Frontiers in Business, Economics and Management
ISSN: 2766-824X | Vol. 21, No. 3, 2025

Research on the Operational Mechanism of Carbon Sink Bank

Hongjun Dai [1], Longfei Song [2]

[1] School of Economics and Management, Huainan Normal University, Huainan 232000, China

[2] School of Finance and Economics, Anhui Occupational College of City Management, Hefei 230000, China

Abstract: With the deepening advancement of the "Dual Carbon" goals, the Carbon Sink Bank, as an innovative value realization mechanism for ecological products, plays an increasingly important role in promoting the capitalization and marketization of carbon sink resources. Based on the Externality Theory, Public Goods Theory, and Property Rights Theory, this paper constructs an operational mechanism framework for the Carbon Sink Bank from six aspects: participant collaboration, acquisition and integration, pricing and trading, transaction and circulation, risk prevention and control, and benefit distribution, thereby facilitating the value transformation of carbon sink ecological products. Addressing practical constraints such as the imperfect accounting system, ambiguous property rights definition, policy gaps, and insufficient support from financial instruments faced by the Carbon Sink Bank, this paper proposes optimization paths including improving the carbon sink accounting system, refining the carbon sink property rights system, and innovating financial instruments. The aim is to provide theoretical reference and practical guidance for the standardized operation of Carbon Sink Banks, enrich the value realization mechanisms for carbon sink ecological products, and support the national "Dual Carbon" strategy.

Keywords: Carbon Sink Bank; Operational Mechanism; Value Realization of Ecological Products; Carbon Sink Trading.

1. Introduction

Global climate change has become the most significant non-traditional security challenge to human development. As a responsible major country, China has signed the Paris Agreement and proposed the "Dual Carbon" goals. Against this backdrop, the valorization and capitalization of carbon sink resources have emerged as crucial pathways towards green and low-carbon development. The Carbon Sink Bank, as a novel value realization mechanism for ecological products, draws on the commercial bank model of "decentralized input, centralized output." It integrates, manages, enhances credibility, and facilitates transactions for fragmented carbon sink resources, effectively addressing issues in the value realization of carbon sink ecological products such as inefficient supply-demand matching, high transaction costs, and low participation of social forces. With the introduction of the "Opinions on Establishing and Improving the Value Realization Mechanism for Ecological Products" in 2021, exploring pilot carbon sink rights trading has become an important direction of national policy.

International practices of ecological banking started earlier. Weems & Canter (1995) pointed out that the U.S. Wetland Mitigation Banking achieves "no net loss" of wetlands through a "credit trading" mechanism, and its "government supervision + market operation" model provides a reference for Carbon Sink Banks [1]. The EU carbon sink trading platform, with its unified accounting standards and allowance trading, has established a "Monitoring-Reporting-Verification" (MRV) system, offering experience for carbon sink bank pricing and regulation. Currently, China's carbon sink trading market is still in its early stages of development. The value realization degree of carbon sink ecological products remains relatively low, constrained by bottlenecks such as difficulties in attracting social capital, low-scale operation capacity, and high transaction costs. Domestic scholars have conducted research on Carbon Sink Banks from various perspectives. Cui Li et al. (2019) summarized the "Resource-Asset-Capital" transformation mechanism through the case of Nanping, but did not highlight the particularity of carbon sinks [2]. Xie Jianbin et al. (2022) studied the operational model and mechanism of the Nanping Ecological Bank based on the perspective of "Resource-Asset-Capital" transformation [3]. Experiences from Water Banks in pricing mechanisms and transaction processes provide references for Carbon Sink Banks. For instance, Jiang Fan (2023) proposed a supply-demand game pricing model, and Tian Guiliang et al. (2021) designed a water rights deposit-loan balance mechanism [4-5]. Yuan Xiaoling et al. (2023) proposed a "Government-Market-Society" model and analyzed its evolutionary logic of "Resource Valorization → Value Capitalization → Capital Industrialization → Industrial Ecologicalization" [6]. Qin Tao et al. (2025) compared the Shunchang Forest Ecological Bank in Fujian and the Quzhou Cultivated Land Ecological Bank in Zhejiang, proposing a "Resource-Asset-Capital" transformation framework [7]. Fan Yingqi et al. (2022) suggested that ecological banks require support from digital technologies [8].

