A Research of Agricultural Informationalization Evaluation and Decision Support System

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Abstract: This research aims to develop a comprehensive evaluation method to help the establishment of agricultural informationalization evaluation and decision support system. The research has made considerable progress in the realization of the evaluation index systematic establishment, the index data acquisition, statistic analysis, the presentation of the evaluation result, etc. It provides a tool with great effectiveness and practical values. With these findings, both horizontal and vertical comparison of the agricultural informationalization evaluation work by different provinces can be made easily.

Keywords: Agricultural Informationalization, Evaluation, Decision Support System.

1 Introduction

14 indexes. Liu Shihong(2007) argued that there need to be 6 factors and a total of 25 indexes included in the rural i In recent years, both the Party Central Committee and the State Council have paid considerable attention to agricultural informationalization of China, developed a series of documents and policies, and implemented a number of informationalization projects. As a result, the construction of basic facilities in China's agricultural informationalization, the ability to develop and use information resources, and the system of information services are continuously improved, so that the information technology has been better adopted during agricultural affairs. The envi-

ronment for informationalization development has been gradually enhanced, and the agricultural informationalization progress of China has been obviously accelerated.

Despite those achievements that China has made, some problems have been emerged during the agricultural informationalization development. For example, from the country level to the local level, the agricultural informationalization development lacks of a scientific and appropriate agricultural informationalization evaluation index system. Under this circumstance, a practical agricultural informationalization evaluation index system has been established for the urgent need of guiding the development of agricultural informationalization in various regions. This should be the guidelines of the agricultural informationalization in different regions, and the basis for the examination of the agricultural informationalization progress. Therefore, the establishment of a scientific agricultural informationalization evaluation index system means the motivation for guiding the agricultural informationalization work nationwide.

Taking the above analysis into consideration, the establishment of a scientific agricultural informationalization evaluation index system for the promotion of agricultural informationalization evaluation work is of particular necessary. Using a survey, Bai Wanping(2008)has succeeded in the establishment of a rural informationalization construction effect evaluation index system in western regions. Huang Zhiwen(2009), for the evaluation of rural informationalization level in various regions throughout China, has designed 5 index numbers and nformationalization evaluation index system. Zhang Xicai, Qin Xiangyang, Zhang Xingxiao (2008)applied the industry chain theory of agricultural informationalization, and developed a series of Beijing rural informationalization evaluation index system including 6 first-class indexes and a total of 23 second-class indexes. Gao Ya and Gan Guohui(2009) have selected 24 indexes from 6 perspectives for the establishment of agricultural informationalization evaluation index system.

There seems no attempt to develop the agricultural informationalization evaluation and decision support system so far. Based on the technology of Geographical Information System, an evaluation and decision support system developed by Zhao Yongpeng(2007), combining data storage, managing, analysis, and decision support, used to evaluate the effect of the vegetation recovery on dumps, has been a decision support system related to evaluation. Xia Yuanyong, Yan Dongmei, Shen Hong and Zhou Qiangxin (2006)contributed a evaluation and decision support system based on Web to the stability of side slopes around the Three Gorges reservoir areas, and took the actual situation of side slopes around the Three Gorges reservoir areas into considera-

tion during the analysis of the demand, function, and operation process of the system, so that the operation modules are divided, and the frame graph of the entire system is finally figured out. Based on the characteristics of systematicness, diversity, spatiality, dynamicness during the urban sustainable development, Wang Guixin and Chen Ping(2006) have established a evaluation and decision support system for the future sustainability of urban development from the perspectives including architecture, functional module, integration methods, etc. In order to solve the problem of the fuzzy comprehensive evaluation of the eco-cities, Hu Jianyuan and Huang Kun(2006) set up an evaluation and decision support system for eco-cities, and presented the eco-city multilevel fuzzy comprehensive evaluation model and an evaluation support system.

Based on the need of the establishment of agricultural informationalization evaluation index system, this paper presents a study on the design of a an agricultural informationalization evaluation and decision support system. The system incorporates the analytic hierarchy process and aggregative index number in supporting the evaluation processes.

2 System Analysis

2. 1 Analysis of System Users

There are mainly three groups of users of this system, including system administrators, provincial administrators, and experts. System administrators use the system, mainly for the purpose of division and management of system users and their limits of authority, and for the maintenance of the stable operation of the evaluation and decision support system, who, at the same time, have to be equipped with considerable system maintaining knowledge to re-adjust relative parameters of the evaluation index system in accordance with the evaluation requirements in necessity. What provincial administrators mainly do is to collect and update the data of local agricultural informationalization; therefore, a certain amount of system maintaining knowledge is needed. As for experts, some web application skills are required to be grasped, so that they are able to grade on the website and submit the grading result.

