
Discussion on Performance Audit Evaluation System of Environmental Protection Special Fund based on AHP

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Abstract:

"Ecological prosperity is the prosperity of civilization, ecological decline is the decline of civilization". The ecological environment is a major political issue, as well as a major social issue related to people's livelihood. In recent years, the state and various regions have invested a lot of special funds for ecological management. In this paper, based on the combing relevant literature, we try to construct an evaluation index system for the performance audit of special funds for environmental protection based on the main line of "Fund Input → Process Management → Project Output → Comprehensive Benefit", in order to provide some theoretical reference and empirical evidence for promoting the performance audit of special funds for environmental protection. Theoretical reference and empirical evidence for promoting the performance audit of environmental protection funds.

Keywords: *Ecological civilization construction, Special funds for environmental protection, Performance auditing, Audit evaluation index system.*

I. INTRODUCTION

Over the past 40 years of reform and opening up, China has created a "miracle of economic growth" that has attracted worldwide attention, but the economic growth has been accompanied by serious problems of environmental pollution and ecological damage. How to carry out ecological environmental protection, coordinate the relationship between economic development and environmental protection, preserve the "clear waters and green mountains", and build a high-quality modern economic system has historically become the theme of the times. The construction of ecological civilization has been elevated to a national strategy, and "ecological priority and green development" are widely practiced throughout the country. At the same time, the central and local governments have also increased the investment in environmental protection funds while balancing the central financial revenue and expenditure. For example, in 2019, the Ministry of Finance invested 60 billion yuan in air, water and soil pollution prevention and control, focusing on winning the battle of pollution prevention and control, with a 35.9% year-on-year increase in investment. China's environmental protection special funds to increase

investment, but the use of funds is not very satisfactory, there are different degrees of emphasis on funding applications, light on fund management, project construction, light on performance management phenomenon, seriously affecting the implementation of environmental protection policies and environmental protection special funds to enhance the efficiency of allocation. 2015, the State Ministry of Environmental Protection, the Audit Office and other departments jointly promulgated the "on the development of government environmental audit pilot work Notice" to explore and promote the construction of environmental performance audit system. However, since performance auditing in China, especially performance auditing of environmental protection special funds, started late, the relevant evaluation index system, evaluation standards, practical guidelines, and supporting measures are still being improved, so it is especially urgent to explore a scientific, reasonable, and practical evaluation system for performance auditing of environmental protection special funds.

Based on the above-mentioned background, based on the literature at home and abroad, this thesis explores the construction of the performance audit index system of environmental protection special funds from four dimensions, such as input, management, output, and benefit, based on the implementation of environmental protection policies and the movement of environmental protection special funds, in order to promote the performance audit evaluation of environmental protection special funds. To give full play to the audit "cure the disease, prevent the disease" role, to improve the environmental protection special funds performance audit assessment system and accountability system to provide some theoretical reference.

II. ENVIRONMENTAL PROTECTION SPECIAL FUNDS PERFORMANCE AUDIT CONNOTATION AND VALUE ORIENTATION

2.1 Environmental Protection Special Funds and their Funding Projects

Special funds for environmental protection are funds allocated by higher-level departments to lower-level departments and arranged by the government at this level specifically for environmental protection. Environmental protection special funds have three typical characteristics: first, they are allocated from the financial budget; second, they serve these designated purposes such as environmental protection, pollution control, and environmental safety and security capacity building, such as regional ecological and environmental restoration and key pollution source control; third, they are earmarked for specific purposes[1,2].

Environmental protection special fund projects mainly include key pollution prevention and control category, rural environmental protection category, environmental governance and supervision system construction category, ecological and environmental security guarantee system construction category, etc.[3] Among them, special funds for key pollution prevention and control and construction of environmental governance and supervision system are the most common, and environmental protection departments also mainly allocate resources between these two types of projects. Applicants for these special fund projects are mainly enterprises related to pollution prevention and control and environmental monitoring agencies, information centers, and environmental protection departments at all levels related to

the environmental governance and supervision system[4].

2.2 Environmental Protection Special Funds Performance Audit

2.2.1 The connotation of performance auditing of special funds for environmental protection

Performance auditing of environmental protection special funds is the use of specialized techniques and methods for audit supervision and performance evaluation of the operation of environmental protection special funds projects[5]. Drawing on the theoretical distinction between the broad and narrow sense of financial special funds performance auditing, we can also distinguish environmental special funds performance auditing in the broad and narrow sense, from the narrow sense, environmental special funds performance auditing is to audit the economy, efficiency and effectiveness of environmental special funds. From a broad perspective, in the national emphasis on the implementation of environmental governance policies and violations of the law are still repeated, compliance audits should be included in the audit evaluation, in addition to the consideration of China's ecological civilization construction goals, environmental is also one of the content of the performance audit[6]. In other words, the performance audit of special funds for environmental protection in a broad sense includes auditing its economy, efficiency, effectiveness, compliance and environment[7].

2.2.2 The significance of performance audits of special funds for environmental protection

First, it helps to build a modern and efficient national governance system. The construction of ecological civilization is one of the core elements of the socialist cause with Chinese characteristics, which is related to the well-being of the people, the future of the nation, and the realization of the Chinese dream of the great rejuvenation of the Chinese nation. "Pollution prevention and control" is one of China's three major battles, environmental protection funds to achieve the core path of China's ecological civilization construction strategy, to enhance the efficiency of environmental protection funds is, to a certain extent, the performance of national governance optimization[8]. In order to further enhance the efficiency of the allocation of special funds for environmental protection, play a leading role in the financial special funds in ecological environmental protection, and constantly improve the national governance system to promote government functions, it is necessary to carry out in-depth performance audits of special funds for environmental protection.

