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Literature Review on Expert System in Agriculture

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Abstract : Agriculture is backbone of Indian economy and it is primary sector of country. Growers (Farmers) require advance or experts knowledge to take decision during soil preparation, seed selection, fertilizer management, pesticide management, water scheduling, weed management etc, so that to get high yield.
Expert system is now being using into agriculture sector. Expert system is most powerful approach that simulates human knowledge from an expert in certain domain for assist human to make decision at a level of or greater than human expert. Expert system helps to Growers in making economically viable and environmentally strong decision related to crop management. After considering success of expert system various expert systems were developed in agriculture. This paper explains need of expert system in agriculture and review of various expert systems in agriculture.
Keywords : Agriculture, Expert System , Production rules

1) INTRODUCTION:

Expert system is a computer program that contains expert knowledge about a particular problem domain, often in the form of if – then rules that is able to solve the problems at a level equivalent to or greater than human expert. Knowledge Engineer collects knowledge from domain expert and transfers it into production rules and creates Knowledge Base. Inference engine then apply different knowledge acquisition techniques and catch the knowledge and deliver it in the form of advice to solve problem. Because of it's explanation facility, it can be used as training tool to agricultural persons.
High yield is aim of Grower. To achieve this, it should acquire expert knowledge, so that depending on that knowledge, Grower can take decision related to different factors like soil preparation, seed selection etc.
Expert system can be used to make decision at different levels in agriculture. Operational Level and Planning Level. On Operation Level, the extension workers in the villages, districts and /or Governorate can use the system to support him in making his decision in giving appropriate advice to Growers. On the Planning level, the decision makers can use expert system who predicates need of water, fertilizers and pesticides. (Rafea, 1996).
Since it combines a lot of knowledge of so many expert at one point. "By helping people to consider all of the relevant information and by assimilating this information into an understandable format, Expert System assists people in making of environmentally sound and economically viable for farm management decision" (Robinson, 1996).

2) NEED OF EXPERT SYSTEM IN AGRICULTURE:

2.1) Need of information support:

In this information age, the available information from various sources is growing at phenomenal rate, and this information is primary requirement and considered as the heart of Precision Agriculture. Numerous researches are being carried out, new results are discovered at the research institutions and they continue to accumulate in the form of Reports and Dissertation. Most of these findings, recommendations do not reach to the farmers at implementation level. That is because there is lack of proper channel between researcher and farmers. The lack of proper decision support system to disseminate timely, relevant farming advice, has been observed as a major road block for adopting precision agriculture (McBratney etal. 2005). But there is some good working framework for disseminating agriculture information using advances in information and communication technology are being tested and developed in many South Asian countries. So need of hour is virtual expert who can give personalized expert advice to a large community of farmers, specific to their need and aspiration considering various knowledge bases, since it is almost impossible for any human expert to consider every piece of available information before arriving at optimal decisions. To solve this problem some decision support systems are making exists to farmers. But these DSS have some inherent drawbacks and they do not provide recommendation like human expert.

2.2) Expert system for decision making:

The conventional decision support have predefined set of input data, after that they begin analysis. They precede the data, step by step as directed by algorithm, to reach conclusion. Here the algorithm plays important role since knowledge is represented in the form of Algorithm. If knowledge of problem got changed then Algorithms need to be changed or rebuilt. Also solving new problem in same domain needs to develop new system. Against this, human expert tend to follow cognitive approach rather than algorithm. They rely on extensive knowledge base (in their mind) which may contain facts, assertions, past mistakes, trial – by – error method. The machine equivalent human experts are expert systems. The expert system works with cognitive approach and stress the knowledge in knowledge base which is separate component. So that changes in knowledge do not change whole structure of expert system. Another advantage is reasoning capability. They can explain reasons for arriving at particular decision.

3) REVIEW OF DIFFERENT EXPERT SYSTEM IN AGRICULTURE SECTOR:

At the end of 1970's ,the expert system starts to be applied in agricultural domain. After nearly 30 years development, its application domain has spread into the crops cultivation management, installation horticulture management, poultry raising, aquaculture activity, plant protection breeding as well as economical decision making. Yang and Okrent (1991) had said that the most successful application of Artificial Intelligence (AI) in decision making so far is the

development of Decision Support System (DSS), particularly expert system, which is a computer program that act as a 'consultant' or 'advisor' to decision makers (Wash, 1999). Expert systems are cheaper compared to human experts in the long-term scenario. However, expert systems are relatively costly to develop but easy and cheap to operate. In addition, expert systems allow automation of many tasks that could not be effectively handled by human experts.

