

Geographical Information System For Farm Entrepreneur

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ABSTRACT

In India, agriculture base is very strong. Creation of an information system is essential for the development and enhancement of agriculture field. If a system can provide right information at right time, it will be helpful to enhance the agriculture field. Now a day the most of the users (farmers) are literate, they can plan the strategies and take a decision for the current and next season with the help of information system. This paper presents the geographical information system, which is build by analyzing the mechanism and features of component GIS for farm Entrepreneur. This system has the ability of analysis, forecast, NPK values in soil, annual rain fall, sowing and harvesting period of different crops in Punjab (India) and aided decision-making, so attain the aim of guiding more agriculture yield. This system is very useful in managing the agriculture farm information, providing service for the management of farm resources; moreover it is useful in making scientific analysis, production decisions and evaluation on farming.

1. INTRODUCTION

It is proved that agriculture is the prominent aspect of human world. Approximately 70% population of India is depended on agriculture for their living resources. Everybody can see the clear image of past and present conditions of farmer's work process. It is very essential for farmer to get the latest and productive knowledge regarding farming. In now days agriculture become the concept of world level competition. By this point it is necessity for the best development of system about farm management. In this new era the business of farming has took a step forward with a key to success perfectly and where the update information and correct decision making have to do carefully. There are various production options in hand of farmer for the best result by utilizing the latest development of research and technology. So, to ensure profitable performance of the farmer, informed and quick decision making is required.

On the other hand agriculture infrastructure is one of the most important measures which is very utilizing to promote rural economics and betterment of the modernization of agriculture and rural of our country. This is the necessity to strengthen it project management for the improvement of the project quality in infrastructure construction of agriculture. The projects like farmland irrigation improvement, fertilizing, garden cleaning and land remediation are included for the project of agriculture infrastructure construction. It have different departments, so many business and process change frequently and it is very hard to control the progress of project which concerned lots of heterogeneous data, having spatial and non-spatial data (instance for the text and pictures). Presently the project management most of the time manage through paper documents, because of this it's difficult to time to time master the progress of construction and give it a real time control which proved as hard to achieve co-operative work and information sharing between departments. Workflow can give a quick response with the changes in business processes to meet the long term multi sector, multi user collaboration and data sharing. GIS provide a scientific and visual analysis results for the users by managing both the spatial data and attributes data very effectively. This paper will introduced workflow and GIS into the project management system for agricultural infrastructure construction, the key technologies and their realization, made the business processes of the project management flow automatically, the spatial and attribute information seamlessly integrated and managed. This paper will introduced workflow and GIS into the project management system for agricultural infrastructure construction, the key technologies and their realization, made the business processes of the project management flow automatically, the spatial and attribute information seamlessly integrated and managed.

1.1 Concept of GIS

The GIS is an abbreviations about the geographic information system, is a special spatial information system. With the support of the software and hardware of computer, using the systems engineering and the informatics theory, GIS could scientific manage and synthetically analyze the geography data that has special connotation, to provide the needing information for programming management, decision-making and research.

1.2 Essentiality of developing precision farming expert system based on GIS

1.2.1 Essentiality of researching the precision farming expert system

The main idea of precision farming is to realize scientific management for agricultural production by using different information technology. The precision farming can obtain the adaptability analysis in the cultivated land for different area and condition, adjust measures to local conditions, excavate the farming productive potentialities further, enhance the yield and using efficiency of cultivated land. The precision farming expert system is the artificial intelligence expert system that is design and development conforming to the modern agriculture development demand. It has several features as follow: first, it combine the expert knowledge of farming domain with the artificial intelligence technology, grip the main problem of farming produce, use the rich knowledge of expert and the information processing ability of computer, introduce the high technology to the farming produce territory, be in favor of enhance the level and effect of farming service. Second, it provide a method for researching correlative problem of measuring farming produce by processing semi-structure and non-structure problem of farming produce. Third, as an applied tool, it can provide save, propagation, use and measurement for evaluating farming knowledge. This expert system setting interface for data collecting particularly, possess the function of intelligent analyze and process for correlative data, to provide the scientific forecast and aided decision-making for farming producing.

1.2.2 Reason for using GIS as the development platform

The precision farming production management feature of variability and pertaining to a region tell us we should handle the problem from the angle of time and space location when we do the product management and product decision, so, we can dynamic monitor the farming production. Since the fact that GIS is an information system based on the geographic data. It has the powerful ability of analyze and express space problems at the same time, it also have powerful graphic operation and handle ability, great superiority showed on data recording, data management and data analysis in precision farming. On the aspect of expression, we can see both the pictures and texts.

