Digital Management Strategy of Natural Resource Archives Under Smart City Space-Time Big Data Platform

Yifan Wang, Sichuan Aerospace Vocational College, China*

Pin Lv, Sichuan Aerospace Vocational College, China

ABSTRACT

The data under the smart city spatio-temporal big data platform is very diverse, and there are many modern spatial and spatial databases in the archives management system related to natural resources. Big data can effectively improve the quality and classification of natural resource archives management (referred to as NRAM for convenience of description). However, the traditional NRAM method and informatization level can no longer meet the needs of the current NRAM, so people must continue to make efforts to digitize the natural resource archives. To this end, this paper analyzed the characteristics and problems of NRAM and then used the big data platform to make corresponding management adjustments to promote the development of NRAM. Under big data, the degree of management improvement and management efficiency were better than the original NRAM, and the degree of management improvement was 14% higher than the original NRAM. In short, both big data and artificial intelligence can improve the integrated management of natural resource archives.

KEYWORDS

1. INTRODUCTION

With the full completion of the urban digital geospatial framework project, the smart city spatio-temporal big data platform is being tested worldwide. Big data can effectively improve the digital management level of resource documents, making management more convenient. The features involved to enhance the digital management are sensible structure, simplicity of usage, updating, mobile compatible, internal collaboration, backing and protection, and so on. On the one hand, the smart city spatio-temporal data platform has multi-scale dynamic geographic information database; on the other hand, due to the effective integration of databases such as population, legal person, macro-economy and geographic address, information sharing among government departments has been promoted, which has had a very positive impact on the modernization and reform of NRAM.

*Corresponding Author

NRAM can effectively integrate data related to natural resources. Mineral wealth, when effectively managed, serve as the cornerstone for preserving and enhancing the standard of living for everyone on the planet and can significantly contribute to responsible development. Coleman Kimberly conducted a case study on four landscape level initiatives in the forest landscape restoration cooperation plan, and the results showed that successful natural resource management increasingly required cooperation between cross-border and different stakeholder groups (Groce, J. E., et al, 2019). The main problems include eroding & deterioration of the terrain, the groundwater, or the species, in addition to the most vital elements like the pollution levels or sunshine, that are critical for the production of high-quality foods and value-added activities. To build and further understand the role of social networks in achieving environmental outcomes, Groce Julie E created a typology that deconstructed social processes, social outcomes and environmental outcomes into options for each theme and social and ecological measures (Crausbay, S. D., et al, 2022). Crausbay Shelley D tried to stimulate the research agenda of transformation science, which focused on ecological and social sciences and was based on five core issues, consistent with the boycott-acceptance-direct framework (Krampe, F. et al, 2017). Essentially said, a boycott is an endeavor to persuade a sizable portion of people not to patronize a specific company or individual. Sometimes, whenever another country declines to cooperate in commerce, that nation could be the target of a boycotting. Krampe Florian reflected on the status quo of post conflict natural resource management research and emphasized the need to reduce instability through the implementation of environmental cooperation initiatives (Van Assche, et al, 2017). Van Assche Kristof put forward a conceptual framework, which expanded his views on the relationship between power and knowledge to connect with current views on natural resource management research and broader environmental research (Hamm, J. A. et al, 2017). Hamm Joseph A showed that credibility and motivation play an important role in promoting the willingness and behavior of cooperation. Although it is important for natural resource management institutions to pay attention to their credibility, they should not ignore the motivation generated by the benefits they provide (Wilmer, H., et al, 2021). Wilmer Hailey drew on his experience in the collaborative team. Based on the existing work of natural resources, environmental health, protection and ecology, social sciences and humanities scholars, he developed an expanded framework for ethical research partnerships (Huntington, J. L., et al, 2017). The Internet of Things (IoT) is a promising development for understanding sustainable smart cities. Smart cities can offer a range of application scenarios, including industry 4.0, smart finance, and internet of vehicles. This research expanded a trustworthy as well as efficient data-sharing strategy using cryptocurrency techniques (Kumar, P. M., et al, 2022). The above studies all described the importance of natural resource management, but did not describe the corresponding digital management strategy.

NRAM is a professional project. Huntington Justin L briefly outlined the software application development and design of the climate engine, and the ability to access climate and remote sensing data archives through on-demand parallel cloud computing (Li, L., et al, 2021). Li Lei payed attention to citizens' communist behavior towards urban natural resource assets in the age of big data, and used potential Dirichlet allocation algorithm and stepwise regression analysis to evaluate citizens' experience and feelings about urban natural resource capitalization (Glynn, P. D., et al, 2017). Among the most widely used techniques for topic modelling is latent Dirichlet allocation. Every documentation has a variety of words, and certain utterances can be connected to particular topics. Stepwise regression is the repetitive process of building a linear regression in stages while choosing different factors to be included in the production version. Glynn Pierre D discussed how this process and framework can improve scientific and policy governance for different types of systems and problems, and provided examples in the fields of natural resources, hazards and environment (Murray, G., et al, 2019). Murray Grant, centering on Ghana's model of community resource management areas and protected areas, assessed how to assess resource management at the local level. The Forestry Authority of Ghana's Wildlife Department created the Nonprofit Organization Managed Zone (CREMA) idea to encourage cooperative and participative wildlife administration throughout the nation. The idea entails a number

of beginning to integrate to an agreement over the leadership style of a crowded location. Through this mechanism, local people can participate in decision-making processes related to resource management more transparently and freely (Gemmell, A., et al, 2021). The above studies have all described the strategy of natural resource management, but there are still some deficiencies in big data analysis.

