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Normative Structure and Institutional Improvement of Judicial Application of Carbon Sinks in National Parks

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Abstract

Against the backdrop of accelerated restructuring of the global climate governance system and coordinated advancement of the "Dual Carbon" target, national parks, as the core carrier of nature reserves, have seen the judicial application of their carbon sinks become a key field connecting ecological protection and climate governance. At present, the judicial application of carbon sinks in national parks is confronted with three dilemmas: first, the basic system for carbon sink subscription needs to be improved, manifested in the generalized scope of application and insufficient supply of legal basis; second, there exists a contradiction between the diversity of subscription forms and the consistency of implementation, with inconsistent accounting standards and verification methods; third, the transparency and standardization of capital flow management are insufficient, and a regulatory mechanism is absent. The root causes lie in the realistic constraints imposed by the complexity of ecological environment governance and the systematic absence of legal systems, as well as the obstacles at the level of principle guidance caused by the absence of the ecological priority principle, legal application principle and due process principle. To resolve the above dilemmas, institutional improvement should be promoted from the following dimensions: clarify the scope of application and establish the relevance standard for damage to carbon sink functions; unify subscription standards, integrate trading platforms and construct a cross-regional judicial collaboration mechanism; strengthen capital supervision and establish a dual-track transparency mechanism. Through the above normative structure, a two-tier model of general application of carbon sinks and priority application of national park carbon sinks can be formed, providing theoretical support and practical guidance for the law-based realization of ecological protection in national parks and the "Dual Carbon" target.

Keywords

national parks, judicial application of carbon sinks, alternative restoration, ecological restoration liability, Dual Carbon target

1. Problem Raising

In 2020, China formally put forward the strategic goal of "striving to peak carbon dioxide emissions before 2030 and achieve carbon neutrality before 2060". The realization of this goal requires not only controlling carbon emissions at the source but also consolidating and enhancing the carbon sink capacity of ecosystems. The Opinions of the Central Committee of the Communist Party of China and the State Council on Fully, Accurately and Comprehensively Implementing the New Development Concept to Promote Carbon Peaking and Carbon Neutrality clearly lists "continuously consolidating and enhancing carbon sink capacity" as one of the key tasks to achieve the "Dual Carbon" target. As the core carrier of nature reserves, national parks host forest, grassland, wetland and other ecosystems with extremely high carbon sequestration value and potential. Protecting and restoring the "carbon pools" of national park ecosystems is regarded as the most cost-effective path to achieve the "Dual Carbon" target (Liu, Zhou, Chen et al., 2023).

At the level of institutional innovation, "carbon sink subscription", as an emerging alternative restoration mechanism for the ecological environment, has been explored and applied in judicial practices in many regions by guiding infringers to purchase carbon sink products through judicial organs to compensate for carbon sink losses caused by ecological environment damage. In March 2020, the People's Court of Shunchang County, Fujian Province, took the lead in innovatively practicing the model of subscribing to carbon sinks for ecological restoration in the trial of the case of Wu Mouhui's crime of wantonly felling trees. Since then, people's courts across the country have continuously seen judicial cases of carbon sink subscription. In April 2022, the Supreme People's Court issued the Interpretation on Several Issues Concerning the Application of Law in the Trial of Civil Dispute Cases Involving Forest Resources, providing a normative basis for forestry carbon sink subscription at the judicial interpretation level for the first time. In February 2023, the Supreme People's Court further issued the Opinions on Fully, Accurately and Comprehensively Implementing the New Development Concept to Provide Judicial Services for the Active and Steady Advancement of Carbon Peaking and Carbon Neutrality, emphasizing guiding infringers to purchase carbon sink products through judicial channels.

However, the judicial application of carbon sinks in national parks has exposed many institutional dilemmas in its rapid development. In terms of the scope of application, some courts require infringers to subscribe to carbon sinks even in scenarios where no direct carbon emission damage is caused, showing a tendency of generalized application (Fu, 2025). In terms of standard unification, diverse subscription forms and varying accounting methods exist across regions, and the coexistence of different models such as "one-yuan carbon sinks" and exchange-traded carbon sinks leads to

inconsistent implementation standards. In terms of capital supervision, the management of carbon sink subscription funds lacks transparency and standardization, posing a risk of fund misappropriation. The root causes of these dilemmas lie in both the realistic constraints of the complexity of ecological environment governance and insufficient legal system supply, and the absence of basic principles such as ecological priority and due process. Therefore, it is of great theoretical value and practical significance to systematically examine the realistic dilemmas of the judicial application of carbon sinks in national parks, interpret its legitimacy logic from the jurisprudential level, and then construct a standardized institutional path.

