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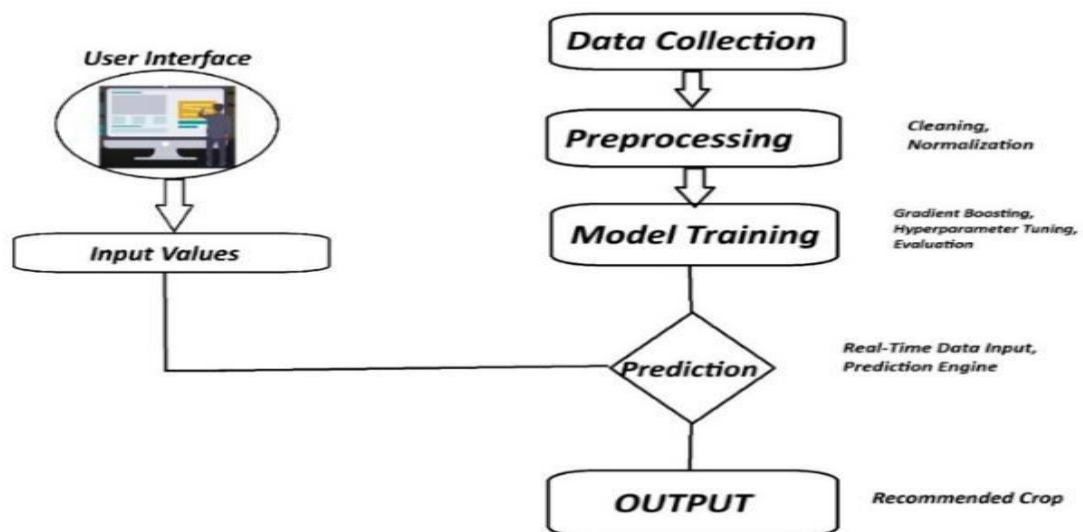
# Smart Crop Advisor using Machine Learning

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**ABSTRACT:** Now-a-days selection of crop is a significant challenge for farmers it becomes more difficult, if they are having no experience or do not have knowledge to select the best possible viable crop. Introducing the Smart Crop Advisor (SCA) which aids in such recommendations to local conditions. Smart Crop Advisor is an online decision support system that adopts Gradient Boosting algorithm to improve the accuracy of agricultural decisions, and gives low-level farmers a personal crop selection advice. Smart Crop Advisor is Designed using Python, HTML and CSS. Python is used for backend development and machine learning model implementation. The user interface is designed using HTML and CSS, allowing for anyone to just add their conditions easily. This application provides insights based on data by utilizing a large agricultural database. The farmers have to enter the specifications based on their soil test report like PH value, climatic conditions such as humidity, temperature. The system proposes best crops suited for particular region and situations. SCA improves crop yields and minimizes chemical inputs, reduces resource loss by selecting the right crops for a specific region and climate, farmers can improve crop yields and reduce waste. It promotes sustainable farming S which the system promotes sustainable farming practices by recommending crops that are well-suited to the local conditions.



## **I. INTRODUCTION**

Agriculture is a critical base to address climate change, environmental degradation and population growth in this era; sustainable agriculture has never been greater. At the foundation of global economies, agriculture is a linchpin for enhancing both human health and globally providing food security demands but also confronting interrelated challenges at unprecedented rates. The rising complexity of crop selection criteria has become a fundamental problem in farming, which is compounded by volatile climate patterns and soil fertility degradation along with the scarcity of land. The world's population is projected to reach 9.7 billion by the year 2050, and food demand will be higher than ever before as a result so choosing what crop to plant might just make better decisions on how land gets used still an important thing in decision making process. This traditional way of crop selection, using local knowledge and historical practices have become outdated under changing agricultural scenario. As such, there is an immediate demand for solution in the form of tools that can empower farmers with data-driven insights needed to take decisions on what type of crops they should be planting which will directly translate into better yields, reducing wastage and moving towards sustainable farming. In this paper, a data-driven Smart Crop Advisor is proposed by using machine learning to improve the precision and stability of crop selection in different environmental conditions.

In recent years, developments in machine learning have provided some of this upgrade to agricultural practices. Machine learning models, and especially ensemble methods such as Gradient Boosting have shown to be amazingly accurate predictors over a vast amount of different prediction tasks through exploiting complex non-linear relationships within the data. By crunching a wealth of agricultural information (e.g soil parameters, weather patterns or historical yield data), such machine learning models can generate insights customized regarding which crops to grow by analyzing the current factor states. In today's increasingly complex and challenging agricultural landscape, farmers face a multitude of challenges in selecting the right crops to grow. With the ever-growing demand for food, farmers are under pressure to increase their yields and productivity while minimizing their environmental impact. However, selecting the right crop can be a daunting task, especially for small-scale farmers who may not have the necessary expertise or resources.

