RESEARCH ARTICLE OPEN ACCESS

# SMARTCROP : AGRICULTURE CROP RECOMMENDATION BASED ON FUTURE DEMAND

Mrs. Amitha S[1], Harshal V Pai[2], Joshna M J[3], Kavya S[4], M Jeswanth[5]

Associate Professor, Student, Student, Student, Student

Department of Computer Science and Engineering,

K S School of Engineering and Management, Bangalore, Karnataka, India

**Abstract:** Using machine learning and predictive analytics to estimate future demand, this project presents a novel method of crop management. Machine learning algorithms generate predictive models by examining past data on crop yields, market trends, weather, and consumer preferences. The smart crop management system provides farmers with well-informed decision-making tools for optimal yields and financial returns by taking into account factors like climate, soil health, market trends, and consumer preferences. The goal of real-time data updates and feedback loops is to improve adaptability to shifting market dynamics by offering a dynamic tool for coordinating agricultural operations with future demand, thereby fostering higher productivity and sustainability.

***Keywords*** — Climate conditions, market trends, data analysis, machine learning, predictive analytics,

## 1. INTRODUCTION

In order to overcome the drawbacks of conventional crop selection techniques, this project introduces a smart crop management system that combines predictive analytics and machine learning. Farmers now have access to a dynamic decision-making tool that takes into account factors such as consumer preferences, market trends, soil health, and climate conditions, allowing them to make well-informed decisions that will increase productivity and generate profits.

## 2. LITERATURE SURVEY

### 2.1 Crop Plantation Recommendation using Feature Extraction and Machine Learning Techniques -2020

The study looks into how to recommend optimal crop plantations using machine learning and feature extraction. Data on soil types, weather patterns, and historical yields must be gathered and processed. The models for crop recommendation are then trained using machine learning algorithms. Future improvements, challenges encountered during implementation, and results are discussed.

### 2.2 Crop Price Prediction Using Machine Learning - 2021

Using machine learning, the paper attempts to forecast crop prices. Utilizing machine learning algorithms, it generates predictive models by collecting data on production rates, weather, and

market demand. Decisions about agriculture are probably discussed in terms of evaluation, difficulties, and implications.

### 2.3 Crop Price Prediction Using Supervised Machine Learning Algorithms- 2021

A crop recommendation system that helps farmers choose the best crops to cultivate is presented in this research. Personalized recommendations are generated by combining information on soil types, climate, and historical yields. With machine learning, most likely, it provides customized advice to improve farming output. There is also discussion of evaluation and possible advantages for raising agricultural yields.

### 2.4 Crop Recommendation System - 2020

The algorithm for crop recommendation presented in this study makes recommendations for the best crops based on soil, climate, and historical yield data. It probably uses machine learning to provide tailored advice in an effort to increase agricultural output.

## 3. PROPOSED SYSTEM

The Crop Recommendation System was developed in response to farmers' ongoing difficulties matching crop selections to anticipated market demands. Farmers are exposed to mismatches between the demands of consumers and the produce they raise since current methods frequently lack the foresight necessary to effectively foresee market shifts.

This technology provides a comprehensive solution by utilizing machine learning and other advanced data analytics techniques. Numerous important variables are examined, such as soil properties, past crop performance, weather patterns, and market trends. The system uses this data to provide customized recommendations based on the objectives and particular conditions of each farmer.

This system's capacity to provide farmers with practical insights makes it significant. Based on the system's recommendations, farmers can make well-informed judgments.

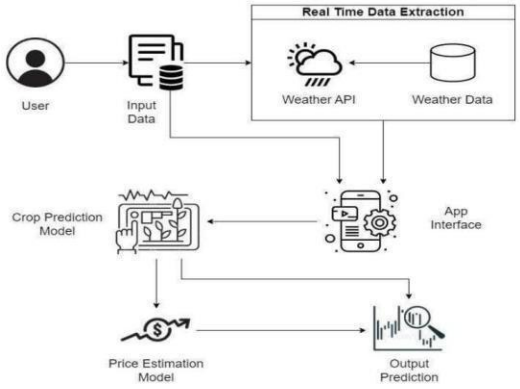


**Fig 1.Crop Prediction and Price Estimation model**

### 3.1 Proposed model

In response to the challenge of accurately predicting the most suitable crop for a given set of conditions, our proposed system aims to provide a robust solution ensuring farmers maximize their profit. The system utilizes a combination of classification and regression models for crop prediction and price estimation, respectively. Input variables such as soil nutrient levels (Nitrogen, Phosphorus, Potassium), rainfall, and district information are collected from the farmer. Additional weather data including temperature and humidity are obtained via the OpenWeatherMap API. These inputs feed into a crop prediction model, which outputs the most suitable crop for cultivation. Subsequently, the predicted crop and district information are used to estimate crop prices for the next 12 months, aiding farmers in decision-making regarding cultivation timing. The architecture diagram (Fig 3.1) illustrates the flow of this process, emphasizing the sequential input-output mechanism facilitated by the application interface.

### 3.2 Crop Prediction Model

The crop prediction module employs a dataset sourced from official platforms like data.gov.in and www.indiastat.com, supplemented by weather data from the OpenWeatherMap API. Key independent variables include soil nutrient ratios (NPK), humidity, rainfall, and temperature. The dataset undergoes rigorous preprocessing to handle missing values, outliers, and normalization to enhance model performance. A classification ensemble comprising KNN, SVM, Decision Tree, and Naïve-Bayes classifiers is trained and optimized through hyperparameter tuning using GridSearchCV. This ensemble approach ensures robust predictions of suitable crops tailored to specific climatic and soil conditions.

