Crop And Fertilizer Recommendation Based On KNN And Boosting Machine Learning Algorithms

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Abstract- *India is known as an agricultural country, where the recommendations are given by traditional methods. While using these traditional methods there is a high level of failures. Variations in weather, climate, and other such environmental conditions have become a major risk for the healthy existence of agriculture. So, by identifying losses and risk in traditional methods of crop and fertilizer recommendation we have to find solution to these problems to increase of crop yield. Predicting right crop and fertilizer will improve productivity of small farmer also. Proposed research will perform these recommendation using KNN and ADABOOST machine learning methods. Results are also compared with existing methods.*

We propose crop and fertilizer recommendation system by giving agricultural data using machine learning algorithms.

Keywords- Recommendation system, crop recommendation, fertilizer recommendation, machine learning, KNN, boosting, precision agriculture.

I. INTRODUCTION

India is one among the oldest countries which is still practicing agriculture. But in recent times the trends in agriculture have drastically evolved due to globalization. Various factors have affected the health of agriculture in India. Farming plays a significant role in the production and employment sector of India. One of the common problems faced by farmers is determining the plant based on soil kind and its conditions, sowing season, and geographical location. The soil testing program starts with the collection of a soil sample from an agriculture field. It is the important factor of economy in India and till now many of the methods followed by agriculture is outdated. Precision agriculture has provided a solution to this problem for farmers. Agriculture has become more significant due to precision agriculture. It will be used to research data of soil characteristics, soil types, crop yield data collection and suggests the farmers the right crop based on their site-specific parameters.

The mainstream Indian population depends either explicitly or implicitly on agriculture for their livelihood. It is, thus, irrefutable that agriculture plays a vital role in the country. A vast majority of the Indian farmers believe in depending on their intuition to decide which crop to sow in a particular season. They find comfort in simply following the ancestral farming patterns and norms without realizing the fact that crop output is circumstantial, depending heavily on the present-day weather and soil conditions. However, a single farmer cannot be expected to take into account all the innumerable factors that contribute to crop growth before reaching a consensus about which one to grow. A single misguided or imprudent decision by the farmer can have undesirable ramifications on both himself as well as the agricultural economy of the region. A combination of Big Data Analytics and Machine Learning can effectively help alleviate this issue.

Many new technologies have been evolved to regain the health. One such technique is precision agriculture. Precision agriculture is budding in India. Precision agriculture is the technology of "site-specific" farming. Recommendation of crops is one major domain in precision agriculture. Recommendation of crops is dependent on various parameters. Precision agriculture aims in identifying these parameters in a site-specific manner in order to resolve. The "site-specific" technique has improved the results yet there is a need to supervise the results of such systems. Not all precision agriculture systems provide accurate results. But in agriculture it is important that the recommendations made are accurate and precise because in case of errors it may lead to heavy material and capital loss. India is farming oriented country. An explosion in the use of ICT for farm management has pushed technical solutions into rural areas and benefited farmers and customers alike. Farmers of rural areas are uneducated. They are not aware of various crops and fertilizer to use. There exist a need for providing a solution to guide them as per their soil attributes and type of crop and fertilizer to use.

System should be able to check soil quality and predict the crop yield accordingly along with it provide fertilizer recommendation if needed depending upon the quality of soil. A fertilizer Selection Method improves net

yield rate of the crop. It suggests a series of weather, soil type, water density, crop type.

Many research works is being carried out, in order to attain an accurate and efficient model for crop prediction. Ensemble is one such technique that is included in such research works. Among these various machine learning techniques that are being used in this field.

II. RELATED WORK

Soil nutrients are the dominant part of agriculture. To improve the soil nutrients, many works are going in and around the world. Estimating the nutrients present in the soil is an important factor. For better crop management, currently there exists traditional method for soil testing, in which the farmers collect the soil samples from their fields or farm and send it to the nearby soil nutrients testing laboratory. For this method there are some drawbacks like the nutrients value may change during scheduling process and this method is time consuming. The lab tests the availability of the nutrients in the soil and suggests the suitable crops. To overcome this limitation in automated crop prediction method [1] the authors have suggested a method that integrates wireless sensors to accurately estimate the soil nutrients along with NPK sensors, soil moisture, and soil pH atmospheric sensor attached to it.

