

Research on the Value Realization Path of ESG-Enabled Watershed Ecological Products

Shali Bai

*Accounting Department, Ningbo University of Finance & Economics, Ningbo, China
2752520361@qq.com*

Abstract. Under the background of ecological civilization construction and the goal of "double carbon", the realization of the value of ecological products in China's river basins has made some practical progress in the construction of GEP accounting system, the exploration of multiple transformation paths, and the pilot of cross-regional ecological compensation. However, it still faces practical obstacles such as fragmented monitoring system, inconsistent accounting standards, insufficient market-oriented hematopoietic capacity, and imperfect ecological compensation mechanism. The concept of ESG integrates the three-dimensional value core of environment, society and governance, and provides a new perspective for solving the problem of value transformation of watershed ecological products. This paper takes ESG empowerment as the core clue, combs the current situation and international experience of the value realization of watershed ecological products, and constructs the whole chain path of data support, value accounting, market development and incentive guarantee.

Keywords: watershed ecological products, ESG empowerment, GEP accounting, ecological compensation

1. Introduction

Since the 18 th National Congress of the Communist Party of China, China has issued a series of policies on the realization of the value of ecological products and the protection of river basin ecology, and initially constructed an institutional guarantee system for river basin ecological governance. In 2025, the Ministry of Ecology and Environment and other seven departments issued the "Action Plan for the Protection and Construction of Beautiful Rivers and Lakes (2025-2027)," clearly pointing out that it is necessary to "coordinate water resources, water environment and water ecosystem management, and clarify key tasks such as water environment management, ecological water use security and water ecological restoration," which provides policy guidance for the transformation of ecological advantages into development advantages. In recent years, the realization of the value of ecological products in China's river basins has made many practical progress in the construction of GEP accounting system and the exploration of multiple transformation paths. However, in practice, it still faces practical obstacles such as inconsistent accounting systems, poor institutional cohesion, and imperfect transformation paths [1], making it difficult to achieve effective synergy between ecological protection and economic development. As

a sustainable development framework integrating multi-dimensional values of environment, society and governance, the ESG concept can provide a new perspective and starting point for unblocking the value transformation path of watershed ecological products. Therefore, how to construct a suitable path to realize the value of watershed ecological products under the guidance of ESG concept is the main problem of this paper.

Around the above problems, the academic community has carried out a lot of discussion, and the existing research mainly focuses on the following two aspects. The first is to discuss the value accounting and compensation mechanism of watershed ecological products. Yang Shuo et al. used the GEP accounting method to construct the value accounting index system of aquatic ecological products, and revealed the regional heterogeneity characteristics of value composition [2]. Wang Yiqi and Liu Jiale measured the value of ecological products by combining quantity accounting and value accounting methods, and empirically tested the effect of horizontal ecological compensation policy on the value of ecological products [3]. The second is the application of ESG concept in ecological governance. Some scholars have begun to pay attention to the macro-empowerment role of ESG. For example, Sun Na and Qu Weihua start from the fit between ESG and new quality productivity, sort out the research context, explain the internal logic, construct the relevant evaluation index system and put forward the promotion path, so as to provide decision-making reference for the development of new quality productivity [4]. Liu Xuexin and Cao Chengzi also focused on the macro-empowerment of ESG to new productivity. Starting from the high compatibility between the two, they explained the connotation of new productivity and the theoretical basis of ESG, built a theoretical framework and proposed a practical path to provide theoretical support for ESG to empower new productivity [5]. In summary, the existing research results are relatively rich, but the systematic design of the practice path is still weak. The existing research mostly stays in theoretical discussion or local link optimization, and pays insufficient attention to the overall realization path covering the top-level target system and the whole process mechanism guarantee. There is a certain gap between the research results and the actual needs of watershed governance, and there is still room for improvement in operability and cross-regional reproducibility.

In order to solve the above problems, this paper aims to introduce the concept of ESG, combine the reality of river basin ecological governance in China and draw lessons from international advanced experience, and construct the realization path of ESG-enabled river basin ecological product value. The marginal contribution of this paper is mainly reflected in two aspects : first, the ESG concept is introduced into the field of watershed ecological product value realization, which provides new theoretical support for watershed ecological value transformation and governance optimization ; the second is to build a holistic path covering the target system and mechanism guarantee, and form a perfect and implementable value realization scheme of river basin ecological products.

