

Crop Recommendation for Smart Farming using Machine Learning Techniques

-A Survey

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Abstract – Agriculture is an important part of India's socio-economic fabric. The huge agricultural industry is the country's largest asset; nonetheless, farmer productivity in India is not even equivalent to that of other large countries. Farmers' failure to choose the appropriate crop for their land using conventional methods that are not scientific is a severe problem in a nation where farming employs around 58 percent of the total population. Aside from that, shifting agricultural prices and market instability are also important concerns. This research aims to review all crop recommendation and price prediction strategies utilizing machine learning techniques.

Keywords - Machine Learning, Smart Farming, Agriculture, Crop Recommendation

1. Introduction

In India agriculture is one of the most important occupations. It is the country's largest economic sector and plays a critical part in its overall development. To meet humanity's needs, more than 60% of the country's land is dedicated to agriculture. To achieve the stringent criteria, agricultural techniques must be modernized. As a result, embracing new agricultural technologies is critical. This will lead to profit for our country's farmers. Farmers frequently make mistakes when it comes to crop selection. Because our farmers

are not successfully using technology and analysis at the moment, there is a risk of incorrect crop selection, which will diminish their income.

Incorrect Crop Selection will always result in a lower yield. Farmers will be protected from picking the wrong crop if they have access to accurate and up-to-date information regarding crop prices. With the tools available to us different types of websites have been created to resolve this issue by giving predictive crop sustainability insights and suggestions based on machine learning algorithms.

Prior crop recommendations were performed based on farmers' experience in a particular location as well as various data available from soil tests. The studied systems assist the farmers in choosing the right crops by providing information that other farmers don't usually keep track of, hence reducing the probability of crop failure and improving the farmers' productivity. These also prevent them from facing losses. Various web and mobile applications incorporate a user-friendly interface that provides access to recommendations of crop cultivation to a large number of farmers across different regions of the country.

2. Related Work

Priyadharshini A et. al.[1], the proposed model allows the farmers to select the proper crop by presenting the insights that everyday farmers do not maintain, thereby decreasing the probabilities of crop failure and growing productivity. It additionally prevents the farmers from incurring losses.

Artificial Neural Network is considered to select the crop with the excessive yield rate. Earlier than cultivation, the crops have been ranked primarily based totally on Decision Tree Learning-ID3 and the K Nearest Neighbors Regression algorithms.

Linear regression suits a straight-line among rainfall, temperature, pH, and manufacturing which will produce a y-pred price value for every crop. In the end, sorting of annual production is primarily based on the price value by the means of the linear regression version that uses quick sort, giving the crop

with the prime score first within the list. The entire proposed system is split into 3 modules: Analysis of Profit, Crop recommender and prediction of crop sustainability.

Shilpa Mangesh *et.al.*[2], proposes a model that tends to solve the issues relating to the prediction for crop yield taking into consideration the various parameters like soil type, climate and even taking into account precise knowledge of crop history with the prime objective of getting a variety of crops that can be grown in that time of the year.

This paper also suggests the creation of a mobile application that can add to the ease for the farmer by predicting the best crops for that season. The entire model can be divided into 2 parts, 1st location can be picked up from the GPS of the mobile and then precise prediction is made for the best crops that can be grown by using quality datasets from portals like Kaggle and 2nd to tell the farmer the accurate time of when to use the fertilizer by taking weather into consideration (so as to avoid the rain just after using the fertilizer) and thereby actually maximizing the crop yield.

Girish *et.al.*[3], identified the research already done in the areas of price forecasting using different models. The various methodologies include backpropagation neural networks to predict tomato price, KNN for crop price forecasting, N supply, losses, and demand for precision N management for corn, ARIMA for future price prediction of cotton, LSTM for the closing price, SARIMA for price forecasting of tomato and so on.

In most cases, only specific attributes are used, like soil, temperature, historical price, etc.

Zeel Doshi *et.al.*[4] proposed a model named AgroConsultant. The main problem it addresses is farmers, growing similar crops in nearby areas, making vague guesses, for the purpose of making instant profits and the like. But such decisions have created several problems in the past and are likely to create in the future as well.

