Database Management System Construction for the Evaluation Results of Intensive Land Use in the Development Areas of Hunan Province

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Abstract Using spatial data integration and database technology, analyzing and integrating the assessment results in all the development zones at different time in Hunan Province, the paper is intended to construct the database and managerial system for the assessment results of land use intensity in development zones, thus formulating "one map" of Hunan Development zones and realizing the integrated management and application of the assessment results in all the development zones at any time of Hunan above the provincial level. It has been proved that the system has good application effect and promising development in land management for land management departments and development zones.
Key words Spatial data integration, Evaluation of intensive land use, Development areas, Database management system

The evaluation project of intensive land use in the development areas stems from "Land Resources Monitoring and Survey Project". It is an important part of "Potential Assessment Project of Urban Intensive Land Use", and a kind of basic work deployed by the Ministry of Land Resources. Since 2008, Hunan Province has completed three rounds of provincial or ministerial evaluation of intensive land use in the development areas and updating work, bringing rich results and achieving good results. The evaluation of intensive land use and updating work in the development areas is still in the process of continuous improvement, so there are still "islands of information" between the results completed in different development areas, between different rounds of results, that is, the sharing and intercommunication can not be achieved immediately. Meanwhile, the existing updating system of the development areas is once every two years[1]. How to achieve flexible management and application of increasingly massive results to quickly and visually provide the basis for the land use management has become an urgent problem to be solved. Currently, the scholars have done a lot of exploration on the spatial data integration[4-8], but there is a shortage of researches on the use of it for the evaluation of intensive land use in the development areas. Hou Li[2] conducted useful exploration on this respect, but it was only confined to the specific circumstance of a certain development area, and it never formed the integrated management and application of development area data within a hierarchy. Zhao Xiang *et al*.[3] paid attention to the research of intensive land use results management system in the development areas from the system architecture in theory. In this paper, based on the aforementioned studies, we pay attention to the actual progress and requirements of intensive land use work in the development areas of Hunan Province and the entire country, and propose the spatial data integration program suitable for

Hunan Province, in order to build a management system of practical application value.

1 Spatial data integration

1.1 Concept Through the data conversion and communication, data integration is to unify data structure and data meaning, to eliminate "islands of information" and achieve full range sharing of distributed heterogeneous data.

On the basis of taking full account of the accuracy of spatial and temporal characteristics and attribute characteristics of spatial data as well as the geographical characteristics and process of spatial data, spatial data integration is to carry out organic concentration logically or physically of spatial data, based on different sources, different formats and different characteristics of spatial data.

It is mainly reflected as follows: (ⅰ) eliminating various differences between multi-source heterogeneous spatial data; (ⅱ) establishing integrated management model of spatial data and attribute data, to achieve data integration.

1.2 Spatial data integration method based on database technology The space-based database, middleware technology and database communication technology are used to achieve the integration, call and data updates of heterogeneous geospatial information resources.

1.3 The spatial data integration method for the intensive land use in development areas For the spatial data integration of land use in the development areas, we need to first analyze the content of the data to be integrated, the data format and quality and other specific circumstances, and determine the content, requirements and methods of database to be integrated based on the relevant standards and technical requirements, to process the intensive land use spatial data to be integrated into the standard data meeting the requirements of the results. Finally, we carry out the incoming test on the integrated data, and build the intensive land

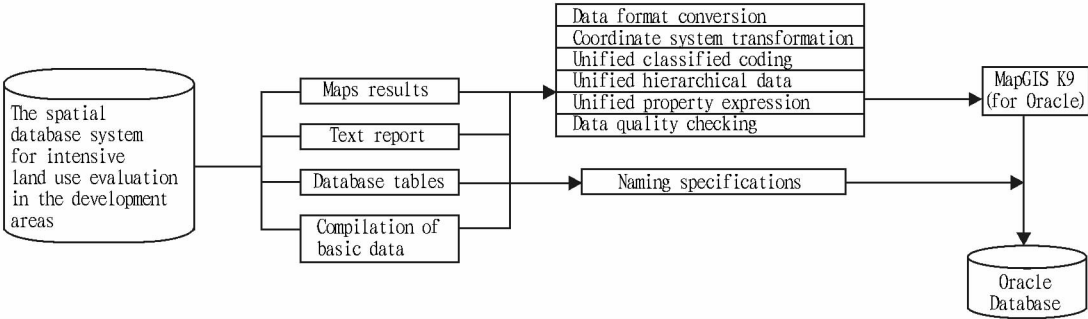use spatial database of development areas (Fig. 1).

