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Expert System: An ICT Tool for Decision Making in Agriculture

C.R. Monikha

Krishi Vigyan Kendra, Tirunelveli, Tamil Nadu (627 852), India

Abstract

Agriculture is backbone of Indian economy and it is primary sector of country. In these days rural India is drastically moving towards digitalization and technology. Farmer's enquire advance or experts knowledge to take decision during soil preparation, seed selection, fertilizer management, pesticide management, water scheduling, weed management, pest and disease management, so that to get high yield. In agriculture, expert systems are capable of integrating the perspectives of individual disciplines such as plant pathology, entomology, horticulture and agricultural meteorology into a framework that best addresses the type of ad hoc decision-making required of modern farmers. Expert systems can be one of the most useful tools for accomplishing the task of providing growers with the day-to-day integrated decision support and transferring expert-driven knowledge instantly at the level of farmer's field.

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Corresponding Author

C.R. Monikha

e-mail: harini.moni@gmail.com

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Introduction

An Expert System (ES), also called a Knowledge Based System (KBS), is a computer program designed to simulate the problem-solving behavior of an expert in a narrow do main or discipline. In agriculture, expert system could be developed for decision-making and location specific technology dissemination process. It helps in selection of crop or variety, diagnosis or identification of pests, diseases and disorders and taking valuable decisions on its management. Expert systems developed under Tamil Nadu Agricultural University were Paddy doctor, Coconut doctor, Banana doctor, Ragi doctor, Sugarcane doctor *etc*., and for Animal Husbandry Cattle Expert system, Poultry Expert system and sheep and goat Expert system. Agriculture experts have brought smart farming technologies that enabled them to reduce costs, maximize yields and increase profits (Kaur *et al*., 2020).

Structure of an Expert System

An Expert system can be viewed as having two environments the system development environment in which the expert system is constructed and the consultation environment which describes how advice is rendered to the users. The development environment starts with the knowledge engineer acquiring the knowledge from the expert. This acquired knowledge is then programmed in the knowledge base as facts about the subject and knowledge relationship. The consultation environment involves the user, who starts the process by acquiring advice from the expert system. It provides a conclusion and explanation, using its inference engine. It is used by end-users (*i.e.*, farmers/ extension workers in agriculture domain) to obtain experts knowledge and advice. The three major components that

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E-mail: *bioticapublications@gmail.com*

appear in virtually every expert system are the knowledge base, inference engine, and user interface (Mishra *et al*., 2014).

Components of the Expert System

The homepage of the expert system has three important components *viz*., Information System, Decision Support System and Diagnosing System (Crop Doctor).

Information System

Information system (Figure 1) is web based static information wherein all the technological and complementary information from A to Z about the crop are pooled and loaded in this component. It is a ready reckoner and user-friendly navigation with image based presentation, up scaling and updating the content at any time. The static information system is highly useful for the extension officials, scientists and farmers.

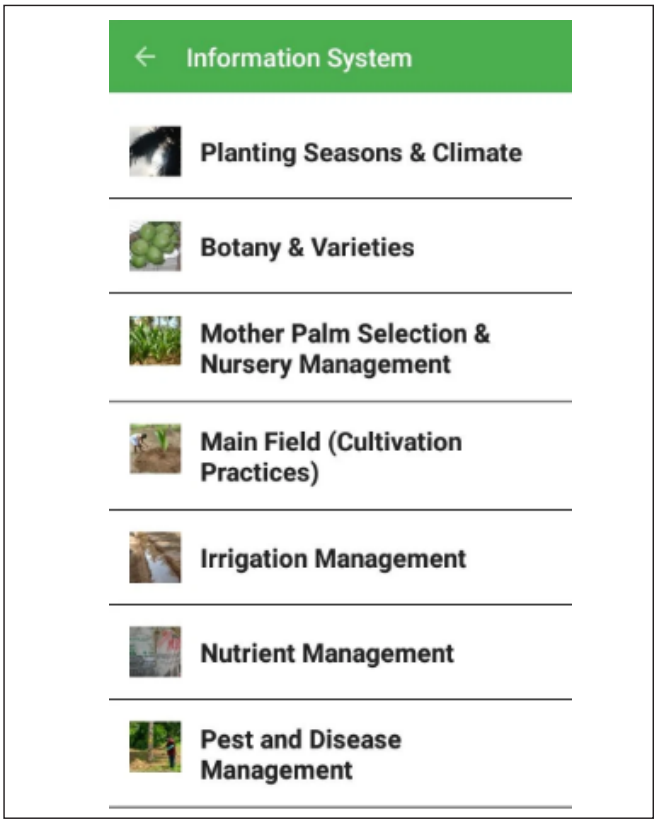

Figure 1: Information System

Decision Support System

Decision support system is a computer-based information system including knowledge based system that support decision making activities. The Decision Support System (Figure 2) is consisting of details about Season, Climate, Variety, Nursery Management, Cultivation Practices, Irrigation Management, Nutrient Management, Crop Protection, Farm Implements, Post Harvest Technology, Marketing, Institutions, Schemes and FAQ's.

