Survey on Crop and Fertilizer Recommendation using Machine Learning

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Abstract: India is an agriculture country. Agriculture is the primary source of livelihood. for about 58% of India's population. As per first revised estimates of National income for 2020-2021 released on 30th May 2021, the contribution of agriculture sector to GDP is 20.2%. Therefore, Indian economy depends on agriculture yield growth and agro-industry product. In the agriculture sector machine learning is an emerging research field. Using machine learning models, it becomes easy to predict crop yield and the suitable fertilizers for their crops. Yield and crop prediction is a vital issue in agriculture. Farmer are always curious to know about how much yield he will have at the end of the season, which crop they should grow, and which fertilizer will be optimal for his crops. Study of various attributes like location, crop yield data, fertilizer data etc. have been made . With the help of third-party applications like APIs for weather and temperature, nutrient value of the soil there in region, amount of rainfall within the region can be determined. All this data is going to be studied, train machine learning algorithms that is SVM and Random Forest for creating models. The system will produce a model that will be accurate in predicting crop yield and deliver the user proper recommendations about which crop to sow to expect better yield and increase farmer's revenue. Along with it will recommend the right amount of fertilizer required by the crops. The proposed system uses Html, CSS, JavaScript for developing the web application

Keywords:—Support Vector Machine(SVM), Random Forest, Web Application, Agriculture

I. INTRODUCTION

As we know that, agriculture sector is one of the most important yet largely unorganized sector in India , it still remains far away from the technological advancements. The farmers are not much aware about the right quantity of fertilizer to be used and they do not have the right understanding or information about which crop to grow under certain circumstances and how much yield of the crop they will have, this lack of awareness spoils the organic nature of the crop and sometimes the excess fertilizer makes the crop unhealthy to consume. Also, this inadequate information degrades the overall yield. Hence, this makes the agricultural sector overall unorganized and less economical Excessive use of fertilizer also makes the land infertile for farming as well as it causes soil pollution. Inadequate quantity of fertilizers will directly affect the overall health. Unduly high concentration or intake of elements and nutrients can have adverse effect on plant growth. Also, few elements, especially heavy metals have tendency to bio-accumulate. The plants can become source of excess heavy metal intake in human beings. Meeting the growing need for food is a challenge. For this , agriculture land per unit area is required to achieve maximum efficiency. Use of fertilizer and nutrients is one way to supply achieve this. The presence of heavy metals affects the plant growth. Excess use of fertilizers may lead to heavy metal accumulation, eutrophication and accumulation of phosphate and nitrate.Excessive phosphorus is potential threat to water quality. Our projects aim to limit the use to fertilizer and to recommend only then required kind of fertilizer for each crop. So, here is an idea to implement a machine learning model which suggests whether the crop should be planted in that area or not, basically it benefits the farmers and saves them a lot of trouble, machine learning algorithms will be used to recommend crops, crop yield and fertilizers .

II. LITERATURE SURVEY

[1](2019)The researchers C.P.Wickramasinghe ,P.l.N.Lakshitha, H.P.H.S Hemapriyaa from Sri Lanka Institute of Technology , Malabe , Sri Lanka proposed smart crop and fertilizer prediction system which uses sensors to get soil readings and then multi class **SVM algorithm** is used to optimize the quantity Nitrogen, Phosphorus, potassium, then generate suitable crop list for the land. There are many types of data mining techniques that can be used for agriculture according to their research. As, an example they have used **k-nearest neighbor** for simulating daily precipitations and other weather variables and estimating soil water parameters and climate forecasting and **Neural Networks** for the forecasting of water resources variables in agriculture. It achieves over 80% accuracy after building the model using the trained data set.

[2](2020)The researchers N.Manjunathan, P.Rajesh, E.Thangadurai,A.Suresh , Department of Computer Science and Engineering, Vel Tech Rangarajan Dr.Sagunthala R & D Institute of Science and Technology, Chennai, Tamil Nadu, India. Proposed this model, the model mainly focuses on crop production based on four factors and one Machine Learning algorithm **called SVM (support vector machine)** and also to produce accurate results and helps farmer to choose the right crop according to the area and climatic conditions because in prediction process of the system , they include the data of soil nitrogen, underground water, temperature, rainfall which may produce the accurate results in recommending farmer to invest in farming that crop or not. This Machine Learning model which is trained with Support Vector Machine has managed to obtain an **accuracy percentage of 96.5%**

[3](2019)Devadatta A. Bondre, & Mr. Santosh Mahagaonkar ,NICT Solutions & Research, Belagavi, Karnataka .This paper proposes and implements a system to predict crop yield from previous data. This is achieved by applying machine learning algorithms like **Support Vector Machine and Random Forest** on agriculture data and recommends fertilizer suitable for every particular crop. The paper focuses on creation of a prediction model which may be used for future prediction of crop yield. It presents a brief analysis of crop yield prediction using machine learning techniques. This paper suggests that prediction of crop yield based on location and proper implementation of algorithms have proved that the higher crop yield can be achieved. From this work, this has been concluded that for soil classification Random Forest is good with **accuracy 86.35%** compared to Support Vector Machine.

