A Research on the Development of a Publicly Owned Natural Assets Management and Supervision Platform

Jiaqiang Ren[1,a*], Huijing Chu[1,b]

[*] Corresponding author: 1939251760@qq.com[a], Chj20211202@163.com[b]

School of Management, Shenyang Jianzhu University, Shenyang, Liaoning, China[1]

Abstract: To meet the practical needs of natural resources management and supervision, based on the inventory results of natural resource assets such as the state-owned land, minerals, oceans, forests, grasslands, wetlands, water, etc., and the basic information platform for the land and space, and by the unified provincial standards, we will gradually build an integrated natural resources management and supervision platform with functions including statistical accounting, asset allocation, and evaluation and assessment through exploring the measures such as "business reshaping, data integration, and application integration", etc. The platform will provide strong and favorable technical support for planning and preparation, administrative review and approval, monitoring and supervision, evaluation and decision-making, etc. for the natural resources, and effectively improve the level of modernization of natural resources management.

Keywords: Natural Asset Management, Regulation, Platform Development.

1 INTRODUCTION

There are many types and large quantities of natural resources. Therefore, their asset value assessment is affected by multiple factors such as resource type, environment, market value, and ecological benefits. Their management and value assessment is quite complex and calls for theories, methods, and norms in the work. Since the 18th National Congress of the CPC, the institutional mechanism for the management of natural resource assets owned by the public has been gradually established and improved, which has played a positive role in promoting the construction of ecological civilization. However, there are still problems such as a lack of owners in place and unclear management responsibilities. The problems of excessive resource exploitation, weak protection, and ecological degradation are still quite serious. Currently, the management of natural resource assets in various regions is still in the exploration stage. Standards and measures with uniform regulations have not yet been formed, and the informatization construction is insufficient. Establishing an information support platform to serve natural asset management is demanded if the owner's responsibilities are to be fulfilled, and it is also demanded if the owner's rights and interests are to be realized [1].

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Following the general principle of integrated management of natural resources, we analyzed the characteristics of various work tasks and businesses, studied the key technologies such as efficient big data computing, platform cloud architecture, efficient spatial data rendering, and visualization components, and built a natural resource assets management information system and carried out application practice to support natural resource assets management and supervision.

2 SYSTEM REQUIREMENTS ANALYSIS

2.1 Challenges for the Natural Resources Information Management

Natural resource asset management is a systematic project that involves a wide range of areas and multiple sectors. It is comprehensive and systematic. Traditional management methods are often inadequate, and a unified management and supervision platform has not been established between different departments, making it difficult to effectively conduct resource management. As a result, it faces five outstanding problems including a lack of owner in place, unclear assets inventory, insufficient market allocation, imperfect revenue management, and inadequate ownership assessment and supervision.

2.2 The Necessity of System Building

The integrated natural resources management and supervision platform provides favorable technical support for planning and preparation, administrative examination and approval, monitoring and supervision, and evaluation and decision-making for natural resources development and utilization, and effectively improves the modernization level of natural resource management. In the background of the “Internet +” era, it is imperative to establish an integrated natural resource management and supervision platform to form unified data standards and norms and break down departmental barriers.

3 SYSTEM DESIGN

3.1 System Architecture

The system architecture consists of an infrastructure layer, a data resource layer, a platform support layer, and an application layer. It is shown in “Fig 1”.

