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Intelligent Agricultural System by Using Machine Learning and AI

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ABSTRACT: India is a country of hardworking farmers. Agriculture plays a very important role where economic growth of a country like India is considered. Up to 60% of the land in India is used for agriculture. This feeds a total of 1.2 billion people. Overall, agriculture is the backbone of India while also playing a key role in the Indian economy, providing a certain percentage of local produce to ensure food security. Nowadays, however, food production and forecasts are depleted due to unnatural climate change, which can hurt farmers' economies by leading to low yields andmaking it difficult for farmers to become familiar with long-term forecasts. Accurate crop prediction results can be achieved by using relevant parameters such as precipitation patterns, temperature patterns, soil structure and other factors such as crop diseases. We use Random Forest and other machine learning/artificial intelligence algorithms to generate an accurate model. With the help of our system, we can recommend the best possible harvest under certain conditions. This system would also help reduce farmers' financial losses from poor cultivation.

KEYWORDS: Crop recommendation, Fertilizer recommendation, Plant Disease Detection, Machine Learning

I. INTRODUCTION

In India, we all know that agriculture is the most important sector in the country. A large part of the population of India considers agriculture to be their main occupation. Agriculture-related industries such as forestry and fisheries contributed for 16.6% of 2009 GDP and around 50% of the total workforce. Agriculture's monetary contribution to India's GDP is decreasing [1].A boon to the country is the overwhelming size of the agricultural sector. Crop production plays an important role in our country. Poor crop production is often due to over or under use of fertilizers.However, the yield per hectare of the crops is deplorable compared to international standards. Farming was in bad shape. Farmers repeatedly grow the same crops without testing a new crop variety and apply fertilizers in random amounts without knowing the bad content and amount. Therefore, this directly affects crop yields and also causes soil acidification and topsoil damage. The typical challenge faced by Indian farmers is a lack of knowledge about the appropriate crop for their location.Due to its space requirements, this has an impact on production. Indian farmers face several obstacles when deciding which agricultural technology to use and which crop to choose based on the climate. The predominant problem faced by Indian farmers is that they do not select the right crops to maximize their yields. The usage of various fertilizers is also uncertain due to changes in seasonal climatic conditions and basic assets such as soil, water, and air. The crop yield depends on multiple factors such as climatic, geographic, organic, and financial elements [6]. It is difficult for farmers to decide when and which crops to plant because of fluctuating market prices [7].In this scenario; the crop yield rate is steadily declining [2]. Maximize yields based on topographical and economic factors. A crop recommendation, fertilizer recommendation and disease prediction system will be developed to help farmers select the right crop and fertilizer during a given season. The system interacts well with users.

Farmers are committing a staggering number of suicides, with low crop yields and the destruction of agricultural fields contributing to this. Due to changes in market prices, farmers find it difficult to choose when and which crops to grow. According to Wikipedia, India's suicide rate has been between 1.4 and 1.8 precent per 100,000 people for the past decade.The farmers' lack of knowledge about what crops to grow and what fertilizers to use was one of the most important factors. Farmers lack knowledge about weather forecasts and which fertilizers can be used to successfully increase yields. The crop yield prediction is a significant problem in the agriculture sector [3]. Every farmer tries to know crop yield and whether it meets their expectations [4], thereby evaluating the previous experience of the farmer on the specific crop predict the yield [3]. Accurate information on crop history is critical for making decisions on agriculture risk management [5].Farmers are disappointed when their farms are destroyed by heavy rains, storms or other events and they subsequently go out of business.