[4](2017) Prof. D.S. Zingade1 ,Omkar Buchade ,Nilesh Mehta ,Shubham Ghodekar,Chandan Mehta Department of Computer Engineering, All India Shri Shivaji Memorial Society's Institute of Information Technology, Kennedy Road. 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 give insight into which crops are suitable to be cultivated in a particular area. The proposed system will integrate the data obtained from repository, weather department and by applying machine learning algorithm: **Multiple Linear Regression**, a prediction of most suitable crops according to current environmental conditions is made.

[5](2016)MRS.hemageetha & Dr.G.M Nasira, (Department of Computer Science, Periyar University, India). This paper analyzes whether the Salem district soil is suitable soil or non-suitable soil for crops cultivate on based on pH value using data mining classification techniques. Classification of soil is critical to the study because depending upon the fertility class of the soil, the domain experts determine the type of crops to be cultivated in particular soil and also determine the type of fertilizers to be used for the same. Naive Bayes algorithm is used in soil Ph value prediction. Graphical model is used in Bayesian network. It is used to learn relationships between the items and can also be used to understanding the problem domain and consequences of intervention. From the data base collected out of 792 instances of soil samples 701 instances have been considered for proposed methodology Out of 701 instances J48 has classify 701 instances correctly, the Accuracy is 100% which is high compared with other classifiers.

[6] D. Ananthan Reddy, Bhagyashri Dadore, Aarti Watekar from Kavikulguru Institute of Technology and Science, Ramtek, Nagpur, Maharashtra. This method takes three parameters into consideration, viz: soil characteristics, soil types and crop yield data collection based on these parameters suggesting the farmer suitable crop to be cultivated. This method gives solutions like proposing a recommendation system through an ensemble model with majority voting techniques using random tree, CHAID, K _ Nearest Neighbor and Naive Bayes as learner to recommend suitable crop based on soil parameters with high specific accuracy and efficiency.

[7]Pradeepa Bandara, Thilini Weerasooriya, Ruchirawya T.H from Sri Lanka Institute of Information Technology, Sri Lanka.This paper is consisting of a theoretical and conceptual platform of Recommendation system through integrated models of collecting environmental factors using Arduino microcontrollers, Machine learning techniques such as Naïve Bayes (Multinomial) and Support Vector Machine (SVM), Unsupervised machine learning algorithm such as K-Means Clustering and also Natural Language Processing (Sentiment Analysis) concerned with the Artificial Intelligence to recommend a crop for the selected land with site-specific parameters with high accuracy and efficiency. The overall accuracy of the proposed system is more than 92%.

[8](2015)Rameshkumar, M.P. Singh, Prabhat Kumar and J.P. Singh proposed that Agriculture planning plays a significant role in economic growth and food security of agro-based

country. Se-lection of crop(s) is an important issue for agriculture planning. It depends on various parameters such as production rate, market price and government policies. Many researchers studied prediction of yield rate of crop, prediction of weather, soil classification and crop classification for agriculture planning using statistics methods or machine learning techniques. If there is more than one option to plant a crop at a time using limited land resource, then selection of crop is a puzzle. This paper proposed a method named **Crop Selection Method (CSM)** to solve crop selection problem, and maximize net yield rate of crop over season and subsequently achieves maximum economic growth of the country. The proposed method may improve net yield rate of crops.

[9](2019)Miss Vaishali Patil professor, Sachin Deshpande Department of Computer Engineering Vidyanagar Institute of Technology, Mumbai, India Department of Computer Engineering Vidyanagar Institute of Technology, Mumbai, India proposed that —Looking at the current situation faced by farmers, it has been observed that there is an increase in suicide rate over the years. The reasons behind this situation are weather conditions, debt, family issues. Sometimes farmers are not aware about the crop which suits their soil quality, soil nutrients and soil composition and rain fall value. The work proposes to help farmers check the soil quality depending on the analysis done based on data mining approach. Thus, the system focuses on checking the soil quality and rainfall value to predict the suitable crop for cultivation and that can maximize the crop yield by using machine learning algorithm like decision tree algorithm and SMA.