This study first focuses on the actual progress and outstanding problems in the realization of the value of watershed ecological products, systematically sorts out the achievements made in China's watershed GEP accounting, value realization path exploration and ESG concept integration, deeply analyzes the practical problems, and then clarifies the enabling entry point of ESG concept. Secondly, it combs the typical practices of the United States, the European Union, Japan and Australia in the realization of the value of watershed ecological products, summarizes the effective experience that can be used for reference, and provides international reference for the construction of relevant paths in China. Finally, the specific path of ESG empowering the value realization of watershed ecological products is constructed.

2. Analysis of the status quo of China's ESG-enabled watershed ecological product value realization

At present, under the dual guidance of the 'dual carbon goal' and the construction of ecological civilization, the relevant research and practice of the realization of the value of watershed ecological products in China have made phased progress, and gradually built up the basic framework from value accounting, path exploration to mechanism guarantee, which has laid a realistic foundation for the coordinated promotion of watershed ecological protection and economic development.

First, from the perspective of value accounting, a mature framework system has been formed around GEP accounting. The existing accounting generally covers the two core dimensions of ecological product supply service and adjustment service. Through the measurement method of combining physical quantity and value quantity, it responds to the core problem that the value of watershed ecological products is difficult to quantify for a long time. At the national level, the technical specifications for the accounting of the total value of ecological products have been issued, and localities have also issued exclusive accounting guidelines based on the characteristics of the river basin, promoting GEP accounting from theoretical research to practical application. Relevant research has applied this system to the value accounting of water ecological products in the middle and upper reaches of the Yellow River Basin. By constructing multi-dimensional accounting indicators, the total value, structural characteristics and spatial distribution pattern of water ecological products in the basin are described, which further verifies the applicability and operability of GEP accounting at the basin level, and also provides quantifiable and traceable data support for the realization of the value of ecological products in the basin.

Second, from the perspective of path exploration, the diversified value transformation path of river basin ecological products has been continuously expanded. In the process of exploration, various effective value realization methods such as cross-regional ecological compensation and green ecological product development have been gradually formed. Some watersheds also directly link the ecological compensation mechanism with the GEP accounting results, and rely on the quantified ecological product value to determine the compensation basis and standard, so that the effectiveness of ecological protection can be more effectively transformed into economic benefits. For example, the ecological compensation model of Xin'anjiang inter-provincial river basin co-constructed by Anhui and Zhejiang provinces has effectively promoted the collaborative governance of upstream and downstream through the compensation mechanism with water quality assessment as the core, and provided a replicable and replicable typical experience for cross-regional ecological protection and value transformation.

Thirdly, from the perspective of mechanism guarantee, with the gradual maturity of the accounting system and transformation path, the realization of the value of watershed ecological products has also begun to move from a single-point pilot to a normalized and long-term direction. The integration of the ESG concept provides an important support for the long-term operation of this system. At present, through policy incentives, environmental assessment and other means, all localities promote the ESG concept to be embedded in all aspects of watershed ecological protection and value transformation, and further broaden the channels of market-oriented participation. The State-owned Assets Supervision and Administration Commission of the State Council has incorporated ESG performance into the performance evaluation system of central enterprises, and promoted central enterprises to implement ESG management requirements in ecological management projects in key river basins such as the Yangtze River and the Yellow River. Zhejiang, Guangdong and other places have also linked the ESG evaluation results of enterprises with river

basin management assessment and green financial support, injecting market-oriented endogenous power into the realization of the value of river basin ecological products.

Although the theoretical research and pilot practice of the realization of the value of ecological products in China's river basins have achieved many initial results, in the process of promoting practice, it still faces outstanding problems and challenges in the construction of the whole chain system.

First, the fragmentation of the investigation and monitoring system has led to an unclear base, which has become a source of short board restricting the smooth operation of the whole chain of value realization [6]. The watershed ecosystem has the natural attributes of cross-administrative region and cross-departmental collaboration. However, under the current fragmented management system, the ecological environment, water conservancy, natural resources, forestry and grassland departments carry out independent monitoring respectively, which not only makes it difficult to unify the monitoring standards and statistical calibers, but also causes repeated data collection and waste of resources. At the same time, the data lacks a unified sharing carrier and collaborative management mechanism, forming a 'information island' that is separated from each other. In addition, the coverage of hidden ecological products is not comprehensive, and the normal closed-loop monitoring mechanism covering the whole basin has not been established, which directly leads to the ambiguity of the core base of the quantity, quality and distribution of ecological products in the basin. It not only makes the decision-making of ecological management in the basin lack scientific data support, the prevention and control of ecological risks lag behind, but also leads to the lack of basic basis for the definition of property rights and the confirmation and registration of ecological products. This source data defect will be transmitted to the subsequent value accounting and evaluation link, which will become the core cause of value quantification.

