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Judicial Innovation in Enhancing Forest Carbon Sinks: Evidence from China

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Abstract: Sustainable forest management plays a crucial role in climate change mitigation and adaption, as well as the achievement of the 2030 Sustainable Development Goals (SDGs). Recognizing the significance of sustainable forest management, China has implemented a range of the legislative measures and policies for the conservation and restoration of key forest ecosystems and has launched the Three-North Shelterbelt Forest Program and other key forest programs, resulting in an increase in forest coverage and forest carbon sinks. In addition to forestry ecological restoration projects (FERPs) initiated by the administration and project developers, the Chinese courts have also actively engaged in exploring various strategies to enhance forest carbon sinks. In both criminal and civil cases, afforestation and reforestation activities, buying forest carbon credits, and participation in forest management and other restoration activities by offenders have been regarded as factors in determining legal responsibility. Moreover, the courts have also established forest restoration centers, either independently or in collaboration with local governments. These judicial innovations in China have provided positive incentives for the conservation, restoration, and sustainable management of forests, thereby significantly contributing to the achievement of the Climate Action Goals (SDG 13). However, these developments also raise several concerns, particularly the fair application of forest carbon sink mechanisms, the comparability in ecosystem service between damaged natural resources and compensatory measures, and the interconnection of the various SDGs. It is imperative to establish clear guidance on buying forest carbon credits, to develop standards and procedures to assess forest carbon sinks, and to strengthen cooperation between the judiciary and governmental agencies. Additionally, it is essential to integrate the forest carbon sink with broad economic development goals and social justice frameworks to ensure sustainable and inclusive outcomes.

Keywords: forest restoration projects; forest carbon sinks; afforestation and reforestation; buying forest carbon credits; sustainable development goals

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1. Introduction

As the largest pool of carbon in terrestrial ecosystems [1], forests have a significant impact on the achievement of sustainable development goals (SDGs), including meeting climate action targets (SDG 13) [2], halting biodiversity loss (SDG 15) [3], fostering economic growth and inclusive employment (SDG 8) [4], and reducing hunger (SDG 2) [5]. Forests are estimated to absorb an average of 2 billion metric tons of carbon from the atmosphere [6]. Due to this carbon sink function of forests, a variety of policies and economic incentives to protect and enhance forest carbon sinks have been developed at the local, national, and

international levels, ranging from the Bonn Challenge to restore deforested areas to the development of forest carbon offset projects around the world [7].

At the early stage, afforestation was recognized as the ecological measure with the greatest potential for sink enhancement [8]. According to the Marrakesh Accords adopted at the seventh Conference of Parties (COP) in 2001, afforestation and reforestation projects would be the only eligible CDM projects in the forestry sector during Commitment Period 1 [9]. However, such measures do not address sustainable forest management, the prevention of forest degradation, or combating deforestation. The critical actions necessary to maintain and enhance forest carbon sinks are to halt emissions from deforestation and degradation, while protecting the substantial carbon stocks that forests have accumulated over centuries [10]. With the advent of the post-Kyoto era, the international legal regime relating to forest carbon sinks has gradually shifted from afforestation and reforestation to reducing forest destruction and degradation, forest conservation, and sustainable forest management. For instance, at COP13 in 2007, participants agreed on the Bali Roadmap, which formally recognized Reducing Emissions from Deforestation and Forest Degradation (REDD) as a legitimate forestry carbon sink project. Acknowledging the crucial role of reducing emissions from deforestation and forest degradation, as well as the need to enhance the removal of greenhouse gas emission by forests, the REDD-plus framework was established, extending the original REDD initiative by incorporating additional measures, including the forest conservation and sustainable forest management [11]. Therefore, forest carbon sink projects primarily encompass afforestation, reforestation, reductions in deforestation and forest degradation, forest conservation, and sustainable forest management [12–14].

