Practical Dilemma and Innovative Path of Ecological Compensation Mechanism in Watershed Governance-Taking Yangtze River Economic Basin as an Example

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Abstract. In the background of ecological pressure continues to increase, the problem of water pollution is escalating, and state to green and sustainable development attaches great importance. Watershed management has gradually been emphasized, and ecological compensation mechanism is widely used, but various problems have been encountered in the actual application process. This paper takes the Yangtze River Economic Zone as an example, reveals its importance in watershed governance, and takes the Yellow River as a comparison, highlighting the special characteristics of the ecological compensation mechanism in it. Meanwhile, it explores the challenges of unclear property rights, difficult cross-provincial cooperation, serious government dependence, and difficult value accounting, at the same time, analyzes the reasons behind their emergence. In order to cope with the challenges, this paper combines the actual situation and the literature from various parties and puts forward the methods of refining accounting the process, screening the scientific indicators, constructing a standard compensation accounting model, and introducing the market forces to play the role of the trading of water rights and green finance. The above suggestions aim to optimize the operation mode and improve the implementation efficiency, streamline the operation cost in order to stimulate the vitality of all parties.

1 Introduction

Against the background that the construction of ecological civilization has gradually been upgraded as a national strategy and the carrying capacity of the environment is gradually approaching its limit, the conflicts and contradictions between environmental governance and economic development are receiving increasing attention. The ecological compensation mechanism plays a crucial role in realizing regional coordinated development and ecological environmental protection. As an important spatial unit for water resources allocation, ecosystem services and social-economic activities, the systematic and complex nature of river basins provides a huge space for the application of compensation mechanisms.

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As the most important economic hub and ecological barrier in China, The Economic Belt of the Yangtze River, which extends over the three main regions of the East, Middle East, and West, is a significant contributor to China's economic development and provides multifaceted guarantees for the security of the country's ecological species. Under the situation of continuously increasing ecological pressure, water pollution, and deepening conflict between infrastructure construction and ecological protection, the ecological compensation mechanism has been widely used in the governance of problems in the Yangtze River area. However, due to the wide inter-regional scope, ecological environment differences, and uneven levels of economic development, the mechanism faces many challenges and dilemmas in practical application. Problems such as conflict of interest among different subjects of ecological compensation mechanism, insufficient scientific accounting of ecological protection compensation standards, lack of assessment of ecological protection compensation benefits, and unreasonable distribution of compensation amount still need to be further solved [1].

This paper will take the Economic Belt of Yangtze River as an object of study, and discuss the practical dilemmas faced in the light of the theoretical basis and real-life examples involved in the mechanism. Meanwhile, this study will compare Yangtze River Basin with other basins horizontally, and emphasize the feasibility, importance and special features of the mechanism for compensating for ecological damage. Finally, this paper will put forward operational countermeasures from the scientific and technological perspectives, such as the construction of ecological value accounting indexes, the optimization and expansion of compensation methods, and the precision of compensation benefits, in an attempt to propose a scientific and reasonable ecological compensation system. And at the same time, from the ecological compensation market mechanism, government enterprise cooperation mode and other political perspectives, it tries to reveal the potentials and bottlenecks of ecological compensation in coordinating upstream and downstream interests of watersheds and promoting regional green synergistic development, so as to provide theoretical support and policy references for the modernization of China's watershed governance.

2 Importance and specificity of the ecological compensation mechanism in the Yangtze River

2.1 Importance of the mechanisms

The Yangtze River basin holds an irreplaceable strategic position in China. In terms of economic development, over 40% of the country's GDP is covered by it, which encompasses 11 provinces and cities. The industrial and agricultural areas along the river are well-developed, and it is an important industrial belt and transportation hub in the country. In terms of ecological value, the Yangtze River is a significant water source in China, providing a large amount of water for production and living for the cities along the river, and is the habitat of many rare species, with a very high ecological value. Therefore, it is an undeniably vital task to guarantee a stable long-term situation [2]. However, it is currently facing a series of problems caused by the balance between preserving ecological integrity and promoting economic growth. The mechanism is fundamentally important in the ecological environment management and economic structure transformation, and it is the core policy tool to solve the contradiction between "fostering and safeguarding"[3].

In terms of ecological environment improvement, the ecological compensation mechanism can realize the improvement of water quality in the Yangtze River Basin through incentives and pollution constraints to achieve the purpose of ecological species diversity restoration. Moreover, the transmission of compensation can promote the removal of illegal facilities and the increase of wetland protection in the Yangtze River Basin, accelerating the recovery of the Yangtze River's ecological space. In terms of social-economic structure, the compensation mechanism has also led to the rise of green industry and environmental protection prioritization, which not only promotes the employment transformation of traditional industries such as fishermen, but also further optimizes the industrial structure of the Yangtze River Basin [4].

2.2 Specificity of the mechanism in the Yangtze River

The mechanism is a significant contributor to the management of the Yangtze River, the Yellow River Basin and many other watersheds, but due to the variations in the natural geography and economic structure of various watersheds, the mechanism in the governance of Yangtze River has a special feature that is not found in other watersheds. Next, the study will take a comparison to explain the reasons.

In terms of natural geographic conditions, the Yangtze River has a smooth and stable current, a superior environmental foundation, and 35% of the country's total water resources, making it the most water-rich basin in China, with diversified ecological services. A good ecological and environmental foundation allows many enterprises to optimize their own industries and control emissions in the ecological compensation mechanism to achieve environmental improvement. The Yellow River, on the other hand, has rapid and ferocious currents, poor ecological environment, fragile ecosystems and total water resources of only 7% of the Yangtze River, and per capital water resources of less than 1/4 of the national average, which makes the role of environmental protection in the Yellow River minimal, and it is hard to mobilize the enthusiasm of the enterprises, and it is more necessary for the government to force the intervention of the engineering restoration. In terms of social-economic structure, the economic value contained in the Yangtze River is much higher than that in the Yellow River, which makes it easier to promote market-based compensation (e.g., carbon trading, green finance) ,while the market-based conditions in the Yellow River are weaker, and can only be led by the government at present. This condition makes the ecological compensation mechanism can get higher economic benefits in the governance of the Yangtze River Basin [5]. Moreover, the Yangtze River Basin is highly urbanized and has a diversified structure of industrial types, which provides sufficient operating space for controlling pollutants. Meanwhile, most of the enterprises in the Yellow River are heavy industries, and there is limited space for optimization of pollution emissions.

3 Dilemma analysis of ecological compensation mechanisms

3.1 Poorly defined property rights

The definition of property rights is the core of the governance, but due to the fact that the Basin spans multiple provinces, the definition of property rights is faced with many dilemmas, which seriously affects the efficiency of governance. It is mainly manifested in three aspects: ambiguous property rights of water resources, cross-ownership of land and ecological resources, and disputes over property rights of inter-administrative districts.

The blurring of property rights over water resources can easily lead to a "tragedy of the commons". For example, the water-grabbing incident between Jiangsu and Shanghai, which occurred in 2014, in the Yangtze River estuary area because of the invasion of salty tides led to the tight supply of fresh water, so that Jiangsu and Shanghai competed for freshwater resources, and finally led to the difficulties of Shanghai Qingcaosha Reservoir, which triggered a controversy. At the same time, the unclear definition of such property rights is very likely to stimulate conflicting interests in the upper and lower basins.

Land and ecological resources are intertwined. The Yangtze River Basin involves a large number of ecological reserves, but some of them overlap with farmers' collective land, and the conflict between the need to protect ecological species and the practical benefits of farmers has led to the contradiction between conservation and development. For example, the phenomenon of "people and birds competing for land" occurred in Poyang Lake in Jiangxi Province. Poyang Lake wetland is an internationally important habitat for migratory birds, but the farmers around the lake have been relying on reclamation and cultivation and fishing for a long time. The conflict between wetland protection and farmers' land management rights makes it difficult to promote the policy of returning farmland to wetlands.

Cross-administrative property rights disputes make coordinated governance difficult. The Yangtze River flows through 11 provinces and municipalities, and the division of responsibility for water resource utilization and pollution management is blurred across provinces. Meanwhile, as the treatment cycle time continues to lengthen, and it will face the high transaction costs and governance costs. For example, in 2020 Chishui River part of the cross-section of the water pollution surpassed the limit, central environmental protection inspectors found that the standard was not met by the water pollution and it is mainly attributed to the border of the three provinces of the white wine factories, coal factories, the three provinces shirked their responsibilities and blamed each other to make it difficult to solve the problem.

3.2 High government dependency path

Due to property rights, transaction costs and other issues, the mechanism in China is mainly led by the government, in short term, this choice does ensure the stability of the program implementation. However, in the long run, over-reliance on government leadership will weaken the government's motivation and threaten the sustainability of funding sources.

In terms of sources of funding, the proportion of central financial payments is too high, and the rate of local matching funds in place is seriously insufficient. This path dependence increases the government's financial pressure and also tends to foster inertia among local enterprises. In the previously mentioned 2021 Yunnan, Guizhou and Sichuan signed the "Chishui River Basin Horizontal Ecological Compensation Agreement" Yunnan and Guizhou provinces owed 170 million yuan of compensation, and the 100 million yuan of environmental technology reform funds promised by the wine enterprises are only 38% in place. This caused the problem of a shortage of funds and slowed down the progress of the project.

In terms of program implementation, the biggest problem is that the single configuration has resulted in low social capital participation and insufficient public participation. In the Chongqing Guangyang Island Ecological Restoration Project, which began in 2018, the project leader proposed to adopt community supervision to increase public participation, but in fact, less than 15% of the "Community Co-Governance Committee" is made up of resident representatives , and the number of actual on-site inspections conducted by community supervisors each month is far lower than the number required by the regulations , so the community supervision is a mere formality. At the same time, participating individuals often lack a holistic perspective and large-scale thinking, focusing only on a single species, which may have a negative impact on the overall biodiversity conservation [6].

3.3 Lack of science and accuracy in value accounting

Because of the difficulty of quantifying the positive and negative externalities generated by the ecological environment and the enterprises' sewage or environmental protection behaviors, the accounting of ecological value faces many challenges in practice, which seriously affects the scientific nature of the compensation standard and the implementation effect. Meanwhile, it is difficult to make a distinction between environmental differences and different regions, which seriously affects the measurement of compensation standards [7].

In terms of accounting standards for ecological compensation funds, because of the lack of unified and scientific accounting basis, the current standards are mostly based on administrative directives rather than scientific calculations, which makes the compensation fail to scientifically reflect the significance of ecological services. At the same time, ecological benefits are mostly public products, and there is no pricing mechanism in the market. It makes it difficult for the government to make compensation based on the improvement of ecological benefits, and the compensation is difficult to meet people's economic needs, resulting in a situation in which the income is not enough to cover the expenditure [8]. For example, in the Dongting Lake Wetland Protection Compensation carried out by Hunan Province in 2018, the short-term benefits are "not obvious" because it takes 3-5 years for migratory bird populations to grow significantly after wetland protection. The government's failure to accurately account for compensation standards, which were lower than farmers' income from grain cultivation and did not take into account the cost of migration required by residents, triggered a great deal of dissatisfaction.

4 Exploring the innovative path of ecological compensation mechanism

4.1 Modeling compensation rate assessments

In order to accurately quantify the value of ecological services, balance stakeholder demands, and promote sustainable resource management, needs to construct a scientific assessment model for compensation standards. From the perspective of compensation fund structure, in order to further clarify the destination, refinement and categorization can be done to refinance compensation standards. Relevant scholars have constructed a framework of a horizontal mechanism for compensating for ecological protection, divided the compensation funds into two parts: basic compensation and incentive compensation [1]. The basic compensation is allocated according to the annual ecological facilities investment, protection responsibility and resource contribution of the watershed administrative area, it is measured by three factors, namely, financial tax difference, ecological protection task and water resource contribution. Incentive compensation is allocated taking into account the ecological protection performance of the watershed, including river water quality and water use efficiency [1]. The model rewards ecological protection efforts and achievements while penalizing environmental degradation through the allocation of basic and incentive compensation funds, ensuring that the compensation funds are allocated fairly according to the actual ecological protection effects. The redesign of the compensation mechanism framework refines the sources of compensation funds, and the more transparent structure is stimulating the motivation of enterprises.

From the perspective of specific accounting of compensation funds, quantifying the ecological compensation benefits and the value of the surrounding environment through various indicators is a necessary way to construct a scientific compensation standard model. Relevant scholars utilize the entropy weight method to determine the weights of relevant indicators through information entropy, select 12 basic indicators from three dimensions of economy, environment and society, construct a basin quantitative ecological compensation evaluation index system, which realizes the digitization of environmental protection benefits and ecological environment value of each place [9]. The construction of the accounting model gives specific value to the ecological environment, which makes the distribution of compensation funds no longer ambiguous, and is conducive to stimulating the competitiveness and enthusiasm among the municipalities and enterprises.

4.2 Promoting the application of market-based instruments

In the management of the Yangtze River, excessive reliance on the government has led to unsustainable funding, insufficient market vitality, and limited local motivation, resulting in more and more serious problems. In order to solve this problem, it is necessary to take advantage of the market force, introduce the participation of major enterprises, complete the transformation of the multi-dimensional synergistic model, and realize the transformation from "blood transfusion type" to "blood-forming" mechanism.

First of all, scholars must make good use of the power of the exchange of water rights in the ecological trading market. The market can transform the basin's water conservation, carbon sinks, biodiversity and other "invaluable" ecological services into tradable "valuable" products, in order to introduce the participation of all parties to make up for the shortcomings of the traditional financial compensation. Meanwhile, through the market transaction can directly feed the ecological conservationists, forming a positive cycle of "conservationists’ benefit". For the trading is still led by the government, there are insufficient endogenous motivation, the difficulty of water right confirmation, backward water rights trading system, and other problems, in order to stimulate the vitality of the water rights trading market and feed the eco-compensation mechanism, scholars must introduce more market players. Therefore, related scholars propose to reserve ecological water demand in the water rights trading market by introducing agricultural water conservation to increase water demand, and to include wetlands as a market subject, so that the ecological water use can directly participate in the redistribution of water rights, which will stimulate the market vitality and improve the effectiveness of ecological water distribution. From a practical point of view, considering the existence of a large number of natural wetlands in Yangtze River, there is a lot of space for the mechanism to be utilized [10]. The participation of natural wetlands in the trading mechanism not only meets the water demand of natural wetlands, but also effectively controls the total amount of water used in social production and the total amount of Chemical Oxygen Demand (COD) discharged in the river area, therefore, the government should strengthen the theoretical and institutional research on wetland protection, expand the scope of practical pilots [10].

Not only the ecological trading market, but also the green financial products derived from the market also play an important role. Green finance, as an innovative financial instrument characterized by environmental regulation, has the impact of broadening the source of funds for ecological compensation. Relevant scholars pointed out that green finance and Yangtze River Economic have a deep degree of coupling and coordination, green finance can direct the flow of capital for energy-efficient initiatives., broaden the avenues for investing and financing, and reduce the carbon emissions of enterprises. Secondly, the impact of green finance on green growth is important, significantly reducing the financing costs of upstream and downstream enterprises, mobilizing the commitment of companies; green credit provides financial support for the transformation of low-carbon technology for enterprises, and injects new vitality into the flow of funds in the market. Therefore, the government should further improve the incentive mechanism for green financial development. Enterprises, on the other hand, utilize all kinds of innovation products to enhance the availability of funds and promote the high-quality and coordinated development of green finance.

5 Conclusion

This paper systematically examines the current situation and development prospect of the application of the ecological compensation mechanism in China's watershed governance from perspectives of political background demand and ecological environmental protection. It is found that the mechanism plays an irreplaceable role in encouraging the synergistic advancement of ecological protection, environmental protection, and social development. From the political background, as "ecological civilization construction" has been upgraded to a national strategy, the ecological compensation mechanism has become a realizing key institutional arrangement for the concept. At the level of ecological environmental protection, this mechanism regulates the interests between ecological protectors and beneficiaries through economic means and effectively solves the problem of externalities in watershed management. At the same time, this paper compares the ecological environment and economic development of the Yangtze River with Yellow River and demonstrates the feasibility of the execution of the ecological compensation mechanism in the Yangtze River as well as the great economic benefits it can bring. However, many problems have been revealed in practice. First, the unclear definition of property rights has led to frequent compensation disputes, such as the difficulty of accurately quantifying the value of ecological services in transboundary watersheds; secondly, there is excessive reliance on government finance and insufficient development of market-based compensation methods; thirdly, the compensation standard lacks scientific validity. These problems have seriously constrained the implementation effect of the ecological compensation mechanism. In order to cope with these challenges, this paper proposes systematic solutions to the above problems in terms of accounting standards and operational mechanisms. In terms of accounting standards, a method for quantifying entropy is introduced to determine the weights of ecological elements, and key indicators such as water quality improvement rate and biodiversity index are selected to construct a scientific accounting model that includes ecological service value, governance costs and other dimensions. In terms of operation mechanism, it is recommended to Set up a marketplace for water rights transactions to promote the market-oriented flow, and to develop green financial instruments, such as issuing ecological bonds and setting up environmental protection funds, so as to broaden the source of funding channels.

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