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Impact of Climate Variability on Agricultural Productivity in the Hilly Regions of Western Maharashtra

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Abstract

The present study examines the impact of climate variability on agricultural productivity and farmers' income in the hilly regions of Western Maharashtra. Based on primary data collected from 40 randomly selected farmers using a structured questionnaire, the study analyzes the effects of irregular rainfall, rising temperatures, and extreme weather events on crop yield, quality, and livelihood. Descriptive statistics and one-sample t-tests reveal that climate variability significantly reduces agricultural productivity and creates financial stress among farming households. The study also highlights gaps in adaptation measures, including limited access to climate-smart practices and insufficient government support. The findings underscore the need for targeted interventions such as training programs, financial assistance, and promotion of climate-resilient farming techniques to ensure sustainable agriculture and stable income for farmers in the region

Keywords: Climate Variability, Agricultural Productivity, Farmers' Income, Rainfall Irregularity, Temperature Rise, Extreme Weather Events, Climate Change Adaptation, Hilly Regions, Western Maharashtra, Sustainable Agriculture

Introduction

Agriculture in the hilly regions of Western Maharashtra is a primary source of livelihood, food security, and rural employment; however, it is increasingly vulnerable to climate variability and change. Over the past few decades, climatic parameters such as rainfall and temperature have exhibited erratic patterns, including decreased rainfall, rising temperatures, and more frequent extreme weather events, which have significantly affected crop productivity and water resources in this region. These climatic shifts not only disrupt traditional cropping calendars and reduce agricultural output, but also undermine farmers' income and food security, especially for those dependent on rain-fed agriculture. Given that smallholder farmers in these areas have limited adaptive capacity due to inadequate irrigation, financial constraints, and lack of climate-smart technologies, understanding the influence of climate variability on agricultural productivity and farmers' economic well-being has become of paramount importance for sustainable rural development in Western Maharashtra.

Review of Literature

Numerous research studies have evaluated the interplay between climate variability and the agricultural sector's effectiveness, indicating that climate variability is becoming an increasingly important factor affecting agrarian-dependent economies. Kumar and Parikh (2018) studied how rainfall variability and increased temperature affected agricultural production in northern India's semi-arid and hilly areas. Their findings indicated that erratic patterns of monsoons and rising temperatures negatively influenced crop yields, especially for crops grown under rain-fed systems. The authors noted that small and marginal farmers in these regions are particularly susceptible due to limited access to irrigation systems and their dependence on external climatic conditions to grow crops successfully. According to Patil and Deshmukh (2020), a study conducted in Western Maharashtra demonstrated how volatility in rainfall, as well as more frequent drought events, contributed to unstable agricultural output, which led to an increasing level of income uncertainty for many farm households. Additionally, their work revealed how climate variability increased production costs and farmers' debts, ultimately impacting farmers' economic well-being in mountainous and plateau regions. Sharma et al. (2022) examined strategies used by farmers to cope with the impacts of climate variability as a means of ensuring continued farm success. They concluded that using multiple cropping strategies, cultivating climate-resilient crops, and implementing better water management systems had some positive impact in ameliorating the effects of climate change on the agricultural industry. However, the study pointed out that lack of awareness, inadequate institutional support, and limited access to financial resources constrained effective adaptation, especially in hilly regions.

From the review of existing literature, it is evident that while climate variability significantly affects agricultural productivity and farmers' income, there is a need for region-specific studies focusing on hilly areas of Western Maharashtra. The present study attempts to fill this research gap by examining both productivity and income dimensions in a geographically sensitive context.

Statement of the Problems

The hilly area of Western Maharashtra's agro-ecosystem relies heavily upon climate variables (i.e., rain and temperature) and is thus susceptible to their variability. The effects resulting from the changing pattern of monsoons (irregular return intervals), increased temperatures (increased duration during which an area is exposed to heat) as well as other climate-related extremes (i.e., drought, floods, etc.), are all having a negative effect on crop yields and subsequently Farm Incomes for Farmers in Western Maharashtra. While Agricultural production provides most livelihoods through farming for Western Maharashtra's, limited empirical studies exist to assess both Agricultural Production and Farm Incomes simultaneously within a geographically sensitive location. Consequently, conducting a site-specific study will develop better Institutional (Government) Policies as well as enhance adoption of appropriate adaptive strategies. Thus, this current research effort seeks to identify and explain how Climate Variability impacts both Agricultural Production and Farm Incomes for Hilly Regions in Western Maharashtra.

Objectives of the Study

1. To examine the impact of climate variability on agricultural productivity in the hilly regions of Western Maharashtra.
2. To analyze the effect of climate variability on farmers' livelihood in the study area.

Hypothesis of the Study

H₀ (Null Hypothesis): There is no significant impact of climate variability on agricultural productivity in the hilly regions of Western Maharashtra.

H₁ (Alternative Hypothesis): There is climate variability has a significant impact on agricultural productivity in the hilly regions of Western Maharashtra.