2. Theoretical Justification for the Judicial Application of Carbon Sinks in National Parks

2.1 Legal Attributes of Judicial Application of Carbon Sinks

Regarding the legal nature of the judicial application of carbon sinks, there are two main viewpoints in academic circles: the "ecological restoration liability theory" and the "ecological damage compensation liability theory". The former holds that carbon sink subscription is one of the ways to fulfill the "ecological environment restoration liability" stipulated in Article 1234 of the Civil Code; the latter argues that its essence is to assume ecological damage compensation liability through monetary payment (Xu & Liu, 2023). Accurately defining the legal attributes of the judicial application of carbon sinks is a prerequisite for constructing a standardized institutional framework.

From the perspective of the normative system, Articles 1234 and 1235 of the Civil Code stipulate ecological restoration liability and ecological damage compensation liability respectively. Although the two are highly similar in applicable circumstances and prerequisites, there are obvious differences in institutional purposes. Ecological restoration liability emphasizes restoring the initial ecological functions of the natural environment through remedial measures afterwards, taking the integrity and originality of environmental legal interests as the reference standard; ecological damage compensation liability focuses on assessing the damage consequences and determining the compensation amount, mainly adopting monetary compensation means (Lü & Dou, 2017). The judicial application of carbon sinks reflects both economic punishment on offenders and restoration and compensation for ecological legal interests at the jurisprudential level, and should first be defined as a type of ecological restoration liability (Wang C., & Wang, Z., 2023).

In the system of ecological restoration liability, it can be further divided into two forms: direct restoration and alternative restoration. Direct restoration refers to direct intervention on damaged parts without changing the original ecosystem, namely "in-situ and homogeneous" restoration, applicable to cases where the ecological environment is slightly damaged and can be restored in situ and in original form. Alternative restoration refers to other restoration measures adopted when direct restoration is impossible or inappropriate, presenting different forms such as "in-situ heterogeneous", "ex-situ homogeneous" and "ex-situ heterogeneous". As an "ex-situ heterogeneous" restoration method, carbon sink subscription essentially involves inconsistencies in the spatial location of ecological restoration

and the functional level of the ecosystem. It does not truly restore the damaged ecosystem itself, but compensates for the loss of legal interests by purchasing heterogeneous ecological products such as carbon sinks (Liu, 2022). Therefore, the application of carbon sink subscription should be premised on the impossibility of direct restoration, which is an inherent logical requirement for its role as an alternative restoration method.

2.2 Special Attributes of National Park Carbon Sinks

Compared with general carbon sink products, national park carbon sinks have significant characteristics of publicity, complexity and integrity, which constitute the jurisprudential basis for their priority application and special protection.

From the perspective of property rights attributes, the property rights of national park carbon sinks present dual characteristics of publicity and complexity. According to the Overall Plan for the Establishment of the National Park System, national parks are public welfare assets for the whole people, and their carbon sink functions are typically non-exclusive and non-competitive. The protection and utilization of carbon sink resources must obey national strategic needs, and the distribution of carbon sink benefits must give priority to public interests, forming a public governance closed loop of "protection-benefit-re-protection" (Fu, 2025). At the level of ownership, carbon sink resources owned by the whole people are entrusted by the State Council to provincial governments to exercise management rights on their behalf; at the level of use rights, carbon sink development rights are granted to third-party enterprises through rights confirmation and registration, while retaining the ecological benefit rights of indigenous people, forming a horizontal property rights bundle of co-governance by forest farmers, enterprises and the government. This complexity is in sharp contrast to the single property rights circulation model of commercial forestry carbon sinks, requiring judicial adjudication to solve the problems of "vacant property rights" and "power conflicts" (Fu, 2025).

From the perspective of ecological functions, national park carbon sinks have systematic and functional restoration goals. The ecological restoration of national parks needs to coordinate the life community of "mountains, rivers, forests, farmlands, lakes, grasslands and deserts", and synergistically promote the restoration of carbon sink functions and ecological service functions such as biodiversity conservation and soil and water conservation (Fu, 2025). By quantifying carbon sink capacity to transform ecological services into tradable indicators, it not only directly restores the carbon absorption function of damaged areas, but also links synergistic effects such as biodiversity conservation and soil and water conservation. This holistic characteristic determines that the judicial protection of national park carbon sinks cannot be limited to a single environmental element, but should be designed from the perspective of the overall functional restoration of the ecosystem.