Farmers register their NPK sensor with the main server and it collects nutrients level from the soil sample and updates the data to the main server through Raspberry Pi or Arduino Based on the values obtained from the sensor, the algorithm makes predictions to the registered farmers about the suitable crop, through SMS service. In soil data analysis using classification technique and soil attribute prediction [2] has developed an automated system for soil classification based on fertility of class labels and carried out a comparative study of the various classification techniques with the help of data mining tool known as WEKA (Waikato Environment for Knowledge Analysis).The soil sample instances were classified into fertility class label as: very high, high, moderately high, low, moderately low. Attributes were predicted using linear regression. A new system has been emerged with the basic principles of the fiber optics [3]. Fiber optic sensor is developed to detect the deficiency of the nutrients N, P or K in the soil. The sensor is fabricated which has concentric arrangement of source and receiving fibers. It is based on the colorimetric principle where absorption of light by a solution results in variation in the output of the sensor. Aqueous solutions of the soil samples are prepared for testing and then calibrated using proper signal conditioning circuit and micro-controller. The system thus designed is advantageous as it reduces the undesired use of fertilizers to be added in the soil. One can properly select the fertilizer quantity to be used for reducing the deficiency in the soil at a particular field. Fiber optic sensors are widely used in various industrial applications as well as in agriculture for their inherent advantages such as light weight, immunity to EMI (Electromagnetic Interference) and RFI (Radio-Frequency Interference), economical. In the Amritaspandanam [4] the ECG signals of the patient at remote areas captured through the device. These signals are passed to the framework and it can be monitored by the doctors regularly. In the technology SULTAN [5] developed in Philippines which are mostly prone to landslides because of its geographical conditions. In this they have developed a new technology to measure landslide occurrence and notify the migrants of the country with the possibility of the landslide. They collect the values of inputs from each of the places using the mobile application and sent to the server and the values is being processed and send the notification of the landslide to the people of that region and other people with a warning message of the occurrence of the landslide. In the Amrita Jeevanam [6] weight, temperature, blood pressure etc values are captured using the different sensors of a patient at remote area. And these values are passed to the eHealth platform server and it can be monitored regularly by the doctors and in case of the emergency a alert message is passed as a SMS. In India 80% of the landslides are occurred due to the heavy rainfall. It can change the moisture and water pressure of the soil. So monitoring these parameters constantly with a technology that can effectively measure. In this [7] uses electrical resistance, the regression equations are found from this and the prediction is made. In [8] the authors deal with the security challenges in IoT. It also deals with the security references about the SDN frame work. It also deals with the dynamic provision at run time.

Heamin Lee et al. [50] designed IoT system for disease and pest prediction in orchard. All the weather conditions affect the growth of plants. Amount and frequency of pesticide can be reduced by monitoring weather data. They developed four modules: weather forecast, pest prediction, user application (web application, mobile phone), server. They are attached sensors to weather station near orchard as well as video camera is placed for monitoring purpose. The weather data is stored in database. Pest prediction module reads weather data and real-time data and calculates the probability of infection and their occurrence date. This estimated date is stored in database and server sends notification to user priory so that user can manage the things. This helps farmer economically as it prevents from huge loss.

Shufen Zhang et al.[51] proposed a system which uses ZigBee network to connect the terminal sensing devices, and connect the big data platform by IoT designed for wheat

diseases, pests and weed with expert system. They build intelligent warning system of wheat diseases, pest and weeds based on the platform. The users can monitor what is happening to the wheat using PC or hand-held terminal. The system consists of data acquisition system, Video monitoring system, information transmission system, equipment remote control system, data processing system and expert system. Relay circuit is used for equipment control. Data is acquitted from sensors (temperature, humidity, weather condition, camera, wind speed, CO2, soil temperature, soil humidity).Expert system has previous data related to wheat diseases, pests and weeds and images taken from camera are processed by digital image processing. Only damage parts of crops are processed. System also has real time expert system through which user can asks questions to agriculture experts. Early warning algorithm system based on data mining as it integrates wireless sensor network, Internet and mobile communication network.

