REVIEW PAPER ON SMART CROP, FERTILIZER RECOMMENDATION AND PLANT DISEASE DETECTION

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Abstract *- The foundation of our nation is the agricultural sector. In order to make farming simpler and to increase productivity, several new technologies are being incorporated into the field, including Deep Learning and Machine Learning. Farmers often choose the wrong crops, planting them in the wrong season or choosing ones that wouldn't produce much for the specific soil. A reduced yield will always be the consequence of improper crop selection. We created a machine learning recommendation model that describes the ideal crop to grow and the seed fertilizer depending on the weather & Soil conditions. Third-party apps that service APIs for climate and temperature, soil category, soil nutritious content, quantity of rainfall in that zone, and soil configuration are connected with location. It also kinds use of nutrient percentages for nitrogen (N), phosphorus (P), and potassium (K). When creating a model from the data, all of these features will be looked at utilizing a variety of legitimate machine learning approaches.*

In today's complex environment, accurate and effective plant disease control starts with accurate diagnosis. As smart farming has expanded, plant disease diagnosis has gone digital and data-driven, enabling sophisticated decision support, astute analysis, and strategic planning. This work presents a deep learning based mathematical model for plant disease diagnosis and recognition that improves training efficiency, accuracy, and generality. Our assignment suggests a deep learning-based model that will be developed using a dataset including images of crop leaves in both good and unhealthy conditions. All algorithms' impacts are quantified using a range of metrics, such as measure, precision, and accuracy. By comparing events that were properly and erroneously predicted, accuracy is determined. The findings demonstrate that the Decision Tree algorithm achieves the other approaches in terms of presentation, with the greatest precision of 86%, and requires less time to construct the model. Thus, by employing our method, farmers may produce new crops at different times of the year, increase their profits, and avoid contaminating the land.

Keywords *- Machine Learning, Crop & Fertilizer Recommendation & Plant Disease Detection, Decision Trees & XG Boost Algorithm*

1. Introduction

Approximately 58% of the workers in our nation is working in farming, making it one of the most important foundations of income. The majority of India's 1.2 billion workers work in agriculture. India is the world's second-largest producer of fruits and vegetables; nevertheless, crop loss puts farmers in jeopardy, according to the Ministry of Agriculture, Co-operation and Farmer Welfare's annual report.

Modern agricultural techniques are being implemented for the benefit of farmers. To greatly rise productivity and value, Deep learning, machine learning, and data mining methods are now being used by a few researchers. The state of the soil, which in turn depends on the nutrients in the soil, is the primary factor influencing agricultural production. Farmers should be advised on crops based on soil analysis in order to boost agricultural yield and, in turn, improve their financial status. Fertilizer misuse costs farmers a great deal of money as well.

Crop selection errors are common among farmers; examples include planting in the wrong season or choosing a crop that would not yield much on a given soil. A decreased yield is always the result of improper crop selection. Farmers have uncertainty over which crop to plant during a given season due to the unpredictable nature of the environment. The use of distinct fertilizers is also subject to seasonal fluctuations in the surrounding environment and the accessibility of vital components like as air, water, and soil. To get a larger yield, we need to consider not only rainfall, which is one of the key components, but also soil type and fertility characteristics. While dry land is better fit for cash crops, wetland is outstanding for wheat and sugarcane. fifteen regions of agro weather India's regions are divided based on the

types of structure found in each place. Every agro climatic zone may support the growth of some crops. We must recommend the farmer on the best crop among those natural to those specific climatic zones based on it. The ultimate goal of the project is to deliver the largest harvest at the lowest possible yield.

Offering farmers a user-friendly The solution to the problem is the recommender system. The project's objective is to create a system that would help farmers choice the best crop based on the properties of the soil and outside fundamentals including moisture, temperature, precipitation, and soil PH value. our method would assist farmers in planting the appropriate seeds according to the needs of the land in order to boost output and profit. This enables farmers to grow the appropriate crop, raising both the yield and the country's total production. Decision Trees and the XG Boost Algorithm are two machine learning prediction models that employ all of the input data to classify shapes in the data before evaluating it based on input parameters.