Second, it is conducive to promoting the optimal allocation of environmental protection resources. At present, China is in the emerging economic transition period, the domestic economy downward pressure, the government's financial contradictions are more prominent, how to optimize the allocation of financial resources is also one of the main purposes of financial special funds performance audit. Therefore, the need for environmental protection special funds through the performance audit to improve the efficiency of the use of environmental protection special funds, revitalize the stock of funds, avoid waste of resources, play the role of audit "to cure the disease, prevent the disease"[9].

Third, it is conducive to the implementation of major policies and measures for ecological environmental protection. Audit of environmental protection special funds project construction and operation of the system construction, system operation, the use of funds and project benefits will help from the policy implementation, implementation of two aspects of the effect of the implementation of major policy measures [10].

III. CURRENT SITUATION AND PROBLEMS OF PERFORMANCE AUDIT OF SPECIAL FUNDS FOR ENVIRONMENTAL PROTECTION

Performance auditing of special funds for environmental protection in China is still in its infancy, its theoretical system is not mature enough, and standards vary in the practice process. Only by fully recognizing the actual situation facing this work and clarifying the various challenges that may be encountered in its development can we further optimize the performance audit index system for environmental protection special funds and put forward policy recommendations to standardize performance auditing.

3.1 Lack of Authoritative Guidelines for Auditing the Performance of Funds

A sound legal system can provide a strong basis for performance auditing of special funds for environmental protection, and is a prerequisite for ensuring effective performance audit evaluation. However, because performance auditing research in China started late and is still in the stage of continuous exploration and development, there is still a lack of unified and standardized performance auditing system for environmental protection special funds and specific evaluation guidelines and other normative documents [11]. For example, environmental protection laws and regulations for major areas such as water, soil, and atmosphere have been relatively sound, but there is a lack of specific policies for performance auditing of environmental protection special funds in these areas, and the details of the relevant provisions are not clear enough, and there are no detailed and operable regulations, so it is difficult to obtain legal protection for performance audit evaluation standards, and it is also difficult for environmental protection special funds performance audits to produce particularly objective and fair evaluation results.

3.2 Insufficient Match between Auditor Literacy and Audit Needs

At this stage, most of the auditors in China have a single professional knowledge, only with the knowledge of auditing and finance and accounting. Due to the strong professionalism and extensive fields involved in the performance audit of special funds for environmental protection, there are higher requirements for the comprehensive knowledge and ability of auditors. In addition to financial accounting, auditing and other professional knowledge, auditors also need to have some knowledge of environmental protection, public management, engineering budget and accounts, and statistics[12]. In addition, because local governments do not carry out environmental protection work with the same intensity, local policy regulations are not consistent, in the specific work, it is also necessary to combine the policy regulations

issued by the local government to deal with local conditions. As a result, many auditors may have knowledge deficiencies in practice and cannot meet the work requirements to complete the performance audit of environmental protection special funds for a particular project independently. The overall quality of the environmental protection special fund performance audit practitioner team is not high enough, and the quality of audit work varies.

3.3 Performance Audit Evaluation Index System Lacks Systematization

China has not yet determined a unified performance audit evaluation system for environmental protection special funds. Audit departments lack a recognized, scientific standard for conducting performance audits of special funds for environmental protection, and can only refer to the guidelines for performance audits of special funds developed by some provinces and municipalities, such as the "Performance Audit Operation Guide for Audit Authorities in Jiangsu Province" and the "Performance Audit Operation Guide for Audit Authorities in Shanghai".[13] On the other hand, the current auditing work is mainly combined with local environmental protection regulations, special funds management methods, and listening to the opinions of industry experts to determine the evaluation system, the whole system lacks internal logical relationships, indicators lack interconnection, and indicator weights are not always reasonable, which may lead to ambiguous thinking of auditors in the audit implementation process and prone to errors.

3.4 Evaluation Index Values and their Weights are Determined Subjectively

First, China's environmental protection special funds audit evaluation in the use of a large number of qualitative indicators, the indicators of each indicator value estimation and audit evaluation are dependent on the environmental protection special funds project team and audit evaluation project team of professional subjective judgment, and then the evaluation of the situation and audit evaluation criteria for comparison scoring, this measurement method is arbitrary, subjective; second, in the design of the weight of each indicator part, the audit evaluation team did not scientific and objective method to determine the weight of each indicator, but only according to expert scoring or self-professional judgment to determine an approximate weight base, which is obviously difficult to meet the needs of China to strengthen the performance audit supervision of special funds for environmental protection[14].

IV. THE CONSTRUCTION OF PERFORMANCE AUDIT INDEX SYSTEM FOR ENVIRONMENTAL PROTECTION SPECIAL FUNDS

4.1 Design Principles of Audit Evaluation Indicators

4.1.1 Principle of Importance

Environmental protection special funds performance audit involves various aspects, to use a limited number of indicators to comprehensively and objectively portray the environmental protection funds input,

environmental protection funds management, environmental protection output, environmental protection benefits and other circumstances is unrealistic, therefore, in the selection of indicators as far as possible to highlight the focus, on the one hand, can reflect the environmental protection special funds input, management, output, benefits of the specific circumstances, evaluation of the whole process of environmental protection funds movement. On the other hand, to highlight the reflection of environmental protection special funds input, management, output, effectiveness of the performance of major responsibilities, to achieve the target, to improve audit efficiency.