The management of digital archives of natural resources involves the use of different digital technologies, cloud storage technologies and large-scale data processing technologies to gradually transform various forms of resource archives management into digital information. The combination of big data management and natural resource archives fully realizes the digitalization of natural resource archives. The important natural assets are combined with human innovation to create ecosystem services. Humans do not create or create mineral wealth, but they can affect ecological assets (For instance, travel & relaxation, a stunning setting, or the finding of a unique species). In addition, the digitalization of natural resource archives provides a basic premise for the automatic management of resource documents to effectively protect their integrity.

2. EVALAUTION OF ELEMENTS OF DIGITAL MANAGEMENT OF NATURAL RESOURCE ARCHIVES

2.1 Features of NRAM

The management of natural resource archives has repeatability, confidentiality, richness and durability, as shown in Figure 1. The first is repeatability. The functions of the natural resources department are now more diversified, including more electronic archives and branches. It combines the administration of heritage resources, landscape use design, flood control, nature conservation, as well as the long-term viability of sectors including timber, miners, farming, & tourists. The management of archives requires overlap and communication between branches. Although information administrators balance document management with constitutional limits and corporate objectives, preservationists often concentrate on the historically and cultural relevance of archives. NRAM is far more power-efficient than DRAM in steady state or flashing in aggressive state, as well as being faster and thicker than DRAM, non-volatile similar flashing, but extremely resilient to external cues. When managing specific resources, staff must make full use of other aspects of the information to make the work more transparent and complex. All these efforts require natural resource management agencies to carefully review the information to ensure its accuracy and effectiveness. Becoming open and honest with the

Figure 1. Characteristics of natural resource archives management
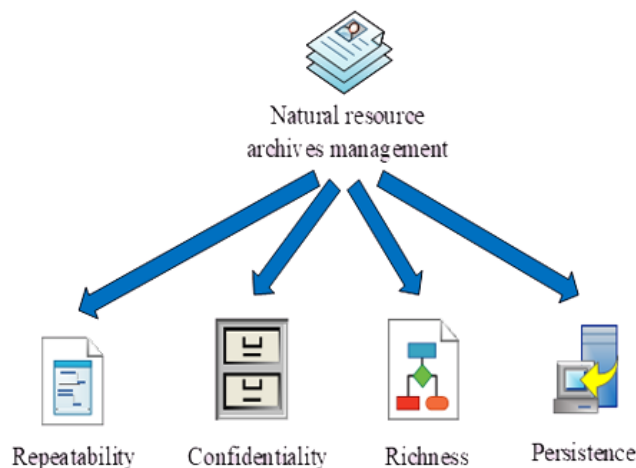
staff will making it simpler for everyone to have to understand each other, that society accepts and companion piece because you'll be aware and concerned for each other. Through encouraging the staff to provide comments and opinions about the business and how it operates. Discuss effectiveness with staff members on a daily basis. Communicating the good and the bad: Workers need to be aware of both good and bad information. The second is confidentiality. Natural resource archives are rich and diverse, some of which are directly related to government security and interests. Therefore, privacy and confidentiality are one of the main challenges faced by document owners. In addition, there are uncertainties in archiving data in the network environment, and relevant departments should strengthen security construction. The third is richness. As part of the institutional reform, the natural resources sector has also been restructured. At the same time, archives can be divided into different types according to different standards and types. The cross of documents further increases the amount of resources for review. The fourth is persistence. Managing natural resource archives is not a short-term task, but a highly specialized systematic work. Effective management of archives requires a lot of material and financial resources, energy and time. At the same time, archive management personnel must systematically analyze, study and deal with the actual situation of natural resources. With large workload and strong continuity, archive resources can only play an effective role in solving resource problems if they can provide accurate and real-time information.

