Crop Recommendation System and Plant Disease Classification using Machine Learning for Precision Agriculture

Mahendra Choudhary, Rohit Sartandel, Anish Arun, Leena Ladge

SIES Graduate School of Technology, Maharashtra, India

Corresponding author: Rohit Sartandel, Email: rohit.sartandel18@siesgst.ac.in

The Agriculture sector is the backbone of our country. It provides a living for the vast majority of India's inhabitants, but it only accounts for 15% of the country's GDP. In comparison to other countries, our country's crop yield is quite poor. This could be one of the reasons for India's increased suicide rate among marginal farmers. Another cause for this is that farmers do not plan their crops properly.Another reason for this situation is that farmers frequently make incorrect crop selection decisions, such as planting in the wrong season or picking a crop that would not yield much for the particular soil. Incorrect crop selection will always result in a lower yield. It is difficult to survive if the family is entirely dependent on this revenue. In this paper, we offer a model that addresses these concerns. The suggested methodology allows for crop selection based on economic and environmental factors, intending to boost crop yields to satisfy the country's growing food demand. The proposed model predicts the crop yield by studying factors such as rainfall, temperature, humidity, soil nutrients, ph value of the soil. The model assists farmers in maintaining soil nutrient levels. In addition to that, the app will enable farmers to identify diseases in their plants.

Keywords: Agriculture, Crop Suggestion System, Machine Learning, Fertilizer Recommendation, Plant Disease Classification.

2023. In Saroj Hiranwal & Garima Mathur (eds.), *Artificial Intelligence and Communication Technologies*, 39–49. Computing & Intelligent Systems, SCRS, India. https://doi.org/10.52458/978-81-955020-5-9-4

1 Introduction

Agriculture is one of the most significant sources of income, employing around 58 percent of our country's population. According to the 2016-17 Economic Survey, a farmer's average monthly income in 17 states is Rs.1700/-, resulting in farmer suicides and the conversion of agricultural land for non-agricultural activities. Furthermore, 48% of farmers do not want their children to take care of their farms, preferring to live in cities. The reason for this is that farmers frequently make incorrect crop selection decisions, such as planting in the wrong season or picking a crop that would not yield much for the particular soil. Incorrect crop selection will always result in a lower yield. It is difficult to survive if the family is entirely dependent on this revenue. Crop yield is affected by different factors such as meteorological, geographic, organic, and economic considerations. It is difficult for farmers to select a suitable crop due to shifting market prices. According to Wikipedia, India's suicide rate has varied between 1.4 and 1.8 percent per 100,000 people during the last ten years. Due to climate unpredictability, farmers are unsure which crop to cultivate in a particular season. The use of various fertilizers is also unpredictable due to seasonal climate fluctuations and crucial components such as soil, water, and air. Crop yields are progressively dropping in this environment. The solution to the problem is to offer farmers a user-friendly recommender system. In this paper, we offer a model that addresses these concerns. The suggested methodology allows for crop selection based on economic and environmental factors, intending to boost crop yields to satisfy the country's growing food demand. The proposed model predicts the crop yield by studying factors such as rainfall, temperature, humidity, soil nutrients, ph value of the soil. The model assists farmers in maintaining soil nutrient levels. In addition to that, the app will enable farmers to identify diseases in their plants.

2 Literature Review

This research implements the random forest approach to agricultural yield prediction and product cost determination using temporal details. Essentially, this strategy works for maize and rice crops. It has demonstrated that the proposed system operates on a static dataset and generally operates in a small area[1].The authors in sajib et.al.[2] contemplated the influence of atmospheric conditions on users' moods to determine appropriate crops for their farm. The weather data gathered has been extensively used to recommend the suitable crops that should be opted by the farmers in given soil and climate conditions. Pudumalar et. al.