Abdullah Na et al. [52] designed a system for remote monitoring of soil characteristics. For a farmer it is important to have knowledge about soil and its characteristics so based on it he can develop strategies. Soil has different characteristics like capacity of holding moisture, temperature, pH value and its organic components and they helps crops growth. They collected soil samples and measured its humidity, pH value and temperature remotely in real-time through smartphones.

Ibrahim Mat et al. [53] proposed a of proper irrigation system for greenhouse. It shows that automatic irrigation system requires less water as compared to schedule irrigation system. One soil moisture sensors is attached at each 100 polybags. These sensors sends data to gateway through xBee and then gateway sends data to central database over wifi and user can see soil moisture condition in graphical form on mobile phone and computer. Proposed system has also temperature sensor, pH sensor but the main focus is on moisture sensor for irrigation system. In this experiment to get correct volume of soil solids they baked soil in oven for some period of time. From this experiment we can detect capacity of soil of holding water. This capacity varies from location to location.

Pawan Kumar et al. [54] developed a M3SS system for crop monitoring system. It is multi-modal, multi-application and multi-parameter soil sensing (M3SS) sensor node for real-time sensing and monitoring. To increase crop yield it gives alerts and advice from experts. There are three modes as user mode i.e. farmers mode, scientific/research mode, expert mode. The soil sensing parameters are transmitted to these three modes. It can transmit data over Bluetooth, ZigBee and wifi as it is using Intel Galileo gen2 processor board with solar panel as energy provider. The proposed system takes reading at 15 min intervals. It will take readings processed by processing unit and stored in memory and data is transmitted over communication unit and then sleeps and power off mode. Krishi mobile app is developed for farmers so that they can have sensed data and advice from expert system. It has multiple soil sensing parameters as soil temperature, moisture, pH and environmental parameters. This developed system consumes less power and having low data rate processing capability and real time data processing. With these features the disadvantage is not having WSN sensing nodes.

S.Pudumalar et al. [55] proposed a crop recommendation system through an ensemble model with majority voting technique using random tree, CHAID, K-nearest neighbor and naïve bayes as learners to recommend a crop for specific parameters. First task is to collect data related to soil like soil temperature, pH, soil color, texture, permeability and erosion, drainage for crop recommendation. They considered various crops like groundnut, sugarcane, banana and paddy, etc. ensemble model is designed to increase the accuracy of prediction of the system. Majority voting technique is used for ensemble model. In this model each learner predicts the class on its own way and finally, the class which is predicted by majority of learners is voted. The learners should be competitors as well as complimentary to each other to avoid error. The rules are induced in each model in terms of if then rules. The estimated prediction accuracy is 88% which needs to be improved.

III. PROPOSED SYSTEM

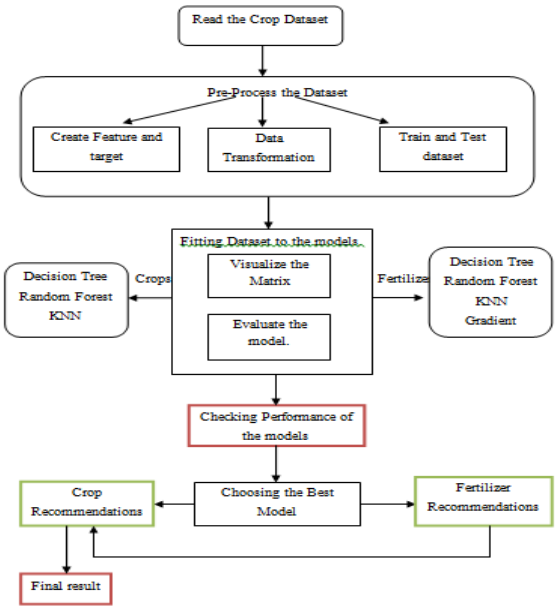

Fig 1: Proposed architecture

The proposed model is a technique which will recommend Crop for particular area and also recommend the type of fertilizer that has to be used for that particular crop.

