Smart Fertilizer Distribution System with Crop Yield Prediction: A Review

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Abstract: Agriculture is one of the important part in almost every country. Sector of agriculture supports various outputs such as economical boost, food, employment and raw material for industry. In the field of agriculture and development, the fertilizer industry plays an important role. Farmers are not receiving the fertilizers in the time when they required and even in the sufficient manner. To overcome this, farmers pre-order the fertilizer to the company based on retailers. Presence of increasing the proper fertilizer distribution system which is in effectively and efficiency. Along with this, farmers will get crop recommendation for the particular soil using Nitrogen (N), Phosphorous (P), and Potassium (K) npk values of soil. Almost every farmer facing most problems in the agriculture, but one of the important problem is Yield prediction. And each farmer is very interested and eager to know how much crops they can grow in their field. The system comes with a model that farmers can reach sufficient fertilizers and farmers can also get the information about the crop recommendation based on npk values and yield prediction based on soil sample, area. This will help to farmers to increase their profit. By using some of the techniques for distribution of fertilizers, farmers can gain benefit for understanding and knowing of agriculture things.

Keywords: Soil sample, crop recommendation, fertilizer distribution, Crop prediction.

I. INTRODUCTION

Agriculture plays an important role in every individual's life. Being the backbone of India, Agricultural sector has been improving by the needs of the public, as the technology improves. In agricultural activities, about two-thirds of population is belonged. In the world India Framers might face some of the problems like water shortage, limited amount of fertilization low yield and so on. Farmers facing the more loss and facing huge financial loss and leads to suicide. Around the world, India is standing in the place of second in the crop output. India is having 1.4 million square-kilometers of land is under cultivation. The food which we all consume is based on the agriculture. Not only for the food, it is important for the raw materials also. If the costs of seed and chemical increases suddenly, it creates more issues for farmers within the least period of time. In rural India, agricultural marketing continues to be in a worst way. Farmers are not getting sufficient fertilizers. Even if they get fertilizers, sometimes they bought fertilizers by purchasing in high cost. To reduce this insufficient, farmers pre-order fertilizers that how much they required to the company through retailers. Fertilizer sales and application services area unit necessary business areas for farm supply cooperatives. In some of the situations or conditions, farmers are facing serious issues. Type of soil is one of the important factor or attribute for crop yield. Suggesting the information about the fertilizers to the farmers which helps to create helpful for cropping part. By the use of and knowing the knowledge of mining, we can predict the crop yield. By totally using the previous or old information we can recommend the farmer for a crop for the higher yield.

Fig 1: Agriculture: Backbone of India

For higher yield we want to think about soil sort and soil fertility things. Crop recommendation is done by using the npk values. The main goal of this paper is to achieve the maximum crop at minimum yield. Initial finding of issues or problems and management of these problems will give the solution for the farmers for maximum crop yield. For saving the food, prediction of crop yield is one of the important factor which also helps to the people. By using the standard knowledge of crop yield and by using the machine learning we can predict the yield with the help of previous large information, one can give advice to the farmer for a far better crop. This crop yield recommendation is done by using sample of the soil of particular land. After taking the sample of the soil, we will test the amount of nutrients like Nitrogen (N), Phosphorous (P), and Potassium (K) by taking into the laboratories. This recommendation is done by using some machine learning algorithms. Along with crop recommendation farmers can also predict crop yield based which is very helpful to the farmers. This crop prediction is done on certain factor by some machine learning algorithms.
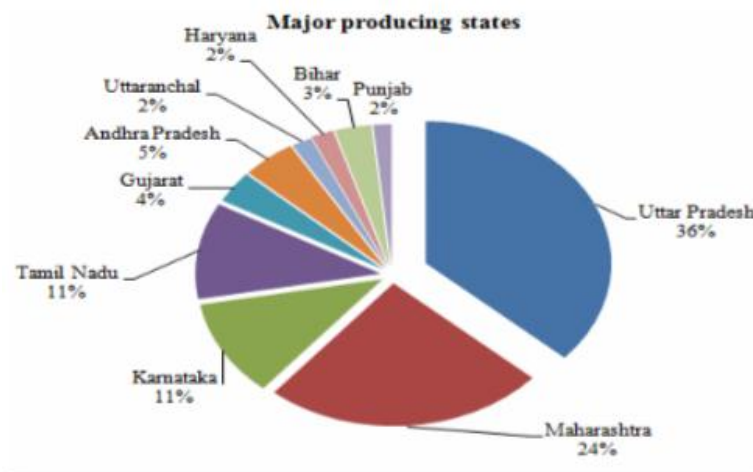

Fig 2: Major crop producing states

This paper is organized as follows: Section I focuses on 'Introduction'. 'Related Work' has been discussed in section II. The last Section III will conclude the information of this paper.

