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Review

Performance Management of Natural Resources: A Systematic Review and Conceptual Framework for China

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Abstract: In recent decades, the issue of "Performance management of natural resources" has received increasing attention. To explore the optimization of performance management of natural resources is of great significance to the sustainable development of a country's society and economy. Based on the relevant literature of "Performance management of natural resources" and "performance management and evaluation of nature resources" in Web of Science from 1990 to 2021, this study reviews the research progress of performance management of natural resources (including water resources) with the help of the CiteSpace V. Through literature review and inductive analysis, the authors found that the pursuit of sustainable utilization and management of natural resources has become the frontier direction of research. However, performance management of natural resources still lacks a general conceptual interpretation and analysis framework, and its evaluation system and methods still need to be further improved. The existing research on influencing factors of natural resources management performance still lacks depth, and the application of quantitative models needs to be strengthened in the future. The combination of research and quantitative models also needs to be further strengthened. Based on the existing literature and the practical experience of countries all over the world, this study constructs the research framework of performance management of natural resources for China. On the basis of multiple evaluation objectives, subjects and means, the authors describes the process and mechanism of performance management of natural resources, and gives some feasible evaluation methods for the performance management of natural resources, in order to provide decision support for the sustainable utilization of natural resources for China.

Keywords: natural resources; performance management; conceptual framework

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1. Introduction

The sustainable development and utilization of natural resources is one of the important issues for the long-term survival and development of human beings. With the development of natural resources protection and utilization practices, human beings' understanding of natural resources is constantly deepening. Garrett proposed the theory of "the tragedy of the commons" [1], which is a natural resource management problem caused by the public goods nature of natural resources. After 1945, some developed countries began to attach importance to the regulation of natural resources. Through reform and legislation, these countries have gradually transformed natural resources management to unity and comprehensiveness [2]. Almost all sustainable development issues in China are related to natural resources [3]. Therefore, the management of natural resources is particularly important for China. China's natural resources management mainly began in 1949, when the country paid more attention to natural resources, such as land and minerals, which played a key role in social and economic development, and the natural resources management system remained to be improved. By 1990, it was still at the stage of relatively decentralized management. Since 1990, China's natural resources management has gradually changed from decentralized management to centralized and unified management.

Since the 18th National Congress of the Communist Party of China, Secretary General Xi Jinping has proposed the conclusion that "the mountains, rivers, forests, farmland, and lakes form a community of shared life " from the overall perspective of ecological civilization construction, emphasizing "overall management of mountains, rivers, forests, farmland, lakes and grasslands" to "carry out the construction of ecological civilization in all directions, the whole region and process". In March 2018, the State Council of the People's Republic of China approved the establishment of the Ministry of Natural Resources of the People's Republic of China, and stipulated that the supervision of the development, utilization and protection of natural resources is one of the responsibilities of the Ministry of Natural Resources. Changes in institutions responsibilities and management concepts have brought new challenges to the governance of natural resources. Carrying out research on performance management of natural resources in China is conducive to grasping the protection and utilization of natural resources and further improving the level of natural resources utilization in the country.

The concept of natural resources in the United Nations System of Environmental-Economic Accounting (SEEA) refers to natural biological resources (such as wood and aquatic resources), minerals and energy, water resources and land. Natural resources management relates to the human impact on the natural environment, the productivity of land and water bodies and its impact on ecosystem services and qualities, such as water allocation, soil loss and biodiversity [4]. Natural resources management is the act of taking a series of measures to protect and improve the status of natural resources through the management of natural resources, such as water, forests, land, and minerals. Natural resources provide raw materials and products for human production and life, and some natural resources, such as mineral resources are non-renewable resources. The performance management of natural resources involves many different issues on a global scale. Increasing the potential of natural resources management requires reducing resource conflicts, improving institutional performance, and reducing corruption [5]. At present, scholars from various countries have conducted many studies from different perspectives. Some researchers have paid attention to the performance evaluation of certain types of natural resources. Hambira argued that Natural Resources Accounting (NRA) is an important tool for performance management of natural resources, especially water resources. He found that Water Accounting could contribute to Integrated Water Resources Management after assessing the water accounts report to determine its contribution to integrated water resources management [6]. Some authors focused on systematic performance evaluation of natural resources. Conley and Moote discussed Collaborative Natural Resources Management, with the believe that a meta-analysis of existing case studies may be more effective for many evaluative questions [7]. Through the continuous development and discussion of researchers, research trends, such as the concept and connotation discussion of natural resources management and performance, the measurement and evaluation of natural resources systems and management performance, and the analysis of factors affecting natural resources performance have been formed. Campbell et al. believed that management performance is the core of natural resources management and performance evaluation needs to be carried out through systematic modeling; the authors discussed possible evaluation methods, such as simple additive index, derived variables and canonical correlation analysis [8]. However, there is still a lack of systematic thinking and summarization of performance management of natural resources. An analytical framework for performance management of natural resources needs to be urgently established.

In-depth analysis of performance management of natural resources requires a comprehensive review of the existing international literature. With the help of good analytical tools, we can better understand the evolution trend of the research, and we can also learn about excellent cases and the historical experience of performance management of natural resources around the world. With the help of the CiteSpace V, this study conducted an inductive analysis on the basis of bibliometrics and a large number of related literature. On the premise of objectively reviewing the research progress of performance management of

natural resources and summarizing the existing research deficiencies, an analytical framework of natural resources performance management for China was constructed in order to provide theoretical support for the overall management of natural resources and also to promote high-quality development and improve resource utilization efficiency.