2.2 Analysis of Functional Requirements

According to surveys, it is concluded that there are mainly five perspectives of functional requirements of the system as follows:

(1)User information management. This system, with three groups of users involved, is in a prerequisite need of settings of the user management function.

(2)Setting of the index system. The evaluation index put forward in this article is in need of the criterion of practices, and it has to be modified appropriately according to the actual situation during the application period. Accordingly, the setting function of the index system has to be reserved.

(3)Setting of index weights. Experts have to grade via the analytic hierarchy process, and the system will process the grading result and finally figure out the weight values of all indexes.

(4)The collection and process of index data. The stability of this system and the regularity of the efficient functioning have to depend on the reliability of the data, which is the basis of the entire evaluation process. Due to the fact that most of the index data collected in the research are quantified, the collection of data is one of the major function of the system.

(5)The calculation of agricultural informationalization indexes and the display of the evaluation result. The core of the system is the scientific and reasonable evaluation for agricultural informationalization levels in various provinces. Therefore, on the basis of the confirmation of index weights and index database, the code design is wanted for the realization of the calculation of agricultural informationalization indexes, whose result has to be displayed in tables or histograms via an efficient MSMMI.

3 System Design

3.1 System Structural Design

The agricultural informationalization evaluation and decision support system adopts layered structure, involving data layer, application layer, and presentation layer, shown in Figure 1.

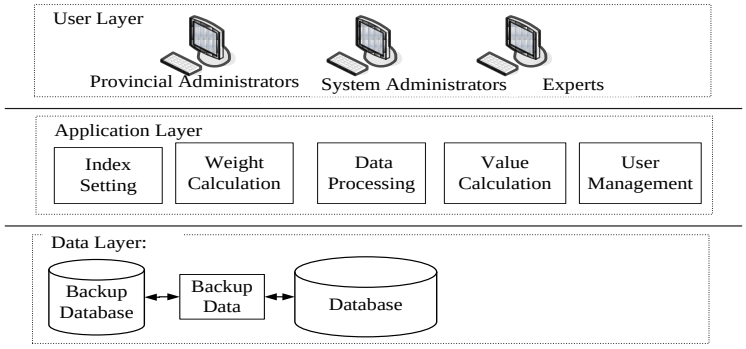

Fig. 1. System Structure

(1) Data layer

The database of this system has to save the data information as follows: 1) user information; 2) information of index system setting; 3) index weight information; 4) index normalized value; 5) the data input by provincial administrators and the database after data integration. For the reliability of the system, the backup database was kept on this layer, and all data will be saved as backups all the time.

(2) Application layer

The application layer, which has been regarded as the core of the system, calls relative data in the database for the realization of agricultural informationalization evaluation and analysis, and adopts the needs during the evaluation to achieve further system management, including the setting of indexes and the modification of index weights.

(3) User layer

The client for human machine interface is various commonly used internet explorers, where users are allowed to enter the interface of the agricultural informationalization evaluation and decision support system, e.g. experts are able to grade, system administrators are capable of system maintenance, and the provincial administrators can have a visualized understanding of the evaluation results.

3.2 Design of System Function

According to the demand analysis of system function, the function of agricultural informationalization evaluation and decision support system can be figured out as what Figure 2 demonstrates, including following functional module:

