A REVIEW OF SOFT COMPUTING BASED DSS IN FERTILIZER MANAGEMENT IN INDIA

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Abstract

Soft computing is a problem solving methodology applied in the domain of impreciseness to address complex analytical problems and to model solution framework based on human intelligence. Soft computing paradigm is imminent as a decision support model in the domain of uncertainty, vagueness and human behavior. The methodology of soft computing is studied and applied in many areas of research and development in last few years. In agricultural sector researchers and analysts have developed new methods using soft computing constituents like evolutionary computing, fuzzy logic, artificial neural network and genetic algorithm to study soil conditions, to analyze fertilizer applications and to monitor crop growth in view of improving crop productivity. Fertilizer management is a multifaceted and complex process that greatly affects crop productivity. This paper presents the study of soft computing techniques in agricultural domain. A review of Soft computing methodology to improve crop productivity, to perform complex analysis and to support decision making with respect to fertilizer management is presented.

Keywords: Soft Computing, DSS, agriculture, fertilizer management.

Introduction

India is an agricultural country where farming is main source of earning. The agricultural industry is one of the major contributors in the Indian economy. In rural areas, farmers face many challenges and have to take decisions related to cropping. Application of fertilizers is of utmost importance as various soil factors are to be considered to manage cost effectiveness as well as health and environmental feasibility (Pal et. al., 2009). Fertilizer application majorly affects crop productivity. Agricultural production can be improved by providing information to farmers that is useful in decision making. The recommendations about quality and quantity of fertilizers can facilitate farmers to have appropriate fertilizer application and crop estimations. Thorough study of soil and atmosphere, crop type and expectations , availability and cost effectiveness is involved in decision making (Ganesan, 2007). Soft computing paradigm is complementary with decision support models in the domain of uncertainty, vagueness and human behavior.

An expert system based on soft computing paradigm may be devised to provide easy, simple and accurate decision support facilities. The system may provide analytical and decision support

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activities based on farmers' knowledge and experience for many different cropping situations (Sutar 2012).

Review of literature

Crop nutrition, soil conditions are major issues related to crop productivity. Latest technology and research in agricultural domain can help in obtaining security and growth in economic sector. Moreover cropping systems in India are mainly dependent on soil, water supply through rainfall and weather conditions (Rajvanshi 2013). The application of fertilizers needs to reflect the soil fertility needs of the soil based on regular soil testing.   In addition, many factors including nutrient level, NPK balance, soil type, crop type, weather and water supply affects soil fertility (Bhushan et. al. 2014).   Information and communication technology enhances the process of agricultural and rural development. eAgriculture is an upcoming   field in research and development that is reaching out rural and interior part of India. The government of India has undertaken a number of initiatives to improve agricultural development (Singh 2012). The main objectives of the agricultural DSS are to improve crop prediction, to minimize risks, to increase economic and social benefits and to enhance planning and forecasting features (Vishwajith et. al. 2014).

Soft computing paradigm provides approximate problem solving models to address real life problems (Zadeh 1994). It is a combination of several fields like neural networks, fuzzy logic and evolutionary computing. The methodology of soft computing is studied and applied in many areas of research and development in last few years (Zadeh 1994).

In agricultural sector researchers and analysts have developed new methods using soft computing constituents like evolutionary computing, fuzzy logic, artificial neural network and genetic algorithm to study soil conditions, to analyze fertilizer applications and to monitor crop growth in view of improving crop productivity.

Research Methodology

The objective of proposed research is to study DSS based fertilizer recommendation to facilitate the farmer to apply appropriate fertilizers that will improve crop production and quality through the use of advanced IT techniques. It will also analyze contribution of soft computing paradigm involving agricultural research, especially focusing on fertilizer application in improving crop management in India.

The following table describes the current DSS with type of DSS, main goal, advanced IT features from soft computing domain, country and region where DSS is developed.

Table 1 Findings of Decision Support System Evaluation in India and abroad

Type of DSS	Main goal	IT Features	Country	Region
Web based DSS with mobile services	To select and cultivate variety of crops	Web Technology, Mobile computing	Greece	Yongxin
Wireless Sensor Network	To get faster and accurate results from field analysis	WSN	India	Kolkata
GIS based DSS	To perform land assessment and decide crop suitability	GIS, GPS	India	Madhya Pradesh
DBMS based DSS	To utilize water resources and to achieve maximum productivity	DBMS, Software Programming	India	Bihar
Software based DSS	To facilitate fertilizer recommendation, water management and crop protection		India	Kerala
Multilayered software framework		Dynamic database system, linear programming concepts	China	Yongxin
Online DSS		Dot Net, SQL Server, MVC, Fuzzy Logic	India	Maharashtra
Fuzzy based DSS		Fuzzy inference system,	India	Maharashtra
Integrated DSS with manure management		Software programming	Canada	
Special DSS		Space technology, GIS, It techniques	India	

Proposed research framework for soft computing based DSS in Indian Agriculture

Module 1 : Research Statement

The primary focus is in the study of current fertilizer management DSS available for crop management and analysis of Soft computing usage in developing fertilizer recommendation DSS for India cropping systems mentioned.

