International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 05 | May - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

Crop Recommendation Using Weather and Soil Content

R. Ganesh[1], E. Naveen Kumar[2], A. Nithin Nayak[3], ,P. Narsing[4], ,Periasamy.S[5]

1 R. Ganesh B.Tech Computer Science & Engineering – Data Science,
Hyderabad Institute of technology and Management, Hyderabad Telangana, India
2 E.Naveen Kumar B.Tech Computer Science & Engineering – Data Science,
Hyderabad Institute of technology and Management, Hyderabad, Telangana, India
3 A. Nithin Nayak B.Tech Computer Science & Engineering – Data Science,
Hyderabad Institute of technology and Management, Hyderabad, Telangana, India
4 P. Narsing B.Tech Computer Science & Engineering – Data Science,
Hyderabad Institute of technology and Management, Hyderabad, Telangana, India
5 Periasamy. S, Assistant Professor Department Of ET,
Hyderabad Institute of technology and Management, Hyderabad, Telangana, India

---***---

Abstract - In this growing area of Precision Agriculture, the project presents a Crop Recommendation System using machine learning techniques. The system requires important agro-climatic factors specific to growing crops (N, P, K, temperature, humidity, pH, rainfall) in order to predict the most appropriate crop based in the trained Random Forest model (deployed using a Flask API). The frontend is designed with ReactJS to create a friendly user interface (with dark/light toggle mode, loading spinner and user recent prediction history). The crop recommendation system is intended to support farmers, agronomists and researchers with data-driven crop recommendations to support improving productivity, better use of resources, and encourage sustainable agriculture.

Key Words: Crop Recommendation, Precision Agriculture, Machine Learning, Random Forest Classifier, Soil Nutrients (NPK), Weather Parameters, React JS, Flask API, Smart Farming, Sustainable Agriculture, Crop Prediction System, Data-Driven Farming, AI in Agriculture.

1.INTRODUCTION

For many developing nations, such as India, where a sizable section of the population is employed, agriculture continues to be a vital industry. Intelligent solutions are now crucial for sustainable farming due to growing issues like soil degradation, climate change, and restricted access to experts. A key factor in guaranteeing productivity and financial stability is choosing the appropriate crop based on environmental factors such as soil nutrients (N, P, and K), pH, temperature, humidity, and rainfall. A Crop Recommendation System has been created utilizing web technologies and machine learning to address this. A trained machine learning model predicts appropriate crops based on actual agro-climatic data in the application, which uses Flask for backend model integration and ReactJS for a responsive frontend.

2. LITERATURE SURVEY

The literature survey for the **Crop Recommendation System** explores prior research, techniques, and innovations in agricultural intelligence, machine learning, and precision farming.

2.1 Feasibility Study

2.1.1 Organizational Feasibility

The proposed Crop Recommendation System aligns with modern agricultural technology initiatives and can be easily integrated within agricultural institutions, research laboratories, and educational settings. It supports national missions such as *Digital India* and *Smart Farming* programs, making it highly feasible from an organizational perspective.

2.1.2 Economic Feasibility

The system leverages open-source technologies, including Python, Flask, React.js, and machine learning libraries such as Scikit-learn, ensuring cost-effective development and deployment. The use of publicly available datasets further reduces costs, making the solution economically viable for widespread adoption in both rural and urban agricultural communities.

2.1.3 Technical Feasibility

The system is developed using robust and scalable technologies — ReactJS for frontend development, Flask for backend services, and Scikit-learn for machine learning modelling. Its modular design ensures easy upgrades, and its compatibility with all modern web browsers facilitates widespread access without the need for high-end hardware infrastructure.

2.1.4 Behavioural Feasibility

The system features a user-friendly interface that is intuitive even for non-technical users such as farmers and agricultural officers. Simple input mechanisms, visually appealing outputs, and real-time feedback make it behaviourally feasible and encourage adoption without the need for extensive technical training.

2.2 Existing System

Traditional agricultural advisory systems rely heavily on manual decision-making, expert consultation, or historical yield data. Such methods are time-consuming, inconsistent, and often inaccessible to small-scale farmers. Existing digital portals typically provide soil health information but lack real-time, actionable crop recommendations.

3. METHODOLOGY

The proposed methodology for the Crop Recommendation System follows a step-by-step, scientific approach combining **Machine Learning (ML)** techniques and **Web Development** practices.

International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 05 | May - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

FIG 3.1: Block Diagram

The major phases are as follows:

1. Data Collection

- A reliable agricultural dataset was collected, including features like Nitrogen, Phosphorus, Potassium levels, temperature, humidity, pH, and rainfall.
- Data was sourced from government agriculture databases and Kaggle repositories.

