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Crop Prediction for Maximum Yield Using Machine Learning

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Abstract

The majority of the GDP of an agriculture-basedeconomy comes from farming[1]. This initiative was inspired by the rising suicide rates among farmers, which may be related to poor crop yields. The field of agriculture is now seriously threatened by changes in the climate and other environmental factors. For this problem to be solved effectively and practically, machine learning is a crucial strategy. Estimating agricultural output based on historical information such as Ph,humidity temperature,rainfall,N,P,K[2]. We used the machine learning method to achieve this. We compared a number of machine learning algorithms, including logistic regression,decision tree, random forest algorithm and we ultimately settled on the Random Forest Algorithm, which provided accuracy of 97.87%. A windows server that forecasts crop yields for aspecific crop has been created as part of this project.[3]

Introduction

Main emphasis was given to this field considering the importance of production in India, although it is very important in every corner of the world, In terms of farm output, India is rated second globally [4]. About 50% of all workers were employed in the agricultural and related industries in 2009, which contributed16.6% of the GDP [5]. Agriculture's financial contribution to India's GDP is steadily shrinking.Plant crop production is influenced by a varietyof variables, including climatic, geographic, biological, political, and economicconsiderations. When there are multiple crops tobe grown, it can be challenging for farmers, especially if they are unaware of market values.According to estimates from Wikipedia, between2004 and 2005, India's farmer suicide rate wasbetween 1.4 and 1.8 per 100,000 people. Farmersuicides increased from 5650 in 2014 to over8000 in 2015 [6].Using technology to raise awareness about farming has been a need in recent years. Food insecurity is brought on by seasonal climate changes that are harmful to basic resources including soil, water, and air. A smart system that can address the issue of declining crop output is required in a situation where crop yieldrates are continually falling short of fulfilling demand. In order to solve this issue, we suggesta system that would allow farmers to choose crops based on economic and environmental considerations in order to maximize their output,which will subsequently assist them fulfill the nation's growing demand for food supplies. The suggested system makes use of machine learningto make informed estimations.To ensure that farmers receive the most possible yield from their crops, the system will offer crop recommendation and crop selection depending on weather conditions that are optimal for the crop. The system analyses variables like rainfall,temperature, N,P,K,humidity to predict suitable crop.Predicting the right crop is a significant agricultural issue. Every farmer strives to determine whether it will satisfy their goals. In the past, such prediction calculations were basedon an examination of a farmer's prior knowledgeof a particular crop. Agricultural production is largely influenced by the weather, pests, and harvest operation planning.When making judgments about agricultural risk management, accurate knowledge on crop history is crucial. Therefore, precise knowledge of the historical context of harvest is important for helping executives make decisions related to horticultural risk. Artificial intelligence's branch of machine learning describes a machine's capacity to imitate intelligent human behaviour. To automate complex operations, artificial intelligence systems are used in a similar mannerto people [2]. The foundation of machine learning is data, such as records of transactions, people, or images.To serve as training data for the machine learning system, the data is gathered and analysed. The software displays better resultswith more data. The developer then chooses a machine learning (ML) model to use, inputs the data, and trains the system to recognise patterns or predict outcomes on its own.

Literature survey

In [7],Shilppa Mangesh has proposed a system which provides connectivity to farmers via a mobile application. GPS helps to identify the user's location. The user provides the area & soiltype as input. the results deduced from selected algorithms for Maharashtra and Karnataka regions. The parameters used for algorithms are crop type, year, season, soil type, area, and region.. To predict the crop yield, selected Machine Learning algorithms such as Support Vector Machine (SVM), Artificial Neural Network (ANN), Random Forest (RF), Multivariate Linear Regression (MLR), and K-Nearest Neighbor (KNN) are used and accuracy of the crop yield prediction is compared. Among them, the Random Forest showed the best results with 95% accuracy. Additionally, the system also suggests the best time to use the fertilizers to boost up the yield..The proposed system by Pallavi Kamath et al.[8] involves a prediction module based on data mining classification algorithm namely Random Forest and uses it to forecast the yield of major crops based on historical data. Some soil agronomic parameters, such as chalky, clay, loamy, sandy, and so on, as well as different seasons, are included. For the training purpose 80% of data is used and remaining 20% of data is used for testing.They've designed a website that consists of Four functional modules :1) Crop Module 2) Soil Module 3) Weather Module: By entering the city name the user can get the live weather forecast.4) Predict: It allowsthe user to select the district name, crop name, soil type and area. After selecting these values the user can click the predict button to get the estimated yield.This framework put forward by M.S. Minu et al.[9]focuses on climate estimating, crop yield expectation and harvest cost determination. Reasonable grouping strategies like RF,SVM,Logistic Reasoning(LR) and ANN are utilized. The information of anticipated yield is available for the cultivators through a web application. This guides them to choose the yieldthey might want to plant for the expected year.The web application likewise gives a discussion to the ranchers to stock the merchandise without mediators which help themto acquire the most cost for their items.This paper by Aruvansh Nigam et al. [10] takes into consideration the inconsistent data from temp & rainfall datasets in order to provide a consistent trend.Time Series ML algos areapplied eg. Simple RNN, LSTM. Crop production dataset that is used to predict the name and yield of the crop is fed into classification and regression algorithms like RF, XGBoost, KNN, LR, Linear Regression and ANN. The outcome of these techniques is compared on the basis of mean absolute error.

Experiments were conducted on an Indian government dataset and it has been established that RF gives highest yield prediction accuracy when all parameters are combined. Sequential model ie. Simple Recurrent Neural Network performs better on rainfall prediction while LSTM is good for temperature prediction.Combined dataset in the paper by Anakha Venugopal et al. [11] has 4261 instances.

