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Survey on Decision Support System in Agriculture

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Abstract

Today a big demand of agricultural product with its best quality essentially needed to survive the product in the market. However, achieving best quality of product with unfavourable climatic conditions and variable soil parameters rises the problems for farmers. As evaluation in modern farming moving forward to agriculture 4.0, there is need of better, trustable and user-friendly decision support system.The objective of this paper is to analyze the real time problems which are faced by farmers community, those needs to be conceded for developing decision support system. Future researchers can improve the decision support systems by overcoming these detected challenges. Authors herewith review state-of-art research on decision support systems with various parameters such as soil parameters, metrological parameters, geographic location parameters. Authors further propose future directions for improving decision support system by using latest technology such as Artificial intelligence, Cloud computing, Internet of things, Machine learning, Deep learning and Big data.

Keywords-Agriculture 4.0, Artificial Intelligence, Decision Support System, Deep Learning, Machine Learning

I. INTRODUCTION

Agriculture is extremely immeasurable area of research for researchers. Agriculture is the science and skill of cultivating plants. Agriculture domain is playingimportant role in India's economy. It is the process of producing food and other products by the cultivation of certain plant. In agriculture, progressiveevaluation process has four different versions Agriculture 1.0 to Agriculture 4.0. Traditional agriculture system generally referred as Agriculture 1.0. It mainly depends on animal and manpower and gives low productivity.In 19th century agriculture 2.0camein the existence, it used agriculture machineries and chemicals for increasing the production. This is followed by, version 3.0 which was introduced in 19th - 20th century. This version was promoted by inventions of computer systems and also by designing some computer robotics applications to give high productivity. Presently agriculture is running in 4.0 version. This version is enhanced with Artificial intelligence, Cloud computing, Internet of things, Machine learning, Deep learning, Big data, etc. This will help to minimize user efforts and gives future guidelines. Following Fig.1 shows the basic agricultural framework.

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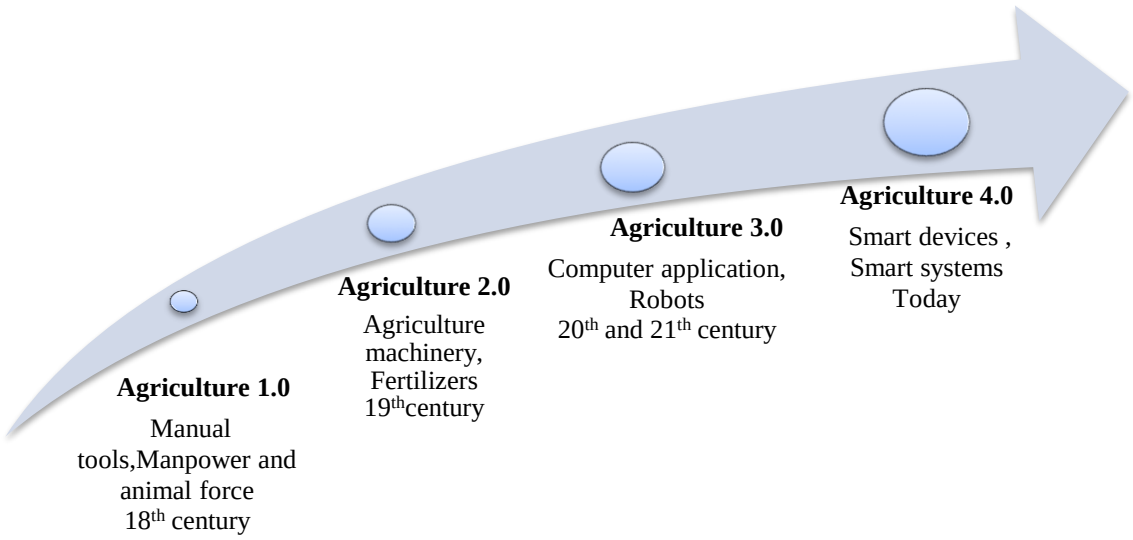

Fig.1 Basic Agricultural framework

A. General architecture of decision support system of agriculture

Fig.2 shows the general architecture of decision support system which contains following blocks. In data, various parametric data is stored. Data includes various soil and metrological parameters, geographical locations of field with its catching reading frequencies.Next in Module Block various models designs and developments like Crop Production Module,Disease detection module, Irrigation Module, Evaluation Module to get future predictions. Hence, user can have facility to reconfirm model results with expert opinion.