2. LITERATURE SURVEY

Upendra et. Al. (2014) said as a developing country agriculture has traditionally dominated the Sri Lankan economy and there are various issues such as overproduction, under supply, pest and disease outbreaks which has affected the farming community. Controlling diseases and pests related to cultivation is one of the major issues that farmers face during their farming activities. The current process of detecting and controlling pests and diseases is very time consuming in terms of collecting, analyzing, processing pest and disease related data and notifying outbreaks to the relevant parties. This limits the timely and proactive actions that could have been taken to control those pests and diseases.

K.Anji Reddy et. al. (2012) discussed that India has a strong agriculture base and agriculture being the field of high developmental priority, the creation of a suitable Computational Agriculture Information System has become essential as development of agricultural sector is a potential catalyst for socio-economic development. There is a need to locally develop information systems which are based on local needs and structures. That is why a country like India needs to adopt and develop information systems based on its own needs and structures, using their own methods and practices in the areas like healthcare, agriculture, education etc. Some of the problems faced towards informatics development for agriculture in India are: Unavailability of appropriate Agriculture Information Systems to facilitate Agriculture Informatics suitable to the Indian requirements.

Xuefen Mao et. al. (2011) said to improve the efficiency and effectiveness of agricultural infrastructure construction, a project management system integrated workflow and Geographical information system (GIS) with traditional information management system is necessary. To achieve this, agricultural infrastructure construction project business processes and specific functions were identified, and then the system architecture model based on the WFMC reference model, the database model based on spatial database engine (SDE) technology and the functional models were designed. Result shows that the business process of agricultural infrastructure construction project can be flexibly customized by integrating dynamic workflow management and statistical processes, and with the support of SDE and other GIS functions, the related map and other information of project can be seamlessly managed and displayed, also the spatial information can be online submitted, edited, and processed.

Ms. Neha Agarwal et. al. (2011) discussed that GIS is increasingly using geospatial data from the Web to produce geographic information. It is necessary to provide mechanisms to prepare data to help retrieval of semantically relevant data. Geospatial information (GI) constitutes to be the key factor in decision-making in a variety of domains, such as emergency management and agriculture. One way is the use of semantic annotations to store the produced and relevant information. This paper illustrates study of semantic annotations of agricultural resources, using domain ontology's.

Sukristiyonubowo et al (2011) Study on management of inherent soil fertility of newly opened wetland rice for sustainable rice farming in Indonesia was conducted in Bulungan District, from 2009 to 2010. The aims were to know the soil fertility status and properly manage its fertility status to improve rice yield and sustain rice farming. Six treatments were imposed including T0: farmers practices, T1: farmer practices + compost + dolomite, T2: NPK recommended rate, N and K were split two times, T3: NPK recommended rate, N and K were split three times, T4: NPK recommended rate, N and K were split three times + compost + dolomite and T5: NPK recommended rate, N and

K were split two times + compost + dolomite. The residual effect of dolomite and compost applied in 2009 was continually assessed in 2010.

Zhuang Weidong et. al. (2010) said that agriculture machinery guidance technology is one of precision agricultural important technologies. Based on GPS and GIS, it can raise working efficiency and improve the quality, reduce production costs, reduce driver working difficulty. This research's general goals realize the aided guidance function for agriculture machinery driving on road and straight line operation in the field by lightbar. The system uses Visual Basic 6.0 and MapObjects 2.2, uses the RS232 serial port communication, uses the AgGPS 332 receiver, uses the DGPS signal offered by Satellite Based Augmentation Systems, uses touch-screen vehicle carries computer for the superior computer, applies the existing area electronic map, develops region's farmland and path's geographic information system, enables the farm machinery to obtain the guidance information for transportation between the fields.

3. RESEARCH MEANS

3.1 Aim of the system

The aim of the research of precision farming expert system is to combine agro technique, scientific research result, specialist's experience with computer technique, so that we can establish a comprehensive precision farming expert system which is high intelligence. So, the knowledge of the expert and the ability of solving problem can be extended and inherited. As the guide of the farming production, it enhanced the level of the scientific management. The system adopt the system project guiding ideology, make the agriculture field experts' knowledge to be more systematize and formalization using the computer and artificial intelligence techniques, it is a comprehensiveness experts system which use the means of face to target to solve many kinds of problem. The system deal with the date separately, such as deal with the figure data and different property data, utilizing the mathematics logic and fuzzy reasoning means to carry on reasoning and analysis evaluation, make the system possess the ability of analysis, forecast and assistant decision, moreover version as the running environment.

