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Research on Improving the Optimization System of Agricultural and Forestry Resource Allocation Management Measures by Using Multi- Objective Optimization Algorithm



Abstract: -At present, there are some problems in the use of forestry resource database, such as large amount of data and data centralization, which leads to the low efficiency of the system. Therefore, an application software platform for forestry informatization is built based on optimized Hadoop cluster. The system consists of four parts: permission management, file management, interface management and data processing. In this paper, a control strategy FDMDR is designed, which implements dynamic copy management according to user access frequency. A method of file access frequency limit based on DMDR is proposed, and the data in the system is processed dynamically. The experiment proves that the system can integrate traditional files, images, videos and other contents organically. The system has achieved a better integration of traditional agricultural information resources. It has good performance and scalability.

Keywords: Objective Optimization Algorithm; Agricultural Information Resources; Massive Small Files; Dynamic Copy Strategy; Resource Management System.

I. INTRODUCTION

With the rapid development of the Internet and computer technology, the Internet of Things technology based on computer technology has been applied to various fields of agriculture on a large scale. In this case, agricultural informatization has become an inevitable development direction. At present, China's traditional agriculture is developing in the direction of modernization, digitalization and information technology, and agricultural information resources with Internet as the main body have gradually formed. Agricultural resources have the characteristics of mass, heterogeneity and diversity, which meet the requirements of "big data". Effective management of agriculture with big data can greatly improve the level of agricultural information technology in China. By 2013, more than 100,000 large-scale agricultural information resource systems had been established in all provinces [1]. From 2011 to 2014, the number of satellite images and geographic information, plant and animal growth information, agricultural product supply information, multimedia information and other services in China's rural areas increased from 1012B to 1014B, totaling hundreds of TB. From this, it can be seen that the amount of agricultural information is not only huge, but also because of the different agricultural regions, crop varieties and information management methods, a large number of decentralized documents, databases, knowledge bases and network service resources have been generated. These products are available in Beijing, Shandong, Henan and other places, stored in cheap, low-performance, outdated computers [2]. However, due to regional dispersion, seasonal changes and other reasons, various types of resources in different regions lack of correlation, resulting in the independence of various types of agricultural information resources, forming information islands, local order and overall chaos [3]. How to manage these huge agricultural data efficiently is an important problem that needs to be solved urgently.

In recent years, with the continuous emergence of emerging concepts such as mobile Internet, intelligent sensor network, Internet of Things, and cloud computing, new technologies have developed rapidly, and massive data and knowledge have also erupted, and the era of big data has quietly arrived. Peer-to-peer computing aiming to achieve end-to-end services of information resources, service computing emphasizing on-demand services, grid computing with dynamic and cross-virtual organization resource collaboration as the main feature, pervasive computing to achieve ubiquitous computing resources and accessible to users anytime and anywhere, and service-oriented cloud computing aiming at transparent use of resources by users, have emerged one after another

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[4]. These studies have played an active role in promoting the effective management of information resources from different aspects. Some scholars have designed a lightweight file system FlatLFS, which uses a flat way to store and access the above distributed file system, replacing the traditional file system. A distributed storage technology based on network is proposed, which can effectively solve the storage problem of small files. However, FlatLFS comes at a cost in terms of performance and does not have the layered structure of traditional distributed file systems. In recent years, some researchers have designed an optimal access mechanism by storing it in a continuous memory [5]. This method can effectively reduce the fragments of documents, increase the access ability of small documents and the use of memory, and also reduce the overhead of creating networks, thus greatly improving the efficiency of document transfer. Some scholars have studied the small document fusion algorithm for the association relationship between multiple documents. The ability of continuous access to them is further improved by preloading them. Cloud storage is a new technology accompanied by the emergence of cloud and the expansion of its applications [6]. The cloud storage system aims to provide secure, reliable, fast, and low-cost storage services. It uses technologies such as distributed file system, grid technology, and clustering technology to effectively integrate massive heterogeneous resources scattered in networks in various regions. In the cloud storage environment, the replication mechanism can reduce the access response time, improve resource fault tolerance, balance node loads, reduce network communication costs, reduce remote data transmission, and improve data reliability. At present, there have been many researches on this problem. The project will take HDFS and MapReduce as the core, conduct a comprehensive analysis of Hadoop cloud computing architecture from the internal mechanism, and install JDK in Linux environment, set SSH passwordless Settings and configure Hadoop. Finally, the corresponding profile information is released to each child node in a distributed way, so as to achieve efficient migration of Hadoop cloud computing. This paper establishes the agricultural information construction platform [7]. Using SSH2 architecture, it realizes four main functions, such as permission management, file management, interface management and data processing. In the user authorization management, users add, modify, delete and other operations; File management can complete file upload, download, delete, browse; Through interface management, the Web service interface and HDFS are connected. The statistical processing part completes the statistical processing of data through three methods: classified statistics, sub-regional statistics and joint statistics.

II. AGRICULTURE AND FORESTRY RESOURCE ALLOCATION SYSTEM

A. System Architecture

According to their respective functions, they are divided into four parts: permission management, file management, statistical analysis and interface management. In the user authorization management, users add, modify, delete and other operations; File management can complete file upload, download, delete, browse; Through interface management, the Web service interface and HDFS are connected [8]. The statistical processing part is completed by three methods: classified statistics, sub-regional statistics and joint statistics. Its structure is shown in Figure 1 (image cited in EnLiFT Model 1.0: a household income and food security model for rural areas of A Manual).

