

FarmaSuit: -The Agricultural Recommendation System

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ABSTRACT—

Agriculture plays a vital role in the Indian economy and supports the livelihood of millions of people. However, improper crop selection, excessive fertilizer usage, and changing weather conditions often reduce agricultural productivity. FarmaSuit is a machine learning-based agricultural recommendation system developed to assist farmers in making informed farming decisions. The system provides crop recommendations and fertilizer suggestions based on soil nutrients (N, P, K), pH value, temperature, humidity, and rainfall data. Multiple machine learning algorithms including Random Forest, Support Vector Machine (SVM), K-Nearest Neighbors (KNN), Gradient Boosting, and Neural Networks were evaluated to identify the most suitable prediction model. The system was implemented using React for the frontend, FastAPI for the backend, and MongoDB for data management. Experimental results demonstrate that the proposed system provides accurate recommendations and supports sustainable farming practices through data-driven decision making. FarmaSuit serves as an intelligent decision support platform that bridges the gap between traditional agriculture and modern technology.

Keywords-

Agriculture, Machine Learning, Crop Recommendation System, Fertilizer Recommendation, Smart Agriculture, Precision Farming, Soil Analysis, Weather-Based Prediction, Decision Support System, AI ChatBot Sustainable Farming, FastAPI, React, MongoDB.

1. INTRODUCTION

Agriculture remains one of the most important sectors in India, contributing significantly to the economy and employment generation. Farmers frequently face challenges related to crop selection, fertilizer management, and unpredictable climatic conditions. Traditional farming decisions are often based on experience rather than scientific analysis, leading to reduced productivity and inefficient utilization of resources.

To address these challenges, FarmaSuit – Agricultural Recommendation System was developed as an intelligent web-based platform that utilizes machine learning techniques to provide crop and fertilizer recommendations. The system analyzes important agricultural parameters such as soil nutrients, pH value, temperature, humidity, and rainfall to generate accurate recommendations.

The platform integrates machine learning models with modern web technologies to provide a user-friendly solution for farmers. By offering personalized recommendations based on real-time inputs, FarmaSuit helps improve crop productivity, optimize fertilizer usage, reduce resource wastage, and promote sustainable farming practices.

PROBLEM STATEMENT

Farmers often face difficulties in selecting suitable crops and fertilizers due to the lack of scientific decision support systems. Incorrect crop selection and improper fertilizer application can result in lower yield, increased production costs, and environmental degradation. Existing agricultural systems frequently focus on individual aspects of farming and fail to provide an integrated solution. Therefore, there is a need for a smart agricultural recommendation platform capable of analyzing soil and environmental parameters to provide accurate crop and fertilizer recommendations. FarmaSuit addresses this challenge by using machine learning techniques to assist farmers in making informed and data-driven agricultural decisions.

3.RELATED WORK

Several research works have focused on applying machine learning techniques in agriculture to support farmers in crop selection, yield improvement, and fertilizer recommendation. Most of these systems use soil nutrients (N, P, K), pH, rainfall, temperature, and humidity as key parameters for prediction and recommendation.

1 Crop Recommendation using Machine Learning (2021)

A study presented in the Proceedings of the Fifth International Conference on Intelligent Computing and Control Systems (ICICCS 2021) analyzed different ML techniques used for crop yield prediction, showing that machine learning is highly useful in supporting crop yield estimation under varying soil fertility and climatic conditions. The paper also included a comparative analysis where SVM achieved an accuracy of 97.77%, with 96.55% sensitivity and 99.24% precision in crop-related classification tasks. This work highlights the strength of ML models in extracting patterns from agricultural datasets, while also pointing out limitations like performance reduction when handling nonlinear relationships in some ANN-based models.

2.Crop Prediction Model Using Machine Learning Algorithms (Applied Sciences, MDPI 2023)

proposed a crop prediction system that evaluates 15 machine learning algorithms using features including nitrogen (N), phosphorus (P), potassium (K), soil pH, rainfall, humidity, and temperature. The dataset used contains 2200 records and 22 crop labels. The experimental results reported very high performance where Bayes Net achieved 99.59% accuracy, while Naïve Bayes Classifier and Hoeffding Tree achieved 99.46% accuracy, showing strong classification ability for crop recommendation systems.

3. Data-Driven Soil Analysis and Evaluation for Smart Farming Using Machine Learning Approaches” (2023)

Huang et al. (2023) proposed a data-driven soil analysis system that combines crop identification, irrigation recommendation, and fertilizer (nitrogen) prediction in a single integrated framework. The system uses satellite/remote sensing data and public soil-climate features and applies machine learning models such as Random Forest, SVM, AdaBoost, Linear Regression, and MLP. The reported results show that the best crop identification accuracy reached ~78% using MLP, while the fertilizer recommendation model achieved the highest accuracy of 93.3% using MLP, demonstrating strong performance for soil-based smart farming decision support.

4.Can Machine Learning Models Provide Accurate Fertilizer Recommendations? (Precision Agriculture Journal)(2024)

Tanaka et al. studied whether machine learning models can provide reliable fertilizer recommendations by estimating economically optimal input rates (EOIRs) using real on-farm precision experimentation data. The work compared models such as Random Forest, XGBoost, Support Vector Regression, and Artificial Neural Networks. While the models could predict crop yield with reasonable accuracy, the fertilizer recommendation results showed high uncertainty, as EOIR outputs varied significantly depending on the selected model and input features.