Table1. Parameters used as basic for the research

Sr. No.	Parameter	Description
1.	Demand For Good Quality Crops	<ul style="list-style-type: none">• Growth in exports of agriculture produces to international market.• Enhanced food regulatory standards.
2.	Soil Based Crop Selection	<ul style="list-style-type: none">• Technology is doing wonders to make comfortable and easy, similarly information technology can be used to develop a system which would help farmers to take decisions about their crops using NPK values.
3.	Area Based Crop and Soil	<ul style="list-style-type: none">• Crops can be produced at a lower cost if weather data is used.• A good crop can be saved from being a bad crop due to bad weather.
4.	Availability of Scientific Knowledge of Agriculture	<ul style="list-style-type: none">• Field specific, crop specific knowledge can be co-related with information technology for the betterment of agriculture. E.g. Sowing and Harvesting Period.
5.	Dissemination of Localized data	<ul style="list-style-type: none">• Local information such as – Area under food and non food crops, production of fruits, vegetables etc can be made available to all so that marketability and profitability of agricultural produces be increased.

3.2.3 Forecast means

The difference of dynamic forecast is based on the difference of model, the main forecast means are tendency remove equal forecast, linear programming, exponential smooth forecast, multiple linear regression forecast model, nonlinear regression forecast model and forecast test method is adopted to be the system test method.

3.3 Investigation of data sources

Use the concept of "Object-oriented" to establish expert knowledge model, establish concept mode of the express object as their relationship, take the decision of fertilize before seeding of winter wheat as the instance of the model, show as figure 1. Fertilize before seeding decision mainly have three process:

- (1) On the basis of climate, soil fertility, product condition, scientific and technologic level to fix to the scientific yield target.
- (2) Actualize earth nutrient maturation.

(3) Based on the yield target and earth nutrient maturation value to fix the reasonable base fertilizer and fertilization scheme and fertilization value.

3.2 Technical support of system research

3.2.1 Choosing secondary development language

Using the method of Object-oriented, choose VB which has high development efficiency and easily operated as secondary development language.

3.2.2 Development platform

Using Arc/View as the GIS platform which could handle the space figures. Adopting Win2000 or the advanced

4. SYSTEM DESIGN

4.1 System Design

4.1.1 Design of basic structure

The system basic structure is consist of knowledge base, model base, database, inference engine and man-machine interface.

4.1.2 Frame of the whole system

The frame of the whole system show as figure 1

Dynamic database: store the existed information that before the beginning of inference, intermediate result in the reasoning process and finally conclusion. These data stored in block according to the function, in order to enhance the efficiency when reasoning read/write dynamic database.

Knowledge base: consist of illustration and production. The illustration part define the program data object and external function, the data of program processing is stored in the work memorizer, the program production part is the regular list, which is stored in the regular storehouse. Mapping sub-system: use the datum accumulated in many years to draw every kind of topic pictures, effect pictures, synthetic pictures, at the same time, output the figure data.

Knowledge base of model expert's knowledge and experience which is needed in model building have arranged and stored beforehand, establish model knowledge base, it have greatly auxiliary help to the model building.

Study engine of model: it has the building capability of fast response the expert, it can give out the response result, so it is convenient for expert to summarize the knowledge and experience, modify their assumption and estimation, continuously deepen the regulation, sum up knowledge and experience, accelerate model building process.

Model base: Establish system model according to the particular factors in the precision farming which has also been established, establish system model and sum up experience gradual, improve the model have existed. Integrated data base: storing the different kinds of data that correlate with model building, take out of date from it continuously while establishing the model.