II.   RELATED WORK

2.1   Machine learning in the field of agriculture:

S.Bhanumathi et al [1] specifies that India is initially and until now called as agriculture country, its production and consumption of goods preponderantly based on agriculture like crop yield growth and agro-industry product. Production of crop Yield could be a main problem in agriculture. Every farmer is curious to know about what quantity of crop can be grown which is near to expect. Analyze the varied connected variables like pH worth from that pH scale of the soil is determined and location. Alongside it share of nutrient contents such as Nitrogen (N), phosphorous (P), and Potassium (K). Some of the attributes like weather, temperature, soil type or moisture, nutrient contents in the soil region is going to be analyzed, train the data with numerous appropriate machine learning algorithms like Artificial neural network (ANN), Random forest algorithm, Backpropagation algorithm. The system developed with a model to be right or approximate in predicting crop yield and this information will be informed to the farmer as a crop recommendation which is based on atmospherically and soil parameters of the land that increase to extend the crop yield.
Yield prediction of the crop and economical usage of the chemical which is passed foreseen and additionally taken the economical formula from each the formula and received the foremost economic result of the yield.

Mrs. K. E. Eswari et al [5] define that in agriculture, the important problem is Crop prediction. Solution is using the clustering and classification techniques based on data analytics concepts for crop yield prediction by using Bayesian network and SVM. These techniques are application for increasing the crop production by predicting the yield of crops. A supervised learning model i.e., Bayesian network Classification which means previously knowing of data about rainfall and temperature of crop data. This data is used for probability and classification values of Coconut, Black pepper, Rice, Dry ginger crops. For exploring the dataset, the Bayesian network Classification technique is used. The mean absolute error (MAE), root mean squared error (RMSE), relative absolute error (RAE) and root relative squared error (RRSE) were calculated. The performance of other algorithms on the same information was much better compared to SMO, when the results are shown.

Sriram Rakshith et al [9] state that by using Machine learning techniques and by sensing parameters, some of them are soil, weather, PH, Nitrogen-phosphate-potassium contents of soil, temperature, rainfall and humidity to improve farming by technical knowledge and to make the agricultural sector more easy for the farmers to predict the suitable crop. Some of the technologies used here are Artificial Neural Network(ANN), Information Fuzzy Network. ANN consist of three layers. Those are input, output and hidden layers. The input given to the ANN is neurons. To produce output, firstly it is performed by hidden layers and it is used by output layers. Around the globe, tomato is widely used crop. For tomato crop detection, artificial intelligence and machine learning algorithms like ID3 and other optimizing algorithms are used. For Information Fuzzy Network, the inputs are Soil moisture content, ground biomass and repository organ. The easiest way of this algorithm is it will reject the behind a year and uses the rest of the data. By comparing the yield with the one that is left out, the deviation is determined.

The task of prediction of crops can be achieved using different methodologies. ANN algorithm give us a better or accurate predictions. To provide accurate predictions about the crop yield for a particular region is done by using the soil, weather and market prices. This is done by using ANN algorithm.

Miss.Snehal S.Dahikar et al [11] describe different situations have been considered for climatologically phenomena which affects to local weather conditions. Crop yield is one of the main effective thing based on the weather conditions. To increase farmer's effectiveness and for crop prediction, Artificial neural networks is used. Nitrogen, soil type, potassium, PH, phosphate, depth, humidity, organic carbon, Sulphur, manganese, calcium, rainfall, magnesium, copper, temperature, iron are the parameters. In 'artificial neural network', the word network means communication between the neurons which is present in the various layers. This model having three layers. The data is send via synapses by first layer to second layer and then more synapses to the last layer which is results neurons. In other words, the second layer is for the updating of weights of interconnection. Third layer is for the activation of output. Here the neurons are called as nodes. One of the important and common network architecture is feed forward back propagation neural network.

