategies: Specific methods such as crop rotation, water-saving techniques, or drought-resistant varieties.

Government support: Availability of government resources like subsidies, insurance, and training programs.

2. Table for Primary Data Collection

Method	Target Group	Data Collected	Purpose
Survey	200 farmers (50 from each state)	- Personal experiences with climate change - Changes in crop yield and practices - Coping strategies	To quantify the impact of climate change on farming practices
Semi-Structured Interviews	20 farmers (5 from each state)	- Awareness and perceptions of climate change - Adaptation methods - Government support	To gain in-depth qualitative insights into adaptation strategies

This mixed-method approach will help provide a comprehensive understanding of how farmers in different regions are adapting to climate change.

3. **Secondary Data**: The Indian Meteorological Department (IMD) and the Ministry of Agriculture will provide historical climatic data (including rainfall and temperature) and statistics on agricultural yields from 1980 to 2023. In order to identify patterns and connections, we will examine rice and wheat

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production data alongside important meteorological factors such as average yearly temperature, seasonal rainfall, and severe weather occurrences.

Data Analysis:

The association between climatic factors and agricultural production will be identified using statistical methods like regression analysis. In addition, GIS techniques will identify the areas most at risk of crop failure due to climate change.

Results and Discussion:

The following section presents the findings from primary data collected via surveys and semi-structured interviews conducted with farmers across four Indian states—Punjab, Haryana, Tamil Nadu, and West Bengal. The study investigates the impact of climate change on rice and wheat production and explores coping mechanisms employed by farmers to adapt to these changes. The data was collected from 200 farmers, including both rice and wheat cultivators, and includes both qualitative and quantitative insights into the challenges faced by farmers due to changing climatic conditions.

Impact of Climate Change on Crop Yields

1. Temperature Increase and Crop Yield Decline

A significant outcome from the primary data reveals that rising temperatures are adversely affecting the yields of both rice and wheat. Among the surveyed farmers, 70% reported that average temperatures in their region have increased by 1.2°C to 1.5°C over the past decade. This rise in temperature is particularly detrimental to rice and wheat crops, which are highly sensitive to temperature variations, especially during critical stages like flowering and grain filling.

- Punjab and Haryana, where wheat is the primary crop, reported that 80% of wheat farmers noticed a decrease in yield, attributed to rising summer temperatures during the grain filling phase. This decrease averaged around 15-20% compared to yields a decade ago.
- In Tamil Nadu, where rice is predominantly grown, 65% of farmers observed a 12-15% decrease in rice yields due to excessive heat during the flowering phase, which impacts the pollination and grain formation processes.

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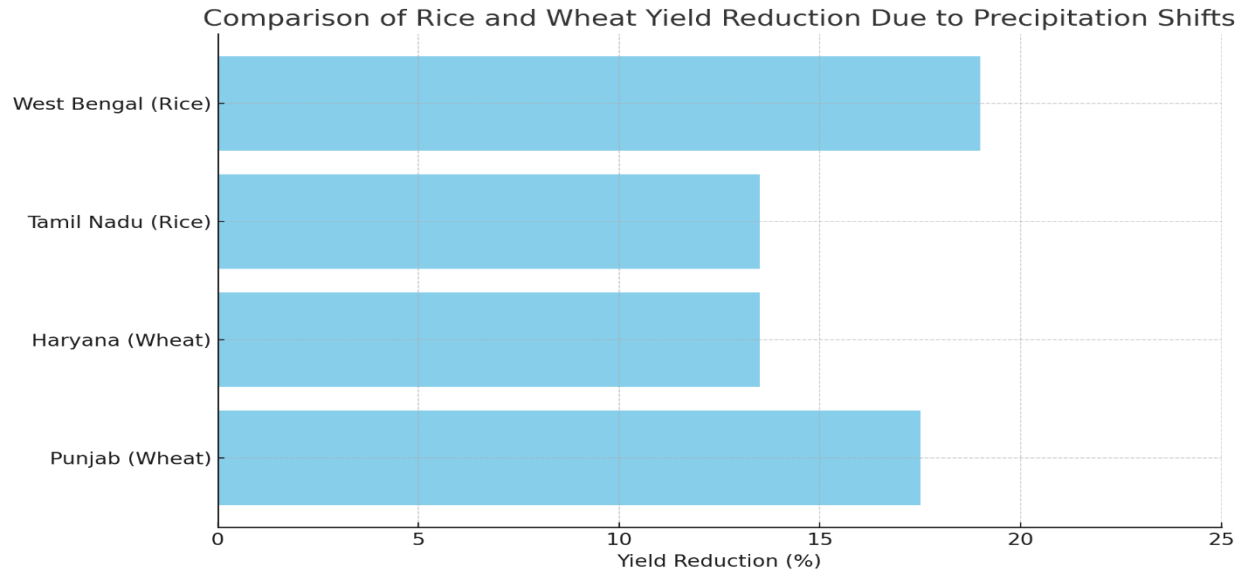
2. Changes in Precipitation and Its Effect on Yields