Fig. 1 Integration of intensive land use spatial database in the development areas

2 The spatial data integration of intensive land use evaluation in the development areas of Hunan Province

2.1 Brief introduction of the development areas in Hunan Province

In 1991, approved by the State Council, Changsha High-tech Industrial Development Area was established; approved by Provincial People's Government, Yueyang Economic and Technological Development Area and Chenzhou Economic and Technological Development Area were established, opening the prelude to the construction of development areas in Hunan Province. After more than twenty years of development, the important role of development area becomes increasingly prominent, and it has become the important economic point and carrier for the province's economic growth and social development, effectively boosting the province's rapid economic and social development. As of the end of 2011, there were 78 provincial development areas.

2.2 Content and form of the results

The corresponding relationship of content and form of three rounds of intensive land use evaluation results of the existing development areas in Hunan Province (Table 1).

Table 1 Corresponding relationship of the content and form of evaluation results

Content	Form
Report	Paper reports and the corresponding electronic documents (. doc document)
Maps	(i) Paper chart (ii) Vector electronic maps (MAPGIS format) (iii) JPG maps
Compilation of basic data	Paper reports and the corresponding electronic documents (. doc document)
Database table	MDB format
Graphics database	MapGIS format

2.3 Result analysis

By studying the existing reports on evaluation results of intensive land use in the development areas of Hunan Province, the regulations that each round of evaluation is based on, the database standards, review standards and other documents materials, the content, data formats, data quality and other specific circumstances of the database to be integrated are analyzed, and the inspection and evaluation of the database are carried out. At the same time, based on the specific requirements of database system construction projects, this article ultimately determines the purpose, content, requirements and methods of data integration, develops the implementation program for database integration to determine the data organization mode, and deploy the software and hardware devices.

2.4 Data integration

2.4.1 Making up for the deficiencies. This study makes up for the deficiencies in the file form for the three rounds of data in 78 provincial development areas of Hunan Province, remove unnecessary files, and sort the results, to make the data of each development area stored in a uniform file form.

2.4.2 Data file naming and organization. The naming rules of all levels of files, text data files, table data files and map data files are treated and stored according to specifications.

2.4.3 Mathematical foundation. If the mathematical basis of data in the database does not meet regulatory requirements, we need to process them using the following methods:

(i) If the database has no mathematical basis, it should be defined in accordance with normative requirements of mathematical basis;

(ii) If the mathematical basis of database does not meet the above requirements, it should be converted into the mathematical basis meeting the above requirements by coordinate transformation, projection transformation, *etc*.

2.4.4 Element stratification. The database elements to be integrated are stratified, and if there is no optional layer, it must be re-established, but its content is allowed to be null.

The stratification of processed database elements must meet the following requirements:

(i) The stratification of data elements should be the same;

(ii) The stratification of elements should follow the principle of "tolerance", that is, it must be based on the total set of the mandatory layers in the database to be integrated (constraint value of M) and the most complete optional layers (constraint value of O).

2.4.5 Expression of property value. The forms of expression are standardized, and the expression of property value which does not comply with the requirements is modified.

2.4.6 Data integration storage. The vector diagram of develop-

ment areas in Hunan Province is drawn, storage and navigation linking are carried out on the data collected by all the prefecture – level cities, to generate a map of development areas in Hunan Province with dynamic linking, with a view to lay a data foundation for the future application and management.

2.4.7 Data association. The vector data stored are associated with the related business data, graphic data, and evaluation results data, or viewing and output.

3 System design and implementation

3.1 System framework Through a series of steps, such as data importing, data checking, data processing and data updating, the land use basic information database is established, to form a map of economic development areas in the whole province. The system provides the functions of browsing, query, and thematic map results output. Through the system, we can have a clear understanding of the current status, development trends and regional development of various economic development areas, to provide data base for the development planning, status management and decision support (Fig. 2).

3.2 Design of system functional modules In the process of evaluation of intensive land use and updating work in the development areas, the Ministry of Land Resources has developed a an audit software for the evaluation results of intensive land use in the development areas according to the data reporting and review, which can be embedded as a module for reporting and auditing of results.

At the same time, according to the actual needs of the land management work and the relevant requirements of the Ministry of Land Resources on data collection, the functional modules of the

system are designed.

