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# Crop Recommendation System Using ML Algorithms

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**Abstract:** This paper aims to give a comprehensive overview of crop recommendation systems, fastening on the operation of machine learning (ML) algorithms. Crop recommendation systems have achieved significant attention in recent times because of their capability to help growers in making proper opinions regarding crop selection and optimization. This paper reviews the vital generalities, ways, challenges, and advancements related to ML algorithms employed in crop recommendation systems. likewise, it discusses various datasets, evaluation criteria, and case studies available in the literature to illustrate the capabilities and limitations of being systems. The check concludes by relating implicit avenues for future disquisition and pressing the significance of ML in revolutionizing husbandry.

**Keywords:** Crop recommendation, Humidity, Rainfall, pH, Machine Learning (ML), Random Forest (RF), Decision Tree (DT), Support Vector Machine (SVM), Logistic Regression (LR), and Naïve Bayes (NB), Data collection, Pre-processing, Feature extraction.

## I. INTRODUCTION

Crop recommendation systems plays a important part in modern farming by using technology and data- driven approaches to make informed crop selection opinions. These systems are of consummate significance as they enhance agricultural productivity, optimize resource operation, and contribute to sustainable husbandry practices. By furnishing adapted recommendations predicated on environmental data and nonfictional perceptivity, crop recommendation systems empower farmers to maximize yields, minimize risks, and meliorate their overall profitable issues. In substance, these systems bridge the gap between traditional husbandry practices and the evolving demands of a changing world, icing food security and profitable stability for tending communities. Machine learning (ML) algorithms are necessary in addressing the challenges of crop selection by analysing vast datasets and making data- driven recommendations. In India moment, husbandry has made significant advancements. Precision husbandry's secret armament is" area-specific" civilization. Although advancements have been made, there are still some problems with perfection civilization. Crop recommendations are significantly told by perfection husbandry. Variety of factors are determined for crop recommendations.

Precision agriculture focuses on relating these parameters in an area-specific way to identify issues. Not all the results given by perfection husbandry are accurate to affect but in husbandry, it's significant to have accurate and precise recommendations because in case of crimes it may lead to heavy material and capital loss. Numerous exploration workshop is being carried out, to attain an accurate and more effective model for crop vaticination. Machine Learning algorithms play a pivotal part in colorfulaspects.ML algorithms can reuse and interpret different data sources, including literal rainfall data, soil quality assessments, and geographical information, to prize meaningful perceptivity. ML models can prognosticate the performance of different crops under specific conditions, helping growers choose the most suitable crops for their land. ML algorithms continuously learn and acclimatize, perfecting recommendations over time by incorporating real- time data and stoner feedback. ML- driven recommendations enable precise resource allocation, reducing waste and environmental impact while maximizing yields.

The purpose of this paper is to give a comprehensive overview of the current state of Crop Recommendation Systems (CRS) that use Machine Learning algorithms. It aims to review being exploration, technologies, and operations in this field to understand the advancements, challenges, and unborn directions. The compass of this paper covers colourful aspects of CRS, including data sources, ML algorithms, system infrastructures, case studies, challenges, and unborn prospects, offering precious perceptivity for experimenters, interpreters, and stakeholders in husbandry and technology.

## II. LITERATURE SURVEY

We've reviewed related work about this design in the history. For a crop recommendation system using ML algorithms, you should explore being studies, disquisition papers, and systems that are nearly related to your work. (1) Kumar, Y. Jeevan Nagendra, V. Spandana, V.S. Vaishnavi, K. Neha, and V.G.R.R. Devi. "The Supervised Machine Learning Approach for Crop Yield Prediction in an Agriculture Sector".In this proposed system crop yield prophecy can be done from the history nonfictional data which includes factors analogous as temperature, humidity, pH, downfall, crop name. Under this system, maximum types of crops will be covered across different sections of India. (2) Suresh G.A., Senthil Kumar, S. Lekashri, and R. Manikandan. "Effective Crop Yield Recommendation System Using a Machine Learning for Digital Farming".