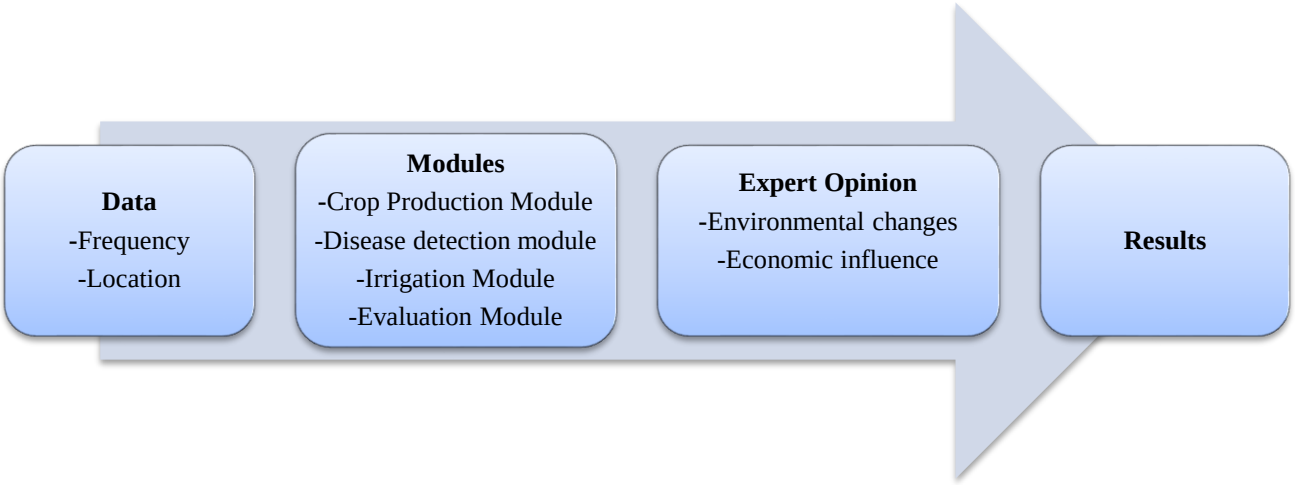

Fig.2 General architecture of decision support system of agriculture

II. LITERATURE SURVEY

In 2008, J. R. Prasad, R. S. Prasad, U. V. Kulkarni proposed decision support system for agriculture using natural languge processing. This system mainly focuses on seasonal crop production decision making for prdictions author uses rainfall pattern and soil structure parameter as input parameters [6]. In 2015, E. Giusti, S. Marsili-Libelli suggested the decision support system which will work as fully automated irrigation system for crops. They tested this system for Corn, Kiwi and Potato farming. The moisture content and evaporation rate with available temperature provides model as input to work and amount requirment for irrigation system. This facility can be available on web basis[4]. In 2016, H. Navarro-Hellin, J. Martinez-del-Rincon, R. Domingo-Miguel, F. Soto-Valles, R. Torres Sanchez