[10] (2015)M.R. Bendre, R.C. Thool, V.R.Thool, NGCT .This paper gives an idea about how to discover additional insights from precision agriculture data through big data approach.
Big data analytics in agriculture applications provide a new insight to give advance weather decisions, improve yield productivity and avoid unnecessary cost related to harvesting, use of
pesticide and fertilizers.The results forecast using a regression model and big data handle by Mapreduce of this study shows a considerable potential of data fusion in field of crop and water management for applications such as precision agriculture.

[11](2021)Mr. Mahesh B.L1, Ms. Aditi, Ms. Aisha Reza GD, Mr. Akhil Roy, Mr. Nikhil M. The proposed methodology has two phases, training phase and test phase. In the training phase data will be collected and preprocessed. The preprocessed data will be clustered using **K-Means algorithm**. The proposed methodology will be conducted using Python matplotlib and Seaborn which is used for data visualization. Data preprocessing are performed by using the Pandas library of python, Sensor technologies are implemented in countless farming sectors. This paper aids in getting maximum yield rate of the crops. Also assists in selecting proper crop for their selected land and selected season. The accuracy may vary with each crop and location.

[12](2019)researchers Devadatta A. Bondre Student, NICT Solutions & Research, Belagavi, Karnataka, India, and Mr. Santosh Mahagaonkar Research Head, NICT Solutions & Research, Belagavi, Karnataka, India .Proposed a model which implements a system to predict crop yield from previous data. This is achieved by applying machine learning algorithms like **Support Vector Machine and Random Forest** on agriculture data and recommends fertilizer suitable for every particular crop. The crops selected in this work are based on important crops from selected location. The selected crops are Rice, Jowar, Wheat, Soyabean, and Sunflower, Cotton, Sugarcane, Tobacco, Onion, Dry Chili etc. The dataset of crop yield is collected from last 5 years from different sources. d. It achieves good accuracy for soil classification by Random Forest that is 86.35% compared to Support Vector Machine. For crop yield prediction Support Vector Machine is good with accuracy 99.47 % compared to Random Forest algorithm.

[13][2019] researchers Nitin N. Patil, Mohmmad Ali M. Saiyyad .It describes various approaches presented by different researchers for agriculture data analysis. In this implementation, they used the Naive Bayesian classification technique to recommend the crops and fertilizers. The proposed technique uses the input data more accurately using five weather and soil related parameters to obtain reliable crop recommendations. In this approach, the results are promising and useful for crop and fertilizer recommendation which will help the farmers according to crop fields. In agriculture sector, seasonal dataset for various crops are available.

[14][2021] Sayed Mazhar Ali1 ; Bhagwan Das, Dileep Kumar, Department of Electronic Engineering, Quaid-e-Awam University of Engineering, Science and Technology, Nawabshah, Sindh, Pakistan. The goal of this study is to demonstrate the impact of meteorological variables on agricultural production in order to improve crop yields, which will help farmers. The linear regression system model is created in Python. The dependence of crop production on temperature is also examined in this paper, and a crop prediction is made based on the results. There are some aspects of this study that require additional investigation in order to learn more about crop recommendation prediction using regression analysis. Rainfall, minerals accessible in soil such as potassium, nitrogen, and phosphorous, rainfall, and crop market value may all be included to the input parameters, making the model forecast more accurate and lucrative. It achieves the accuracy of about 86.88 % throughout the study . Prediction Support Vector Machine is good with accuracy 99.47 % compared to Random Forest algorithm.

(15)[2016]Mr. Khakal V.S., Mr. Deshpande. N. M , Mr. Varpe P. B, Department of E &TC , PDVVP COE Ahmednagar. This System deals with the design, optimization, and development of a practical solution for application to the agricultural monitoring and control. The

proposed system utilizes sensor for Micro parameter measurement (N,P,K),temperature level detection, Motion detection , Humidity , Soil moisture ,Soil Ph For management of Agricultural environment. It included Real-time Video Monitoring and Agricultural Parameters measurement using Sensor Networks for Precision Agriculture. After the proper measurement of N,P,K content from soil it will become simple to judge about the fertilizer combinations.

III. CONCLUSION

The conclusion drawn from literature survey is that SVM classifier is used to predict crop yield, fertilizer, and crop recommendation. SVM is used to classify the crop based on the factors of the area, season. And there is a Web Application that enables the users to interact with the ML model and make their prediction with their given inputs. We hope to give a contribution to the agriculture sector through our work and present a farmer friendly project.

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