This study is organized as follows: Section 1 includes the introduction of the research context and the main problem. Section 2 contains the research methodology. Section 3 contains a bibliometric analysis and a review of key literature on performance management of natural resources research. Section 4 further summarizes the research progress of performance management of natural resources. Section 5 presents a theoretical framework of research on performance management of natural resources for China. Section 6 includes the author's discussion of the marginal contribution of this research, the prospect of future research and the discussion of the limitations of this study.

2. Materials and Methods

2.1. Bibliometric Method

Bibliometrics refers to the quantitative analysis of knowledge carriers using mathematical and statistical methods. CiteSpace V is a bibliometric software tool that enables researchers to use it to perform visual and quantitative analysis of literature to discover and to observe new trends and sudden changes in a research field [9,10]. In order to obtain the evolution of performance management of natural resources research, the authors obtained data from Web of Science and carried out bibliometric research with the help of the CiteSpace V, then they analyzed the number of documents and citation evaluation, the evolution of keywords and subject words, main authors and influential publications, etc.

Based on the core database of Web of Science, this research used the method of combining "subject" and "Web of Science classification", and set the subject heading as "Performance management of natural resources" or "performance management and evaluation of nature resource". We limited the direction of research to "Public Administration" or "Environmental Science Ecology" or "Operational Research Management Science" or "Water Resources" or "Agriculture" or "Forestry" and set the time span from 1990 to 2021. For document types, we chose: "Article", "Proceeding Paper" and "Review". The language was set to English. In order to ensure the objectivity and accuracy of the research, we further screened and eliminated the literature that was not highly relevant to this topic and finally obtained 1607 important literature sources on performance management of natural resources, with a total citation frequency of 36,983.

Figure 1 shows the time trend of research on performance management of natural resources. From 1990 to 2021, the annual number of published papers on performance management of natural resources increased from 1 to 185. The scale of research continues to expand, and the number of annual publications shows a fluctuating upward trend. During the research period, the citation frequency of research results increased rapidly, and the citation frequency will reach 5757 times in 2021. It shows that the degree of attention and academic influence of research results has been greatly improved, especially since the 21st century, the average annual growth rate of citation frequency has reached 20.98%.

2.2. Inductive and Deductive Method

The inductive and deductive methods is a common analytical method in academic research. It has been widely used in management, sociology, biology, and other disciplines by virtue of its combination of qualitative and quantitative advantages [11–13]. Based on the collection of literature, the authors combed the basic theory, frontier flashpoints and research methods of performance management of natural resources" and analyzed the commonality and lack of research. Finally, combined with the latest national policy requirements, an analytical framework for performance management of natural resources was constructed to provide theoretical support for the sustainable utilization and management of natural resources in China.

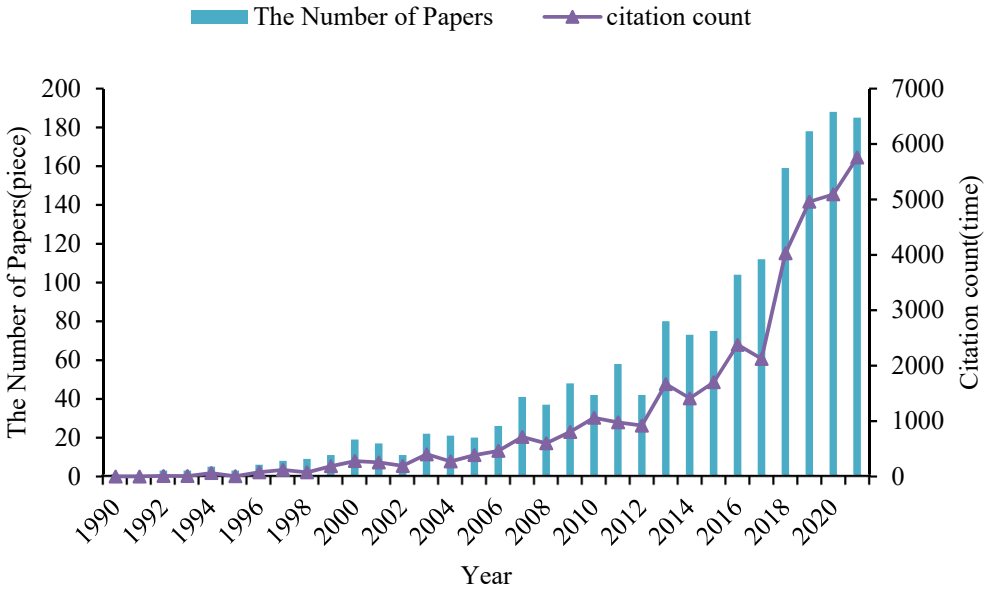

Figure 1. The number and citation count of literature on performance management of natural resources from 1990 to 2021.