Overall, existing research has established a preliminary understanding of the concept and value of Carbon Sink Banks. However, systematic studies on their operational mechanisms remain insufficient, particularly regarding core mechanisms such as organizational structure, business processes, and risk control. Based on this, starting from the theoretical foundations of the Carbon Sink Bank, this paper systematically analyzes its overall framework, operational mechanisms, and constraints, and proposes targeted optimization paths. The aim is to provide references for the theoretical innovation and practical exploration of Carbon Sink Banks.

2. Conceptual Definition and Theoretical Basis of Carbon Sink Bank

2.1. Connotation and Characteristics of Carbon Sink Bank

The Carbon Sink Bank draws on the operational characteristics of commercial banks, namely "decentralized input, centralized output." It is a platform facilitating the circulation, integration, market-oriented trading, and sustainable operation of carbon sink resources. Its essence is a market-oriented trading platform for ecosystem services. By centrally integrating fragmented and dispersed carbon sink resources, it forms scaled, tradable carbon sink asset packages, thereby realizing the value transformation of carbon sink ecological products from "resource" to "asset" to "capital". Unlike traditional commercial banks, the Carbon Sink Bank is not solely profit-oriented. It combines government leadership with market mechanisms, focuses on carbon sink property rights, and balances ecological and economic benefits.

2.2. Theoretical Basis

(1) Externality Theory

Carbon sink ecological products possess positive externalities due to their functions such as climate regulation and air purification, which often lead to insufficient market supply. The Carbon Sink Bank is an institutional arrangement based on the Pigouvian tax theory to internalize the externalities of carbon sink ecological products. By centrally acquiring carbon sink resources and converting the ecological value of carbon sinks into economic income through market transactions (e.g., controlled enterprises purchasing carbon sinks to offset emissions), the Carbon Sink Bank provides reasonable compensation to suppliers (e.g., forest farmers, forest farms), incentivizing them to continuously provide carbon sinks and achieving a closed loop from "external benefits" to "economic income" .

(2) Public Goods Theory

Public goods theory indicates that carbon sink resources are non-excludable and non-rivalrous, making them prone to overuse and the "tragedy of the commons." The Carbon Sink Bank transforms carbon sinks, a public good, into a commodity with clearly defined property rights through property rights definition and market transactions, thereby effectively avoiding overconsumption and waste of carbon sink resources. For instance, as demonstrated by the bamboo forest carbon sink practice in Anji, Zhejiang, by clarifying the ownership of bamboo forest carbon sinks and establishing a carbon sink acquisition and trading platform, bamboo forest carbon sinks were transformed from "priceless" to "valuable," effectively preventing the "tragedy of the commons" for carbon sink resources.

(3) Property Rights Theory

Vague property rights over carbon sink resources are a core obstacle to transactions. According to the Coase Theorem, clearly defined property rights are a prerequisite for market transactions. The operation of the Carbon Sink Bank must be based on property rights theory. Firstly, it requires clarifying the ownership of carbon sink property rights. Secondly, it involves defining the specific rights, such as separating ownership, usufruct, and income rights, allowing the Carbon Sink Bank to obtain operational rights. Thirdly, it necessitates standardizing the rules for circulation, i.e., using contracts to stipulate the terms, durations, and responsibilities for acquisition, storage, and transactions.

