# Vivekanand Education Society's Institute of Technology


## Department of Computer Engineering

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## Project Synopsis (2024-25) - Sem VII

# FarmImpact: Impact of Climate Change on Agriculture in India

Dr. Gresha Bhatia
Deputy HOD, Department of Computer Engineering

Vishakha Singh
VESIT
2021.vishakha.singh@ves.ac.in

Manasi Sharma
VESIT
2021.manasi.sharma@ves.ac.in

Anushka Shirode
VESIT
2021.anushka.shirode@ves.ac.in

## Abstract

Climate change poses a significant threat to agriculture in India, a sector that sustains a large portion of the population and contributes substantially to the country's economy. This research aims to identify and analyze the climate and environmental factors that have the most profound impact on agricultural productivity in India. By examining variables such as temperature fluctuations, changes in precipitation patterns, frequency of extreme weather events, soil degradation, and water scarcity, this study seeks to understand their direct and indirect effects on crop yield and farming practices. Through comprehensive data analysis and modeling, the research will provide insights into how these factors interact and influence agricultural outputs. The findings will be crucial for developing adaptive strategies and policies to mitigate the adverse effects of climate change on agriculture, ensuring food security, and sustaining the livelihoods of millions of farmers.

## Introduction

Indian agriculture is crucial for ensuring food, nutrition, and livelihood security but is currently facing significant challenges. These include stagnating net sown area, plateauing yields, soil quality deterioration, and reduced per capita land availability. Climate change exacerbates these issues, particularly affecting rainfed areas, which constitute about 60% of cultivated land. With over 80% of farmers being small and marginal, the agricultural sector is under immense pressure from a growing population and lacks the capacity to cope with these stresses. Increased greenhouse gases like CO2, CH4, and N2O are driving global warming, resulting in rising temperatures and more extreme weather events that negatively impact crops, soils, livestock, and pests, thereby threatening food security and agricultural sustainability.

The impact of climate change on Indian agriculture is profound, particularly with the increased frequency of climatic extremes such as droughts, floods, frosts, heat waves, and cyclones. Predictions indicate a significant rise in global temperatures within the next 50 years, leading to more crop losses, malnutrition, and shifts in pest and disease patterns. Rainfed regions, which produce 40-45% of India's total agricultural output, are highly vulnerable to these changes. Water resources are becoming scarcer, soil health is deteriorating, and livestock and fisheries are also adversely affected. Addressing these challenges requires innovative, climate-resilient agricultural technologies and adaptive management strategies to ensure the sustainability of Indian agriculture in the face of climate change.

To address these pressing challenges, it is essential to adopt a multi-pronged approach that integrates scientific research, technological innovation, and effective policy frameworks. Investments in climate-resilient crops, efficient irrigation systems, and soil conservation practices are critical for enhancing agricultural productivity and sustainability. Additionally, leveraging data-driven tools such as climate modeling and predictive analytics can provide valuable insights for proactive decision-making. Strengthening institutional support and providing targeted training to farmers will empower them to implement adaptive practices and technologies effectively. Collaboration between government agencies, research institutions, and

international organizations will be crucial in developing and disseminating solutions that are both practical and scalable. By fostering resilience through these combined efforts, Indian agriculture can better withstand the impacts of climate change, ensuring continued food security and economic stability for the nation.

## Problem Statement

To identify and analyze the climate and environmental factors that most significantly impact agricultural productivity in India. This study aims to provide insights into how variables such as temperature fluctuations, precipitation changes, and extreme weather events affect crop yields and farming practices.

## Proposed Solution

The proposed solution involves developing a comprehensive analytical framework that integrates climate data, environmental variables, and agricultural yield statistics to identify key factors affecting productivity. By leveraging machine learning algorithms and predictive modeling, the study will forecast crop yields under various climate scenarios, enabling the formulation of adaptive strategies and policy recommendations to enhance agricultural resilience and sustainability in India.

## Methodology / Block Diagram

1. Climate change adaptation in agriculture requires a comprehensive and systematic approach. The first step involves Assessment and Analysis, which includes conducting a situation analysis, climate risk ranking, and collecting baseline data. This foundation helps in understanding the current state and vulnerabilities of agricultural practices.
2. Next is the Development of Adaptation Strategies, where various climate change scenarios are modeled, and new technologies are designed to address potential impacts.
3. Following this, Implementation and Operationalization involves the deployment of these adaptation technologies, training farmers, and developing state-specific action plans to ensure practical application on the ground.
4. Finally, Monitoring and Evaluation ensure that the implemented strategies are effective, by conducting climate impact assessments, evaluating the success of adaptation strategies, and continuously monitoring crop productivity.

This systematic approach ensures that agriculture in India can adapt to the challenges posed by climate change and continue to sustain the population and economy.

