Climate Change Impact on Food Security Using NASA POWER Data

Project Progress Report

1. Introduction

Climate change poses a significant threat to food security, especially in climate-sensitive regions such as India. Variations in rainfall patterns and rising temperatures directly affect agricultural productivity, water availability, and crop resilience. Understanding these climatic changes through data-driven approaches is essential for identifying vulnerable regions and developing adaptive strategies.

In this project, we aim to analyze historical climate data and assess food security risk by constructing a composite index that integrates rainfall variability and temperature stress using reliable satellite-based datasets.

2. Data Source and Study Area

We use climate datasets obtained from the **NASA POWER (Prediction Of Worldwide Energy Resources)** database, which provides standardized and validated meteorological information.

Dataset characteristics:

- Data format: CSV
- Temporal resolution: Yearly
- Study region: Selected Indian cities
- Key parameters: Annual rainfall (mm) and average annual temperature (°C)

Each dataset is augmented with metadata such as city name, state, and climate type (e.g., Indo-Gangetic Plain, Coastal, Arid) to support regional comparison.

3. Objectives of the Project

The main objectives of our project are summarized in Table 1.

Table 1: Project Objectives

No.	Objective
1	To analyze long-term rainfall and temperature trends using NASA POWER data.
2	To quantify climate variability through normalized rainfall and temperature indices.
3	To develop a climate-based Food Security Risk Score.
4	To compare food security risks across different climate regions.
5	To visualize trends and relationships using graphs and heatmaps.

4. Work Completed So Far

4.1 Data Processing

We successfully imported and cleaned climate datasets for multiple cities. Relevant parameters were filtered, missing values were handled, and all city-wise datasets were merged into a single unified dataframe for analysis.

4.2 Parameter Derivation

The following parameters have been derived:

- **Annual Rainfall (Rainfall_mm):** Extracted from yearly precipitation data.
- **Rainfall Normalization:** Performed using Min-Max scaling for inter-city comparison.
- **Climate Risk Score:** Calculated using rainfall deviation from long-term averages.
- **Temperature Normalization:** Applied to assess relative heat stress levels.

4.3 Food Security Risk Index

A composite **Food Security Risk Score** was developed using a weighted combination of rainfall variability, temperature stress, and low rainfall penalty. This index provides a quantitative measure of climate-induced food insecurity risk.

4.4 Visualization

We generated several visualizations, including heatmaps, trend plots, and comparative charts, to support interpretation of climatic impacts across regions.

5. Preliminary Observations

Our initial analysis indicates noticeable inter-annual rainfall variability and a gradual rise in temperature across multiple regions. Areas experiencing both rainfall irregularity and higher temperatures tend to show elevated food security risk scores, highlighting the strong linkage between climate change and food insecurity.

6. Work Plan and Timeline

The planned activities and timeline are presented in Table 2.

7. Conclusion

At this stage, we have completed data acquisition, preprocessing, parameter derivation, and initial analysis. A structured climate-based food security risk model has been developed and supported through visual analytics. In the next phase, we plan to refine the model, expand the analysis, and prepare a comprehensive final report.

Table 2: Project Timeline

Phase	**Duration**	**Activities**
Phase 1	Completed	Data collection, cleaning, preprocessing
Phase 2	Completed	Parameter calculation and index development
Phase 3	Ongoing	Visualization and trend analysis
Phase 4	Upcoming	Model refinement and validation
Phase 5	Upcoming	Final report preparation using Overleaf