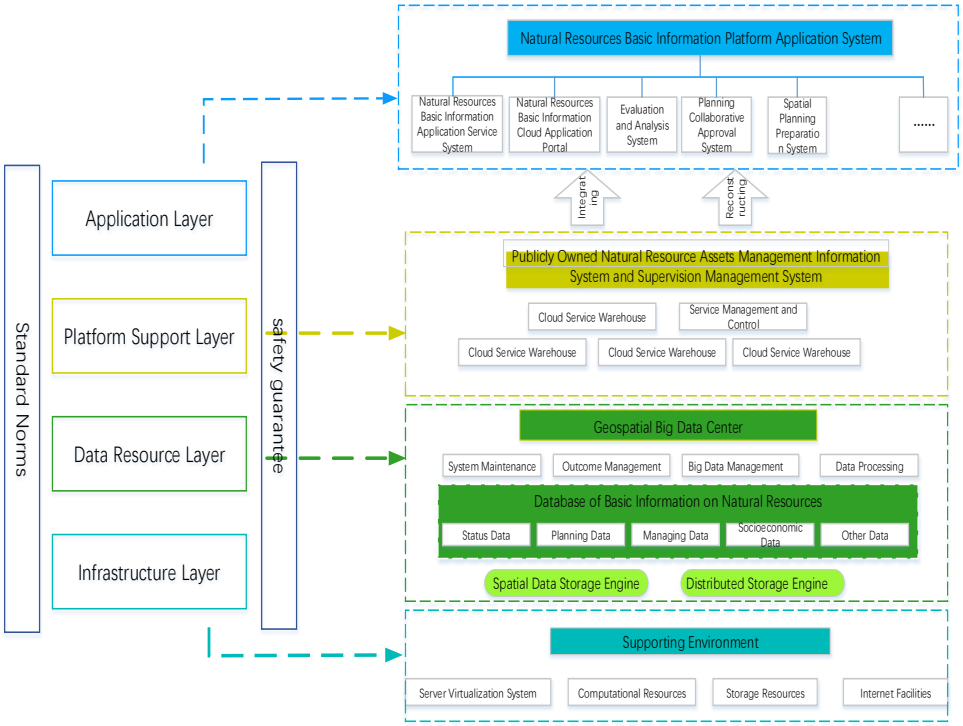

Fig 1 Natural Resources Integrated Information System

3.1.1 Infrastructure Layer

As a supporting environment, the infrastructure layer provides the infrastructure supporting the databases and application systems, including required computing resources, storage resources, network environment facilities, and server virtual systems. The infrastructure layer relies on the results of natural asset inventory and information platforms. It is established based on the government extranet interconnected by provincial, municipal, and county departments, which ensures the stability of operation and the convenience of use at the city and county levels [1].

3.1.2 Data Resource Layer

The prerequisite for centralized management of natural resource data at the data resource level is the formation of a unified data standard. Then relying on data management and service platforms and various data processing tools, we may continuously update, maintain, and manage natural resource data. In the natural resources integration database, the province's land, minerals, oceans, forests, grasslands, wetlands, water, and other planning data from different years are collected to ensure that all relevant data are further improved during the implementation process, and that data support is provided for higher level applications.

3.1.3 Platform Support Layer

The platform support layer completes various supporting tasks such as data collection, extraction, integration, quality inspection, operation, and maintenance based on the database, and enables data extraction, fusion, analysis, and computation by customizing basic algorithms and building computational models. The service interface solves the problems of decentralized storage and separate management of a large number of natural resource business data and provides the application system with the required spatial computing capabilities and public data support.

3.1.4 Application Layer

The application layer uses the basic data related to the daily management of natural resource assets and the index data of rich information and various forms to provide users with a visual page. It facilitates the end users to clearly and intuitively understand the situation of natural resource assets in the whole province. It has the function of directly realizing the work and serving the management work of natural resource assets.

3.2 Business Reshaping

When building an integrated management and supervision platform for natural resources, the business process should be clarified. Based on the needs of natural resource management and supervision, scientific management concepts and advanced and feasible information technology should be used to fully prepare and optimize the process, and the natural resource management business should be packaged into different categories and re-integrated to make the processing more flexible and the operation more convenient and faster. First of all, the core tasks of natural resources management and supervision should be clarified, for example, what functions should the natural resources integrated management information system and supervision platform have and what aspects should be covered. The relationship between various businesses should be clarified to form a business system. We need to comprehensively consider the business content of the natural resources such as the state-owned land, minerals, oceans, forests, grasslands, wetlands, water, etc., determine the relationship context, build an integrated management and supervision platform, establish a unified login portal and information entry and output channels, etc., improve the business process, strictly standardize and supervise the handling and implementation of each work task, and form a standardized manual covering processing procedures, business rules, required materials, time of limit of work, etc. Only by doing so will we be able to provide guidance and regulation to the processing of the related business.