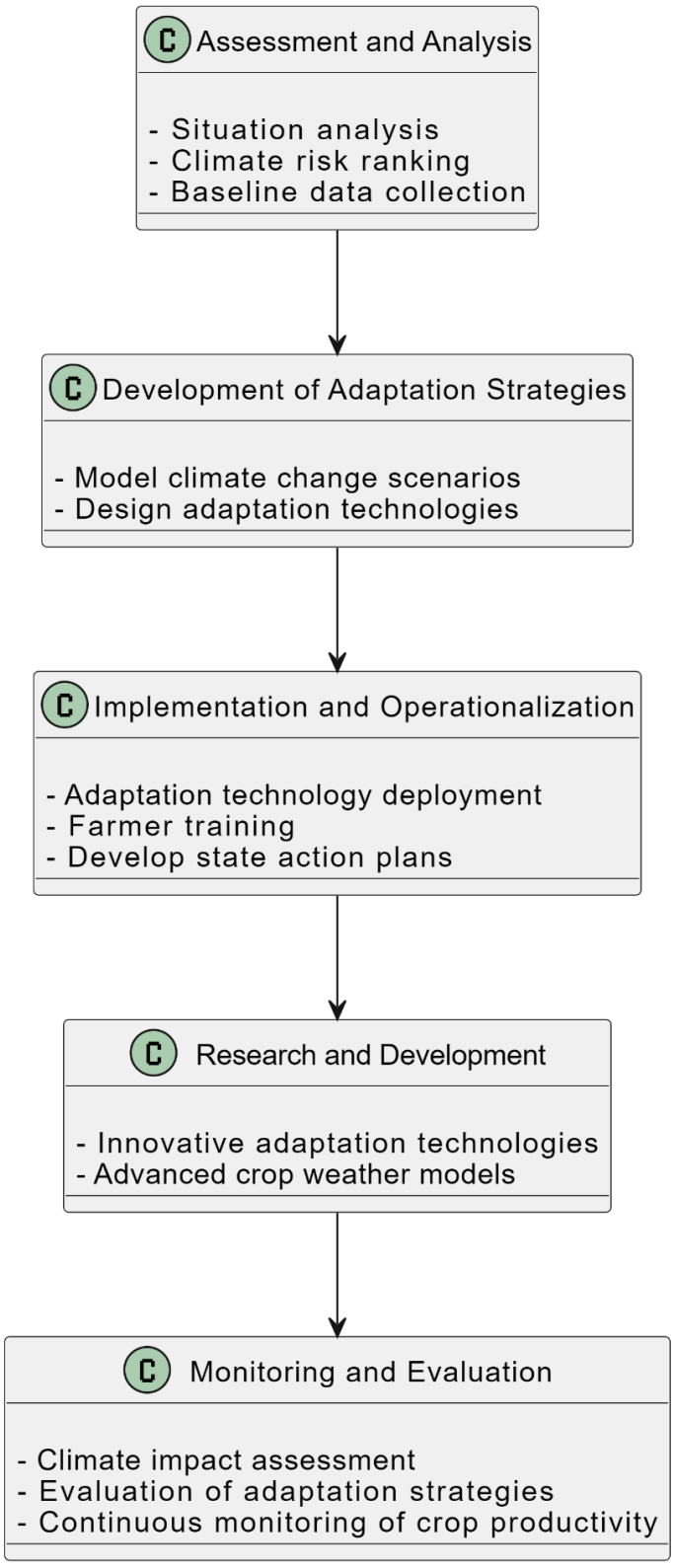


Fig 1. Class diagram of climate change adaptation in agriculture

## Hardware , Software and Tools Requirements

Hardware:

- Processor (CPU): Intel Core i5
- RAM : 16 GB
- PC and/or laptop

Software:
Operating System - Windows 10 or 11

Machine Learning Tools:

- Python - 3.10+
- Anaconda: Package distribution - 2023.05
- TensorFlow/PyTorch: Deep learning frameworks - 2.12.0
- scikit-learn: Machine learning library - 1.3.0
- Matplotlib/Seaborn: Python libraries for plotting - 3.7.1

Geospatial Analysis:

- QGIS: GIS software - 3.30

## Proposed Evaluation Measures

Evaluating the impact of climate change on agriculture involves analyzing parameters like rainfall, weather patterns, temperature, and location. Key evaluation measures include sensitivity, which identifies true positives (actual climate impacts on crops); specificity, which identifies true negatives (normal variations not due to climate change); and accuracy, providing an overall correctness of predictions. Precision assesses the correctness of positive identifications, while recall (sensitivity) ensures capturing all relevant climate impacts. The F1 Score balances precision and recall, especially useful in imbalanced datasets. ROC-AUC evaluates model performance across thresholds. Mean Squared Error (MSE) and Root Mean Squared Error (RMSE) measure prediction accuracy, and the correlation coefficient assesses the linear relationship between predicted and actual values. R-squared indicates the proportion of variance explained by the model. These measures help researchers and policymakers understand climate change impacts on agriculture for informed decision-making and adaptation strategies.

## Conclusion

This research highlights the urgent need to address climate change impacts on Indian agriculture. By analyzing how changing weather patterns affect crop yields, the study aims to develop strategies for more resilient farming practices. Key measures include creating climate-resilient crops, improving water and soil management, and using advanced forecasting tools. Collaborative efforts and integrating modern technology with traditional practices are crucial. The findings will help shape policies to ensure a stable and sustainable agricultural sector in India.

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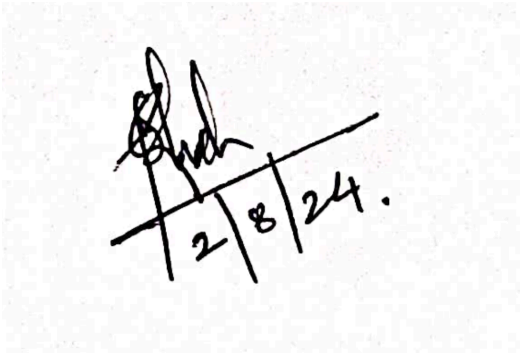
**Signature of Mentor**




**Signature of group members**

Vishakha Singh
D17B - 54

Manasi Sharma
D17B - 51

Anushka Shirode
D17B - 53