The word "back propagation" means specifying the work of type of neural network is trained and supervised training. Here both inputs and anticipated results are present for providing the network. The anticipated results are compared with the actual results**.**

Avinash Kumar et al [18] introduced the system to help farmers to awareness of the requirements of the crop such as minerals, soil moisture and other soil requirements. Farmers facing many problems in the pest also which affect the crops for the production. With the help of Support Vector Machine (SVM) classification algorithm, Decision Tree algorithm and Logistic Regression algorithm there is possibilities to find the best crop to grow and pest which is not affecting to the crop. In SVM, classification is based on the structured and unstructured data. To predict the crop SVM algorithm and decision tree. Firstly, train the data by applying into the model with the help linear SVM and decision tree algorithm. The system will show the output as the prediction of the crop by entering the parameters. The model also specifies the pests that affected to the crops and removal of those.

Daryl H. Hepting et al [14] study helps to the farmers facing many problems about climate which is considered as the one of the factor depends on agriculture. So farmer should think or previously know about the climate once they choose crops for the coming year. Choosing of crop may occur difficult or not predicting well when there is a presence of climate changes rapidly or repeatedly. Without any proof or low knowledge about the crop and climate, it is very difficult to trust recommendations which are visualized of crop choices. In this paper there is a presence of helping to the Canadian farmers by informing the selection of crops which describes the design and implementation of a tool. In this paper REAP (Resilience Enhancement of Agro- Ecological Production zones) system is used by using decision tree. By using this system which advice or inform or recommend about the crop performance along with data using of previous years. By using the data which could be mined to provide or give the information about the details and specifications of different crops and the conditions which are based on the reports of different farmers on different crops.

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Nidhi H Kulkarni et al [19] the author aims to solve the problem of farmers which is facing like production of crop because farmers are not choose the correct cultivation crop. Machine learning is used for crop productivity i.e. ensembling technique by specifying which crop can be grown depending on the type of soil details. This model uses the algorithm like Linear SVM, Naive Bayes and Random Forest. With respect to the four crops like Sugarcane, Rice, wheat, Cotton, this system is developed. In the system, firstly the dataset is previously sent or entered by the farmers and then the ensembling technique is performed. To provide the best accuracy Voting technique is used. 99.91% accuracy is obtained by this technique. Objectives is the system which specifies the approximate crop recommendation by using the attributes

like surface temperature parameters, rainfall, different soil. Improvement of crop production is also done along with the reduction of wrong choice by the farmers.

2.2   Data Mining in the field of agriculture:

Saiyyad Mohmmad Ali Muzffar Ali et al [2] describe that agriculture provides numerous outputs like food, raw materials, economical employment. Crop recommendation is important factor for the farmers. With respect to variables which are depending on the agriculture input and result, it should contain vast data. Data processing techniques are application on to assumption the one or more dimensional, time specific information in sector of agriculture to supply more data from it which might be wont to boost the economy. Farmers can get the profit by recommending the crops early. During the research, they tend to survey numerous approaches employed by totally different man of science to affect analysis of agriculture sector to produce crops to increase production and effective use of resources that successively will increase the economy during this sector.

They gift numerous approaches conferred by completely different researchers for agriculture knowledge analysis. By using algorithms such K-means, SVM, PCA and so on, the fundamental data processing approaches like clustering, classification can be done.

Ramesh A. Medar et al [3] state that agricultural system is having large data based on number of factors. For farmers or producers, consultants or advisers, and the organizations which are related to agricultural field, prediction of crop yield is one of the important topic. In this paper, they used data mining techniques in agricultural field such as K-Means, K-Nearest Neighbor(KNN), Artificial Neural Networks(ANN) and Support Vector Machines(SVM). The two classification techniques learn to classify unknown samples from training set to classify different samples which are unknown, those are Support Vector Machines and Neural Networks. Another classification technique, which is useful for classification and this is using some training data in every step or time and that classification name is K- Nearest Neighbor, so therefore this classification is not having learning phase. Farmers will give the input such as city, land area, status of economic and region. The farm knowledge is involved in the crop knowledge base like ph, name of region, id of region, rainfall, type of soil, humidity, city, information of pesticides, sunlight, parameters of environment, information of land, knowledge of like type of seed, type of crop. For grouping contents, the data goes to classification and association rule after selection of attribute. To get results in terms of crop, rules of prediction will be achieved to get the results of clustering.

Pooja M C et al [7] report that agriculture is known as backbone of India. In this paper, an approach was applied on agriculture by using data mining techniques. The technique they used are J48 of C4.5 algorithms. Using of some of the data in this algorithm, those are type of soil, pH, ESP, EC of a exact region. These are used to get better crop yield estimation. This system is used for the suitable crop in particular region and improving in the crop yield. This will help to the farmers. This experiment uses the simple and easiest classifier i.e. J48 to make decision tree in a best result. Based on the soil sample which is taken from the laboratories to testing and cropping pattern, the recommendation of the suitable fertilizer is done by the system.

J48 of C4.5 is called the implementation of java. The algorithm which builds a decision tree is C4.5 using labeled data as input. The extension of ID3 algorithm is C4.5 algorithms. This system is used for the suitable crop in particular region and improving in the crop yield. This will help to the farmers.

D Ramesh et al [8] identifies a system to helpful for the agrarian society or agricultural society is facing many problems to increase the crop productivity in India. Crops which is still depends on monsoon rainfall more than 60 percent. For this purpose, data mining techniques are the better choice. For finding the future crop production, the different Data Mining techniques are used. Some of the techniques used here are Multiple Linear Regression (MLR) technique and Density based clustering technique for the selected region i.e. East Godavari district of Andhra Pradesh in India. The method used to predict the climate conditions is MLR which helps for the crop yield. The number of things which are beside of particular data things is known as Density. A cluster continues to maximizes as far as the number of objects or things in the beside which increases some parameter in these approaches.

Firstly, for the existing data Multiple Linear Regression technique is applied. The results which were obtained were verified and analyzed the information using data mining technique like Density-based clustering technique. In this procedure, there is a presence of 2 methods. Those 2 methods are compared based on region i.e. East Godavari district of Andhra Pradesh in India.

Zhouqiao Ren et al [12] study specifies to calculate the amount of variety of nutrients during the crop growth, choosing suitable fertilizers and arranging fertilization time Crop fertilization recommendation system is developed. To help for the farmers, an organizational and facilities of knowledge base and its uses is introduced. Here usage of object-oriented is used with the usage of C++ programming. Entity, parameter, and operator these are the categories of the system. This type of categories is done because to get the software system objects by converting the entity objects. To run model, the

required knowledge is classified to four types and lastly reasonable decision inference engine is designed. This is developed because to control local entities.

For the flexible integration between the knowledge and system, the infrastructure of knowledge base and the corresponding applying mechanism has been developed. This is for the Fertilizer distribution system for the farmers.

Ansif Arooj et al [13] determined that agricultural analysis has strong in the most effective use of economic gain, internationally and is extremely large and necessary field to achieve a lot of edges. Data mining is the process of analyzing or examine something, some actions and checking the datasets. This data mining is mainly used for prediction. To develop the improved recommendation for the crop yield productivity, reduce fertilizers dependence and farming productivity, the main source is the understanding of soils classes. In the place of Kasur district, Pakistan, this experiment was conducted. For analyzing and construction the classification and predictive model, OneR, J48, BF tree and Naïve Bayes is used. OneR means One Rule which gives the results of the weighted error for every example which is by generating one rule for every predictive variable. For representing the errors frequency table is used.

In agriculture, crop prediction is the important source which helps to the farmers. It is the main advantage for the farmers.

S.Pudumalar et al [16] shows that for analyzing the various biotic and abiotic factors, data mining is used. Farmers are not choosing the correct crop based on the soil requirements. Precision agriculture is one of the technique which uses to the research information of characteristics of soil, type of soil, data collection of crop yield and giving information about the farmers the exact crop depends on their site some variables. Technique like Random tree, CHAID, K-Nearest Neighbor and Naive Bayes are used to recommend a crop for the specific parameters with high accuracy and efficiency. Majority Voting technique must need at least two base learners and they are select in which competent to each other. Higher is the chance of better prediction with higher the competition. CHAID means Chi-squared Automatic Interaction Detection and uses multi way splits. K-Nearest Neighbor is used for classification and regression which stores all available cases and classifies new cases.

This work helps to the farmers by growing the correct crop based on the soil sample. This helps in increasing the amount of the crop yield.

Yogesh Gandge et al [20] shows about the work is to predict the amount of crop initially to its harvest can useful to the farmers and Government organizations to make some approximate planning like selling, storing, importing/exporting, fixing minimum support price etc. for crop prediction requires large or vast data like pH, quality of soil, N, P, K EC etc. Presence of seven parts in the data mining, those are data cleaning, data integration, data selection, data transformation, data mining, pattern estimation, knowledge display. Initially the values should be entered to the system and the data should be in normalized form. The output is crop recommendation and prediction based on acre. Different types of algorithms can be used to recommend and yield prediction.

There's still importance for the development in output throughout in this paper that they administered it's determined that the algorithmic rule that is employed with the help of most of the authors doesn't uses an approach which is unified wherever altogether the attributes which are depending on the crop yield may be combined at the same time for crop yield prediction. There is still having more importance of improvement because the data that was taken into account was little. So, the output may be better by employing massive data.

2.3 IOT in the field of agriculture:

Santosh T Warpe et al [4] introduced Wireless Sensor Network (WSN) is used in the agriculture for automated farming. There is a requirement of automated distribution of fertilizer system in developing country like India. This will help the farmers for distribution of fertilizers in a better way. The fertilizer values and if needed required fertilizer is also supplied so that low cost, low power and less complex methodology can be achieved to automate fertilizer distribution system, this is monitored by Wireless Sensor Network. WSN is an arrangement of ad-hoc strewed sensors across network in Layman's term. These sensors work together by conglomerating the information required to process to get results and sense physical phenomenon. A WSN composed of protocols and algorithms. Habitat monitoring (Plants, animals) and environmental monitoring, weather forecasting systems is one of the application in the field of agriculture. It is also used for broadcast communication. it is not having global ID, due to the large number of sensors and amount of overhead. Wireless Sensor Network (WSN) is used in the agriculture for automated farming.

A. Izuddin Zainal Abidin et al [15] specifies that manual chemical spreading method will be inefficient as the quantity of chemical unfold could also be deficient or an excessive amount. Ifeeder will gets the soil analysis which is very quick, result observation and providing fertilizer distribution based on crops using mobile application with the help of pH sensor. By the implementation of technology, the ability of introducing the distribution of fertilizer on crops in the sector of agriculture through implementation of method has been developed. Giving the correct quantity of fertilizer at the correct time will results better crop yields and production of productivity. The projected system is very helpful to the farmers by using the mobile application which is having a major profit and nice results to the farmers and the analysis of technology

based on agriculture fields and detector and microcontrollers in distributing chemical on crops and watching on condition of soil within the sector of agriculture.

Malaysia and Malaysian Agricultural Research and Development Institute (MARDI) which are trying to reach a goal to support the process to build a data, Communication and Technology (ICT) in the sector of agriculture with the help of agriculture ministry.

2.4 IOT and Machine learning in the field of agriculture:

Anna Chlingaryan et al [10] analyze that Agriculture needs essential requirements i.e. accurate yield estimation and optimized nitrogen management. For farming systems, Remote sensing (RS) systems are broadly used in creating decision support environment to improve yield production and nitrogen management. The approaches which is based on the RS require an enormous number of sensed information from various platforms. There is also need of machine learning (ML) for the process of large amount of data. This is for the prediction of crop yield approximately and estimation of nitrogen status. For approximate prediction of crop yield which is done by the Back-propagation Neural Networks and the important factor is to find the various vegetation indices. The reduction of the error and feature extraction from the data is done by combining of Convolutional Neural Networks and one of the other method called Long-short Term Memory by using process called Gaussian Processes. For automatic choosing of wavebands with the different characteristics of plant leaves is done by the Gaussian Processes. Multi-class crop prediction is done by the M5-Prime Regression tree. To identify Nitrogen Status, the Least Squares Regression Machine is used. For yield prediction and crop management Fuzzy Cognitive Map (FCM) is used.

By using the methods like sensing technologies and ML techniques, one can predict the crop yield and estimation of environment status and also making of correct decision is also done.

2.5 Big Data in the field of agriculture:

Rashmi Priya et al [17] study provided about the agriculture has more than seventy percent of the population. With the help of big data, agriculture can get the profit like data analysis, data processing, and data storage. to suggest farmers that to inform the correct crop according to field conditions, precision agriculture model is developed mainly in region of Telangana. Naive Bayes classifier is used in this model to crop recommendation. The methodology describes crop recommendation with the help of the naïve Bayes algorithm. For providing or supporting of parallel processing operation we are using Map reduce functionality like Hadoop Distributed File Systems (HDFS). This having large amount of data. This system having two models, one is when the values are passed, system specifies which crop can be grown for particular soil. Second is shows the month which having higher yield. By this way farmers can get higher yield prediction with the help of map reduce and Naïve Bayes.

2.6   Information and Communication Technology (ICT) in the field of agriculture:

Priyanka Roy et al [6] describe the present situation in which ICT technology is used for distribution of fertilizer in India. Presence of increasing the proper fertilizer distribution system which is in effectively and efficiency. Farmers are not getting fertilizers according to their requirements. In other words, farmer's requirements are not fulfilled. For fertilizer distribution system aadhar enabled system is used which is timely and proper distribution of fertilizers to the farmers and established in ICT model. Presence of application which is used by the farmers and having the concept of ICT. Application records the property owned by the farmers and also variation of the land if the farmer sold or purchased like that. If the farmer requests the requirement of fertilizers even though cross the limit of their lands, then the application will reject that request and specifies no more fertilizers to that particular farmer. Updating to the farmers is done with text messages.

To gain the profit for the farmer for fertilizer distribution is done with the help of ICT methodology for using in a correct manner with less human effort is monitored by the ICT.

Table 1: Different Approaches In Agriculture For Fertilizer Distribution And Crop Yield Prediction

Sl no	Different fields	Description	Algorithm used	Advantages	Disadvantages
1	Machine learning	System for the approximate prediction of crop amount and proper distribution of fertilizers based on soil attributes.	Artificial neural network	Capacity of predicting is great in ANN ANN is more efficient algorithm	Need large amount of data. Time requirement for processing is large.

			Random forest algorithm	Random forest algorithm uses both small and large data	Probability will be difficult if the values are new
			Naïve Bayes	Results will be accurate even if the data is small	System is using considering small data of soil attributes
			SVM	SVM algorithm gives better accurate results	Overfitting may be possible
			Logistic Regression	Efficient and not require more resources	Results are not accurate sometimes
			Bayesian Network	Produce good results with the help of small data	Speed is less
			Fuzzy network	Simple mathematics are used	
2	Data Mining	Different approaches for crop recommendation that which crop can be grown	J48 of C4.5	J48 is based on the decision tree and which is fast and easy to implement	J48 is based on depth of tree which leads to process complexity
			K-means	Computation is faster when the data are more	Selecting the parameter K in the K-Means
			Multiple linear Regression	Good results can be reach with having small data	MLR is sensitive
			Naïve Bayes	Naïve Bayes classifier is more accurate Requires less data (Naïve Bayes)	Prediction is difficult with new values
			PCA	Reduce the dimension of data	Sometimes the data may be loss
			SVM	SVM is good when there is no idea	Difficult to understand
			K-Nearest Neighbor	Does not require training data	KNN does not work with large data
			Artificial neural network	Having the feature of fault tolerant	Depending on hardware components
			Density based clustering	While clustering, this algorithm having ability to search data which is noisy	Failure of distinguishing of density clusters
3	IOT	Usage of wireless sensor network for sensing of fertilizer values and for proper distribution	Bluetooth technique	Sensing of fertilizer details is more benefit than manually	System was not having the ability to detect components of air and water.
			Rapid Application Development (RAD), Sensors like pH	Ease of receiving data by using sensors	Automatic irrigation system is not developed for watering and fertilization

4	IOT and Machine learning	Some of the parameters are easily received from the remote sensors (RS)	Random Forest, K-means, Gaussian Processes	Can detect a greater crop field area	Cost of remote sensors are more
5	Information and communication	Distribution of fertilizers in a proper way	ICT	System is having less complexity	Requirement of humans are more
6	Big Data	Crop prediction is done with the help of naïve Bayes	Map reduce, Naïve Bayes	Naïve Bayes is more efficient	Not presence of recommendation of pesticides

III. CONCLUSION

Fertilizer Distribution is major role with benefits for the farmers. Farmers are not getting the required amount of fertilizers as they requested and they face loss in the way of purchasing fertilizers also. We gave solution that for the prediction of crop and crop yield, different techniques can be used. With the help of technologies like IOT, Machine learning, Data mining, big data, the crop yield prediction and proper fertilizer distribution can be done. Agriculture is having large dataset which is in multidimensional. By using these data and technique crop yield prediction and fertilizer distribution is possible. Recommendation of crop is done with the help of percentage of nutrients present in soil (N, P, K). Yield Prediction is also done with the help of soil sample and area. Farmers can get the information about which crop best suited to grown in land based on soil type & NPK values & also, they get the approximate amount of production of crops.

REFERENCES

[1]. S.Bhanumathi, M.Vineeth and N.Rohit, "Crop Yield Prediction and Efficient use of Fertilizers", 978-1-5386-7595-3/19/$31.00 ©2019 IEEE
[2]. Saiyyad Mohmmad Ali Muzffar Ali, "A Survey on Agriculture Crop Recommender System", Volume 7, Issue 2, February 2018, ISSN: 2278 – 1323(IJARCET)
[3]. Ramesh A. Medar[1], Vijay. S. Rajpurohit[2], "A survey on Data Mining Techniques for Crop Yield Prediction", Volume 2, Issue 9, September 2014 ISSN: 232 7782(IJARCSMS)
[4]. Santosh T Warpe, Ravi Singh Pippal, "A Study of Fertilizer Distribution System for Agriculture using Wireless Sensor Network", International Journal of Computer Applications (0975 – 8887) Volume 147 – No.2, August 2016
[5] [1]Mrs. K. E. Eswari, [2]Ms. L.Vinitha, "Crop Yield Prediction in Tamil Nadu using Baysian Network", Volume-6 Issue-2 ISSN:2348-2079 IJIAREC
[6]. Priyanka Roy, Anugrah Pandya, Vikas Deep, Purushottam Sharm, "ICT based Fertilizer Distribution System",978-1-5386-5657-0/18/$31.00 2018 IEEE
[7]. Pooja M C[1], Sangeetha M[2], Shreyaswi J Salian[3], Veena Kamath[4], Mithun Naik[5], "Implementation of Crop Yield Forecasting Using Data Mining", Volume: 05 Issue: 04 | Apr-2018 (IRJET)
[8]. D Ramesh[1], B Vishnu Vardhan[2], "Analysis Of Crop Yield Prediction Using Data Mining Techniques", Volume: 04 Issue: 01 | Jan-2015 IJRET eISSN: 2319-1163 | pISSN: 2321-7308
[9]. Sriram Rakshith.K, Dr. Deepak.G, Rajesh M1, Sudharshan K S, Vasanth S, Harish Kumar N, "A Survey on Crop Prediction using Machine Learning Approach", Volume 7 Issue IV, Apr 2019 (IJRASET) ISSN: 2321-9653
[10]. Anna Chlingaryan, Salah Sukkarieh, Brett Whelan, "Machine learning approaches for crop yield prediction and nitrogen status estimation in precision agriculture: A review", Elsevier B.V. 2018
[11]. Miss.Snehal S.Dahikar[1], Dr.Sandeep V.Rode[2], "Agricultural Crop Yield Prediction Using Artificial Neural Network Approach", Vol. 2, Issue 1, January 2014 IJIREEICE
[12]. Zhouqiao Ren, Xiaonan Lu, "Design of Fertilization Recommendation Knowledge Base and Appllication", IEEE
[13]. Ansif Arooj, Mohsin Riaz, Malik Naeem Akram, "Evaluation of Predictive Data Mining Algorithms in Soil Data Classification for Optimized Crop Recommendation", Elsevier 2018
[14]. Daryl H. Hepting, Timothy Maciag, Harvey Hill, "Web-Based Support of Crop Selection for Climate Adaptation", 2012 IEEE
[15]. A. Izuddin Zainal Abidin[1], Faizal Ahmad Fadzil[2], Yen Shin Peh[3], "Micro-controller Based Fertilizer Dispenser Control System", 2018 IEEE
[16]. S.Pudumalar, E.Ramanujam, R.Harine Rajashreeń, C.Kavyań, T.Kiruthikań, J.Nishań, "Crop Recommendation System for Precision Agriculture", 2016 IEEE
[17]. Rashmi Priya, Dharavath Ramesh, Ekaansh Khosla, "Crop Prediction on the Region Belts of India: A Naïve Bayes MapReduce Precision Agricultural Model", 2018 IEEE
[18]. Avinash Kumar, Sobhangi Sarkar and Chittaranjan Pradhan, "Recommendation System for Crop Identification and Pest Control Technique in Agriculture", 2019 IEEE
[19]. Nidhi H Kulkarni, Dr. G N Srinivasan, Dr. B M Sagar, Dr.N K Cauvery, "Improving Crop Productivity Through A Crop Recommendation System Using Ensembling Technique", ISBN: 978-1-5386-6078-2 © 2018 IEEE
[20]. Yogesh Gandge, Sandhya, "A Study on Various Data Mining Techniques for Crop Yield Prediction", 978-1-5386-2361-9/17/$31.00 ©2017 IEEE