2.2 The Significance of Digital Management of Natural Resources Archives

There are three advantages of establishing NRAM, as shown in Figure 2. The first is to encourage the sharing of information resources. The construction of digital natural resource archives has gradually changed the traditional NRAM model, from material data management to content management, and from paper NRAM to electronic archives management. It is a sort of nonvolatile random-access storage that is predicated on where carbon nanotubes have been grown on a surface that resembles a chip. Theoretically, exceptionally high concentration memory is possible due to the nanostructures' tiny dimensions. The establishment of a network search platform can create favorable conditions for sharing documents related to natural resources. Secondly, people can make better use of resource archives. According to incomplete statistics, the utilization rate of natural resource archives is less than 10% (Gebeyehu, M. N. et al, 2019). The big data platform can promote the expansion of digital construction of natural resource archives and change the NRAM model to a certain extent. Big data can assist organizations in identifying possible risks and issues at the ground by being used from the design phase on building initiatives. For example, the system assesses labour and material efficiency then alerts program managers to any unexpected delays, weariness, or excess material on the worksite

Figure 2. Significance of digital management of natural resource archives
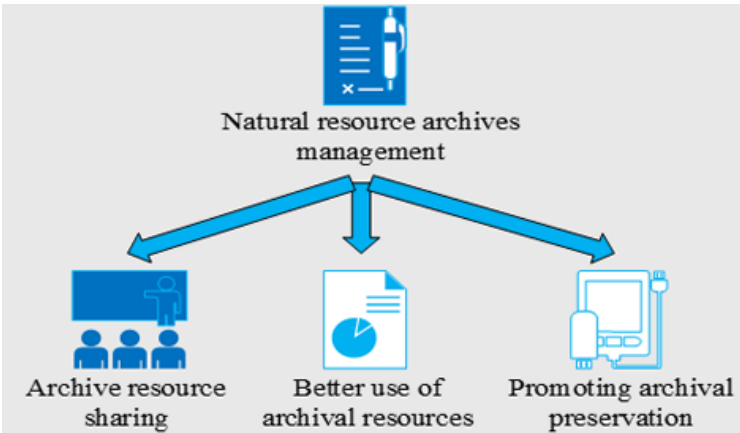
(Zhang, Y. et al, 2021). The structure of the digital system allows archives to go beyond time and space and maximize the use of resource files. The second is to promote the preservation of natural resource archives. The paper documents related to natural resources have high environmental requirements in the storage process. Therefore, retrieving or copying the documents related to natural resources would have an irreversible impact on the documents related to natural resources (Chen, Z. et al, 2022). By strengthening the digital structure of the original documents, and without affecting the data, the security of the original documents is ensured to a certain extent during the search process. It covers protocol choice, transfer, and conservation issues for their development and capturing. The topic of managing dependable digital repositories is covered, along with the finances, technologies, and administration required for designing and sustaining digital archiving solutions. At the same time, digital management of raw material archives can meet the needs of electronic management through office automation and protection of raw material archives. The development of digital substitutes can improve current protection includes by minimizing the manipulation of original documents. This can be extremely useful for protecting delicate or exceptionally unusual, expensive goods from damage.

2.3 Problems in Digital Management of Natural Resources Archives

The main problems of NRAM can be analyzed from three aspects, as shown in Figure 3. First, the management method is backward. At present, the NRAM system has not been digitized, and this natural resource management method cannot meet the current information processing needs, increasing the difficulty of file management. At the same time, this situation has increased the error rate in the management of archives resources, and has also caused a waste of resources to a certain extent. Second, the management system is not perfect, and the staff is not professional. Making sure that quality treaties cover three essential information needs documents quality, integrating data disposal into communications system design process, or greater accessibility over time—is key for archivists as well as information specialists. The current archive management personnel do not attach importance to the later business and services, resulting in low efficiency and poor service quality. Some natural resource archives still lack professional knowledge and digital thinking, leading to the backward integration of natural resource archives. Due to the accumulation of archives and the untimely input of information, incomplete statistical data and insufficient resource research have seriously affected the development of archives resources. Third, the management platform is not perfect, and the digital management data exchange system is backward. The leadership of the Ministry of Natural Resources does not recognize the value of archives and does not attach importance to the informatization of

Figure 3. Problems in digital management of natural resource archives
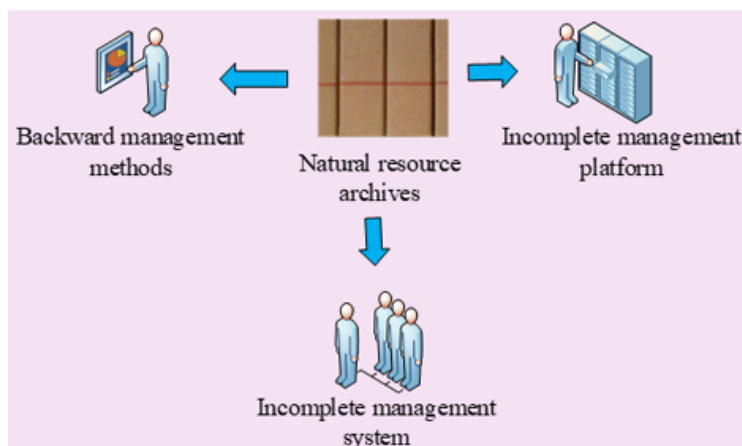
archives management. Moreover, the head of the Ministry of Natural Resources lacks the practical ability and level to deal with information, which makes it difficult to combine information technology with document management; the lack of necessary investment in the information infrastructure of the Ministry of Natural Resources has hindered the construction of the information infrastructure, delayed the updating of information, and failed to meet the actual needs of archive management. The data sharing platform established to improve NRAM requires the joint efforts of all departments. However, in practice, there are some difficulties in the coordination between different departments, which makes the improvement of the platform more difficult.

