

A Structured Impression of the Key Effects of Average Rainfall and Temperature on Indian Crop Yields

Ameya Uchil

The International School Bangalore, Sarjapur Road, Whitefield, Bengaluru, India

Abstract

Climate change has significant and far-reaching effects on agriculture, a cornerstone of the Indian economy, which supports nearly 60% of the population and contributes substantially to national GDP. The most prominent effect is marked by the rising temperatures, changes in rainfall patterns and shifting monsoon cycles which impacts different crop productivity, soil health and farming practices. The present study focuses on understanding the effects of average rainfall and temperature on Indian crop yields such as oilseeds, rice, pulses, maize and wheat over five years (2020-2025) timeframe through tree-based AI models like XGBoost. The relationships between climate variables and yield was determined by Exploratory Data Analysis (EDA), where scatter plots of Rainfall vs. Yield and Temperature vs. Yield was created to visually assess patterns. The test set was predicted and evaluated using R^2 (coefficient of determination) and RMSE (root mean squared error). These metrics quantify model accuracy: a higher R^2 (up to 1.0) and lower RMSE indicate better fit. Results indicated that the optimal rainfall threshold and climate sensitivity vary markedly across Indian states. The average rainfall (mm) and average temperature ($^{\circ}\text{C}$) for the maize, oilseeds, pulses, rice and wheat was found to be in the range of 1080- 1142 mm and 26.96- 27.14 $^{\circ}\text{C}$, with average yield between 33.73- 36.34 q/ha. The data patterns showed that climatic disturbances have led to reduced yields of staple crops thereby affecting food security, rural livelihoods, and income stability.