[3] conversed about the difficulties faced by the farmers because of the inappropriate selection of crops to be cultivated in the available soil due to lack of appropriate knowledge. They developed a recommendation system that can guide the farmers to select proper crops for the available soil. The algorithms used by the authors were Random Forest, Naive Bayes, CHAID model, Kclosest neighbor, etc. This article [4] talks about the various applications of ANN, ML and IoT in agriculture and various models of assistance in precision farming.Pressure on the agricultural sector will increase as the population continues to expand. So, agricultural technology and precision farming have become very important in today's world. This is also known as digital farming which means the use of hi-tech computer system to calculate various parameters like weed detection, crop prediction, yield detection, crop quality and many machine learning farming techniques. In this paper [5], the seed data of the crops were collected with the appropriate parameters like temperatures, humidity, and moisture content. The proposed system uses a Naive Bayes Classifier to recommend the crop. Parameters such as temperature, humidity, location are passed to the model to predict a suitable crop for the farm. DHT11 sensor is used to measure the temperature and humidity of the surrounding air.In this research paper [6], the model predicts late blight disease in potatoes with the help of weather data and the Extreme Learning Machine (ELM) algorithm. Experiments were conducted on the AICR potato databases. The proposed model obtained an accuracy of 91.5%. Priyanka Sharma et. al.[7] proposed a Backpropagation Neural Network to predict a Potato Late Blight Disease based Upon Weather Parameters. Features such as maximum temperature, minimum temperature, maximum humidity, minimum humidity, and crop data were retrieved from AICRP on Potato. Several activation functions such as Sigmoid, TanH, and ReLu were used in neural networks. In this paper, Islam et. al.[8] showcase a method for detecting diseases in potato leaves. The proposed method classifies the diseases on potato flora from 'Plant Village', which is a database of plant images that is available publicly. GLCM is applied for extracting statistical texture features. Usage of the segmentation method and the SVM algorithm demonstrated disease classification in over three hundred images acquired a mean accuracy of 95%. Pavani and Beulet [9] researched the usage of the KNN algorithm to predict agricultural productivity in India. The model performed well in the prediction of crop yield with a minimal discrepancy between anticipated and actual output. The suggested model proposes techniques for reducing agricultural produce waste. It has been demonstrated that KNN clustering outperformed SVM and regression. The paper [10] discusses various machine learning algorithms such as ANN, Fuzzy Network, and various data mining tech-

niques with their advantages.

3 Methodology

3.1 Dataset

Data is a crucial part of any Machine Learning System. Datasets from various government websites and kaggle were used to predict the crops. The dataset for the crops recommendation system consists of 22 crops grown across India. Parameters considered for the crop recommendation model are nitrogen, phosphorus, potassium, rainfall, temperature, humidity, ph. Dataset for crop disease classification consists of images of leaves of 14 plants while excluding healthy leaves, 26 types of images that show a particular disease in a plant. For each plant disease type, there are 1800 images.

3.2 Data Exploration

Data exploration means exploring the relationships between the columns of the dataset. The simple technique to look for correlations between columns is to use a heat map to visualize the correlation matrix. Pearson Correlation is used to visualize the correlation matrix as a heat map.

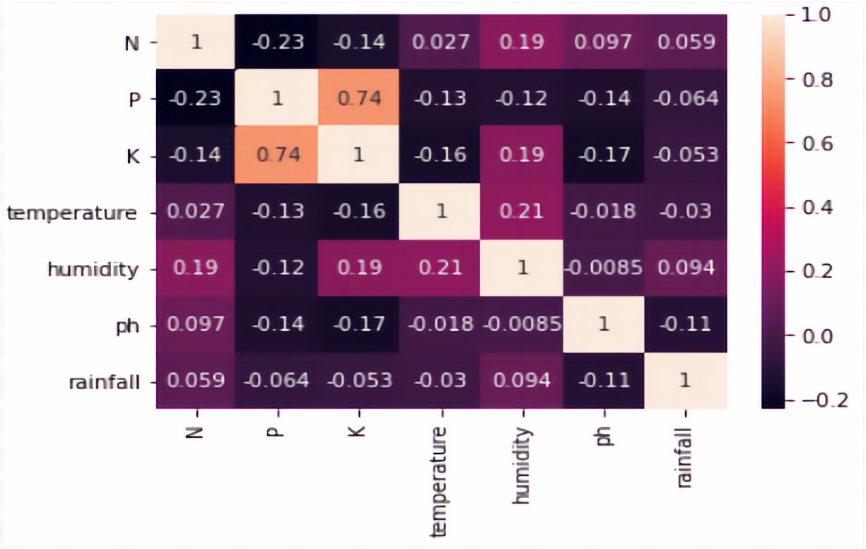

Figure 1: Crop Recommendation Model

3.3 Data Splitting

The input data is segregated into three subsets to prevent the model from overfitting and to evaluate the model effectively. Three subsets are train, valid, and test datasets. Here, we have considered the 60:20:20 ratio which is the most appropriate ratio.