B. System Function Modules

1) Rights Management Module

The user rights management system realizes the personalized service to the user according to the different requirements of the user. It realizes the connection of database, permission login, and the management of the basic information of the user. At the same time, this system can also be modified by the manager, delete, add and other operations. After the user turns on, ensure the security of their data [9]. Users are often asked to enter your desired user name and set password into the system. The system according to the input of user data to determine their own use rights, divided into three types: system administrator, regional administrator, general user. The system administrator has the right to modify, delete, and add information. When the system administrator makes a change or addition, such as whether to store, a dialog box appears, and after administrator verification, the background database is updated. When deleting information data by the system administrator, as long as you click the corresponding button of "Delete", the dialog box of "Confirm to delete" will pop up. After confirming this action, the system database will delete the relevant data table. The region manager provides the general user with the right to correct, delete and add information, if the region manager changes or adds some information, a dialog box will appear, such as whether to save, if the region manager determines their actions, then the system will update the background database [10]. When deleting information data, as long as you click the "Delete"

button, a "Confirm to delete" dialog box will pop up. After confirming this action, the system database will delete the relevant data. The system is also provided to ordinary users, so that they can quickly browse and consult the information they need. The flow of the authorization Management system is shown in Figure 2 (the image is referenced to Leverage the Rights Management-).

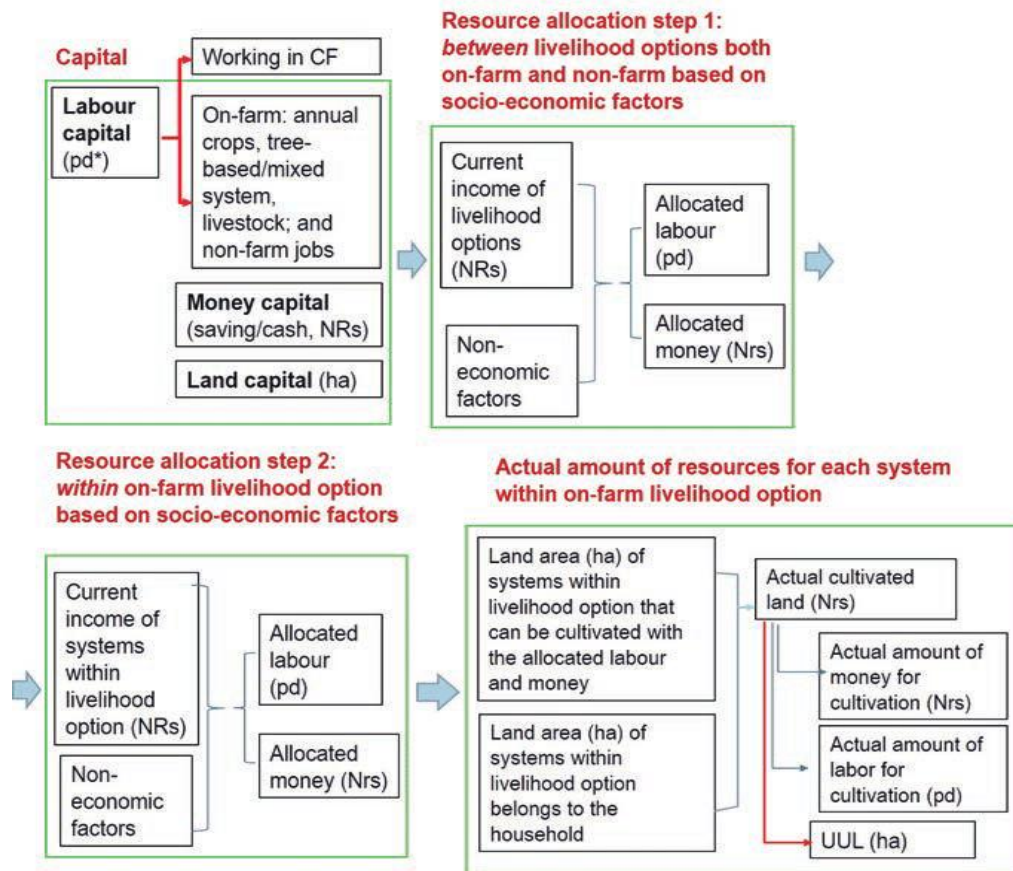


Fig.1 Functional module structure of agriculture and forestry resource allocation system

