Development of Guizhou Drought Monitoring and Early Warning and Disaster Evaluation System

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Abstract. The primary contents of system development are to develop a comprehensive system that can analyze and assess the monitoring information collected by the monitoring stations by the information means such as GIS and Internet with the analysis judgment model, transfer the assessment and judgment results to report forms and diagrams which can be inquired through Internet at the right moment. On the basis of the irritation test of Guizhou crops, it provides a comprehensive network drought assessment system that integrates soil moisture content monitoring, drought analysis, drought assessment and forecasting, and information management, and provides technical support for the flood control and drought relief of Guizhou.

Introduction

Guizhou is an agricultural province, and the dependable crop and high production of crops are directly related to the economic development and social stability in the rural area of Guizhou. However, drought is one of the important factors that threaten the agricultural development of Guizhou. Unique geographical environment and changeable climatic factors lead to frequent seasonal and regional drought in Guizhou and seriously restrict agricultural economic development. The total land never changes with the rapid development of social economy and the increase of population. According to the data of Guizhou Flood and Drought, during 41 years from 1950 to 1990, cropping index rose from 1.1 to 1.93. According to the statistics in 2005, the cropping index had reached 2.74. Meanwhile, due to the improvement of farming techniques and crop cultivation techniques, especially the rapid development of crop cultivation techniques recently, on the basis of 1950s, agricultural output doubled several times both in agricultural yield per unit area and in total yield. In agricultural production, the remarkable increase of output is more sensitive to the drought and has a higher requirement for drought control and resisting. With the establishment of National Flood Control and Drought Relief Contingency Plan, accelerating the building of “Three Yu (plan, prediction and early warning)” of flood control and drought relief has been on the agenda of drought relief departments

System Composition

The structural content of the system mainly includes data collection (and filling) system, analysis and assessment system, data management system and assessment result checking and reviewing system.

Monitoring data collection system mainly includes wireless transmission by monitoring site, publishing network data by relevant units through Internet, filling data of the monitoring region by people, and test index.

Analysis and assessment system primarily include the developed part and reserved (secondary) development port. The developed part includes dry “soil moisture content and drought assessment” (including the drought assessment of different crops) system, drought assessment system in consecutive rainless day, urban drought assessment and forecasting system, drought statistics and analysis and assessment system. The reserved (secondary) developed port includes the assessment system of paddy rice on the basis of “method of water break days” and “method of water deficient
ratio”, irrigation works information management system, water level of river (reservoir) monitoring and forecasting system, irrigation management system of irrigation district.

Data management system primarily refers to the management of evaluation data and the preservation of historical data, including initial data management, assessment data preservation, graphics generation and management, management (secondary development) of irrigation works information.

Assessment result checking and reviewing system includes the system of checking relevant data report and system of reviewing the analysis and forecasting result and graph.

System development takes villages and towns or stations as unit, and regards the county (city) and region (prefecture and city) as a subarea for analysis and assessment. The graph development platform of the system is dominant by China geographic information system (MapGis), and the development language mainly includes Visual Studio .Net 2003, ADBMS and VB6.0.

Table 1. Check list of database.

<table>
<thead>
<tr>
<th>ID</th>
<th>Ename</th>
<th>Cname</th>
<th>Typ</th>
<th>Acesslev</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Areacode</td>
<td>Area code</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Riverparam</td>
<td>River Parameters statistics</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>Canalparam</td>
<td>Chanel project parameters statistics</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>Trismallparam</td>
<td>Three small project parameters statistics</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>Socioecoparam</td>
<td>Statistics of the basic parameters of social economy</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>Waterliftparam</td>
<td>Water life parameters statistics</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>Impoundparam</td>
<td>Impound parameters statistics</td>
<td>1</td>
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</tr>
<tr>
<td>8</td>
<td>Rainfallandeva</td>
<td>County rain fall and evaporation</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>Fieldmonitor</td>
<td>Field monitor data report</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>Waterbreakdays</td>
<td>Drought assessment and grading based on water break days</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>11</td>
<td>Drysoilparam</td>
<td>Basic experiment parameters of dry soil</td>
<td>3</td>
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<tr>
<td>12</td>
<td>Conrainlessdays</td>
<td>Drought assessment and grading based on consecutive rainless days</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

**Function and Principle of System Development**

**System Function**

System function mainly includes drought assessment of the monitoring data in the drought monitoring stations according to the assessment criterion of national regulations and the correction data of irrigation experiment in Guizhou with relevant analysis model, drought loss statistics and assessment of corresponding assessment unit of Guizhou, building the development platform of the secondary development (or system expansion development) content, publishing and checking of the analysis and assessment result through Internet, which provides information support and basis for drought prevention and resisting[2].

