Decision Support System for Drinking Water Safety in Rural Area in Ya’an of China

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Abstract—In consideration of the drinking water safety in rural areas in the western mountainous regions of Sichuan Province, the author adopts the module technique to integrate the GIS with the specialized application function to develop a drinking water safety spatial analysis system. The system provides the Ya’an’s seven counties with each kind of function the daily management of drinking water safety need, such as the spatial data, sketch picture and the information collecting, storing, saving, managing, analyzing, evaluating, converting, inspecting, outputting and renewing, etc; the system still can carry on information inquiry, analysis and decision functions on the wanted area, and provides technical measures of river protection of the area. The system can be used for the protection of water resource, provides the management section of technical personnel with the foundation platform of the daily data processing as well as the government officials the assistance decision tool. It has the instructional significance to solve the problem of rural water supply and reasonable development of Dadu River, Qingyi River basin water resources, and the protection and instaurations of the ecosystem. Compared with the same kind of methods are found, the paper had the outstanding results in the study on drinking water safety in rural areas.

Keywords-Ya’an; Rural Areas; Drinking water safety; DSS

I. INTRODUCTION

The factors that influence drinking water safety in rural area system are multitudinous, which of the non-determinism and the spatial variability characteristics. Based on this, the author join the module type GIS technology and the professional field analysis model in together, carries out the spatial analysis and the system research of the countryside drinking water safety problem in—Ya’an—typical mountainous region of Sichuan west areas.
II. OBJECTIVES OF THE STUDY

To study and solve the problem of countryside drinking water safety and in the mountainous region of Sichuan province, achieve the goal of sustainable development, realize the harmony between the human and the water, promote the construction of the socialistic new countryside, the author has carried on the research and development of countryside drinking water safety GIS decision support system in Ya'an of Sichuan province. This article discusses emphatically the ESRI Mapobjects2.2 and Visual Basic 6.0 as the development tools and establishes Ya'an drinking water safety in rural area decision support system, and unifies the specialized model to carries out the analysis and the appraisal of the ecological environment influence factors and the non-determinism, the spatial variability characteristic of drinking water safety in rural area.

III. METHODOLOGY

A. Key Technologies of the System

Data organization and management: this backstage database of the system selects a method which unifies Microsoft Corporation's Access database and ESRI Corporation's dbf database. Apply the format of ESRI Corporation's dbf database to realize the spatial data management of system, apply the Microsoft Corporation's Access database to manage the attribute data of the graph, then, establish the connection between the two to realize the integrated management of graph data and attribute data. Spatial data operation: the system uses the GIS module to insert into the visible programming environment VB, realize the operation of inquiring, editing, analyzing the spatial data. Map objects is a group of map application module based on the COM technology, composing of an ActiveX named Map and nearly 45 automatic objects. The spatial analysis function of GIS: including the buffer analysis, the traversing analysis, the neighbor analysis and the superimposition analysis. The superimposition analysis is one of the most commonly used methods to extraction space concealment information of geographic information system, not only including spatial relations comparison, but also including the attribute relations comparison. The geographic information system superimposition analysis may divide into the following several kinds: visual information superimposition, spot and polygon superimposition, line and polygon superimposition, polygon superimposition and grid chart level superimposition. Among them, the polygon superimposition is the most commonly used and the most important in geographic information system, also is the most complex superimposition. The polygon superimposition is the operation which to combine two or many polygon charts level and to produce a new polygon chart level, the result is divides the original polygon essential factors into the new essential factors, and synthesizes the original two or the multi-layered attribute. It mainly uses Map objects' two primary functions: Intersect function and Union function. Expert's knowledge library: the main task of expert's knowledge library is processing and judging the non-structured problem, which must rely on expert's knowledge and experience, the knowledge is often expressed by the style of rule structural in knowledge library. The decision-making proposed must draw support from the expert's knowledge library that's forming the policy-making opinion with the help of knowledge inducing equipment after acquiring the knowledge from the library. Knowledge inducing equipment consists of two processes: the knowledge expression and knowledge inference. In the process of analyzing drinking water safety, select the method of using the sealed dynamic storehouse,
which is sealed through the connection between the expert's knowledge library and knowledge inducing equipment in the process of realizing the system. In other way, leave a full connection for the expansion of the knowledge library and the promotion of the system in the future.