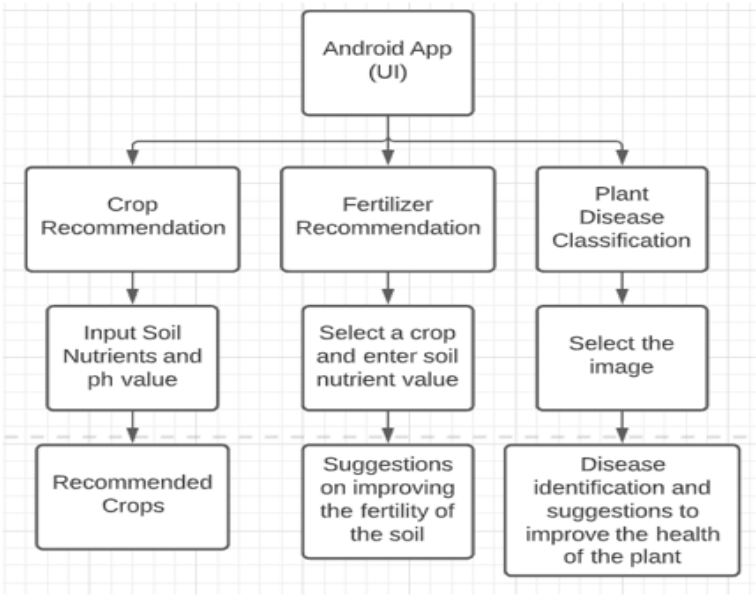

Figure 2: Architecture

3.4 System Architecture

Fig.2 shows the system architecture of our proposed model.It is a mobile app that consists of three modules- crop recommendation, fertilizer recommendation, and plant disease classification. The crop recommendation module recommends the crop based on the values of the different parameters given by the user.The fertilizer recommendation module suggests how to improve the fertility of the soil. The plant disease classification module helps the farmer to identify the disease.

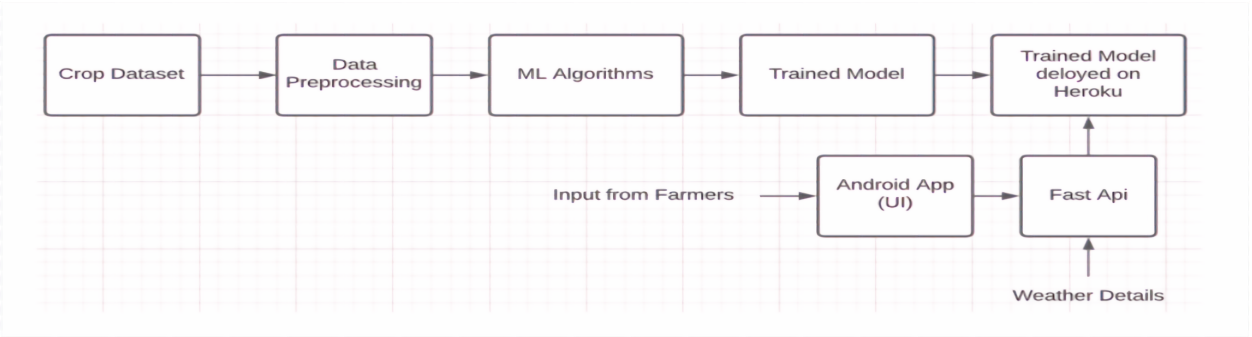

Figure 3: Crop Recommendation Model

3.5 Crop Recommendation

Fig.4 shows the crop prediction page and prediction result. Based on different parameters, the ML model will predict a suitable crop.

3.6 Fertilizer Recommendation

Fig.5 shows the fertilizer prediction page and fertilizer suggestion result. Based on different parameters, the ML model will give suggestions to manage the nutrient level in the soil.

3.7 Crop Disease Classification

Fig.6 show the disease prediction page and its result. The user has to give an input image of the infected plant to the ML model and the model classifies the image explaining why the disease has occurred to the plant. It also suggests remedies to cure the plant.

Fig.7 shows the accuracy of the different machine learning algorithms for the crop recommendation system.

4 Conclusion

Currently, our farmers are not using technology and analytics effectively, so there is a risk of incorrect crop selection for cultivation, which will reduce their income. To prevent such losses, we have developed a farmer-friendly system with a graphical user interface (GUI) that will predict which crop would be the