Secondly, the lack of unified norms and structural imbalances in the value evaluation system has become an obstacle to the transformation of 'lucid waters and lush mountains' to 'Jinshan Yinshan' [2]. China has not yet formed a standardized GEP accounting framework suitable for watershed scenarios. The lack of matching between general norms and the ecological characteristics of the upstream and downstream linkage of the basin has led to significant differences in accounting calibers and methods across regions, and the lack of horizontal comparability and practical authority of the results. At the same time, there is a structural imbalance in the scope of accounting : it focuses on tangible supply ecological products such as forests and aquatic products, and intangible adjustment services such as water conservation, water purification, and soil conservation, which dominate the ecological value of the basin. There is a problem of insufficient accounting coverage and low weight setting. This not only easily leads to the systematic underestimation of the ecological and social values of watershed ecological products, but also leads to the lack of authoritative reference for market-oriented pricing and the difficulty in effectively internalizing the positive externalities of ecological protection, which is not conducive to providing clear value orientation for market-oriented operation and development.

Third, the business development format is primary and the market-oriented hematopoietic capacity is insufficient, which has become a blocking point for the transformation of ecological value from 'quantitative evaluation' to 'market realization'. The existing development is mostly limited to low value-added primary formats, product homogenization is serious, multi-value mining is insufficient, and the uncertainty of income expectation caused by the increase of value quantification is superimposed. The willingness of social capital to participate is significantly weakened, and there are obvious shortcomings in the scale and depth of market-oriented development. This not only makes it difficult to fully transform the potential value of ecological

products, but also makes it difficult to form a virtuous cycle of 'development feeding back protection'. It also causes the realization of the ecological value of the river basin to rely too much on the government-led model, and the market-oriented hematopoietic capacity is insufficient, thus forming a systematic pressure transmission to the end protection compensation link.

Fourth, the market-oriented short board in the operation and development link will be further transmitted to the protection and compensation link at the end of the whole chain [4]. At present, the compensation for the protection of ecological products in the river basin generally has the problems of low standards, single capital channels and limited incentive effects, which is difficult to support the continuous realization of the ecological value of the river basin. Due to the lack of accurate value accounting basis, the existing compensation amount fails to fully take into account the ecological, social and long-term development value of ecological products, which is generally lower than the actual input cost and development opportunity cost of the protection subject, and it is difficult to make up for its development rights and interests transferred for the ecological security of the river basin. At the same time, the source structure of compensation funds is unbalanced, and it is highly dependent on central and local financial transfer payments. Restricted by the lack of marketization of operation and development, market-oriented compensation channels such as water rights, emission rights, and carbon sink transactions are difficult to effectively expand, and social capital cannot be leveraged to form diversified fund supplements. In addition, the inaccurate division of compensation objects, the insufficient matching of rights and responsibilities, and the imperfect long-term incentive and restraint mechanism will not only dampen the endogenous power of the main body of ecological protection, but also may have a reverse restriction on the optimization and upgrading of the front-end links, which will hinder the landing of the whole chain virtuous cycle mechanism.

3. International experience of using ESG to realize the value of watershed ecological products

This paper selects the typical cases of watershed ecological governance in the United States, Australia, the United Kingdom and Japan. The practice of the four countries covers the four core links of monitoring, accounting, development and compensation of the whole chain of ecological value transformation. Its mature paradigm and operation mechanism can provide systematic enlightenment for the construction and implementation of the value realization mechanism of domestic watershed ecological products.

Aiming at the problems of scattered watershed monitoring and unclear ecological home, a relatively complete solution path has been formed in watershed management in the United States [7]. The United States adopts the InVEST model and scenario analysis method as the basic method, integrates the ecological information of different administrative regions and different management departments, constructs an integrated monitoring system in the whole field, determines the value level of key ecological functions, and completes the ecological foundation and standardized management. The value of practice lies in opening up the data islands of various departments and regions, unified management of monitoring data at the data level, unified caliber, and fundamentally solving the problem of scattered monitoring data, thus ensuring that the value mining of monitoring data in later applications has reliable data support. This technology-supported global monitoring idea is used to promote the optimization and upgrading of the basin monitoring system : through the construction of a unified ecological monitoring platform covering the whole region, the responsibilities of various departments in data collection and sharing are clarified, and the data management process is unified and standardized. Realize real-time update and interconnection of

data, fully grasp the home base of river basin ecological products, and further improve the accuracy of accounting with the help of scientific evaluation models.

