Research on Key Technologies of big data analysis in smart irrigation area

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Abstract. Several key data analysis technologies involved in irrigation area construction are discussed. A closed-loop large data management model for irrigation area is proposed, which includes data collection, data sharing, data management, data development and utilization. Five types of analysis, including statistical analysis, professional calculation, planning optimization, system simulation and intelligent algorithm, are compared, and an abnormal water intake behavior early warning, water supply and demand forecast, water-saving irrigation area evaluation and installation are constructed. Four typical application scenarios, such as intelligent research and judgment of abnormal operation, have certain reference value for promoting the construction of intelligent irrigation area.

1. Introduction
In the new era of "Internet+", water resource management mode is constantly updated, information management level of irrigation area is constantly improved, water resource monitoring system in various areas is gradually improved, data resources are rich, a large number of business systems appear, and information level of irrigation area is effectively improved; but at the same time, there are also problems such as information sharing in irrigation area, business system interoperability and repeated investment in system construction. Irrigation area is the core of ensuring national food security. Therefore, it is very important and urgent to establish large data of irrigation area and strengthen the research on water resource management theory of irrigation area so as to use water scientifically, reasonably, planned and emphatically.

2. Composition of big data in irrigation
Irrigation areas need not only water supply for agriculture, but also for industry, urban life, service industry and even ecological environment. The data resources of irrigation area should cover both the data of irrigation area itself and the relevant data of the administrative area in which the irrigation area is located, as shown in Table 1.

| Data category | Data item | Data source Department |
|---------------|-----------|------------------------|
| Basic data    | Name, scale, area and planting structure of irrigation area | Agriculture and Water Department |

Table 1. Composition of big data in irrigation.
3. Data collection and sharing model

3.1. Data collection

Data sharing includes out-of-industry sharing and in-industry sharing. The former is realized through the government public data sharing and exchanging platform, while the latter is realized through the provincial water conservancy data sharing and exchanging platform. The key to data aggregation is to define the process of data sharing.

"V" model is used to conduct data aggregation. It is divided into downward and upward stages and a middle link, in which downward is the sorting and analysis process of data characteristics, upward is the process of validating data results effectively, and the middle is the data collection operation. as shown in the Figure 1.

![Figure 1. "V" word model for data collection and sharing in irrigation area](image_url)

3.2. Data sharing

After data is collected into provincial water conservancy data warehouse, it is necessary to establish a reasonable sharing process to realize data sharing, as shown in Figure 2.
The data demand department defines the required shared data according to the specifications and carries out the demand retrieval on the provincial water conservancy data sharing and exchanging platform. If the data has been collected, then after the task list of data sharing is formed, a shared service application is initiated to complete the sharing through the data sharing interface or batch database table data. If the data is not collected and the demand unit submits the demand, Provincial Information Technology Department will review the format and specification of the demand description and issue the data responsibility list to the digital source department after the review has passed. Data source department confirms data items and related elements, and associates corresponding data catalogues of resources to form responsibility table for providing data, and then collects data in turn.

![Data Requirements](image)

Figure 2. Data Sharing Process in Irrigation Area

4. Data governance
According to the data characteristics of irrigation area, the key technologies of data planning, data database building, data catalogue, data governance and data opening are studied.

Through data governance, we can assess the quality of large amount of integrated multi-source heterogeneous data and improve the efficiency of data governance by using large data analysis methods. Customized development data extraction, cleaning, conversion, integration and loading processes, the original scattered, repetitive and low-quality data will be governed into high-quality data sets with uniform format, uniform type, uniform unit, uniform coding, uniform logic and clear data sources. Through data security management, authority can be assigned according to organization, role, position and user. Data authority can be assigned to function, menu, data and field level.