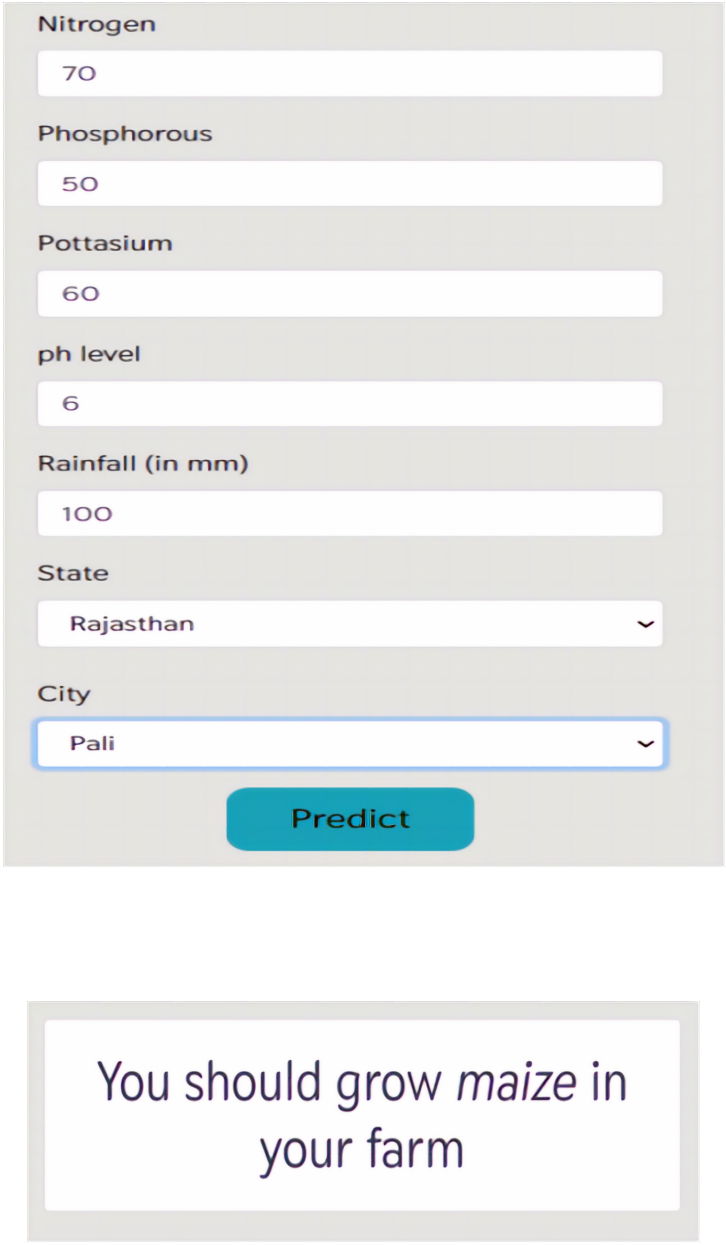

Figure 4: Crop recommendation output

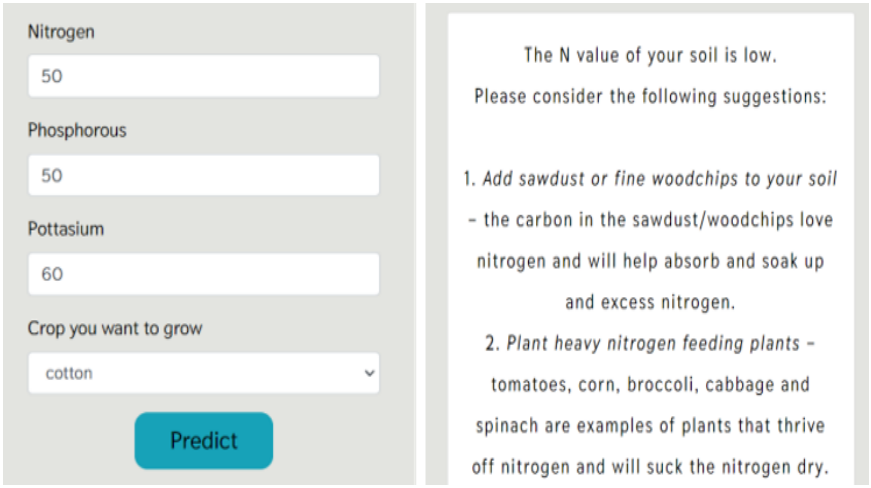

Figure 5: Fertilizer Recommendation Output

Figure 6: Crop Diagnostics

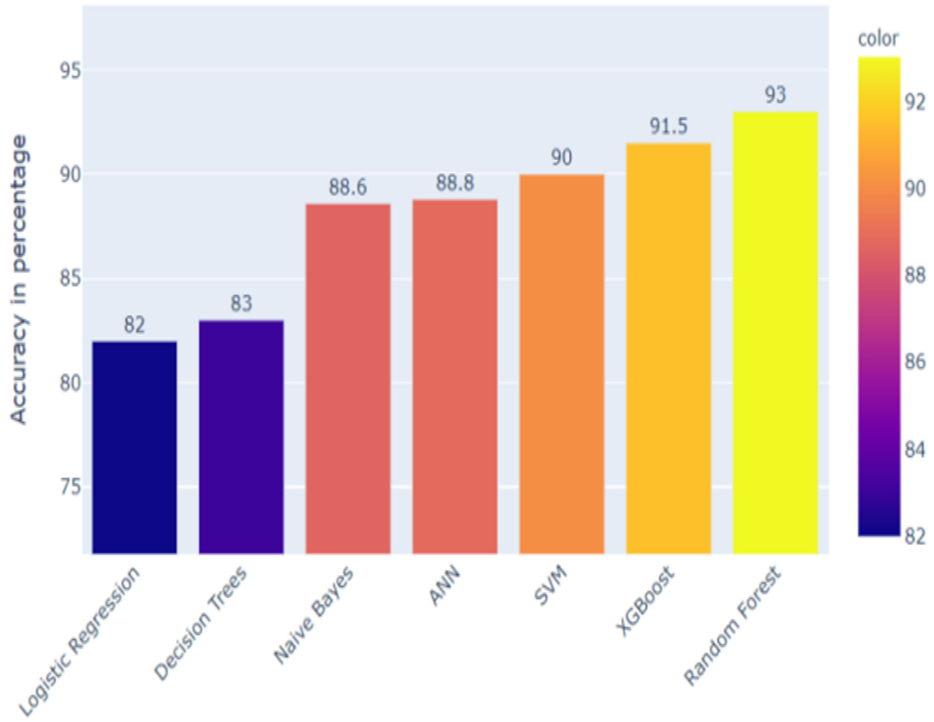

Figure 7: Accuracy Graph

best fit for a specific plot of land. This system will also provide information on required nutrients to add to the soil and help them identify crop diseases. As a result, farmers are more likely to make the proper decisions for crop selection, and farmers will benefit from earning more income. With the help of more complex algoritms the efficiency of the model can be increased.To boost the efficiency of crop selection and revenue, integrate the crop recommendation system with yield prediction. By increasing the dataset's size and by including more crop information and pictures of infected plants,efficiency of the model can be increased.

References

[1] SR Rajeswari, Parth Khunteta, Subham Kumar, Amrit Raj Singh, and Vaibhav Pandey. Smart farming prediction using machine learning. Interna-

tional Journal of Innovative Technology and Exploring Engineering, 8(07), 2019.

[2] Zeel Doshi, Subhash Nadkarni, Rashi Agrawal, and Neepa Shah. Agroconsultant: Intelligent crop recommendation system using machine learning algorithms. In 2018 Fourth International Conference on Computing Communication Control and Automation (ICCUBEA), pages 1–6. IEEE, 2018.

[3] S Pudumalar, E Ramanujam, R Harine Rajashree, C Kavya, T Kiruthika, and J Nisha. Crop recommendation system for precision agriculture. In 2016 Eighth International Conference on Advanced Computing (ICoAC), pages 32–36. IEEE, 2017.