3. Bibliometric Analysis of Performance Management of Natural Resources

3.1. Evolution of Keywords and Topics

The keywords of the literature are the reflection of the core content of the research. With the help of the co-word analysis (co-word analysis) function of the CiteSpace V scientific metrology visualization software, this research calculated the high-frequency keywords (Table 1) and drew a keyword co-occurrence knowledge graph (Figure 2). Based on this, popular areas of research on performance management of natural resources were identified. The parameter settings were as follows: the time span was 1990–2021, time slice was 2 years, node type selected the top 15% keywords, network clipping selected the Minimum Spanning Tree, and others were default settings.

Table 1. High-frequency keywords of research on performance management of natural resources from 1990 to 2021 (frequency > 50).

Keywords	Count	Keywords	Count
performance	356	framework	88
management	344	strategy	71
impact	165	resource based view	69
model	145	natural resources management	66
system	121	ecosystem service	55
climate change	107	life cycle assessment	54
sustainability	93	governance	52
conservation	88		

In Table 1, the authors selected high-frequency keywords with a frequency greater than 50, and the top 5 keywords were "performance", "management", "impact", "model" and "system", respectively. By further classifying and sorting the key words in Table 1, we summarized the research trends of performance management of natural resources into three aspects. The first aspect is the conceptual framework of performance management of natural resources, which discussed the connotation and action mechanism of performance management of natural resources from different perspectives, and tried to build a related research framework. The high-frequency keywords of this research topic include system, framework, resource based view, governance, etc. The second aspect is natural resources performance evaluation and influencing factor analysis, which took natural resources as the

research object to carry out performance evaluation, and discussed the impact of natural and human factors on natural resources. The high-frequency keywords of this research topic include impact, model, climate change, life cycle assessment, etc. The third aspect is the sustainable path and strategy of natural resources management. From the perspective of ecological environmental protection and sustainable development, researchers discussed the sustainable path and strategy of performance management of natural resources. The high-frequency keywords of this research topic include sustainability, natural resources management, conservation, strategy, ecosystem service, etc.

In order to further explore the time evolution trend of keywords and topics, a co-citation analysis was performed on the data sources. Documents with the same clustering topic were placed on the same horizontal line in chronological order to draw a keyword co-occurrence timeline map (Figure 2). The circular circle in Figure 2 represents the node containing the keyword. The curve is a keyword curve, and the thickness of the curve reflects the strength of the correlation between keywords. The "#" on the right is the cluster label of the research topic, and the horizontal solid line in the same cluster group represents the approximate time of the topic. In Figure 2, clusters such as "#0 Evaluation Model", "#1 Resource Management", "#2 Environmental Performance" and "#3 Circular Economy" contain relatively more nodes. The latest cluster labels to appear are "#9 Environment and Development" and "#10 Environment Variables". It shows that the sustainable utilization of natural resources, natural resources performance evaluation and management are becoming the research frontier. In the past 30 years, the research on performance management of natural resources has been based on "performance management". It consists of conceptual models, resource management, environmental regulation, socio-economic systems, and analysis of influencing factors. The research topics and content mainly focused on the theoretical and conceptual discussion of performance management of natural resources, the construction of a research framework, the analysis of the mechanism of action of factors, the interpretation and application of evaluation model methods, the analysis of influencing factors and limiting factors, resource conservation and recycling, etc.

3.2. Major Authors and Influential Publications

The citation frequency of a document reflects its attention and academic influence. Identifying highly cited documents through co-citation analysis is helpful to track the development context and knowledge base of performance management of natural resources research. The CiteSpace V software was used for analysis, and the setting parameters were as follows: The time span was set to 1990–2021, the time slice was 2 years, and the node type was co-cited documents. This research focused on sorting the academic contributions of the top 20 highly cited papers (Table 2). The first author of these articles, the year of publication of these articles, the Citations of these articles and other key information are listed in Table 2. Among them, "Citations" indicates the total number of citations of an article in the Web of Science as of 2021, which can indirectly show the influence of this article. Based on this, the knowledge base of research on performance management of natural resources was discussed from the research content and research scale.