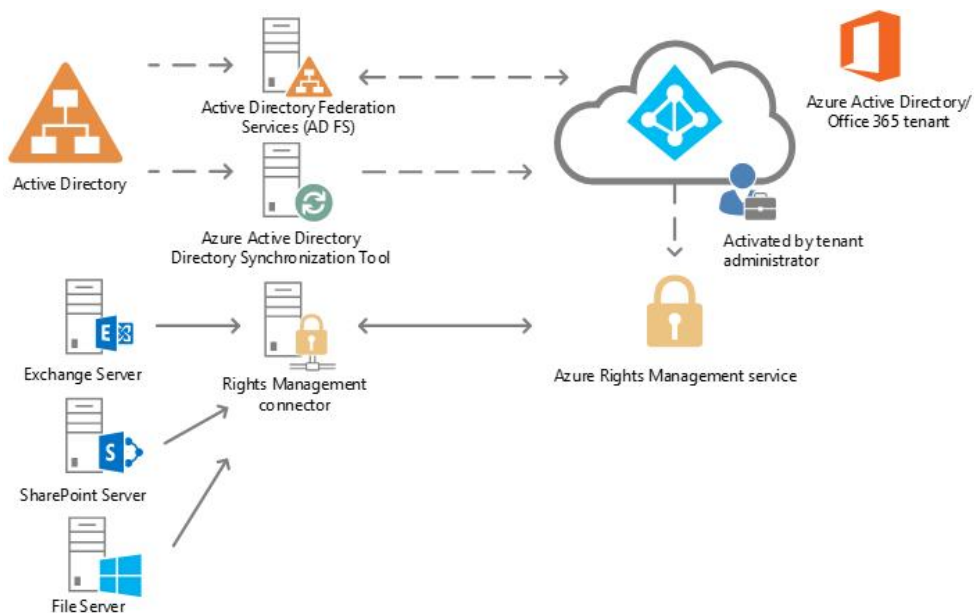


Fig.2 Rights management module flow

2) File management module

The function of the file management module is to perform the corresponding management of the file, including file view, delete, download and upload. After the license is confirmed, the file is treated differently

depending on the owner of the file. The corresponding process of file download: according to their own permissions, let the user choose the document they want to download, and then click "download", there will be a suitable dialog box, in this dialog box, the user can choose the file to save the path, and can also change the file name [11]. After the user has decided to download the file, click "Confirm" to download the file. If the specified file name already exists, the user will be presented with a "File name already exists" reminder window. If the user selects "Continue", the original file will be overwritten, and if the user selects "Cancel", the file download will be terminated. The flow diagram is shown in Figure 3 (image cited in Sensors 2022, 22(11), 4243).

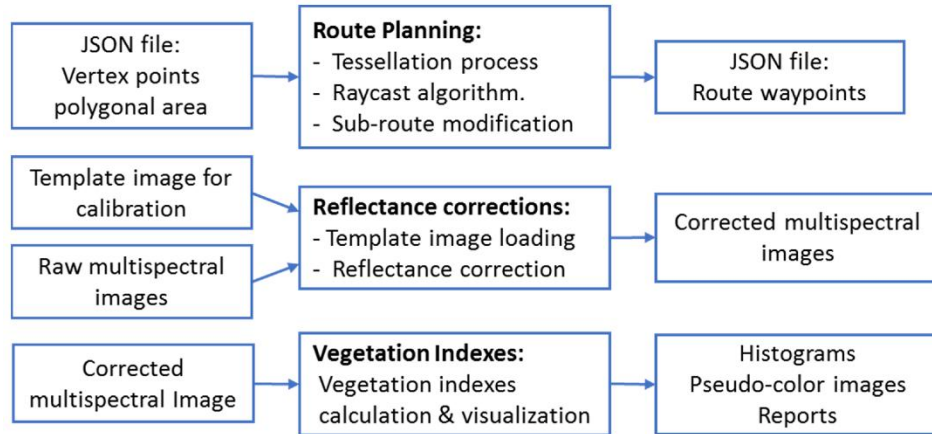


Fig.3 File load management module processing process

In the file view list, the user selects the file to be deleted, and then click the file to be deleted, this time it will determine the user's permission to use, if the system manager to delete a file, then he can freely delete the file; If a file is deleted by a normal user, the user must first identify the uploader of the file, if the file was sent by the user, the user can remove the file, if not, the user will send a message to the user that the user has no right to delete the file. After deleting a document, the relevant information saved in the document must also be changed, if the document does not have a shared user, the operation terminates, if the document has a shared user, the shared information should be removed from the database sharing table [12]. The Process is shown in Figure 4 (image cited in Blockchain-Based Security Access Control System for Sharing Squeeze Casting Process Database).

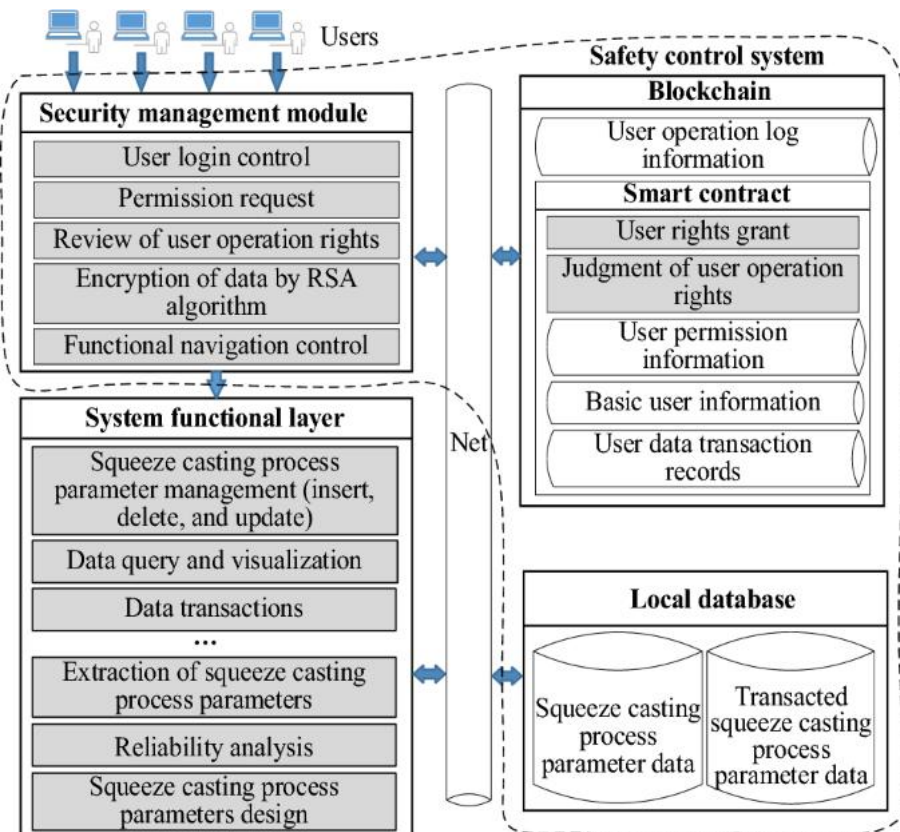


Fig.4 Process of file deletion management module

3) *Statistical Analysis module*

The statistical analysis module of archival data is to present the data of relevant regions by selecting regions or data categories. Use the Fusion Charts plug-in to present the data, including line charts, pie charts, histograms, etc. You can present the data in a variety of ways.

C. *Database Design*

The database of the platform will continue to operate from the time the user logs in to the system, the main entry point of the database is the user login, and an access association must be established between each data table. As shown in Figure 5 (image cited in Remote Sens.2022, 14(1), 77). These materials are all named in English. The id in the category table, the category in the file table, the id in the area table, and the area in the log table are the primary keywords for each data table, and the related arrows in the table represent the interrelation between the various data. Users need to enter the user name and password in the user, click login, do not support the user registration, the user is added through the system to complete the internal addition, users include general users, regional administrators and system administrators [13]. All the functions are operated by the system administrator, and the administrator can only manage the relevant files within this scope, and the general person has the permission to view the data. The system first checks the user name and password of the system. If the user name is blank, "User name cannot be blank" is displayed. If your password is blank, "Your password cannot be blank" will be displayed. When the user name or password is incorrect, "User name or password is incorrect" is displayed. After checking, you need to call the user login method in the background. After entering the user name and password, determine that the user name and password stored in the database table are the same as that typed by the user, ask the user what rights they have, and access the appropriate system.

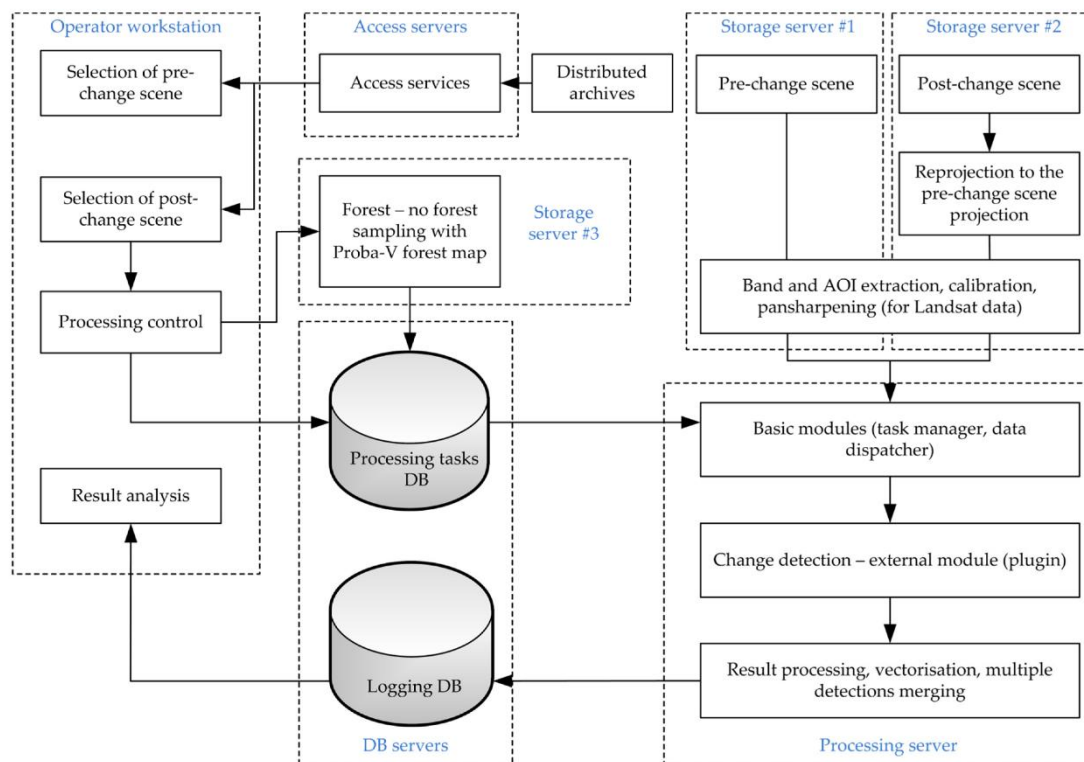


Fig.5 Design of the database architecture

D. *Spatial Data Access Middleware (Arcs DE)*

1) *Composition of integrated data environment system*

ArcSDE is a good middleware. At the same time, it also provides a good interface for the interaction between GIS and spatial database established by relational DBMS. ArcSDE architecture is a relational database based, space, attribute and other data storage and processing infrastructure. ArcSDE is a kind of software based on user/server architecture, it is on the upper layer of relational database system, through the user's needs to search,

retrieve, analyze and other functions. Functions and functions in ArcSDE are implemented by various functions and functions in ArcSDE.

2) *Working mechanism of graphic data acquisition system*

Middleware is a kind of software between an operating system and an application that can provide an executable and executable for its upper application. ArcSDE is a kind of middleware that does not have its own spatial data storage, and its function is to carry out "spatial expansion" to the database. ArcSDE creates an Oracle table space called "Database" in Oracle, which contains a set of Oracle objects, such as: spatial data dictionary, ArcSDE package, etc. In the SDE mode, the spatial data dictionary is used, and the corresponding software package is executed to ensure the consistency of data reading and writing. ArcSDE is an Oracle Server interface procedure to interact with the database. Each ArcSDE service has a calling procedure that listens for user connection requests and clears unconnected user processing [14]. Each client application connected to ArcSDE is assigned a graver process generated through going. Through Oracle Server, graver provides users with all database query and modification requirements. In the operating system, ORACLE logically stores objects in one or more file-supported table Spaces. Oracle typically specifies a separate table space for various types of data. The normal working mode of ArcSDE applications is that ArcSDE's server program specifies a procedure called gsrvr to complete the metadata communication between the client and the server. Since version 8.1, a new linking method has been added. In this form, the power of the gsrvr process is embedded in the client's connection. The function of gsrvr is realized by connecting the client to the application software. The working principle of ArcSDE is shown in Figure 6 (image cited in ISPRS Int.J. Geo-Inf.2015, 4(4), 2078-2093).

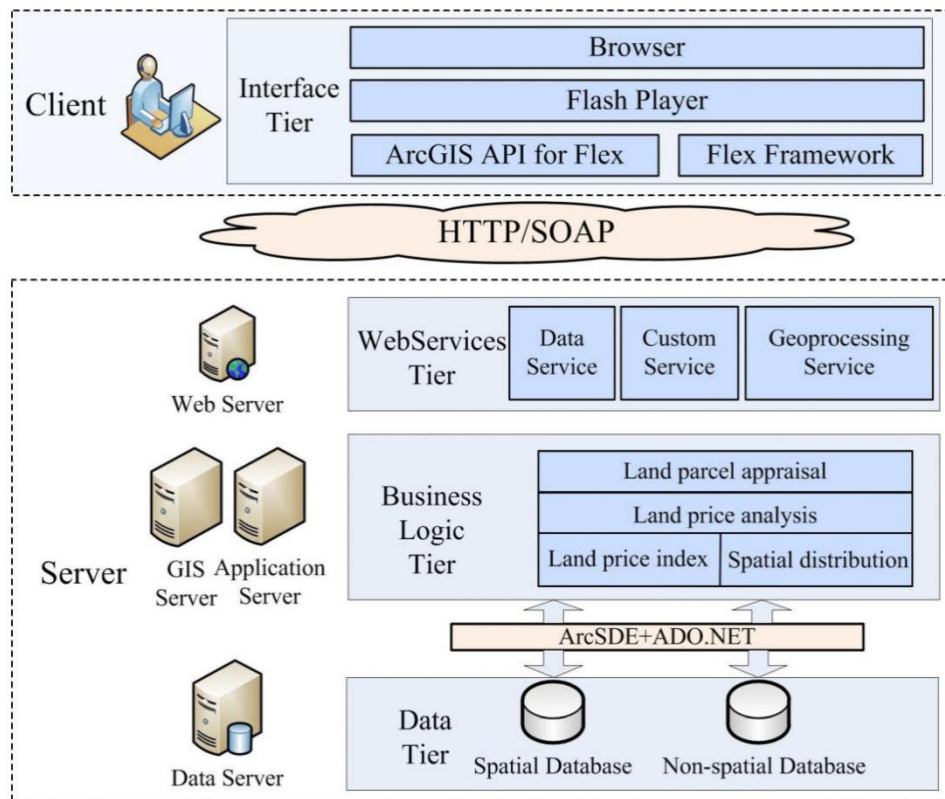


Fig.6 Operation mechanism of ArcSDE

3) *Spatial data storage Management in ArcSDE*

The storage and management of SDE adds a new data type to the relational database without affecting the existing database system. This method completes the unified management of space and attribute by adding a geometric row to the data table. SDE places spatial information and spatial indicators in two separate tables, and links them with a key value. SDE implements the management of space tables by storing data in hierarchical tables. This layer of tables is ArcSDE's metadata, corresponding to each layer, and the name of the table is used to store the name of the business table.

SDE creates three tables to store and manage spatial information. These tables and their relationship to the layer table are shown in Figure 7 (the image is referenced to the Geographic Database System table). A business table adds a geometric data item to an existing associated database table, thus giving the table space. A geometry

data item is an integer type data used to uniquely identify a geometry object. This integer is the element tag number, and business tables can be linked to element tables and spatial index tables by the ID number. The element table, also known as the "property table" or "F table", is used to store the geometric property values of ground objects. The element table holds the geometric features of terrain elements in BLOB binary format. The element table contains the element tag, the type of shape, and the range of packaging. The element table is specified with the code F, which is the layer number of a spatial domain [15]. The business table and the element table are connected by fid. A spatial index table is a reference for geometry falling into a regular grid. The model is represented in a hierarchy of spatial terms and is denoted by S. Grid elements can be modified according to the actual situation, its size is determined by the average size of the filling interface, the grid element size must not be lower than the average size of the element filling interface, otherwise it will cause many grid elements in the index table will produce the same element edge, thereby increasing the length of the index table and search speed.