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design decision support system for irrigation management by inserting various sensors at the field which evaluate weekly requirements of the plants based on few soil and metrological parameters. It uses two different machine learning techniques namely Partial least square regression and adaptive neuro fuzzy inference system for stastistical analysis and prediction.This model will only work for leman crop as it having limited dataset. Rain precetipation parameter is not considered for statistics and prediction can be considered as limitations for this model[2]. In the same year, Niketa Gandhi, Leisa J. Armstrong, Owaiz Petkar suggested the Rice crop yield production decision system. In this they mainly focus on climatic conditions suitable for rice crop. They also focus on range of precetipation, evaporation rate, minimum and maximum temparature data. This information will help them to predict the plant yield as low, moderate and high[5]. In 2018,Sushant. J. Pawar, Rashmi. R. Pagare proposed decision support system for green house management using Internet and different machine learning techniques. The user can remotely handle the green house management using metrological parameters like temperature, humidity and sun light data[10]. In 2019, Avinash Kumar, Sobhangi Sarkar and Chittaranjan Pradhan proposed recommendation system for farmer which will give best suitable crop based on soil parameters as well as it will find out the pest and diseases of the crop. Accordingly,the system will give information to the farmer in the early stage and suggest the different pest control techniques. Author designed and developed this system using three different machine learning techniques SVM classification, Decision Tree and Logistic Regression algorithm. In this SVM classification gives better result than other techniques[7]. In the same year, Taufiq Rizaldi, Hermawan Arief Putranto, Hendra Yufit Riskiawan,Dwi Putro Sarwo Setyohadi, Jeffri Riaviandy proposed Decision Support System for Land Selection to Increase Crops Productivity. This model suggests the user three different crops to be considered for selected land. This paper also takes example for rice soyabin and corn by using parameters like rainfall, ph, altitude and temperature[9]. In 2020, A. Kociana, D. Massac, S. Cannazzaroc, L. Incroccib, S. Di Lonardod, P. Milazzoa, S. Chessaa presents decision support system for crop growth. It will give one day ahead prediction using linear dynamic model with dynamic bayesian network. For prediction it uses various input parameters like temparature, solar radious, vapor pressure, evaporation, leaf area, dry weight. This system is mainly used for testing the performance of three cultivation cycles which will take timely action on crop. Limitation of model includes this model used for some particular crops[1].In the same year,Piero Mannaa, Antonello Bonfantea, Marco Colandreab, Claudio Di Vaioc, Giuliano Langellac, Luigi Marottab, Florindo Antonio Miletic, Luciana Minieric, Fabio Teribilec,d, Simona Vingianic, Angelo Basile proposed system for Olive crop cultivation for Itly geoghaphical area. This is used to develop a design support system to minimize the current problems facing for Olive farming. In this support system they mainly used all data from web sytems available for respective area and also usesoil information and geographical locations for available static and dynamic data[3].In the same year, Hongqing Li, Yaoyang Zhao, feizheng proposed agricultural land-use decision support system based on ecological environmental constraints. It uses multi objective leaner programming for optimization of land man work and it will help the manager to utilize working staff effectively[8].

III. CHALLENGES IN CURRENT DECISION SUPPORT SYSTEM

By reviewing various papers of decision support system in agriculture, we found some challenges in current decision support system. Fig.3 shows the different research gaps in current available decision support system.

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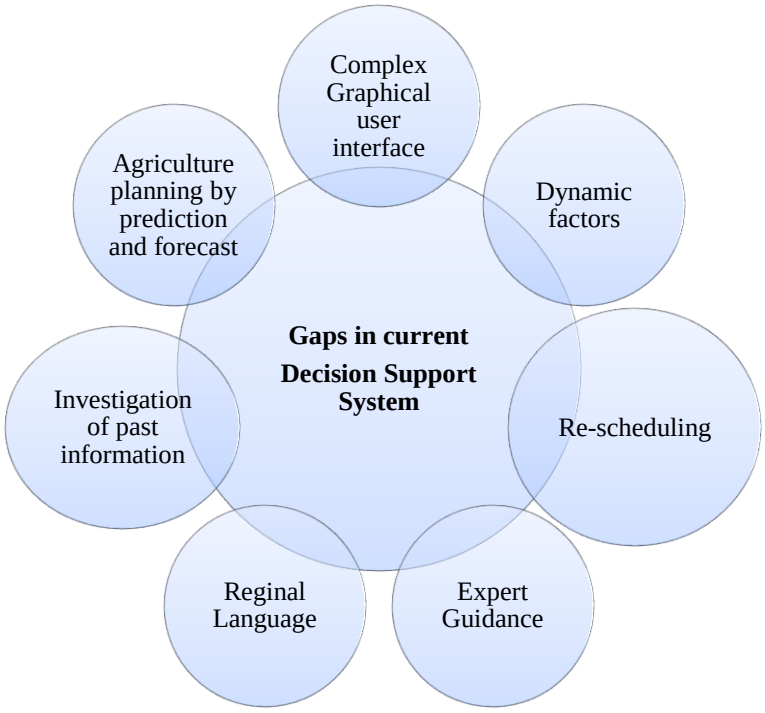

Fig.3 Research gaps in current decision support system

A. Complex Graphical user interface

As most of the farmers are not familiar with computer applications so they hesitated to make use of such decision support systems. It is need to have better graphical system and easy to understand what are the predictions provided by system. Following are the Do's and Don'ts need to consider while performing user interface window.