[4] Konstantinos G Liakos and DimitriosMoshou PatriziaBusato. Simon pearson, and dionysis bochtis.(2018).". Machine learning in agriculture: A review." Sensors, 18.

[5] A Priyadharshini, Swapneel Chakraborty, Aayush Kumar, and Omen Rajendra Pooniwala. Intelligent crop recommendation system using machine learning. In 2021 5th International Conference on Computing Methodologies and Communication (ICCMC), pages 843–848. IEEE, 2021.

[6] BK Singh, RP Singh, Tejasvee Bisen, and Shweta Kharayat. Disease manifestation prediction from weather data using extreme learning machine. In 2018 3rd International Conference On Internet of Things: Smart Innovation and Usages (IoT-SIU), pages 1–6. IEEE, 2018.

[7] Priyanka Sharma, BK Singh, and RP Singh. Prediction of potato late blight disease based upon weather parameters using artificial neural network approach. In 2018 9th International Conference on Computing, Communication and Networking Technologies (ICCCNT), pages 1–13. IEEE, 2018.

[8] Monzurul Islam, Anh Dinh, Khan Wahid, and Pankaj Bhowmik. Detection of potato diseases using image segmentation and multiclass support vector machine. In 2017 IEEE 30th canadian conference on electrical and computer engineering (CCECE), pages 1–4. IEEE, 2017.

[9] S Pavani and AS Beulet. Heuristic prediction of crop yield using machine learning technique. International Journal of Engineering and Advanced Technology (IJEAT), pages 135–138, 2019.

[10] K Sriram Rakshith, G Deepak, M Rajesh, KS Sudharshan, S Vasanth, and N Harish Kumar. A survey on crop prediction using machine learning approach. Int. J. Res. App. Sci. Eng. Techno.(IJRASET)., 7(4):3231–3234, 2019.