Australia has formed a globally recognized and mature practice framework in the field of how to standardize the accounting of ecological values, effectively implement them, and solve the problems of standardization and global integration of monitoring data [8]. With SEEA EA accounting system as the core support, an ecological service accounting system with dual dimensions of physical quantity and monetary quantity is established, the accounting boundary, core indicators and technical methods are clarified, and the accounting results are deeply embedded in the whole process of watershed management. Only by establishing a standard and implementable accounting system and combining accounting results with governance work can it be possible to fundamentally solve the problem of accounting separation from application and open up the key link of transforming ecological value into economic value.

The UK has formed a typical practice model that can be replicated and promoted in the fields of promoting the accurate quantification of the value of ecological products, building a market-oriented trading system, and promoting the efficient realization of ecological values [9]. Focus on the marketization of ecological products in the basin, build a market-oriented governance mechanism with water quality trading as the core, cultivate diversified ecological product development formats, introduce supporting policies to reduce the entry threshold, and widely attract social capital to participate. The practice is to build a variety of value realization carriers around the market demand, supplemented by policy support to reduce the pressure of social capital investment, obtain certain economic benefits while protecting the ecological environment, and stimulate the intrinsic vitality of the value conversion market.

Japan has formed a relatively mature practice paradigm of ecosystem service payment system in terms of building a long-term ecological incentive mechanism, improving the interest linkage model, and improving the closed-loop governance system of the whole chain of ecological protection [10]. According to the ecological protection needs of water source forest in the basin, the payment system of ecosystem services is implemented, and the differential compensation standard is approved according to the ecological value accounting results of water conservation. The interest distribution relationship between the upstream forest management and protection subject and the downstream water use beneficiary is clarified, and the diversified capital investment channels such as forest environment tax and river basin cooperation special fund are broadened to effectively enhance the participation enthusiasm of the relevant subjects of ecological protection. The core approach is to construct the benefit distribution mechanism of upstream forest protection benefit and downstream water use payment according to local conditions, to ensure the supply of ecological compensation funds through multiple ways such as financial co-ordination and cross-regional beneficiary contribution, and to stimulate the endogenous power of various subjects to participate in the protection of watershed water source forests and maintain ecological service functions.

From the experience of river basin governance in the four countries, the value realization of river basin ecological products should focus on the core goal of ESG 'system-market' coordination, which provides a replicable practical sample for solving the practical dilemma of GEP accounting and value realization. Based on the actual development of China's river basin, we should absorb the international mature experience, use ESG logic to connect the dual dimensions of system and market, open up the transformation channel from ecological value to economic value, and build a full-chain and closed-loop value realization system. Only in this way can we truly transform ecological advantages into development advantages, and finally realize the two-way empowerment and synergy of river basin ecological protection and high-quality economic and social development.

4. The path construction of ESG-enabled watershed ecological product value realization

Based on the realistic obstruction of the realization of the value of watershed ecological products in China, combined with the practical experience of watershed management in the United States, Australia, Britain and Japan, the ESG concept is used to coordinate the three-dimensional development requirements of environment, society and governance. According to the progressive logic of 'data support-value accounting-market activation-incentive guarantee', four collaborative empowerment paths are constructed to solve the outstanding problems in each link of value realization one by one, smooth the whole process channel of ecological value to economic value and social value transformation, and promote the deep coordination of watershed ecological protection and economic development.

4.1. Improve the ecological monitoring data sharing

Aiming at the core problems such as unclear base of watershed ecological products and prominent cross-departmental data barriers, improving the global ecological monitoring and data sharing system is the primary basis for the realization of ESG enabling value [11]. It is necessary to build an ecological product monitoring system covering the whole basin and multi-sector linkage, integrate the monitoring data of water conservancy, environmental protection, agriculture and other departments, and realize the normalization and dynamic detection of core indicators such as water conservation, soil conservation and carbon sink reserves. Establish a unified ecological data sharing and open platform for the basin, formulate standardized data collection, update, and interoperability specifications, and break the 'data island' between departments. This system can not only fully find out the base of ecological products in the basin, provide reliable data support for subsequent value accounting, but also provide a unified and objective accounting basis for ESG environmental performance disclosure of enterprises in the basin.