2.3 Jurisprudential Logic of Priority Application of National Park Carbon Sinks

Based on the special attributes of national park carbon sinks, it has sufficient jurisprudential basis to establish a priority application mechanism for national park carbon sinks in the judicial application of carbon sinks.

First, national parks occupy a core position in China's nature reserve system. The report to the 20th National Congress of the Communist Party of China clearly proposes to "promote the construction of a nature reserve system with national parks as the main body" (Liu & Lü, 2023). National parks cover various natural ecosystems such as forests, grasslands, wetlands and deserts, and their carbon sinks are superior to general carbon sink products in ecological stability and ecological product abundance. This special status is determined by both the ecological characteristics of national parks themselves and endowed by laws and policy documents.

Second, the judicial application of carbon sinks and national park carbon sinks present a progressive structure of "universal-special". The judicial application of national park carbon sinks should be strictly limited to the overall framework of the judicial application of carbon sinks, and on this basis, refine the rules in combination with its own particularity and legal status (Ma, 2024). Meanwhile, when actors subscribe to carbon sinks, a priority mechanism for the application of national park carbon sinks should be established, granting a certain priority quota to national park carbon sinks, so as to further promote the effective trading and value realization of national park carbon sinks (Wei & Wang, 2026). This two-tier model not only ensures the uniformity of the rules for the judicial application of carbon sinks, but also highlights the institutional autonomy of national parks.

Finally, from the perspective of ecological value realization, the priority application of national park carbon sinks helps to achieve the coordination between ecological protection and economic development. Guiding actors to subscribe to national park carbon sinks through judicial intervention can transform economic incentives into actual effects of ecological protection, and achieve the rule of law goal of "valued environment, responsible for damage" (Fu, 2025).

3. Review of Dilemmas in the Judicial Application of Carbon Sinks in National Parks

3.1 Generalized Scope of Application and Insufficient Legal Basis

The primary dilemma facing the judicial application of carbon sinks in national parks is the tendency of generalized application. Initially, the carbon sink subscription mechanism was mainly applied in the field of forestry carbon sinks in accordance with the Interpretation of the Supreme People's Court on Several Issues Concerning the Application of Law in the Trial of Civil Dispute Cases Involving Forest Resources, and then gradually expanded to marine blue carbon sinks. However, in the process of institutional transformation from voluntary acts to judicial-led practices, some courts require infringers to subscribe to carbon sinks even in fields where no direct carbon emission damage is caused (Fu, 2025).

Empirical analysis shows that among 49 typical cases, most cases involve damage to forest resources, but 21 cases involve illegal hunting, illegal mining, illegal fishing of aquatic products and other acts (Fu, 2025). In a civil public interest litigation case in Shunchang County, Fujian Province, the defendant was sentenced to subscribe to carbon sinks to compensate for the damage to wild biological resources due to illegal hunting of wild animals. Nevertheless, although hunting behavior has a certain

impact on the ecological environment, it is not a main source of greenhouse gas emissions and has no direct connection with the loss of forest ecosystem carbon sinks (Lü & Dou, 2017). Similarly, in illegal hunting cases, courts have also adopted the practice of requiring actors to subscribe to carbon sinks. This expansion of the scope of application has triggered academic doubts: should the application of carbon sink subscription be premised on the act substantially damaging carbon storage and absorption capacity? Is it legitimate to forcibly apply carbon sink subscription to illegal acts that are not directly related to carbon sink functions?

The generalization of the scope of application is closely related to the insufficient supply of legal basis. At present, the judicial application of carbon sinks mainly relies on policy documents for guidance and regulation, and these policy documents vary greatly in coverage, adjustment methods and key directions, failing to form a systematic and complete institutional framework. At the judicial interpretation level, the Interpretation of the Supreme People's Court on Several Issues Concerning the Application of Law in the Trial of Civil Dispute Cases Involving Forest Resources provides a corresponding basis for the subscription of forestry carbon sinks, but the subscription of marine carbon sinks, wetland carbon sinks, grassland carbon sinks, etc. lacks solid normative support (Hou & Jing, 2025). Although legislation such as the Forest Law, Grassland Law, Wetland Protection Law and Civil Code provides principled support for the relief of ecological environment damage including damage to carbon sink functions, the above legislation cannot meet practical needs in terms of key contents such as carbon sink ownership and legal nature of carbon sink subscription (Li, 2024).