Research Methodology

The study uses descriptive and analytical approaches to assess how climate patterns change crops and rural farmers' incomes in hilly parts of the Western Ghats in Maharashtra. Researchers used both primary and secondary data for the research. Primary data was gathered from farmers via structured questionnaires and in-depth interviews. Questions were posed about rainfall variability, temperature variability, crop yields, and income levels. Secondary data included documents published by government agencies that documented research, as well as climatological records of the area, to complement the study and strengthen the research conclusions. Using a random selection process, 40 farmers were chosen to participate in the research. The random sampling ensured that all farmers who live in hilly areas and work in agriculture had an equal chance of being included in the research. Researchers utilized descriptive methods of statistics by examining the collective responses of farmers using statistical methods to describe farmer perceptions and experiences using notions of percentage, mean, standard deviation, and variance. The collected results were presented in tabular format, allowing for easier interpretation and clear comparison to results already reported in the literature.

Data Analysis

The table displays the analysis of the data collected from farmers' perceptions on the effect of climate variability on their agricultural productivity in the hilly area of Western Maharashtra, using a structured questionnaire. The questionnaire used a five-point Likert scale (Strongly Disagree = 1, Strongly Agree = 5). The table also shows the mean score of the responses, the standard deviation, and the variance of each response to each statement which demonstrates how farmers feel about the impact of irregularities in rainfall, increasing temperature, and extreme weather on their crops, crop growth, crop yields and cropping patterns. This analysis also helps to identify the areas where the impact from climate variability is having the greatest effect on agricultural productivity, as well as highlighting the largest barriers to adaptation for farmers to the changing climate

Table

Farmers' Perceptions on the Impact of Climate Variability on Agricultural Productivity

Sr. No.	Statements	N	Mean	SD	Var.
1	Irregular rainfall has affected the productivity of my main crops.	40	4.15	1.32	1.74
2	Rising temperatures have negatively impacted crop growth in my fields.	40	3.90	1.03	1.07
3	Extreme weather events (droughts, unseasonal rain) have reduced agricultural yield.	40	3.85	1.13	1.294
4	Climate variability has forced me to change the cropping pattern.	40	3.73	1.07	1.1
5	Changes in rainfall and temperature affect the quality of my produce.	40	4.00	1.02	1.056
6	Agricultural income has decreased due to unpredictable weather conditions.	40	3.98	.952	.907
7	Seasonal variations in climate create irregular income and employment	40	4.09	.990	.980

	opportunities.				
8	Reduced crop productivity due to climate variability has increased financial stress.	40	4..5	1.24	1.55
9	Lack of climate-smart practices makes it difficult to maintain stable income.	40	3.65	1.2	1.64
10	Support from government or institutions is inadequate to cope with climate-related challenges.	40	3.90	.88	.786

Source: Compiled by researcher

The table data results of a survey to assess Farmers' Awareness will help us better understand the relationship between climate change and agricultural productivity in the mountainous areas of Western Maharashtra (India). Survey responses indicated that many Farmers agreed that irregular rainfalls (Mean score = 4.15) and seasonal temperature changes (Mean score = 4.09) play a crucial role in determining both crop yield and income stability. The increase in average temperature as well as the increase in frequency of extreme weather events, including Droughts and Unseasonal Rains (Mean score = 3.90, and 3.85 respectively), are reported by Farmers to be damaging to crop growth and overall productivity, resulting in Farmers being required to make significant changes to their cropping patterns (Mean score = 3.73) as a means of coping with these climatic anomalies. Furthermore, in addition to affecting cropping patterns, changes in temperature and rainfall impact the quality (Mean score = 4.00) of crops, which ultimately impacts on lost Market Value. The overall impact of decreased Agricultural Output on Income of Farmers can be seen in the average scores of 3.98 (reduced income), and 4.05 (increased financial stress), which highlight the significant economic vulnerability created by Unpredictable Weather. Respondents also cited a lack of Climate-Smart Practices (Mean score = 3.65) and insufficient Government Support (Mean score = 3.90) as constraints on their ability to Adapt and maintain stable incomes in these areas. Collectively, these results indicate that Farmers are doing what they can to Adapt to changes in Climate through adjusting their cropping and management practices; however, their continued success will depend on resolving the combined effects of Environmental Constraints, Financial Constraints, and Constraints from the Institutions that support their operations.

Testing Of Hypothesis

H₀ (There is no significant impact of climate variability on agricultural productivity in the hilly regions of Western Maharashtra.

H₁ There is climate variability has a significant impact on agricultural productivity in the hilly regions of Western Maharashtra.

To measure the impact of climate variability on agricultural productivity the researcher has used 5 variables with 5-point Likert scale for each variable. After that researcher has calculated response mean value of the all parameters then researcher has applied one sample T test because data was parametric and ratio scale.