4.1.3 Work flow chart of system

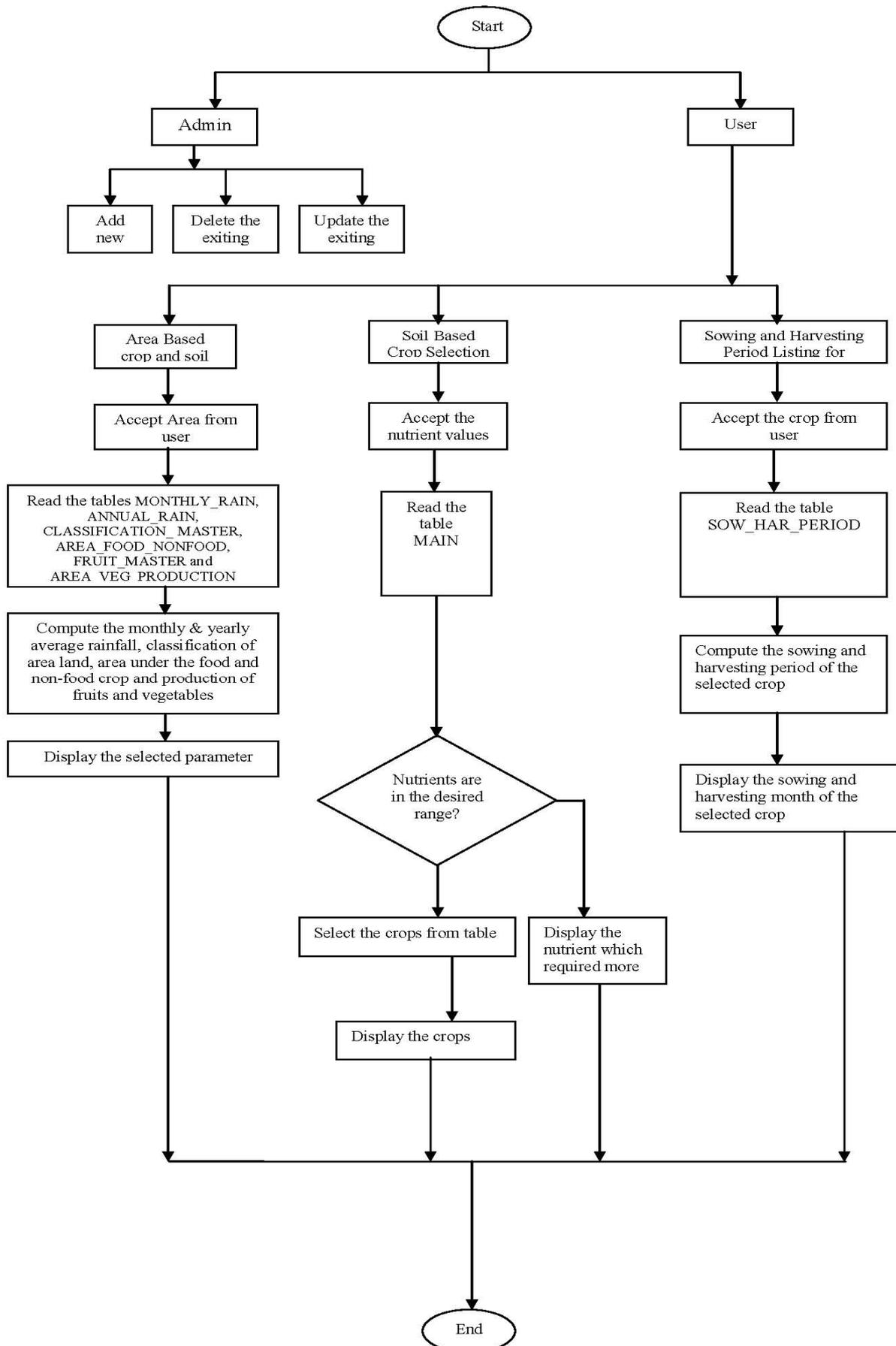


Figure 1: Flow Diagram for Geographical Information System for Farm Entrepreneur

4.2 Development Method

The system adopts the design means of Object-oriented, divide up the problem of precision farming want to solved according to the nature property, depict in the thinking way of mankind, build model and relationship, the advantage of handle the problem are showed in direct and natural way. The entire expert system consists of object, the relationship between the object is by message, use class and inheritance depicts object and build model, message is the instruction flow that request object to carry out some operations, use to unite data layer with control layer, divide object to the different layer, this layer have inheritance. The design mean of “Object-oriented” is convenient for directly communicate with user.

4.3 Key technique

The expression of knowledge and the design of inference engine are the key of expert system research, whether the expert system can successful decided by the inference engine’s capability and the comprehensive degree of regulation. The knowledge consists of fact and regulation. Fact is the short-term information regulation that altered quickly, the regulation is a long-term information, it’s about how to get the new fact and assumption through the current information.