3.2 Fragmented Implementation Standards and Inconsistent Accounting Methods

The second dilemma in the judicial application of carbon sinks in national parks lies in the inconsistency of implementation standards caused by the diversity of subscription forms. In current judicial practice, subscription forms cover forest carbon sinks, marine carbon sinks and innovative models implemented through specific trading platforms. For example, the Shunchang Court used the "one-yuan carbon sink" mini-program in the trial of forest-related cases, and in the cases of "Lin's illegal electric fishing" and "Lin Moumou's illegal mining", the defendants purchased marine carbon sinks through the Fujian Straits Resources and Environment Trading Center as compensation measures (Fu, 2025).

The diversity of subscription forms leads to implementation complexity. Different subscription forms differ in management and implementation, and the inconsistency of platform standards and the complexity of cross-regional supervision increase the difficulty for judicial organs to ensure the scientificity and compliance of subscription acts. Potential conflicts between market-oriented operation and legal norms further exacerbate this problem. As a market behavior, carbon sink trading is significantly affected by market factors in terms of price, supply and trading process. Judicial organs often fail to predict market price fluctuations when making judgments, which may lead to inconsistency between the subscription amount determined by the judgment and the actual market price (Fu, 2025).

The inconsistency of accounting standards is the core manifestation of implementation fragmentation. Courts across regions vary greatly in how to assess the degree of ecological damage caused by actors, failing to form a scientific measurement standard between the amount of carbon sink subscription and ecological damage. For example, when the People's Court of Shunchang County tried the cases of Wu Mouchang's wanton felling of trees and Wu Mouhua, Huang Mouchun's wanton felling of trees, the two cases were similar in nature but had obvious differences in the loss of standing wood volume, yet the court ruled that the actors in both cases subscribed to 20,000 yuan worth of carbon sinks. In addition, courts use different units of measurement when ruling on carbon sink subscription, including "yuan", "kg", "t" or "standing wood volume", lacking a unified measurement standard (Diao, Xiong, & Wang, 2024). The difference in standards leads to inconsistent judgments by different courts in similar cases, affecting the practical effect of carbon sink subscription for ecological restoration.

In addition, there is confusion in verification standards in the judicial application of carbon sinks. Carbon sink projects must meet the "additionality" requirement, that is, emission reduction effects stem from incremental carbon sinks generated by human intervention, rather than natural carbon sink increments (Pan & Fan, 22023). However, there is no unified standard for whether various carbon sink products are measured based on additionality and how to verify additionality in the current judicial application of carbon sinks. There are a wide variety of carbon sink products developed in various regions, with chaotic scientific verification and evaluation standard systems. In judicial application, when courts guide actors to subscribe to carbon sinks, they often fail to clarify the specific carbon sink product projects purchased, making it difficult to guarantee the authenticity and effectiveness of alternative restoration through carbon sink subscription.

3.3 Lack of Capital Supervision and Insufficient Transparency

The third dilemma in the judicial application of carbon sinks in national parks lies in the transparency and standardization of capital flow management. Subscription funds flow through both government and market channels, and while providing financial support for ecological restoration, they also expose the lack of a regulatory mechanism.

In the government management channel, carbon sink subscription funds are usually collected and allocated uniformly by administrative departments. However, due to imperfect information disclosure and supervision mechanisms, there is a problem of insufficient transparency in fund use. Local government departments lack systematic publicity on capital flows and specific uses, making it difficult for the public to understand whether subscription funds are actually used for ecological restoration projects (Fu, 2025). Some regions have diverted carbon sink funds to other administrative projects or failed to invest them in ecological restoration projects on time, increasing uncertainty and efficiency risks in the process of fund management.

In the market trading channel, carbon sink funds are traded through public platforms, but the problem of insufficient supervision still exists. Secondary trading and speculative behavior may weaken the original intention of using funds for ecological restoration, and insufficient regulatory coordination

between trading platforms increases the difficulty of standardized market management. Meanwhile, except for Fujian Province and Guizhou Province, which have clearly stipulated the conversion between carbon sink reduction and subscription amount, other regions have not issued corresponding legal documents, and inconsistent measurement standards are likely to lead to the failure of subscription volume to compensate for ecological losses (Fu, 2025).

The coordination problem of the connection between government and market channels also cannot be ignored. Local governments and carbon sink trading platforms may differ in fund management and supervision standards, making it difficult to connect capital flows and uses. Market trading platforms may pay more attention to maximizing profits, while government management focuses on ecological restoration effects, and this difference in interest orientation increases the difficulty of coordination between the two parties. There is no effective supervision mechanism for carbon sink subscription funds, and without corresponding supporting mechanisms, it is difficult to ensure that subscription funds are actually used for carbon increase activities (Hou & Jing, 2025).

