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AGRICULTURAL EXTENSION

Effectiveness index of expert system applications in agriculture

Ravi Kishore* and Allan Thomas

Department of Agricultural Extension, College of Agriculture, Vellayani, Trivandrum, Kerala, India-695522

*Corresponding author: mrks777143@gmail.com

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Abstract

This research paper focuses on the assessment of the effectiveness index of expert system applications in agriculture with special reference to 'KAU-Fertulator' and 'e-Crop doctor', developed by Kerala Agricultural University. A survey was conducted among three targeted segments of Kerala extension professionals with a total of 100 respondents who were actively involved in the field of agriculture. Based on the relevant review of literature and discussion with experts effectiveness index of agri-expert system was developed and standardized using the applications such as quick availability and opportunity of the expert system to programme itself, expert systems ability to exploit a considerable amount of knowledge, reliability, scalability, pedagogy, expert systems ability on preservation and improvement of knowledge and expert systems ability to address the new areas neglected by conventional computing. These applications were ranked based on their mean scores in decreasing order of importance and effectiveness index was calculated to distribute the respondents in different categories. Results showed that the effectiveness index of expert system application in agriculture was generally medium. In order to improve the effectiveness index of agri-expert system applications in agriculture, it is necessary to augment the attributes of expert systems such as accuracy, timeliness, format clarity and relevancy of the information from agri-expert systems.

Highlights

- Effectiveness index of expert system applications in agriculture is the pioneer study which revealed that effectiveness index of expert system application in agriculture was generally medium.

Keywords: DFL's, traditional area, non-traditional area, sericulture, mulberry, cocoon, profitability

The Expert System in agriculture is a simple expert system based on agriculture related problem solving models, include diagnostics model, prediction model and farm management model. This expert system will allow farmer to interact with the system and can get the solution over the defined problem (Nitin *et al*. 2013). In India, most of the Agricultural Research Institutes are involved in the development of Agricultural Expert System (AES) to satisfy the information needs of the users of agricultural technologies. The researchers who are involved in developing Agricultural Expert System generally conduct validation studies to ensure the precision of knowledge base provided in the system. Whereas the research studies at the users' level in assessing the effectiveness of the system are limited, socio-personal factors responsible for utilization of the system among the users are mostly a forgotten area. Rajotte *et al.* (2005) commented that agricultural expert systems were tools for agricultural management since they could provide the site specific, integrated and interpreted advice that farmers and consultants need to more efficiently manage agricultural concerns. According to Kumar (2004), expert systems were important development in information technology. These

advised the farmers which alternative to choose from a wide range of possible alternatives by processing data from a large number of variables according to certain decision rules. These systems applied the decision rules more consistently and processed the relevant data more effectively than the farmer could himself. Kerala Agricultural University developed Agricultural Expert Systems (AES) for fertilizer calculation and diagnosing pests and diseases called 'KAU-Fertulator' and 'e-Crop doctor' which has drawn tremendous attraction among extension personnel and which could be raised a number of questions among the users. What were the applications of the proposed system? What was the effectiveness index of expert system applications in agriculture? With this contextual, a study was conducted to analyse the effectiveness index of agricultural expert system as assessed by the extension personnel.

Materials and methods

A survey was conducted during 2013-2014 among three targeted segments of extension professionals in the Thiruvananthapuram district of Kerala, India. The sample of the study constituted 100 respondents with a minimum of 40 extension professionals primarily consisting of Agricultural Officers (AO's), 30 front line extension professionals of KVK's (Krishi Vigyan Kendra's) and NGO's (Non-Governmental Organization's) actively involved in the field of agriculture and 30 Scientists involved with extension programmes of Kerala Agricultural University, ICAR (Indian Council of Agricultural Research) Institutes and Commodity Boards. The respondents were selected purposively who were mainly dealing with the Kerala Agricultural University expert systems namely 'KAU-Fertulator' and 'e-Crop doctor'. Effectiveness Index was developed for the study and standardized using the dimensions such as quick availability and opportunity of the expert system to programme itself, expert systems ability to exploit a considerable amount of knowledge, reliability, scalability, pedagogy, expert systems ability on preservation and improvement of knowledge and expert systems ability to address the new areas neglected by conventional computing based on the relevant review of literature and discussion with experts of Department of Agriculture and Kerala Agricultural University.

Quick availability and opportunity to programme itself

As the rule base is in everyday language, expert system can be written much faster than a conventional programme, by users or experts, bypassing professional developers and avoiding the need to explain the subject.

Ability to exploit a considerable amount of knowledge

The expert system uses a rule base, unlike conventional programmes, which means that the volume of knowledge to programme is not a major concern. Whether the rule base has 10 rules or 10 000, the engine operation is the same.

Reliability

The reliability of an expert system is the same as the reliability of a database, *i.e.* good, higher than that of a classical programme.