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Development Principle

The system development mainly takes Mapgis67 as the platform, regards Visual Studio .NET 2003 as the language, considers SQL Server2000 and VB6.0 as data management and develops some application programs. The edition of the system is server edition, dominant by network operation and realizing the authorized visit of terminal. The basic assessment unit of the system focuses on villages and towns and takes a county (city) and region (city) as the assessment unit. Each unit is managed with the corresponding code, and the code above county level is national standard regional code. The schematic diagram of the system is as fig.1:

Detailed System Design

Main Interface of the System

The main interface is the main page of network operation and visit of the whole system, and its contents are the front choice of the system operation. The content includes the general options of the web page and system assessment option.

(1) The general options of the web page include home page, introduction to the unit, news, products, download, member center, customer forum, related links, calendar watch, spot news and scrolling display of notice-board.

(2) System assessment option includes registration of users, checking and browsing relevant subsystem, management of system maintenance and assessment process. The specific options include five parts, namely basic regional parameter collection and report checking system, drought analysis, early warning and forecasting system (soil moisture and drought assessment, drought assessment in consecutive rainless days), agricultural drought assessment, urban drought assessment and map query system.

Basic Regional Parameter Collection and Report Checking System

Basic regional parameters collection and report checking system mainly includes filling of relevant forms and checking of assessment result, and is divided into administrator operation and common user query according to the access authority. Administrator operation includes common user query and can change and add report data. The involved reports are as follows:

(1) The basic data reports mainly include “river parameter statistics”, “channel project parameter
statistics”, “Three small project parameters statistics”, “statistics of the basic parameters of social economy”, “water lift parameters statistics”, and “impound parameter statistics”. (2) Station data mainly includes “rainfall and evaporation of villages and towns”, “field monitor data report”, and “urban rainfall and evaporation”. (3) Test data forms mainly include “drought assessment and grading based on water break days”, “basic experiment parameter of dry soil”, “drought assessment and grading based on consecutive rainless days”, “drought assessment and grading based on water deficient ratio”, “drought assessment and grading based on soil moisture content”, and “test parameters in the crop growth period”. (4) Drought assessment data forms mainly include “urban drought assessment parameters”, “urban drought loss assessment”, “basic parameters of flood control water level monitoring of rivers”, “forecasting data of flood level of rivers”, “statistics of investigation and assessment of drought resisting investment”, “statistics of direct economic losses of agricultural drought”, “statistics of investigation and assessment of agricultural production loss”, “statistics of investigation and assessment of human and animal drinking water loss”, “Drought investigation and assessment of paddy based on water break days and water deficient ratio”, “basic parameters of reservoir”, “forecasting parameters of flood control by reservoir regulation”, “forecasting and assessment of flood control by reservoir regulation”. The above report data can be searched, updated and checked according to the access level through area name, area code and date.

**Drought Analysis, Early Warning and Forecasting System**

Drought analysis, early warning and forecasting system includes soil moisture and drought assessment, and drought assessment on consecutive rainless days. On the basis of the data collected by relevant monitoring station, the system analyzes the data with relevant assessment models, and predicts, judges and assesses the drought on the day, 3 days later and 10 days later according to the “Drought Evaluation Standard” (Trial) issued by the State Flood Prevention and Drought Resistance Headquarters and relevant test data of the central station of irrigation experiment of Guizhou. The assessment result can be checked in the form of form or graph on the network. The graph query includes query of drought grade graph of regions and isoline map (see graphic query system).

**Agricultural Drought Assessment**

Agricultural drought assessment is statistics and analysis system, and takes villages and towns as a statistical unit, a county (city) and district (city) as a statistical cell. The data for assessment are from the data filled by each statistical cell, and statistic report is formed by analyzing the data filled by each region, and the relevant grade is judged and assessed. The assessment result is provided in the form of form or graph for the query.