4.1.2 Dynamic principle

The ecological environment itself has a strong self-regulating ability, and coupled with the influence of human activities, the ecological environment is always in a state of change. Therefore, the performance evaluation index system of environmental protection funds needs to be updated dynamically and continuously, and has timeliness.

4.1.3 Scientific principle

The scientific selection of evaluation indexes directly affects the objectivity, scientificity and practicality of audit evaluation. In this paper, a series of scientific and feasible audit evaluation indicators are selected by combining the objective needs for audit supervision of environmental protection special fund projects in terms of inputs, management, outputs and benefits, and the relevant institutional norms such as the Measures for the Management of Financial Special Funds promulgated by the Ministry of Finance, the environmental protection industry standards corresponding to each type of project, and the quality control standards related to environmental protection at the provincial (municipal) level.

4.1.4 Completeness Principle

Only by designing the evaluation system of indicators as comprehensively as possible can we comprehensively monitor and evaluate the performance of environmental protection funds in terms of inputs, management, outputs, benefits, etc. and the fulfillment of responsibilities, so that we can monitor and review the whole process of environmental protection funds in real time and prevent the risk of one-sidedness caused by using a single indicator and facts to evaluate the situation of environmental protection funds.

4.2 Audit Evaluation Index Selection Basis

4.2.1 Guiding basis

As a guiding basis for the performance audit of special funds for environmental protection, the laws, regulations, departmental rules, local plans, environmental regulatory documents and other authoritative regulations promulgated by the state can provide authoritative guidance for the work in the field of

environmental protection. Such guiding bases are mainly the following.

(i) National level. Environmental protection laws and regulations promulgated by the national legislature, such as the Audit Law of the People's Republic of China, Environmental Protection Law of the People's Republic of China, Environmental Impact Assessment Law of the People's Republic of China, Water and Soil Conservation Law of the People's Republic of China, Flood Control Law of the People's Republic of China, Water Pollution Prevention and Control Law of the People's Republic of China, Land Management Law of the People's Republic of China, Air Pollution Prevention and Control Law of the People's Republic of China Forest Law of the People's Republic of China", "Wildlife Protection Law of the People's Republic of China", "Solid Waste Prevention and Control Law of the People's Republic of China", "Decision of the State Council on Several Issues of Environmental Protection", "Opinions of the CPC Central Committee and State Council on Accelerating the Construction of Ecological Civilization", "Opinions of the State Council on Strengthening the Key Work of Environmental Protection", "Regulations on Urban Drainage and Sewage Treatment", "Regulations on Environmental Protection of Construction Projects Management Regulations" and a series of other laws and regulations and their supporting guidelines, these are the most important and authoritative mandatory auditing standards for performance audits of special funds for environmental protection.

(ii) Local government level. Local governments at all levels make local laws and regulations, local government regulations, relevant normative documents and relevant environmental protection work plans in the "five-year development plan". Local governments implement national policies and make specific plans for environmental protection investment and construction, taking into account the actual economic and social development of the region, which should also become the standard for audit evaluation. For example, the "Key Basin Water Pollution Prevention and Control Plan (2011~2015) Chongqing City Implementation Plan" "Sichuan Province National Economic and Social Development 13th Five-Year Plan Outline" "Water Pollution Prevention and Control Action Plan" (National Development (2015) No. 17) "Sichuan Province Urban and Rural Overall Planning" "Sichuan Province Ecological Construction and Environmental Protection "13th Five-Year Plan The 13th Five-Year Plan", "Sichuan Ecological Function Area Planning" (revised), "13th Five-Year Plan for Energy Conservation and Emission Reduction in Sichuan Province", etc. Although local environmental policies are relatively less authoritative than national policies and laws and regulations, they have the advantage of being highly adaptable, taking into account the differences between different regions, and are therefore the main basis for performance audits of environmental protection funds.

4.2.2 Technical standard basis

Environmental protection technical standards are recognized by environmental supervision and management departments, experts and scholars in the industry, and the public, and have a certain authority in the professional field of environmental protection standards. At present, the main technical standards used in the performance audit of environmental protection funds are the world's common International Organization for Standardization (ISO) standards and our national unified promulgation of "national

standards" and "ministerial standards", such as the international ISO14000 series of environmental management standards and China's "ambient air quality standards" (GB3095-1996) "comprehensive sewage discharge standards" (GB8978-1996) "surface water environmental quality standards" (GB3838-2002) "urban sewage treatment project construction standards" (GB18918-2002) "domestic waste landfill pollution control standards" (GB16889-2008) (2008) "urban sewage treatment plant appurtenant building and appurtenant equipment design standards" (CJJ31-89), etc.

4.3 Audit Evaluation Indicators Specific Screening

This paper combines the requirements of environmental protection policy implementation and the realistic needs of environmental protection special funds campaign audit supervision, and constructs a performance audit evaluation system based on the logical framework method from four dimensions: environmental protection special funds project impact, environmental protection special funds project management, environmental protection special funds project output, and environmental protection special funds project input, etc. The relationship of audit indicators at each level is shown in Fig 1 below.