Other system functions are divided into the following five parts: (i) Data management and maintenance: achieving the integrated management of intensive land use evaluation database in the development areas, and with the development areas as the unit, integrating the intensive land use evaluation databases at different time points in Hunan's provincial development areas into the database management system for management. Forming a map of development areas in Hunan Province, and at the same time, displaying the evaluation data in different development areas at different time points in the shape of tree based on the administrative divisions, and forming exchange with the map of development areas in Hunan Province. (ii) The basic operation of the map: achieving the display, browsing, editing and other basic functions of evaluation vector data of intensive land use in the development areas. (iii) Query and positioning: achieving the query and positioning of the data conditions set, and displaying the the results of the corresponding development areas, including text reports, vector data, JPG maps, evaluation tables and the basic information of development areas. (iv) Data statistical analysis: achieving the statistical analysis of intensive land use evaluation content in the development areas at different evaluation time points, and displaying it in the form of graphics, including structural analysis, potential analysis, trend analysis, sequencing analysis, regional analysis, meta-analysis, cluster analysis, threshold alarm analysis, land use, statistical analysis of idle land, statistical analysis of business and the combination statistical analysis of spatial attribute information on the development areas. (v) Other modules: including user management, log management, metadata management and other functions (Fig. 3).
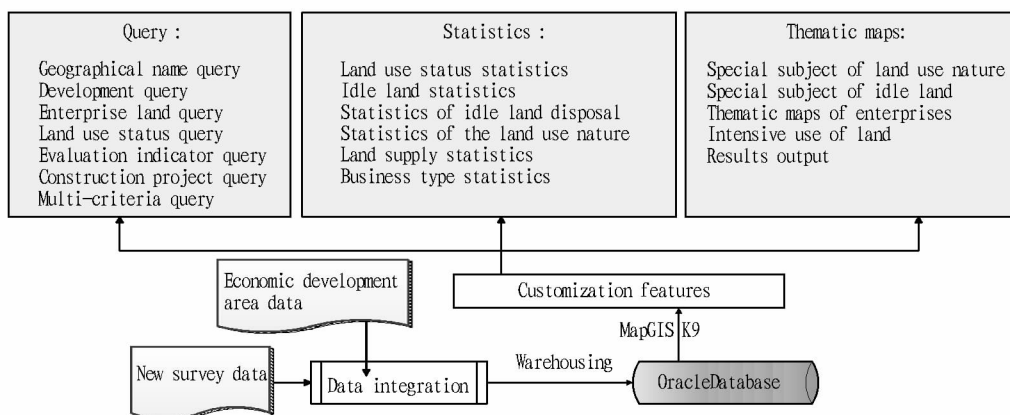

Fig. 2 System framework

3.3 System implementation

3.3.1 System development environment. Taking into account the security, confidentiality, application feasibility of data and other problems, the system uses C/S access mode, and manages the system application and data storage, respectively. Given the rich content and diverse format of intensive land use evaluation results of development areas in Hunan Province, increasing amount of data, and vector spatial data in the MapGIS data format, this article

uses MapGIS K9(for Oracle) and Oracle 11g database management system, to build the spatial database system for intensive land use evaluation in the development areas, and achieve the integrated management of intensive land use spatial data and attribute data of development areas.

With Windows XP/Windows 7 as the client operating system; with Windows Server 2008 as the server system; with Microsoft Visual Studio 2010 Professional Edition as the development
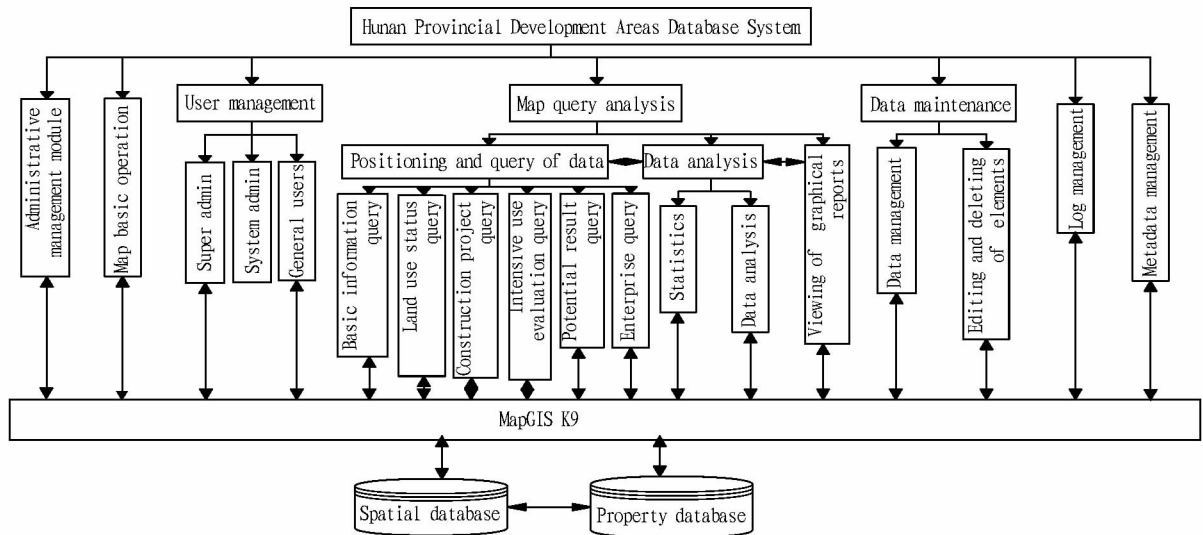
Fig. 3 System function module