5. Development and utilization of big data in irrigation area

5.1. Big data analysis model
All kinds of scenario application can not be separated from the support of intelligent decision-making model. The role of decision-making model is to help people grasp the past, predict the future and make decisions at present by mining and analyzing data resources in irrigation areas. According to the performance requirements of irrigation area management and characteristics of data resources, five decision models are constructed, including statistical analysis, professional calculation, planning optimization, system simulation and intelligent algorithm.
In contrast, large data analysis does not require sampling or hypothesis-making, directly carries out correlation analysis on the data, bypasses the complex hydraulic model, insights into correlation from a large number of heterogeneous and disorderly data, and predicts the development trend of things. For various scenario applications, one or more types of data can be used, and one or more types of algorithms can be used to select the appropriate algorithm based on the principle of utility.

5.2. Application scenarios of big data analysis in irrigation area

5.2.1. Early warning of abnormal water intake behavior. Through the construction of the sky ground integrated monitoring system, the water intake behavior is supervised, and the possible abnormal situation in the process of water resources management is predicted. Through the online data of each water intake monitoring point, the accumulated water intake of each water intake household in a certain period of time is calculated, and the slow or fast water intake behavior is timely reminded; for the irrigation area with reservoir as the water source, the water supply capacity of the reservoir is analyzed, and the available water supply is calculated online with the input of the recent weather forecast information, reservoir water level and other online data.

5.2.2. Forecast of water supply and demand in irrigation area. This paper analyzes the correlation between rainfall, temperature, topography, runoff, runoff coefficient and water inflow over the years, and forecasts the available water supply in the irrigation area based on the data of that year; analyzes the socio-economic factors such as population, GDP, water price and water quota, and the relationship between agricultural development factors such as crop planting structure, irrigation area and irrigation coefficient and water demand over the years With the data of the current year as the input, the water demand can be predicted.

5.2.3. Application scenarios of water saving irrigation area evaluation. Under the condition of limited water resources, it is particularly important to carry out the water use benefit analysis. Around the three red lines of water resources development and utilization, water use efficiency, and water function area limitation, based on the thematic data warehouse of irrigation area, the manual filling should be reduced as much as possible, and the strictest water resources assessment and water-saving irrigation area assessment should be carried out.

5.2.4. Intelligent judgment of abnormal operation of facilities. Through the analysis of the reporting rate, integrity rate and timeliness rate of monitoring data, the intelligent alarm is given when the data reporting is abnormal or the quality of the reported data is not high; the abnormal situation of insufficient power supply caused by the aging of solar panel power facilities is given an alarm by monitoring parameters such as electricity quantity and power; the opening and closing state of the gate is monitored, and the abnormal opening is studied and judged. All kinds of abnormal results are directly pushed to technicians or monitoring equipment manufacturers for timely repair.

6. Conclusions
Data resources of irrigation area are gathered, large data of irrigation area is established, information technology and core business of irrigation area are deeply integrated, which constitutes data brain of irrigation area and helps to realize:

1. Data sharing across departments. Water resource management in irrigation areas involves data from different departments such as water conservancy, environmental protection, meteorology, economy, rural agriculture, etc. Currently, all departments are building perception facilities and department data centers in their respective business areas. Based on the principle of intensive construction, cross-departmental data sharing is realized, regular updating mechanism is established and information islands are broken down. On the basis of data sharing, realize Department linkage, business collaboration and maximize platform efficiency.
(2) Scenario application integration. Scenario management of water resources in irrigation areas and set up large data screens for various scenarios. The large data screen has clear themes, focuses on one or more related practical problems, supports on-demand switching, and can be multi-layer drilled down. The platform construction is open and compatible. Under the unified standard framework, water administrative departments at all levels are supported to expand the application of personalized scenarios according to their own business needs.

(3) Intelligent decision support. Establish the management mechanism of "one source, one source and on-the-job maintenance" of data resources in irrigation areas to ensure data quality. On this basis, it integrates intelligent decision support model, carries out multi-source information fusion and multi-dimensional data mining analysis, realizes the transformation of application function from information monitoring, pushing and displaying to scientific forecasting and intelligent decision-making, provides auxiliary decision-making for Department performance, and comprehensively supports strong water resources supervision in irrigation areas.

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