Scalability

Evolving an expert system is to add, modify or delete rules. Since the rules are written in plain language, it is easy to identify those to be removed or modified.

Pedagogy

It was operationalised as a means to effective learning through expert system and the principles and methods that impart knowledge or skill.

Preservation and improvement of knowledge

Valuable knowledge can disappear with the death, resignation or retirement of an expert. Recorded in an expert system, it becomes eternal. To develop an expert system is to interview an expert and make the system aware of their knowledge. In doing so, it reflects and enhances it.

New areas neglected by conventional computing

It was the ability of expert system to address new areas neglected by conventional computing.

Effectiveness index of expert system was developed. The statements were ranked based on their mean scores in decreasing order of importance. For most important statement score 5 was given and least

important statement score 1 was given in five point continuum.

Effectiveness index was calculated by using the formula as follows:

$$\text{Effectiveness Index} = \frac{\text{Total actual score obtained} - \text{Total minimum possible score}}{\text{Total maximum possible score} - \text{Total minimum possible score}} \times 100$$

Total minimum possible score (7)

Total maximum possible score (35)

Effectiveness index calculated for each respondent was used to categorize the respondents separately that assessed the expert system as high, medium and low using quartiles as measure of check.

Results and discussion

The completed and returned questionnaires from our sample of respondents revealed the effectiveness index of expert system application in agriculture and ranking of those statements by the respondents. It could be evident from the table that highest mean score statement was the first ranked statement and most of the respondents ranked 'pedagogy (as a means to effective learning through expert system)' as first with the mean score 11.08 followed by 'expert systems ability to exploit a considerable amount of knowledge' (10.845), quick availability and opportunity of the expert system to programme itself (10.69), expert systems ability on preservation and improvement of knowledge (10.545), reliability of the expert system (10.265), expert systems ability to address the new areas neglected by conventional computing (10.25) and scalability of the expert system (10.115) respectively. (Table 1)

Perusal of the Table (1) revealed the effectiveness index of expert system application in agriculture. It could be evident from the table that highest mean score statement was the first ranked statement and most of the respondents ranked 'pedagogy (as a means to effective learning through expert system)' as first with the mean score 11.08 followed by 'expert systems ability to exploit a considerable amount of knowledge' (10.845), quick availability and opportunity of the expert system to programme itself (10.69), expert systems ability on preservation and improvement of knowledge (10.545), reliability of the expert system (10.265), expert systems ability to address the new areas neglected by conventional computing (10.25) and scalability of the expert system (10.115) respectively.

Viewing the extension professionals' ranking, most respondents ranked pedagogy (As a means to effective learning through expert system) as first ranked statement with the mean score 3.65 followed by expert systems ability to exploit a considerable amount of knowledge (3.62), expert systems ability on preservation and improvement of knowledge (3.525), quick availability and opportunity of the expert system to programme itself (3.50), expert systems ability to address the new areas neglected by conventional computing (3.45), scalability of the expert system (3.425) and reliability of the expert system (3.375) respectively. With respect to front line extension personnel, most respondents ranked pedagogy (As a means to effective learning through expert system) as first ranked statement with the mean score 3.7 followed by quick availability and opportunity of the expert system to programme itself (3.66), Expert systems ability to exploit a considerable amount of knowledge (3.56), reliability of the expert system (3.53), expert systems ability to address the new areas neglected by conventional computing (3.50), expert systems ability on preservation and improvement of knowledge (3.46) and scalability of the expert system (3.43) respectively. In case of scientists, most of the respondents ranked pedagogy (As a means to effective learning through expert system) as first ranked statement with the mean score 3.73 followed by expert systems ability to exploit a considerable amount of knowledge (3.66), expert systems ability on preservation and improvement of knowledge (3.56), quick availability and opportunity of the expert system to programme itself (3.53), reliability of the expert system (3.36), expert systems ability to address the new areas neglected by conventional computing (3.3) and scalability of the expert system (3.26) respectively.

Hence, 'pedagogy (As a means to effective learning through expert system)' was rated as first ranked statement by all categories of respondents. This might be because majority of the respondents perceived that expert system can impart the knowledge and skill for decision making in various fields. It will work like expert to give the solution for problems when expert is not available. As users of a technology, relevant expertise is needed to solve

a particular problem or to take a suitable decision. The major problems in accessing a human expert in a particular subject area are non-availability or scarcity of experts. Even if the human expert is available, there may be problem of access for common people to contact the expert. Thus, agri-expert system is needed even for an expert to update his knowledge and get help in decision-making process.

Perusal of Table (2) revealed the distribution of respondents based on effectiveness index of expert system application in agriculture. It could be ostensible from the table that majority of the respondents i.e. 62% perceived that effectiveness index of expert system application in agriculture were medium followed by high (29%) and low (9%) respectively.

