Design on Integrated Land and Water Resources Management System Based on Remote Sensing and GIS in Shehezi City

Gaolong ZHU① Xiuwan CHEN②

①② Inst. of RS & GIS, Peking University Beijing 100871, P.R.China

Abstract: Based on the real-time monitoring by remote sensing and dynamic management by GIS on agricultural land and water resources in arid area, we solved the practicability and popularization of small-scale spatial information service system. Through demonstration, the standards of spatial information service database of agricultural land and water resources is set up, and the agricultural land and water resources management system in Shehezi City of XinJiang Autonomy is established, which provides periodically the spatial information services needed by agricultural production to support for sustainable development in arid area.

Key words: Land and Water Resources, Management, Remote Sensing, GIS

1. Introduction

The water source of XinJiang Autonomy comes mainly from snowmelt where there is less rainfall and more evaporation. The water quantity reduces with the rivers flow increasing due to evaporation, irrigation and leakage. The majority of rivers disappear in the deserts or the irrigating regions; only minority of rivers can come into being lakes in the basins. The water resources become more and more lacking and soil degradation is going to be more severe because of the increase of population, abuse of water resources and expanding of plantation. All of these restrict the sustainable development of Xinjiang.

Shehezi city locates north of TianShan, south of ZhunGeEr basin, from 80° 58′ E to 86° 2 4′ E and from 44° 1′ N to 45° 2 0′ N. Its altitude is from 300m to 500m and it belongs to typical oasis region. Shehezi city is less rainfall, plenteous sunlight, intense evaporation, warm in winter and cool in summer. There is short of water resources, plentiful of sunlight and land resources, but land resources quality is worse and salina is severe. The efficiency of water resources utilization in Shehezi city is low. The space matching between water resources and land resources is bad. So the real-time monitoring and dynamic management on land and water resources based on emote sensing and GIS will play important role in the rational and efficient utilization of water resources and the development of agriculture in Shehezi city.

2. Target of system

There are two targets should be realized in the system:

- Establish the land and water resources database of Shehezi city so that the resources information can be

shared

- Establish the land and water resources management system, which can provide scientific basis for the development, utilization, management and decision of land and water resources in Shehezi city.

3. Principle of design

1) Practicability and reliability

System design should be based on application, should be used mature and practiced advanced technology as possible, and should be considered the capability of redundancy and tolerance for error in order to guarantee the reliability of system.

2) Standardization and compatibility

The design and development of system should be kept associating international and vocational criterion, and the same time should be considered adequately of the compatibility with present and future application system.

3) Convenience

The system should provide simple and convenient operational ways and friendly user interface so that it can improve work efficiency.

4) Economy

In order to make the ratio between capability and price best, the function and configuration of system should be combined with the input of users.

4. Logic structure of system

Land and water resources management system is a complicated system project; it includes three layers, that is support layer, management layer and decision layer (see Figure1)

1) Support layer

Support layer is the basic layer of system, including Image Base, Graphics Base and Attribute Base. Remote sensing images are stored in Image Base after processing, which can be used in display, analysis, and information extraction and updating of graphics base and attribute base. Graphics Base and Attribute Base are the important components of GIS. Attribute Base includes a lot of geographic attribute data, social and economic statistic data, and uses the popular relationship database management system to organize and manage.

2) Management layer

Based on the Land and water Resources Database, we develop the special regional Land and water Resources Management Information System using GIS technology, and the same time we integrate a multi-layer and multi-type Land and water Resources Management Model Base in the MIS in order to manage the land and water resources scientifically.

3) Decision layer

Based on the Land and water Resources Management Information System, we integrate a Decision and Support Model Base, then build Land and water Resources Management and Decision Support

System. The decision-makers apply corresponding decision information model in the Model Base and get the useful decision information to make decisions.

5. Database Establishment

1) *Field Spatial Databases*

Crop evapotranspirations differ from each other at different development stage and with different humidity, sunshine, wind velocity, soil moisture, soil type and irrigation mode.

We will choose the corn, cotton and wheat as the experimental crops and the crop development stage will be divided into several phrases such as seedtime, teething, autumn, harvesting periods.

2) *Water Resources Distribution Databases*

The water resources distribution databases include: snowfall or snow database, rainfall database, surface water database, ground water database and ground water exploitation database and so on.

The snowfall (or snow) database includes the following information: the snowfall quantity, snow-covering area, and snow thickness.

The rainfall database has the information of rainfall amount for different place at each period.

The surface water database has the information of stream area and water-storage capacity for different region at each period

The ground water database has the information of water table, water depth and exploitable water amount

The ground water exploitation database has the information of exploited water amount at each period.