The technique recommends a crop to the farmer together with the amount of fertilizer to be used in preparation for the crop. We present a model in this study that tackles these issues. The recommended approach enables crop selection according to financial and environmental elements, with the goal of increasing agricultural yields to meet the nation's rising food demand. To assist farmers in selecting the appropriate fertilizer, we are developing technologies that propose fertilizer. In order to assist farmers in preventing illness, we are also developing plant disease detection technologies.

The fundamental process for diagnosing plant diseases involves uploading a photograph of a leaf with a consistent backdrop using a website that we have integrated into our model. Next, the picture will undergo preprocessing. The model itself extracts features in order to classify the appropriate illness. After the illness has been classified, it is mapped together with the appropriate treatment or fertilizer needed to eradicate the issue and prevent it from coming again. This study investigated and employed several Deep Learning models and ways to accurately identify and categorize plant illnesses using image analysis of plant leave.

The project model involves Crop Recommendation using Random Forest, Fertilizer Recommendation using Decision Tree and Plant Disease Detection using Convolutional Neural Network.

2. LITERATURE SURVEY

In the work" Crop Recommendation System and Plant Disease Classification using Machine Learning," [1] Choudhary and associates introduce a novel approach to agriculture management that leverages machine learning techniques. The study addresses the major difficulties farmers encounter in crop selection and disease detection by proposing an integrated approach that recommends suitable crops based on soil characteristics and environmental parameters. To assist farmers in identifying and effectively managing crop illnesses, the authors also look at the use of machine learning algorithms for accurate plant disease classification. The research provides a general framework for mixing cutting-edge technologies with agricultural methods to maximize yield.

In their publication, "Smart Crop Recommendation System Using Machine Learning," [2], authored by CH. Rajesh et al, the researchers provide a unique approach to crop recommendation utilizing machine learning technology. The challenges farmers have when determined which crops are most suitable for cultivation are covered in this essay. The recommended method uses machine learning algorithms to evaluate a range of factors, such as soil type, climate, and past crop data, in order to deliver farmers optimal crop choices. The project aims to assist farmers make confident crop choices and boost agricultural output by implementing state-of-the-art machine learning algorithms.

Taranjeet Singh et al.'s study, "Crop and Fertilizer Recommendation and Disease Diagnosis System Using Machine Learning," [3], presents an integrated system that leverages machine learning to tackle significant problems in agriculture. The system provides crop selection and fertilizer recommendations based on a variety of factors, such as soil type, climate, and nutrient levels. Furthermore, by utilizing machine learning techniques, the system provides a mechanism for the early diagnosis and treatment of plant illnesses. Using this comprehensive strategy, the research aims to increase agricultural output and decrease crop losses caused by diseases and poor practices.

Aditya Motwani et al.'s study, "Soil Analysis and Crop Recommendation Using Machine Learning," [4], presents a novel method for agricultural making choices. The system analyzes critical soil properties by doing soil analysis using machine learning techniques. The method suggests appropriate crops for cultivation based on the findings of the soil study, taking into consideration elements like soil type, moisture content, and nutrient composition. The objectives of this integrated system are to improve

agricultural production, optimize crop selection procedures, and support sustainable farming methods.

Suresh et al. present a novel approach to crop yield optimization in the context of digital farming in their study "Efficient Crop Yield Recommendation System Using Machine Learning for Digital Farming," [5]. The authors present a machine learning-based recommendation system designed to assist farmers in making informed crop selections. The technology generates personalized crop recommendations based on a variety of agricultural variables, including weather patterns, soil composition, and historical crop productivity data. By incorporating state-of-the-art machine learning algorithms, this innovative approach aims to boost agricultural output in the era of digital agriculture, lower risks, and support sustainable farming practices.

A machine learning framework for recommending suitable crops to farmers is presented by Pande et al. [7] in their publication, "Crop Recommendation using Machine Learning Approach." The technology examines a number of agricultural parameters, including soil properties, climate, and geographic location, to generate personalized crop suggestions.
It uses complex algorithms and data analytic methods to do this. The plan makes use of machine learning models to increase agricultural output, support sustainable farming practices, and assist farmers in making decisions. This work contributes to precision agriculture by offering a data-driven technique to enhance crop selection and yield results.

3. Proposed Methodology

As shown in figure, the recommended system's approach consists of many blocks.