3. Construction of the Operation Mechanism of Carbon Sink Banks

The operation mechanism of carbon sink banks covers the entire process from carbon sink resource input to value output. Based on the characteristics of carbon sink ecological products and experience drawn from successful domestic cases, it is constructed from six dimensions as follows:

3.1. Synergy Mechanism of Participating Entities

The participating entities of carbon sink banks fall into three categories: government, market entities, and social entities, with their respective rights and responsibilities defined as follows:

(1) Government

Relevant government functional departments are primarily responsible for rule formulation, supervision, and guidance. Their specific functions include formulating management measures for carbon sink banks, unifying accounting standards, conducting certification and filing, and introducing supportive policies such as fiscal subsidies and tax incentives to guide social capital participation. Government departments do not engage in direct operations; instead, they focus on top-level design and risk supervision to avoid administrative intervention in market pricing.

(2) Market Entities

Market entities consist of carbon sink suppliers and demanders. Suppliers mainly include forest farmers, forest farms, and ecological restoration enterprises, which deposit carbon sink resources into the bank through trusteeship, equity participation, or redemption to obtain fixed returns or dividends. Demanders mainly include emission-controlled enterprises, public welfare organizations, and organizers of large-scale events, which purchase carbon sink assets or credits through the bank.

(3) Social Entities

Social entities assume the role of professional services and supervision, mainly including third-party institutions and financial institutions. Third-party organizations such as the Chinese Academy of Forestry, appraisal companies, and industry associations provide services such as carbon sink accounting, asset evaluation, and transaction supervision. Financial institutions develop products like carbon sink loans, carbon sink insurance, and carbon sink funds to provide financial support for carbon sink banks. For example, commercial banks offer reserve acquisition loans, while insurance companies develop carbon sink price insurance products.

3.2. Carbon Sink Resource Storage and Integration Mechanism

Resource storage and integration serve as the foundation of carbon sink bank operations, aiming to realize the transformation from fragmented resources to large-scale assets. This process consists of three key phases:

(1) Resource Inventory and Right Confirmation

The objective is to establish accurate archives for carbon sink resources. A combination of remote sensing monitoring and blockchain technology is generally adopted to create a

unified "one-map" system for carbon sink resources. Remote sensing tools, such as high-resolution satellites, are used to collect inventory data of forest, wetland, and other carbon sinks, while blockchain technology records information including resource location, ownership, and carbon sink volume to ensure data immutability.

The right confirmation process can draw on the successful experience of the Shunchang Forest Ecological Bank in Fujian Province. Governments take the lead in conducting carbon sink property right registration to clarify the ownership, right to use, and right to benefit.

(2) Storage Methods

Based on the demands of carbon sink suppliers, a diversified transfer model can be adopted, typically including the following four storage approaches:

Table 1. Carbon Sink Acquisition and Storage Methods

Acquisition Method	Applicable Scenario	Form of Revenue	Advantage
Trustee Management	Farmers lack management capacity	Fixed trustee fee + profit sharing	Reduces farmers' management risks
Equity Cooperation	Forest farms, ecological enterprises	Equity dividends + management decision-making rights	Aligns long-term interests
Purchase and Storage	Farmers voluntarily exit management	One-time buyout funds	Rapid resource integration
Allowance Pledge	Enterprises with unused carbon allowances	Pledged loan + interest	Activates existing carbon assets

(3) Integration and Quality Improvement

First, classified integration is implemented. Carbon sink resources can be categorized by type (e.g., forest carbon sinks, wetland carbon sinks, marine carbon sinks) or by duration to form asset portfolios that meet the preferences of different demanders. Second, quality enhancement and credit boosting of carbon sink asset portfolios are carried out. Specifically, ecological restoration measures are applied to stored carbon sink resources to increase their volume and stability, followed by third-party institutions issuing asset rating reports to enhance asset credibility.

3.3. Pricing Mechanism Design

(1) Pricing Basis

Carbon sink pricing must balance cost compensation and market demand. The cost floor is based on carbon sink supply costs, including ecological conservation costs, monitoring and accounting costs, and bank operation costs. Market prices are determined using value evaluation methods, typically combining the functional value method and market comparison method. The functional value method calculates the ecological regulation value of carbon sinks, while the market comparison method references quota prices in the national carbon market and prices in the voluntary emission reduction market.