3.4 Confusion of Application Hierarchy and Insufficient Application of Restorative Measures

In the process of ecological damage restoration, different restoration hierarchies should be distinguished according to the effectiveness and recovery degree of restoration methods. As an alternative restoration method, the judicial application of carbon sinks in national parks should be premised on the impossibility of direct restoration[0]. Article 20 of the Interpretation of the Supreme People's Court on Several Issues Concerning the Application of Law in the Trial of Environmental Civil Public Interest Litigation Cases and Article 9 of the Trial Provisions on Several Issues Concerning Ecological Environment Damage Compensation Cases both point out that alternative restoration can only be applied when direct restoration is impossible.

However, in judicial adjudication, most courts directly apply the judicial application of carbon sinks as ecological restoration measures to relevant cases, ignoring the practical connection between the judicial application of carbon sinks and the restoration of such environmental legal interests, resulting in the judicial misunderstanding of "application for application's sake". Justice should follow the principle of restorative justice, that is, to remedy the damage to environmental legal interests through judicial means to the greatest extent and ultimately restore the ecological service function to the original baseline. Meanwhile, justice should respect the independent choice right of actors, allowing them to independently choose restoration methods in accordance with legal provisions. However, in practice, due to the convenience and operability of carbon sink subscription in judicial implementation, courts tend to directly guide or require actors to subscribe to carbon sinks to close cases as soon as possible, leading to confusion in the order of judicial application of carbon sinks and infringement of actors' independent choice rights (Jin & Song, 2024).

Insufficient application of carbon sink restorative measures is another prominent problem. In practice, not every environmental criminal case involving carbon sink loss in national parks has identified and relieved the damage to ecosystem functions. Some judgments only present personal sanctions and

economic penalties against defendants, without paying attention to the loss and relief of damaged ecosystem service functions (Hou & Jing, 2025). In some cases where restorative measures are applied, the relief of carbon sink loss needs to be further improved. For example, in some cases, in the relief of damage during forest land ecological service functions, carbon sink loss is not separately identified, but is identified together with other ecological service function losses, requiring the defendant to compensate for the loss of ecological service functions during the period. Due to problems such as low use efficiency and difficulty in special fund use of ecological environment damage compensation funds, it is difficult to achieve the best relief for carbon sink function loss in the form of compensation funds.

4. Jurisprudential Analysis of the Causes of Dilemmas

4.1 Realistic Context: Governance Complexity and Institutional Absence

The formation of dilemmas in the judicial application of carbon sinks in national parks first stems from the realistic constraints of the complexity of ecological environment governance and the absence of legal systems.

The complexity and diversity of ecological environment governance pose the primary challenge. Ecological environment problems in national parks are regional, diverse and complex, and there are significant differences in ecosystem types, carbon sink endowments and governance capabilities in different regions, making it difficult to unify the judicial application standards of carbon sink subscription. For example, Sanjiangyuan National Park is dominated by grassland ecosystems, Wuyi Mountain National Park by forest ecosystems, and Hainan Tropical Rainforest National Park by tropical rainforests. The carbon sink measurement methods and restoration technical paths of each ecosystem are different, requiring judicial organs to fully consider regional ecological characteristics when applying carbon sink subscription. This complexity and diversity put forward higher requirements for judicial capacity.

The imperfection of legal systems further exacerbates application dilemmas. At present, China's legal provisions on the judicial application of carbon sinks are not perfect, lacking a systematic legal framework and clear application standards. As an emerging legal phenomenon, the judicial application of carbon sinks mainly relies on policy documents for guidance and regulation, and these policy documents vary greatly in coverage, adjustment methods and key directions, failing to form a systematic and complete institutional framework. Most policy documents are limited to specific matters at a specific time and have weak effectiveness levels, making it difficult to form cross-field and cross-departmental institutional synergy. Due to the limitations of legislative technology and regional differences, China has not yet issued a unified legal document responding to climate change[0]. Against this background, judicial organs lack clear legal basis and adjudication standards when applying carbon sink subscription, increasing the uncertainty and complexity of judicial application.

4.2 Principle Guidance: Absence of Ecological Priority and Due Process

From the perspective of principle guidance, the absence of the ecological priority principle, legal application principle and due process principle constitutes the main restrictive factor for the judicial application of carbon sinks in national parks.