3. DIGITAL MANAGEMENT OPTIMIZATION OF NATURAL RESOURCE ARCHIVES UNDER THE SMART CITY SPACE-TIME BIG DATA PLATFORM

3.1 Application of Big Data in Digital Management of Natural Resources Archives

Big data helps to make more use of natural resource archives. The construction of digital system would effectively avoid the defects of traditional management methods, change the means and forms of traditional archive management, prevent the restrictions on archive space and time, and improve the efficiency of archive utilization. The two methods for examining archiving research information are hands-on analysis as well as meta-analysis. Information that academics get through collaborations with the surrounding area, collection, or examples of previous projects are those that are being analysed. By simplifying the massive data analysis program, people can maximize the integration, classification and storage of information in natural resource files, better collect valuable information, comprehensively improve document management, provide users and departments with high-quality services, and improve the utilization efficiency of archive resources (Okamoto, D. K., et al, 2020). In addition, using more advanced data processing technology to establish a database is an effective way to centralize the management of archive information and ensure the unified management of the collection, processing and subsequent use of archives.

3.2 Optimization of Archives Management System Under Big Data Platform

The system design requires automatic storage, convenient access, simplified operation, security and reliability. In addition, due to historical reasons, the system must be compatible with all data types in files managed by the source system to avoid loss of source data. Data loss mitigation operating system is available in three primary flavors: connectivity DLP, application server DLP, and virtualized DLP. Therefore, the system can be updated by upgrading the storage data function and converting the system function mode, as shown in Figure 4.

3.2.1 File Data Update Function

According to the regional requirements, the storage information mainly includes attribute and location information. Information about various attributes of data classification includes case number, document number, document type, retention period, retention date, etc. The attribute information can be obtained in the same field as the space and spatial data platform name. If there are data records, the contents of the record fields can be shared. Location information is the coordinate and height system used to search information, which must be consistent with the basic geographic information of urban digital space to ensure smooth communication. This information can be included in the spatial location ratio, and the allowable boundary can be determined to maintain the spatial location. In addition, queries can be compared using the same fields in the spatial data platform geographic address database. If a record exists, people can share the contents of the record field.

Figure 4. Optimization of archives management system under big data platform
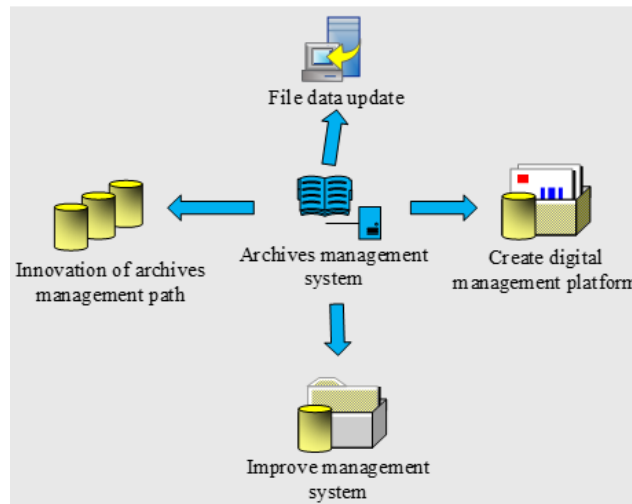
3.2.2 Improving Management System

The data management module can be developed according to the software code based on the dataset database or natural resource database, and can be completely converted to large-scale database management. Several fields, including master information management, data governance, data gathering, advanced analytics, and so forth. The connection among the knowledge & various documentation is represented via the notion of data modelling, in which statistics are constructed using different components. For systems using advanced databases, data can be integrated into large spatio-temporal data platforms or natural resource data centers to generate additional attributes. A historical document of the Natural Resources Department focuses on the reference framework, and develops the geographic information reference system and conversion module to ensure the seamless connection between the time and time data sets of smart cities and the natural resources data center. Uses for GIS use both equipment and software. Such programs could use electronic, optical, financial, or geographic information. Spatial analysis is a method where challenges are modelled economically, outcomes are generated by computational power, and the findings are then explored and examined. Then, according to the spatial retrieval function of the large spatio-temporal data platform, incorporating social goals and spatial dynamics into the management strategy evaluation can reveal the impact of trade-offs and management decisions, thus realizing the spatial and temporal attribute tracking, statistical analysis and query functions (Wesselow, M., et al, 2018).

