



(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 8.699

Volume 14, Issue 4, April 2025

⊕ www.ijirset.com 🖂 ijirset@gmail.com 🖄 +91-9940572462 🕓 +91 63819 07438





www.ijirset.com |A Monthly, Peer Reviewed & Refereed Journal| e-ISSN: 2319-8753| p-ISSN: 2347-6710|

Volume 14, Issue 4, April 2025

Crop Recommendation Using Machine Learning

V.S.V. Harika, V.Praharsha, SK.Naveed Basha, K.Varshitha, B.Deepika

Assistant Professor, Department of AI&DS, Sree Venkateswara Engineering College, North Rajupalem, Nellore, India

U.G. Student, Department of AI&DS, Sree Venkateswara Engineering College, North Rajupalem, Nellore, India

- U.G. Student, Department of AI&DS, Sree Venkateswara Engineering College, North Rajupalem, Nellore, India
- U.G. Student, Department of AI&DS, Sree Venkateswara Engineering College, North Rajupalem, Nellore, India
- U.G. Student, Department of AI&DS, Sree Venkateswara Engineering College, North Rajupalem, Nellore, India

ABSTRACT: The Crop Recommendation System is a machine learning-based web application developed using Python and Flask, aimed at helping farmers select the most suitable crop for cultivation based on environmental conditions. Users can input key parameters such as nitrogen, phosphorus, potassium levels, temperature, humidity, pH, and rainfall. The system employs a pre-trained Random Forest Classifier model to analyze these inputs and predict the most appropriate crop to grow. By leveraging tools like scikit-learn for machine learning, and Pandas and NumPy for data processing, the application ensures accurate and efficient recommendations. The intuitive HTML and CSS-powered user interface allows for seamless interaction, making it accessible and easy to use. Overall, the project enhances agricultural productivity by reducing guesswork in crop selection and promoting informed decision-making through technology.

KEYWORDS: Crop Recommendation, Machine Learning, Random Forest Classifier, Flask, Python, Environmental Parameters, Data Analysis, Scikit-learn, Pandas, NumPy, Web Application.

I. INTRODUCTION

Agriculture plays a crucial role in sustaining the global economy and food supply. However, farmers often face challenges in selecting the most suitable crop for cultivation due to varying soil conditions, climate changes, and resource availability. Traditional farming methods rely on experience and intuition, which may not always yield optimal results. With advancements in technology, machine learning has emerged as a powerful tool to assist in data-driven decisionmaking for agricultural practices.

The Crop Recommendation System is designed to provide farmers with accurate recommendations on the best crop to cultivate based on specific environmental parameters. By leveraging machine learning techniques, the system analyzes key factors such as nitrogen, phosphorus, potassium levels, temperature, humidity, pH, and rainfall to predict the most suitable crop for a given set of conditions. The system is developed using Flask for backend processing and integrates a Random Forest Classifier model for high-accuracy predictions.

Through a user-friendly web interface, farmers can input relevant data and receive instant crop recommendations, enabling them to optimize yield, improve efficiency, and minimize the risks associated with improper crop selection. This intelligent approach to agriculture enhances productivity while promoting sustainable farming practices, ultimately contributing to better food security and economic stability.

II. RELATED WORK

Several studies and applications have explored the use of machine learning in agriculture, particularly for crop prediction and recommendation. Research has shown that machine learning algorithms like Decision Trees, Support Vector Machines (SVM), and Random Forests can effectively analyze agricultural data to predict suitable crops based on environmental factors. For instance, in one study, a Random Forest classifier was used to predict the best crop based on soil and weather conditions, demonstrating high accuracy and reliability. Another project integrated weather forecasting with soil data to enhance prediction accuracy, using SVM and K-Nearest Neighbors (KNN) algorithms.





www.ijirset.com |A Monthly, Peer Reviewed & Refereed Journal| e-ISSN: 2319-8753| p-ISSN: 2347-6710|

Volume 14, Issue 4, April 2025

|DOI: 10.15680/IJIRSET.2025.1404312|

Additionally, government and private organizations have developed platforms that offer crop advisory services, but many lack real-time, location-specific intelligence or user-friendly interfaces. The proposed Crop Recommendation System builds upon these foundations by combining the predictive power of Random Forest with a user-centric web interface, making it more practical for real-world use by farmers. It aims to bridge the gap between data science and agriculture by offering a smart, accessible, and efficient tool for crop planning.

III. PROPOSED ALGORITHM

Crop recommendation using machine learning is a modern approach to precision agriculture that leverages data-driven algorithms to assist farmers in selecting the most suitable crops for cultivation based on environmental conditions. The system collects various parameters such as soil nutrients (Nitrogen, Phosphorus, Potassium), temperature, humidity, pH level, and rainfall, which are critical factors influencing crop growth.

