J Krishi Vigyan 2019, 8 (1) : 38-42 DOI : 10.5958/2349-4433.2019.00067.9

Design and Development of an Expert Support System for Fertilizer Calculation

V G Sunil *, Berin Pathrose and K Prasanth*****

Krishi Vigyan Kendra, Malappuram
Kerala Agricultural University, Mannuthy, Thrissur 680 651 (Kerala)

ABSTRACT

Expert support system has been recognized as a powerful tool to store human knowledge in computers for the purpose of making expert's knowledge available to users. The present study was an attempt to design anexpert system on fertilizer calculation for 100 crops covered in the package of practices of Kerala. The software development activities were carried out in five stages. During the first stage the decision making situation was studied in depth. This was followed by developing the prototype design and defining of variablesas a second stage. The database was developed in the third stage. The software design was completed and validated in the fourth stage. The final validation of the tool with the end users was done at the final stage. The developed software was able to give general and soil test based fertilizer recommendation. The recommendations were given for a single plant/unit area as well as for the whole field. The fertilizers can also be selected according to the local availability. The final software was made available in the domain www.farmextensionmanager.com

Key Words: Expert system, Farm extension manager, Fertilizer advisor, Fertilizer calculator.

INTRODUCTION

Expert system combine heuristics with computer graphics and hypertext to provide need based and highly specific information.These new tools will help decision makers by reducing the time and human resources required for analyzing complex alternative decisions.In India, agricultural sector seeks attention and meticulous planning to enjoy its benefits of increased productivity growth Vandanatyagi (2012); Mahadevan and Renuka, 2003). Educating and training the farmers appropriately and reorienting them to take up new activities through adaptation of new technologies are of utmost importance.

The emerging technologies are making the agriculture ubiquitous and allow potential for enriching it with computer-assisted decision support systemsfor farm management. Decision support systems can either support the decision maker in an on-going decision situation or it can prepare the decision-maker to perform better in the future through decision training (Alenljung, 2008). In designing expert systems, knowledge forms the key component. The way knowledge is collected, synthesized and represented mainly explains the acceptability of the system (Sunil and Vijayaragavan, 2009). Hence, proper insight into the user behaviour during decision-making is very much important. To be more specific, a socio-psychological and extension approach is basically needed in knowledge engineering. However, this job is assigned to computer professionals with little input from extension organization and most of these experts were found going behind complex software programmes.

Corresponding Author's Email: sunil.vg@kau.in

*Assistant Professor, Communication Centre, Kerala Agricultural University, Mannuthy, Thrissur District, Kerala

** Assistant Professor, Agricultural Entomology, College of Horticulture, Kerala Agricultural University,Vellanikkara

***Assistant Professor, KVK Malappuram, Kerala Agricultural University, KCAET Campus, Tavanur, Malappuram District

Table 1. Problems in the farmer level fertilizer usage.

Sr. No	Parameter	No of respondents (%)
1	There is over usage of nitrogenous fertilizers and under use of potassium fertilizers	83
2	Fertilizer dealers opinion are mostly taken in fertilizer decision	81
3	Liming and fertilizer application are often done simultaneously	76
4	Micro nutrients are not used as per recommendation	71
5	The fertilizer are not applied in correct time and stage	62
6	Farmers are going behind complex fertilizers in most cases	60
7	Some farmers feel organic fertilizers are only needed	56
8	Fertilizer are many times applied without proper soil cover	51

A good fertilizer support system should offer scope for giving field specific recommendation on the amount, time, method and type of fertilizer to be used. There are many fertilizer information systems available. However, most of them fail to capture the tacit knowledge and practical needs of farmers (Lindblom *et al*, 2017).Some information system will give recommendation on a single crop only. The recommendations are mostly in straight fertilizer format. There is a lack of a comprehensive system that can work for many crops. So, in the present study the design and validation of anexpert and decision support system was undertaken for fertilizer calculation with the above said requirements.

MATERIALS AND METHODS

The expert system for fertilizer calculation was developed for the state of Kerala. Before designing, an in depth analysis of the user requirements and drawbacks of the existing systems were studied. The required data were collected from the three groups of respondents namely farmers, extension personnel and research scientists and agricultural students.

Agile software development is an approach to software development under which requirements and solutions evolve through the collaborative effort of self-organizing and cross-functional teams and their end users (Collier, 2011). It was used in the present study for design and development of an expert and decision support system for fertilizer calculations. A total of 100 crops included in the package of practices recommendation of Kerala Agricultural University were selected for the development of the fertilizer calculator based on need analysis. For each crop there can be more than one recommendation for different growing conditions. The research scientists and secondary data sources were used to arrive at the different recommendations. A total of 350 types of fertilizer recommendations were identified through the process.