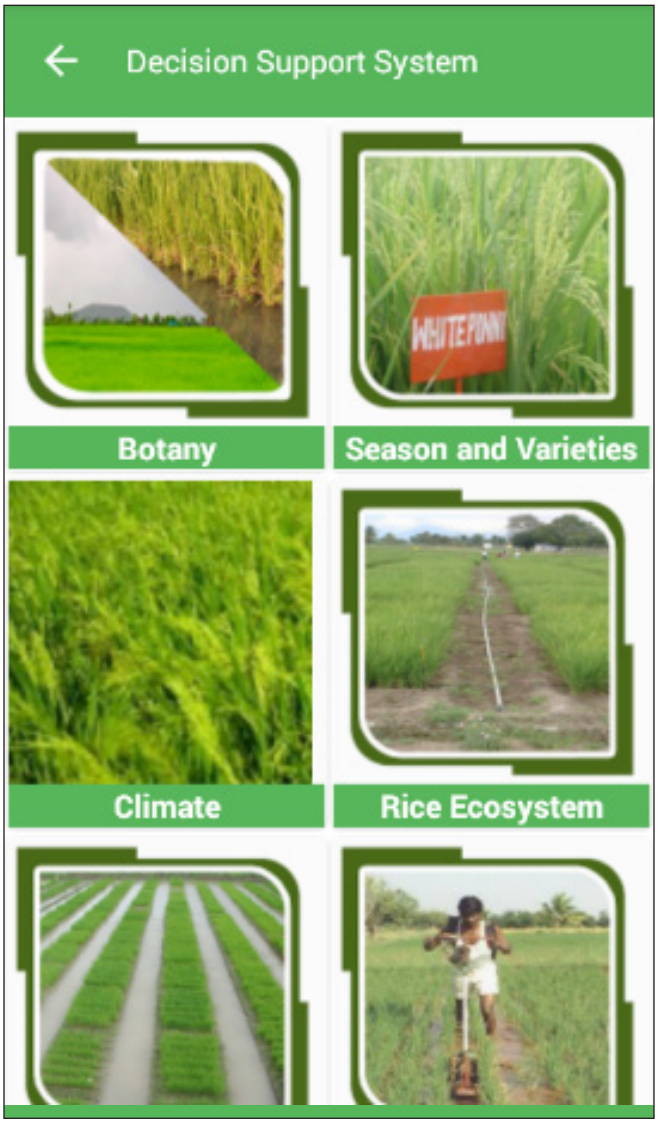

Figure 2: Decision Support System

Crop Doctor

Crop doctor is a vital component in the Expert system which acts as artificial intelligence. It is picture and image based "if and then rule" based programme which has written using Dot Net programme. It deals with diagnosing the pest, disease and nutritional disorders affecting the selected crops. The first obvious sign is given as thumbnail images in the Key Visual Symptoms (Primary Symptom) with multiple sub levels (Secondary Symptoms). Farmers can easily identify the pest and disease on the basis of photographs of symptoms and text descriptions (Rani *et al*., 2011). Farmers by selecting the symptoms, they will make a conclusion on the causes for the damage, identification of pest or pathogens, nutritional disorders and control measures to be taken in the field. In crop doctor, major pests, diseases, deficiency disorders and its management as different control measures like cultural

methods, chemical methods, biological methods, preventive methods, ecofriendly methods and trap methods are given with suitable and relevant photographs.

In nutrient management, deficiency detection is the very crucial part in managing nutrients for proper crop production. Crop doctor helps the user to decide the casual agent or reason behind the occurred symptom. After attaining the conclusion, different methods or choices to come out of the problem are given in this system. It provides flexibility in management methods and gives autonomy state in the process of planning and execution of control measures.

Segments of Crop Doctor

The crop doctor is divided into three segments as: Symptoms of damage, Identification of pest or pathogen and Control measures are given after diagnosing the problem. The detail information about each segments were documented.

Symptoms of Damage

In this part of crop doctor, real field symptoms of affected crop in 449 different angles were used for slide show. The symptoms are visualized both in close up view and long shot views. Attack of a single pest or disease may cause more than one symptoms. All the possible and occurring symptoms used for slide shows are real representatives of particular problem. Specific pest or disease may attack all the stages - seedling stage, growth stage, maturity stage of a crop. For this reason, symptoms have been visualized in stage by stage also. Infected or affected plant portions are used as identification tools. Real videos for field symptoms were also given with specific icon buttons. So, user can very well compare and conclude with his own field symptoms.

Identification of Pest or Pathogen

In crop doctor component, after diagnosing the reason behind the problem, user may want to know the details about the casual agent. For this reason, morphological descriptions about pest or pathogen, its life stages, conditions favoring its multiplication, longevity, its resistance or susceptibility to a particular problem are documented both in words and as visuals.

Management of Pest or Pathogen

This is the most valuable part of crop doctor. While developing management strategy, user has to select different methods that are readily available, economical and applicable at field level. To cater the needs of different critical stage of affected crop, various methods like cultural method, chemical method, biological methods, trap method, preventive method and ecofriendly methods are given in detail with relevant and suitable visuals.

Conclusion

Expert Systems are useful in many aspects and ready to use by end user as advisory system. It facilitates farmers for adopting different crop management practices for increasing the productivity and income. Hence, development of expert system for all crops is very important to provide farm specific advisory services in time and self diagnosis of farm problems. The successfully developed expert systems should be demonstrated to farmers, it will help them to bring significant changes in the lives of farmers and the field of agriculture.

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