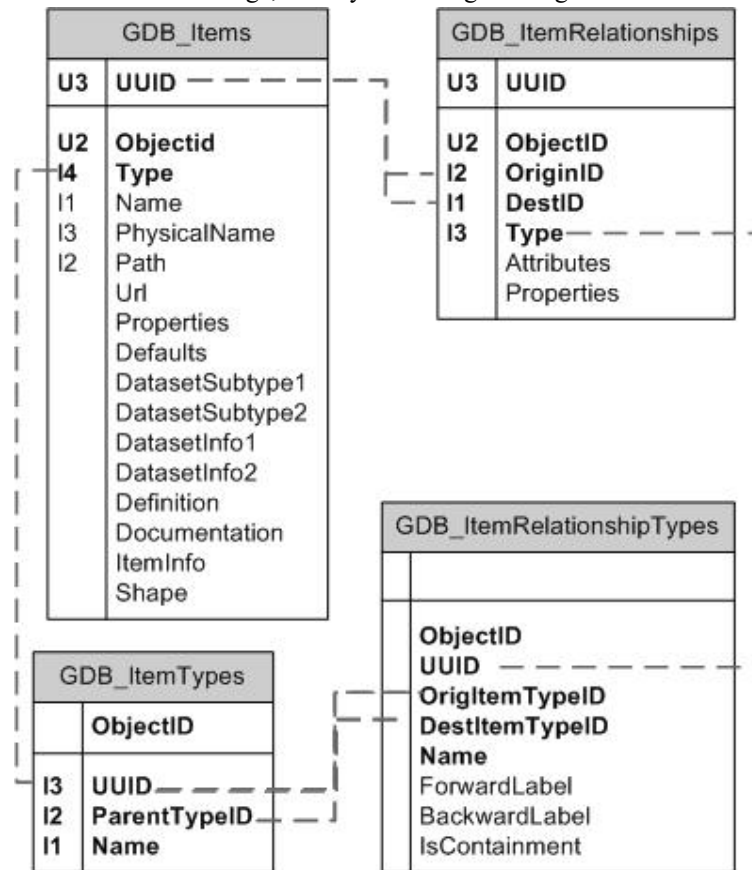


Fig.7 Correlation of individual tables in ArcSDE3

E. Optimal storage of spatial database

1) Database optimization

People need to search it and index it accordingly. If the table and the subscript are placed on the same physical disk, it will cause frequent changes in the head position, resulting in reduced execution performance. If they are stored on separate physical disks, two separate disks can be used for searching, thus saving searching time. Therefore, whenever possible, you should place indexes and tables in two separate tables and correspond them to data on separate physical disks. In general, data with similar properties and the same access type should exist in the same table space; Each type of data should have its own separate table space [16]. However, the amount of data and traffic of the website is also a great reference standard, which should be comprehensively considered.

In general, the table space of an index is separated from other tables, that is, the table of this index is only used for the storage and process of an index. When you don't have many to use at the same time, you can put all your indicators into one index table. At the same time, if there are a large number of users and a large number of data access, it is necessary to establish a corresponding index table for the data of each data/table, so as to improve the retrieval efficiency.

2) Optimization of DBMS Configuration

The cache hit ratio is the ratio at which a user process reads data from memory versus data files. This is a critical metric and is affected by the db_block_buffers parameter. The length of the buffer is represented by db_block, which should not be larger than 1/4 of the memory. The HitRatio is considered very satisfactory, but the minimum should not be less than 90%. Shared_Pool_size Share pool includes shared cursors, stored programs, control structures, and concurrent mail cache. The value of these targets can improve the efficiency of multiple users. Its value is not greater than 1/4 of the memory, and the cache hit ratio is greater than 95%, which is the best. If a request is to be classified, this storage area is used to classify it, and if there is not enough storage capacity, this storage area is used to sort the hard disk [17]. This parameter has an impact on the decision made for cost-based optimization, which is to make an indexed access or sort a result set. The value should be the square root of the required classification, that is, the square of sort_area_size should not be smaller than the number of records to classify. The SGA area usually occupies 1/3 to 1/2 of the storage space.

III. OBJECTIVE FUNCTION

The optimal allocation of agricultural and forestry resources refers to the coordination and coordination between different types of agricultural production factors in different regions and different uses of agricultural production processes [18]. Before establishing the economic-social-environmental benefit evaluation model, the study area is divided into several sub-regions, and then divided into several sub-regions according to the administrative level, and then the resources for agriculture and forestry are classified. Let's call it $i(i = 1, 2, \dots, I)$. The variable x_{0j} is used to represent the amount of agriculture and forestry required by agricultural households in j , and x_{ij} is used to represent the amount of agriculture and forestry supplied by agricultural forest sources in i to agricultural and forestry households in j . The objective function is determined with the objective of the relative optimum of economic, social and environmental benefits.

A. Economic Benefits

The objective function of economic benefit in optimal allocation of agricultural and forestry resources can be obtained by taking the net benefit generated by regional supply for agriculture and forestry as the largest.

$$\max g_1(x) = \max \sum_{j=1}^J \sum_{i=1}^I (\delta_{ij} - z_{ij}) x_{ij} \lambda_i \mu_j \quad (1)$$

In the formula, δ_{ij} is the benefit coefficient, z_{ij} is the cost coefficient, λ_i is the order coefficient for agriculture and forestry, and μ_j is the fairness coefficient for agriculture and forestry.