tool; with Visual C # as the development language; with Microsoft Visual SourceSafe as the tool for source code management.

3.3.2 System implementation. The user interface is divided into four main parts (Fig. 4). The top of the interface is menu bar and tool bar; the left of the interface is the results of various development areas at different evaluation time points in the shape of tree according to administrative divisions, as well as the layer control management page; the center of the interface is the view window, displaying a map of development areas in Hunan Province or various thematic maps of development areas; the bottom of the interface is the attribute display window.

Through the menu, we can realize upload and download of data (Fig. 5), query and positioning of the development areas (Fig. 6), viewing of the results and the statistical analysis of data (Fig. 7 – 12).
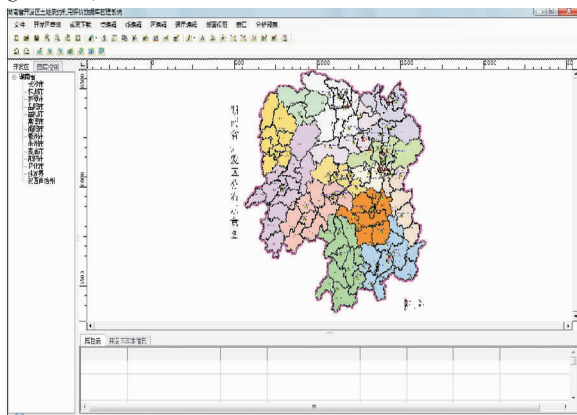

Fig. 5 Data upload and download

Fig. 4 The main interface of the system

4 Conclusions

On the basis of the intensive land use evaluation results of the development areas in Hunan Province, this system analyzes the existing data, using spatial data integration method. With MapGIS K9 as the GIS component, the loose intensive land use evaluation
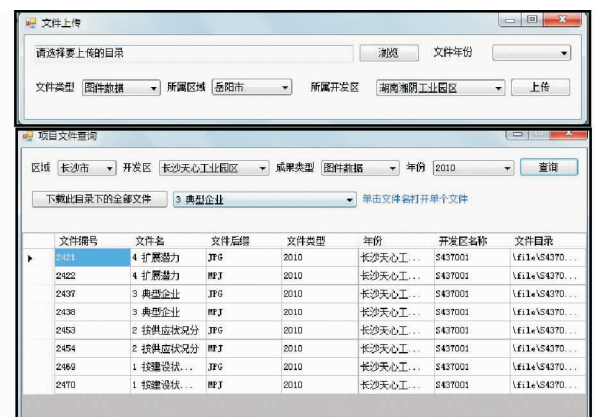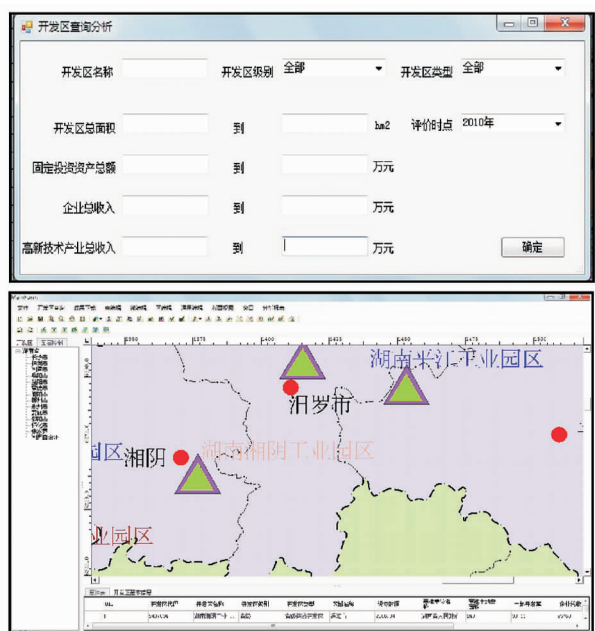