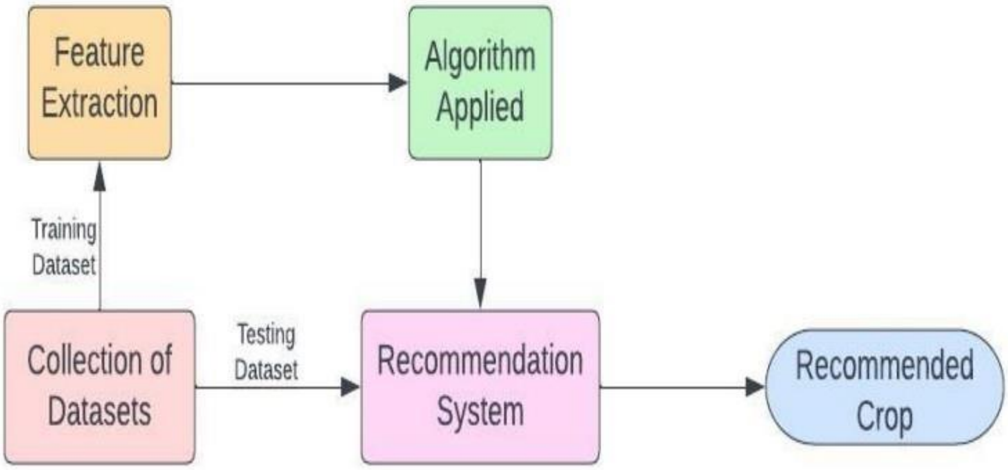
This proposed system is used for identifying particular crop according to the given particular data. By applying Support Vector Machine (SVM) acquired advanced perfection and productivity. This disquisition paper mainly worked on two datasets sample dataset of position data and sample dataset of crop data. husbandry plays a vital part in the life of an economy. It's the backbone for developing countries like India as further than 70 of population depends on husbandry. To increase crop product multitudinous factors are responsible like soil, downfall, rain, conditions and pesticides. They have used soil parameters to increase crop product because it's an essential pivotal factor of husbandry. To maintain nutrient situations in the soil in case of insufficiency, conditions are added to soil. The common problem being among the Indian farmers is that they choose approximate number of conditions and add them manually. spare or shy addition of poison can harm the plant life and reduce the yield.

The paper provides review of various data mining ways used on husbandry soil dataset for poison recommendation. mainly concentrated on various soil parameters like Fe, S, Zn, Cu, N and Ph value etc. In this check, authors also describe some husbandry problems that can be answered by using data mining ways analogous as Agriculture, Soil Fertility, Fertilizer Recommendation, Data Mining, Clustering, Bracket, Neural Network. Algorithms used also are K- mean in Agriculture, K- nearest neighbour in Agriculture, SVMs in Agriculture, Decision Tree in husbandry.

## III. PROPOSED SYSTEM

In this design, we've proposed a model that addresses the being issues. The novelty of the proposed system is to guide the growers to maximize the crop yield as well as suggest the most profitable crop for the specific region. The proposed model provides crop selection grounded on profitable and environmental conditions, and benefit to maximize the crop yield that will latterly help to meet the adding demand for the country's food inventories. The proposed model predicts the crop yield by studying factors similar as State, District, area, season. The system also helps to determine the stylish time to use diseases. The user provides a

State, District, Season, Crop and Area as inputs for product. The user gives a State, District, Season and Area as inputs for Crop Recommendation. According to the demand, the model predicts the crop yield for a specific crop. The model also recommends the most profitable crop and suggests the right time to use the diseases.




The main ideal is to gain a better variety of crops that can be grown over the season. The proposed system would help to minimize the difficulties faced by growers in choosing a crop and maximize the yield.

Fig 1. Block Diagram of Overall Methodology of Proposed System

As demonstrated in the figure, the methodology to prize the sentiment contains the several ways that are described below

(1) Data Collection The dataset consists of parameters like Nitrogen (N), Phosphorous (P), Potassium (K), PH value of soil, moisture, Temperature and downfall. The datasets have been attained from the Kaggle website. The data set has 2200 case or data that have taken from the once major data. This dataset includes twenty- two different crop similar as rice, sludge, chickpea, order sap, chump peas, moth sap, mung bean, Black gram, lentil, pomegranate, banana, mango, grapes, watermelon, muskmelon, apple, orange, papaya, coconut, cotton, jute, and coffee. The dataset is separated in Train and Test sets in which 80 of the whole datasets is taken as Train and 20 as Test dataset.

(2) Pre-Processing (Noise junking) For the successful operation pre-processing is needed. The data which is acquired from different coffers are eventually in raw form. It may contain some deficient, spare, inconsistent data. thus, in this step similar spare data should be filtered. Data should be regularized. We also use Power BI to remove peak/ downfall, original min- maximum, outliers, and junk values

(3) Feature Extraction: This step basically focuses on identifying and using most relevant attribute from dataset. Through this process irrelevant and redundant data is removed for application of classifiers.