Observing the extension professionals' distribution, more than half of the respondents i.e. 60% respondents opined that effectiveness index of expert system were medium followed by high (27.5%) and low (12.5%) respectively. With respect to front line extension personnel, more than half of the respondents i.e. 60% respondents opined that effectiveness index of expert system were medium followed by high (33.33%) and low (6.66%) respectively. In case of scientists, majority of the respondents i.e. 62% opined that effectiveness index of expert system were medium followed by high (29%) and low (9%) respectively.

Hence it was inferred that majority of the respondents i.e. 62% perceived that effectiveness index of expert system application in agriculture were medium followed by high (29%) and low (9%) respectively. This might be because more than half of the respondents among all categories perceived that expert system was able to provide distant users with scientific information using modern tools at a much lower cost. Computer assisted instruction can increase the knowledge gain when delivered in an organised and well-planned approach covering adequate information in easily understandable manner. To impart knowledge to the target group, it is necessary to supplement verbal messages with visual messages. The visual messages in the form of illustrative material enables the learner to see and form correct concept, conceive an idea, overcome language barrier and get motivated to computer-based expert system as a tool for effective decision making against complex problem and technology transfer in various field of agriculture and allied areas. This finding derives support from the results of Helen (2008) that expert system usage among extension professional was medium.

Table 1: Effectiveness index of expert system applications in agriculture

Sl. No	Applications	Extension professionals (SDA). n=40		Front line extension personnel.(FLEP from KVK &NGO's) n=30		Scientists. n=30		Total N=100	
		Mean Scores	Rank	Mean Scores	Rank	Mean Scores	Rank	Mean Scores	Rank
1	Quick availability and opportunity of the expert system to programme itself.	3.5	4	3.66	2	3.53	4	10.69	3
2	Expert systems ability to exploit a considerable amount of knowledge.	3.62	2	3.56	3	3.66	2	10.84	2
3	Reliability of the expert system.	3.37	7	3.53	4	3.36	5	10.26	5
4	Scalability of the expert system.	3.42	6	3.43	7	3.26	7	10.11	7
5	Pedagogy (As a means to effective learning through expert system)	3.65	1	3.7	1	3.73	1	11.08	1
6	Expert systems ability on preservation and improvement of knowledge.	3.52	3	3.46	6	3.56	3	10.54	4
7	Expert systems ability to address the new areas neglected by conventional computing.	3.45	5	3.5	5	3.3	6	10.25	6

Legend: EP- Extension Professionals; SDA- State Department of Agriculture; FLEP- Front Line Extension Personnels; KVK-Krishi Vigyan Kendra; NGO- Non Governmental Organisations

Table 2: Distribution of respondents based on effectiveness index of expert system applications in agriculture

Category	Extension professionals. n=40		Front line extension personnel. n=30		Scientists. n=30		Total N=100	
	No.	%	No.	%	No.	%	No.	%
Low(<Quartile$_1$)	5	12.5	2	6.66	5	16.66	9	9
Medium(Q_1-Q_3)	24	60	18	60	18	60	62	62
High(>Quartile$_3$)	11	27.5	10	33.33	7	23.33	29	29
Quartiles under each class of respondents	Quartile$_1$-57.14 Quartile$_2$-62.5 Quartile$_3$-67.85		Quartile$_1$-57.14 Quartile$_2$-64.28 Quartile$_3$-67.85		Quartile$_1$-57.14 Quartile$_2$-64.28 Quartile$_3$-66.96			

Conclusion

This article reveals the effectiveness index rated by the extension personnel who were exposed to agri-expert systems alone indicated that it could be effectively used in the absence of human experts. Among the dimensions of effectiveness index of expert system, 'pedagogy (as a means to effective learning through expert system)' was the first ranked statement. It showed that the agri-expert systems are means to effective learning and the principles and methods from agri-expert system could be able to impart more knowledge or skill to extension personnel. Scalability of the expert system was assessed with the lowest mean score by the extension personnel. Majority of the respondents perceived that effectiveness index of expert system applications in agriculture were medium. It showed that more than half of the respondents among all categories perceived that expert system was able to provide distant users with scientific information using modern tools at a much lower cost. During the introduction stage extension personnel needed orientation training about applications of expert system to enhance their effectiveness in using expert systems.

References

Nitin, K., Binod, K., Keshao, K. 2013. An expert system approach for improvement of agriculture decision. *Int J Artificial Intelligence and Expert Systems* **5**(1): 8-12

Rajotte, E.G., Bowser, T., Travis, J.W., Crassweller, R.M., Musser, W., Laughland, D., Sachs, C. 2005. Implementation and adoption of an agricultural expert system: In: Symposium on Computer Modeling in Fruit Research and Orchard Management. The Penn State Apple Orchard Consultant. *Ishs Acta Horticulturae*. 313p.

Helen, S. 2008. Agricultural Expert System- A Participatory Assessment. Dissertation, Kerala Agricultural University.