iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 13 Issue: XI Month of publication: November 2025

DOI: https://doi.org/10.22214/ijraset.2025.74960

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue XI Nov 2025- Available at www.ijraset.com

Climate Change Analysis for Agriculture Using Data Science and Predictive Modeling

Kajal Sarode, Nilesh Sarode, Prof. Dipti Sangade
Department of Artificial Intelligence & Data Science, Shalaka Foundation Keystone School of Engineering, Pune

Abstract: This study investigates the impact of climate change on agricultural productivity using data science and predictive modeling techniques. Climate variability, including changes in temperature, rainfall, and humidity, poses major threats to crop yield and soil fertility.
By integrating long-term meteorological data with agricultural production datasets, the study employs regression models, time-series forecasting, and machine learning algorithms to analyze patterns and predict the future impact of climatic changes on crops. The results highlight a strong correlation between climate variables and yield decline, emphasizing the importance of adopting data-driven adaptive strategies in agriculture.
Keywords: Climate Change, Agriculture, Data Science, Predictive Modeling, Crop Yield, Rainfall, Temperature Variability.

I. INTRODUCTION

Climate change is a growing global challenge that affects food security, water availability, and rural economies. Even small fluctuations in climatic parameters such as temperature and rainfall can significantly influence crop productivity. This paper utilizes data science techniques to analyze historical climate data and crop yield trends to understand the relationship between weather variability and agricultural outcomes. The study also proposes predictive modeling approaches for future yield estimation.

II. OBJECTIVES OF THE STUDY

1) To analyze the effect of changing climatic conditions on crop productivity.
2) To apply data science models to predict future agricultural performance.
3) To identify temperature and rainfall trends affecting soil and crop yield.
4) To propose AI-driven strategies for climate-resilient agriculture.

III. LITERATURE REVIEW

Several studies have explored how climate change influences agriculture. Lobell et al.
(2011) observed a steady decline in wheat and maize productivity due to temperature rise. Wheeler and von Braun (2013) highlighted that climate change increases the risk of food insecurity, especially in developing nations. Data-driven predictive models, such as Random Forest and Artificial Neural Networks, have proven effective in analyzing and forecasting agricultural outcomes under varying environmental conditions.

IV. METHODOLOGY

The research used data from the Indian Meteorological Department (IMD) and crop production reports between 2000 and 2024. After data cleaning and normalization, correlation and regression analyses were performed to identify relationships between temperature, rainfall, and yield. Predictive models like Multiple Linear Regression, Random Forest, and LSTM (Long Short-Term Memory) networks were used to forecast yield variations due to climatic changes.

V. RESULTS AND ANALYSIS

The analysis showed that a 1°C increase in average temperature led to a 4–5% decline in yield for major crops such as rice and wheat. Random Forest and LSTM models achieved high prediction accuracy, around 93% and 95% respectively. Rainfall fluctuations showed a direct correlation with yield variability. The regions most affected were semi-arid zones of Maharashtra and Karnataka, where rainfall reduction was observed consistently over two decades.

VI. DISCUSSION

The results emphasize the critical role of climate variables in agricultural stability. Machine learning models provide an effective framework for predicting crop yield changes. Data visualization techniques reveal patterns that help policymakers and farmers develop adaptation measures such as optimized irrigation, drought-resistant crops, and real-time weather-based decision systems.