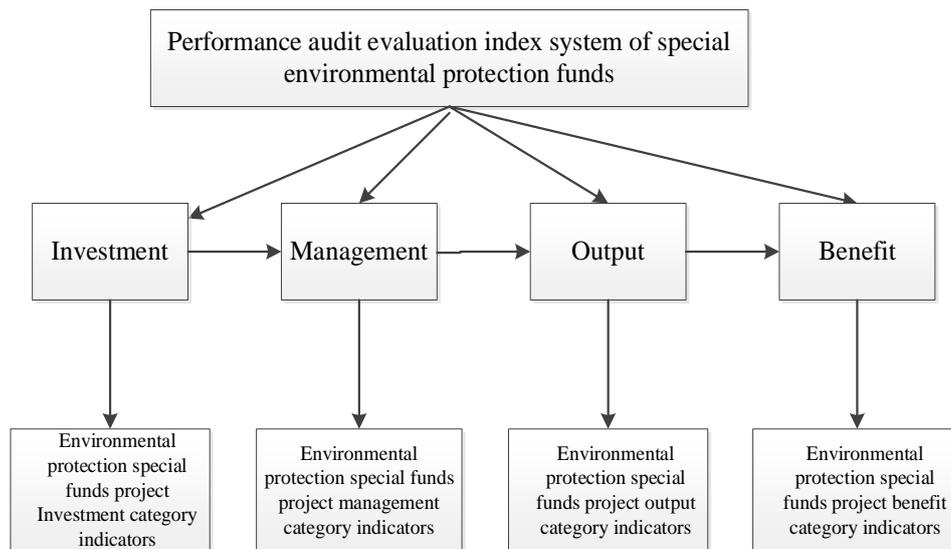


Fig 1: Performance audit index system based on the logical framework method

4.3.1 Project investment indicators of special funds for environmental protection

The input of environmental protection special funds is a prerequisite for the implementation of environmental protection projects, and the allocation efficiency of the input funds directly affects the performance of environmental protection special funds projects. According to the implementation requirements of China's environmental protection policies and the management methods related to financial special funds, we design evaluation indicators from the perspective of the rate of special funds in place for environmental protection, whether special funds for environmental protection are in place in a timely manner, and the use of funds in place for special funds for environmental protection projects, as

detailed in Table I.

TABLE I. Environmental protection special funds project investment category indicators

First-level	Second-level	Explanation of indicators	Indicator properties
Environmental protection capital investment category indicators	Availability rate of special funds	The rate of special funds in place is the percentage of the actual amount of funds in place and the approved amount of funds in place, which reflects whether the environmental protection funds support the project implementation according to the predetermined plan and clarify the responsibilities.	Quantitative indicators
	Timeliness of special funds in place	The timeliness of special funds in place refers to the number of days difference between the actual and planned time in place of the overall quota. It can be divided into three types: early arrival, timely arrival and delayed arrival.	Quantitative indicators
	Fund allocation efficiency	The efficiency of funds = the actual funds put into the project use and produce results / actual special funds in place × 100%, reflecting whether the special funds are used in accordance with the intended goal whether there is waste inappropriate use of the phenomenon.	Quantitative indicators

4.3.2 Environmental protection special funds project management category indicators

The project management of environmental protection funds includes the management of environmental protection funds and the management of the project implementation process. In general, it requires legal compliance in the use of special funds for environmental protection, legal compliance and fairness in the handling of accounts related to the operation of project funds, sound internal controls related to the operation of the project, and the implementation of the project budget. Based on these requirements, we design the management indicators shown in Table II.

TABLE II. Environmental protection special funds project management category indicators

First-level	Second-level	Explanation of indicators	Indicator properties
Environmental protection special funds project management category indicators	Compliance of fund usage	Compliance in the use of funds = $(1 - \frac{\text{the number of illegal use of funds}}{\text{the actual amount disbursed}}) \times 100\%$, to evaluate whether the project management is in line with national regulations.	Quantitative indicators
	Degree of perfection of project internal control system	Whether the division of labor in each department is clear, whether the rules and regulations of each department are sound and complete, and whether the management is systematic.	Qualitative indicators
	Project financial accounting compliance	Evaluate whether the project financial accounting process is compliant, independently accounted for, clear and correct.	Qualitative indicators
	Compliance of expenditure with plan	The degree of conformity = $\frac{\text{actual investment amount}}{\text{planned investment amount}} \times 100\%$, to evaluate whether the scope of the actual project expenditure is consistent with the construction contract.	Quantitative indicators

4.3.3 Environmental protection special funds project output category indicators

The project output of special funds for environmental protection can be examined by designing indicators from the dimensions of the rate of achieving the output of special funds for environmental protection, the efficiency of using special funds for environmental protection, and the qualified output of special funds for environmental protection, as detailed in Table III.