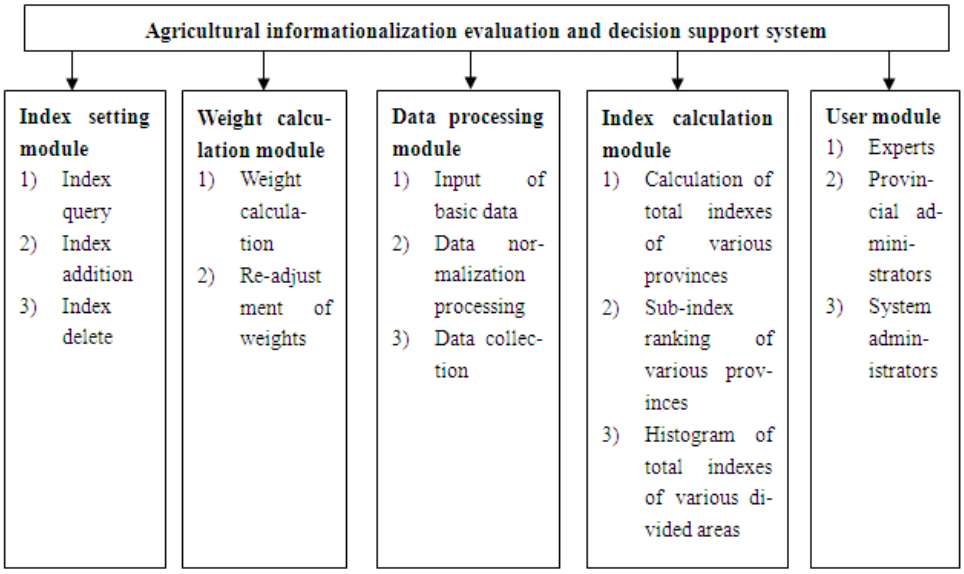

Fig. 2. The figure of system function

(1) Index setting module

According to the agricultural informationalization evaluation system established in this article, three first-class indexes including agricultural informationalization fundamental facilities, agricultural production and management informationalization, agricultural management and service informationalization, involving a total of 12 second-class indexes. At the same time, the system has been successful in reserving flexible customization, which provides the system with more applicability and expansibility with the ability to add and delete indexes.

(2) Weight calculation module

With this module, experts are able to grade via the analytic hierarchy process based on the index weights, during when judgment matrix establishment, single-level sort with its consistency check, and multilevel sort with its consistency check are needed

to figure out the index weight. At the same time, system administrators are able to have the system weight further adjusted.

(3) Data processing module

Provincial administrators are able to input original data of indexes through this module, which leads to the realization of storage management of collected data. At the same time, this module is used to normalize all data, when system administrators can get all input data automatically for further calculation of agricultural informationalization indexes.

(4) Index calculation module

This module can be applied for the calculation of the total indexes of agricultural informationalization of various provinces, and the calculation of the sub-indexes of different indexes of agricultural informationalization of various provinces, which can be displayed in tabular forms. When the agricultural informationalization levels of various provinces are evaluated, the evaluation results of various provinces can be ranked and displayed intuitively in histograms.

(5) User module

The module contributes to the appropriate distribution and management of the authority limits of three groups of users including system administrators, provincial administrators, and experts.

3.3 Design of System Workflow

The agricultural informationalization evaluation and decision support system has integrated functions including index setting, information collection, analysis display, etc. After the indexes are set, index information will be collected. Then, the system, based on the setting of indexes and the collected data, will select an applicable evaluation method for the realization of evaluation, whose results will later be displayed on the stage page for reading and reference. The workflow of the system is shown in Figure 3.

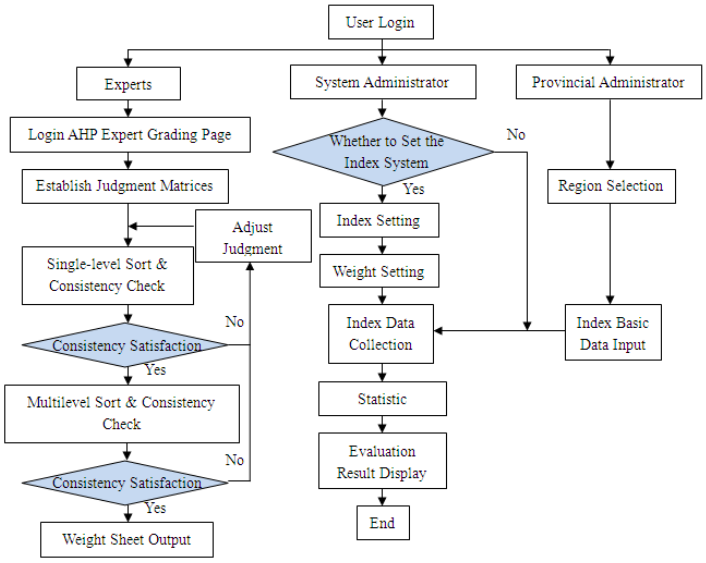

Fig. 3. The workflow of the system

3.4 Database Design

The database of the agricultural informationalization evaluation and decision support system embodies a considerable number of data sheet, including the data sheet of administration regions, a relative sheet of index system structural information, relative sheet of index data collection information, and a relative sheet of index data summarization. On account of the limited length of the article, merely some representative sheets will be listed as examples.