3.3 Data Fusion

For the intensive management and supervision of natural resources, resource sharing, and business collaboration, forming a unified database system is a prerequisite. Based on the inventory results of national land, minerals, oceans, forests, grasslands, wetlands, water, and other natural resource asset and territorial spatial basic information platform data, we gathered and integrated diverse and heterogeneous natural resource-related data, clarified the data context and centralized storage, established management standards, and achieved the purpose of hierarchical data management. In the data fusion process, the target layer is treated according

to the thematic data layer, such as spot breaking, value assignment, area adjustment, spot merging, etc., to perfectly meet the data extraction requirements of various resources [2]. Finally, it provides functions such as data conversion in various formats, automatic real-time data updates, annual data changes, and multi-party sharing.

3.4 Application Integration

To establish an intensive platform for the management and supervision of natural resource assets owned by the public, it is necessary to make full use of the existing hardware and software infrastructure and configuration, such as network environment, application system, information platform, etc., to carry out application integration and change the traditional way of resource management. We need to unify the portal to enable the full coverage of the natural resource asset management information system business, enable the unified scheduling of information and data, break down the barriers between departments, and strengthen the communication and coordination between departments with the help of information technologies such as cloud computing, big data and the Internet of Things, to have smooth communication channels at the departmental level [3]. Secondly, the Internet + supervision method is adopted for unified supervision and management to ensure that various decisions are made in a smooth and orderly manner.

3.5 Highlights Of The Technology

3.5.1 Architecture Upgrade

Unlike the previous chart, cloud architecture is used to support the scheduling of the elasticity of the clusters and nodes. Nodes can be added and reduced to achieve resource controllability, and multiple nodes can be parallelized to improve system performance and computing efficiency with stronger performance stability and scalability of the cloud architecture cluster management. This is shown in “Fig 2”.

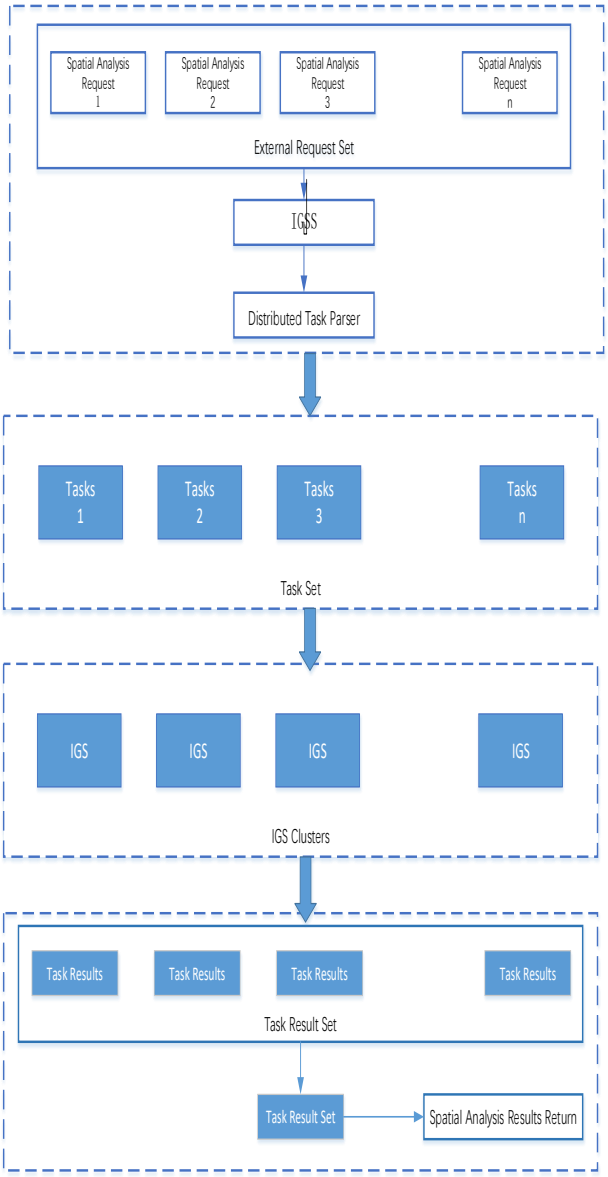

Fig 2 Platform Cloud Architecture

3.5.2 Service Model Upgrade

The service management system adopts multi-level decentralized management, one-level deployment, multi-level use, and information exchange for the service upgrades, as shown in “Fig 3”.