4. PROPOSED ARCHITECTURE

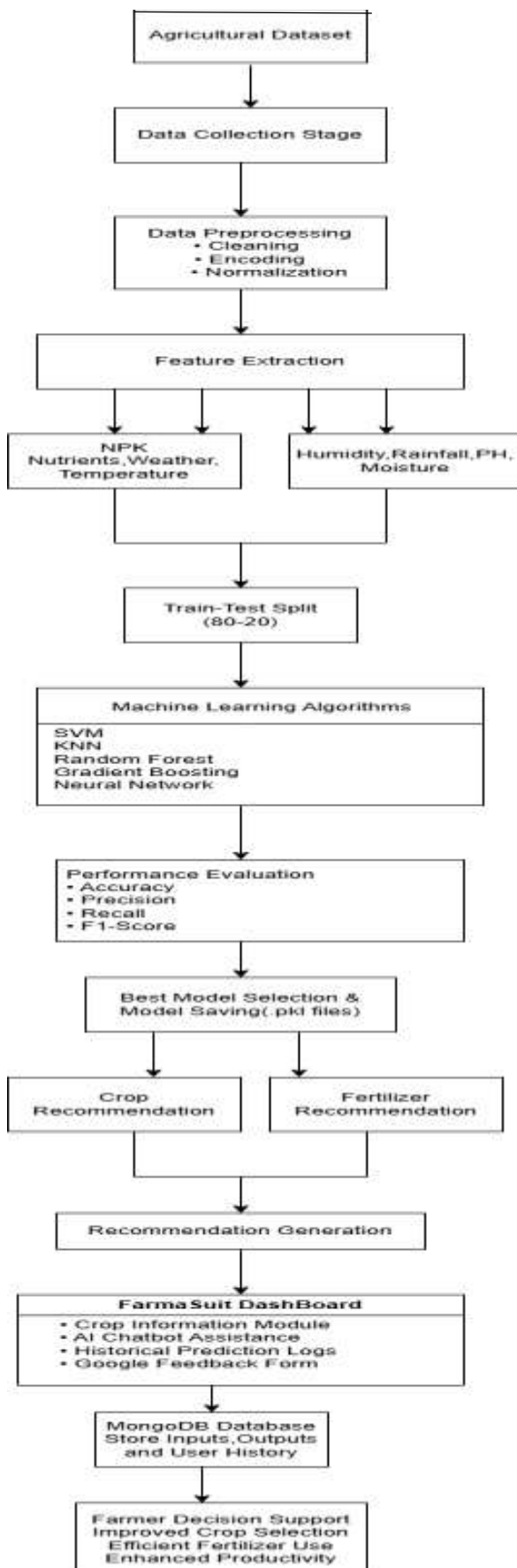


Fig 1. Proposed Architecture

The FarmaSuit architecture consists of data collection, preprocessing, machine learning prediction, and recommendation modules. Users provide agricultural inputs including nitrogen (N), phosphorus (P), potassium (K), soil pH, temperature, humidity, and rainfall values through the web interface. The input data is validated and processed before being passed to trained machine learning models.

The prediction engine analyzes the provided parameters and generates crop recommendations. Based on nutrient deficiencies and soil conditions, the system also provides fertilizer recommendations. Weather information is incorporated to improve recommendation quality and support farming decisions. The final recommendations are displayed to users through the FarmaSuit web application.

5. SYSTEM OVERVIEW

FarmaSuit operates through a structured workflow. Initially, agricultural data is collected from users through the web application interface. The collected data includes soil nutrient values (N, P, K), pH level, temperature, humidity, and rainfall information. The input data undergoes preprocessing to eliminate inconsistencies and prepare it for analysis.

The processed data is then supplied to trained machine learning models including Random Forest, SVM, KNN, Gradient Boosting, and Neural Networks. These models analyze the agricultural parameters and generate suitable crop recommendations. The fertilizer recommendation module further evaluates soil conditions and nutrient requirements to suggest appropriate fertilizers.

The backend services developed using FastAPI handle prediction requests, while MongoDB manages data storage. The React-based frontend presents the recommendations in a user-friendly format. Through this workflow, FarmaSuit provides farmers with reliable recommendations that support efficient and sustainable agricultural practices.

6.CONCLUSION

The FarmaSuit project successfully demonstrates the application of machine learning in modern agriculture through the development of an intelligent crop and fertilizer recommendation system. By analyzing soil nutrients, pH values, temperature, humidity, and rainfall parameters, the system provides accurate and personalized agricultural recommendations. The integration of machine learning models with React, FastAPI, and MongoDB resulted in a complete web-based solution capable of supporting data-driven farming decisions.

The developed platform improves crop selection, optimizes fertilizer usage, and promotes sustainable farming practices. Its user-friendly interface enables easy adoption by farmers and agricultural stakeholders. The successful implementation and evaluation of FarmaSuit highlight the potential of artificial intelligence and machine learning technologies in transforming traditional farming into a more efficient, productive, and sustainable process.

Future enhancements may include mobile application support, regional language integration, IoT sensor connectivity, crop disease prediction, and market price forecasting modules to further strengthen the capabilities of the system.

7.REFERENCES

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