Peter B Goodell & other(1990) [1], have focused on integrated Expert system for Cotton production and management, developed in Egypt. CALEX is user friendly computer program that simulates human problem solving behavior. Growers can use this system to help manage crop production or predicts the effects of any one decision on subsequent events. In 1990, more than 100 cotton producers have taken advantage of the CALEX computer program. CALEX contains plant and pest simulation models to diagnose the pest.

Pinaki Chakraborti, Dr. Dilip Kumar Chakraborti (2008)[2], discussed the success of expert system for management of Malformation disease of Mango i.e. ESMMDM. This system considers variety of plant, the number of malformed shoots, climatic facts etc and prescribes suitable treatment package. It is interactive software tool with graphical user interface.

Fadzilah Siraj & Nureize Arbaiy [3], proposed expert system FuzzyXPest, related to Rice crop since Rice is a staple food of Malaysia. FuzzyXPest is proposed to provide information to farmers and researchers through the internet using fuzzy expert system. This system focused on pest activity on rice crop. Fuzzy logic approach is then used to forecast the pest activity level that will determine the damages caused by pests. This system has been verified by Malaysia Agriculture Research & development Institute (MARDI), Malaysia.

Azizul Azar bin Ramil & Nur Suhallin bt. Suhaimi (2008)[4], discussed the development of an expert system for Oil-Palm disease control diagnosis(PEKA-SEWIT). It will perform diagnosis process for assigning an infected disease treatment solution and also the preventive control. Agricultural Officers and planters who involve directly with oil-Palm plantation may use this system as assistance for helping them in managing crop activities especially in disease control.

G.N.R. Prasad, Dr. A Vinaya Babu (2006)[5], discussed various Agricultural expert system. They said that in order to remain competitive, the modern farmers often relies on agricultural specialist and advisor to provide information for decision making. Unfortunately agricultural specialist assistance is not always available when the farmers need it. In order to solve this problem, expert systems were identified as powerful tool with extensive potential in agriculture. In this paper, author discusses some more expert system.

POMEE is an expert system for apple orchid management. POMEE advices growers about when and what to spray on their apple to avoid infestation. The system also provide advice regarding to winter injuries, drought control and multiple insects problems.

UNU-AES is an expert system in agri forestry management. This system was designed to support land – use officials, research scientist, farmers and other individuals, for maximizing benefits from agri forestry management techniques.

In 1991, Egypt started it's efforts to develop expert systems for different crops. They establish Central Laboratory for Agricultural Expert System (CLAES), by keeping the view that it helps growers for maximize food production. Numbers of expert systems were developed by CLAES. Some are described below.

CUPTEX: This expert system is developed for cucumber crop production. It contains five subsystem First one is Disorder diagnosis, provides user with a disorder diagnosis which causes problem on plantation or verifies a user assumption. Second one is disorder treatment provides user with remediation of disorders. Third one is irrigation scheduling which provide an irrigation schedule for a plastic tunnel. An irrigation schedule demonstrates the water quantity related to each time instance. Forth one is Fertilizer scheduling to determine fertilization requirement for cucumber. Fifth one is plant care subsystem to predict from the last crop and plastic tunnel characteristics.

CITEX: This expert system is developed for Orange production. It contains four subsystems.

First one is Assessment of farm which is to evaluate new farm in a given location. Second one is Irrigation scheduling to produce schedule for irrigation of particular farm. Third one is fertilizer scheduling which determine fertilization requirement by considering aspects like fertilizer type, quantity, application method etc. Fourth one is Disorder diagnosis to conclude causes of user complaints. Fifth one is disorder treatments to provide a appropriate treatment for infected plant.

NAPER-WHEAT is another expert system developed by CLAES for irrigated Wheat management.

TOMATEX is a expert system developed for Tomato with two subsystem. Disorder diagnosis, to conclude causes of user complaints and verifies user assumption. Disorder treatment subsystem is to advice user about treatment operation of the infected plant.

Also Author focuses on expert system initiated by Ministry Of Agriculture, Government Of India. MANAGE is expert system developed to diagnose pest and disease for rice crop. This system is developed by National Institute of Agriculture Extension Management, is an Apex institute set up in 1987, as an autonomous society under Ministry Of Agriculture, Government Of India. This system diagnoses disease and pest and suggest preventive and curative measures. This system considers disease like rice blasé, brown spots, sheath blight, rice tunger virus, false smut fungi, bacterial leaf blight and it include pest like stem borer, rice gall midge, brown plant hopper, rice leaf folder, green leaf hopper, gundhi bug etc.