## IV. DESIGN AND ARCHITECTURE

The architecture diagram gives the overall design of the project. After taking the location as input from the user, the data get processed using soil elements like pH, K, N, Ph and weather attributes that includes the crop details and all other trained data and finally the output which has maximum yield will be given to the user. This architecture ensures a seamless flow from data ingestion to user interaction, facilitating efficient crop recommendations and iterative model improvement. A crop recommendation system using machine learning (ML) algorithms involves creating a model that suggests the most suitable crops for a given area based on various factors. a crop recommendation system can provide valuable insights to farmers, helping them make informed decisions about the most suitable crops for their specific agricultural conditions. The data flow of the system architecture is as follow:

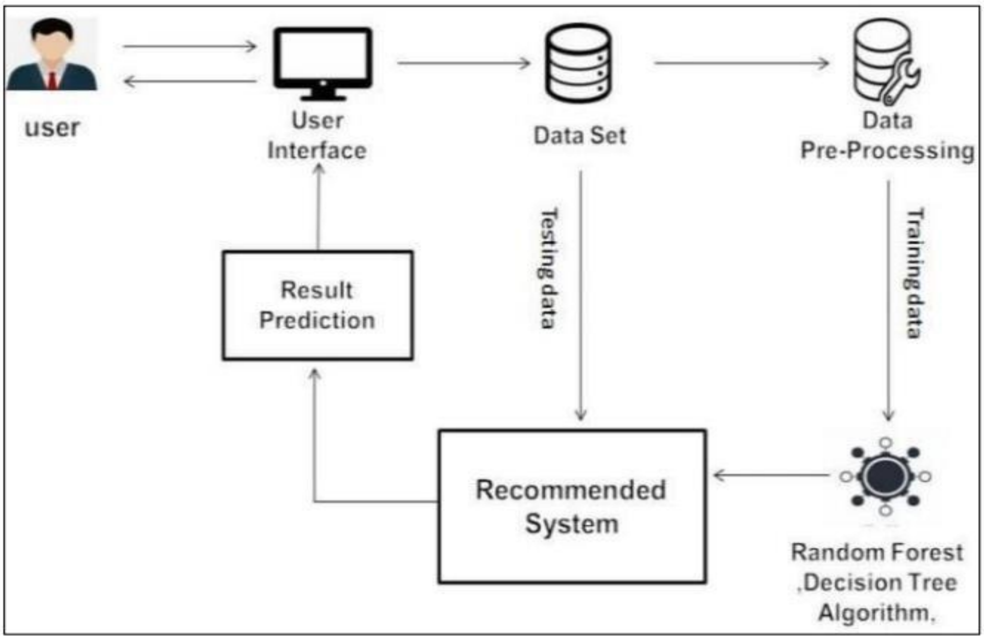



Fig. 2 System Architecture

(1) User: The user interface in the system architecture serves as the entry point for farmers to input relevant data such as soil characteristics and geographical location. This user-provided information is then processed through machine learning algorithms, generating personalized crop recommendations. The intuitive design of the user interface ensures accessibility and ease of interaction for farmers seeking optimized agricultural decisions.

(2) User Interface: The user interface component in the crop recommendation system facilitates seamless interaction between farmers and the machine learning model. It provides an intuitive platform for farmers to input their specific soil and climate conditions, displays personalized crop recommendations generated by the ML algorithms, and ensures a user-friendly experience through clear visualization of results. Integration of user feedback mechanisms enhances the system's adaptability and usability for agricultural practitioners.

(3) Dataset: The dataset for the crop recommendation system includes comprehensive information on soil attributes, climate conditions, and historical crop performance. It encompasses variables such as soil Ph, temperature, precipitation, and crop yield, providing a rich source for training machine learning algorithms to make accurate crop recommendations.

(4) Data Pre-processing: In the data pre-processing stage of the crop recommendation system, raw datasets undergo cleaning to handle missing values and outliers. Feature scaling is applied to normalize variables, ensuring consistent influence during model training. Categorical variables are encoded, and the dataset is split into training and testing sets for algorithm training and evaluation, respectively. Additionally, dimensionality reduction techniques may be employed to enhance computational efficiency.

(5) Algorithms: The system architecture incorporates machine learning algorithms such as Decision Trees, Random Forest, SVM, Gaussian NB, LR and K-NN to analyse the dataset and predict suitable crops. Ensemble techniques and cross-validation are employed to enhance the robustness and accuracy of the recommendations, ensuring adaptability to diverse agricultural scenarios.