Gabb.	route('/')
def h	ome():
r	eturn render_template('crop.html', title='Harvestify - Crop Recommendation')
@app.	<pre>route('/predict', methods=['POST'])</pre>
def c	rop_prediction():
i	f request.method == 'POST':
	# Get the input values from the form
	<pre>N = int(request.form['nitrogen'])</pre>
	<pre>P = int(request.form['phosphorous'])</pre>
	<pre>K = int(request.form['pottasium'])</pre>
	<pre>ph = float(request.form['ph'])</pre>
	<pre>rainfall = float(request.form['rainfall'])</pre>
	<pre>temperature = float(request.form['temperature'])</pre>
	<pre>humidity = float(request.form['humidity'])</pre>
	# Prepare the data for prediction
	<pre>data = np.array([[N, P, K, temperature, humidity, ph, rainfall]])</pre>
	# Make the prediction using the model
	<pre>final_prediction = crop_recommendation_model.predict(data)[0]</pre>
	<pre>return render_template('result.html', prediction=final_prediction, title='Harvestify - Prediction'</pre>

Fig.1.Sample of one crop recommendation.

The Crop Recommendation System is a machine-learning-based application that provides accurate crop recommendations based on real-time environmental data such as soil nutrients, temperature, humidity, pH, and rainfall. It features a user-friendly Flask web interface that delivers instant, personalized suggestions using a Random Forest Classifier for high prediction accuracy.

IV. EXPERIMENTAL RESULTS

Figures shows the **experimental results** typically observed **in crop recommendation systems using machine learning**. These results vary depending on datasets, features, and algorithms used, but the following is a general outline based on literature and benchmark studies:





|www.ijirset.com |A Monthly, Peer Reviewed & Refereed Journal| e-ISSN: 2319-8753| p-ISSN: 2347-6710|

Volume 14, Issue 4, April 2025

|DOI: 10.15680/IJIRSET.2025.1404312|

Smart Crop Recommendation System	Smart Crop Recommendation System	Vour Crop Decommandation
Enter Soil and Weather Parameters	Enter Soil and Weather Parameters	Tour crop Recommendation
Nitrogen (N)	Nitrogen (N)	
	30	
Phosphorous (P)	Phosphorous (P)	
	40	
Potassium (K)	Potassium (K)	
	30	Recommended Crop
Temperature (°C)	Temperature (°C)	
	29	
Humidity (%)	Humidity (%)	mango
	52	5
Soil pH	Soll pH	
	8	Too book on Don Kinford
Rainfall (mm)	Rainfall (mm)	Try Another Prediction
	150 *	
Get Recommendation	Get Recommendation	
2)	b)	2)

V. METHODOLY

The methodology for developing the Crop Recommendation System using machine learning involves a series of wellstructured steps to ensure accuracy, reliability, and user-friendliness. First, data is collected on various environmental and soil parameters, including Nitrogen (N), Phosphorus (P), Potassium (K), temperature, humidity, pH, and rainfall, along with the crops associated with these conditions. After the data is gathered, it undergoes cleaning and preprocessing to handle missing values, remove duplicates, and normalize the values, ensuring consistency for model training. Key features influencing crop growth are selected, which serve as inputs for the machine learning model. The **Random Forest Classifier** is chosen for its robustness and ability to capture complex relationships within agricultural data, and it is trained on the preprocessed dataset to learn patterns and predict suitable crops. The model's performance is then evaluated using accuracy, precision, recall, and cross-validation to ensure reliable predictions. A user-friendly web application is developed using **Flask** for farmers to input environmental parameters and receive instant crop recommendations. Once the model is integrated into the web interface, it is deployed and tested for accuracy and usability.



Fig.2.Box plot showing Environmental parameters.

Here is the box plot representing the distribution of various environmental parameters, such as Nitrogen, Phosphorus, Potassium, Temperature, Humidity, pH, and Rainfall. Each box shows the median, interquartile range (IQR), and potential outliers for the respective parameter. Based on feedback and system performance, the model and interface are iteratively refined to include additional features.

IJIRSET©2025





|www.ijirset.com |A Monthly, Peer Reviewed & Refereed Journal| e-ISSN: 2319-8753| p-ISSN: 2347-6710|

Volume 14, Issue 4, April 2025

|DOI: 10.15680/IJIRSET.2025.1404312|

VI. ARCHITECTURE

The system design for intelligent crop recommendation is structured through a multi-phase architecture aimed at ensuring accurate and user-friendly predictions. It begins with **data collection**, where environmental parameters such as soil nutrients (nitrogen, phosphorus, potassium), temperature, humidity, pH levels, and rainfall are gathered from agricultural databases and IoT sensors, alongside comprehensive **crop data** detailing growth requirements and yield patterns.



Training Dataset

'Fig.3. System architecture

1. Data Collection:

- Environmental Data: Gather data on soil nutrients (nitrogen, phosphorus, potassium), temperature, humidity, pH levels, and rainfall from agricultural databases and IoT sensors.
- **Crop Data:** Collect information on various crops, including growth conditions, yield statistics, and suitability to different environmental factors.