Fawad Baig, Naima Nawaz & Saif – Ur – Rahman (2005) [6], reviewed following expert system in Agriculture sector while discussing significance of expert system in agriculture sector.

NEPER : NEPER is one of those systems, which was implemented using a tool developed at Michigan State University on top of the object-oriented language Small

Talk. The expert system (NEPER) included two subsystems: the strategic subsystem, and the tactical subsystem. The strategic subsystem consists of six modules namely: variety selection, pre-cultivation, pest control, tillage, planting, irrigation and fertilization, and harvest. The tactical subsystem consists of two modules namely: weed identification and control, and diagnosis and treatment (Refea, 1998).

MAIZE/NAPRA : The MAIZE expert system was developed by Penn State University to help extension agents and agribusiness personnel identify pest management strategies in field corn for their clientele. NAPRA (National Pesticide Risk Assessment) was developed by the Soil Conservation Service (now the Natural Resource Conservation Service) to assess the relative risk of pesticides contaminating the ground or surface water. Then a joint MAIZE/NAPRA program was designed by linking the output of the NAPRA program with the MAIZE expert system (MC McClure, 1996).

Sprayer nozzle selection and sizing – expert system: This system was designed to assist in the selection and sizing of spray nozzles, covering 275 nozzles and is rated based on five factors. The overall ranking of the nozzles selected is based on nozzle type, operating pressure, nozzle spacing, boom height and droplet size. A nozzle interchange database is available for five nozzle manufacturers (Grisso, 1994)

A. J. Castro and Garcia – Torres (1995) [7], explains an expert system SEMAGI. An interactive microcomputer program named SEMAGI has been developed for sunflower to evaluate the potential yield reduction from multispecies weed infestations and from the parasitic weed broomrape and to determine appropriate selection of herbicide. It combines relational database on herbicides, weed and their interactions. SEMAGI provides an economic study of any herbicide treatment selected or introduced by the user, based on herbicide treatment cost, expected yield increase from the weed control treatment and sunflower selling price.

Harvinder S. Saini, Raj Kamal and A. N. Sharma (2002)[8], introduces Web based fuzzy expert system for integrated pest management in Soyabean i.e. SOYPEST. Objective of SOYPEST is to provide IPM decision support to the farmers through the internet. This has been used for the crops grown I different regions of India. It provide diagnosis of pest and its preventive and curative measures.

R.S. Michalski and others (1983)[9], discussed an expert system developed by University of Illinois at Urbana-Champaign. PLANT was an excremental expert system developed to provide consultation on the diagnosis of soyabean disease and also for decision making regarding both crop diseases and insect damages.

C. Dale Monks and others (1995)[10], discussed HERB, a computer-based expert system for soybean weed management developed at North Carolina State University, was evaluated for managing weeds under Georgia conditions. The project was initiated in two phases: a) training Cooperative Extension county agents followed by evaluation in six Georgia counties and b) revision, licensing, and distribution across the state. Field evaluations indicated that HERB was not highly accurate for predicting final yield loss because of weed species senescence and environmental extremes later in the growing season. HERB generally provided a reasonable prediction for a positive economic return due to treatment approximately 60% of the time.

Howard W. Beck and others (1989) [11], discussed SOYBUG, an expert system developed to advise Florida farmers on control of four important insect pests of soybeans: velvet bean caterpillar, stink bug, corn earworm, and soybean looper. SOYBUG integrates a variety of threshold rules based on crop phenology and economics, and gives specific recommendations of pesticides and application rates. A major goal of the SOYBUG project was to develop working knowledge acquisition techniques.

Yushu Yang, Fullin Wang, Yongsheng Ma (2005) [12], introduces Intelligent Soyabean Decision- Making System, to help pleasant to solve practice problem which they encounter in the production of soyabean about picked seeds, balance fertilization, prevention and cure the pests, analysis of economic benefits and it provide the technician of soyabean production with decision making service.

4) CONCLUSION:

Expert system is computer program which can be used as virtual expert to guide the Growers. Expert system is a technological way to deliver agricultural knowledge from books, research papers, thesis etc to actual implementation level i.e. at Growers. As a result, application of expert system in agriculture sector become popular and many nations took initiative to develop different expert system. But most of expert system concentrate on particular aspects of crop management like pest or fertilizer management etc. For Eg. In India, for Soyabean, none of the expert system is available which will give guideline to Growers from soil preparation up to harvesting. So researchers have to try to develop such a expert system which will guide to Growers to take decision into different aspects of crop management like soil preparation, seed selection, pest management, fertilizer management, weed control, irrigation management, nutrition management etc.

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