II. RELATED WORK

We are well aware of the fact that India is a developing nation that relies completely on agriculture; its economy is also largely dependent on agro-industrial goods. The proposed model provides crop selection based on economic and environmental conditions, and benefit to maximize the crop yield that will subsequently help to meet the increasing demand for the country's food supplies [8]. Another important work checks the soil quality and predicts the crop yield along with a suitable recommendation of fertilizers [11].In the analysis of crop yields, data mining is considered a new area of study. But a crucial challenge in agriculture is the forecast of yield. It is very important for the farmer to know the anticipated output of yield production. For this, a farmer can analyse several factors that are associated, such as the location and the pH level that is used to measure the soils alkalinity. Location is also used along with the use of third-party applications like APIs for weather and temperature, type of soil, the nutrient value of the soil in a particular region, amount of rainfall in the same region, and soil composition. Moreover, it is used along with a percentage of nutrients, including Nitrogen (N), Phosphorous (P), and Potassium (K). We will surely analyse all of these data attributes, and the data will be trained using different effective machine-learning algorithms to create a model. Suppose you wish to provide the end user with accurate suggestions about the appropriate fertilizer ratio based on atmospheric and soil data of the field. In that case, the system includes a model which enhances the process to boost crop production and raise farmer income.

It is important to protect the world's food supply as it is evident that India has a largepopulation, and here the weather can change at any time. When there is a drought, farmers have significant issues. The kind of soil has a significant effect on the productivity of crops. Therefore, it is advised to the farmers to use fertilizers as they could assist them in making healthy decisions for their farming conditions. There are numerous studies that use Information and Communication Technology (ICT) to forecast one's crop yield. The system connects farmers through a mobile application [1].Additionally, we can predict our crop yield using data mining. We can tell the farmers to plant a better crop to get a higher yield by thoroughly analysing the old data. We must take into consideration: the soil type, soil fertility, as well as groundwater availability, and rainfall as significant factors for greater crop production. Cash crops are preferable on dry soil, while wheat and sugarcane are better grown on wetlands. In India, there are around 15 agroclimatic areas that are separated according to the kind of land supporting different crops. And with this, some particular crops can be grown in each agroclimatic area. Based on it, we must advise the farmer on the ideal crop among those best for each regions climatic condition.

The projects goal is to grow the most crops for the lowest yield possible. Early problem identification, as well as its management, would be helpful for the farmer to get better crop production. Crop yield estimation is an essential element of research that contributes to food security. With the help of a machine learning algorithm, we must consider an enormous amount of data for examination to understand agricultural yields better. This will allow the algorithm to produce an accurate yield for a given crop and also advise the farmer to plant a better crop. The primary motive of precision agriculture is to increase the number of crop yields by employing information technology strategies to understand the crop better. Precision farming's primary objectives include the economic success of the farmer and environmental sustainability for all creatures.

Agriculture has been a support system for our nation since the time of civilization. Today's climate varies drastically on a daily basis. As a result, growing crops requires knowledge of identifying weather patterns. Utilizing technology is essential to learn or comprehending agricultural facts and instructing farmers to develop crops appropriately. Fertilizer is also among the key elements in growing crops appropriately. The soil may lose fertility if fertilizer is used excessively or minimally in the field. These actions could prevent crops from producing as intended. Therefore, fertilizer also becomes a significant factor in crop production. It is better to understand the temperature conditions (primarily important in India) since it will assist the farmers in forecasting crops, which will help them strengthen the Indian economy. Machine learning algorithms will estimate the yields most effective output. Farmers used to be able to anticipate yield based on their previous data, but now because weather conditions could vary unexpectedly, they cannot do so. Furthermore, technology can assist them in predicting the agricultural output and evaluating whether to plant the crop. The productivity of the area where he will plant crops will be anticipated by a machine learning model that will comprehend the structure of the crop plus yield based on different parameters. The greatest challenge for most farmers and in particular subsistence farmers whose contribution in the agricultural sector is a significant one, isbeing able to decide what to grow and where [10] [11] [12].

III. PROPOSED SYSTEM

Therefore, considering all these problems that the current agricultural industry is facing, the proposed system helps to determine the best crop yield and the appropriate fertilizers to use.Many authors have developed various PA models that attempt
to assist farmers in choosing the best crop for their soil based on the attributes of the soil [13] [14] [15].The proposed system would help to minimize the difficulties faced by farmers in choosing a crop and maximize the yield in effect to reduce the suicide rates [9]. In addition, it helps determine the diseases affecting plants. The proposed system is divided into 3 parts:

