DECISION SUPPORT SYSTEMS FOR AGRICULTURAL CROP PLANNING TO ENHANCE FARMERS INCOME

S. S. Managave[*]
R. D. Kumbhar[**]

ABSTRACT

India is a land of farmers. Farming is main part of Indian economy. Cultivator needs up-to-date information to take Operational, strategic and tactic decisions. These decisions directly influence on the yield and price of the agriculture product grown by the farmer. Traditionally Indian farmers take decisions based on expert judgment or their own experience. Very few farmers' approaches agriculture offices, APMC offices and Agriculture Universities seeking latest methods and practices of farming with respect to fertiliser management, pesticide scouting management, scheduling of water, preparation of soil, selection of seed and management of weed.Due to lack of easy availability, farmers are isolated from the guidance of agriculture experts and scientists.The DSS can be implemented through Android app, web and SMS to provide the up-to-date agricultural information.Agricultural DSS can help farmers to take right decision at right time for enhancing the crop yield, get best prices to their products. This paper initially reviews various DSS in agricultural field. Considering numerous DSS developed in agriculture, we sought systems for enhancing the yield of the crop. The income of the farmer is not only depending on the yield of the crop, but it is also influenced by the price offered in the market for the grown crop. The price of agriculture product is purely depending upon the demand and supply. Most farmers incurred the losses or got substantial lower income due to unfair price for their product. Due to which many farmers have committed to suicide. The number is increasing every year. Government has framed many policies such as subsidy, agriculture insurance, offering FRP to each crop etc, in order to control suicides. This paper present need of DSS that provide the farmers with up-to-date information of present requirement of each crop in terms of cultivation area and actual cultivated area of each crop till the date. This DSS can help farmers to select appropriate crop to be is cultivated based on demand and potential supply.Finally paper concluded with a conceptual model of DSS to provide up-to-date information of present demand and potential supply of agricultural crop in order to choose the best crop to be grown.

Keywords:Agriculture, DSS, Demand, Supply

I. INTRODUCTION

India is a land of farmers. Prior to independence, the Indian farmers were practicing subsistence agriculture. It is a self-sufficiency system of farming where the farmers aim was growing sufficient food to feed themselves and their entire families. The result of this type of farming was mostly for local requirements with less or no surplus trade [1]. Later barter system came in to existence where agriculture products were sold to neighbours, relatives and villagers in exchange of other product. In this system requirements were less or no surplus trade. After the globalisation the agricultural products market was extended not only at country level but at global level. Farmers started exporting their produce to other countries. Like western countries, Indian government does not impose any restriction on cultivation area of each crop. Indian farmers have liberty to select economically and socially feasible crop.

* Principal, SJPN Trust's BCA College Nidasoshi, Karnatakaand Research Student Rayat Institute of Research and Development
** HOD IT Dept., K B Patil Institute of Management & Business Research, Satara, Maharashtra

It is quite difficult to think development of our country without improvement of agricultural practices. Substantial amount of data is available with respect to agricultural development techniques. Plenty of research has been done in the agricultural field. The data should be made available in organised way in order to take proper decisions of farming. Various information systems, expert systems and Decision support system have been developed to address problems faced by the farmers.

Decision Support System is computerized system, which includes models and databases used in decision making. They are tools that help everyone who makes decision and choosing the best alternative solution from economic, social or environmental point of view [2]. An interactive computer based expert system that helps decision maker to solve the problem [3].
An Expert System is intelligent computer program designed to simulate the problem solving behaviour of a human being [4]
Farmers are supposed to take decision while doing the management of following activities.
1. Fertilisers management
2. Water management
3. Crop protection
4. Weed management
5. Sales of produced crop
6. Selection of crop

II. *REVIEW OF LITERATURE*

In order to assist the farmers; various information systems, expert systems and decision support systems have been designed, developed and implemented. Following table summarises the name, purpose of the agricultural systems.

