# Weather Based Smart Crop Recommendation and Diseases Prediction

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***Abstract*—Agriculture plays a vital role in food production and economic development. However, selecting suitable crops under varying soil and climatic conditions remains a significant challenge for farmers. This paper presents a Weather-Based Smart Crop Recommendation and Disease Prediction System that utilizes machine learning techniques to support efficient agricultural decision-making. The proposed system analyzes essential soil parameters such as Nitrogen (N), Phosphorus (P), Potassium (K), pH level, along with environmental factors including temperature, humidity, and rainfall to recommend optimal crops. A Random Forest algorithm is employed to ensure accurate and reliable predictions. In addition, the system incorporates a plant disease detection module that enables farmers to upload leaf images for identifying potential diseases using image analysis techniques. Furthermore, the system provides fertilizer recommendations based on soil nutrient levels and integrates market trend analysis to assist farmers in selecting economically profitable crops. The application is developed as a web-based platform using Streamlit, ensuring ease of use and accessibility. The proposed system enhances crop productivity, reduces potential losses, and promotes data-driven decision-making in modern agriculture.**

***Index Terms*—Agriculture, Crop Recommendation, Disease Prediction, Machine Learning, Random Forest, Soil Nutrients, Streamlit.**

## I. INTRODUCTION

Agriculture is one of the most essential sectors globally, playing a crucial role in food production and economic stability. A significant portion of the population, particularly in countries like India, depends on agriculture for livelihood and income generation. However, selecting suitable crops under varying environmental and soil conditions remains a major challenge for farmers.

Crop productivity is highly influenced by multiple factors such as soil nutrients, rainfall, temperature, and humidity. These parameters vary across regions and seasons, making it difficult for farmers to consistently choose the most appropriate crops. In many cases, farmers rely on traditional knowledge, experience, or informal advice, which may not always result in optimal outcomes due to changing climatic patterns and soil conditions.

Advancements in machine learning and data-driven technologies provide effective solutions to address these challenges. By analyzing soil and environmental data, intelligent systems can recommend suitable crops with improved accuracy. In this context, the proposed system introduces a Weather-Based Smart Crop Recommendation and Disease Prediction approach that utilizes machine learning techniques for better agricultural decision-making.

The system employs a Random Forest algorithm to analyze parameters such as Nitrogen (N), Phosphorus (P), Potassium (K), soil pH, temperature, humidity, and rainfall to predict the most suitable crop. In addition, it incorporates a plant disease detection module that uses image classification techniques to identify diseases from leaf images at an early stage, enabling timely intervention and crop protection.
Furthermore, the system provides fertilizer recommendations based on soil nutrient levels and integrates market trend analysis to support economically beneficial crop selection. The solution is implemented as a user-friendly web-based application, allowing farmers to easily input data and obtain real-time results without requiring advanced technical knowledge.

By integrating crop recommendation, disease detection, and market analysis into a unified platform, the proposed system enhances agricultural productivity, reduces crop failure risks, and promotes sustainable farming practices through data-driven decision-making.

## II. LITERATURE SURVEY

Several researchers have explored the application of machine learning techniques to support crop recommendation and agricultural decision-making. Various studies utilize soil parameters such as pH, moisture content, and nutrient levels to predict suitable crops and improve yield. Machine learning models including Random Forest, Support Vector Machines (SVM), and Artificial Neural Networks (ANN) have been widely employed to enhance prediction accuracy.

Advanced approaches have incorporated environmental factors such as temperature, humidity, and rainfall to provide more reliable recommendations. In addition, IoT-based systems and wireless sensor networks have been developed to collect real-time soil and environmental data, enabling continuous monitoring and improved decision-making. These technologies enhance data accuracy and provide dynamic insights into agricultural conditions.

Recent developments also include web-based and mobile applications that allow farmers to input soil and weather parameters and receive instant crop recommendations. These systems aim to improve accessibility and usability, especially for farmers with limited technical expertise.

Despite these advancements, several limitations persist in existing systems. Many approaches rely on complex models that require large datasets and high computational resources, making them less suitable for small-scale farmers. IoT-based solutions, although effective, often involve high implementation costs due to sensor and infrastructure requirements. Furthermore, some applications lack user-friendly interfaces, limiting their practical usability in real-world scenarios.

Overall, the literature demonstrates that machine learning significantly improves crop prediction and agricultural productivity. However, challenges such as system complexity, high cost, and limited accessibility highlight the need for a simple, cost-effective, and user-friendly solution. These limitations motivate the development of the proposed system, which aims to integrate accuracy, efficiency, and ease of use into a unified agricultural decision support platform.

## III. PROPOSED SYSTEM

The proposed system is a Weather-Based Smart Crop Recommendation and Disease Prediction System designed to assist farmers in selecting suitable crops based on environmental and soil conditions. The system integrates multiple modules that work together to provide accurate, reliable, and user-friendly agricultural decision support.