TABLE III. Environmental protection special funds project output category indicators

First-level	Second-level	Explanation of indicators	Indicator
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			properties
Environmental protection special funds project output category indicators	Output completion rate	Output target completion rate = acceptance of the number of qualified / the actual number of completed × 100%, so as to evaluate whether the project results meet the expected construction goals.	Quantitative indicators
	The cost of capital rate	The cost of capital rate = cost of capital employed / net funding × 100%, thus reflecting the ratio between cost of capital and effective funding.	Quantitative indicators
	Output quality compliance	Evaluate the quality of project outputs to meet national access standards or binding standards.	Qualitative indicators
	Regulatory effectiveness	Evaluate whether the project authority's supervision and inspection measures are in place and effective in the course of project implementation.	Qualitative indicators
	Project effectiveness	Project effectiveness = post-construction treatment volume / pre-construction treatment volume, thus evaluating the magnitude of the post-construction treatment effectiveness of the project compared to the pre-construction treatment volume.	Quantitative indicators
	Project cost savings rate	Project cost saving rate = (planned expenditure - actual expenditure)/planned expenditure × 100%, evaluating whether the funds are effectively used in project implementation.	Quantitative indicators

4.3.4 Environmental protection special fund project benefit indicators

According to the ecological civilization construction strategy, the project investment should achieve the harmonization of social benefits, economic effects and environmental benefits. Accordingly, we design pollutant emission reduction indicators, environmental quality improvement indicators, pollutant treatment capacity building indicators, environmental monitoring and exclusion situation indicators to reflect the environmental benefits of special funds for environmental protection projects, with the comprehensive utilization of wastewater yield compliance rate to portray the economic benefits, with public satisfaction,

project sustained operation rate, project demonstration to portray the social benefits, see Table IV for details.

TABLE IV. Environmental protection special funds project benefit category indicators

First-level	Second-level	Explanation of indicators	Indicator properties
	Emission reduction rate of main pollutants	Major pollution reduction rate = (cod discharge at water inlet - cod discharge at water outlet) / special fund expenditure for environmental protection in the current year - special fund expenditure for environmental protection in the previous year) × 100%, evaluate whether the performance target of pollutant emission reduction of the project has been achieved.	Quantitative indicators
Environmental efficiency indicators	Environmental quality improvement	Major pollution reduction rate = (cod discharge at water inlet - cod discharge at water outlet) / special fund expenditure for environmental protection in the current year - special fund expenditure for environmental protection in the previous year) × 100%, evaluate whether the performance target of pollutant emission reduction of the project has been achieved.	Quantitative indicators
	Completion of pollutant treatment capacity	Completion of pollutant treatment capacity = actual pollutant discharge capacity / estimated pollutant discharge capacity, and evaluate the achievement of pollution treatment capacity	Quantitative indicators

	performance objectives of the project.	
Regularly carry out environmental monitoring and troubleshooting	Dynamic supervision mechanism can ensure the effectiveness of project emission reduction, and regular monitoring and troubleshooting of pollutants can improve the operation efficiency of the project. It represents the assessment of the combined scores of ph, chemical oxygen demand, biochemical oxygen demand, dissolved oxygen, ammonia nitrogen, total phosphorus, total nitrogen, anionic surfactants, sulfide, fluoride, selenium, mercury, copper, zinc, and fecal coliform bacteria. Water samples after the completion of the laboratory testing program are scored by experts using standard analytical methods to compare past scores and calculate the increase in water body index improvement.	Qualitative indicators
Improvement degree of physical and chemical index of water body	Average comprehensive wastewater utilization yield attainment rate = comprehensive wastewater treatment plant yield/wastewater treatment plant yield performance target × 100%, which can evaluate the completion of the performance target in the rfp.	Quantitative indicators
Compliance rate of sewage comprehensive utilization income		Quantitative indicators
Public satisfaction	In the form of a questionnaire, the evaluation scores of the total number of participants are weighted average, and the most	Quantitative indicators

	intuitive effect of the environmental protection project is to improve the living environment of the residents and get their approval.	
Project continuous operation rate	Obtain the project sustainability rate based on the audit report of completion and acceptance to evaluate the sustainability of the project after implementation.	Quantitative indicators
Project demonstration	In the form of questionnaire, relevant technical personnel involved in project construction and later management are asked to evaluate the demonstration brought by the new technology and process project. Finally, the evaluation scores are weighted and averaged.	Quantitative indicators

4.4 Determination of Evaluation Index Weights based on Hierarchical Analysis Method

Analytic Hierarchy Process (AHP) is one of the widely used methods for estimating indicator weights in the field of economic and social research, which is simple to understand, easy to operate, and relatively reasonable to assign values, and can be applied to multi-level, multi-indicator, qualitative and quantitative indicators, and can be effectively combined with the performance audit evaluation system. In this paper, the hierarchical analysis method is applied to determine the indicator weights of each level, which is divided into the following four steps, as shown in Fig 2.

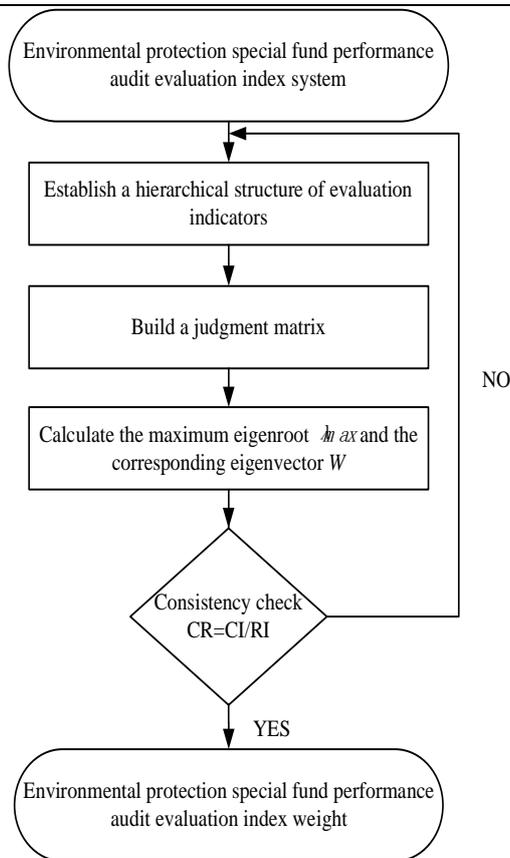


Fig 2: Schematic diagram of the steps of using the analytic hierarchy process to determine the index weight

4.4.1 Build a hierarchical model

Based on the in-depth analysis of actual problems, we separate the above-mentioned four types of index systems into several levels from top to bottom according to different attributes, and the factors of the same level are subordinate to or have an impact on the factors of the upper level, and at the same time dominate the factors of the lower level or are influenced by the factors of the lower level. See Table V for details.

