

# Crop Prediction and Efficient use of Fertilizers using Machine Learning

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## ABSTRACT

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India being an agricultural country, its economy predominantly depends on agriculture yield growth and allied agro industry products. In India, agriculture is largely influenced by rainwater which is highly unpredictable. Agriculture growth also depends on diverse soil parameters, namely Nitrogen, Phosphorus, Potassium, Crop rotation, Soil moisture, and Surface temperature and also on weather aspects which include temperature, rainfall, etc. India now is rapidly progressing towards technical development. Thus, technology will prove to be beneficial to agriculture which will increase crop productivity resulting in better yields to the farmer. The proposed project provides a solution for Smart Agriculture by monitoring the agricultural field which can assist the farmers in increasing productivity to a great extent. Weather forecast data obtained from IMD (Indian Metrological Department) such as temperature and rainfall and soil parameters repository gives insight into which crops are suitable to be cultivated in a particular area.

Keywords: Smart Agriculture, Nitrogen, Phosphorus, Potassium, Crop rotation, Soil moisture, Surface temperature

## I. INTRODUCTION

India being an agricultural country, its economy predominantly depends on agriculture yield growth and allied agro industry products. In India, agriculture is largely influenced by rainwater which is highly unpredictable. Agriculture growth also depends on diverse soil parameters, namely Nitrogen, Phosphorus, Potassium, Crop rotation, Soil moisture,

and Surface temperature and also on weather aspects which include temperature, rainfall, etc. India now is rapidly progressing towards technical development. Thus, technology will prove to be beneficial to agriculture which will increase crop productivity resulting in better yields to the farmer. The proposed project provides a solution for Smart Agriculture by monitoring the agricultural field which can assist the farmers in increasing productivity to a great extent.

Weather forecast data obtained from IMD (Indian Metrological Department) such as temperature and rainfall and soil parameters.

Today security measures are used to protect the core factors of cyber security which are confidentiality, integrity and availability of data. Many new technologies are being used in the medical field in order to prevent attacks and reduce damage. Among various other approaches, in this paper the model proposed, uses a unique network architecture based on next generation firewall, ensuring threat detection and protection against attacks focused on application layer and its sensitive data.. Nowadays climatic conditions vary very often. So, it is hard to grow crops by understanding weather conditions. We need to use some technology to find or understand the crop details and guide the farmers to grow crops accordingly and moreover fertilizer also one of the major factors to grow crops accordingly. If fertilizer is used more or less in the field the soil may lose its fertility and crop may not give the expected yield. so, fertilizer also becomes the major factor in it mostly understanding the temperature conditions is much necessary for India because we can improve the Indian economy with the help of the crop prediction because it plays a major role in the Indian economy. Generally, machine learning algorithms will predict the most efficient output of the yield. Previously yield is predicted on the bases of the farmer's prior experience but now weather conditions may change drastically so they cannot guess the yield. So, technology can help them to predict the yield of the crop weather to go for that crop or no. machine learning model will understand the pattern of the crop.

## II. RELATED WORK

Primary investigation is carried out under the following stages, such as Understanding the existing approaches, Understanding the requirements, developing an abstract for the system.

In this paper the authors proposed crop recommendation based on data mining concepts such as crop and recommendation and prediction of soil and climate condition. Here they have used the ensembling technique and a comparative study of soil classification. The proposed framework will coordinate the information got from archive, climate office and by applying machine learning calculation, Multiple Linear Regression, an expectation of most reasonable yields as indicated by current natural conditions is made. This furnishes an agriculturist with assortment of alternatives of harvests that can be developed. This exploration goes for examination of soil dataset utilizing information mining procedures. It centre's around characterization of soil utilizing different calculations accessible. Another essential design is to foresee untested traits utilizing relapse procedure, and usage of computerized soil test grouping [1].

Indian agriculture sector gives huge employment in different fields of cultivation industry. India cultivates many different kinds of crops, but produces more amounts of rice and wheat. Indian agronomist also farm urad, jowar, small millets, sugarcane and non food crops like hemp, jute, cotton. But nowadays the weather conditions of the atmosphere are not stable like previous days, because of global warming and other man made calamities. The weather conditions are highly unstable and are very difficult for the farmers to rely upon the traditional agricultural techniques.

### B. Necessary Packages

- Numpy
- Pandas
- Tkinter
- Scikit-learn
- Matplotlib

### C. Architecture

The Fig. 2 shows the architecture diagram used in this model.