3) *Land and soil databases*

This item include the following databases:

Land cover database

Land use database

Soil type database

Topography database

4) *Social and economic databases*

Population database

Social database

Economic database

5) *Meteorological databases*

5. System function

The land and water resources management system in Shehezi city will store a mass of land and water information. With the support of GIS platform, the system will improve the work efficiency and decision power with the system function of information gathering, processing, analyzing, forecasting and expressing with graphic/image.

The system that is composed of six subsystems base on data base and model base. The construction and function of the system is showed as figure 2.

(1) **Basic function**

As a application system, their basic function including:

- Data collection
- Map editing
- Database management
- Query and search
- Spatial analysis
- Map output
- The common function of present associated system about data transformation

(2) Special functions

Except of the aforementioned functions, the system will have the power of forecasting, modeling, optimizing, analyzing and management.

- Land and water resources investigation and evaluation with remote sensing;
- Land and water resources planning;
- Agricultural and grassland water supply and requirement dynamic balance;
- Water requirement forecasting ;
- Biomass and productivity estimation, and so on.

8. Conclusions

At the present there is a lack of practical system of land and water for a city or county. Considering the need of development of water-saving agriculture and land and water management in the arid and semiarid area such as Shehezi city in Xinjiang, we have developed land and water management system, not only for experts, but also for common technicians, and provided basic for the optimal and scientific plan of water and land resources in a city or county.

The difficulties in this project include:

- The retrieving of multi-source remote sensing image for evapotranspiration, soil water and crop growth status, and the fast investigation of water and land resources.
- Base on the analysis of regional water resources status, requirement of agricultural water and land yield potential, how to set up the optimization planning model of water and land resources supported by GIS.
- Integration of remote sensing and GIS.

Spatial information technology has developed from independent units to integrated system, and this will meet the need in application field. It will improve our management of water and land resources, accelerate the use of spatial information in resources and environment field, and promote the progress of our information industry.