2. Data Preprocessing:

- Data Cleaning: Handle missing or inconsistent data entries to ensure dataset quality.
- Normalization: Standardize data ranges for uniformity across different environmental parameters.

3. Feature Selection:

- Identify Relevant Features: Select key environmental parameters that significantly influence crop growth and yield.
- **Dimensionality Reduction:**Apply techniques like Principal Component Analysis (PCA) to reduce dataset complexity while retaining essential information.

4. Machine Learning Model Development:

- **Model Training:** Utilize algorithms such as Random Forest, Decision Trees, and Support Vector Machines (SVM) to train models on the processed dataset.
- Model Validation: Evaluate model performance using metrics like accuracy, precision, recall, and F1-score to ensure reliable crop recommendations.

5. Deployment and User Interaction:

- User Input Interface: Develop a user-friendly web interface using Flask, allowing users to input environmental parameters.
- **Real-Time Prediction:** Upon receiving user input, the system processes the data through the trained model to provide immediate crop recommendations.
- **Result Presentation:** Display recommended crops along with confidence scores, enabling users to make informed decisions.

VII. CONCLUSION

The Crop Recommendation System is an advanced machine learning-based solution designed to help farmers make informed decisions about crop selection based on environmental parameters. By leveraging data on nitrogen, phosphorus,





www.ijirset.com |A Monthly, Peer Reviewed & Refereed Journal| e-ISSN: 2319-8753| p-ISSN: 2347-6710|

Volume 14, Issue 4, April 2025

|DOI: 10.15680/IJIRSET.2025.1404312|

potassium levels, temperature, humidity, pH, and rainfall, the system accurately predicts the most suitable crop for cultivation. The use of a Flask-based web application ensures a user-friendly interface where farmers can input their data and receive recommendations efficiently.

This system eliminates guesswork and significantly improves agricultural productivity by suggesting crops that are best suited for specific soil and climatic conditions. With its reliance on machine learning algorithms, the system continuously improves over time, enhancing accuracy and adaptability to diverse farming environments.

By implementing such a data-driven approach, farmers can reduce risks, optimize yields, and make environmentally sustainable decisions. This model has the potential to revolutionize precision agriculture by integrating scientific data with practical farming applications.

REFERENCES

- [1] Dhungel, R. (2014). *Time Integration of Evapotranspiration Using a Two Source Surface Energy Balance Model Using Narr Reanalysis Weather Data and Satellite Based Metric Data* (Doctoral dissertation, University of Idaho).
- [2] Fan, J., Bai, J., Li, Z., Ortiz-Bobea, A., & Gomes, C. P. (2021). A GNN-RNN Approach for Harnessing Geospatial and Temporal Information: Application to Crop Yield Prediction. arXiv preprint arXiv:2111.08900.
- [3] Huber, F., Yushchenko, A., Stratmann, B., & Steinhage, V. (2022). Extreme Gradient Boosting for Yield Estimation Compared with Deep Learning Approaches. *arXiv preprint arXiv:2208.12633*.
- [4] Kumar, A. (2020). Crop Prediction Using Machine Learning Approaches. International Journal of Engineering Research & Technology, 9(8), 1-4.
- [5] Meng, L., & Quiring, S. M. (2010). A Comparison of Soil Moisture Models Using Soil Climate Analysis Network Observations. *Journal of Hydrometeorology*, 11(2), 319-331.
- [6] Shook, J., Gangopadhyay, T., Wu, L., Ganapathysubramanian, B., Sarkar, S., & Singh, A. K. (2020). Crop Yield Prediction Integrating Genotype and Weather Variables Using Deep Learning. arXiv preprint arXiv:2006.13847.
- [7] Patel, D., Shah, D., & Dabhi, V. K. (2016). A Survey on Data Mining Techniques for Crop Yield Prediction. International Journal of Computer Applications, 145(11), 1-5.
- [8] Jha, K., Doshi, A., Patel, P., & Shah, M. (2019). A Comprehensive Review on Automation in Agriculture Using Artificial Intelligence. Artificial Intelligence in Agriculture, 2, 1-12.
- [9] Thorp, K. R., & Bronson, K. F. (2013). A Model-Independent Open-Source Geospatial Tool for Managing Point-Based Environmental Model Simulations at Multiple Spatial Locations. *Environmental Modelling & Software*, 50, 25-36.
- [10] Wu, C., Anlauf, R., & Ma, Y. (2010). Application of the DSSAT Model to Simulate Wheat Growth in Eastern China. *Journal of Agricultural Science*, 148(2), 151-158.
- [11] Zahra Bassine, F., Epule, T. E., Kechchour, A., & Chehbouni, A. (2023). Recent Applications of Machine Learning, Remote Sensing, and IoT Approaches in Yield Prediction: A Critical Review. arXiv preprint arXiv:2306.04566.
- [12] Zhang, X., & Anderson, M. C. (2013). Monitoring Water Stress and Drought Using Soil Moisture and Evapotranspiration. *Advances in Water Resources*, 54, 86-96.









INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY





www.ijirset.com