(6) Recommended System: The recommendation system within the architecture employs machine learning algorithms like Decision Trees or Random Forest to analyse the input dataset and predict suitable crops based on soil and climate conditions. The system integrates user-friendly interfaces for farmers to input their specific parameters, facilitating personalized and optimized crop recommendations.

## V. IMPLEMENTATION

In regions where climate conditions constantly change, it's challenging to calculate solely on rainfall data for crop civilization. Technology is essential for collecting crop data and guiding growers for better yields. also, proper toxin operation is pivotal, as inordinate operation can deplete soil fertility and affect in crummy crop yields. In India, where husbandry significantly impacts the frugality, accurate crop vaticination is vital. Employing data mining ways can give a further dependable vaticination tool, replacing hamstrung and guesswork-grounded styles in husbandry opinions. In the prevailing device climatic conditions range veritably constantly. So, it's long hauls tough to extend foliage with the useful aid of the use of data rainfall situations. We need to use some period to detect the crop data and guide the growers to increase foliage because of this and also toxin likewise one of the important factors to boom foliage as a forestall end result. If toxin is use more or less in the issue the soil might also likewise lose it fertility and crop may not supply the anticipated yield. So, toxin also becomes the number one element in it.
In this system we applied different Machine Learning algorithms like Random Forest, Decision Tree, Support Vector Machine (SVM), Logistic Regression (LR), and Gaussian NB, K- NN algorithm.

1) Random Forest Random Forest is an ensemble literacy algorithm that builds multiple decision trees during training and merges their prognostications. It operates by constructing a multitude of decision trees at training time and labours the mode of the classes (bracket) or the average vaticination (retrogression) of the individual trees.
2) Decision Tree Decision tree classifiers use greedy methodology. It's a supervised literacy algorithm where attributes and class markers are represented using a tree. The main purpose of using Decision Tree is to form a training prototype which we can use to prevision class or value of target variables by learning decision rules derived from former data (training data).
3) Support Vector Machine (SVM) Support Vector Machine (SVM) is a supervised machine learning algorithm or model which can be employed for bracket and as well as for retrogression challenges. still, we substantially use it in bracket challenges. SVM is generally represented as training data points in space which is divided into groups by comprehensible gap which is as far as possible.
4) Logistic Regression (LR) The Logistic Regression model is a astronomically used statistical model that, in its introductory form, uses a logistic function to model a double dependent variable; numerous further complex extensions live. In Retrogression Examination, Logistic retrogression is prognosticating the parameters of a logistic model; it's a form of Binomial retrogression. Logistic Retrogression is a double bracket algorithm used for prognosticating the probability of a case belonging to a particular class.

## VI. RESULTS

After using different machine algorithms for predicting crops, we have come with the following results -