The majority of these forest carbon sink projects have been driven and managed by the government and a project developer. Government-driven national forest and landscape restoration (FLR) plans, strategies, and policies are widespread [15]. A typical example is the European Union, where the Forest Landscape Restoration (FLR) program advances its goals through a combination of top-level strategies, law, and funding plans. For instance, the "EU Biodiversity Strategy for 2030", released in 2020, commits to planting at least 3 billion new trees, prioritizing native species and those resilient to climate change [16]. The EU Forest Strategy, published in 2021, requires member states to develop national forest restoration plans, with a focus on restoring degraded forest land. The strategy promotes the "multifunctionality" of forests, balancing carbon sequestration, biodiversity, and economic value [17]. In 2024, the European Union formally adopted the Nature Restoration Law (NRL) [18]. The Nature Restoration Law, which aims to address the triple crisis of climate change, biodiversity loss, and environmental degradation, covers a wide range of ecosystems, from forests and agricultural land to urban areas, rivers, and marine habitats, with a focus on restoring those ecosystems that have the greatest potential for carbon removal and storage, and on preventing and mitigating natural disasters. It is considered to be one of the most important pieces of environmental legislation to date. As the first comprehensive law covering an entire continent, the NRL sets legally binding restoration targets for member states. Under the NRL, Member States will have to restore at least 20% of the EU's land and sea by 2030, including terrestrial, coastal, freshwater, forest, agricultural, and urban areas [19]. Member States will be required to prepare nature restoration plans for assessment by the Commission and to report regularly on their progress towards meeting domestic targets. In addition to this, the NRL is committed to improving urban green spaces, contributing to free-flowing rivers by removing artificial barriers, increasing the number of pollinators and contributing to the EU-wide target of 3 billion additional trees. In terms of specific action plans, the EU LIFE program promotes forest restoration through diverse projects in Europe, such as LIFE Terra, which advocates for forest ecological restoration and community involvement in the Mediterranean and Nordic regions, and

the Green Forests project in the Danube River Basin, which contributes to floodplain forest restoration [20]. In terms of cooperation, the EU has established frameworks with non-EU countries for cross-border forest restoration in Central and Eastern Europe, such as through the "Carpathian Wetlands Initiative" project for the restoration of cross-border degraded forests [21,22]. Of course, the implementation of FLR plans is also a focus in non-EU countries, such as South Africa [23], the plantations in Bangladesh [24], and food tree plantations in Panama [25]. Governments play a major role in these national FLR programs. For instance, large-scale tree-planting programs in the United States depend heavily on federal funding, such as the Conservation Reserve Program and the Wetlands Reserve Program administered by the Department of Agriculture [26]. In addition to government-driven projects, forest carbon sink projects have been initiated by project developers and other parties. In the context of Forestry Carbon Offsets (FCOs), project developers restore and conserve the degraded forestry ecosystems through tree planting and other measures. The carbon sequestered in both trees and soil is then quantified and sold as certified emission reductions (CERs) within the broader voluntary carbon offset market [27]. In addition, in some regions, regulations have been used to prevent deforestation in companies' operations by standardizing corporate responsibility and supplier requirements. For example, the EU introduced the EU Deforestation Free Regulation (EUDR) in 2023, which requires companies trading in cattle, cocoa, coffee, oil palm, rubber, soy, and wood, as well as derivatives of these commodities, to conduct extensive due diligence on their supply chains to ensure that shipments are not the result of recent (31 December 2020 after) deforestation, forest degradation, or violations of local environmental and social laws. This regulation extends the due diligence obligations of operators and sellers of goods from wood and paper products to agri-food, bio-energy, and other key manufacturing sectors, covering a wider range of products. Unlike previous EU laws on illegal logging and related trade (e.g., the EU Timber Regulation), the EUDR targets deforestation that is legal under the laws of the country of production, requiring companies to be able to trace where these products are grown and verify that deforestation and forest degradation are not occurring on the land where these goods are produced. The EUDR requires companies to follow prescribed methods of due diligence, which can be validly and reliably documented in an efficient and reliable manner, maintaining transparency throughout the supply chain [28]. The EUDR ensures that certain products circulating in the EU market are deforestation-free and produced in accordance with the relevant legislation. This prohibition aims to reduce greenhouse gas emissions and conserve biodiversity. By strengthening market regulation through legislation, the EU seeks to curb deforestation drivers and encourage the further development of forest carbon sink projects [29]. These measures often operate in parallel and have positive effects on sustainable forest management and the mitigation of climate change.

China has consistently demonstrated a commitment to conserve the forest ecosystem through sustained and strategic efforts, including the formulation of legislation and polices concerning forest conservation, setting the red lines for ecological conservation, and the initiation of degraded forest ecosystem restoration projects. The forest coverage and forest reserve in China have maintained growth for the last 30 years, and the growth in forest resources has been largest in the world [30]. As of 2023, China has 283,700,000 hectares of forested land, with a forest coverage rate of 24% and a forest stock of 19.49 billion cubic meters [31]. As early as 2006, China registered the Guangxi Pearl River Basin Reforestation Project, the first CDM afforestation and reforestation project in the world [32]. The Chinese government has pledged to peak carbon emissions by around 2030 and strive for carbon neutrality by 2060 in 2015 [33]. Since then, China has placed greater emphasis on enhancing the carbon stock of forestry ecosystems through forest restoration projects and has actively mobilized the government, enterprises, and the public to participate in forest carbon

sink enhancement activities. Additionally, forest carbon sinks have been prioritized for inclusion in the national carbon trading market, with a continuous increase in forest carbon sink projects related to the carbon trading market. Currently, national and local forest carbon sink strategies have been developed in China, including China Certified Emission Reduction (CCER), the China Green Carbon Foundation (CGCF) forest carbon sink projects, the Fujian Forest Carbon Emission Reduction (FFCER), the Personal Household Carbon Emission Reduction of Guangdong (PHCER), and the Beijing Forest Carbon Emission Reduction (BCER) [34].