(2) Pricing Logic

Pricing is generally determined through supply-demand game and differentiated pricing.

In the supply-demand game, suppliers set their minimum quotes based on the cost floor, while demanders set their maximum quotes based on the utility ceiling (e.g., the emission reduction alternative cost of emission-controlled enterprises). The final price is formed through market bidding.

Differentiated pricing sets price gaps according to carbon sink type, duration, and region to reflect carbon sink scarcity. Generally, forest carbon sinks, with high stability, are priced 10%–15% higher than grassland carbon sinks; long-term carbon sinks are priced 20%–30% higher than short-term ones; and carbon sinks in ecologically fragile areas are priced 15%–20% higher than those in ordinary regions.

3.4. Trading and Circulation Mechanism

Trading and circulation aim to achieve efficient matching and full-process traceability, generally following five steps:

(1) Asset Warehousing

Carbon sink banks input integrated asset portfolios into a digital trading platform and disclose information such as asset type, carbon sink volume, price, and duration.

(2) Demand Matching

Demanders submit purchase applications through the platform (e.g., an emission-controlled enterprise applies for 100,000 tons of forest carbon sinks). The platform uses AI algorithms to achieve intelligent supply-demand matching.

(3) Contract Signing

Upon successful matching, both parties sign an electronic contract specifying transaction amount, delivery time, and performance obligations (e.g., compensation clauses for insufficient carbon sink volume).

(4) Delivery and Settlement

Demanders make payments, and the bank issues carbon sink delivery certificates that can be used for offsetting in the carbon market. Funds are settled through a third-party escrow account to avoid default risks.

(5) Filing and Disclosure

The bank submits transaction information to government regulatory authorities for filing and discloses details such as transaction prices and carbon sink volumes to the public through the platform to accept social supervision.

In practice, multiple trading models can be adopted: spot trading to meet short-term emission reduction needs; forward trading to help demanders lock in costs; and option trading to hedge against carbon sink price fluctuation risks.

3.5. Risk Prevention and Control Mechanism

Carbon sink banks typically face four types of risks: ecological, market, policy, and credit risks. A full-chain prevention and control system featuring "prevention-monitoring-response" must be established.

Table 2. Risk Prevention and Control Measures

Risk Types	Risk Manifestations	Prevention and Control Measures
Ecological Risks	Damage to carbon sink resources, resulting in insufficient carbon sink volume	1. Establish a "space-air-ground" monitoring network; 2. Mandate the purchase of carbon sink insurance; 3. Reserve 10%-15% of carbon sink reserves as emergency supplements
Market Risks	Carbon sink price fluctuations and supply-demand imbalance	1. Develop carbon sink forward and option products to hedge price risks; 2. Establish a supply-demand early warning mechanism; 3. Introduce strategic investors to stabilize the market
Policy Risks	Adjustments to carbon sink accounting standards and changes in carbon market policies	1. Set up a policy research team to track policy dynamics in real time; 2. Design flexible transaction clauses; 3. Strengthen communication with government departments and participate in policy formulation
Credit Risks	Default by transaction entities	1. Establish a credit rating system for transaction entities; 2. Collect 5%-10% performance bonds; 3. Include defaulting entities in the industry blacklist and restrict their subsequent participation

3.6. Revenue Distribution Mechanism

Revenue distribution shall follow the principles of "benefiting protectors, charging users, and sharing proceeds with developers", with clear distribution ratios and methods defined for all parties:

(1) Distribution Entities and Ratios

Carbon sink suppliers: Generally receive 50%–60% of total revenues, including fixed returns (e.g., trusteeship fees, redemption funds) and floating returns (e.g., dividends from the appreciation of carbon sink asset portfolios).

Carbon sink banks: Usually obtain 20%–25% of total revenues. After deducting operating costs such as platform maintenance and personnel salaries, the remaining funds can be set aside as risk reserves.