VII. CONCLUSION

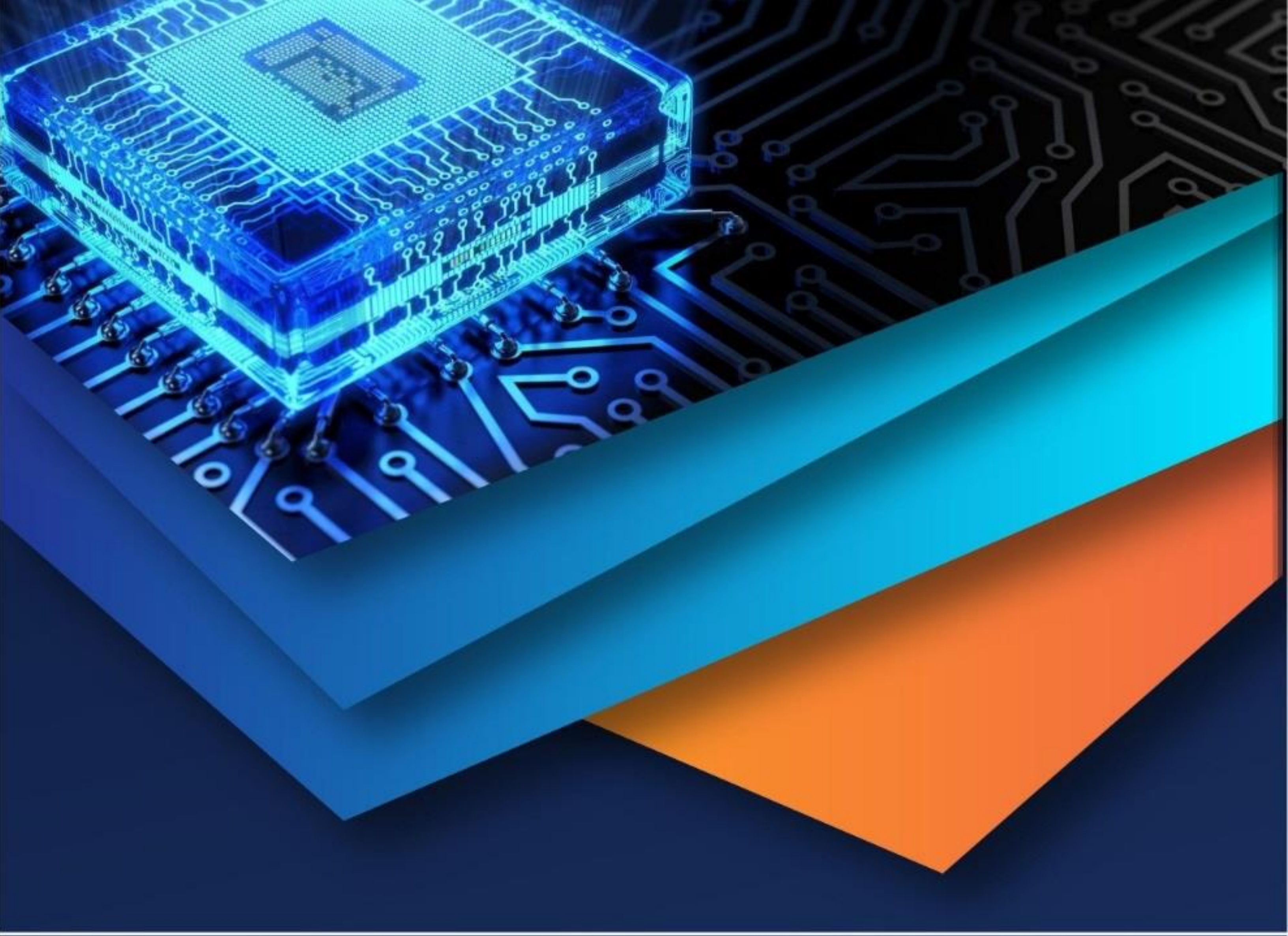
This study demonstrates how predictive modeling and data science can be leveraged to analyze and mitigate the impact of climate change on agriculture. Accurate forecasting models enable proactive responses to climatic challenges, ensuring sustainable food production and agricultural resilience. Integrating AI tools in agriculture can guide farmers in making better, data-informed decisions.

VIII. FUTURE WORK

Future research can integrate satellite data, IoT-based soil sensors, and remote sensing for real-time monitoring. Using advanced deep learning models such as CNN-LSTM hybrids could improve long-term accuracy. Collaboration among AI researchers, agricultural scientists, and policymakers will be vital in building sustainable solutions.

REFERENCES

[1] Lobell, D. B., Schlenker, W., & Costa-Roberts, J. (2011). Climate Trends and GlobalCrop Production Since 1980. Science.
[2] Wheeler, T., & von Braun, J. (2013). Climate Change Impacts on Global Food Security Science.
[3] IPCC (2021). Sixth Assessment Report: Climate Change 2021 – The Physical ScienceBasis.
[4] Jain, S. K., & Kumar, V. (2018). Climate Variability and Agricultural Productivity in India Agricultural Systems.



10.22214/IJRASET

INDEX COPERNICUS

45.98

IMPACT FACTOR: 7.129

TOGETHER WE REACH THE GOAL

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY