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Review on Precision Farming : A Modern Technique for Crop Yield Enhancement

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Abstract— In India agricultural sector plays a vital role in the development of the country. The farmers should be introduced to the modern farming techniques because upon their well-being depends the welfare of the nation. E-agriculture is a field which focuses on the enhancement of agricultural and rural development through information and communication technologies (ICT). It involves the conceptualization, design, development, evaluation and application of innovative ways to use ICTs in the rural domain, with a primary focus on agriculture. Thus, e-agriculture plays a very important role in managing challenges related to crop yield. This paper presents a review on generic architecture for e-agricultural system comprising of knowledge management and recommendation system. It also proposes a system which will provide best suitable crops and fertilizers to the farmers according to the type of soil and weather conditions, to produce the best yield.

Keywords— e-agriculture, precision farming, knowledge base, data analysis, GIS, GNSS, recommendation system

I. INTRODUCTION

India being an agricultural country has a huge population engrossed into farming and also plays an important role in development of its economy. There are various factors like globalization and digitization which are changing the aspect of agriculture rapidly. The current agricultural practices should have economic and environmental stability. Various problems are being faced like soil degradation, land degradation, water logging issues, lack of knowledge about crop diseases and chemical deterioration, type of soil etc… It causes environmental pollution because of excessive and indiscriminate use of fertilizers and chemicals. So there is need to use different techniques so as to bring out the best possible solution the field of agriculture. One of the techniques is precision farming.

Precision farming is a farming management concept based on the observing, measuring and responding to inter and intra –field variability in crops. It is one of the modern farming practices that make production and yield more efficient. It has also provided an application of precise and correct amount of input like water, fertilizers, pesticides etc. at the correct time to the crop for increasing its productivity and maximizing its yields. It allows precise mapping of the farms with appropriate software so as to inform farmers about the status of the crop and their requirements. For small farms, precision agriculture may include sub surface, drip irrigation for precise water and fertilizer applications.

The relevant knowledge in agricultural domain is improved for the farmers to make decisions and to satisfy the information needs. The agriculture domain needs the help of ICT through development of knowledge management and a monitoring system. Knowledge management is about getting and providing right information at the need of it. It is divided into two sub systems: - knowledge base and recommendation system. The ICT application developed in agriculture domain include expert system, mobile based agro advisory system, knowledge management system and monitoring system. The above mentioned systems have paved the way to reduce the risk and uncertainty factors in agriculture. ICT has a great potential in facilitating access to information that drive or support knowledge sharing.

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II. LITERATURE SURVEY

Mohanraj I et al. in "An architectural framework for E-agricultural system" [1] provides all information regarding the crop and to monitor the field by using the field map provided by farmer. This paper mainly concentrates towards the knowledge and monitoring system developed in agricultural domain. The model proposed by Mohanraj I et al. provides the required information to farmers to make decision on what crop to grow depending on weather condition, water table content, the soil type, market availability, retention and selling price, among other. Knowledge base contains the information on selling information, crop information and geo-spatial data. Selling information includes information about sellers, dealers, warehouses, funds, credits, dedicated website, call centers and e-learning. Monitoring includes daily weather reports using GPS, irrigation planner, schedule reminders of fertilizers with pesticides and others. The application is proposed in regional language with audio and video facilities for better understanding of regional farmers. Field map is required, to get the information on quantity of crops and to map a field for it by setting distance between the crops providing a pattern like field to cultivate. The framework proposed in this paper can be sustainable growth in agriculture in developing countries due to its adaptability.

Another approach discussed in the paper "A New Approach to Detect Soil Nutrient Content Based on NIR Spectroscopy Technique" [2], the author Haiyan song et al. provides all information about the soil nutrients using NIR technology. NIR spectroscopy is a technique that can be considered with good potential to access soil nutrients in a mixed soil. NIR could be useful in situ as a rapid technique that can be combined with Geographic Information System and precision farming technique. The paper concentrates on the understanding of the soil spatial variability which is very important due to is the responsible that crops yield distributed unevenly within the field and it is soil specific crop management program that will help to improve soil quality. But this soil composition, an exhaustive process has to be dedicated to laboratory analysis where time and economic indicators appear as drawback. Therefore, the author is using NIR technology. A total 165 soil samples were obtained from the field and analyzed their features. 135 samples were used during calibration and cross validation stage and remaining 30 samples were used to predict N, P, K and OM concentration. The objective of the paper is to analyze the NIR spectroscopy potential to estimate P, N, K and OM contents in a loamy mixed active thermic aeric endoqualfs soil and to combine these predicted macronutrients concentration with GIS system and statistic using P, N, K and OM spatial variability within field to obtain its distribution maps and correlation among them.

S.Pudumalar et al. gives the system which suggests the technique for the best crop selection in the paper "Crop Recommendation System for Precision Agriculture" [3]. The author has discussed about the common problems which are faced by the most of the farmers due to insufficient knowledge about a particular crop. This leads to an improper selection of the crop based on their soil requirements in the farm. This results in a poor productivity of the crop. So the paper suggests to have a crop recommendation system by using precision farming technique. The system recommends the best suitable crop according to their soil requirements to the farmer by using classification and clustering in the Naïve Byes and K-Nearest Neighbor algorithm. The system has a dataset which contains the information about the particular crop based on the attributes like Depth, Texture, PH, Soil Color, Permeability, Drainage , water holding etc. By considering all these attributes, it analyses and suggests the best suitable crop to the farmer according to the type of soil. Thus this system will help the farmers in sowing the right seed based on soil requirements to increase productivity and acquire profit out of such a technique. Thus the farmers can plant the right crop increasing his yield and also increasing the overall productivity of the nation.

The paper "Contribution of GNSS in Precision Agriculture" [4] proposed by Muzaffer KAHVECİ gives an overview of the modern technologies like PAMS, GNSS, GIS and ICT. The PAMS i.e. the precision Agriculture Management System is a system which is based on advanced navigation and the information and communication technologies. This system takes input as the coordinates of the field and divides the field into several smaller units and for each area different information and data related to the soil and vegetation characteristics are then stored in the database called as the Geographical Information System database. The data

from this database is then analyzed further and useful results are extracted from it. This paper also discusses about the need of these different technologies like Global Navigation Satellite System, Geographical Information System and the Information and Communication Technologies. The uses of these technologies have made the Precision Agriculture Management System more efficient. The data collected by this system is analyzed and whose results will provide the farmer to analyze and understand all the conditions along his farm. It also helps in constructing a relationship between the crop variability and various field conditions using the GIS database. PAMS has overall helped in increasing the crop yield and reducing the overall cost. In short it helps in taking the right decision in right time at the right place.

In the paper "Cloud-based monitoring and analysis of yield efficiency in precision farming" [5], Li Tan et al. proposed and developed a cloud-based yield efficiency monitoring and analysis system for specialty crops. The system is used for accurate and low-cost yield mapping of specialty crops which is an important tool for visualizing and analyzing yield efficiency in precision farming. The process starts with collecting labor data using previously developed Labor Monitoring System (LMS). The LMS collects harvesting data from the field via LMDs (Labor Monitoring Devices). The approach proposed by Li Tan et al. requires enhancing an existing LMD with a GPS unit. By extending a LMD with a GPS unit, they augment the harvesting labor data with its geological location information. The LMD sends the geo-tagged harvesting labor data to a data acquisition server. The data is pre-processed and stored in the database for use in a variety of data-processing functions, including real-time labor monitoring and yield mapping. The proposed method is used for deriving yield data from labor data using customization yield distribution functions. The system enables to define a yield distribution function based on the characteristics of harvesting operations. How different factors of an orchard operation, such as canopy architecture, may impact the harvesting operations and hence change the yield distribution function is discussed in this paper. Two yield distribution functions for orchards with traditional canopy architecture and the UFO architecture are proposed and used in the experiments by the author. The system has been deployed on Amazon Web Services EC2, a cloud-based computing platform based on Ruby-on-Rails application framework. It provides a real time and low-cost way for growers to monitor and analyze yield efficiency in orchards, from a web browser.

The main objective of the paper "water irrigation using GIS" [6] proposed by Xi LIANG et al. is to introduce the applications of geographical information system techniques in irrigation water management where GIS is used as tool to explore different databases. This paper has used integration of different GIS techniques to analyze the irrigation water requirement and estimation of the future demand. Also the spatial analysis and the management capabilities have made it a powerful tool for expanding the irrigation estimation from a farm level to a regional level. It also helps in increasing the crop productivity and facilitates the selection of the most suitable cropping patterns. GIS techniques allow modeling of the water demand taking into account of variations in soil, climate etc. and facilitate the generation of irrigation demand maps. The Basic data related to the soil, climate and weather are collected to form a spatial database. A Decision Support System is also used to aid decision making. It improves demand planning by considering different scenarios and visualizing impact under these scenarios. Different database like the soil database and the climate database are maintained by the system. The climate database uses the historical monthly minimum and maximum temperature and precipitation in a period of 51 years around the area. It also records the daily climate change. The soil database is maintained by testing the soil based on the given location considering different physical and chemical properties obtained at different depths. Finally the databases are integrated by using the ARC/INFO by applying overlay functions.

Research papers discussed here gives a broader view on various systems developed for precision farming. These systems provide information regarding the crop and to monitor the field by using the field map provided by farmer, talks about effect of Soil Nutrients using NIR technology. NIR is useful in situ as a rapid technique that can be combined with geographic information system and precision farming technique. The approach discussed also suggests a Crop recommendation system which analyses and suggests the best suitable crop to the

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farmer according to the type of soil which will help the farmers in sowing the right seed based on soil requirements to increase productivity and acquire profit out of such a technique.

With reference to the papers discussed here, a gap analysis related to crop yield enhancement suggests a focus on parameter: fertilizer and its usage. Fertilizers have been playing an important role in the field of agriculture as the quantity and the quality of the fertilizer affects the yield of the crop. Hence a system is proposed here which has a proper dataset of the fertilizers and their characteristics and which would be analysed according to the characteristics of the soil taken as input by the system and the output of such a system would be a proper recommendation of the fertilizer. This system will try to bridge the gap between the different characteristics of the soil and the usage of fertilizers.

III. System Architecture

The main components of the proposed system architecture are knowledge base and recommendation system. In this system farmers will be provided with all the information they require to make decision on what crop to grow depending on contents of soil like moisture, texture, PH, soil color, permeability, drainage and water holding.

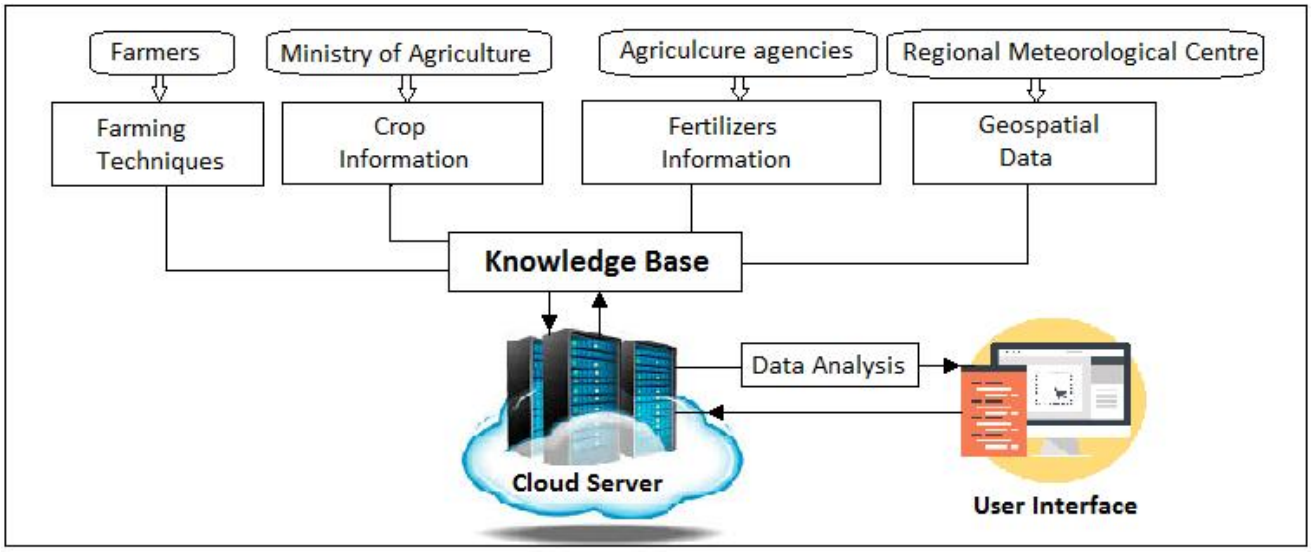

Fig 1.1: An Architectural Framework for Precision Farming

A. Knowledge Base

Knowledge Base contains sections on fertilizers, farming technique, crop information and geospatial data. Farming techniques include the best practices in farming to succeed maximum yield and new farming techniques that mobilize farming methods based upon the previous successful recommendation by the system. The proposed system can also recommend the best technique depending upon the soil contents and weather .The user can explicitly provide the feedback of different farming techniques which are successful and so that even those can be recommended. Hence, farming technique will basically give us the best suitable technique depending upon the input data of soil and also update their respective outcomes and experience .The information about different crops in knowledge base collected from ministry of agriculture based on the crop type, different crop variety, weather information such as temperature required, rainfall required, soil nutrients required. It also considers different disease information, pest and disease control method and fertilizers required. The crop information also includes the various sowing methods, stages of growth, reaping method and post harvesting method. These details of the crop should be sorted and include in the knowledge base in a detailed fashion .The data collected from different weather analysis is used to import the weather details, helping farmers choose the best suitable crops.

The second component in knowledge base is fertilizers information. This is an important step for understanding the fertilizers. Analysis is essential while choosing the suitable fertilizer to purchase and apply. They are identified by a chemical analysis process. The three numbers on the bags refers to the percentage of nitrogen, phosphorous and potassium components in the fertilizers. They are basically of two types: granular and water soluble. The granular is printed on soil whereas water soluble is mixed with water and the feeding is accomplished by sprinkling on the leave.

The different components and nutrients of fertilizers help in a healthy growth of roots, stems and leaves in plants. Nitrogen is used for producing greener and luster leaves. Phosphorus is used for fruit development and produces strong root system where as potassium is used for increasing the strength of plant and yield of plant.

Fertilizers play an important role in the growth of a crop as excessive use of fertilizers would degrade the quality of soil forever. Hence it is necessary to have a proper analysis of the fertilizer before mapping them to particular crop or soil.

The next component of the knowledge base is geospatial data which contains different weather report analysis. Weather plays a critical role in the growth of crop as different environmental factors has great impact on the crop .Weather has a maximum contribution in the success of a crop. Hence these weather details helps farmer choose the better suitable crops. Various environment factors and land use also come across this geospatial section. Hence the system will give the weather information depending upon location given by the farmer. It will be using Global Positioning System (GPS) to do so.

B. Recommendation System

In this unit the proposed system will analyze the knowledge base using different data mining techniques. Hence, it will basically map the soil information taken from farmer to the crop and fertilizers from the knowledge base.

By analyzing the soil information, the system will have different soil components and features of the soil by which, it will recommend different crops suitable to that particular soil. Also depending upon the type and contents of soil such as humidity, moisture, pH, texture etc... The proposed system will recommend different fertilizers and its quantity explicitly. Hence this unit basically works to map the soil information, the fertilizer information and the crop information, so as to give the right decision about which crop and fertilizer should be used for a particular soil given as an input by the farmer.

C. User Interface:

The proposed system will provide a web application which will take input of soil information from the farmer. The knowledge base is stored in the cloud. From this cloud the system will recommend the best suitable crop and precise amount of fertilizers suitable to the soil by using data analysis. The system will also provide a reminder scheduler system, which will be used to remind the farmer, on the schedules of fertilizer spraying and timings using SMS or mail system.

IV. Acknowledgement

We would like to thank Neeta Maitre (Assistant Professor, Cummins College of Engineering for Women, Pune) for providing us with her valuable guidance.

V. Conclusion

Precision farming technology in India has various facets from agricultural perspective. The proposed system uses Modern techniques for data acquisition, data storage and effective utilization for making crop related decisions. Fertilizer usage being the most important amongst them is addressed through the proposed system. Thus the system will be beneficial to many farmers in villages if implemented by Government on “One Man-One Computer” basis. The scheme can give valuable inputs to farmer to get an enhanced crop yield.

VI. References

[1] I. Mohanraj and J. Naren, "An architectural framework for e-agricultural system," *2016 3rd International Conference on Computing for Sustainable Global Development (INDIACom)*, New Delhi, 2016, pp. 1600-1604.

[2] Haiyan Song and A. Y. He, "A New Approach to Detect Soil Nutrient Content Based on NIR Spectroscopy Technique," *2005 IEEE Engineering in Medicine and Biology 27th Annual Conference*, Shanghai, 2005, pp. 3149-3152.

[3] S. Pudumalar, E. Ramanujam, R. H. Rajashree, C. Kavya, T. Kiruthika and J. Nisha, "Crop

recommendation system for precision agriculture," *2016 Eighth International Conference on Advanced Computing (ICoAC)*, Chennai, 2017, pp. 32-36.

[4] M. Kahvecı, "Contribution of GNSS in precision agriculture," *2017 8th International Conference on Recent Advances in Space Technologies (RAST)*, Istanbul, 2017, pp. 513-516.

[5] L. Tan and R. Wortman, "Cloud-based monitoring and analysis of yield efficiency in precision farming," *Proceedings of the 2014 IEEE 15th International Conference on Information Reuse and Integration (IEEE IRI 2014)*, Redwood City, CA, 2014, pp. 163-170.

[6] X. Liang and J. Wu, "The application of GIS in the field of irrigation water management," *Proceedings of 2012 2nd International Conference on Computer Science and Network Technology*, Changchun, 2012, pp. 1497-1500.

[7] F. Viani, M. Bertolli and A. Polo, "Low-Cost Wireless System for Agrochemical Dosage Reduction in Precision Farming," in *IEEE Sensors Journal*, vol. 17, no. 1, pp. 5-6, Jan.1, 1 2017.

[12]

[8] X. Yao, Wencai Du, Siling Feng and Jun Zou, "Image-based plant nutrient status analysis: An overview," *2010 IEEE International Conference on Intelligent Computing and Intelligent Systems*, Xiamen, 2010, pp. 460-464.

[9] L. Tan, H. Hou and Q. Zhang, "An Extensible Software Platform for Cloud-Based Decision Support and Automation in Precision Agriculture," *2016 IEEE 17th International Conference on Information Reuse and Integration (IRI)*, Pittsburgh, PA, 2016, pp. 218-225.

[10] U. Dorji, T. Pobkrut and T. Kerdcharoen, "Electronic nose based wireless sensor network for soil monitoring in precision farming system," *2017 9th International Conference on Knowledge and Smart Technology (KST)*, Chonburi, 2017, pp. 182-186.

[11] P. Lottes, M. Hoeferlin, S. Sander, M. Müter, P. Schulze and L. C. Stachniss, "An effective classification system for separating sugar beets and weeds for precision farming applications," *2016 IEEE International Conference on Robotics and Automation (ICRA)*, Stockholm, 2016, pp. 5157-5163.