### A. User Authentication Module

The system includes a secure login and registration mechanism for users. Farmers can create accounts and access the platform using their credentials. This module ensures secure access, enables personalized recommendations, and maintains user data along with historical records. It also allows users to track previous crop suggestions and disease analysis results for better decision-making.

### B. Crop Recommendation Module

This module predicts the most suitable crop based on key soil and environmental parameters. The input parameters include Nitrogen (N), Phosphorus (P), Potassium (K), soil pH, temperature, humidity, and rainfall. A Random Forest machine learning algorithm is employed to analyze these inputs and generate accurate crop recommendations. The model enhances prediction reliability by combining multiple decision trees.

### C. Plant Disease Detection Module

The system incorporates an image-based disease detection module. Farmers can upload images of plant leaves, and the system analyzes them using image classification techniques to identify potential diseases. This enables early detection and helps farmers take timely preventive measures to reduce crop damage.

### D. Fertilizer Recommendation Module

Based on the analysis of soil nutrient levels, the system provides appropriate fertilizer suggestions. This module helps improve soil fertility and supports

optimal crop growth by recommending suitable nutrient supplements.

E. Market Demand Prediction Module
To assist farmers in maximizing profitability, the system includes a market analysis component. It uses time-series models such as Long Short-Term Memory (LSTM) and AutoRegressive Integrated Moving Average (ARIMA) to analyze market trends and predict crop demand and pricing patterns.

F. Decision Fusion Module
The final recommendation is generated by combining outputs from all modules using a weighted scoring mechanism. This integrated approach ensures that the recommended crop is not only suitable for environmental conditions but also economically viable.

The proposed system is implemented as a web-based application, ensuring ease of access and usability for farmers with minimal technical knowledge. By integrating multiple functionalities into a single platform, the system enhances agricultural productivity and supports data-driven farming practices.

## IV. METHODOLOGY

The methodology of the proposed system involves systematic steps including data collection, preprocessing, model development, and evaluation to ensure accurate crop recommendation and disease prediction.

A. Data Collection
The system utilizes an agricultural dataset comprising soil nutrients, environmental parameters, and crop labels. The dataset includes attributes such as Nitrogen (N), Phosphorus (P), Potassium (K), soil pH, temperature, humidity, and rainfall. It contains information related to 22 different crop types, enabling the model to learn diverse agricultural patterns.

B. Data Preprocessing
Prior to model training, the collected data is preprocessed to enhance its quality and reliability. This step includes handling missing values, validating input ranges, and normalizing numerical features to ensure uniform scaling. Data preprocessing improves model performance by reducing noise and inconsistencies in the dataset.

C. Machine Learning Model
The system employs the Random Forest algorithm for crop prediction due to its robustness and high accuracy. Random Forest is an ensemble learning technique that constructs multiple decision trees and combines their outputs to generate reliable predictions. In addition, other models such as Logistic Regression and Long Short-Term Memory (LSTM) networks are used for comparative analysis and performance evaluation.

D. Model Evaluation
The dataset is divided into training and testing sets to assess model performance. The model is trained using the training data and evaluated on the testing data to measure its predictive capability. Performance metrics such as accuracy are used to validate the effectiveness of the model. The Random Forest algorithm demonstrated superior performance compared to other models, making it suitable for real-world agricultural applications.

## VI. CONCLUSION AND FUTURE WORK

This paper presented a Weather-Based Smart Crop Recommendation and Disease Prediction System that leverages machine learning techniques to support effective agricultural decision-making. The system analyzes soil nutrients and environmental parameters to recommend suitable crops, while also incorporating a plant disease detection module that identifies diseases from leaf images using image processing and classification techniques.

The proposed system enables farmers to improve crop yield, reduce financial losses, and make data-driven decisions. The integration of fertilizer recommendation and real-time weather data further enhances the accuracy and reliability of the system. By incorporating environmental factors such as temperature and humidity through external weather APIs, the system ensures that recommendations are aligned with current climatic conditions.

The implementation of the system as a web-based application using the Streamlit framework provides an intuitive and user-friendly interface, allowing users to input data, upload images, and visualize results efficiently. Cloud deployment ensures

accessibility across multiple devices without requiring specialized infrastructure, making the system practical for real-world usage.

Overall, the proposed system demonstrates the potential of artificial intelligence and data-driven approaches in improving agricultural productivity and promoting sustainable farming practices.

In future work, the system can be enhanced by integrating IoT-based sensors for real-time soil monitoring, incorporating advanced deep learning models for improved disease detection, and developing a mobile application to increase accessibility. Additionally, the inclusion of satellite data and multilingual support can further expand the system's usability and effectiveness across diverse agricultural regions.

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