B. Social Benefits

Social welfare, an important factor to measure the optimal allocation of forestry resources, has been mainly reflected in the typical index, which is lack of appropriate reference and difficult to integrate. Therefore, this project intends to take the coordination degree W of regional agricultural and forestry resources supply and demand as the evaluation object [19]. The coordination of supply and demand of agricultural and forestry resources refers to the coordination and coordinated development between the supply and demand of different agricultural and forestry sources or compound agricultural and forestry sources in the agricultural and forestry system. The higher the degree of harmony, the more it can reflect the greater social benefits. It is calculated as follows:

$$W = \sum_{k=1}^K \sum_{j=1}^J \frac{1}{12} \times \sum_{\sigma=1}^{12} \{ \eta_i(\sigma) [x_{0j}^k(\sigma) - x_{ij}^k(\sigma)] \} \quad (2)$$

$x_{0j}^k(\sigma)$ and $x_{ij}^k(\sigma)$ are the quantity of agriculture and forestry required and supplied at time σ of user j in subregion k , respectively. $\eta_i(\sigma)$ is the grey correlation coefficient of time σ comparing sequence $x_{ij}(\sigma)$ to reference sequence $x_{0j}(\sigma)$, and its calculation formula is as follows:

$$\eta_i(\sigma) = \frac{\min_i \min_{\sigma} |x_{0j}(\sigma) - x_{ij}(\sigma)| + \zeta \max_i \max_{\sigma} |x_{0j}(\sigma) - x_{ij}(\sigma)|}{|x_{0j}(\sigma) - x_{ij}(\sigma)| + \zeta \max_i \max_{\sigma} |x_{0j}(\sigma) - x_{ij}(\sigma)|} \quad (3)$$

ζ is the resolution coefficient, $\zeta \in (0,1)$. By setting the value of ζ , the influence of $\zeta \max_i \max_\sigma |x_{0j}(\sigma) - x_{ij}(\sigma)|$ in equation (3) on data transformation can be controlled. Here ζ is 0.5. The objective function of social benefit in the optimal allocation of agricultural and forestry resources can be expressed as:

$$\begin{aligned} \max g_2(x) &= \max(W) \\ \max g_2 \end{aligned} \tag{4}$$

C. Environmental Benefits

It is expressed by the smallest emission of important pollutants. According to the actual situation, COD is selected as an important pollution factor in this study. The objective function of environmental benefit in the optimal allocation of agricultural and forestry resources can be expressed as:

$$\max g_3(x) = -\min \sum_{j=1}^J 0.01s_j q_j \sum_{i=1}^I x_{ij} \tag{5}$$

s_j is the content of important pollution factor (COD) in the waste agricultural and forestry emissions of user j , mg/L; q_j is user j agroforestry emission coefficient of waste pollution.

Constraints

(1) Constraints on the carrying capacity of agricultural and forestry resources. The amount of agriculture and forestry required must not exceed the utilization potential of agricultural and forestry resources, namely:

$$\sum_{i=1}^I \sum_{j=1}^J x_{ij} \leq \sum_{i=1}^I E_i \tag{6}$$

E_i is the available agricultural and forestry quantity of i agricultural forest source.

(2) Different use of agriculture and forestry households need agriculture and forestry quantity constraints. The required quantity of agricultural and forestry households is stable, that is:

$$P_{\min,j} \leq \sum_{j=1}^J x_{0j} \leq P_{\max,j} \tag{7}$$

$P_{\min,j}, P_{\max,j}$ refers to the minimum and maximum amount of agriculture and forestry required by j agricultural and forestry households respectively.

(3) Variables are non-negative constraints. The quantity of agriculture and forestry required and the quantity of agriculture and forestry supplied are both greater than or equal to zero, that is:

$$x_{0j} \geq 0, x_{ij} \geq 0 \tag{8}$$

IV. EFFECT AND EVALUATION

Oracle Cache was set to 8, 16, 24, 40, 64 MB and optimized. In Figure 8, the trend of the number of queries under different cache values is shown. As you can see from Figure 8, the speed of the cache changes significantly as the cache size goes from 8 to 16 MB, and becomes more stable as the cache size increases [20]. The cache should be properly adjusted during execution as required. In the test case of this system, a cache of 40 MB is sufficient. The level of the class has 1,843,173 elements. For those components, the average filling limit is 347, and the spatial grid is 1040, which is three times the average packing limit. The values for each spatial grid are 1040,2000,3000,4000. The trend in the number of queries corresponding to each spatialgrid is shown in Figure 9. If the value of an exponential grid is too large, there will be too many elements in the grid, which will affect the speed of the query. Therefore, it should be set to three times the average fill range. In Figure 10, the change trend of query times corresponding to the maximum capacity corresponding to each maximum capacity is shown in Table 10. As the maximum capacity increases, the time required for retrieval decreases. However, if you want to increase the maximum capacity, it depends on the storage capacity of the server. For example, if 100 people use 7 element classes, ArcSDE will provide 44,800 kB of storage space for the server's transfer cache, so the maximum MAXBUFSIZE value will quickly consume the server's physical storage space.