### 3.3 Crop Price Estimation Model

For predicting crop prices, historical price data along with crop and district information are utilized. Similar to the crop prediction model, preprocessing steps are applied to the dataset to ensure data integrity. Encoding categorical variables and imputing missing values prepare the data for training. A stacking ensemble regressor comprising RandomForest and XGBoost regressors is trained to predict crop prices for the next 12 months. Hyperparameter tuning further optimizes model performance, ensuring accurate price estimations crucial for informed decision-making by farmers.

### 3.4 Web App Interface

The frontend of the web application is designed to facilitate seamless interaction with farmers. It collects essential input variables such as NPK levels, rainfall, and district information. Upon submission, the backend ML models process the data to provide crop recommendations and price estimations. Visual aids such as tables and charts display predicted crop prices, enabling farmers to interpret and utilize the information effectively.

## 4. IMPLEMENTATION

In this section, we detail the tools utilized and algorithms implemented for the development of our agriculture crop recommendation system.

### 4.1 Tools Utilized

#### 4.1.1 OpenWeatherMap API

The OpenWeatherMap API served as a fundamental tool for retrieving real-time weather data crucial for predicting suitable crops. By providing access to current weather conditions, including temperature and humidity, the API facilitated the integration of environmental factors into our prediction model.

#### 4.1.2 Visual Studio Code

Visual Studio Code, a versatile integrated development environment (IDE), was employed for scripting in Python. Leveraging its extensive feature set, including robust debugging capabilities and seamless integration with various extensions, we developed and fine-tuned our machine learning models efficiently.

#### 4.1.3 Google Colaboratory

Google Colaboratory, a cloud-based platform, played a pivotal role in our development workflow. Offering free access to computational resources such as CPUs, GPUs, and TPUs, Colab provided an ideal environment for running resource-intensive machine learning tasks. Its integration with Jupyter Notebooks facilitated collaborative coding and streamlined experimentation.

#### 4.1.4 Scikit-learn

Scikit-learn, a powerful open-source machine learning library in Python, formed the backbone of our predictive modeling efforts. With its comprehensive suite of algorithms and tools for data preprocessing, model selection, and evaluation, Scikit-learn enabled us to build robust and scalable machine learning pipelines with ease.

### 4.2 Crop Prediction

The crop prediction module focused on determining the most suitable crop based on input

parameters and climatic conditions. Leveraging the OpenWeatherMap API for weather data retrieval, we implemented a multi-step algorithm for crop prediction, encompassing data preprocessing, model training, and performance evaluation.

### 4.3 Crop Price Estimation

In the crop price estimation module, we aimed to predict crop prices for the next 12 months in a given district. Leveraging a combination of machine learning algorithms, including Random Forest Regressor and XGBoost Regressor, we developed an ensemble model capable of forecasting crop prices with high accuracy.

## 4. CONCLUSION

To sum up, the creation and application of the Crop Recommendation System represent a significant breakthrough in tackling the intricate issues that face contemporary agriculture. Through the application of advanced machine learning algorithms and cutting-edge data analytics, this system provides a comprehensive answer to the enduring problem of matching agricultural growing practices with future market demands.

By means of a rigorous examination of many datasets that comprise soil characteristics, past crop performance, meteorological factors, and market patterns, the Crop Recommendation System produces customized suggestions that are adapted to the distinct circumstances and goals of individual farmers. In addition to improving crop selection precision and accuracy, this tailored method gives farmers practical insights to enable them to make decisions that maximize sustainability and productivity.

Furthermore, the system's built-in predictive capabilities allow for proactive planning, which enables farmers to foresee changes in market dynamics and modify their agricultural plans accordingly. In order to give farmers a competitive edge in navigating the unstable agricultural markets, the system offers insight into new trends and possible shifts in consumer demand. Essentially, the Crop Recommendation System is a paradigm shift in agricultural management approaches rather than only a technological advancement. This system not only improves the productivity and profitability of individual farming operations but also makes a significant contribution to the global objectives of food security, environmental sustainability, and economic resilience by bridging the gap between traditional farming wisdom and modern data-driven approaches.

## 5. ACKNOWLEDGMENT

We would like to thank Mrs. Amitha S, Associate Professor, for all of her help and support during the project's development. Her knowledge, support, and perceptive criticism have been invaluable in helping us to clarify our thinking and improve our strategy. Her steadfast passion and commitment are greatly appreciated, since they have greatly aided in our endeavor's success.

## 6. REFERENCES

[1] [1] S. Vashisht, P. Kumar and M. C. Trivedi, Improvised Extreme Learning Machine for Crop Yield Prediction 2022 3rd International Conference on Intelligent Engineering and Management (ICIEM), London, United Kingdom, 2022, pp. 754-757, doi: 10.1109/ICIEM54221.2022.9853054.

[2] [2] S. M. M. Nejad, D. Abbasi-Moghadam, A. Sharifi, N. Farmonov, K. Amankulova and M. Lászlź, Multispectral Crop Yield Prediction Using 3DConvolutional Neural Networks and Attention Convolutional LSTM 47 | P a g e Approaches in IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, vol. 16, pp. 254-266, 2023, doi: 10.1109/JSTARS.2022.3223423.

[3] [3] F. Ji, J. Meng, Z. Cheng, H. Fang and Y. Wang, "Crop Yield Estimation at Field Scales by Assimilating Time Series of Sentinel-2 Data Into a Modified CASA-WOFOST Coupled Model," in IEEE Transactions on Geoscience and Remote Sensing, vol. 60, pp. 1-14, 2022, Art no. 4400914, doi: 10.1109/TGRS.2020.3047102.