Module 2 : Research Methods

Research methods explore academic qualities such as literature review, illustrates technical expertise with the use of soft computing paradigm and KDD, as well as contributes to knowledge in terms of designing an artifact.

Module 3 : Research Activities

Build : to perform specific task

Evaluate : to determine the progress in research work

Theorize : to explicate the characteristics of the artifact

Justify : to gather evidence to test the theory (March & Smith 1995).

Module 4 : Research Outcome

The outcome, an artifact will help in enhancing the development of DSS model for fertilizer application using soft computing constituents.
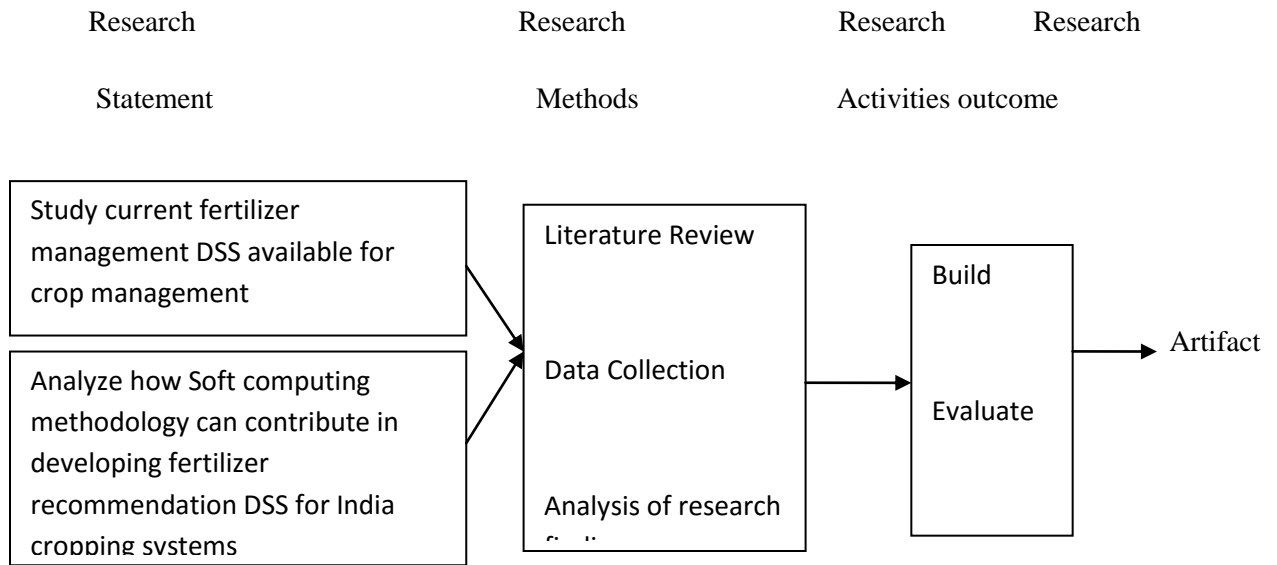
| Research | Research | Research | Research |
| Statement | Methods | Activities outcome | |

Study current fertilizer management DSS available for crop management	Literature Review	Build	
	Data Collection		Artifact
Analyze how Soft computing methodology can contribute in developing fertilizer recommendation DSS for India cropping systems		Evaluate	
	Analysis of research findings		

Figure 2 : Research Framework modified from (March & Smith 1995)

Conclusions and Future Enhancement

In agricultural development fertilizer management is very important aspect. In India especially where agriculture plays major role in development and economy it becomes important to address all issues with new and latest perspective. The major area under cultivation in India falls in rural regions where decision making is done by farmers. For rural development agricultural growth is

essential which can be achieved by introducing decision support system. In an agricultural DSS, fertilizer application is important as it affects crop productivity. The appropriate fertilizer at right time, in right proportion can improve productivity and can be cost effective and profitable as well. Also insufficient amount of fertilizers and high prices are major issues to be considered.

In today's high and varying demands of food , it has become essential to reform the land use. Due to inadequate information about need, selection and cultivation of multiple suitable crops is becoming difficult for agricultural stake holders. An advanced DSS with information, support and communication services via latest and commonly used Information and communication technology as well as with highly powerful soft computing technology can be developed to find reasonable alternatives in production (Antonopoulou, E et. Al 2010).

An approach of expert system modeling can be adopted to develop site specific integrated DSS with new and innovative feature of bio-fertilizer recommendation. The system can processes data of animal waste and consider eco-friendliness and health issues. It can assist to select suitable alternatives in manure management systems and sub-system implementation in future (Karmakar, S. et. al. 2010).

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