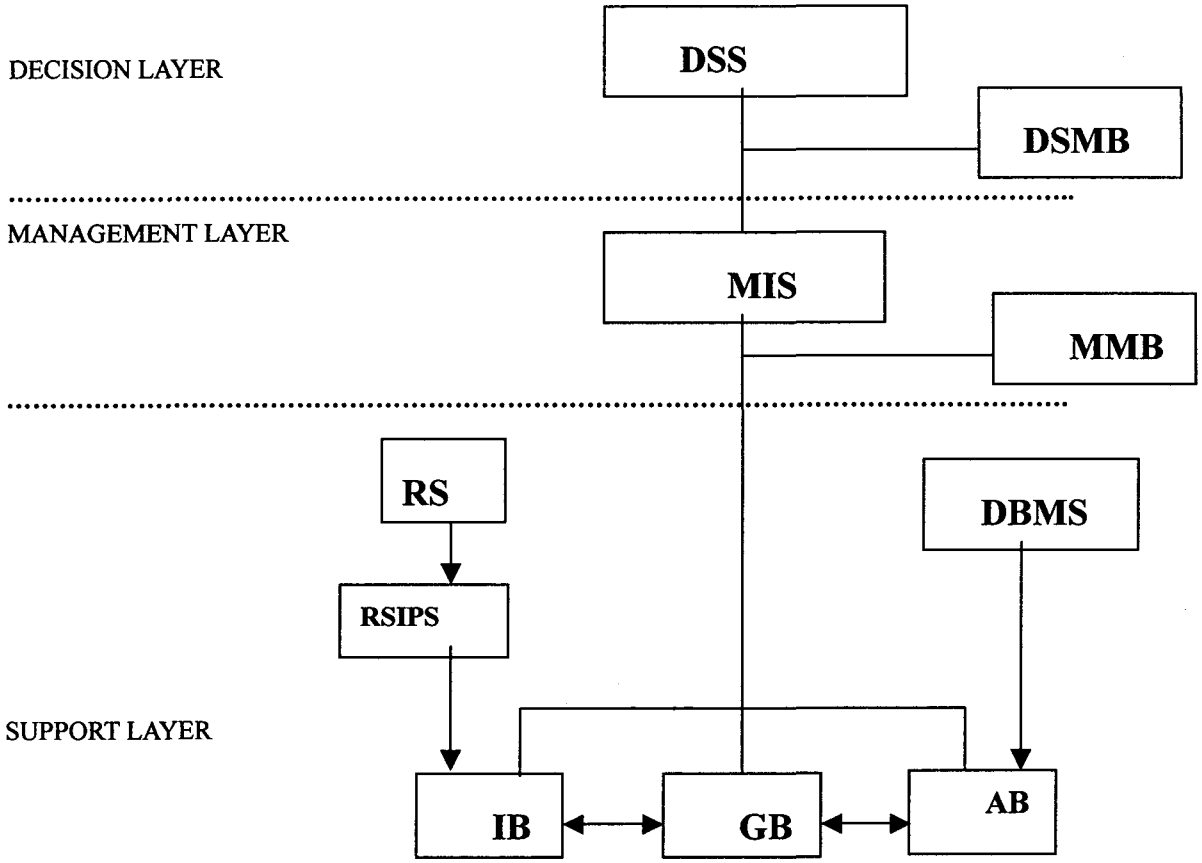

Figure1. Land and water Resources Management System in Shehezi City

DSS: Land and water Resources Decision Support System
MIS: Land and water Resources Management Information System
DSMB: Decision Support Model Base
MMB: Management Model Base
IB: Image Base
GB: Graphics Base
AB: Attribute Base
DBMS: Database Management System
RS: Remote Sensing
RSIPS: Remote Sensing Image Processing System

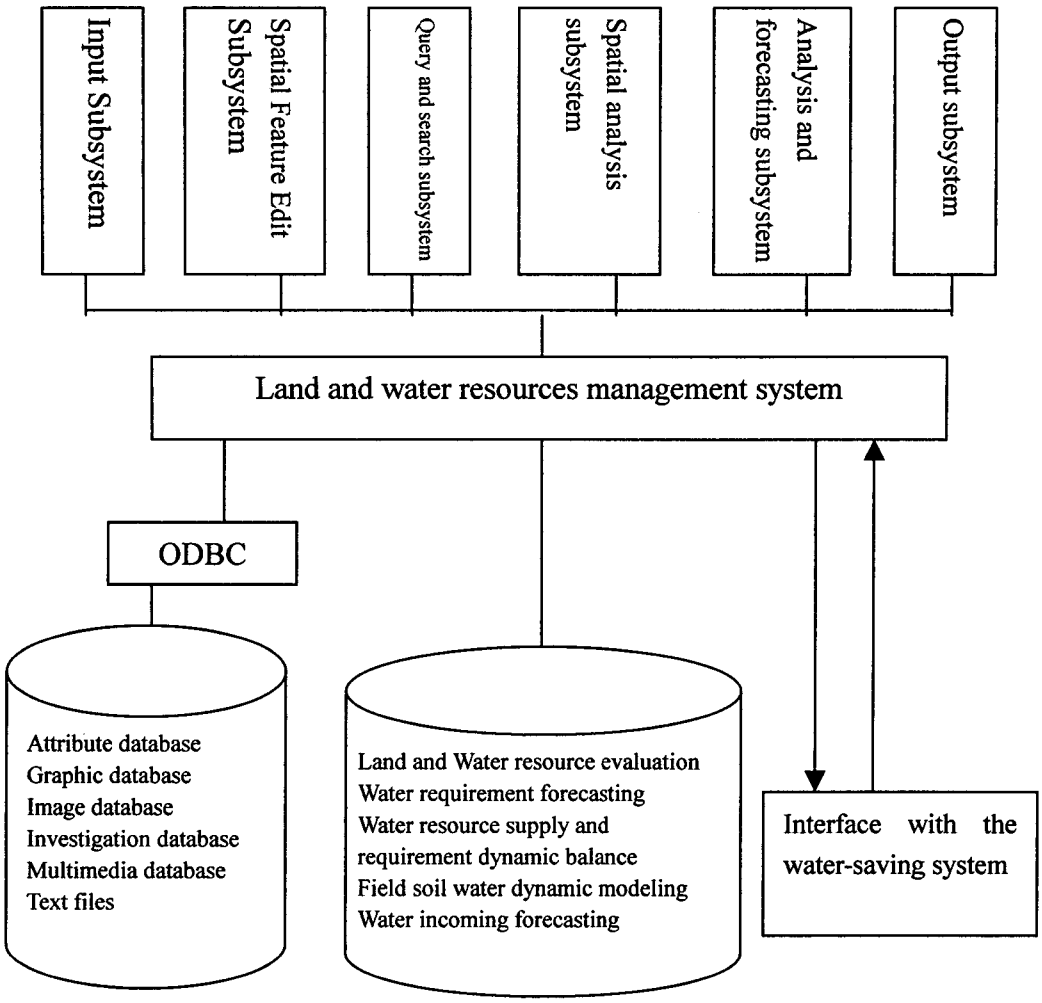

Figure2 The construction and functions of the land and water resources management system in Shehezi city