When the climate actions by administrative bodies have failed to achieve the target of GHG emissions reduction, domestic courts have been called on to oblige the political branches to align the laws, policies, and administrative decisions with international obligations [35]. Although there was considerable skepticism about the prospect of climate change litigation, the 2015 Paris Agreement clearly recognized the importance of the engagement of all levels of government and various actors in addressing climate change [36]. Some landmark cases, such as *The State of the Netherlands v. Urgenda Foundation* and *Neubauer et al. v. Germany*, demonstrated the strength of climate change litigation and stimulated the global expansion. In recent years, climate change litigation has grown rapidly both in developed countries and developing countries, with 230 new climate cases filed in 2023 [37]. China's courts have also actively engaged in climate actions, taking a series of innovational approaches to mitigate and adapt to climate change and enhance forest carbon sinks. In terms of application scenarios, enhancement methodologies, and involved stakeholders, these measures to enhance forest carbon sinks taken by the judiciary bodies differ significantly from forest carbon sink enhancement, which is primarily led by governments and project developers. However, the existing literatures have predominantly focused on the scientific evidence of forest carbon sinks enhancement [38,39], the potential of forest carbon sinks [40], and specific options for forestry sink enhancement [41,42], paying insufficient attention to the role of the court in forest carbon sinks. It is valuable to examine the innovative practices taken by China's courts, analyze the challenges in forest carbon sink enhancement, and discuss its implications for climate change policy. The forestry ecological restoration projects (FERPs) initiated by the government and project developers are capable of rapidly advancing forest restoration and achieving large-scale results. However, as proactive initiatives, they require additional financial investment and management costs. In parallel, the Chinese courts have actively engaged in exploring various strategies to enhance forest carbon sinks. The role of the Chinese courts in dispute resolution is to provide impartial guidance, aiming to increase the contribution of forestry restoration in specific environmental cases. This involves calculating the criminal or illegal costs associated with particular cases and applying them to forest restoration efforts.

This article explores the judicial innovation concerning enhancing forest carbon sinks through several key sub-sections. Section 2 outlines the methods employed in this study, explaining the standard and procedure used to search and collect the legislation, policy, and court ruling. Section 3 elaborates on the legal background of judicial innovation, describes the application scenario of court rulings, and sorts out the specific approach to enhancing forest carbon sinks by the courts. These descriptions provide a robust foundation for the subsequent discussion. Section 4 critically examines the challenges associated with the implementation of these innovative strategies and proposes valuable insights, with a focus on the achievement of the SDGs and carbon neutrality. Finally, the conclusion summarizes the key findings of this research and the potential implication for policy reform.

The aim of this article is to highlight the efforts and innovations made by judicial entities, beyond the government and project developers, in the sustainable management of forests. This is crucial for promoting the participation of multiple stakeholders in forest

restoration and the enhancement of forest carbon sinks. Due to the gaps in Chinese environmental law regarding forest restoration and carbon sequestration, a phenomenon of "judicial practice preceding legal provisions" exists, wherein courts take the initiative in fostering innovations in forest carbon sinks. Typically, courts, operating within the framework of existing laws, combine policy goals and regional realities, adopting flexible approaches that go beyond rigid textual guidance, and endeavoring to bring creativity to abstract legal provisions. This practice creates a new path for forest carbon sink improvement, led by the courts and based on individual cases within the Chinese context. Compared to government-driven initiatives, this approach brings together the efforts of individuals, collectives, and society, while, in contrast to projects developed by commercial developers, it places more emphasis on overall effectiveness and unified efficiency. However, when observing China's progress in forest carbon sinks, challenges remain, such as the equitable application of carbon sequestration mechanisms, the comparability of damage and compensation assessments, and the linkage between sustainable development goals. These issues require the Chinese courts to ensure transparency and fairness in their procedures, further develop methods for assessing both forest carbon sink damage and sequestration gains, and carefully consider the interconnections and synergies between various sustainable development objectives.