The software development activities were carried out in five stages. During the first stage the decision making situation was studied in depth. This was followed by developing the prototype design and operationalization of variables. The database was developed in the third stage. The software design was completed and validated in the fourth stage. The final validation of the tool with the end users was done at the final stage.

RESULTS AND DISCUSSION

Analysis of the decision making situation

The farmer level fertilizer usage behavior was studied from the selected respondent group (Table 1). The result showed that there was over usage of nitrogenous fertilizers and under use of potassium fertilizers among farmers (83 %). It could also read

Table 2. Issues with the existing fertilizer calculators.

Sr. No	Parameter	No of respondents (%)
1	Fertilizer calculators are crop specific	83
2	Options for selection of fertilizers is rarely available	81
3	Some calculators works only in offline mode	76
4	There is a need for login before taking recommendation	71
5	Blanket recommendations are only provided	62
6	Micro nutrient recommendation are not given	60
7	Details of fertilizers are not provided	56
8	Soil testing ranges and interpretation ignored	51

from the results that fertilizer dealers opinionswere mostly taken by the farmer in fertilizer decision (81 %).

The fertilizer calculator was considered as an option to help the extension workers and farmers calculate the fertilizer requirement correctly. Hence, it was decided to take their response on the existing fertilizer calculators. A detailed study of 7 fertilizer calculators developed by various agencies and relevant to the state of Kerala was made by the selected respondents (Table 2).

The result showed that most of the fertilizer calculators were crop specific (83 %). This was followed by option for selecting fertilizer according to local availability is rarely available in most of the calculators (81 %).

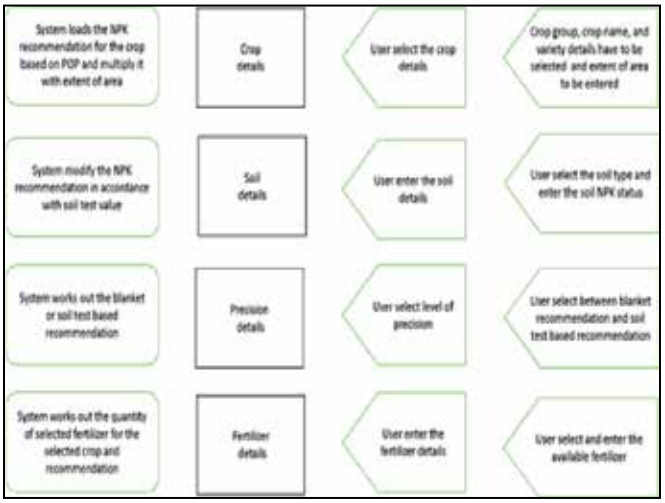

Fig.1. Prototype design of the fertilizer calculator

Design of a prototype model for the tool

The prototype design of the interactive tool on fertilizer was done at four basic layers (Fig.1.). The first layer asks for the crop specific details. Here, the users have to take from the broad crop group the required crop and variety. Once, the selection is made, they have to enter the extent of cultivation of the crop. Based on the data entered, the system works out the nutrient recommendation as per Package of Practice of Kerala Agricultural University.

The second layer is the soil details. Here, the user can enter the soil test values for nitrogen, phosphorous and potassium and also the soil type. Once the values are entered, the system will modify the nutrient recommendation in accordance with the soil test values. It is designed as optional menu, and hence the users can also skip it.

The third layer is the precision details. Here the user can go for the blanket recommendation or the soil test based recommendation. Once, the selection is made, the system displays the appropriate recommendation. The recommendation will be presented in per plant/unit area and also for the total field. The nutrient recommendation will be converted to fertilizer format and will be displayed in accordance with the stages of application. The fertilizer recommendation is given in the straight fertilizers format as it is cheaper.

The fertilizer details form the fourth layer for the system. Here, the user can select market

available fertilizer and work out their quantity as per recommendation. The system will show the required nutrient for auto adjustment. Further, the fertilizer button will give specific details of the fertilizer.

The prototype model starts working when the user makes an entry to the first layer. Once the user enters all the needed details, the system will take the recommendation for the concerned crop and variety and multiply it with the number of plant or area to arrive at the nutrient requirement. Once the process is complete the system will again convert the recommended nutrient into various fertilizer format taking the conversion factor from the database. Hereafter, it will further modify the recommendation to splits of application and places the results in the correct space. In case of soil test based recommendation, the interactive tool will modify the blanket recommendation based on soil test values. So, even if the farmer knows the soil test value for a crop, he can generate the recommendation for other crops also.