DSS and ES for Fertilisers Management		
Sr. No.	Name	Purpose
1.	DSSAT	DSS for agricultural technology transfer-Decides type of seed to grow, crop yield prediction, how much to irrigate, frequency of fertilizer application. [6]
2.	CROP-9-DSS	Identification of pests and disease control ,fertilizer management, water management of 9 crops of Kerala [4]
3.	CROPLOT	An Expert System that determined suitability of a plot for a given crop[7]
4.	CALEX	A DSS for cotton irrigation management.[8]
5.	ESIM	Expert system for irrigation management. [9] .
6.	CropSyst	A model for water –Nitrogen interaction in wheet crop. Agricultural water management system regime [10]
7.	CROPGRO	DSS for increasing soybean yield in water limiting environment based on climatic data [11]
8.	AQUAMAN	Web based DSS for irrigation scheduling of peanut [22]
9.	TUNGGUL	Development model DSS for rain water management in semi aridarea[23]
10.	DAIRY MGT	A DSS for management of the Dairy business[24]

Contd...

11.	APSIM	APSIM is the System developed to simulate biophysical process in farming systems for economic and ecological outcomes of management practice in the face of climatic risk [25]
12.	Android Based ADSS	Android based DSS to select the crop variety according to whether conduction and availability of water[21]
13.	Intelligent fertilization DSS Based On Knowledge Model and Web GIS Decision For Fertilization	The study constructed the basic frame of decision support system for fertilization.[19]
14.	CROPWAT	system for irrigation management.[7].
15.	IPM	This DSS is mainly used by the farmers of West Bengal to get climate date to decide the crop .this system has provided comprehensive awareness of the paste management.[17] .
16.	CROPMAN	A DSS used by farmers in Punjab to get site specific climate data. This system has helped farmers to enhance the yield by changing the transport schedule from May to June [12]
17.	MKRISHITM	A DSS applied by the farmers in Maharashtra t acquire the climate data for particular crop. The system helped the farmers to schedule the scouting of paste and nutrients. [13]
18.	MKRISHITM	A DSS applied by the farmers in Maharashtra t acquire the climate data for particular crop. The system helped the farmers to schedule the scouting of paste and nutrients. [13]
19.	Rayat Mitra	The web portal created by Department of Agriculture to provide Agricultural Extension services to farmers and to transfer the latest technical knowledge to the farming community, introduction of high yielding varieties, laying demonstrations, imparting training to farmers to improve skills & knowledge to boost up the agricultural Production and productive[14]
20.	Farmer web portal	This web portal to make available relevant information and services to the farming community and private sector through the use of information and communication technologies, to supplement the existing delivery channels provided for by the department. Farmers' Portal is an Endeavour in this direction to create one stop shop for meeting all informational needs relating to Agriculture, Animal Husbandry and Fisheries sectors production, sale/storage of an Indian farmer.[15]
21.	Bhoomi	This portal is the project of on-line delivery and management of land records in Karnataka. It provides transparency in land records management with better citizen services and takes discretion away from civil servants at operating levels.[16]
22.	eSagu	A agricultural DSS that helped the farmers of Tamil Nadu to farm specific decisions in order to enhance the yield of by assessing the crop specific climate data from the system [26]