Abundantly growing crops in 14 districts in Kerala were chosen and their name was predicted and yield was calculated on the basisof area, production, temperature, humidity, rainfall and wind speed. The pre-processed dataset was trained using RF classifiers. Chosen district's instant weather data accessed from APIwas used for prediction. Trained model resulted in right crop prediction for the selected district. The classifier models used here include LR, Naïve Bayes and Random Forest, out of which the RF provides maximum accuracy.Five ML models (linear Reg., LASSO, LightGBM, RF, and XGBoost) and six ensemble models have been designed to address the research question presented by Mohsen Shahhosseini et al.[6] . The results suggest that adding simulation crop model variables (APSIM) as input features to ML models can decrease yield prediction root mean squared error (RMSE) from 7 to 20%.Furthermore, we investigated partial inclusion ofAPSIM features in the ML prediction models and we found soil moisture related APSIM variables are most influential on the ML predictions followed by crop-related and phenology-related variables.The paper [12] aims to discover the best model for crop prediction, which can help farmers decide the type of crop to grow based on the climatic conditions and nutrients present in the soil. Results reveal that RF gives the highest accuracy among the three In completion, we concluded that the crop prediction dataset showed the best accuracy with Random Forest Classifier both in Entropy and Gini Criterionwith 99.32%. In contrast, KNN has the lowest accuracy among the three with 97.04%, and the accuracy of Decision Tree Classifier is in between KNN and RF Classifier. When comparing the accuracy value, Decision Tree Gini criterion gave a better accuracy of 98.86% compared to Decision Tree Entropy Criterion. Inthe future, new

data from the fields can be collected to get a clear image of the soil and incorporate other machine learning algorithms and deep learning algorithms such as ANN or CNN to classify more varieties of crops. .M.Kalimuthu et al. [13] have proposed a system that analyzes the application of supervised machine learning approaches. The class with the very best chance is taken into account as the possible class. Here the category is nothing however the crop that gets foretold forthe given input parameters. Once the crop is foretold, it will facilitate the farmers to predict the affordable crop for their individual land. Then, the farmers are guided with an applicationin mobile to make them understand what quiet seeds we will tend to sow in land to inducehigher yielding. Within the past preceding data, crop prediction was calculated by analyzing farmer's previous expertise on climatic conditions. So, the correct data regarding history of climatic conditions is a vital factor for creating selections in choosing crops. Therefore,this paper proposes a thought to predict the affordable crop for the given input parameter forthe poor farmers using machine learning. Thereby this proposed work will suggest the farmers with effective solutions for more profitable cultivation.

Sandeep Gupta et al. [14] have proposed a system that is a machine learning-enabled methodology for agricultural yield prediction that is accurate and early in the season. *e first input data set, which contains all of the crop-related details, is gathered. Relief algorithmis then used to choose the characteristics that will be used. It is possible to achieve accurate findings through feature selection by categorizing relevant features that are connected to a certain real-world situation. *e LDA technique is then used to extract the features from the data. *The classification process is thencarried out using machine learning techniques such as PSO-SVM, KNN, and random forest.

Sonal Agarwal et al. [15] have proposed a structure that uses Artificial Intelligence (AI) and calculates for making expectations like Multiple Linear Regression to recognize the model among information. Further, it is processed as indicated including conditions. Thus, it will provide the best feasible reaps as demonstrated by given biological conditions. Hence, this system simply needs the area of the customer and suggests various beneficial yields. It provides a decision to the farmer about which harvest to develop.

E. Manjula et al. [16] have proposed a system evolution of a prediction model which may be used to predict crop yield production. The proposed method uses data mining techniques topredict the crop yield production based on the association rules.This model analyzes the crop yield production based on available data. The Data mining technique was used to predict the crop yield for maximizing the crop productivity..

In [17],The proposed model by prof.Zingade predicts the crop yield by studying factors such as rainfall, temperature, area, season, soil type etc. The system also helps to determine the best time to use fertilizers. The existing system which recommends crop yield is either hardware-based being costly to maintain, or not easily accessible. The proposed system suggests a mobile-based application that precisely predicts the most profitable crop by predicting the crop yield. The use of GPS helps to identify the user's location. The user provides an area under cultivation and soil type as inputs. According to the requirement, 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 fertilizers.

Shafiulla Shariff et al. [18] have proposed a model from which information is collected and processed to be utilized as training data for the machine learning system. If the data is morethen the software shows better results. After that,the developer selects a ML model to use, input the data, and train the system to find patterns or make predictions on its own.

Mahindra N et al. [19] have proposed a system that will recommend the most suitable crop for particular land. Based on weather parameters and soil content such as Rainfall, Temperature, Humidity and pH. They are collected from V C Farm Mandya, Government website and weatherdepartment. The system takes the required input from the farmers or sensors such as Temperature, Humidity and pH. This all input data applies to SVM and Decision tree to identify the pattern among data and then processit as per input conditions. The system has some other specifications like displaying approximated yield in q/acre, required seed for cultivation in kg/acre and the market price of thecrop.

Vishwakarma et al. [20] have designed the system using machine learning algorithms for betterment of farmers. After the data pre-processing, train the models using Decision tree classifier into a training set. For a predictionof the crop, we consider various factors such as temperature, humidity, soil PH and predicted rainfall. Those are the input parameter for a system that can be entered by manually or taken from the sensors. Predicted rainfall and input parameter values will be appended in a list. The Decision tree algorithm will predict the crop based on list data. This system contains some other feature such as display the current market price and approximated yield in quintal per acre for recommended crop. Those details will help farmers in choosing the most profitable crop.

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