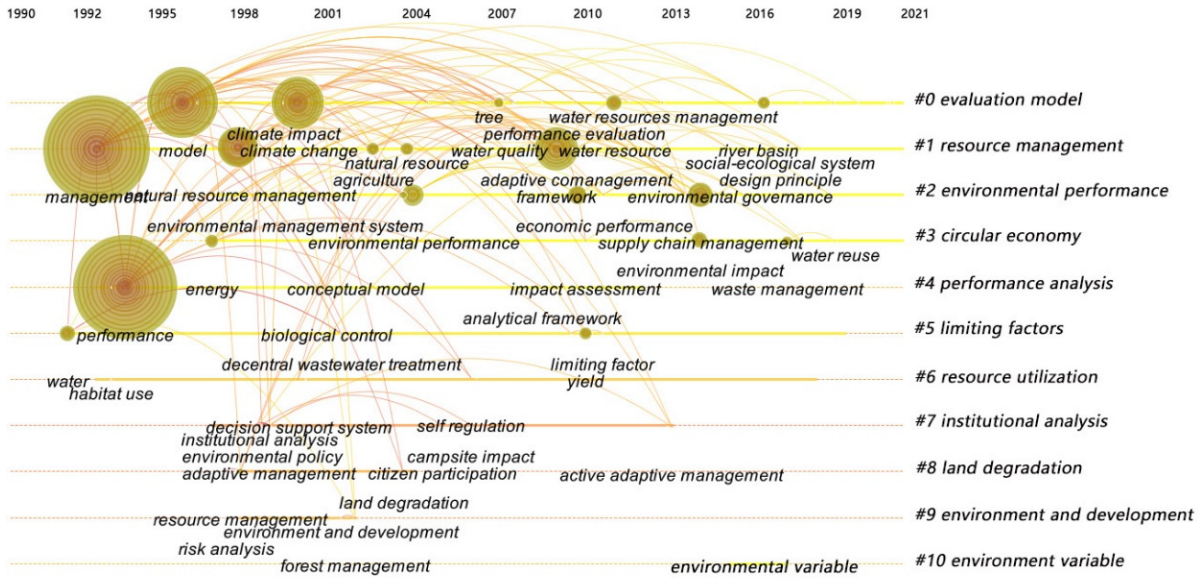

Figure 2. Keyword co-occurrence timeline graph of performance management of natural resources research from 1990 to 2021.

Table 2. High-cited literature on research on performance management of natural resources from 1990 to 2021.

First Author	Years	Journal	Main Contribution	Citations
Khalid [14]	2011	Waste Management	Proposed to manage solid organic waste in a sustainable manner to avoid depletion of natural resources and to minimize environmental burden and maintain the overall balance of the ecosystem.	1100
Armitage [15]	2005	Environmental Management	Through case studies, it examines adaptive capacity, community-based natural resources management performance, social institutional determinants of collective action.	946
Fletcher [16]	2013	Advances in Water Resources	Treated rainwater as a resource, carried out rainwater management research from the perspective of urban hydrology. The authors pointed out that further studies on the spatiotemporal dynamics of urban rainfall are needed to improve short-term rainfall prediction.	824
Conley [7]	2003	Society & Natural Resources	This study analyzed how natural resources management is assessed and who is being assessed, and highlighted the importance of case studies for assessment.	781
Lee [17]	2015	Journal of Cleaner Production	Based on the resource-based view and the natural resource-based view, the importance of resources was clearly recognized, and the impact of green R&D investment for ecological innovation on environmental and financial performance was discussed.	413

Table 2. *Cont.*

First Author	Years	Journal	Main Contribution	Citations
Wong [18]	2012	International Journal of Production Economics	Drawing on a natural resources-based perspective, it examined the boundary-crossing role of green operations and discussed the impact of environmental management capabilities. This research shows that process management has a positive impact on performance outcomes, and that suppliers' environmental management capabilities moderate the relationship between process management and financial performance.	394
Silvestre [19]	2015	International Journal of Production Economics	From the perspective of supply chain management, the authors found that compared with other supply chains, the local supply chain is usually more geographically limited and more vulnerable to the needs of local society.	392
Picazo-Tadeo [20]	2012	European Journal of Operational Research	Various indicators representing different goals related to economic and ecological performance were selected, and the case area ecological efficiency was assessed using directional distance functions and data envelopment analysis techniques.	280
Campbell [8]	2002	Conservation Ecology	This study proposed systems modelling as a tool for assessing natural resources management performance and explored five possible ways to conduct nature management performance assessments.	274
Zhang [21]	2018	Journal of Cleaner Production	Concepts, research questions, and methods in the water-energy-food domain were reviewed, and guidance was provided on selecting an appropriate modelling approach.	241
Doran [22]	2016	Business Strategy and the Environment	The research pointed out that companies face environmental challenges, such as natural resources reduction and pollution control, and evaluating the impact of nine different types of eco-innovation factors on company performance. The results show that regulation and customer pressure are viable mechanisms to encourage companies to undertake eco-innovation.	240
Tung [23]	2020	Journal of Hydrology	By using artificial intelligence models for water management related research, the authors pointed out that artificial intelligence models are perfect tools for river water quality monitoring, management, sustainability and policy formulation.	155
Li [24]	2019	Journal of Environmental Management	A comprehensive evaluation system was developed to quantify different combinations of low-impact development units using the Storm Water Management Model and AHP, providing a reference for optimal selection and performance evaluation of other sponge city low-impact development practices.	126
Kraus [25]	2020	Technological Forecasting and Social Change	The impact of corporate social responsibility on environmental performance was discussed, and the results show that corporate social responsibility has no direct and significant impact on environmental performance, and environmental strategy and green innovation have an intermediary role.	118

Table 2. *Cont.*

First Author	Years	Journal	Main Contribution	Citations
Chen [26]	2019	Journal of Hydrology	Considering groundwater as one of the most beneficial natural resources in the world, two new hybrid data mining techniques were used to map groundwater potential in the study area to inform decision-making in regional groundwater management.	101
Asadi [27]	2020	Journal of Cleaner Production	The impact of green innovation on sustainability performance was investigated, and the findings demonstrate the importance and potential of green innovation in promoting sustainable performance in the hospitality industry.	88
Tikhamarine [28]	2020	Journal of Hydrology	Combining the grey wolf optimization algorithm with an artificial intelligence model, a flow prediction model for water resource management was constructed, and quantitative performance indicators were introduced to evaluate the effectiveness of the integrated model.	79
Alhawari [29]	2021	Sustainability	The authors pointed out that focusing on the efficient and efficient use of resources in the ecosystem is conducive to the optimization of environmental and economic performance. The authors recommended that future research should pay attention to digital transformation to increase the implementation of circular economy, as well as their impact on digital performance management.	53
Sarkodie [30]	2021	Science of the Total Environment	Ecological performance, bio-capacity, and carbon footprint of different countries were mapped. The authors used cross-country time-series techniques to assess environmental performance and the socioeconomic drivers of convergence.	49
Baah [31]	2021	Sustainable Production and Consumption	This study explored the framework through which organizational and regulatory stakeholder pressures influence the adoption of green production practices, firm reputation, environmental and financial performance.	48