Fig. 6 Query and positioning of the development areas
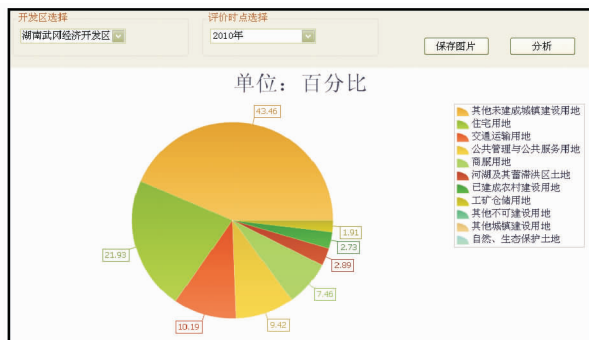
Fig. 7   Structural analysis
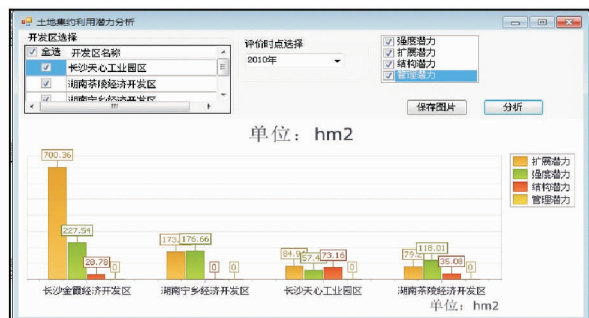

Fig. 8   Potential analysis

Fig. 9   Meta-analysis

Fig. 10   Cluster analysis

results of development areas are integrated and elevated into the database management system for intensive land use evaluation in

Fig. 11   Trend analysis

Fig. 12   Regional analysis

the development areas of Hunan Province，to provide strong technical basis for the scientific decision-making of land management.

References

[1] TD/T 1029 – 2010, Regulations of index system of intensive land use evaluation in development area[S]. (in Chinese).

[2] HOU L. The integration and application of development zone land – use spatial database [D]. Taiyuan：Taiyuan University of Technology, 2012. (in Chinese).

[3] ZHAO X, TANG X, LIU YL. Developing managerial software system for the assessment results of land use intensity in development zones at provincial level[J]. China Land Science, 2012, 26(2)：67 – 73. (in Chinese).

[4] NIE ZL, TANG JH. Research of land and resources spatial data integration [J]. Central South Forest Inventory and Planning, 2007, 26(4)：39 – 42. (in Chinese).

[5] DING LY. Application oriented geography data integration method research [J]. Modern Surveying and Mapping, 2009, 32(3)：30 – 31. (in Chinese).

[6] ZHANG ML, XIAO GR. Research on regional geospatial data integration technology[J]. Computer & Digital Engineering, 2011, 39(1)：48 – 52. (in Chinese).

[7] HOU L, CAO HL, GAO YP. Study on integration and application of land – use spatial database[J]. Huabei Land and Resources, 2012 – 4, 2(47)：53 – 55. (in Chinese).

[8] WANG X, JIANG J, HUANG W, et al. Research on village multi – source spatial data integration methods and technical process——Taking the village of Wuxingsi in Beijing as an example[J]. Geomatics World, 2010, 3(6)：16 – 19. (in Chinese).

[10] Jeffrey M. Wooldridge. Introductory econometrics：A modern approach [M]. Beijing：China Renmin University Press, 2003：541 – 542. (in Chinese).

[11] ZHANG YL, HUANG ZH. Characteristics and trends of the new generation migrants：Survey and analysis on 10 villages in Gansu Province[J]. Chinese Journal of Population Science, 2008(2)：80 – 87. (in Chinese).

[12] LIANG H. Reflection on land security of rural family in South Jiangsu[J]. Chinese Journal of Population Science, 2000(5)：32 – 39. (in Chinese).