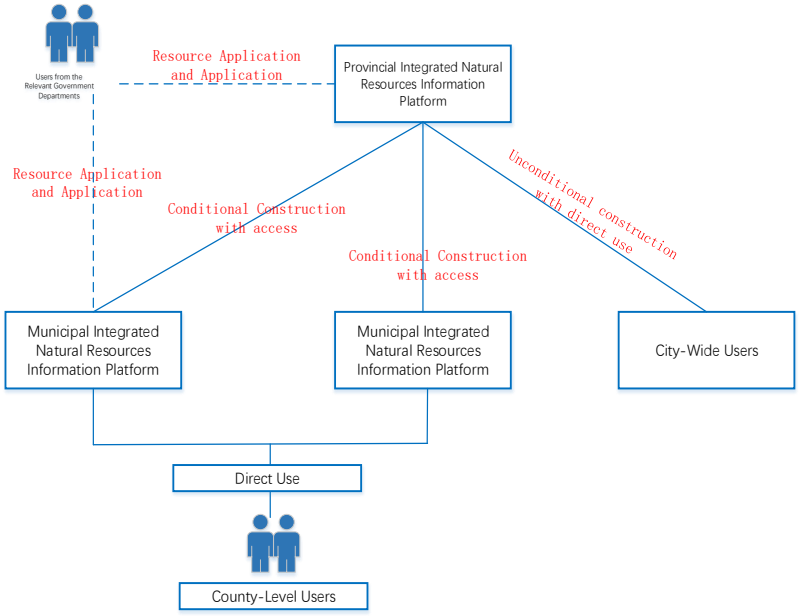

Fig 3 Service Mode Diagram

3.5.3 Dynamic Fast Rendering of Data

The massive vector data is directly displayed in an unsliced manner, saving a lot of time for image resizing and enabling browsing in seconds under high concurrency, achieving a browsing speed comparable to that of the tiles. When related data changes, they are updated synchronously on the client side, so that the data changes and information can be instantly shared.

3.5.4 Efficient Big Data Computing

The platform supports multi-source data access from various data sources such as MapGIS, SDE, and MapGisDatastore. Distributed and efficient computation can realize distributed spatial computation of hundreds of millions of vector data. Compared with the traditional computation model, the computation has been greatly enhanced and the computation results are directly presented in the form of rich statistical charts, providing visual support for decision-making.

3.5.5 Full Sharing of Natural Resource Information

A series of service resources such as the cloud service portal includes the application service system, and the relevant departments can apply for online access through the portal. The basic data, examination and approval, planning, evaluation, supervision, and other applications of the natural resource assets such as state-owned land, forests, oceans, grasslands, minerals, wetlands, and water are all incorporated into the integrated platform of natural resources

management, which enables the whole chain business, assists daily office work and improves work efficiency.

4 CONTENT OF THE CONSTRUCTION

4.1 Database Construction

Natural asset management is complex work, and the complete, detailed and effective natural asset data is the premise and basis for smooth management and supervision. The natural asset database is built based on the inventory results of natural resource assets such as state-owned land, minerals, oceans, forests, grasslands, wetlands, water, etc., and is a basic information platform for territorial space. The database construction is completed following the requirements of a unified spatial positioning benchmark, unified naming rules, and a unified data format of the data structure.