1. Cultivation recommendation system
   a. Most Suitable Crop That Can Be Grown
   b. Top 5 Crops in the Right Conditions
2. Recommendation System for Fertilizer
   a. Depending on the content of the soil and the harvest, they indicate the quality of the soil
   b. Based on the quality of the soil, give suggestions and recommendations for improving the soil
3. Detection of plant diseases
   a. Based on the picture of the plant, classify them as sick or healthy and assign the plant name
   b. Enter for the way out of the disease:
      i. Cause of Disease
      ii. methods for prevention

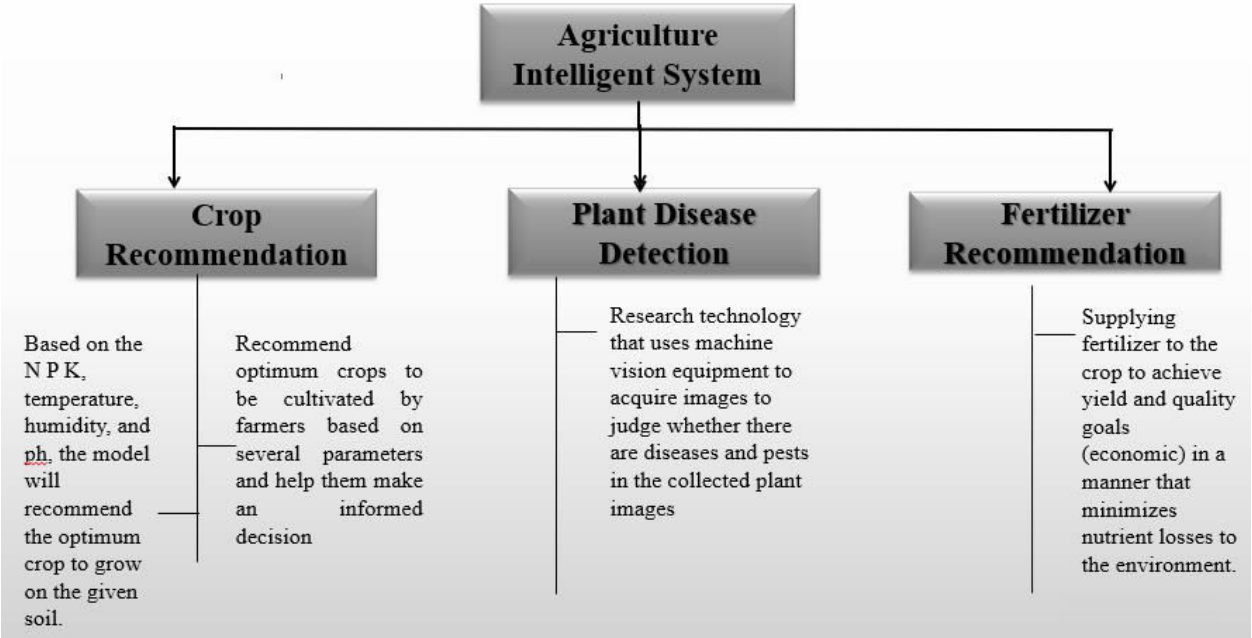

Fig.1.Overview of Agricultural Intelligent Systems

Crop recommendation:

Crop recommendation system is that it encourages farmers to maximize yields and suggest the most profitable crops for a given region. The proposed model involves crop selection based on economic and environmental conditions and maximizes yields, which will then help meet the growing demand for in the country's food supply [8]. The proposed model predicts yield based on factors such as rainfall, temperature, area, season, soil type, etc. The system also helps determine the best time to apply fertilizer. The existing system that recommends returns is hardware based and expensive to maintain, or is not readily available. The proposed system proposes the mobile application that accurately predicts the most profitable crop by predicting yields. Also recommends the best-yielding crop and suggests the right time to apply fertilizer to farmers.

Crop Recommendation System Objectives:

1. Environmental conditions vary from region to region, so AI/ML models are used to predict the best crop species for selected soils:
2. A crop recommendation application allows users to provide soil data from their site and the application predicts which crops the user should plant.
3. Use machine learning algorithms to train a crop recommendation model using data collected from IoT sensors to identify the best crops with the highest growth probability.
4. Build robust models that accurately and accurately predict crop sustainability in specific states of specific soil types and climatic conditions.
5. Purpose of the Fertilizer Recommendation System to provide recommendations of the most befitting yield in the area so that there is no loss to the farmers.