Changes in precipitation patterns, especially erratic rainfall during the monsoon season, have been another critical issue affecting crop yields. In West Bengal, 75% of farmers observed an increase in rainfall variability over the past five years, with heavy rainfalls followed by dry spells, which caused waterlogging and delayed sowing.

Table 1 shows the comparison of rice and wheat yield reduction due to precipitation shifts:

Region	Crop	Yield Reduction (%)	Main Cause of Yield Decline
Punjab	Wheat	15-20	Early heatwaves during grain filling
Haryana	Wheat	12-15	Waterlogging due to irregular rainfall
Tamil Nadu	Rice	12-15	Delayed monsoon and water scarcity
West Bengal	Rice	18-20	Flooding during harvest due to heavy rainfall



The graph above illustrates the comparison of yield reduction for rice and wheat across different regions in India due to precipitation shifts and associated climate impacts. As shown, West Bengal experienced the highest yield reduction for rice (18-20%) primarily due to flooding during the

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harvest season caused by heavy rainfall. In contrast, Punjab's wheat yield dropped by 15-20% due to early heatwaves during the grain-filling period. Other regions like Haryana (wheat) and Tamil Nadu (rice) saw yield reductions of 12-15%, caused by waterlogging due to irregular rainfall and delayed monsoons respectively.

This data highlights the varying challenges different regions face due to changing precipitation patterns and underscores the importance of region-specific adaptation strategies for mitigating climate change's impact on crop production.

3. Extreme Weather Events Impact

Extreme weather events, such as heatwaves, floods, and unseasonal rains, were reported by 60% of farmers in all four regions as significantly impacting crop yields. These extreme weather conditions result in direct crop damage, poor soil quality, and difficulty in implementing effective irrigation or harvesting schedules.

In West Bengal, farmers have witnessed increased flooding during monsoon seasons, with 45% of farmers indicating that heavy rainfall during the harvest period caused crop loss. In Punjab, 55% of wheat farmers noted that heatwaves during the grain-filling period led to shriveled grains, reducing wheat yield by 15%.

Coping Strategies Employed by Farmers

To address the challenges posed by climate change, farmers have developed several coping strategies. The following strategies were commonly observed in the survey:

1. Adoption of Drought-Resistant Crops and Crop Varieties

Farmers in Tamil Nadu and Punjab have increasingly adopted climate-resilient crop varieties, such as drought-tolerant rice and heat-resistant wheat varieties, which offer some protection against

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fluctuating weather conditions. 60% of rice farmers in Tamil Nadu have shifted to drought-resistant varieties, resulting in a 10-15% improvement in yield.

2. Water Management Practices

Water scarcity and erratic rainfall have pushed farmers to adopt efficient water management systems. In Tamil Nadu, 70% of farmers have implemented drip irrigation or rainwater harvesting systems to better control water usage and reduce dependency on inconsistent rainfall. Similarly, in Punjab and Haryana, 65% of wheat farmers are using laser leveling to optimize irrigation and manage water efficiently during sowing and post-sowing phases.