3.2.3 Creating Digital Management Platform

The Ministry of Resources has established a digital management platform synchronized with the network structure of all ministries, increased financial resources, purchased hardware and software equipment for the digital management platform, and organized a professional network system for professionals. Resource management done correctly may lower prices, increase efficiency, and increase production for the company. The establishment of a comprehensive management platform within the Resources Department would help to share resources more effectively with other departments, and facilitate access to archive data at any time and anywhere. The creation of digital archives management platform can not only improve the convenience of document management, but also make more effective use of resources. At the same time, it can also enhance the value of archive resources and promote the development of natural resource industry towards intelligent digital development.

3.2.4 Innovation of Archives Management Path

The innovative approach of archives management path is a key theme that natural resources departments need to deal with in the context of big data. Innovation management is based on four main foundations: Competence, Organization, Environment, and Direction. Keeping such principles in perspective makes it easier to keep organized because any novel thought can be considered innovative. There is no doubt that incorporating big data technology into document management can greatly improve efficiency, but without the support of archive resource management practices, the value of documents cannot be reduced. If human factors are not considered, natural resources cannot be analyzed or managed (Coleman, K., et al, 2018). In order to run a firm effectively, administrators must increase their own productivity while assembling a group of successful workers who can carry out the organizational objectives. All firms thrive in the electronic era when groups are self-managing as well as people are empowered to make their own choices. In view of the successful experience of archives management in other fields, relevant workers should explore effective management methods and means under the background of actual development of NRAM.

4. APPLICATION OF MULTI-STAGE GENETIC ALGORITHM IN NRAM

In order to study the management effect of NRAM, this paper conducts data analysis on the number of archives management in natural resource management and the optimization objective function of archives management through multi-stage genetic algorithm, and studies the implementation effect of archives management under the big data platform according to the analysis results. The first stage of the suggested genetic algorithm program includes initializing the number of hidden layers. Fixing the quantity of synapses in every buried level is the goal of the stage 2. The input layer as well as algorithm required for training neural network architectures are generated in the end of the process. As a consequence, the multi-population optimizer is produced (MPGA). The MPGA separates the populace of a normal GA into N sub-populations, every of which has the identical number of individuals (the sub-population amount is represented by N). This paper first constructs the overall archive management function of the number of archives under management and the effective quantity after management as follows:

$$\min A = \sum_{j=1}^{T} \sum_{i=1}^{S} \left[a_i \cdot \sum_{s=1}^{j} \left(m_{i,s} - n_{i,s} \right) \right] \tag{1}$$

Among them, $m_{i,s}, n_{i,s}$ is the managed quantity and the effective quantity after management. Programs for managing files on a computing platform are called document management tools. Because all information is stored in documents, folders play a crucial role in the network. According to the file management function, the efficient file management effectiveness Q is:

$$Q(i) = \sum_{s=1}^{T} m_{i,s} \tag{2}$$

The uniform distribution function of the number of file administrators is:

$$f_i \left(k_{i,d(i)} = k \right) = \begin{cases} \dfrac{1}{k_i^{\max} - k_i^{\min}}, k_i^{\max} \leq k \leq k_i^{\min} \\ o, \text{other} \end{cases} \tag{3}$$

Among them, k is the total management quantity of archivists, and $d(i)$ is the archivist. The linear equation known as a probability density expresses the likelihood that a system would adopt a certain number or range of possibilities. The middle of the range [a,b] or the normal of the variables a & b, however, provides the anticipated significance of the uniform[a,b] dispersion. For the purpose of representing and resolving the linear programming optimization issues, objective functions are frequently employed. The choice factors x and y are used in the optimization problem, which has the format Z = axe + by. Then, according to the uniform distribution function, the optimization objective function of the overall archive management function is calculated as follows:

$$\min A = \sum_{j=1}^{T}\sum_{i=1}^{S}\left(a_i \cdot \sum_{s=1}^{j}\left(m_{i,s} - n_{i,s}\right)\right) + \sum_{i=1}^{S} oa_i \cdot \left(R_i^{(r)}\right)^+ \tag{4}$$

$$R_i^{(r)} = R_i - \sum_{s=1}^{T}\left(d_s \cdot \sum_{d(i)=1}^{k_i}\left(b_{i,d(i),s}\right)\right), 1 \leq i \leq N \tag{5}$$

Among them, $\left(R_i^{(r)}\right)^+$ is the total management quantity of archivists, and oa_i is the digital cost of the total management quantity. Then according to the optimized objective function, the optimization effect of the management model can be obtained as follows:

$$\max e_{i,s} = \sum_{d(i)=1}^{k(i)}\left(b_{i,d(i),s} \cdot k_{i,d(i)}\right), 1 \leq i \leq I \tag{6}$$

Among them, $e_{i,s}$ is the general file management effect of the administrator. Finally, according to the management effect, the probability saturation of natural resource management can be obtained as follows:

$$Y_j = \left\{Y_j \middle| P\left(Y_{j,s} \leq Y_j\right) = \delta\right\} \tag{7}$$

Among them, δ is probability satisfaction.