This model takes its one input from the rainfall predictor. The schema of the training dataset involves Soil Type, Aquifer Thickness, Soil pH, Thickness of Topsoil, Precipitation, Temperature, and most importantly the location parameters.

On observing the dataset, it was found that to a single instance more than one class could be assigned hence the authors of [4] thought multi-label classification to be the best choice. And hence the options for Machine Learning Algorithms converged to 4, the ones which had in-built support for MLC. Map Visualization which was an exclusive and amazing feature implemented by the authors of [4] used a JavaScript library called Leaflet.js and Flask.

On trying on all the Machine Learning Algorithm options available to the authors of [4], they found that Neural Network provided the greatest accuracy percentage.

As a result, on selecting the parameters from the schema, the farmer gets the list of crops he can grow, and also in map visualizations, he can view the decisions made by the nearby farmers to avoid having similar crops in the same region. This provides a prediction that is vast and is not only based on environment or geography but the economic factors as well.

Pudumalar *et.al.*[5], discussed that in agriculture to analyze biotic and abiotic factors data mining techniques can be used. The Indian farmers have common problems such as being unable to choose the right crop based on soil requirements which harm productivity. In this paper, the authors try to address this problem through precision agriculture.

This technique uses attributes such as soil types, yield data, etc. Later based on site-specific characters, the model suggests the right crop. In this paper, the authors used an ensemble model. They used majority voting techniques with random trees, CHAID, K Nearest Neighbors, and Naive Bayes. Using an improved dataset with a greater number of attributes or parameters, this model can be further enhanced. Also, it is required to predict the yield of a crop.

TABLE I
COMPARISON OF VARIOUS TECHNIQUES

Paper Title	Year of Publication	Authors	Model/Accuracy	Limitations/Remarks
Intelligent Crop Recommendation System using Machine Learning	2021	Priyadharshini A , Swapneel Chakraborty ,Aayush Kumar	89.9% using Neural Network	Lacks a frontend application . Accuracy can be improved using ensemble methods such as a random forest.
Crop Recommender System Using Machine Learning Approach	2021	Shilpa Mangesh , Dr. Prem Kumar Ramesh , Anmol, B.R Aishwarya, Karuna Rohilla, Kumar Shaurya	95% using Random Forest	This discusses only about 2 states– Karnataka and Maharashtra.
A Study on Agriculture Commodities Prediction and Forecasting	2020	Girish Hegde , Vishwanath R Hulipalled , J. B. Simha	N.A	Most models make crop and location specific price predictions.
AgroConsultant: Intelligent Crop Recommendation System Using Machine Learning Algorithms	2018	Zeel Doshi , Subhash Nadkarni , Rashi Agrawal , Prof. Neepa Shah ,	71% from Rainfall Predictor model	Relies on another recommendation system whose accuracy may impact the accuracy of the current model.
Crop Recommendation System for Precision Agriculture	2016	S.Pudumalar, E.Ramanujam, R.Harine Rajashree, C.Kavya, T.Kiruthika, J.Nisha ,	88% from the majority voting model.	Predictions are made for only 10 crops.

3. Future Work

Multiple dataset for crop recommendation are available with varying numbers of crops , parameters and geography. In addition to this , data can be obtained from other sources as well which include the web

, government websites etc. Using this data and appropriate algorithms , highly accurate crop recommendation systems can be developed. Machine learning methods such as Decision Trees , Random Forest , Naive Bayes and Deep Neural Networks are very appropriate for such problems. After cleaning and transforming the data into forms that can be used for training, various models will be trained using different methodologies, and based on accuracy models can be selected and finely tuned.

Models can be developed using Python programming languages. Numerous libraries exist which allow training machine learning and deep learning models easy and fast. After finalizing the model, it can be stored as a pickle object and used later for making predictions.

After all this work, the use of frontend tools, like Django , Flask , Streamlit will allow the creation of a frontend for farmers that will make this work user-friendly and easily accessible by the farmers. The user-friendly frontend will help the farmers to choose which crop to grow thereby helping them to do intelligent farming.

4. References

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