TABLE V. Hierarchy of performance audit indicators for special funds for environmental protection

Target layer	Criterion layer	Scheme layer
	Investment of environmental protection funds b1	Availability rate of special funds c1
		Timeliness of special funds in place c2
		Efficiency of fund use c3

Performance audit and evaluation of special funds for environmental protection a	Environmental protection fund management b2	Fund use compliance c4
		Degree of perfection of project internal control system c5
		Project financial accounting compliance c6
		Compliance of expenditure with plan c7
	Environmental protection output B3	Output completion rate c8
		Capital cost rate c9
		Output quality compliance c10
		Regulatory effectiveness c11
		Project effectiveness c12
		Project cost saving rate c13
		Emission reduction of major pollutants c14
		Environmental quality improvement c15
		Completion of pollutant treatment capacity c16
		Regularly carry out environmental monitoring and troubleshooting c17
	Environmental benefits b4	Improvement degree of physical and chemical index of water body c18
		Standard rate of average comprehensive utilization income of sewage c19
		Public satisfaction c20
		Project demonstration c21
		Project continuous operation rate c22

4.4.2 Constructing the judgment matrix

Based on the clear hierarchy of each indicator, a judgment matrix is constructed to judge the importance of each indicator within the same level, and the importance between indicators is quantified according to the 1-9 scale method (as shown in Table VI). For example, among the first-level evaluation indicators, the most important environmental protection special fund performance audit is the environmental protection benefit achievement of the project, followed by the environmental protection

output completion evaluation of the project, and finally the environmental protection fund management and environmental protection fund input evaluation, so the importance degree of the first-level indicators is $B_4 > B_3 > B_2 > B_1$, and it is considered that B_4 is more important than B_1 , then the proportional scale of B_4 for B_1 is positive, such as 2, 3, etc., then the scale of B_1 for B_4 is inverse, such as $1/2$, $1/3$, etc. After comparing and assigning values to different indicators at the same level two by two, a specific judgment matrix is formed, and the form of the constructed judgment matrix is shown in Table VII.

TABLE VI. Table of judgment matrix scales and meanings

Values of X_{ij}	Interpretation
1	X_i and X_j are equally important
3	X_i is slightly more important than X_j
5	X_i is more important than X_j
7	X_i is much more important than X_j
9	X_i is significantly more important than X_j
2, 4, 6, 8	The important is between adjacent rank

TABLE VII. General form of judgment matrix

C	C_1	C_2	C_n
C_1	A_{11}	A_{12}	A_{1N}
C_2	A_{21}	A_{22}	A_{2N}
.....
C_n	A_{N1}	A_{N2}	A_{NN}

4.4.3 Weight estimation and consistency test

Firstly, experts and scholars with high attainments in the field of environmental auditing, audit elites in practice, backbone of environmental monitoring field and experts and scholars were invited to form a hierarchical analysis expert scoring group, and 42 questionnaires were issued to score the hierarchical analysis questionnaires; secondly, the results of the expert questionnaires were collected and checked for completeness to determine the validity of the questionnaires. In the end, except for two questionnaires with incomplete information, all other questionnaires were valid, with a total of 40 valid questionnaires (95.2% effective rate), as shown in Table VIII.

TABLE VIII. Basic information of survey respondents

Items	Basic information categories	Sample size	Proportion
Workplace	High school teachers	6	15%

	Audit bureau staff	14	35%
	Ecology and environment department staff	12	30%
	Environmental protection project manager	8	20%
Academic status	Phd	14	35%
	Graduate student	12	30%
	Undergraduate	8	20%
	College	6	15%
Working years	1 - 5 years	1	2.5%
	5-10 years	22	55%
	More than 10 years	17	42.5%

Then, the maximum characteristic roots " λ_{\max} " and the corresponding eigenvectors of the judgment matrix are calculated according to the index importance values, and the consistency test is performed. The specific calculation steps are as follows.

(i) The maximum characteristic root " λ_{\max} " is calculated according to the judgment matrix, and the maximum characteristic root " λ_{\max} " is calculated by formula (1).

$$\lambda_{\max} = \sum_{i=1}^n \frac{(Bw)_i}{nw_i} \quad (1)$$

(ii) According to the obtained λ_{\max} calculates the consistency index CI, which is calculated by formula (2).

$$CI = \frac{\lambda_{\max} - n}{n - 1} \quad (2)$$

(iii) The consistency test is performed according to the obtained consistency indicator CI, and the consistency test is calculated by equation (3).

$$CR = \frac{CI}{RI} \quad (3)$$

Among them, if $CR < 0.1$, the judgment matrix is consistent, otherwise it is not satisfied. See Table IX for the value of random consistency index RI.