5. EXPERIMENTAL EVALUATION OF NRAM UNDER THE SMART CITY SPACE-TIME BIG DATA PLATFORM

In order to study the specific effects of NRAM under spatio-temporal big data, this paper analyzes the characteristics, problems and probability saturation of natural resource management through multi-stage genetic algorithm, and adjusts the corresponding management mode according to the analysis results. This paper first investigated the satisfaction of natural resource managers in three regions directly under the Central Government in a region with archive management under space-time big data, including 100 people in each region, as shown in Table 1. The preceding capacity control strategies are used by organizations to increase resource productivity, frequently depending on technology purpose of providing visibility to aid executives in making more detailed account choices. According to the data described in Table 1, the archive management personnel in the three regions directly under the Central Government in this region were all highly satisfied with the archive

Table 1. Satisfactory effect of natural resource managers on archive management under space-time big data

	Satisfied	**Commonly**	**Dissatisfied**
Region 1	85	10	5
Region 2	86	8	6
Region 3	84	7	9
Total	255	25	20

management under big data, with the most satisfied personnel in Region 2 and the most dissatisfied personnel in Region 3. Moreover, the number of satisfied people in these three regions accounted for 85% of the total number, and from more to less, and they were Region 2, Region 1 and Region 3 in turn; the general personnel accounted for about 8.3% of the total number of people, from more to less, and they were Region 1, Region 2 and Region 3; the number of unsatisfied people accounted for 6.7% of the total number, and the number of unsatisfied people was in the order of Region 3, Region 2 and Region 1. Satisfied archivists believed that big data can facilitate them to quickly search archives and sort them according to the information of archives, which can save them a lot of time and improve the accuracy of archive sorting. The dissatisfied archivists believed that the management under big data requires them to invest a certain amount of time to improve their digital thinking. This paper then analyzes the change of NRAM's archive utilization and archive storage effect in half a year under big data, and analyzes the specific effect of archive digitization according to its change, as shown in Figure 5.

According to the histogram depicted in Figure 5, the file utilization rate and file storage effect of file management under big data are gradually increasing, among which the initial value of file utilization rate was 15%, which increased to 69% in the sixth month, and the whole process increased by 54%; the archive storage effect was 21% at the beginning, increased to 79% in the sixth month, and increased by 58% in the whole process. Natural resource management under big data can store the data of natural archives in the cloud and classify them in a certain order, which is very conducive to the use and storage of resource archives, and big data can also ensure the security of archives. Then,

Figure 5. Changes in archive utilization rate and archive storage effect of natural resource archive management in half a year under big data
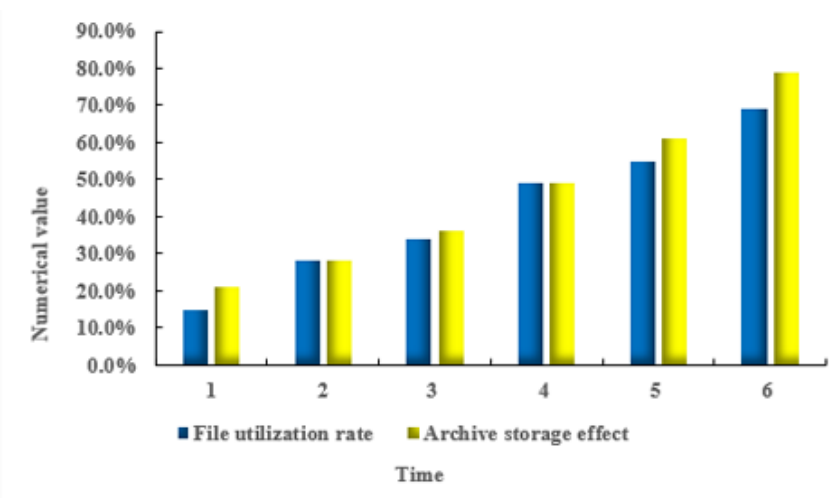
the multi-stage genetic algorithm was used to analyze the optimization effect of archive management and the change of probability saturation, as shown in Figure 6.

It can be seen from the curve drawn in Figure 6 that the optimization effect and probability saturation of archive management are growing over time, in which the average value of archive optimization effect was about 79.6%, and the average value of probability saturation was about 65.7%. In the whole process, the optimization effect of NRAM was improved by 26%, and the probability saturation was increased by 20%. The growth of optimization effect shows that big data can promote the archive management effect of natural resources and improve the accuracy of archive management. The increase of probability saturation indicated that digital archive management can improve the overall utilization rate of resources, make the resource archive management tend to be saturated, and make the archive processing cloud have the maximum capacity. Later, this paper analyzed the degree of management perfection under the digitalization of natural resource management and the contrast effect between the management efficiency and the original natural resource management, as shown in Figure 7.