Preparation of database for the tool

The database for the tool was developed in two different stages. During the first stage the general recommendation of fertilizer for all crops was collected from package of practice textbooks and other literary sources. The recommendation was hereafter standardized on a per plant basis by dividing it with the recommended spacing. A total of 200 number of recommendation was there for 100 crops. The total number of data combination is 3500. In the next stage, efforts were made to collect ad-hoc recommendation table for converting soil test values into fertilizer format from soil test laboratory. Information on the nutrient content of various fertilizers and details of the same was also collected.

Development of software materials

Converting the theoretical design to computer design is meant by the term software development. The development of software was done in such a way so as to work both in offline and online mode. And based on the analysis of data structure, it found necessary to develop the software in three basic layers. The three basic layers include the user side interface layer, the business logic layer and the database layer at the bottom.

The user side interface layer represents the layer of the programme that appears in front of us. The user interface was designed using Hyper Text Markup Language. The business logic layer acts as the connecting link between the database layer and client side interface layer. The request from the users are processed and replied through this layer. The business logic application layer for the programme was developed through Java script. Database layer represent the area where the basic data to be used by the system was stored. The data base layer for the system was developed in java script language.

The software thus developed tested in three stages. During the first stage the working of the programme were tested. In the second stage, the language parts of the software were checked for spelling and grammatical errors. In the third stage, the programmes were used in different computers with different operating systems to see its working. The problems noticed were rectified every now and then. And the final software was made available in the domain www.farmextensionmanager.com

Final testing and validation of the tool

The final testing of the interactive tool was done with a group of selected respondents. The respondents were first asked to calculate the quantity of fertilizers needed for any one of the crops from their area based on standard recommendation. Then they were asked to check their results with that of the system and find the difference. Hereafter, the respondents were asked to write their observations about the system (Table 3).

The results showed that 95 per cent of the respondents find that the soil test based

Table 3. User response about the fertilizer calculator.

Sr. No	Parameter	No of respondents (%)
1	Soil test based recommendation can be generated for most of the crops	95
2	Recommendations are available in various units like per plant, total area etc.	88
3	Stage wise fertilizer application recommendation is available	79
4	Users should be able to take recommendation according to market available fertilizer combination	74
5	Details of chemical fertilizers such as nutrient content, action in soil etc. are given	65
6	Options for comparing the cost of different fertilizer in terms of nutrient content is available	63
7	The soil test classification parameters are clearly defined in the system	60
8	The software works online and is free to use	59

recommendation generation as most useful. The calculation of fertilizer to specific area or per plant basis was the most useful (88 %). Based on the results, it can be inferred that the overall design of the interactive tool has a very high acceptance among the respondents.

CONCLUSION

The present study was an attempt to design an expert system on fertilizer calculation for 100 crops covered in the package of practice of Kerala. The developed software was able to give blanket fertilizer recommendation and soil test based fertilizer recommendation. The fertilizers can also be selected according to the local availability. Majority of the respondents find that the soil test based recommendation generation most useful. Next to it, calculation of fertilizer to specific area/ unit was the most useful. Based on the results, it can be inferred that the overall design of the interactive tool has a very high acceptance among the respondents.

ACKNOWLEDGEMENT

Department of Agriculture and Farmer Welfare, Kerala for the financial assistance provided for the project

REFERENCES

Anonymous (2016). *Package of practices recommendations*: crops 15th edition. Kerala Agricultural University, Thrissur-392 p.

Alenljung B (2008). *Envisioning a future decision support system for requirements engineering: A holistic and human-centred perspective*. Ph.D. Thesis, Department of Computer and Information Science, Linko¨ping University, Sweden.

Collier K W (2011). *Agile Analytics:* A Value-Driven Approach to Business Intelligence and Data Warehousing. Addison-Wesley Professional. pp.121.

Lindblom J, Lundstrom C, Ljung M and Jonsson A (2017). Promoting sustainable intensification in precision agriculture: review of decision support systems development and strategies. *Precision Agri* **18**: 309–331.

Mahadevan and Renuka (2003). Productivity growth in Indian agriculture: the role of globalization and economic reform. *Asia Pacific Dev J* **10** (2): 57-72.

Sunil VG and Vijayaragavan K (2009). Validation of Information and Decision Support System for its Utility Among Different Users. *Indian J. Ext Edu***45**(1 & 2): 94-97.

Vandanatyagi (2012). India's agriculture: challenges for growth and development in present scenario. *J Physical and Soc Sci* **2**(5): 116-128.

Received on 13/11/2019 *Accepted on 08/10/2019*