TABLE IX. RI reference values

N	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Ri	0	0	0.58	0.9	1.12	1.26	1.36	1.41	1.46	1.49	1.52	1.54	1.56	1.59

Finally, after aggregating the scoring results of all personnel, the weights of each indicator were estimated. In order to explain the process of measuring the weights of each indicator more directly and clearly, the estimation process of the weights of the indicators for the performance audit evaluation of special funds for environmental protection and the data of each step are explained below.

(i) Constructing a judgment matrix for the target level of performance auditing

TABLE X. Target layer judgment matrix

	B1	B2	B3	B4	WI
B1	1	1/2	1/3	1/4	0.0887
B2	2	1	1/2	1/4	0.1388
B3	3	2	1	1/4	0.2173
B4	4	4	4	1	0.5552

As shown in Table X, the yaahp software was used to calculate the maximum eigenvalue $\lambda_{max}=4.1425$, $CR=0.0534$, CR less than 0.1, which passed the consistency test, and the weights of the indicators in the target layer were obtained as $W=(0.0887, 0.1388, 0.2173, 0.5552)^T$.

(ii) Calculate the judgment matrix for the input class of environmental funding projects at the guideline level

TABLE XI. Judgment matrix of project input categories for environmental funding at the guideline level

	C1	C2	C3	WI
C1	1	3	1/3	0.2583
C2	1/3	1	1/5	0.1047

C3	3	5	1	0.6370
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As shown in Table XI, yaahp software was used to calculate the maximum eigenvalue $\lambda_{max} = 3.0385$, CR = 0.0370, CR less than 0.1, which passed the consistency test, and the weights of the indicators of the input class were obtained as $W = (0.2583, 0.1047, 0.6370)^T$.

(iii) Calculate the judgment matrix of the project management category of environmental protection funds at the guideline level.

TABLE XII. Judgment matrix for the project management category of environmental funds at the guideline level

	C4	C5	C6	C7	WI
C4	1	3	2	2	0.4079
C5	1/3	1	1/3	1/2	0.1064
C6	1/2	3	1	3	0.3192
C7	1/2	2	1/3	1	0.1665

As shown in Table XII, yaahp software was used to calculate the maximum eigenvalue $\lambda_{max} = 4.1425$, CR = 0.0534, CR less than 0.1, which passed the consistency test, and the weights of the indicators of the management category were obtained as $W = (0.4079, 0.1064, 0.3192, 0.1665)^T$.

(iv) Calculate the judgment matrix for the output category of the environmental funding project at the guideline level.

TABLE XIII. Judgment matrix of the output categories of environmentally funded projects at the guideline level

	C8	C9	C10	C11	C12	C13	WI
C8	1	3	1/2	2	4	2	0.2510
C9	1/3	1	1/2	3	2	2	0.1659
C10	2	2	1	3	2	2	0.2818
C11	1/2	1/3	1/3	1	2	1/2	0.0913
C12	1/4	1/2	1/2	1/2	1	1/3	0.0691
C13	1/2	1/2	1/2	2	3	1	0.1409

As shown in Table XIII, yaahp software was used to calculate the maximum eigenvalue $\lambda_{max}=6.4137$, CR=0.0657, CR less than 0.1, which passed the consistency test, and the weights of the indicators in the output category were obtained as $W=(0.2510, 0.1659, 0.2818, 0.0913, 0.0691, 0.1409)^T$.

(v) Calculation of the criterion level environmental funding project benefit class judgment matrix.

TABLE XIV. Judgment matrix for benefit classes of environmental funding projects at the guideline level.

	C14	C15	C16	C17	C18	C19	C20	C21	C22	WI
C14	1	3	3	2	1/2	1	1/2	2	2	0.1369
C15	1/3	1	2	2	1	1/3	1/2	3	3	0.1073
C16	1/3	1/2	1	3	1/3	1/2	1/2	3	3	0.0891
C17	1/2	1/2	1/3	1	1/3	1/3	1/3	2	1/2	0.0523
C18	2	1	3	3	1	2	1	3	2	0.1805
C19	1	3	2	3	1/2	1	1/2	3	2	0.1432
C20	2	2	2	3	1	2	1	2	2	0.1781
C21	1/2	1/3	1/3	1/2	1/3	1/3	1/2	1	1/3	0.0428
C22	1/2	1/3	1/3	2	1/2	1/2	1/2	3	1	0.0698

As shown in Table XIV, the yaahp software was used to calculate the maximum eigenvalue $\lambda_{max} = 9.8019$, $CR = 0.0687$, CR less than 0.1, which passed the consistency test, and the weights of the indicators of the benefit category were obtained as $W = (0.1369, 0.1073, 0.0891, 0.0523, 0.1805, 0.1432, 0.1781, 0.0428, 0.0698)^T$.

(vi) Summary of environmental protection special funds performance audit evaluation index weights (see Table XV for details).