The table below shows the recommended methods of measuring plant performance, here the factors N, P, K, humidity, temperature, PH, precipitation are taken into account and a corresponding result is generated.

Sr. No.	Attribute Name	Attribute Description
1	Nitrogen	Unique Value- N
2	Potassium	Unique Value- P
3	Phosphorous	Unique Value- K
4	Humidity	Concentration of water vapor present in the air
5	Temprature	Temprature Value
6	Ph	Unique Value- Ph
7	Rainfall	Total amount of rain that falls in a particular place
9	Outcome(Label)	Outcome variable (Label- Crop Recommendation.)
		'rice' 'maize' 'chickpea' 'kidneybeans' 'pigeonpeas' 'mothbeans' 'mungbean' 'blackgram' 'lentil' 'pomegranate' 'banana' 'mango' 'grapes' 'watermelon' 'muskmelon' 'apple' 'orange' 'papaya' 'coconut' 'cotton' 'jute' 'coffee'

Table 1. Crop Recommendation Metrics

Fertilizer recommendation:

Fertilizer tips may be made using fertilizer data, crop data, and site data. This section recommends suitable crops, and the required fertilizer for each crop.

Fertilizer Recommendation System Objectives:

1. The Fertilizer Recommendation application allows the user to enter data about the soil and crop type being grown. The application predicts soil deficiencies or excesses and recommends improvements.
2. Build robust models using AI/ML modeling to accurately recommend optimal fertilizers.

The table below shows the performance measures - recommended fertilizer, here the temperature, humidity, humidity, soil type, plant type, nitrogen, potassium and phosphorus are taken into account so that the result is generated accordingly.

Sr. No.	Attribute Name	Attribute Description
1	Temperature	Temperature value
2	Humidity	Humidity Value
3	Moisture	Moisture is the presence of a liquid/Water values
4	Soil Type	It may be Sandy, Black, Red, Clayey etc.
5	Crop Type	Like as Maize, Sugarcane, Cotton, Tobacco etc.
6	Nitrogen	Unique Value- N
7	Potassium	Unique Value- P
8	Phosphorous	Unique Value- K
9	Outcome(Fertilizer Name)	Outcome variable (It will suggest the Fertilizer Name like Urea, DAP, 24:24, 28:28, 10:26 etc.)

Table 2. Fertilizers Recommendation Metrics

Plant Disease Detection

3. The quality of harvests and yields depends on important factors such as plant diseases and pests. Plant diseases and pests can be identified using digital image processing. Deep learning has dominated the field of digital image processing in recent years and has far overtaken traditional methods.

Plant Disease Prediction

1. Plant Disease Predictor allows the consumer to insert a picture of a leaf of a diseased plant and the application will predict which affliction it is.
2. The application also contains information about the disease and suggestions for its treatment

The following table shows the performance measurements - detection of plant diseases, here the plant images are taken into account and the result is generated accordingly.

Sr. No.	Attribute Name	Attribute Description
1	Plant Images	This dataset consists of about 87K rgb images of healthy and diseased crop leaves which is categorized into 38 different classes. The total dataset is divided into 80/20 ratio of training and validation set preserving the directory structure. A new directory containing 33 test images is created later for prediction purpose.
2	Outcome (Disease Name)	Outcome variable (It will suggest the Disease Name)

Table 3. Plant Disease Detection Metrics

IV. CONCLUSION AND FUTURE WORK

As we all know, a lot of agricultural research has been and is being done to improve productivity, boost Indian economy and most importantly help farmers to increase their income. To achieve this, the proposed system will advise farmers on the best crops to grow on their land. So that farmers can benefit from it. There is a slight improvement in productivity due to the intrusion of technology into farming. Innovation has led to new concepts such as digital farming, smart farming, precision farming, etc.It has been noted in the literature that analyses of agricultural soils have been performed that revealed hidden patterns using a data set of climatic conditions and yield data. There are many

activities in the field of agriculture, such as Weather Forecast, Soil Quality Assessment, Seed Selection, Yield Forecast, etc. This study focused on a specific business, yield forecasts and identified key trends.

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