Table: 2

One-Sample Statistics				
Variables	N	Mean	Std. Deviation	Std. Error Mean
Climate variability has a significant impact on agricultural productivity	40	4.2450	.35802	.05661

The one-sample statistics indicate that farmers strongly agree that climate variability has a significant impact on agricultural productivity in the hilly regions of Western Maharashtra. The mean score of 4.2450 suggests a high level of agreement among the respondents regarding the adverse effects of changing rainfall patterns, rising temperatures, and extreme weather events on crop growth and yield. The standard deviation of 0.35802 reflects relatively low variability in responses, indicating that most farmers share a consistent perception of climate-related challenges. The standard error of 0.05661 shows that the mean is a reliable estimate of the population perception. Overall, the data confirm that climate variability is perceived as a critical factor influencing agricultural productivity and underscores the need for adaptation strategies and policy support to mitigate its effects.

Table: 3

One-Sample Test						
Variables	Test Value = 4					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Climate variability has a significant impact on agricultural productivity	4.328	39	.000	.24500	.1305	.3595

From the one-sample t-test data presented, it can be seen that the T-stat is 4.328 with a degree of freedom of 39, and there is a p-value (sig. 2-tailed) of 0.000, which is below the normal alpha level of 0.05. The t-test indicates that the average perception of the farmer's was significantly above the test value of 4, with a mean difference of

0.245. The 95% confidence interval (between 0.1305 and 0.3595) shows that the mean difference is statistically significant because it does not pass through zero. Based on the p-value being less than 0.05, the null hypothesis (H_0) has been rejected; therefore, the alternative hypothesis (H_1) has been accepted. This indicates that the variability in climate has significantly impacted the agricultural productivity of farmers in the hilly areas of Western Maharashtra, as supported by the robust perceptions reported by the farmer participants regarding the negative effects that variability in rainfall and temperature and increased frequency of severe weather events have on crop yield and farming practices.

Findings Of the Study

1. Climate variability significantly affects agricultural productivity and farmers' income: The study revealed that irregular rainfall, rising temperatures, and extreme weather events strongly influence crop growth, yield, and quality, leading to reduced agricultural output and financial stress among farmers. Both descriptive statistics (mean scores above 4) and one-sample t-test results confirmed that farmers perceive climate variability as a major challenge in sustaining their livelihoods.
2. Increased Vulnerability from Insufficient Adaptation Measures & Support. Farmers indicated that their lack of access to climate-smart practices (CSPs) and supports (whether from Government or other entities) were significant limitations on their ability to respond effectively to CC. Many farmers in developing nations have adapted their cropping practices. However, the inconsistency in the availability of training, cutting-edge methods and financial assistance limits the impact of the adaptations that are made.

Suggestions

1. It is suggested that government and agricultural institutions should provide comprehensive climate-resilient training programs, financial support, and access to modern agricultural technologies to help farmers adapt to changing climatic conditions and maintain stable agricultural productivity.
2. It is suggested that promotion of climate-smart agricultural practices, such as water conservation methods, drought-resistant crop varieties, and crop diversification, should be encouraged to reduce dependency on rainfall and minimize income fluctuations caused by climate variability.

Conclusions

The research concludes the changing climate has a major effect on farmers' income and agricultural productivity in the hilly regions of western Maharashtra. Unpredictable rainfall, increasing temperatures and extreme weather events are detrimental to crop growth, yield, and quality of produce. As a result, farmers are experiencing financial difficulties and fluctuations in income. Farmers are trying to adapt their cropping patterns to address these changing conditions, however, their ability to adequately mitigate these impacts is limited because of a lack of access to climate-smart practices and inadequate government support. The results indicate an urgent need for targeted interventions. Interventions should include training programs, financial support and promotion of climate-resilient farming techniques to increase agricultural productivity, create stable income sources for farmers and develop sustainable livelihoods within the region.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

References

1. Singh, N. P., Anand, B., Srivastava, S. K., Rao, K. V., Bal, S. K., & Prabhakar, M. (2025). *Assessing the Impacts of Climate Change on Crop Yields in Different Agro-climatic Zones of India*. Journal of Atmospheric Science Research. DOI:10.30564/jasr. v3i4.2269.
2. Kumar, S., & Upadhyay, S. (2019). *Impact of Climate Change on Agricultural Productivity and Food Security in India: A State Level Analysis*. Indian Journal of Agricultural Research, 53(2), 133–142.
3. Pandey, V. (2023). *Climate Variability, Trends, Projections and Their Impact on Different Crops: A Case Study of Gujarat, India*. Journal of Agrometeorology, 25(2), 224–238.
4. Balasubramanian, I., & Kavi Kumar, K. S. (2010). *Climate Variability and Agricultural Productivity: Case Study of Rice Yields in Northern India*. Working Paper, Madras School of Economics.
5. Khedikar, S. Y., Panchabhai, S. N., & Mandal, T. K. (2023). *Study on Effect of Rainfall Variability on Crop Productivity of Tur (Arhar) and Cotton Crops for Various Districts of Maharashtra, India*. International Journal of Environment and Climate Change.
6. "Climate variability, rainfall shocks, and farmers' income diversification in India." *Economics Letters*, Volume 174 (2019).
7. *Farmers' Perception and Efficacy of Adaptation Decisions to Climate Change*. MDPI Agriculture (2025).