III. CONCEPTUAL MODEL OF DECISION SUPPORT SYSTEM FOR CROP PLANNING
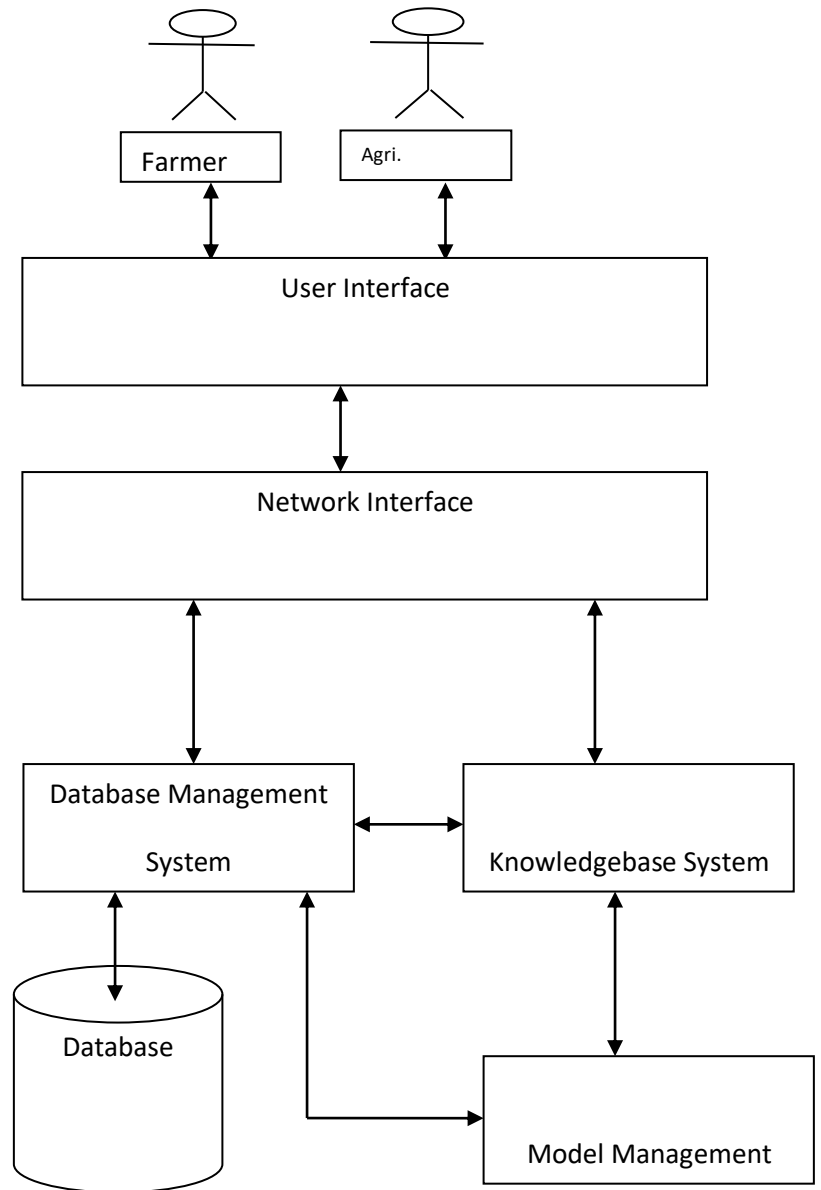
The conceptual model shown above consist of three types of users viz. Farmers, Agricultural Officers, and Agricultural Experts Such as University Professors, scientists and five functional components viz. User interfaces, Network Interface, database Management system, Knowledge base system and model management system.

1. Users

i. Farmers

Although, there are many types of stakeholders of the system, the focus of developing the system is to enhance the income of the farmers. Traditionally, the Indian farmers have been practicing farming based on their own experience, expert judgment or opinion of their peers. This practice is good for better yield and cost cutting of the crop production. Of course the income of the farmer is directly proportionate to the yield and cost of the crop production. The price of the product is also playing an important role in the farmers overall income. Thus practice of farming based expert judgment and peer recommendations does not assure the reasonable pricing of the agricultural product. This is because; the price of any product is completely depending upon the demand and supply data of that product. This data is not available to farmers. The result of this is, farming becomes uncertain and income of farmer is probabilistic.

The government agriculture department and revenue department officials are tasked to collect information related to total area of cultivation of each crop, fertilizers utilization, pesticide scouting, production of each crop etc. This collected information is forwarded to higher level officers in the hierarchy till it reaches to the ministry of the government. This information is used by the government for forming the policies. But there is no back bearing of this information, which is more crucial for farmers to take their strategic decision of crop selection.

The western countries like America, Brazil etc., have policies to restrict the area of cultivation of each crop based on the requirements. This policy assures reasonable pricing of each crop. But in India no such restriction is imposed on farmers to control the excess production of certain crop. Government has given liberty to select any crop and grow it. As a result of this liberty there is huge surplus production of some crops and scarcity of remaining crops. Ultimately the prices of scarce crops go high and surplus crop goes drastically down. Most of the time farmers do not recover the cost of production due to lower prices. On the other hand the common people who are the consumers of the agricultural products cannot afford the price of such scarce crops. The price of pigeon peas (Toor Daal) and onions and alike are the recent examples. In either case of surplus or scarcity of production the consequences of the pricing is affecting economics the common people of the country.