- Based on predicted rainfall, soil contents and weather parameters the system will recommend the most suitable crop for cultivation.
- Crop prediction is an essential task for the decision-makers at national and regional levels for rapid decision-making.
- It allows the farmers to choose any of the alternative combinations of fertilizers depending on the recommended crop and soil conditions.
- An accurate crop yield prediction model can help farmers to decide on what to grow and when to grow.

Detailed architecture consist of following components:

- Exploratory data analysis and pre-processing
- Model development
- Crop recommendation model building
- Fertilizer recommendation model building
- Model evaluation

Data Set Based on existing system, two data sets are made as following for recommendation system as well as for final result: 1. Crop Data Set: This crop data set consists of crop name, temperature, humidity, pH, nutrients (Na, Mg, N, P, Cl, Ca). 2. Fertilizer Data Set: This data set consists of fertilizer name, crop name, date.

IV. RESULT

We have proposed a Boosted model based crop recommendation and fertilizer recommendation system to analyze the growth and production of a crop in an agricultural fields. Our model also helps the farmers to decide which crop will be idle for them to grow based on the temperature, humidity and pressure readings from the sensors. It also helps the farmer to determine that if the crop is ready or not using machine learning.

The process starts with the data acquisition from environment, soil or agricultural field and plant. There the data is processed and visualized. Seeing the visualized data farmers can decide if the conditions are idle for the growth of crop. By taking the temperature, humidity, and atmospheric pressure values as inputs, the model can predict the idle crop for cultivation using proposed ensemble algorithm. We have also compared some other Base algorithms like Decision Tree, Random forest and Existing models. Figure below shows some of the snapshot of models.

Table 1 Comparison of Existing and Proposed Model.

Models	**Existing Method Accuracy**	**Proposed Model Accuracy**
Decision Tree	**80.74% [15]**	**86.94%**
Random Forest	**84.17% [15]**	**96.61 %**
Proposed Model	**89.30% [15]**	**97.43%**

Graphical chart is shown below:

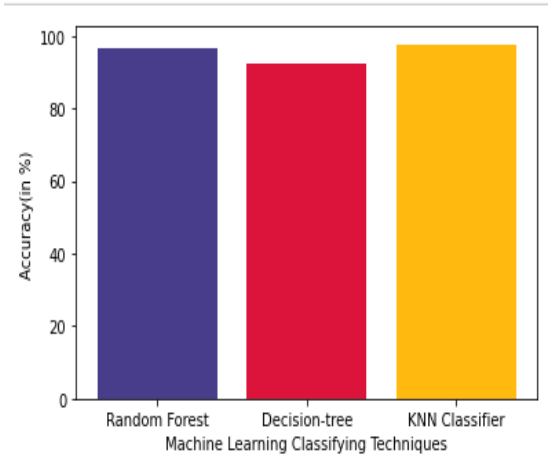

Fig 2: Comparison on accuracy

For fertilizer prediction accuracy is shown below:

Model	Accuracy of the model
K-Nearest Neighbors	0.8182
Decision Tree	0.9091
Random Forest	0.9697
Gradient Boosting	0.9697

Fig 3: Accuracy for fertilizer prediction

V. CONCLUSION

This thesis proposed a model that will plays a major role in assisting the farmers to make a decision on the best crop to be grown on their farm land located depending on their location and environment. This system considers various soil and environmental factors, to predict accurate crop. It also recommends the fertilizer for the best crops to be recommended. The proposed model provides an advantage by using the accuracies of proposed KNN algorithms and gives a resulting accuracy which is higher than the accuracy of the existing techniques.

The present research shows several existing models that consider elements such as temperature, weather condition, performing models for the effective crop and fertilizer recommendation. Ultimately, the experimental study showed the combination of ML with the agricultural domain field for improving the advancement in crop and fertilizer recommendation.

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