The ecological priority principle should be the core principle of the judicial application of carbon sinks, requiring a balance between ecological environment protection and economic development to ensure the priority protection of the ecological environment. However, in judicial practice, some courts tend to choose carbon sink subscription rather than direct restoration measures for case closure efficiency and implementation convenience, which essentially deviates from the requirements of the ecological priority principle. As an "ex-situ heterogeneous" restoration method, carbon sink subscription has different ecological restoration effects compared with direct restoration. If carbon sink subscription is prioritized when direct restoration is possible, the best ecological restoration effect may not be achieved.

The legal application principle requires ensuring the uniformity and authority of judicial application. However, there are great differences in the current judicial application of carbon sinks in terms of application scope, subscription forms, accounting standards, etc., and inconsistent judgments in similar cases occur from time to time, impairing judicial credibility. Various regions formulate institutional documents in line with local needs according to regional characteristics, which can improve the regional applicability and enforceability of rules, but due to the low level of local documents, they can only be applied in specific regions and cannot form a national rule system. Most national parks have cross-administrative regional characteristics, which will increase institutional collaboration costs and generate regional interest conflicts and protectionism when involving multi-regional collaborative carbon sink subscription.

The due process principle requires protecting the legitimate rights and interests of relevant subjects. In the process of judicial application of carbon sinks, judicial organs must abide by legal procedures to ensure that the right to know and participate of relevant subjects are fully protected. However, the current public participation mechanism in judicial collaboration is not perfect. The existing judicial collaboration model mainly focuses on coordination and cooperation between public power subjects, while there is little cooperation and interaction between public power subjects and private subjects, and private subjects show insufficient participation in this model. There are a large number of communities and residents inside and around national parks, who are not only important forces for ecological protection, but also may act to damage the ecological environment driven by interests. The failure of judicial organs to fully absorb public participation not only affects the legitimacy of procedures, but also restricts the actual effect of ecological protection.

5. Normative Approaches to the Judicial Application of Carbon Sinks in National Parks

5.1 Clarify the Scope of Application: Relevance Standard for Damage to Carbon Sink Functions

The primary path to solve the dilemma of judicial application of carbon sinks in national parks is to reasonably limit the scope of application and establish an application standard centered on "relevance of damage to carbon sink functions".

As an ecological restoration mechanism, the application scope of carbon sink subscription should mainly focus on cases directly related to carbon sink functions and having an actual impact on the carbon sink capacity of ecosystems. The core criterion for judging the application of carbon sink subscription should accurately focus on whether the act substantially damages or weakens the carbon storage and absorption capacity of a specific area, rather than the superficial characteristics of the act itself[0]. Specifically, national park carbon sinks should be applied to cases highly relevant to carbon absorption and sequestration, including carbon leakage and decreased carbon sequestration function caused by damage to forests, grasslands and marine environments. National park carbon sinks should be applied cautiously to cases weakly relevant or irrelevant to carbon absorption and sequestration functions. If acts only involve ecological pollution, wild animal poaching, etc., the judicial application of national park carbon sinks should not be separately taken as a form of liability assumption.

Judicial practice should follow the restoration hierarchy principle of the Technical Guidelines for the Identification and Assessment of Ecological Environment Damage, give priority to in-situ restoration, and directly restore the structure and functions of damaged ecological elements. Carbon sink subscription and other alternative restoration measures can only be considered when direct restoration is impossible. Specifically, the impossibility of direct restoration includes: first, inability to carry out in-situ and original restoration due to objective conditions; second, excessively high direct restoration costs disproportionate to the damage consequences; third, failure of direct restoration to achieve the expected ecological function restoration effect (Fu, 2025). Under these circumstances, carbon sink subscription as an alternative restoration method has a legitimate basis.

From an international perspective, the limitation of the application scope of carbon sink subscription should also be combined with the prevailing rules of the international carbon market. Carbon sink trading should ensure that its ecological benefits and service functions are basically consistent with the original state of the damaged ecosystem, and should be prioritized in the same or similar ecosystems to ensure the pertinence and effectiveness of restoration. As carbon sink providers, national park management institutions must have corresponding qualification certification; as carbon sink demanders, enterprises or individuals must meet specific conditions before participating in carbon sink trading.

5.2 Unify Implementation Standards: Certification System and Platform Integration

To solve the contradiction between the diversity of subscription forms and the consistency of implementation, it is necessary to unify carbon sink subscription forms and standards institutionally, and establish a national unified certification system and trading platform.

First, unify the accounting standards and verification methods of carbon sink subscription. The state should formulate unified carbon sink subscription standards, covering subscription processes, certification specifications of carbon sink projects and capital flow management, to ensure that different types of carbon sink projects have consistent ecological restoration functions and capital transparency (Fu, 2025). Especially in judicial judgments, courts should require parties to subscribe to certified carbon sink projects in accordance with this standard to ensure the consistency of law, technology and ecological benefits in the implementation process. The judicial application of national park carbon sinks should establish a clear verification mechanism. When accounting for national park carbon sink projects and preparing carbon sink project reports, monitoring should be strengthened to ensure that the carbon sinks applied by the judiciary have additionality and guarantee the openness of national park carbon sinks, including the whole process of generation, subscription and offset. The accounting of carbon sink projects by national parks should be carried out under the unified leadership of competent departments to ensure the rationality and universality of standards, and on this basis, further develop carbon sink accounting methods for each park.

Second, establish a national unified carbon sink trading platform. To further standardize carbon sink subscription acts, the state should set up a national unified carbon sink trading platform to integrate transactions of various carbon sink projects in various regions and ensure that all carbon sink transactions are certified and managed under unified standards (Fu, 2025). This platform will bring all transactions under unified supervision and prevent implementation inconsistencies caused by platform standard differences. In the transition stage, all regions can rely on existing carbon trading markets or environmental rights trading platforms to gradually realize rule docking and information sharing.

Third, strengthen cross-regional judicial collaboration. The cross-regional nature of carbon sink trading increases implementation difficulty. Due to differences in geographical location, ecological conditions and market factors, it is difficult for judicial organs to implement unified supervision. Therefore, it is particularly important to construct a cross-regional judicial collaboration mechanism. Through the establishment of a unified data sharing platform and joint supervision mechanism, the implementation of cross-regional carbon sink subscription can be standardized and consistent (Fu, 2025). This collaboration mechanism will enhance the implementation efficiency of cross-regional cases and ensure the effectiveness of the carbon sink subscription mechanism nationwide. At the operational level, drawing on the experience of Fujian, Sichuan and other provinces, provincial courts can take the lead, jointly sign judicial collaboration framework agreements with relevant national park management institutions, forestry departments, etc., and clarify collaboration contents, procedures and standards (Hou & Jing, 2025).

5.3 Strengthen Capital Supervision: Dual-Track Transparency Mechanism

To solve the problems of transparency and standardization in capital flow management, a dual-track transparency supervision mechanism needs to be established to ensure that carbon sink subscription funds are actually used for ecological restoration.

First, clarify the purpose and flow of carbon sink subscription funds. According to the provisions of the Technical Guidelines for the Identification and Assessment of Ecological Environment Damage, ecological environment restoration should give priority to in-situ restoration, that is, restore the same type and quality of ecological functions at the damaged site. Funds should be used for substantive restoration of damaged areas, such as vegetation greening and soil restoration, to enhance carbon sink capacity (Fu, 2025). When direct restoration is not feasible, alternative restoration methods should be adopted, and capital flows should target specific projects to ensure that their restoration effects match the damaged functions. When direct or alternative restoration is difficult to fully recover, carbon sink subscription as a supplementary restoration method requires funds to be invested in projects that can effectively compensate for the loss of carbon sink functions, and its capital flow should be strictly supervised to ensure use in certified carbon sink restoration projects.

Second, construct a supervision and use mechanism for carbon sink subscription funds. Only when carbon sink subscription funds are actually used for carbon increase projects can the filling of carbon sink losses be realized. To avoid illegal use of subscription funds, an information disclosure system should be established to regularly publish information such as the total amount, balance and use of funds, accepting supervision from the public (Hou & Jing, 2025). When subscription funds are used for non-carbon increase activities, the public can report and supervise in a timely manner, and pursue the legal responsibility of relevant responsible persons. Alternatively, the specific destination and use plan of subscription funds can be clearly specified in the judgment to ensure that the funds are actually used for carbon increase projects. The state should set up a special regulatory agency to monitor the flow of carbon sink funds in real time to prevent fund misappropriation or abuse.

Third, improve the effect evaluation and publicity system of fund use. The restoration effect after fund use should be regularly disclosed to the public to ensure that the public understands the actual progress and ecological benefits of the project. For cross-regional carbon sink projects, a cross-regional fund supervision and collaboration mechanism should be established to ensure that the use of funds in different regions complies with national standards and regulatory requirements (Fu, 2025). This mechanism will further ensure the transparency and rationality of capital flows and realize the effective flow of funds and ecosystem restoration of cross-regional carbon sink projects. By clarifying the order and capital flows of direct restoration, alternative restoration and supplementary restoration, combined with a strict capital supervision mechanism, carbon sink subscription can play a more effective role in ecological restoration in judicial practice.