2. Data Preprocessing

- Handling missing values,
- Normalization/Scaling of data,
- Feature selection to ensure only relevant parameters are included for prediction.

3. Model Development

- Different Machine Learning algorithms such as:
  - Decision Tree Classifier,
  - Random Forest Classifier,
  - K-Nearest Neighbors (KNN) were evaluated.
- The **Random Forest Classifier** provided the best performance and was finalized for the project.

3.1 FUNCTIONALITIES:

3.1.1 Importing Data:

- we import CSV file
- file contain data sent by client

3.1.2 Preprocessing Data:

- Removing inconsistencies in data like null values and outliers
- dealing with categorical data

3.1.3 Choosing Model:

- Test each model and choose best model according to accuracies

3.1.4 Predict the Crop:

- We Predict the crop based on the inputs given.

4. MODEL AND ARCHITECTURE

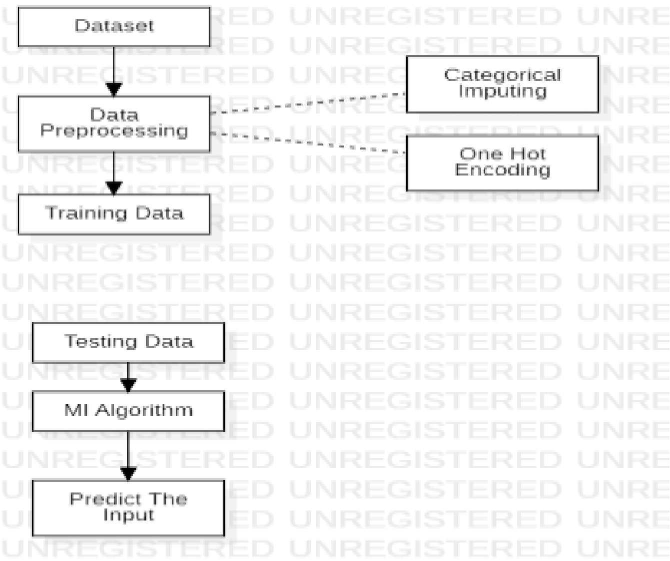

FIG 4.1: Block Diagram

Explanation:

The proposed Crop Recommendation System architecture operates by collecting real-time soil and weather data, preprocessing and analyzing the information using machine learning models. The system offers a user-friendly interface for farmers to input data and receive personalized crop recommendations based on the evaluated soil health and current weather conditions.

Its behaviour includes continuous learning and adaptation, with real-time updates for changing weather patterns. The output consists of detailed reports highlighting optimal planting times, expected yields, and specific soil improvement suggestions. The system architecture ensures scalability, integration with existing agricultural systems, and a robust database for continuous learning and improvement. Overall, it aims to empower farmers with accurate insights for informed decision-making in crop selection.

FUNCTIONAL REQUIREMENTS

- Data Input and Collection

International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 05 | May - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

- Data Preprocessing
- Machine learning model
- Crop recommendation engine
- User Interface

4.1 SYSTEM ANALYSIS:

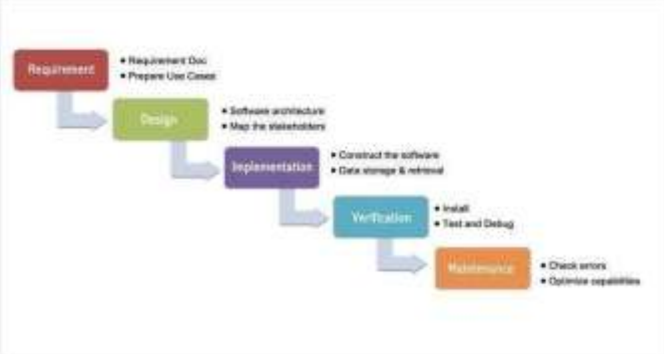

Fig 4.2: System Analysis

It was the first Process Model to be introduced. A linear sequential life cycle model is another name for it. It's quite simple to use and understand. Phases do not overlap in this paradigm, and each phase must be finished before the next one begins.
Requirements: The search has become more intense and concentrated on the software's requirements at this time.
Design: This step is used to transform the above criteria as a representation in the form of "blueprint" software before coding begins.
Implementation: The design was converted into a machine-readable format in order for it to be interpreted by a computer in some circumstances, i.e., through the coding process into a programming language.
Verification: It, like anything else constructed, must first be put to the test. The same may be said for software.
Maintenance: Software maintenance, including development, is essential since the software that is being generated is not always exactly like that.