4.2 Construction of the Information Release Platform

The natural asset data system is relatively quite huge. Achieving rapid display in the system not only places high requirements on management functions but also places high requirements on system performance. This platform applies Web service technology and SOA system architecture completes platform construction concerning OGC standard service specifications, realizes distributed management, centralized sharing, and service of natural asset information, supports multi-source heterogeneous data, supports third-party services based on OGC standards, supports various file structures, supports dynamic tile acquisition and other technologies, and facilitates the quick browsing and access by the users.

4.3 Data Center Management System Construction

To ensure quality data storage, preprocessing such as inspection, editing, and data conversion must be performed on the data by the relevant specifications to ensure the quality and standardization of data storage. The data center management system consists of a data management maintenance subsystem, a data exchange and update subsystem, a data query and statistical analysis subsystem, an application service management subsystem, and a system maintenance subsystem.

4.4 Construction of Data Sharing and Exchange Service System

The data information sharing service system is mainly built to complete the dynamic release of data information, information query, data sharing, and other functions, publishing the data information on the extranet portal website, making full use of and integrating natural asset database resources, building a public information service platform integrating spatial data and attribute data, realizing relevant data sharing, information browsing, and inquiry functions, providing information services to enterprises, the public and government departments, and improving the online approval and declaration system.

5 FUNCTIONAL ANALYSIS

The integrated natural resources management and supervision platform is an intelligent management platform that can perform data analysis, plan difference analysis, assist natural government approval, and serve natural resource supervision and regulation, the natural resource information sharing with the integrated functions such as statistical accounting, asset allocation, evaluation, and assessment. The main functions are as follows:

5.1 Data Analysis

Based on the data resource catalog, we collected and sorted out all kinds of territorial spatial data at all levels, established a data resource classification system, formed a natural resource data center, and provided auxiliary planning preparation and review tools for planning preparation organizations and personnel. The data center enables editing and revision of the planning data, quality monitoring of planning results, spatial analysis and evaluation, comparison and coordination of planning differences, and the three-district and three-line inspection of spatial planning zones to improve the planning preparation efficiency and quality of results. Through the establishment of an evaluation model, a comprehensive analysis of the current situation, planning, and socio-economic data existing in the database was carried out, and the carrying capacity and development suitability of the land and space resources was monitored and evaluated. Thus, a scientific basis is provided for the rational regulation and control of ecology, agriculture, urban space, etc[4].

5.2 Planning Difference Analysis and Compliance Review

Planning difference analysis, compliance review, and comparative analysis between multiple layers can be used for conflict detection in land planning, urban and rural planning, forestry planning, etc., to provide technical support for resolving various planning conflicts, conduct compliance reviews of each resource application, achieve a “speaking-with-data” method to determine whether the application conforms to the master plan and issue monitoring and analysis reports and compliance details to assist planning approval.

5.3 Auxiliary Natural Resources Government Approval

Functions such as graphic positioning and query services provide visual spatial graphic support and information query services for natural resource e-government approval. In addition, by spatially superimposing, caching, and statistical processing of various kinds of natural resource data, the top ten administrative review functions are enabled, and effective natural resource management can be carried out[5].

5.4 Serving the Regulation and Supervision of Natural Resources

For land resource supervision, the platform enables the whole life cycle supervision of land "pre-examination, approval, land supply, land use, compensation, and investigation", and provides overall supervision of land use pre-examination, construction land, land supply projects, development and consolidation projects, etc. For mineral resource supervision, the platform enables the full life cycle supervision of mineral resources, provides exploration

project registration, mining right application registration query, and supports multi-condition combination query, keyword query, etc. According to the specific needs, it also serves the regulation and supervision of other natural resources such as forests, wetlands, oceans, water, etc.

5.5 Serving Natural Resources and Information Sharing

Through service cluster management, it supports dynamic resource scheduling and elastic scaling; supports the registration, publication, and formation of service resource pools of vector spatial data, structural data, file type data, and three-dimensional models. Through the unified service portal, it provides a service resource center for government departments, corporations, and the public, supports self-service applications and offline use, and enables multi-party sharing of natural resource information.