Sheet 1 Administration Regions Information

Field Name	Name	Data Type	Size	Non-null	Explanation
regID	region ID	varchar	11	Yes	Six-figure administrative codes united by the country are used
regName	region name	varchar	30	Yes	Names of provincial administrative units
regNameforshort	region	varchar	30	Yes	Names of provincial adminis-

	name for short				trative units for short

Sheet 2 Index System

Field Name	Name	Data Type	Size	Non-null	Explanation
IndextID	Index number	int	8	Yes	
IndexName	Index name in Chinese	varchar	40	Yes	
IndexCode	Index name in English	varchar	40	Yes	
IndexDimension	Index dimension	varchar	30	Yes	
IndexDescartes	Index description	varchar	1000	Yes	
ClassOneIndexSum	First-class index sum	int	11	Yes	
ClassTwoIndexSum	Second-class index sum	int	11	Yes	

Sheet 3 Index Weight

Field Name	Name	Data Type	Size	Non-null	Explanation
IndextID	Index number	int	8	Yes	
IndexName	Index name in Chinese	varchar	40	Yes	
IndexCode	Index name in English	varchar	40	Yes	
IndexWeight	Index Weight	decimal	8	Yes	

Sheet 4 Index Standard Value

Field Name	Name	Data Type	Size	Non-null	Explanation
IndextID	Index number	int	11	Yes	
IndexName	Index name in Chinese	varchar	40	Yes	
IndexCode	Index name in	varchar	40	Yes	

IndexStandardValue	English Index standard value	Int	8	Yes	

Sheet 5 Originality Data

Field Name	Name	Data Type	Size	Non-null	Explanation
ID	Record number	int	8	Yes	
regID	Region code	varchar	11	Yes	
IndextID	Index number	int	8	Yes	
IndexValue	Index data	Int	8	Yes	
IndexDimension	Index dimension	varchar	30	Yes	
GatherDate	Collection data	date	40	Yes	

4 Key Technology

Eclipse, the development tool of the agricultural informationalization evaluation and decision support system, has been developed, compiled and debugged in the environment of Windows XP+ JDK 1.5.0+Tomcat 5.0+SQL Server 200, seen in the figure as follows. The development mode of MVC, based on Struts, was adopted for the establishment of the agricultural informationalization evaluation and decision support system, in the B/S systematic structure based on WEB. Struts is the framework of considerable popularity based on MVC in nowadays, which has led to the general realization of the separation between the business logic layer, the presentation layer, and the control layer, and at the same time contributes to the promotion of extendability and circulativity of the application software.

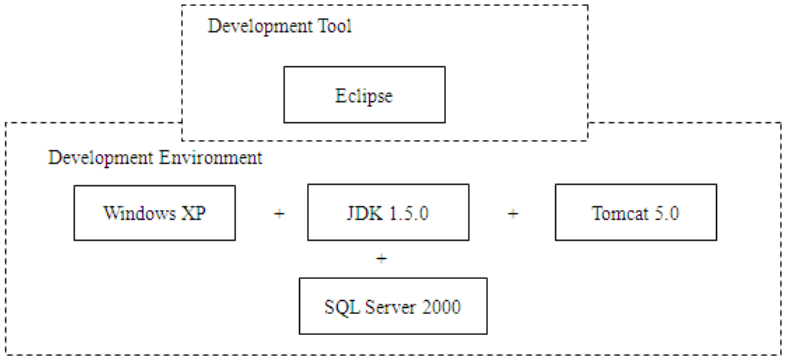

Fig. 4. The Software Environment of System Development

4.1 The realization of MVC Design Mode

The MVC mode embodies 3 categories of components: 1) the model object is the core of the entire application software, in charge of packaging the structure of software data and the operation as well as the work flow of processing services; 2) the view object is the connector between the application software and the outside, by forwarding the input of its user to the controller, consulting the business situation, and synchronizing the relative date to the user via visualization; 3) the controller object is the link between models and the view. On the one hand, it provides the user input with analysis into the order for model implementation; on the other hand, it, in accordance with the user input, calls relevant models and the view to satisfy the demand data visualization for the user.

With the application of MVC mode, the data processing, the control of system input and output are both separated with data presentation, making the system structure clear and flexible, so that it leads to the avoidance of entanglement and confusion of the data processing, program function, and show code when early developers are using the method starting from the interface and then code. The design of Struts MVC mode is demonstrated as follows.