Until the government takes some action to impose restriction on uniform cultivation as per ratio of requirement, some system should be developed to provide farmers with the latest information of current requirement of each crop and actual cultivation of each crop in the current season. So that farmers can take decision of selecting the crop with less cultivated crop.

ii. Agriculture Officers

In the agricultural department at district level there is a Joint Director. An Assistant Director at each Taluk provides current status of crop cultivation information every week to joint director.

An Agriculture Officer at each hobli center collects information from village accountant and gives it to Assistant Director. Village accountant provides the current crop cultivation through pahani (Survey) from farmers and provides it to the Tahasildar and agricultural officers. Agriculture officers can enter this information directly in to the system through Web Portal or Android App.

iii.   User Interfaces

The system should provide three types as mentioned below:

      i.   **Web Portal:** farmers and agriculture officers who are connected through internet and computer literate can use this interface to access the information and enter the crop cultivation information

      ii.   **Android Application**: Farmers and agriculture officers who are connected through internet and using smart phones can use this interface to access the information and enter the crop cultivation information

      iii.   **SMS**: most of the farmers are still illiterate so they cannot use neither computer nor smart phones to access the information for crop selection. Every farmer has simple mobile phones, which can receive SMS on these phones. The present status of crop cultivation of proposed crop can be accessed through SMS irrespective internet connection on simple (2G) mobile phones.

iv.   Database Management System

Database management system manages the data required for DSS. The system needs to maintain the records of the farmer's details, land details, crop details, cultivation of crops, yield and price of agriculture products, harvesting etc. The data entered by the users through interfaces is stored in the respective tables. This data is extracted to deduce the information regarding requirement of each crop and actual cultivation of each crop. From this information farmers can assess the crop with excess cultivation and crop with lower cultivation compared to requirement.

v.   Knowledgebase Management System

This module is heart of the DSS which actually deduce the information from the database and the model management system. This module accepts the user input parameters and search the information from database and model management system required for the selection of crop.

vi.   Model Management System

Each crop has certain requirements like type of soil, fertilizers requirement, water schedule, pesticide schedule, weed management, season, etc. This system maintains the standard requirements of each crop based on expert suggestions and best practices of farmers. This pattern is used for selection of crop.

IV. CONCLUSIONS

Farmers have been provided with various decision support systems for water management, weed management, fertiliser management, pesticide management and climate information. These systems will be used for enhancing the yield of the crop. But none of the system has been provided to ensure reasonable price for his crop. This paper has provided with conceptual framework of DSS that helps the farmer to select the crop based on the information of demand and potential supply of crop.

REFERENCES

https://en.wikipedia.org/wiki/Subsistence_agriculture

B. Manos, A. Ciani ,Th.Bournaries, I Vassiliadou, J Papathanasiou, "*Taxonomy Survey Of Decision System In Agriculture*", Agriculture Economics Review, vol 2,PP.80-93, Aug 2004.

Vidya Kumbhar, T.P.Singh "*A Comprehensive Study of Application of Decision Support System in Agriculture in Indian Context*" International Journal of Computer Applications, Volume 63– No. pp.6-11, 14, February 2013.

Ganesan V.: "*Decision Support System Crop-9-DSS for Identified Crops*", World Academy of Science, Engineering and Technology International Journal of Biological, Bimolecular, Agricultural, Food and Biotechnological Engineering Vol:1, No:12, 2007. Pp.186-188

J.W. Jones, G.Hoogenboom, C.H Porter, K.J.Boote, W.D.Batchelor, L.A.Hunt, P.W Wilkens, U Singh, A.J.Gijsman,J.T Ritchie, *"The DSSAT cropping System model"*, European Journal of Agronomy, Volume 18, Issues 3–4, January 2003.

K.R.Thorp, K.C. DeJonge, A.L. Kaleita, W. D. Batchelor, J. O. Paz. *"Methodology for the use of DSSAT models for precision agriculture decision Support"*. Computers and Electronics in Agriculture, Volume 64, Issue 2, December 2008.