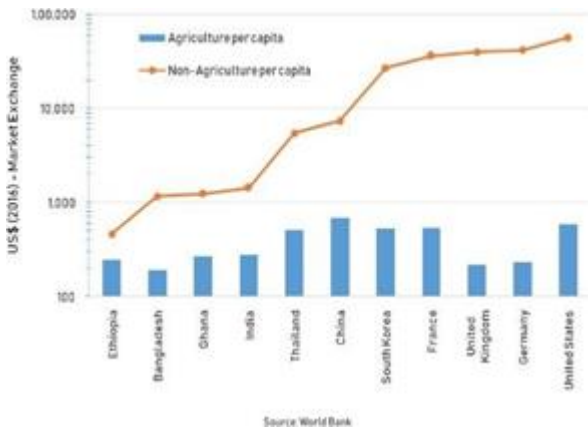


Fig.1 Process of an SQL Injection attack

Agriculture plays a crucial role in the life of an economy. It is the backbone for developing countries like India as more than 70% of population depends on agriculture. To increase crop production many factors are responsible like soil, weather, rain, fertilizers and pesticides. They have used soil parameters to increase crop production because it is an essential key factor of agriculture. To maintain nutrient levels in the soil in case of deficiency, fertilizers are added to soil. The common problem existing among the Indian farmers is that they choose approximate amount of fertilizers and add them manually. Excess or insufficient addition of fertilizer can harm the plant life and reduce the yield. The paper provides review of various data mining techniques used on agriculture soil dataset for fertilizer recommendation. Mainly focused on various soil for better yield of a crop. Fertilizer prediction is based on six factors; these factors are temperature, humidity, moisture, nitrogen, potassium and phosphorous.

### III. IMPLEMENTATION METHODOLOGY

Estimating the production of crop using the potent algorithm and prediction of which type of fertilizer to be used on crop.

#### A. Data Set Explanation

In this model we are utilizing two datasets. Fig 7 is for prediction of crop yield, this data frame consists of six

factors which are trained by various machine learning techniques to predict the production of crop and from fig 8 we can predict the fertilizer name which should be used

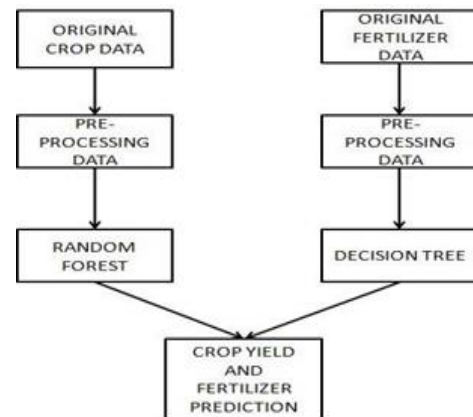


Fig. 2 Architecture

#### D. Metadata

In this stage we are going to encode all the categorical data (state name, district name, season and crop) into a unique number that is one unique number is given to one state, district, season and crop as shown in fig.3. The same number is not given to the other elements. By converting original data into metadata we can easily process the dataset. This converted data consists of more than 35 states, 600 districts, 5 seasons and around 100 crops all over India.

Index	State_Name	District_Name	Crop_Year	Season	Crop	Area
0	0	427	2000	1	2	1254
1	0	427	2000	1	74	2
2	0	427	2000	1	95	102
3	0	427	2000	4	7	176
4	0	427	2000	4	22	720
5	0	427	2000	4	28	18168
6	0	427	2000	4	38	36
7	0	427	2000	4	106	1
8	0	427	2000	4	108	5
9	0	427	2000	4	109	40
10	0	427	2001	1	2	1254
11	0	427	2001	1	74	2
12	0	427	2001	1	95	83
13	0	427	2001	4	22	710

Fig. 3 Categorical data

### IV. PROPOSED METHODOLOGY

In the prevailing device climatic conditions range very frequently. So, it's miles tough to extend flora with the useful aid of the use of facts weather situations. We need to use some era to locate o recognize the crop facts and guide the farmers to increase vegetation because of this and moreover fertilizer furthermore one of the important factors to boom flora as a forestall end result. If fertilizer is use more or less in the issue the soil might also moreover furthermore lose it fertility and crop may not supply the anticipated yield. So, fertilizer moreover becomes the number one element in it. Broadly talking statistics, the temperature situations are a lot important for India due to the truth we are able to enhance the Indian economic tool with the help of the crop prediction as it plays a first rate function within the Indian economic tool. This device would possibly in all likelihood help farmers to make vital alternatives which have been in advance taken through way of using inefficient trivial strategies or through way of guessing. The prediction tool might be finished with the beneficial resource of the use of facts mining techniques. Previous researches depict the software program software of facts mining techniques within the agricultural area.