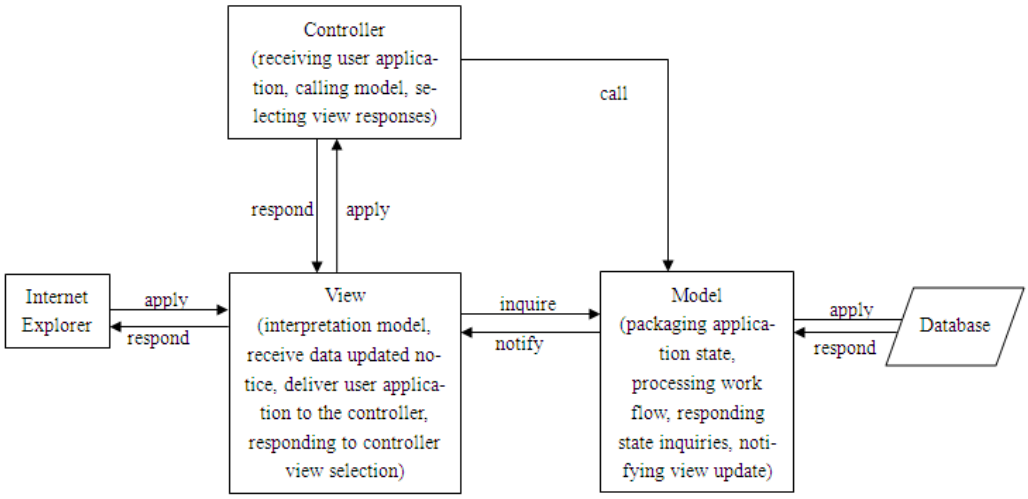

Fig. 5. The Design of Struts MVC Mode

This system uses Struts framework for realization. The Struts framework is a frame realized based on the application of JSP Model2. The mode of MVC contributes the advantages as follows to this system: 1) data model, the control of input and output, and the user view are of mutual independence, making the system design progress more clear, and strengthening the system maintainability; 2) With the MVC mode, each model can be counted as an independent category, and the controller is used to link different models and provide the structure with greater clearness; 3) the function that each model is able to offer several views data has improved the flexibility of data presentation and the reusability of codes.

4.2 HTML

HTML, short for Hypertext Markup Language, as a common language in the internet and a simple and universal explanatory markup language, is a descriptive text consists of HTML orders. The HTML order is able to explain languages, images, movies, sounds, figures and interlinkages. The structure of HTML can be divided into the head part and the body part, in which, the former one is used for the description of the information demanded by the explorer, and the latter one is the detailed and specific content of the page.

4.3 Javascript

Javascript is a scripting language developed from LiveScript by Netscape. As a script, it is able to write Javascript code into HTML files, and it can be compiled and executed while the internet explorer reads it. Javascript can effectively save the download time on the client page by increase the interactivity of webpage and simplify some regularly repeating HTML files. Furthermore, Javascript is capable of transferring some operations such as user authentification on the client side and reduce the burden of servers.

4.4 JSP

JSP, similar to the ASP technology, is a technology realizing mixed code of regular static HTML and dynamic HTML. It inserts Java program segment and JSP label into traditional webpage HTML files. The JSP is of the ability to realize the separation between web logics, design and presentation, for the design based on the reusable components, resulting in rapidity and simplicity of the application software development based on Web.

4.5 Servlet

Servlet, namely the server applet, is Java application software independent from both the system operation platform and the network and transport protocols server, for the extension of server functions and the generation of dynamic Web pages. It is the Java application software at the server side inside the Web server, which differs from the Java application software that is started from the traditional order line. Servlet is loaded by Web server, which has to embody the Java virtual machine for Servlet support. Servlet, in the MVC mode, is capable of the matching of models and views and the accomplishment of the user request.

4.6 Struts

Struts is an open source project organized by Apache organization, based on the Web application in MVC mode, which provides the MVC system development with bottom support. It, adopting Servlet as the main technology, is able to reduce the time to

develop Web application with the application of MVC design model. Struts frameworks such as JSP, user custom tags or so are helpful for the improvement of developing efficiency and for development of system maintainability and extendibility.

5 Conclusion

Addressing the need of the agricultural informationalization evaluation and decision support system,a agricultural informationalization evaluation and decision support system is developed based on MVC development mode in the environment of Windows XP+Tomcat 5.0+SQL Server2000. This article provided information on the system design, functions, database and work flows. The research has achieved its objectives by developing a tool which can support the agricultural informationalization evaluation effectively and efficiently.

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