## **II. LITERATURE REVIEW**

Crop yield prediction using machine learning techniques (2022), Umakeswari, Vinoth kumar, International Journal of Innovative Technology and Exploring Engineering (IJITEE). Development of a hybrid machine learning model for crop recommendation in precision agriculture (2021), Ashik Iqbal, Md.islam, International journal of agricultural research (academic journals). Machine Learning Techniques Based Prediction for Crops in Agriculture (2022), Manendra Sai, Satish, Mohammad Rafi Journal of Survey in Fisheries Sciences. Crop Yield Prediction Using Machine Learning Algorithms (2022) S Hussain, Ali Khan, Mustafa Ali, JES (Journal of Engineering Sciences). A Lightweight Gradient Boosting-Based Crop Recommendation System for Mobile Devices (2023) Md. Ashraful Hoque, Md. Ariful Islam, Md. Rashedul Islam, Journal of King Saud University - Computer and Information Sciences (Elsevier).

## **III. METHODOLOGY**

The The agricultural sector plays a crucial role in food production and sustaining livelihoods around the world. However, many farmers, particularly those without extensive experience or agricultural training, face significant challenges in selecting the most suitable crops for their local conditions. This often leads to sub-optimal yields, resource wastage, and increased dependence on chemical inputs, which can have detrimental effects on both the environment and human health. To address these challenges, we introduce the Smart Crop Advisor (SCA), an innovative online decision support system designed to provide personalized crop recommendations based on local conditions. The SCA leverages advanced data analytics and machine learning techniques to enhance agricultural decision-making for smallholders and low-level farmers.



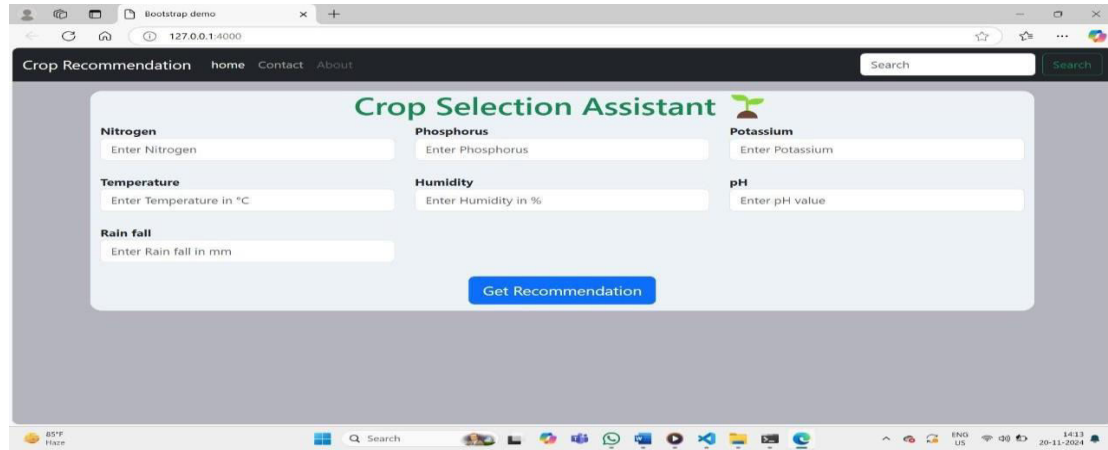


Fig 1: Smart Crop Advisor UI

Gradient Boosting Algorithm: Use the Gradient Boosting algorithm to train a model on the pre-processed data. The model will learn to predict the best crop for a given set of conditions.

Hyperparameter Tuning: Perform hyperparameter tuning to optimize the model's performance using techniques such as grid search or random search.

#### IV. IMPLEMENTATION

##### 1.Data Collection:

Collect a large dataset of agricultural data, including:

- Soil characteristics like (PH value, etc.), Climatic conditions (temperature, humidity, etc.),
- Crop yields and characteristics (e.g., water requirements).

##### 2.Data Preprocessing:

- Clean and preprocess the data by handling missing values.
- converting data types, and normalizing the data.