Government: Generally allocates 10%–15% of total revenues to an ecological restoration fund, which is used for degraded forest improvement and R&D of carbon sink accounting technologies.

Social entities: Third-party institutions typically charge 2%–3% of total revenues as service fees, while financial institutions earn interest or handling fees.

(2) Innovation in Distribution Methods

Long-term cooperation projects (equity cooperation for more than 5 years): A model of "fixed dividends + revenue sharing based on carbon sink increments" can be adopted to incentivize suppliers to increase carbon sink volumes.

Projects in ecologically fragile areas: Additional subsidies are provided to suppliers (e.g., increasing dividend ratios by 5%–10%) to balance ecological protection and livelihood improvement.

Digital distribution: Blockchain technology is used to realize automatic revenue splitting and real-time fund transfer, reducing interception in intermediate links.

4. Practical Constraints on the Operation of Carbon Sink Banks

4.1. Imperfect Accounting System

Current carbon sink accounting methodologies primarily focus on forest and bamboo carbon sinks, while methodologies for carbon sinks from wetlands, oceans, and grasslands are not yet mature, making it difficult to incorporate such carbon sink resources into bank acquisition and storage. Furthermore, the existing methodologies are complex to operate; for instance, forest carbon sink monitoring requires a period of over five years, imposing costs that are difficult for small and medium-sized suppliers to bear. Additionally, the measurement error of existing monitoring technologies for carbon sink volume is approximately 15%-20%, which hinders the banks' need for accurate pricing of carbon sink assets. Moreover, data from different monitoring institutions are not interconnected, creating "information silos" and increasing the integration costs for banks.

4.2. Ambiguous Property Rights Definition and Policy Gaps

Carbon sink property rights are attached to existing rights such as land and forest rights, but current laws fail to clearly define the independent status of carbon sink property rights. This leads to disputes over the distribution of carbon sink benefits among forest farmers, village collectives, and forest farms in practice, which affects the enthusiasm for participation in the acquisition and storage process. Secondly, there is currently no nationwide management measure specifically targeting Carbon Sink Banks. Most local pilots rely on temporary policies, and there is a lack of policies connecting Carbon Sink Banks with the national carbon market.

4.3. Insufficient Support from Financial Instruments

The existing financial products are primarily limited to carbon sink loans and carbon sink insurance, lacking long-term financing tools such as Carbon Sink REITs and carbon sink asset securitization. This results in insufficient capital for banks to acquire and store carbon sink assets. Simultaneously, the risk pricing mechanisms for carbon sink financial products are imperfect, leading to low participation willingness among financial institutions.

5. Optimization Paths for the Operational Mechanism of Carbon Sink Banks

5.1. Improving the Accounting System

At the national level, efforts should be organized to research and develop accounting methodologies for wetland and ocean carbon sinks, and to simplify operational procedures, for example, by shortening the monitoring period to within three years. Carbon sink accounting methods tailored to local characteristics should be formulated to enhance applicability. A dynamic update mechanism for carbon sink accounting methodologies should be established to adapt to technological advancements in carbon sinks. The application of "UAV + LiDAR" monitoring technology should be promoted to reduce the carbon sink measurement error to below 10%. A nationally unified carbon sink

monitoring data platform should be constructed, integrating data from departments such as forestry and ecological environment. Competition among third-party monitoring institutions should be introduced, selecting cost-effective institutions through tendering to lower monitoring costs.

5.2. Refining the Carbon Sink Property Rights System

Amendments could be introduced to the "Forest Law" and "Wetland Protection Law" to include clauses on carbon sink property rights, clarifying the relationship between carbon sink property rights and land/forest rights. A unified registration system for carbon sink property rights should be implemented, issuing "Carbon Sink Property Rights Certificates" and incorporating them into the real estate registration system. A carbon sink property rights circulation system should be established, allowing carbon sink property rights to be mortgaged or leased separately to activate existing carbon assets. It is recommended that the State Council issue the "Carbon Sink Bank Management Measures" to standardize establishment conditions, acquisition and storage processes, and pricing rules. The Ministry of Ecology and Environment should formulate the "Detailed Rules for the Connection between Carbon Sink Banks and the National Carbon Market," clarifying that carbon sinks traded through banks can be used for offsetting within the national carbon market, with a specific offset ratio not exceeding 5%. Local governments should introduce supporting policies to facilitate Carbon Sink Bank pilots.