Figure 6. Optimization effect of archive management and change of probability saturation
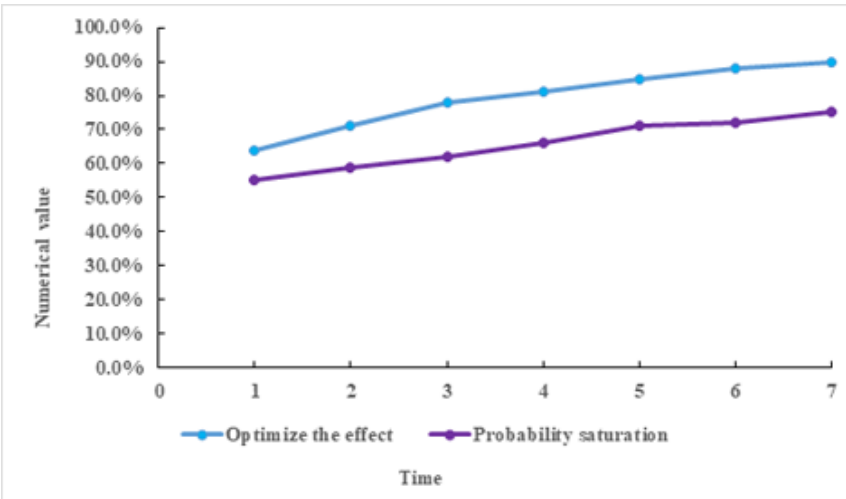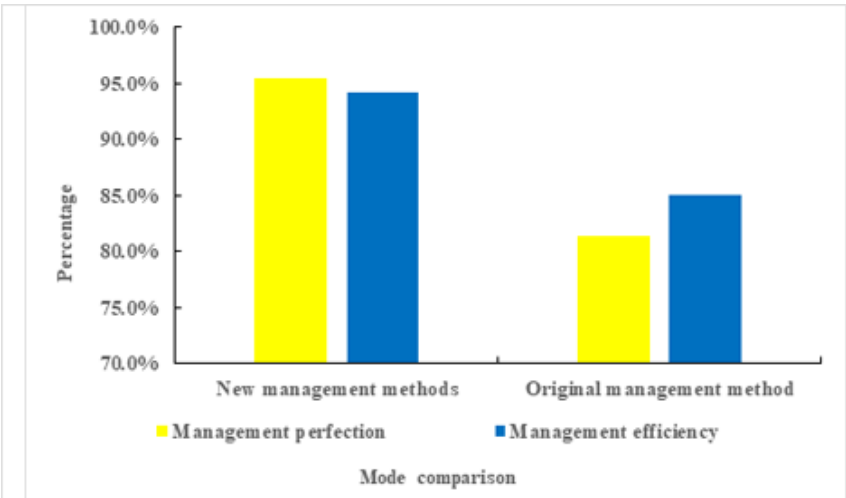

Figure 7. Changes in management perfection and management efficiency under the digitalization of natural resource management

According to the comparative data in Figure 7, the degree of management improvement and management efficiency under big data were better than the original NRAM, and the degree of management improvement was 14% higher than the original NRAM. The management efficiency was also 9.1% higher than the original NRAM. The digitalization of natural resource archives can effectively promote the management and distribution of natural resources, and big data can also improve the accuracy of natural resource information and promote the information management of natural resources. At the same time, the big data platform can also improve the quality of archives management and the emergence of digital thinking of managers, and promote the effective management and monitoring of natural resources by improving the security of archives.

6. CONCLUSION

NRAM is crucial to the scientific management and rational allocation of natural resources. The arrival of the big data era has brought new opportunities and challenges to archive management. Big data can improve the quality and efficiency of archive management. NRAM is a confidential and systematic project. Relevant managers must form a big data concept, be strictly responsible for archive management, and increase relevant knowledge of archive management. In addition, modern information technology should also be applied to specific file management to improve management efficiency and quality, so as to promote the development of digital file management and provide support for the development of the times and social stability.

REFERENCES

Chen, Z., Sivaparthipan, C. B., & Muthu, B. (2022). IoT based smart and intelligent smart city energy optimization. *Sustainable Energy Technologies and Assessments*, *49*, 101724. doi:10.1016/j.seta.2021.101724

Coleman, K., & Stern, M. J. (2018). Exploring the functions of different forms of trust in collaborative natural resource management. *Society & Natural Resources*, *31*(1), 21–38. doi:10.1080/08941920.2017.1364452

Crausbay, S. D., Sofaer, H. R., Cravens, A. E., Chaffin, B. C., Clifford, K. R., Gross, J. E., Knapp, C. N., Lawrence, D. J., Magness, D. R., Miller-Rushing, A. J., Schuurman, G. W., & Stevens-Rumann, C. S. (2022). A science agenda to inform natural resource management decisions in an era of ecological transformation. *Bioscience*, *72*(1), 71–90. doi:10.1093/biosci/biab102

Gebeyehu, M. N. (2019). Remote sensing and GIS application in agriculture and natural resource management. *International Journal of Environmental Sciences & Natural Resources*, *19*(2), 45–49. doi:10.19080/IJESNR.2019.19.556009

Gemmell, A., Sterckx, A., Vargas, C. R., Abrahams, E., Flügel, T., Hugman, R., & Mosesane, B. (2021). *Big Data Analytics and Transboundary Water Collaboration*. Academic Press.