### A. UI of Website:

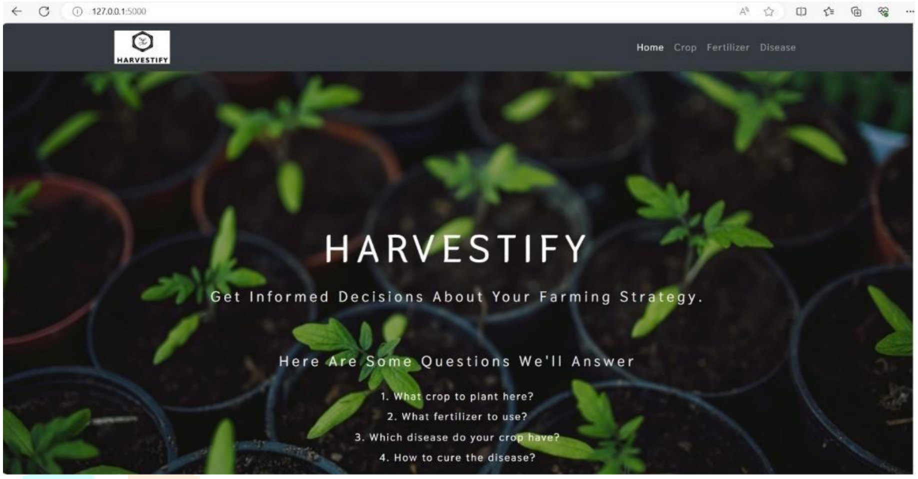



Fig. 3 UI of Website

### B. Adding Farm details for Crop:

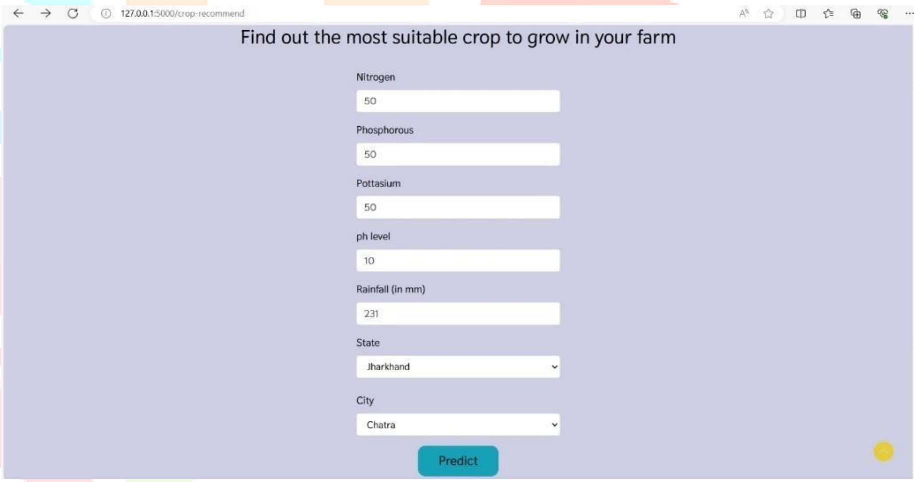



Fig. 4 Adding farm details for crop

### C. Recommended Crop:

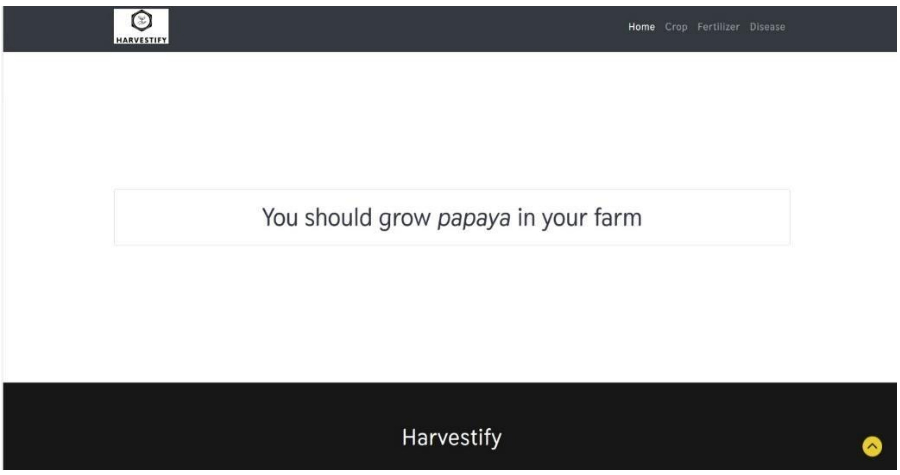



Fig. 5 Recommended crop

### D. Adding Farm details for Fertilizer:

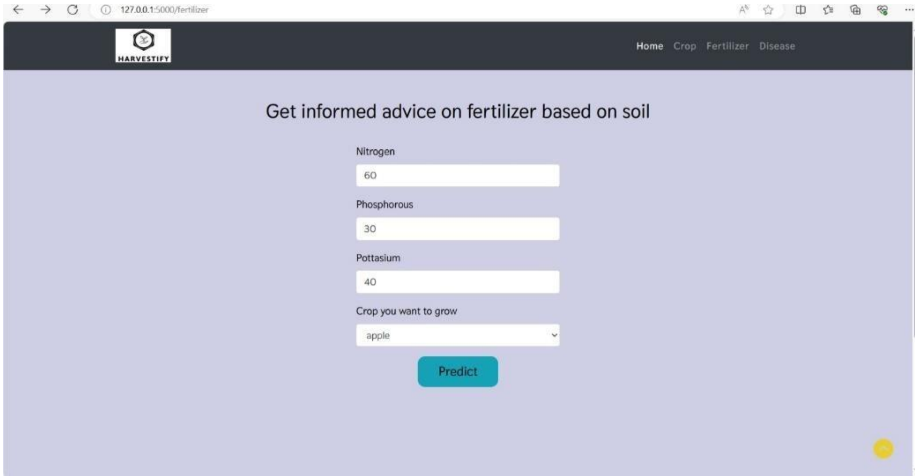



Fig. 6 Adding farm details for fertilizer

### E. Recommended Fertilizer:

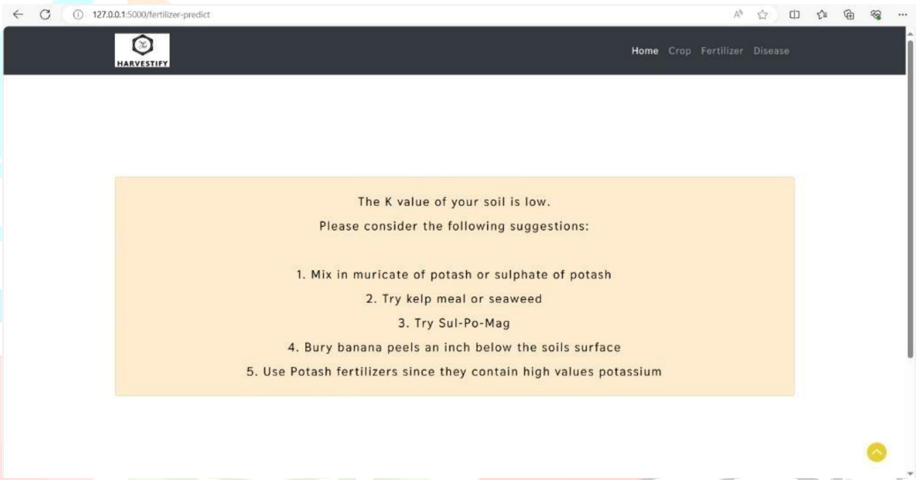



Fig. 7 Recommended fertilizer

### F. Upload Disease Plant Image:

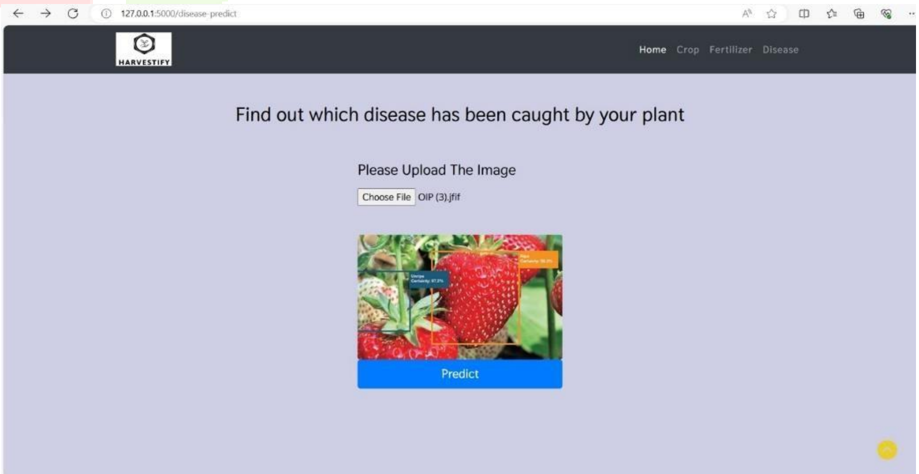



Fig. 8 Upload disease plant image

### G. Predicted Disease:

Fig. 9 Predicted disease

We have suggested and built a smart crop recommendation system using the finding of this paper that farmers in India can utilize with ease for better application of farming. Based on factors including nitrogen, phosphorus, potassium, pH, moisture, temperature, and rainfall, the system decides which crops to produce. Using this research to increase the productivity of the country, farmers could get profits from such techniques. In this way, farmers can grow the right crops, increase their yields, and increase the overall profitability of the country. We use various machine learning algorithms such as Random Forest, KNN, SVM etc. to express recommendations for different Indian cultures.

## VII. CONCLUSION

In conclusion, the implementation of a Crop Recommendation System (CRS) utilizing Machine Learning (ML) algorithms offers immense promise in addressing the multifaceted challenges of crop selection in modern agriculture. This technology driven approach has the potential to revolutionize the agricultural landscape by providing farmers with data-driven insights and recommendations, thereby significantly enhancing agricultural productivity, sustainability, and economic outcomes. Through the synthesis of data from various sources, including historical weather data, soil quality assessments, and geographical information, ML algorithms enable the creation of predictive models capable of making accurate and tailored crop recommendations. These recommendations not only empower farmers to optimize resource allocation and mitigate risks but also contribute to the efficient and sustainable use of land and resources. Furthermore, the adaptability of ML algorithms ensures that CRS can continuously improve and evolve. By incorporating real-time data and user feedback, the system becomes increasingly precise and responsive, ultimately benefiting both farmers and the environment.

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