6 PRACTICAL APPLICATIONS

6.1 A New Data Resource Classification System

Natural resource data has numerous sources and abundant volume. Standardized data management is required in building the new data resource classification system, management mechanism, and organization method for basic information, data source information, data dictionary, and storage information. According to the data resource catalog, various types of natural resource data are collected and collated at all levels to form a natural asset big data center. *As shown in "Fig 4".*

Fig 4 Resource Classification System Interface

6.2 Analysis and Evaluation

By establishing a comprehensive evaluation model, the current situation, planning, and socioeconomic data existing in the database are comprehensively analyzed for weighted calculations, and the state of natural assets is tested and evaluated.

6.3 Auxiliary Natural Resources E-Government Approval

By displaying various types of natural resource data, the platform provides visual spatial graphic support for natural resources e-government approval. *As shown in "Fig 5".*

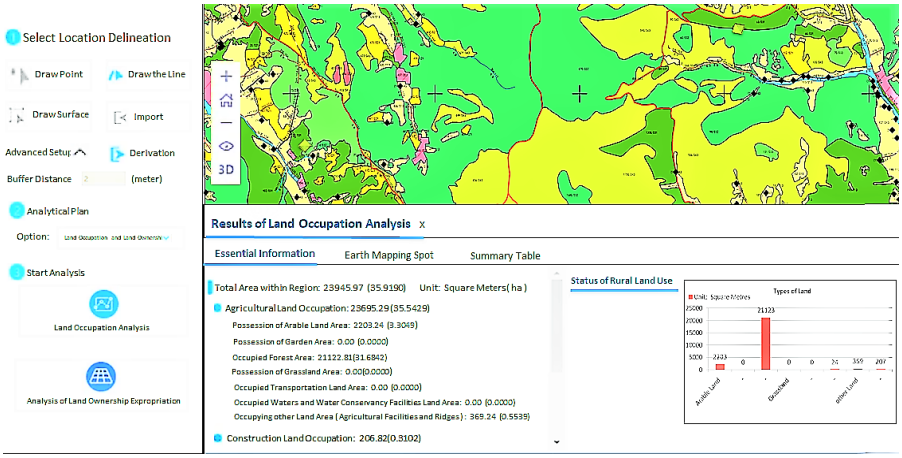

Fig 5 Natural Resources E-Government Approval Interface

6.4 Supervision of Natural Assets

Taking state-owned land as an example, example, it realizes full-lifecycle supervision of land "pre-examination, approval, land supply, land use, land supplementary, and inspection", and provides overall supervision of land use pre-examination, construction land, land supply projects, development and consolidation projects.

6.5 Information Resource Sharing

Through service cluster management, it supports dynamic resource scheduling and elastic scaling; supports registration and publication of various data and 3D models to form a data resource pool. Government departments, enterprises, and the public can apply for online use of the platform through the unified service portal. *As shown in "Fig 6".*

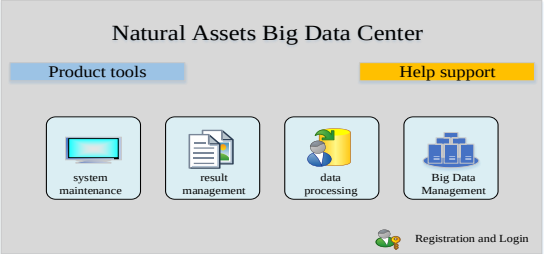

Fig 6 Unified Service Portal Interface

7 CONCLUSIONS

Based on the natural resource asset inventory results, the spatial data of the territorial spatial basic information platform, and the natural resource management requirements, this paper constructs an integrated natural resource information management and supervision platform with the support of emerging technological means such as big data, the Internet, GPS, etc., to serve natural resource management and supervision. It enables real-time tracking of natural resource dynamics, breaks down departmental barriers, improves work efficiency, and effectively improves the modernization level of natural resource management capabilities. First of all, natural resource assets are a huge system, and there are many types of data. There is still a long way to go before we can achieve complete storage of data. Next, we need to carry out further data mining work and complete the supplementary storage of data. Second, it is necessary to continuously improve and maintain the system during actual application.

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