4.3.1 Design of knowledge module

Knowledge module is consisting of knowledge base management system, knowledge base, inference engine and different interfaces. Interface: language interface, knowledge base system and database, interface of model base. The production structure is adopted in the design of knowledge base system.

4.3.2 Design of inference engine

The reasoning utilizes the non-exact inference mechanism, combine the certainty with probability organically, struggle shorten the reasoning process, adopt forward reasoning, backward reasoning , combination of forward and backward reasoning. The main design pattern of the inference engine: match of data and regulation, conflict elimination, conflict selection, and conflict execution.

5. RESUT & DISCUSSIONS

In this system user can take decision according soil type. There are three main nutrient in soil for grow any crop. These three nutrients are nitrogen (N), phosphorous (P) and potassium (K). The values of these nutrient are varies from crop to crop. There are the two main season of crops that are rabi and kharif. In this module user enter the season and values of nitrogen (N), phosphorous (P), potassium (K). The output of this module is display all the crops of entered season that required the entered range of nutrients. If the entered value of any nutrient is below then the minimum values required for any crop then advice to the farmer which nutrient required more. Table1: show the range of nutrients for the different crops. For instance, a farmer wants to know what crop suits best to his agricultural land/farm, he puts values of NPK (Nitrogen =26, Phosphorus =8, Potassium =0) and season as Rabi in the system as shown in the figure 2 and submit, then the system shows/Suggests crop “Toriam” as shown in Figure 3.

Table 2: Range of nutrients for the different crops [Punjab Agriculture University, Ludhiana]

ID	Season	Crops	Nmin	Nmax	Pmin	Pmax	Kmin	Kmax
1	Kharif	Rice	45	55	10	14	10	14
2		Basmati Rice	6	10	5	10	4	8
3		Maize	45	55	22	26	10	14
4		Bajra	45	55	22	26	3	7
5		Moong	4	6	14	18	0	0
6		Mash	4	6	8	12	0	0
7		Arhar	5	7	14	18	10	14
8		Rice Bean	5	7	6	10	0	0
9		Soyabean	10	15	30	35	0	0
10		Cotton	55	65	10	14	0	0
11		Sugarcane	85	95	10	14	0	0
12		Ground Nuts	5	7	7	9	8	12
13		Sesamum	12	16	5	10	0	0
14		Guara	6	10	18	22	0	0
15		Mentha	55	65	14	18	5	9
16	Rabi	Wheat	45	55	25	27	9	14
17		Barley	14	18	10	14	5	7
18		Winter Maize	65	75	4	8	22	26
19		Gram	5	7	6	10	0	0
20		Lentil	4	6	6	10	0	0
21		Field Pea	10	14	14	18	0	0
22		Toria	23	27	6	10	0	0
23		Raya	35	45	10	14	0	0

The screenshot shows the 'Geographical Information System' interface. At the top, there is a logo and the text 'Geographical Information System'. Below this is a navigation bar with links for 'home', 'about', and 'contact'. A 'Welcome' banner is present. On the left, a sidebar menu lists: 'Area Wise Information', 'Year Wise Information', 'Find Good Crop', 'Find Area', and 'Find Sow/Harv Periods'. The main content area is titled 'Find the Crop' and contains a form with the following fields: Nitrogen (N) with value 26, Phosphorus (P2O5) with value 8, Potashium (K2O) with value 0, and Season with a dropdown menu set to 'Rabi'. There are 'Submit' and 'Reset' buttons at the bottom of the form.

Figure 2: Inesrt the Values of NPK of soil

The screenshot shows the 'Geographical Information System' interface after a search. The navigation bar and sidebar menu are the same as in Figure 2. The main content area is titled 'Your Crops Are:' and displays a table with the following data:

ID	CROPS	SEASON
22	Toria	Rabi

Figure 3: Showing the Result to the Farmer

6. FUTURE SCOPE

The Scope for the future research is:

- The Farm Management System can be made more useful for the farmers by converting the language of the system to Punjabi.
- Further development of the economic model is required in order to address more complicated resource management patterns effectively.
- Market information relating to prices of the crop, particularly if quoted higher than the maximum support price offered by the government.
- Information transfer to the farmers can be increased substantially by providing email, news groups, messenger services, online chatting, and discussion groups.
- Voice support in local language can be provided for illiterate or semi-literate farmers.
- In the present form this system is a local system i.e. particularly for the state of Punjab only but it can also be upgraded for national or international level uses.

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