The research content of performance management of natural resources has shifted from focusing on the dialectical relationship among natural resources, ecological environment and human activities to quantitative evaluation and influencing factors of natural resources performance. Through the study and induction of highly cited literature, the early research mainly discussed the interaction mechanism between humans, natural resources and the ecological environment from the perspectives of sustainable resource utilization and management regulation. For example, Armitage explored the relationship between adaptive capacity and natural resources management performance, and found that natural resources management performance is affected by institutions, culture, and knowledge [15]. Khalid et al. pointed out that the management of solid organic waste in a sustainable way can reduce environmental damage and avoid the depletion of natural resources [14]. Wong et al. drew on a natural resources-based perspective, examined the boundary-crossing role of green operations, and explored the impact of environmental management capabilities [18]. Since then, researchers from various countries have carried out many studies on natural resources performance evaluation and influencing factor analysis. For example, Picazo-Tadeo et al. conducted research from the perspective of eco-efficiency, arguing that eco-efficiency refers to the ability to create more goods and services with less impact on the environment and less consumption of natural resources. On the basis of designing ecological performance indicators for different objectives, the data envelopment analysis method was used to measure the ecological efficiency [20]. Kraus et al. found that corporate social responsibility has no significant impact on environmental performance but

is positively related to environmental strategy and green innovation, thereby improving environmental performance again, that is, they significantly mediate between corporate social responsibility and environmental performance [25].

The research scale of performance management of natural resources includes macroscopic and microscopic levels. Macroscopically, it is reflected in taking natural resources as a whole to carry out research on conceptual framework, quantitative assessment, and analysis of influencing factors, and these studies are often carried out on a global or national scale. For example, Campbell et al. focused on the performance evaluation of natural resources systems. He proposed to select evaluation indicators through sustainable livelihood methods and emphasized the importance of participatory evaluation [8]. Conley and Moote studied the assessment of collaborative natural resources management in the United States, discussed how natural resources management is assessed, and who is being assessed, etc., and they highlighted the importance of case studies for assessment [7]. Sarkodie et al. used novel cross-country time-series techniques to assess environmental performance and convergent socioeconomic drivers, finding that expansion of national biocapacity improves ecological performance [30]. Microscopically, it is mainly reflected in taking a single type of natural resources as the research object or carrying out research at the level of districts, counties, river basins, and enterprises. For example, Lee et al., conducted research at the enterprise level to explore the impact of green R&D investment for ecological innovation on environmental and financial performance and found a positive relationship between green R&D and financial performance [17]. Tung et al. took natural resources, such as water resources, as the research object and used artificial intelligence models to carry out research on water resources evaluation and management [23]. Tikhamarine et al. took water resources as the research object, constructed a flow prediction model for water resources management, and introduced quantitative performance indicators to evaluate the effectiveness of the comprehensive model [28].

4. Research Progress on Performance Management of Natural Resources

On the basis of our bibliometric analysis, this research further summarized the research progress of performance management of natural resources. The authors believe that the main research progress of performance management of natural resources is reflected in four aspects: the concept and connotation discussion of natural resources management and performance, the measurement and evaluation of natural resources system and management performance, the analysis of the influencing factors of natural resources performance, and the evolution of relevant institutions and laws of performance management of natural resources. In the paragraphs below, we analyzed the progress of natural resources performance management research from these three aspects. In addition, water is one of our most important natural resources, it has a significant impact on regional crop production and human food security [32], and water scarcity has become one of the most important global challenges of the 21st century [33]. Therefore, this article also used water as an example to further analyze the research progress of natural resources.

Discussion on the concept and connotation of natural resources management and performance. In the face of the severe situation of tight resource constraints and serious environmental pollution, it has gradually become a consensus to realize the sustainable management of natural resources [34]. Performance management is one of the methods to promote the sustainable management of natural resources. There has been extensive academic discussion around natural resources management and performance. Some authors discussed the shift of the focus of natural resources management, the concept of comprehensive management and the interests of different groups, etc. [35,36]. Some researchers paid attention to ecological performance and natural resources performance [37–40]. In addition, it is worth noting that due to different national conditions, countries around the world have formed different models of natural resources management. The United States has attached great importance to the asset management of natural resources and has formed a relatively complete management system for the value of natural resources

assets [41]. China implements natural resources management through the system of spatial planning and property rights [42]. Japan has attached great importance to the protection of important ecological resources and has implemented state-owned and public ownership of natural resources with important ecological locations [43]. Australia has implemented a natural resources property right registration system, with clear regulations on the rights and obligations of different types of natural resources on land [44]. In terms of water resource management and performance, researchers have carried out relevant research from different perspectives, which has enriched the concept and connotation of water resource management performance. Knieper and Pahl conducted an analysis of water governance, water management and environmental performance in the watershed and found that polycentric governance combined with further contextual factors (i.e., high per capita income and low corruption) leads to good water management practices [45]. Wang et al. analyzed the performance of water management in villages of water user associations supported by the World Bank and found that the establishment of water use associations promoted the improvement of water management in these villages [46].