Don'ts-

1. More TEXT as output.
2. More Input fills from user side
3. More writing from user

Do's-

1. Add more graphical representation like pie charts, graphs, pictures, etc.
2. Limited input from user side
3. Drag-drop, copy-pest, add-remove, etc. Such options are appreciated

B. Agriculture planning by prediction

System model should run with all three types of planning which includes Short term, midterm and long term planning decision support system.In short term user will get guidelines on daily and weekly basis, which includes planning of watering for crops, inspection of specific disease on crop, machinery travel path for easy loading and unloading of goods, etc.In Midterm user will get guidelines on seasonal conditions, which includes planning of selection of crop for particular season, which are the best day's for sowing to harvesting, fertilizer application, checking of growth of crops, etc. In midterm user also get guideline support from metrological department to know any pre-sign warnings. In long term user will get guidelines on yearly basis, which includes planning of machinery servicing or change of any wear and tear of machinery part which will impact major cost in between the year, also it provide guideline which machinery will not required anymore after completion of specific task.By prediction and forecast farmer can get prepared in advanced by considering following problems.

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- Crop growth by giving early estimation to the farmer. They can improve the production by maintaining the different factors such as different soil parameters, metrological parameters, fertilization and irrigationrequired for crop growth.
- Climatic safety can be achieved by forecasting climatic changes and by adjusting crop planning to avoid climatic risk to the farmer
- By detecting early symptoms using prediction and forecast, decision support system can warn the farmer for future diseases.

C. Dynamic factors

Seasonal changes due to changes in metrological parameters like uncertainty in time and amount of precipitation, extension of specific season, etc. Which majorly affect the crop production and mainly if affect the quality of product going to produce.

Second dynamic factor will be Moisture and nutrients present in soil. More or less moisture presence in soil will directly affect the irrigation support provided for the crop. Furthermore, the amount of nutrients present will affects the schedule of application time and amount of specific fertilizer.

Third and main important factor will be the market condition for specific crop. It usually works as demand, supply and distance from the market. This will directly affect the investment involved for particular crop from its sowing to harvesting. If farmer produces the best quality product and more cost involved to produce it and if the markets demand low then the farmer won't get desire price of his crop.

D. Re-scheduling

This is very rare case but very important as backup when current planning fails due to dynamic factors consider in above paragraph. Model should reschedule itself and provide output to user according to changes happened. The re-scheduling should start from where the failure happened, this will help the farmer to not starts from beginning and get use of what is present condition. He will know what he has until now and what will be the minimum cost in future for rescheduling.

E. Expert Guidance

Model should provide expert opinion on provided output as interfacefor critical situation arises in the agriculture field. Sometimes the model will provide decisions that need to be cross verified with experts with its actual feasibility on real time scenario

F. Regional language

As decision support systems are developing mainly for farmers, it needs to be available in their own languagebecause the average farmers are not educated that much to understand the inputs and prediction provided from decision support systems. It will be the best if they have audio input and output facility. Expert guidance videos also need to be available in regional language for better planning and decision making.

G. Investigation of past information

Past information contains useful information like successful experiences as well as failure cases so model should analyse the past history using different dataset to give correct prediction. It is very challenging task to compare current dataset with past dataset to generate feasible solution with very short computation time using different techniques like machine learning, Deep learning and Artificial neural network.

IV. CONCLUSION

This paper presents survey of available decision support systems and parameters that need to be considered to enhance current systems. Decision support system helps the farmer form crop

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germination process to crop harvesting process. Therefore, there is a need of enhancement in current decision support system. This paper identifies some challenges which are faced by farmers while cultivating crops. To enhance the current decision support system, researchers may consider graphical user interface, agriculture planning by prediction, dynamic factors, re-scheduling,expert guidance, regional language and investigation of past information. This will definitely assist to resolve the real time problems for farmer as a user.

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