Architecture

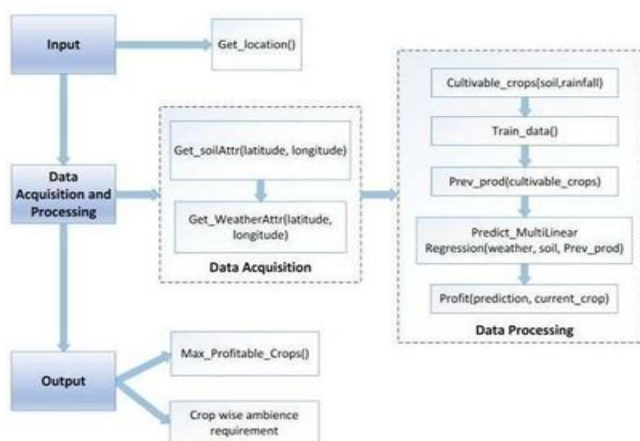


Fig. 4 System Architecture

The architecture diagram represents the overall design of the project. After taking the location as input from the user, the data get processed using soil attributes and weather attributes that includes crop details and all other trained data and finally the output that has maximum yield will be given to the user.

V. ALGORITHM OVERVIEW

Prediction of agriculture yield is essential to deal with storage of crops, transportation decisions and risk management issues related to crops. Current system is manual where we compare the previous results with the present. Based on the previous experiences and results we come to know how much crop yield will be produced. There is no automation to predict the crop yield using the constraints temperature, rainfall, humidity, area and region. Problems of existing system: The major problems faced in the present available system is: Manual Process, Time Consuming, Less Reliable, Less Efficient, Less User Satisfaction

A. Methodology

The proposed work can be demonstrated using the Visual Studio platform which can easily work on a normal PC or laptop with 4GBs of RAM. We use DOTNET framework and uses the programming language C#.NET .MS SQL server as backend to store database of yield prediction of previous years.

- Selection of agriculture field: Consider any agriculture field for the crop yield Prediction system.
- Selection of crop: Consider any crop of choice which will be shown in that field.
- Input data: Data may include information regarding soil (Nitrogen (N), Phosphorus(P), Potassium(K) Content, micro nutrients present in soil, moisture in soil etc) which is collected over some period of time.
- Pre-processing: Data which is collected should be pre processed.
- Attribute Selection: Important Features have to be extracted.
- Classification Algorithm: two efficient

algorithms as been employed. Naive Bayes Algorithm for Crop yield prediction. This algorithm provides us high accuracy and KNN Algorithm is used for Fertilizer Recommendation.

Naïve Bayes Algorithm formulae:

$$P(\text{attribute value}(a_i)/\text{subject value}(v_j)) = \frac{(n_c + mp)}{(n+m)}$$

KNN Algorithm formulae:

$$\text{Distance} = \text{Sqrt} [(q_1-p_1)^2+(q_2-p_2)^2+(q_3-p_3)^2]$$

- **Result:** Prediction and recommendation can be provided to the farmers based on the results obtained.

## B. Expected Outcomes

This system is an agriculture application which analyses the previous data related to rainfall, temperature, humidity and other factors and crop yield. Proposed system makes use of data mining in agriculture for decision making

The work is conducted taking under consideration the various constraints such as temperature, rainfall, humidity, region, area and other constraints. System uses Naive Bayes Algorithm for crop yield prediction and KNN algorithm for suitable fertilizers recommendations.

Data collected from government sector (region, temperature, rain, humidity and yield prediction based on year wise and location wise) can be used to predict crop yield and suitable fertilizers to improve yield.

## VI. PERFORMANCE ANALYSIS & RESULT

Here result is represented by using tkinter user interface. Crop yield prediction is done by Random Forest regression and fertilizer prediction is done Decision Tree algorithm. Random Forest model was experimented with different types of attributes like state, district, year, season, crop and area in various regions across India to predict the result. Fertilizer

dataset is train with six attributes to predict the fertilizer used on the crop land. For crop yield prediction the user should enter seven fields (state name, district name, year, season name, crop name and area) to get the output is shown in Fig. 3. The input of the fertilizer data takes six factors; temperature, humidity, moisture, nitrogen value, potassium value and phosphorous value.

## VII. CONCLUSION

Prediction of crop yield and fertilizer prediction is successfully predicted by using efficient machine learning algorithm (Random Forest Regression and Decision Tree Algorithm). The experimental output tells that Random Forest Regression got highest accuracy percentage and performance compared to other algorithms used. The result is developed using python Tkinter which is a GUI tool kit. In future we can develop using the app application which makes the user to use this application more effectively.

## VIII. ACKNOWLEDGEMENT

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