Natural resources systems and management performance measurement and evaluation: Rauschmayer et al. explored concepts related to natural resources assessment in Europe, arguing that a combination of results-oriented and process-oriented approaches is needed for biodiversity and water governance [47]. Reinhardt et al. conducted assessments of integrated natural resources management under different scenarios and found that all types of scenario assessments address many sustainability challenges but more complex scenarios based on stories, simulations and model coupling are the most comprehensive [48]. Many studies evaluated efficiency as an important indicator of natural resources performance. Some researchers measure ecological efficiency by comparing environmental performance indicators [49–51]. Some authors have carried out related research from the perspective of land use efficiency [52,53]. Some authors focused on agricultural ecological efficiency and carried out related research [54–56]. Other researchers regarded ecosystem service value as an evaluation index of natural resources performance [57–60]. In terms of water performance measurement and evaluation, scholars have made many explorations in the construction of evaluation indicators and the application of methods. Wang established a comprehensive benefit evaluation model for urban water resources-related policies based on AHP [61]. Cao et al. evaluated the natural carrying capacity of water resources in the case area based on the principal component analysis method [62]. Wang et al. regarded agricultural water use efficiency as an important measure of water resources performance and so measured agricultural water use efficiency in the Heihe River Basin in China, finding that there was obvious heterogeneity in agricultural water use efficiency in different counties [63]. Some scholars pay attention to tourism water resources management and propose that a new set of water resources performance management indicators should be established [64].

Analysis of influencing factors of natural resources performance: Auty et al. illustrated how the System of Integrated Environment and Economics Accounting and net savings can be used to diagnose policy failures and improve economic performance, using case studies from Chad and Mauritania [65]. By using an empirical approach, Anshasy and Katsaiti examined the interplay between different institutional quality and fiscal policy and their impact on growth in resource-rich economies, arguing that better governance improves fiscal performance, leading to more high growth rate [66]. Wang et al. used the difference method and stochastic frontier analysis method to analyze the impact of natural resources regulation on the efficiency of construction land, and believed that natural resources regulation can promote the development of the bidding market, and thus have an indirect impact on land management [67]. In the research on the influencing factors of water resources performance, researchers have discussed the influence of different factors on water resources performance. Pan and Xu used the method of multiple regression combined with correlation analysis to estimate the influencing factors of water resources management performance in irrigation areas. This study found that performance is mainly

affected by management enabling environment and management system [68]. Song et al. found that water resource efficiency is related to the level of economic development to some extent, technological improvement is an important factor to improve water resource efficiency, and the impact of economic development level on water resource efficiency is non-linear [69]. Zou and Cong analyzed the factors affecting the utilization efficiency of industrial water resources in my country. This study found that industrial water use efficiency is greatly promoted by natural resources endowment, economic development level, industrialization degree and technological progress but is significantly inhibited by industrial water use intensity and environmental regulation [70]. Yi et al. analyzed the impact of cross-regional collaboration networks in 41 cities in China's Yangtze River Delta region on water resource governance performance [71].

The evolution of relevant institutions and laws of performance management of natural resources: To make natural resources produce economic benefits to improve human welfare at present and in the future, it is necessary to carry out legal and institutional management of natural resources. Developed countries have established a relatively perfect property rights system of natural resources through legislation to regulate the rights of occupation, use, income and disposition of natural resources and to carry on resource management through resource accounting. Additionally, it includes the accounting of water resources [72]. Some countries or regions carry out the management of natural resources by means of planning, such as spatial planning in Germany, Denmark, the United Kingdom, etc. [73]. Through continuous development, many countries have formed relatively mature laws related to natural resources management, such as the natural environmental protection law of Russia, the national environmental policy law of the United States, and so on. In terms of management institutions, the institutions managed centrally by the government and those with public participation deserve more attention.

Combining the previous research and related literature, it can be seen that the related concepts of natural resources management and performance are constantly changing with the management practice of human society. Scholars at home and abroad have carried out a large number of theoretical and empirical studies from individual (such as water resources) or whole natural resources to improve the performance of natural resources and to seek natural resources. The sustainable utilization and management of resources has become the frontier direction of research. There are also some mature international cases in the legal and institutional systems related to natural resources management. However, there are still many different views on concepts, such as natural resources, natural resources performance, and ecological performance, and there is a lack of a general conceptual interpretation and analysis framework. Natural resources system and management performance measurement is mainly quantitatively calculated by introducing model methods, such as principal component analysis and data envelopment analysis. Most of the existing studies were single evaluation of single natural resources or regarded resource carrying capacity, resource utilization efficiency and ecosystem service value as important indicators of performance evaluation of natural resources. Comprehensive and quantitative evaluation of different types of natural resources performance and its difficulties is a current research trend. The natural resources performance evaluation system and methods still need to be further improved. The relevant research on the analysis of the influencing factors of natural resources performance in the academic circles was mainly aimed at diagnosing key influencing factors and improving the performance of natural resources. Quantitative analysis was the main research method in this direction. However, the existing research on influencing factors of natural resources performance still lacks depth, and the application of quantitative models needs to be strengthened. In view of this, it is of great research value to explore and construct a performance management analysis framework for natural resources, such as mountains, water, forests, fields, lakes, grasses, and sands and to provide theoretical support for the sustainable utilization and management of natural resources.