Nevo and I. Amir. 1991. CROPLOT : "*An expert system for determining the suitability of crops to plots*". Agric. Syst., 37: 225-241.

R.E. Plant, R.D. Horrocks, D.W. Grimes and L.J. Zelinski. 1992. CALEX / Cotton: "*An integrated expert system application for irrigation scheduling. American Society of Agricultural Engineers.* " 35(6): 1833 –1838.

R. Srinivasan, B.A. Engel and G. N. Pandyal 1991. *"Expert system for irrigation management (ESIM)."* , Agric. Syst., 36: 297-314

A. K. Singh, R. Tripathy, U. K. Chopra, "*Evaluation of CERES-Wheat and CropSyst models for water– nitrogen interactions in wheat crop*", Agricultural Water Management, Volume 95, Issue 7, July 2008.

V.S. Bhatia, P. Singh, S.P. Wani, G.S. Chauhan, A.V.R. Kesava Rao, A.K. Mishra, K. Srinivas, "*Analysis of potential yields and yield gaps of rain-fed soybean in India using CROPGRO-Soybean model*", Agricultural and Forest Meteorology, Volume 148, Issues 8–9, 4 July 2008

S. K Jalota, A Sood,W. L. Harman, "*Assesing the response of chickpea(Ciceraeritium L.) yield to irrigation water on two soils in Punjab(india) a simulation analysis using the CROPMAN Model*", Agricultural Water Management, Volume 79, Issues 3, 10 Feb 2006.

A Pande et al. "*m-KRISHI Market facing innovation*", TATA Consultancy services TCS innovation Labs Mumbai.

(2017) Rait Mitra Web Portal [Online] available: http://raitamitra.kar.nic.in/

(2017) Farmers Web Portal[Online] available: http://farmer.gov.in/

(2017)Bhoomi Project[Online] available: " http://www.bhoomi.karnataka.gov.in/"

L. Patel,Mondal C, Maitra N, "*Cell Phone –A Decision support for sustainable Plant Protection of the district south 24 Parganas,West Bengal*", Global Journal of Bio-Science & Bio-Technology,2012 Volume 1, p(59-64)

L. Patel,Mondal C, Maitra N, "*Cell Phone –A Decision support for sustainable Plant Protection of the district south 24 Parganas,West Bengal*", Global Journal of Bio-Science & Bio-Technology,2012 Volume 1, p(59-64)

Yang Yushu,WangFilin,ZhaoJie, "*Intelligent fertilization DSS Based On Knowledge Model and Web GIS Decision For Fertilization*" IEEE,2009, ISBN 978-1-4244-4520-2, p(232-253)

G.B.S. Chahal,ASood,S.K. Jalota,B U Choudhari, P K Sharma, "*Yield- Evapotranspiration and water productivity of rice, Wheat system in Punjab as influenced by transplanting date of rice and wheat parameters*", Agriculture water management, Volume 88,Issue 1-3,16 March 2007.

Ms Rachana Koli, Mr. SuhasRaut, "*Android Application Agriculture Decision Support System*", International Journal of Engineering Research and Applications, Volume 4,Issue 43, April 2014 p(63-66).

Yashvir S. Chauhan, Graeme C. Wright, Dean Holzworth, Rao C. N. Rachaputi, José O. Payero, "*AQUAMAN: a web-based decision support system for irrigation scheduling in peanuts*", irrigation science, Volume 31,Issue 3, May 2013

Petr Hanzlík, FrantišekKožíšek, Josef Pavlíček ," *Design of intelligent decision support systems in agriculture*", International Journal Of Mathematics And Computers In Simulation, volume 9, 2015

Jay M. Janowski and Victor E. Cabrera," *Decision Support System Program for Dairy Production and Expansion*"

B A Keating, B S Carberry and others, "*An overview of APSIM, a model designed for farming systems simulation*", European journal of agronomy, Volume 18, Issue 3-4, January 2003

(2017) E-Sagu,Web Portal[Online] available: http://farmer.gov.in/

***