4.2. Establish the normative framework of value accounting

Aiming at the key problems of ecological product value accounting, a unified accounting standard framework at the basin scale is established, and the index system and scientific calculation method are specifically implemented to realize the accurate calculation and evaluation of the value of ecosystem service functions. The problems of different accounting calibers and significant differences are fundamentally overcome to ensure that the accounting results are objective, credible, verifiable and available. To promote the application of accounting results in ecological compensation, resource allocation, policy formulation and other key work, to achieve quantitative ecological value has become an important reference for the implementation of governance development and policy optimization, to further improve the accounting process of watershed ecological product value, and to support the evaluation of ESG value quantification, and effectively solve the problem of value quantification.

4.3. Diversified development attracts social participation

Breaking through the traditional mode of developing ecological products in the form of a single industry, relying on the advantages of river basin ecological resources to develop various forms of business such as ecological tourism, ecological agricultural products, and ecological carbon sink assets, enriching the types of ecological product supply, enhancing the market-oriented evaluation

and trading functions of ecological products, and continuously improving the market-oriented level of ecological products. We will introduce targeted support policies, improve investment conditions, guide social entities to actively participate in the protection and restoration of ecological environment and the supply of ecological products, clarify their ESG responsibilities and income rights, give full play to the role of market entities, promote the supply of ecological products in the basin, expand the market-oriented channels of ecosystem service functions, encourage market entities to invest in ESG, and achieve a virtuous cycle of 'investment-supply-acquisition-reinvestment'.

4.4. Optimize compensation to strengthen the main incentive

The ecological protection compensation is included in the value accounting results of ecological products. On the basis of respecting the objective reality of the upper and lower reaches of the basin and different regions, a reasonable classification and grading compensation standard is determined, and the compensation resources are allocated scientifically, fairly and accurately [12]. On this basis, co-ordinate the use of ecological products trading income, widely absorb social donations and other channels of funds, establish a benefit incentive system based on the performance of ecological environment protection as the basis of income distribution, and incorporate the effectiveness of ecological environment protection into the ESG performance evaluation of various subjects such as enterprises, individuals and governments, so as to maximize the enthusiasm of all parties to participate in environmental protection and share ecological achievements, and gradually form a 'who benefits, who compensates, who protects, who benefits' ecological protection long-term mechanism as the goal.

5. Conclusion

This study focuses on the core theme of ESG-enabled value realization of watershed ecological products, systematically sorts out the current situation and problems of China's practice, and draws on the international experience of watershed ecological governance in the United States, Australia, the United Kingdom and Japan, and proposes to improve the sharing of ecological monitoring data, establish a normative framework for value accounting, diversify development to attract social participation, and optimize compensation to strengthen the whole chain realization path of subject incentives. The conclusions are as follows:

First, the realization of the value of watershed ecological products in China has achieved phased practical results in the construction of GEP accounting system, the exploration of multiple transformation paths, and the embedding of ESG concepts into governance mechanisms, but at the same time, it still faces multiple practical difficulties: the ecological monitoring system is fragmented, and the monitoring data of each subject is difficult to effectively communicate and share; the GEP accounting standards are lack of unified norms, and the practicality and comparability of accounting results are insufficient. The market development ability is weak, and the value conversion efficiency of ecological products is low. The ecological compensation mechanism is not perfect, and the compensation standard, compensation method and incentive effect fail to form an effective closed loop. The synergistic development effect of ecological protection and economic development has not been fully released, and the imbalance between the two is still prominent.

Secondly, the practical experience of the realization of the value of international river basin ecological products shows that the efficient transformation of the value of river basin ecological products needs to follow the systematic implementation logic of global integrated ecological

monitoring, standardized value accounting, market-oriented operation and development, and diversified compensation incentives. Through the overall constraint and collaborative empowerment of the three-dimensional dimensions of environmental performance (E), social responsibility (S) and governance structure (G), the ESG concept can effectively break through the barriers between ecological value accounting and market-oriented transformation, and become the core link between the two, providing a full range of conceptual support and practical guidance for the realization of the value of watershed ecological products.

Thirdly, based on the sharing of comprehensive ecological monitoring data, the establishment of a value accounting normative framework as the core, diversified market development as the driving force, and accurate compensation incentives as the guarantee, the ESG-enabled watershed ecological product value realization full-chain path can be constructed. It can systematically solve various practical problems in the process of realizing the value of ecological products in China's river basins, promote the efficient transformation of ecological advantages to development advantages, and provide a solid theoretical support and operational practice path for the in-depth promotion of China's ecological civilization construction and the timely realization of the 'double carbon' goal.

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