5.4 Standardize Application Hierarchy: Principle of Priority for Direct Restoration

To ensure the legitimacy and effectiveness of the judicial application of carbon sinks, the principle of priority for direct restoration should be clearly established, and the application hierarchy of carbon sink subscription in the system of ecological restoration liability should be reasonably defined.

Courts should implement the principle of priority for direct restoration. When actors can directly carry out ecological restoration, they should be ordered to conduct direct restoration, and other alternative

restoration measures shall not be applied to ensure the maximization of direct ecological restoration effects (Wei & Wang, 2026). Direct restoration measures include “replanting and greening”, “breeding and releasing”, “sea sand backfilling”, etc. These measures can directly act on damaged ecosystems to achieve “in-situ homogeneous” restoration, which is the most effective and direct relief method for ecological environment restoration. Only when direct restoration is impossible can courts consider actors subscribing to carbon sinks for alternative restoration. As an “ex-situ heterogeneous” restoration method, carbon sink subscription essentially involves inconsistencies in the spatial location of ecological restoration and the functional level of the ecosystem, and should take the impossibility of direct restoration as a prerequisite for the judicial application of subscribing to national park carbon sinks (Wei & Wang, 2026).

In specific application, courts should also pay attention to the relief of carbon sequestration function loss during the period from damage occurrence to restoration completion. In accordance with the principle of full compensation, in addition to requiring defendants to undertake basic restoration measures such as replanting and greening, attention should also be paid to the relief of carbon sequestration function loss during the period. The relief measures for carbon sequestration loss during the period can be carbon sink subscription or increasing the number of replanted plants. This institutional design not only reflects the full relief of ecological environment damage, but also avoids the alienation risk of “replacing punishment with purchase” (Hou & Jing, 2025).

Meanwhile, the independent choice right of actors should be respected. When trying relevant cases, courts can innovate liability assumption methods, granting actors independent choice rights while ensuring restoration effects. Actors can either choose direct ecological restoration methods to achieve full compensation for ecological damage, or choose a composite liability assumption method of “restoration + subscription” to increase the range of lenient sentencing, forming institutional incentives to promote actors to produce “additional” ecological restoration effects (Wei & Wang, 2026). At the procedural level, an ecological damage adaptation mechanism should be established to select matching carbon sink projects according to the characteristics of damaged ecosystems, and maximize restoration effects through precise correspondence between carbon sink functions and ecological damage.

6. Conclusion

Against the backdrop of accelerated restructuring of the global climate governance system, the judicial application of carbon sinks in national parks, as a key field connecting ecological protection and climate governance, undertakes the dual mission of achieving the “Dual Carbon” target and innovating ecological restoration mechanisms. A systematic analysis of 49 typical cases shows that although the current judicial application of carbon sinks in national parks has formed a preliminary framework in terms of judicial leadership, diverse subscription forms and dual-channel capital flows, it still faces severe challenges in the dimensions of application scope, implementation standards and capital supervision. The root causes of these dilemmas lie in both the realistic constraints of the complexity of

ecological environment governance and insufficient legal system supply, and the institutional absence of basic principles such as ecological priority and due process.

To resolve the above dilemmas, collaborative promotion is needed from both the jurisprudential basis and institutional structure levels. At the jurisprudential level, the legal attribute of carbon sink subscription as an alternative restoration method should be clarified, the basic logic of taking the impossibility of direct restoration as the application premise and the relevance of damage to carbon sink functions as the application standard should be established, and a priority application mechanism should be constructed based on the public and complex characteristics of national park carbon sinks. At the institutional level, a two-tier model of general application of carbon sinks and priority application of national park carbon sinks should be promoted by clarifying the application scope, unifying accounting standards, strengthening capital supervision, standardizing the application hierarchy and other paths.

In the future, with the in-depth implementation of the "Dual Carbon" target and the continuous improvement of the national park system, the judicial application of carbon sinks will play a more important role in the field of ecological protection. Judicial organs should continue to exert their initiative, promote the improvement of relevant legislation on the basis of summing up experience, and ultimately form an institutional pattern of benign interaction between legislative guidance and judicial innovation, contributing China's wisdom and rule of law solutions to ecological protection in national parks and global climate governance.

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