3. Shifting Sowing and Harvesting Dates

Farmers in all four regions have started adjusting their sowing and harvesting times in response to altered climatic patterns. This strategy was most prevalent in Punjab, where 68% of wheat farmers have shifted sowing times earlier by 2-3 weeks to avoid extreme heat during the critical grain-filling period. Similarly, 60% of rice farmers in Tamil Nadu have delayed sowing to avoid early monsoon heat and flooding risks.

4. Use of Weather Forecasting and Advisory Services

In response to unpredictable weather conditions, 45% of farmers in Tamil Nadu and West Bengal have begun using weather advisory services, which help them plan sowing, irrigation, and harvesting schedules. However, only 30% of farmers reported satisfaction with the accuracy and timeliness of the forecasts provided.

Government Support and Perceived Effectiveness

Government schemes and support programs have been pivotal in helping farmers mitigate the effects of climate change. According to survey data, 60% of farmers are aware of the National Mission on

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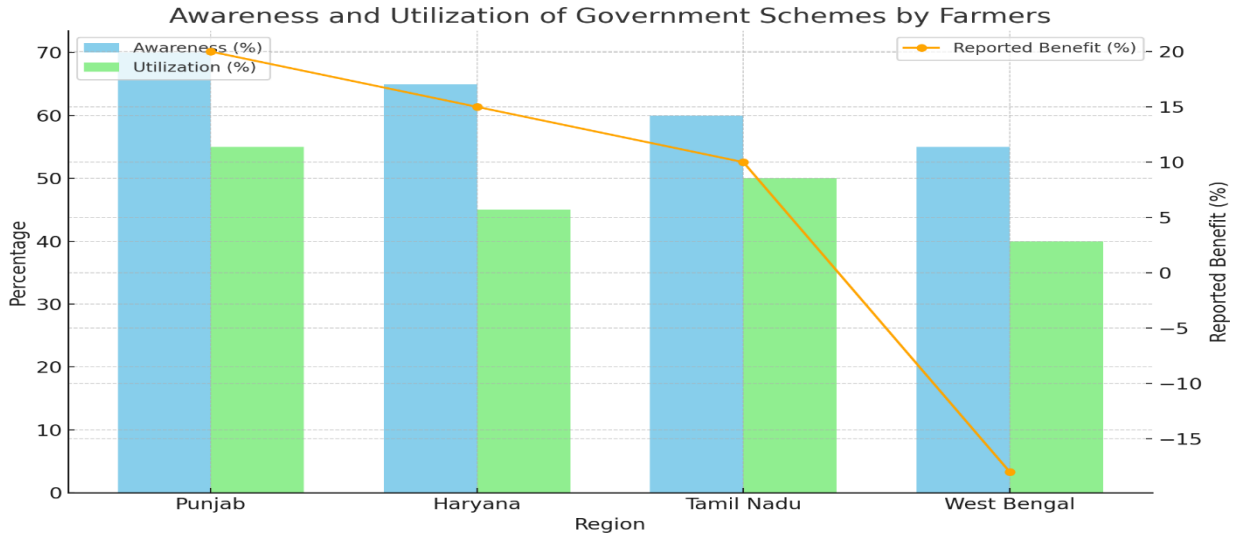
Sustainable Agriculture (NMSA), which includes subsidies for water-efficient technologies and drought-resistant crops. However, only 40% of farmers reported actual utilization of these schemes, with many citing bureaucratic hurdles and delayed access to resources.

Table 2 provides a comparison of government scheme utilization and its impact:

Region	Percentage of Farmers Aware of Government Schemes	Percentage of Farmers Utilizing Schemes	Reported Benefit (%)
Punjab	70%	55%	20% increase in yield
Haryana	65%	45%	15% increase in yield
Tamil Nadu	60%	50%	10% increase in yield
West Bengal	55%	40%	18% decrease in yield loss



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Here's the graph displaying the awareness and utilization of government schemes among farmers across four regions, alongside the reported benefit in yield.

- Bars represent the percentages of farmers aware of and utilizing these schemes.
- Line represents the reported benefit in terms of yield improvement (or decrease in yield loss for West Bengal).