5. Performance Management Analysis Framework

The above analysis and review of the international literature on performance management of natural resources is to summarize the mature international experience and provide reference for the practice of developing countries, especially China. China's natural resources management has undergone a process of change from a combination of classified management and unified management to a comprehensive and unified management [74]. One of the responsibilities of the Ministry of Natural Resources is to conduct centralized development and management of mountains, rivers, forests, fields, lakes and grasslands. At present, the performance management and evaluation in the field of natural resources in China is still in the exploratory stage, and the evaluation subjects, evaluation standards, evaluation methods, and application of evaluation results need to be further improved [75]. Therefore, this study constructed an analysis framework for performance management of natural resources (Figure 3) and described the process and mechanism of performance management of natural resources on the basis of multiple assessment objectives, subjects, and means.

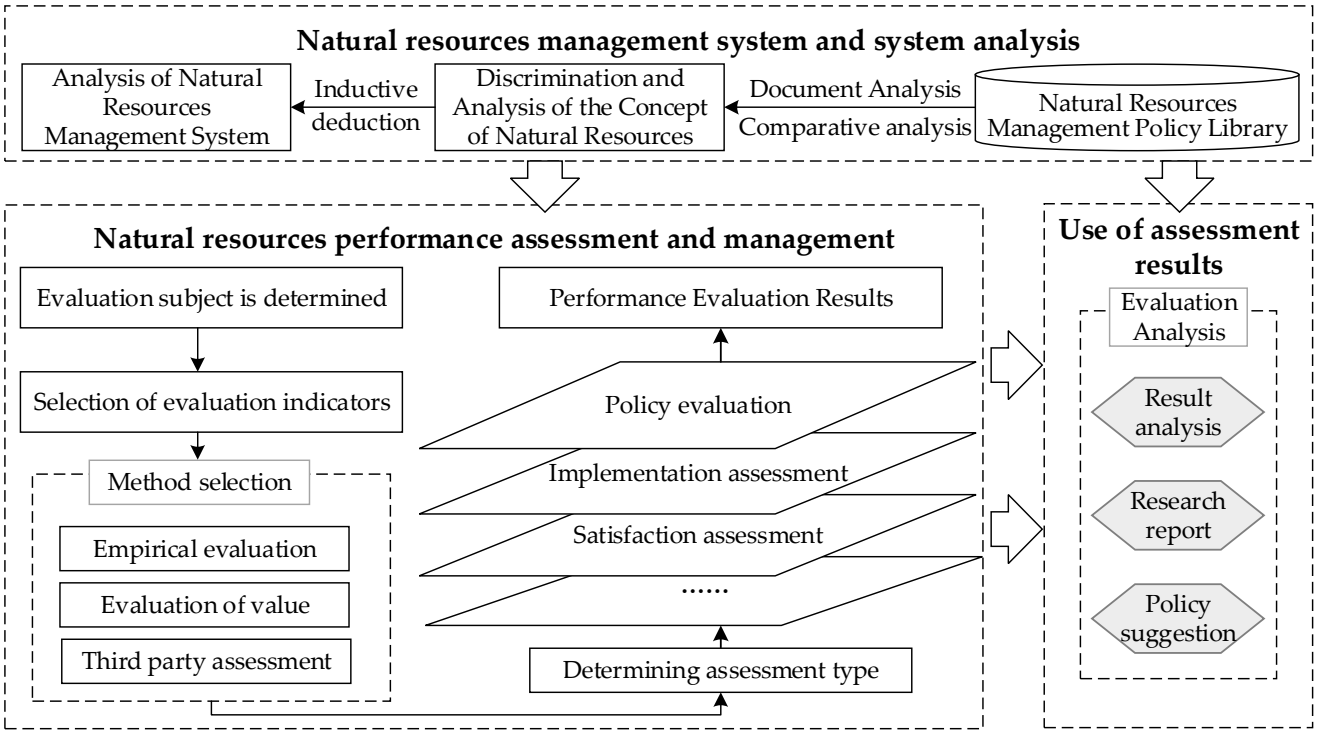

Figure 3. Theoretical Framework of research on performance management of natural resources for China.

Natural resources have always played an important role in social and economic development, and economic growth is accompanied by an increase in natural resources input [76]. However, China's emphasis on natural resources management is constantly increasing, and the natural resources management system, concept and method are gradually becoming more perfect and mature. However, there are also many practical problems in the practice of natural resources management. It is necessary to sort out the actual cases in the practice of natural resources management. People need to discover practical problems that restrict natural resources management and think about solutions.

At the same time, natural resources performance evaluation is an important part of the natural resources management process. It helps to promote the scientific and democratization of policies and to improve the governance level and governance capacity of natural resources management departments. The performance management evaluation of natural resources first needs to determine the specific evaluation subject. It may be for a certain natural resources elements, such as water resources, land resources, forest resources, etc.