B Establishment of GIS

The database includes the space-graphics database and the attribute database. The space-graphics database mostly consists of dynamic analysis figure, actuality water quality figure, uncertain analysis result figure, and so on. The attribute database mostly composed of water quantity, water quality, convenience degree and guarantee rate, hydrology weather, watering place and recreational water conceptual design figure, etc. The data source includes the investigation and evaluation report of the drinking water safety in rural areas in Ya’an in 2005, the dynamic datum of drinking water safety research, the investigation data on the spot, the detection data in open country, etc. The data mentioned above comes down to decades of observation progeny. Because the data is very complex, it should be verified when input the data, transform when input the space-graphics data, accept or reject when input attribute data.

C Implement of DBMS

The function of the database management subsystem includes the database management and the database table operation. The main function of DBMS contains management, display, inquiry and edition. The management function: it provides all management functions of the general DBMS; the display function: it may open in a new window when the user had designated the data sheet name, and demonstrates this data sheet by the form and activates the corresponding functional key; inquiry function: the user may search the content which he needs in the entire database table, and then the data indicator will aim at the recording line, if not, will give the prompt by springs the text frame; edition function: including the data input, the revision, deletes and so on the operations.

IV. RESULTS

A Demonstration and Operation

The main function of demonstrating and operating in the map is shown as follows: reproducing the map, managing the chart level, establishing, deleting, inducing and deriving of the database and the data sheet, revising the data sheet structure, as well as increasing and deleting the records of the data sheet. The specialized function includes making the table for customs, producing kinds of topic charts which are applied in statistic and analysis as well as analyzing the specialized model.

B Inquiry and Analysis

Considering the user's actual demand, the system provides four kinds of inquiry and analysis ways: the foundational inquiry, the inquiry based on the information of geometric figure and the definitional inquiry based on the administrative regionalization, the user may select the appropriative according to their respective demand. The foundation inquiry: carry on the secure inquiry according to the inquiry year and the inquiry condition of user's choice. The inquiry based on the administrative regionalization: the user chooses the interested regions to inquiry the safety of drinking water and other information according to the administrative regionalization. The definitional inquiry: carry out the SQL sentence inquiry according to user's actual demand.

C Output

Customized report: carry out the printout according to the custom-made report, which includes the water quality, the water quantity, the
convenience degree, the guarantee rate, the judgment table of safety, kinds of view, the water quality report, the material report of hydrometeorology, and so on. Other reports: printout the data sheet that the user glancing over.

D Statistical graph
The analysis and statistical chart of the sample data: express various appraisal targets of the water quality, the water quantity, the convenience degree, the guarantee rate according to the two-dimensional or three dimensional columnar or the diagram of curves. The specialized statistical chart: according to the various sequence of a year and years or the contrast situation of years in the same time express a series of data, including the observation data of the precipitation, the evaporator station and the current capacity as well as the data of mining quantity of water resources, which are listed in the authorized data sheet, in a form of the two-dimensional or three dimensional or the diagram of curves.

E Non-determinism computation and Analysis result inquiry
The system provides the grey theory, the fuzzy mathematics, the wavelet theory, the BP neural network and other non-definite methods to analyze and study the graph of computed results, which are based on the applying algorithm, model and the opinion of research, besides combined with the computer technology. The analysis model of the system mainly apply to analyze the relationship of the water quality, the water quantity, the convenience degree, the guarantee rate, etc, as well as to analyze and study and compute the influence of other ecological factors.

V. CONCLUSIONS
Based on the common GIS applied in the drinking water safety system, the informational system joins the common function of GIS and the specialized knowledge into an organic integration seamlessly. The system has improved the information degree and the management level of the countryside drinking water safety, provided the public welfare platform to analyze and appraise the problem of rural drinking water safety. It has worked efficiently in the practice. Compared with the same kind of methods is found, the paper had the outstanding results in the study on drinking water safety in rural areas.

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