##### 3.Feature selection:

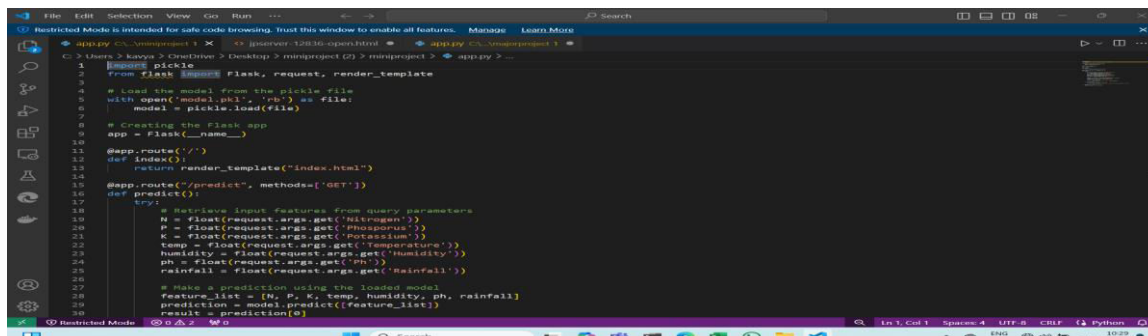
- Feature selection is an integral part of developing a Crop Recommendation System (CRS) with the Gradient Boosting algorithm.
- This is the step of identifying the data features and selecting too important to add them in a model performance.

##### 4.Model Training:

- Train the model using the preprocessed training data.
- Use the Gradient Boosting algorithm to develop a machine learning model that can predict the best crop for a given region and climate.

##### 5.Testing and Evaluation:

- Test the system using the data to evaluate its performance and accuracy.
- Conduct usability testing with farmers to ensure the system is easy to use.
- Evaluate the trained model using the reserved testing dataset to assess its predictive performance on unseen data.



```

1 # Import pickle
2 from flask import Flask, request, render_template
3
4 # Load the model from the pickle file
5 with open('model.pkl', 'rb') as file:
6     model = pickle.load(file)
7
8 # Creating the flask app
9 app = Flask(__name__)
10
11 @app.route('/')
12 def index():
13     return render_template("index.html")
14
15 @app.route('/predict', methods=['GET'])
16 def predict():
17     # Retrieve input features from query parameters
18     N = float(request.args.get('Nitrogen'))
19     P = float(request.args.get('Phosphorus'))
20     K = float(request.args.get('Potassium'))
21     temp = float(request.args.get('Temperature'))
22     humidity = float(request.args.get('Humidity'))
23     ph = float(request.args.get('pH'))
24     rainfall = float(request.args.get('Rainfall'))
25
26     # Make a prediction using the loaded model
27     feature_list = [N, P, K, temp, humidity, ph, rainfall]
28     prediction = model.predict(feature_list)
29     result = prediction[0]
30

```

Fig 2: Gradient Boosting Algorithm

## V. RESULTS AND CONCLUSION

This section presents the results obtained from the system testing and simulations, along with a detailed discussion of their implications.

The Smart Crop Advisor (SCA) is a revolutionary online tool that empowers farmers to make informed decisions about crop selection, taking into account their local conditions and specific needs. By leveraging machine learning and a large agricultural database, SCA provides personalized crop selection advice to farmers, enabling them to improve crop yields, reduce resource waste, and promote sustainable farming practices. With its user-friendly interface and ability to accommodate diverse farm conditions, SCA has the potential to transform the agricultural sector by increasing efficiency, reducing costs, and improving the overall quality of life for farmers. As the global population continues to grow, innovative solutions like SCA will play a crucial role in ensuring food security and sustainable development.

In conclusion, the development of a Crop Selection Assistant (SCA) using the powerful Gradient Boosting algorithm represents a significant stride toward addressing the challenges in modern agriculture. The incorporation of diverse datasets, including soil properties, climate data, historical yields, and crop characteristics, ensures a comprehensive understanding of the factors influencing crop selection. The Gradient Boosting algorithm, with its ability to handle complex datasets and adapt to diverse agricultural conditions, emerges as a robust solution for precise and adaptive crop recommendations. Through a systematic process of data collection, preprocessing, and feature selection, the SCA is equipped to provide farmers with data-driven insights for informed decision-making.

## VI. LIMITATIONS AND FUTURE WORK

Feature selection is an integral part of developing a Crop Recommendation System (CRS) with the Gradient Boosting algorithm. This is the step of identifying the data features and selecting too important to add them in a model performance6Correlation Analysis: Perform correlation analysis to identify the most relevant features that are correlated with the target variable (best crop).

Feature Ranking: Rank the features based on their correlation with the target variable and select the top features.

Feature Elimination: Eliminate features that are highly correlated with each other to avoid multicollinearity.

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