The management of a natural resources sector conducts a performance evaluation. Different evaluation indicators need to be selected for different evaluation objectives and evaluation objects. The indicators are mainly divided into quantitative indicators, quality indicators, efficiency indicators and value indicators. Evaluation methods include empirical evaluation, value evaluation, third-party evaluation, etc. Among them, empirical evaluation is to carry out empirical research through model methods and to measure the value of relevant evaluation indicators; value evaluation is realized by calculating the economic value of natural resources; third-party evaluation is the evaluation of the evaluation object through a third-party organization. Due to the differences in evaluation objectives, the evaluation of natural resources can also be divided into various types, including policy evaluation, policy implementation capability evaluation, and satisfaction evaluation. Among them, policy evaluation is generally an evaluation of the rationality of the policy before it is implemented. The system dynamics models, the computable general equilibrium models, and difference-in-difference models are commonly used models for policy evaluation or simulation. The assessment of policy implementation capacity is also an assessment of the policy implementation capacity of natural resources management departments before policy implementation, and based on this, policy adjustment is made to make it better implemented. The satisfaction assessment is the assessment of the implementation effect after the implementation of the policy, and also involves people's subjective feelings and value judgments, reflecting the public's participation in public policies. The evaluation results obtained at the end of the evaluation will provide basic data for subsequent comparative analysis.

The ultimate purpose of policy evaluation is to provide guidance for policy improvement and practice. Therefore, it is necessary to make full use of the evaluation results of performance management of natural resources. Evaluators should carry out comparative analysis based on the evaluation results, comprehensively present the evaluation results in the form of research reports and policy analysis reports, and make an in-depth analysis of the differences among the evaluation objects and the problems existing in the process of policy implementation. Based on these analyses, the researchers can help natural resources management institutions to formulate targeted policy recommendations so as to improve the science and rationality of policies and enhance the efficiency of natural resources governance.

6. Discussion

6.1. Marginal Contribution

Based on the fact that the performance management and evaluation work in the field of natural resources in China is still in the exploratory stage, this study makes an extensive review and summary of the relevant literature at home and abroad. At the same time, the literature review was also carried out with water resources as a typical natural resource. The authors draw lessons from the historical experience of international performance management of natural resources and pointed out the deficiencies and development directions of existing research. According to the reality of China, the authors constructed a theoretical framework of research on performance management of natural resources. They clarified the logical relationship between various research links and pointed out the research focus and research direction of performance management of natural resources and evaluation in the future. The research also provided references for performance management of natural resources and evaluation practices.

6.2. Futures

The natural resources management system is in the process of continuous evolution and improvement. Existing studies have insufficient generalization of the evolution of the system, insufficient analysis of the current status of performance management of natural resources and existing problems. There are still disputes on the related concepts of performance management of natural resources in academic circles, and a general consensus

has not yet been reached. In the evaluation of natural elements, there is still no clear solution to the environmental capacity and the amount of regionally available water resources. Future research needs to start with theoretical analysis and conceptual definition, then clarify the research object and its scope, further clarify the research ideas of performance management of natural resources, and gradually build a complete evaluation process and a mature method system.

At present, the performance management and evaluation in the field of natural resources in China is still in the exploratory stage, and the results of natural resources performance evaluation are obviously insufficient in practical guidance or application. In the future, the mechanism construction and scientific research on the application of natural resources performance evaluation results should be strengthened. For example, consideration may be given to including the assessment results in the annual assessment of the governing body; The appraiser can carry out comparative analysis between different units, rank the evaluation results, and formulate corresponding rewards and punishments to fully stimulate the enthusiasm of managers; we can also strengthen the analysis of the evaluation results and put forward targeted policy recommendations.

6.3. Limitations of the Research

One of the limitations of this study is the limited literature review. When doing bibliometrics, this study selected only articles in several major related research fields that we focus on for analysis, including "Public Administration", "Environmental Science Ecology", "Water Resources", etc. In fact, there are also some studies related to the theme of this article in other research fields. It may be more comprehensive if they are included and sorted together, but this also leads to the problem that the theme cannot be focused.

In addition, this study proposed a theoretical framework for research on performance management of natural resources based on the management and practical needs of China's natural resources field through a large number of literature review. However, generally speaking, the current research on performance management of natural resources lacks depth, and there is no broad consensus on the understanding of related concepts and theories. The mechanism, index system, evaluation methods and other aspects of natural resources management and evaluation need to be discussed in depth. Therefore, in the future, it is necessary to strengthen the concept identification, mechanism and mechanism analysis and evaluation practice research of performance management of natural resources to further improve the level of performance management of natural resources.

In conclusion, the related concepts of natural resources management and performance are constantly changing with the management practice of human society. "Performance", "management", "impact" and "model" and "system" are the top five high-frequency keywords in performance management of natural resources research. Scholars from all over the world have carried out a large number of theoretical and empirical studies from individual or whole natural resources. The sustainable utilization and management of resources has become the frontier direction of research. There are also some mature international cases in the legal and institutional systems related to natural resources management. This study describes the process and mechanism of performance management of natural resources for China from three aspects: evaluation objectives, evaluation subjects and evaluation means, in order to provide decision-making reference for performance management and assessment in the field of natural resources.

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