5.3. Innovating Financial Instruments

Carbon Sink REITs products could be developed, bundling long-term carbon sink assets for listing to attract social capital. Carbon sink price insurance could be launched to protect Carbon Sink Banks and suppliers against price fluctuation risks. Pilots for carbon sink pledge loans could be conducted, allowing banks to use carbon sink asset packages as collateral for financing from financial institutions, thereby broadening funding sources.

6. Conclusion

Carbon Sink Banks provide a systematic solution for the value realization of ecological products through the "resource-asset-capital" value transformation mechanism. The core of their operation lies in the collaboration among the government, the market, and society, establishing an operational framework through five key links: acquisitionand integration, pricing and trading, transaction and circulation, risk prevention and control, and benefit distribution. In the future, it is necessary to overcome the difficulties in the practice of Carbon Sink Banks by improving the carbon sink accounting system, refining the carbon sink property rights system, and innovating financial instruments, thereby contributing to China's "Dual Carbon" goals and global climate governance.

Acknowledgements

Research Project on Innovative Development of Social Sciences in Anhui Province in 2023 (2023CX024); Philosophy and Social Science Planning Project of Anhui Province (AHSKY2019D097); 2024 Anhui Provincial Research Plan Preparation Project (2024AH052176): Research on the Transmission Mechanism and Practical Path of Green Finance Empowering Low Carbon Development in Resource based Cities; 2024 Anhui Provincial Research Plan Preparation Project (2024AH053237): Research on Innovation Driven High Quality Development Path of Anhui Province's Coal City Economy under the Background of New Quality Productivity; 2024 Anhui Province Youth Teacher Training Action Project "General Project for Excellent Youth Teacher Training" (YQYB2024176).

References

[1] Weems W A C, Canter L W. Planning and Operational Guidelines for Mitigation Banking for Wetland Impacts [J]. Environmental Impact Assessment Review, 1995, 15(3):197-218.

[2] Cui Li, Li Xinjian, Cheng Zhe. Research on the Realization Mechanism of Natural Resource Capitalization—A Case Study of Nanping's "Eco-bank" [J]. Management World, 2019(9):95-100.

[3] Xie Jianbin, He Yinghong. Research on the Mode and Mechanism of Nanping Eco-bank Based on the "Resource-Asset-Capital" Transformation Perspective [J]. Journal of Subtropical Resources and Environment, 2022, 17(2):80-86.

[4] Jiang Fan, Qin Tao, Tian Zhiwei. Research on the Construction of a "Water Eco-bank" Trading System [J]. Qinghai Social Sciences, Wetland Science & Management. 2023, 19(04):34-39.

[5] Tian Guiliang, Yang Tao. Concept of Establishing a "Water Bank" Operation Mode for the Hanjiang-to-Weihe River Water Diversion Project [J]. Water Resources Finance and Economics, 2021(4):17-19.

[6] Yuan Xiaoling, Guo Yilin, Huang Tao, et al. Carbon Sink Bank: An Innovative Model for Realizing the Value of Carbon Sink Ecological Products [J]. Contemporary Economic Science, 2023, 45(4):59-71.

[7] Qin Tao, Yu Hang, Ren Lijiu, et al. Comparison of "Eco-bank" Models, Development Dilemmas, and Innovation Strategies [J]. World Forestry Research, 2025, 38(2):129-136.

[8] Fan Yingqi, Zheng Hang, Liu Yueyi, et al. Mechanism Design of a Water Bank Based on the Internet of Water: A Case Study of Ningxia Hui Autonomous Region [J]. Water Resources Development Research, 2022, 22(2):51-57.