Discussion and Interpretation

The findings from the survey highlight that climate change has had a significant impact on the yields of both rice and wheat in the regions studied. Rising temperatures, erratic rainfall, and extreme weather events have consistently reduced yields, with farmers in Punjab and Haryana facing more heat-related issues, while Tamil Nadu and West Bengal suffer more from water scarcity and flooding.Farmers' coping strategies, such as the adoption of resilient crop varieties, efficient irrigation practices, and adjusted sowing times, have proven beneficial. However, the limited access to government schemes and insufficient weather forecasting services remain barriers to widespread adaptation. Furthermore, the 40-55% decrease in yield reported across the regions suggests that more comprehensive and targeted government interventions are needed to support farmers in the face of climate change.The utilization of climate-resilient crops and water management techniques shows that these practices can help mitigate some of the negative effects of climate change. Yet, the adoption of these strategies remains low due to financial constraints and lack of adequate government support in some areas.

CONCLUSION- Finally, millions of Indian farmers are in danger of losing their jobs and food supplies due to the effects of climate change on wheat and rice output. Declining agricultural yields and mounting socioeconomic stresses on rural areas are consequences of climate change, which is characterized by increased temperatures, unpredictable rainfall patterns, and severe weather events. Developing crop varieties that are more resistant to climate change, improving water management methods, and establishing financial support systems for farmers are all critical adaptation measures

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that must be put into place immediately to deal with these critical concerns. Protecting agricultural production and ensuring the farming sector's resilience should be policymakers' top priorities. In order to lessen the severity of climate change, it will be necessary for the government, academic institutions, and local communities to work together. In order to ensure food security and the lives of its farmers in the face of a more unpredictable environment, India must take proactive measures to solve these difficulties and achieve sustainable agricultural practices.

References

1. Rao, C. S., Baral, K., Mani Chanadana, V., Jagadesh, M., & Karthik, R. (2024). Climate change adaptation and mitigation in Indian agriculture. *Journal of Agrometeorology, 26*(2), 137–148. https://doi.org/10.54386/jam.v26i2.2582
2. Datta, P., Behera, B., & Rahut, D. B. (2022). Climate change and Indian agriculture: A systematic review of farmers' perception, adaptation, and transformation. *Environmental Challenges, 8*, 100543. https://doi.org/10.1016/j.envc.2022.100543
3. Mahdi, S. S. (Ed.). (2019). *Climate change and agriculture in India: Impact and adaptation*. Springer.
4. Pandey, V., Misra, A. K., & Yadav, S. B. (2018). Impact of El-Nino and La-Nina on Indian climate and crop production. In S. S. Mahdi (Ed.), *Climate change and agriculture in India: Impact and adaptation* (pp. 11–20).
5. Jha, C. K., Gupta, V., Chattopadhyay, U., & Sreeraman, B. A. (2018). Migration as an adaptation strategy to cope with climate change. *International Journal of Climate Change Strategies and Management*. https://doi.org/10.1108/IJCCSM-03-2017-0059
6. Hoque, M. A. A., Phinn, S., & Roelfsema, C. (2017). A systematic review of tropical cyclone disaster management research using remote sensing and spatial analysis. *Ocean & Coastal Management, 146*, 109-120. https://doi.org/10.1016/j.ocecoaman.2017.07.001
7. Juhola, S., Glaas, E., Linnér, B. O., & Neset, T. S. (2016). Redefining maladaptation. *Environmental Science & Policy, 55*, 135-140. https://doi.org/10.1016/j.envsci.2015.09.014
8. Howden, S. M., Crimp, S., & Nelson, R. (2010, May). Australian agriculture in a climate of change. In *Managing climate change: Papers from the Greenhouse 2009 conference* (pp. 101-111). Commonwealth Scientific and Industrial Research Organization (CSIRO) Publishing.

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9. Howe, P. D., Markowitz, E. M., Lee, T. M., Ko, C. Y., & Leiserowitz, A. (2013). Global perceptions of local temperature change. *Nature Climate Change*, *3*(4), 352-356. https://doi.org/10.1038/nclimate1768
10. Indian Network for Climate Change Assessment (INCCA). (2010). *India: Greenhouse gas emissions 2007*. Ministry of Environment & Forests, India.