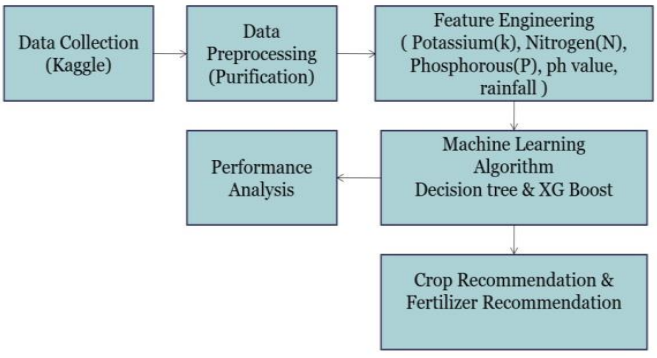

Fig-1: Data Flow Diagram for Crop & Fertilizer Recommendation

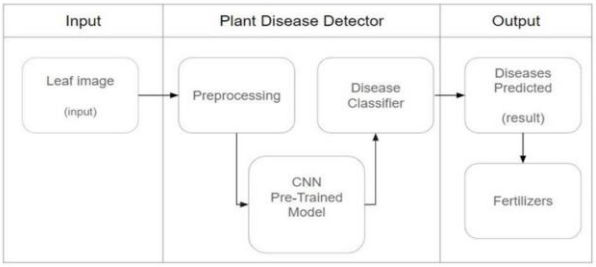

Fig-2: Data Flow Diagram for plant disease

Data Collection - The most common method for collecting and evaluating data from many sources is information collecting. For the dataset to give the system an estimated data set, it has to contain the following characteristics. The following factors will be taken into account while recommending crops and fertilizer: PH value, humidity, NPK levels, rainfall, and state are the first five factors.

Data Pre-Processing - After the data is collected from several sources, pre-processing is required so that the model may be skilled. Data pre-processing can be done in a variation of methods, beginning with reading the obtained dataset and proceeding through data purification. Certain dataset properties are redundant when data is cleansed, and they are not taken into consideration while harvesting. Consequently, we have to eliminate undesirable attributes and datasets that have some missing data. To recover them, we need to more precisely drop or fill these missing values with undesirable non values.

Feature Engineering - Feature engineering takes raw data and uses domain expertise to extract features (characteristics, traits, and attributes). The goal is to leverage these additional characteristics to raise the caliber of machine learning output.

Training set - A data set that has been categorized is called a training set. Included are the vectors for the input and output. The prototypical is trained using supervised machine learning practices on this dataset.

Testing set - A data set without any marked data is called a testing set. With the help of the training data set, it makes forecasts about the result. It is independent of the training set.

Machine Learning Algorithm - Highly precise estimation based on previously learnt data is required by machine learning prediction algorithms. The application of data, statistical techniques, and machine learning methods to predict future outcomes is known as predictive analytics historical information. This model makes use of the Decision Tree, XG Boost, and Gradient Boosting techniques.

Crop Recommendation - Based on the soil's pH, rainfall, and NPK content, the model will recommend the ideal crop to grow on the given soil.

Fertilizer Recommendation - The program will suggest how much soil nutrients your farm needs based on the N P K value and the crop you sowed.

Plant Disease Detection - The model will identify the right illness based on the leaf picture. Following classification, the sickness is mapped using the appropriate fertilizer needed to eradicate the issue and fend off the illness.

Performance Analysis - A professional field known as presentation analysis employs systematic goals to enhance routine and decision-making.

4. Conclusion

As is well known, the primary aims of a large amount of farming research have been and continue to be increasing efficiency, boosting the Indian budget, and, most importantly, helping farmers become more profitable. The suggested method would help farmers do this by advising them on what kind of crop to plant on their land so they may profit from it.

This study brought to light the shortcomings of the methods in use today and how useful they are for yield prediction. Users may choose a crop using a number of tools available in the online application. A prediction mechanism included into the system helps farmers predict the production of their crops.

Crop yield prediction and effective fertilizer application are both successfully anticipated. The most effective yield is attained by identifying the efficient method from both algorithms. Future online applications should be developed with this philosophy in mind, made simple to use, and designed to assist users understand the desired crop's yield when planted during that particular season.

5. References

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