**Urban Drought Assessment**

Urban drought assessment system takes a city (county and district) as the object of statistics, judges and assesses the relevant level through the filled drought loss of each city. The assessment result is provided in the form of report forms for querying.

**Map Query System**

Map query system mainly includes area distribution map query, query of area display of drought, and query of isoline map. The area distribution map includes “Guizhou area distribution map” and “Guizhou urban distribution map”; area display of drought includes “Guizhou agricultural drought map” and “Guizhou soil moisture and drought of subarea map”; The isoline map includes “isoline of Guizhou soil moisture content” and “isoline of rainless days of Guizhou”.

**Primary Innovations of the System**

The innovations of the development of Guizhou drought monitoring and early warning and disaster assessment system include the following aspects:
The system is developed aiming at Internet operation, has realized system analysis and assessment and network sharing of assessment result, and provides a convenient query method for users to timely understand the drought situation. Each subsystem can be inquired, browsed and consulted according to the data source and requirements. Query and browse includes data report forms query and graph browsing. On the one hand, it is convenient for the grass-root units to understand the drought situation and recent prediction timely and reasonably arrange agricultural activities. Meanwhile, it provides relevant information timely for the departments in charge and the governmental departments to prevent and resist drought, guide the drought prevention and resisting, and reduce drought losses.

(2) The data are from an automatic collection and artificial filling, which improve the collection density of raw data and the flexibility of data input. According to the feature that relevant monitoring station has not been allocated widely, the initial data for analysis and assessment is from automatic (direct input by monitoring stations) collection and artificial input (data is filled on the network and gathered and input by the analysis center), which makes up for the lack of station distribution and data discontinuity, and improves the operation reliability and flexibility of the system.

(3) As a comprehensive network platform integrating drought monitoring and assessment and water conservancy information management, the system saves cost and improves efficiency. The system framework is a comprehensive platform integrating drought analysis and assessment, drought prediction, agricultural drought assessment, urban drought assessment, water conservancy information management, reservoir monitoring and information consultation. With the operation and improvement of the system, it will realize all-around water conservancy information management and disaster monitoring, integrate resources and improve the amount of information.

(4) The system can assess and predict drought, judge and adjust the test index to make it more suitable for the drought assessment and judgment in Guizhou. The development and operation of the system referred to the water saving irrigation research achievements of Guizhou Hydro Science and the agricultural irrigation test of Guizhou Irrigation Test Central Station, and amended the assessment and judgment index through relevant tests to make it more suitable for the reality of Guizhou.

(5) Flexibility and compatibility of updating and expanding the system are strong. The main development environment of the system is .NET 2003, and map management is dominant by MapGis. .NET and MapGis are widely used in the domestic servicer operation system and geographic information development, and have universal development environment. In the process of development, multiple system planning and gradually developed framework are the premise. Subsystem can be added according to requirements, which provides convenience for updating and expanding development of the system.

Conclusions

The purpose of system development is to cooperate with the state to build the “Three Yu (plan, forecasting and early warning)” for flood control and drought relief. Depending on China University of Geosciences’ application and development of information technology and geo-information system as well as the advanced technique in development in addition to the professional knowledge and research results in disaster monitoring and water-saving irrigation technology of Guizhou Hydro Science Institutions, combining the irrigation test of Guizhou crops, a comprehensive network drought assessment system integrating soil moisture monitoring, drought analysis and drought assessment and forecasting and information management is provided for Guizhou.

After the system is successfully developed, drought can be analyzed and forecasted according to the monitoring and relevant judgment index which can be inquired and browsed through Internet. On the one hand, the system provides consultation of drought development for agricultural production and arranging agricultural production activities at the right moment, reasonably distributing water resources, improving the ability to prevent and control drought, effectively
resisting drought, and reducing drought losses. On the other hand, the system provides drought information for the governmental institutions and relevant drought relief departments timely, supplies the basis for the decision-making of prevention and resisting of drought, and thus improves the efficiency of drought prevention and resisting. The system is of great importance to promote the water-saving irritation in the whole province, advance the optimization and adjustment of agricultural planting structure, drive the development of agricultural economy, help peasants increase income, and accelerate the construction of agricultural informatization.

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Reference