Glynn, P. D., Voinov, A. A., Shapiro, C. D., & White, P. A. (2017). From data to decisions: Processing information, biases, and beliefs for improved management of natural resources and environments. *Earth's Future*, *5*(4), 356–378. doi:10.1002/2016EF000487

Groce, J. E., Farrelly, M. A., Jorgensen, B. S., & Cook, C. N. (2019). Using social-network research to improve outcomes in natural resource management. *Conservation Biology*, *33*(1), 53–65. doi:10.1111/cobi.13127 PMID:29738621

Hamm, J. A. (2017). Trust, trustworthiness, and motivation in the natural resource management context. *Society & Natural Resources*, *30*(8), 919–933. doi:10.1080/08941920.2016.1273419

Huntington, J. L., Hegewisch, K. C., Daudert, B., Morton, C. G., Abatzoglou, J. T., McEvoy, D. J., & Erickson, T. (2017). Climate engine: Cloud computing and visualization of climate and remote sensing data for advanced natural resource monitoring and process understanding. *Bulletin of the American Meteorological Society*, *98*(11), 2397–2410. doi:10.1175/BAMS-D-15-00324.1

Krampe, F. (2017). Toward sustainable peace: A new research agenda for post-conflict natural resource management. *Global Environmental Politics*, *17*(4), 1–8. doi:10.1162/GLEP_a_00431

Kumar, P. M., Rawal, B., & Gao, J. (2022, January). Blockchain-enabled Privacy Preserving of IoT Data for Sustainable Smart Cities using Machine Learning. In *2022 14th International Conference on COMmunication Systems & NETworkS (COMSNETS)* (pp. 1-6). IEEE. doi:10.1109/COMSNETS53615.2022.9668530

Li, L., Ma, S., Wang, R., Wang, Y., & Zheng, Y. (2021). Citizen Participation in the Co-Production of Urban Natural Resource Assets: Analysis Based on Social Media Big Data. *Journal of Global Information Management*, *30*(6), 1–21. doi:10.4018/JGIM.291514

Murray, G., Agyare, A., Dearden, P., & Rollins, R. (2019). Devolution, coordination, and community-based natural resource management in Ghana's community resource management areas. *African Geographical Review*, *38*(4), 296–309. doi:10.1080/19376812.2018.1426022

Okamoto, D. K., Poe, M. R., Francis, T. B., Punt, A. E., Levin, P. S., Shelton, A. O., Armitage, D. R., Cleary, J. S., Dressell, S. C., Jones, R., Kitka, H., Lee, L. C., MacCall, A. D., McIsaac, J. A., Reifenstuhl, S., Silver, J. J., Schmidt, J. O., Thornton, T. F., Voss, R., & Woodruff, J. (2020). Attending to spatial social–ecological sensitivities to improve trade-off analysis in natural resource management. *Fish and Fisheries*, *21*(1), 1–12. doi:10.1111/faf.12409

Van Assche, K., Beunen, R., Duineveld, M., & Gruezmacher, M. (2017). Power/knowledge and natural resource management: Foucaultian foundations in the analysis of adaptive governance. *Journal of Environmental Policy and Planning*, *19*(3), 308–322. doi:10.1080/1523908X.2017.1338560

Wesselow, M., & Stoll-Kleemann, S. (2018). Role-playing games in natural resource management and research: Lessons learned from theory and practice. *The Geographical Journal*, *184*(3), 298–309. doi:10.1111/geoj.12248

Wilmer, H., Meadow, A. M., Brymer, A. B., Carroll, S. R., Ferguson, D. B., Garba, I., Greene, C., Owen, G., & Peck, D. E. (2021). Expanded ethical principles for research partnership and transdisciplinary natural resource management science. *Environmental Management*, *68*(4), 453–467. doi:10.1007/s00267-021-01508-4 PMID:34324013

Zhang, Y., Geng, P., Sivaparthipan, C. B., & Muthu, B. A. (2021). Big data and artificial intelligence based early risk warning system of fire hazard for smart cities. *Sustainable Energy Technologies and Assessments*, *45*, 100986. doi:10.1016/j.seta.2020.100986

Yifan Wang graduated from the Southwest Minzu University of Accounting in 2021. Employed in Sichuan Aerospace Vocational College. His research interests include resource management and financial management.

Pin Lv studied in School of Management Science, Chengdu University of Technology. His research interests include Resources Evaluation and Management.