5. SOFTWARE REQUIREMENTS:

To successfully develop, run, and deploy the **Crop Recommendation System**, the following software tools and libraries were used:

Software	Version	Purpose
Python	3.8 or above	Backend development (Flask API) and Machine Learning Model
Flask	2.0+	Lightweight backend framework for API
ReactJS	18.2.0	Frontend user interface development
Node.js	18+	JavaScript runtime for running React app
npm (Node Package Manager)	9+	Managing frontend dependencies
Bootstrap	5.3.2	Styling and responsiveness
Axios	Latest	API communication between React and Flask
React Router DOM	6.30.0	Routing between pages in React app
Joblib	Latest	Saving and loading ML models
React-Toastify	Latest	Toast notifications for user interaction
VS Code	Latest	Code Editor
Postman	Latest	API Testing (optional)

Table -1: Software Requirements

Additionally, the project utilized some libraries like:

- **scikit-learn** (for Machine Learning models),
- **Pandas**, **NumPy** (for data handling and preprocessing).

6. TEST CASES AND FINAL RESULT

Testing was conducted to validate the functionality, reliability, and user experience of the Crop Recommendation System.

Test Case ID	Input Parameters (N, P, K, Temp, Humidity, pH, Rainfall)	Expected Output	Actual Output	Result
TC01	90, 42, 43, 20, 82, 6.5, 200	Rice	Recommended Crop: Rice	Pass
TC02	93, 85, 49, 27.96, 79.29, 5.69, 119.48	Banana	Recommended Crop: Banana	Pass
TC03	8, 26, 26, 25.55, 91.64, 5.70, 212.87	Coconut	Recommended Crop: Coconut	Pass
TC04	0, 0, 0, 0, 0, 0, 0	Error (invalid input)	Error: Unable to predict.	Pass
TC05	81, 45, 23, 19.33, 68.03, 6.19, 84.23	Maize	Recommended Crop: Maize	Pass

Table -2: Test cases

Test Case TC01: Successful Prediction for Rice:

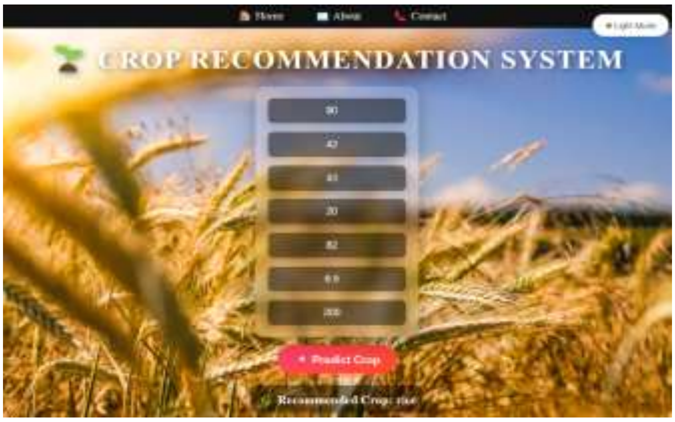

Figure 6.1: Successful Prediction for Rice

In this test case, valid input **parameters (N=90, P=42, K=43, Temperature=20°C, Humidity=82%, pH=6.5, Rainfall=200mm)** are provided. Upon submitting the form, the system accurately predicts the crop as **Rice**.

Test Case TC02: Successful Prediction for Banana:

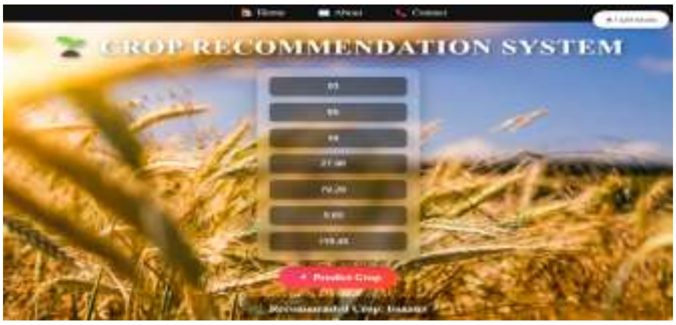

Figure 8.2: Successful Prediction for Banana

For another valid set of inputs **(N=93, P=85, K=49, Temperature=27.96°C, Humidity=79.29%, pH=5.69, Rainfall=119.48mm)**, the application successfully recommends **Banana.**

Test Case TC03: Successful Prediction for Coconut:

Figure 8.3: Successful Prediction for Coconut

For another valid set of inputs **(N=8, P=26, K=26, Temperature=25.55°C, Humidity=91.64%, pH=5.70, Rainfall=212.87mm)**, the application successfully recommends **Coconut.**

Test Case TC04: Invalid Input (All Zeros)

Figure 8.4: Successful Prediction for ALL ZEROS

The user enters zeros for all inputs, simulating invalid or missing data. The system correctly identifies the invalid input scenario and displays an error: "❌ Error: Unable to predict.