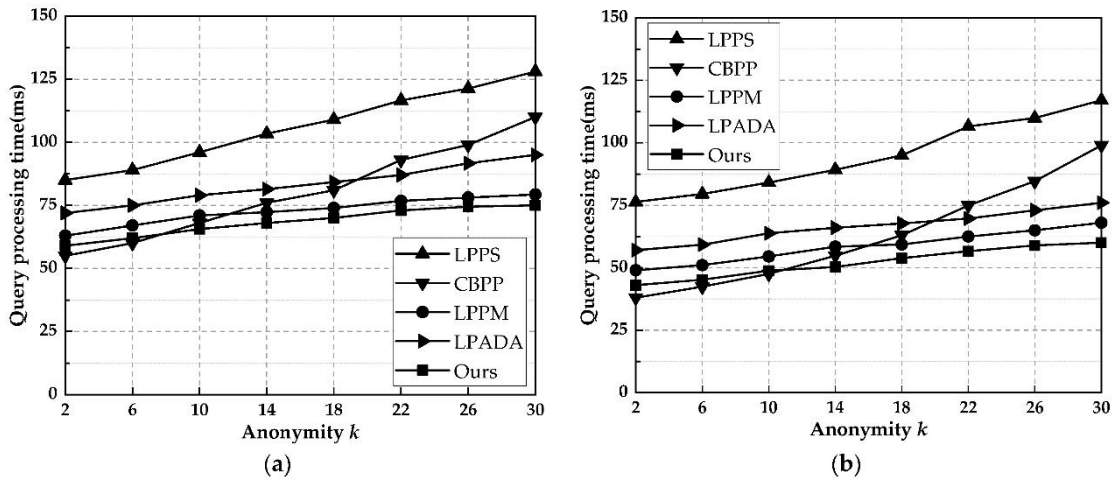


Fig.8 Query times for different cache values

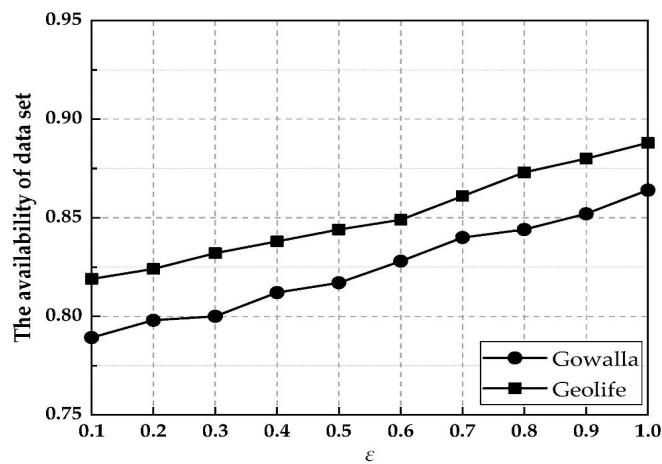


Fig.9 Query time for different grid values

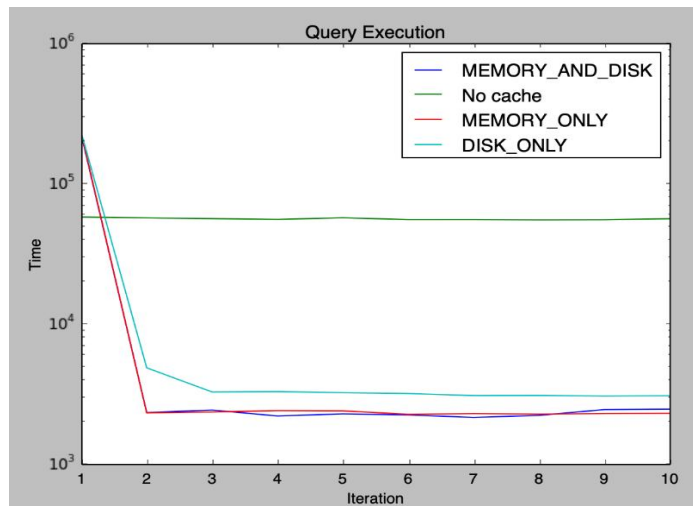


Fig.10 Query times for different MAXBUFSIZE values

Only the method using the intermediate table has been tested here. The statistical data of the secondary census of Henan Province are classified, and the smallest category statement is stored in an intermediate table for reporting statistical retrieval, which greatly improves the retrieval speed. Table 1 shows that for the stand data, the computational efficiency of intermediate form retrieval and original form retrieval can be more than 3000 times.

Table 1. Influence of data preprocessing on query efficiency in agricultural and forestry resource database system

Original data name	Query object	Query grouping factor	Query processing mode	Response time /s
Basic information for small classes	Region and accumulation	Ownership, tree species, major tree species	Preprocess the results used as the data source	0.104
Small class stand data	Region	Land ownership	Preprocess the results used as the data source	0.063
Basic information for small classes	Region and accumulation	Ownership, tree species, major tree species	Direct processing of raw data	255.229
Small class stand data	Region	Land ownership	Direct processing of raw data	209.4

V. CONCLUSION

The corresponding modifications are made for the relational database management system and ArcSDE in virtual environment. The background DBMS for Oracle is realized by adjusting the size of SGA partition properly, changing the physical path of data and records, and changing the boot parameters of Oracle database. The experimental results show that Oracle SGA partition size, ArcSDE index mesh size and maximum BUFSIZE are important indexes to determine the overall performance of the database, and the overall performance of the system can be effectively improved by adjusting them. This method can greatly improve the efficiency of retrieval by establishing the intermediate table which is consistent with the user's query purpose. In the process of data structure optimization, the rational organization of logical structure, the dispersion of physical structure and the establishment of efficient index mechanism are the fundamental ways to realize efficient data retrieval.

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