TABLE XV. Weight of performance audit evaluation indicators of special environmental protection funds

Target layer	Criterion layer	Scheme layer
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Performance audit and evaluation of special funds for environmental protection	Investment of environmental protection funds (0.0887)	Availability rate of special funds (0.0229)
		Timeliness of special funds in place (0.0093)
		Efficiency of fund use (0.0565)
	Environmental protection fund management (0.1388)	Fund use compliance (0.0566)
		Degree of perfection of project internal control system (0.0148)
		Project financial accounting compliance (0.0443)
		Compliance of expenditure with plan (0.0231)
	Environmental protection output (0.2173)	Output completion rate (0.0545)
		Capital cost rate (0.0360)
		Output quality compliance (0.0612)
		Regulatory effectiveness (0.0198)
		Project effectiveness (0.0150)
		Project cost saving rate (0.0306)
	Environmental benefits (0.5552)	Emission reduction of major pollutants (0.0760)
Environmental quality		

			improvement (0.0596)
			Completion of pollutant treatment capacity (0.0495)
			Regularly carry out environmental monitoring and troubleshooting (0.0290)
			Improvement degree of physical and chemical index of water body (0.1002)
			Standard rate of average comprehensive utilization income of sewage (0.0795)
			Public satisfaction (0.0989)
			Project demonstration (0.0238)
			Project continuous operation rate (0.0387)

4.5 Determination of Total Score of Environmental Protection Special Fund Performance Audit Evaluation

The performance audit measurement of environmental protection special funds uses a hierarchical evaluation system (as shown in Table XVI). In specific audit practice, auditors compare the various types of data obtained with specific audit criteria to derive the scores of each indicator item, and then calculate the score of each indicator by combining the indicator weights estimated above, and then summarize and calculate the total score of the comprehensive measurement.

We divided the evaluation results into four levels: $90 \leq F \leq 100$ as excellent, $80 \leq F \leq 89$ as good, $60 \leq F \leq 79$ as qualified, and $F \leq 59$ as unqualified. Usually set 79 points as an early warning line for the evaluation of the performance audit of special funds for environmental protection, $F > 79$ means that the overall implementation of special funds for environmental protection projects is good, $F < 79$ means that the implementation of projects in environmental protection funds is poor, and carefully check the modules to clarify the reasons for the proposed targeted audit and rectification advice.

TABLE XVI. Comprehensive score interval for performance audit evaluation of special funds for environmental protection

	Comprehensive score of environmental protection special fund performance audit	Grade interval
V.	0~59	Unqualified
	60~79	Qualified
	80~89	Good
	90~100	Excellent

CONCLUSIONS AND IMPLICATIONS

As an important people's livelihood project, in recent years, the Chinese government has introduced a series of environmental protection policies and measures, continuously increased the investment of financial environmental protection funds, and vigorously supported the construction and operation of environmental protection projects. However, due to the long cycle of environmental protection projects and the slower results, there are many problems in the project construction process, such as lax management system for the use of funds and slow progress of the project, which weaken the role of environmental protection special funds to a certain extent. We believe that the performance audit and evaluation of environmental protection special fund projects will help improve the economy, efficiency, effectiveness, environmental sustainability and fairness of the use of environmental protection special funds. Secondly, the establishment of a set of highly operational and perfect environmental protection special fund performance audit evaluation index system is an important embodiment of improving the performance audit of environmental protection special funds and optimizing audit responsibilities. We should take "capital investment → process management → project output → comprehensive benefits" as the main line, and try to build a performance audit and evaluation index system for environmental protection special funds. Finally, we must establish a sound environmental governance system. And especially, it is necessary to continuously strengthen the people's environmental awareness, standardize the people's environmental behavior, and strengthen the governance at the source.

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REFERENCES

- [1] Patrick R, Shaw Freeman A, et al. (2019) Human Wellbeing and the Health of the Environment: Local Indicators that Balance the Scales. *Social Indicators Research An International & Interdisciplinary Journal for Quality of Life Measurement* (5):146-163

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- [2] Liu JY (2008) The scientific concept of development as a guide to promote the comprehensive development of audit work. *Audit Research* (3):3-9
- [3] Liu XY, Li SS (2015) Research on the role of national audit in the construction of ecological civilization. *Management World* (1):173-175
- [4] Parder L (1987) Performance-Comparison Projects in Local Government: Participants' Perspectives. *Managerial Auditing Journal* (2):10-15
- [5] Gao (2004) Results-Oriented Government: GPRA Has Established a Solid Foundation for Achieving Greater Results. *Government accountability office reports* (2):10-25
- [6] Intosai (2001) Guidance on Conducting Audits of Activities with an Environmental Perspective. 2001-10
- [7] Ramani KV (2006) Logical Framework Analysis . *Ecological Economics* (3):331-347
- [8] Shan-Mei LI, Jia-Wen, C (2012) Performance auditing evaluation of environmental projects based on PSR concept. *Resources & Industries* (4):210-212
- [9] Jae-Young K, John WD, Robert R (2014) A comparative evaluation of money-based and energy-based cost-benefit analyses of tertiary municipal wastewater treatment using forested wetlands vs. sand filtration in Louisiana. *Ecological Economics* (3):331-347
- [10] Dixon GA (2004) The necessary characteristics of environmental. *Managerial Auditing Journal* (3):234-240
- [11] Orford RJ (1992) Negative Political Feedback: An Examination of the Problem of Modelling Political Responses in Public Sector Effectiveness Auditing. *Accounting Auditing & Accountability Journal* (1):21-45.
- [12] Mauree D, Naboni E, Coccolo S (2019) A review of assessment methods for the urban environment and its energy sustainability to guarantee climate adaptation of future cities. *Renewable and Sustainable Energy Reviews* (2):17-20
- [13] Zhou P, Ang BW, Poh KL (2008) Measuring environmental performance under different environmental DEA technologies. *Energy economics* (1):1-14
- [14] Behn RD (2003) Why Measure Performance? Different Purposes Require Different Measures. *Public Administration Review* (5):586-606