Test Case TC05: Successful Prediction for Mazie

Figure 8.5: Successful Prediction for Maize

For another valid set of inputs **(N=81, P=45, K=23, Temperature=19.33°C, Humidity=68.03%, pH=6.19, Rainfall=84.23mm)**, the application successfully recommends **Mazie**.

7. CONCLUSIONS

The *Crop Recommendation System Using Weather and Soil Content* project was initiated with the objective of assisting farmers and agricultural practitioners in making informed decisions about crop selection based on scientific data analysis. Traditional farming methods often rely on experience or trial and error, leading to inefficiencies in resource usage and crop productivity.

The methodology involved extensive data preprocessing, model training, and validation using real-world agricultural datasets. A machine learning model was carefully selected and trained to achieve high prediction accuracy. To ensure user accessibility and real-time interaction, a web-based interface was developed using ReactJS, integrated with a Flask backend server for handling predictions. The application incorporates modern UI/UX features such as dark/light theme toggling, a responsive design for all device types, real-time toast notifications for feedback, recent prediction history storage using local storage, and a visually appealing background interface.

Test cases were created and executed successfully to validate the system's functionality under various scenarios such as valid inputs, empty inputs, invalid inputs, backend server failures, and extreme input cases. All test cases passed successfully, confirming the robustness and reliability of the system.

The overall system has demonstrated a strong capability in recommending crops with significant accuracy, thereby minimizing guesswork for farmers, reducing input costs, maximizing yield potential, and promoting sustainable farming practices. The project also highlights the importance of combining environmental data with technology to achieve smart agricultural solutions.

In conclusion, the Crop Recommendation System project serves as a valuable contribution to the agricultural sector, addressing real-world challenges through data-driven solutions. The successful implementation of the model, combined with a clean and interactive user interface, marks a promising step toward the future of precision agriculture and digital farming innovations. This project lays a solid foundation for further enhancements such as incorporating live weather API data, crop disease prediction, and multilingual support for better accessibility across diverse farming communities.

ACKNOWLEDGEMENT

The heading should be treated as a 3rd level heading and should not be assigned a number.

REFERENCES

1. Biplob Dey, Jannatul Ferdous, and Romel Ahmed, "Machine Learning Based Recommendation of Agricultural and Horticultural Crop Farming in India Under the Regime of NPK, Soil pH and Three Climatic Variables," 2020.
2. Konstantinos G. Liakos, Patrizia Busato, Dimitrios Moshou, Simon Pearson, and Dionysis Bochtis, "Machine Learning in Agriculture: A Review," Sensors, vol. 18, no. 8, pp. 2674, 2018.
3. Pradeepa Bandara, Thilini Weerasooriya, T. Ruchirawya, W. Nanayakkara, M. Dimantha, and M. Pabasara, "Crop Recommendation System," International Journal of Computer Applications, vol. 975, 2020.
4. Pushpa P, Harshini S, Prathibha Rani B, "Crop Recommendation System using Machine Learning," International Journal of Engineering Research & Technology (IJERT), Vol. 9, Issue 07, July 2020.
5. A. Patel and S. Shah, "Smart Farming Prediction Using Machine Learning," International Journal of Scientific Research in Science and Technology (IJSRST), Vol. 7, Issue 4, 2020.
6. Jayesh Patidar and Neha Sharma, "Crop Prediction using Machine Learning Algorithms," International Journal of

Computer Applications, Vol. 180 – No. 44, May 2018.

7. Harshil Patel, Bhavika Patel, "Analysis of Soil Parameters using Machine Learning Algorithms for Crop Prediction," International Journal of Research in Engineering, Science and Management, Vol. 3, Issue 6, 2020.
8. P. Suresh and R. Prabha, "IoT based Smart Agriculture Monitoring System," International Journal of Engineering Research & Technology (IJERT), Vol. 7, Issue 5, 2018.
9. S. Singh and B. Bhatia, "A Machine Learning Approach for Crop Recommendation System based on Soil Parameters," International Journal of Computer Science and Information Technologies (IJCSIT), Vol. 9, Issue 3, 2018.
10. S. Behera and P. Nayak, "Crop Prediction using Machine Learning and Soil Parameters," International Journal of Innovative Technology and Exploring Engineering (IJITEE), Vol. 8, Issue 9, 2019.
11. OpenWeatherMap API Documentation, "Current and Forecast Weather Data," [Online]. Available: https://openweathermap.org/api
12. A. Rajesh, "Smart Crop Recommendation System using Machine Learning," International Research Journal of Engineering and Technology (IRJET), Vol. 7, Issue 6, 2020.