2. Methods and Data Sources

2.1. Methods

This paper adopts a qualitative analytical approach, combining normative analysis with typical case analysis, to conduct research on judicial innovations in increasing forest carbon sinks in China. Through the normative analysis and case study method, the provisions and practices of increasing forest carbon sinks in legal norms, policy texts, and judicial practices are clarified. The normative analysis in this paper is mainly based on policy texts and legal texts.

Proper understanding of policy content, legal provisions, and legal terminology is crucial to examine how China will achieve its sustainability goals through forestry ecological restoration. The central government of China has issued numerous policy documents and legal norms for forestry ecological restoration, and local governments have also stipulated numerous local regulations. In addition to the administrative agencies, judicial organs at all levels, including the Supreme People's Court, are also actively promulgating judicial documents to promote innovations in forestry ecological restoration. Based on the analysis of legislation and judicial documents on forestry ecological restoration, especially forest carbon sink enhancement, it is possible to clarify the process of implementation, the direction of evolution, and the effect of forest carbon sink enhancement judicial innovations on the promotion of the SDGs.

After conducting a search on judicial cases relating to forest carbon sinks, we analyze cases, such as case types, applicable scenarios, relevant legislation and regulations, responsible entities, methods of enhancing forest carbon sinks, and benefits of implementation. This is to illustrate the current judicial practice of forest carbon sinks in China and its effectiveness in achieving the SDGs.

2.2. Data Sources

To obtain the comprehensive literature on forestry sink enhancement, we searched the literature published from 2015 to 2024 in databases, including CNKI, SpringerLink, Scopus, Web of Science, and Wiley Online Library and using both Chinese and English keywords (see Figure 1). The reason for choosing this period is that the SDGs were adopted in 2015, and we would like to better observe the literature on forest carbon sinks, which is more

related to the SDGs. The keywords used in the search were "forest", "carbon sinks", "forest carbon sinks", "forestry ecological restoration projects", "forest restoration", "court", and "forestry carbon sequestration in China".

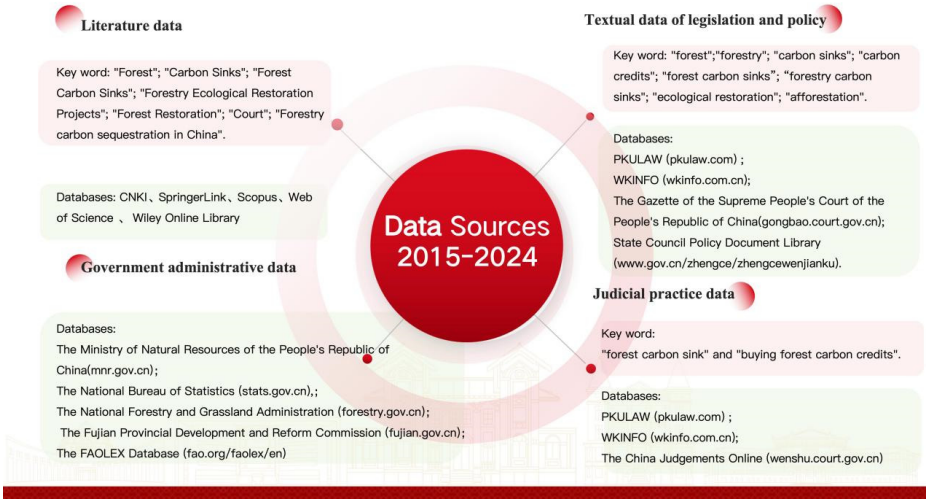


Figure 1. Summary diagram of data sources from 2015 to 2024.

To obtain the data on China's forestry ecological restoration and forestry sink enhancement from 2015 to 2024, we visited the relevant official websites of central governments, local governments, and international organizations, including the Ministry of Natural Resources of the People's Republic of China (mnr.gov.cn), the National Bureau of Statistics (stats.gov.cn), the National Forestry and Grassland Administration (forestry.gov.cn), the Fujian Provincial Development and Reform Commission (fujian.gov.cn), and the FAOLEX Database (fao.org/faolex/en).

Concurrently, to find legislation, policy, and judicial documents related to judicial innovations in forest carbon sink enhancement, we accessed two legal databases—PKULAW (pkulaw.com) and WKINFO (wkinfo.com.cn)—and visited the Gazette of the Supreme People's Court of the People's Republic of China (gongbao.court.gov.cn), and the State Council Policy Document Library (www.gov.cn/zhengce/zhengcewenjianku). The search terms included "forest", "forestry", "carbon sinks", "carbon credits", "forest carbon sinks", "forestry carbon sinks", "ecological restoration", and "afforestation". Because forestry ecological restoration and forest carbon sinks are important manifestations of the SDGs, we also visited the websites of the Conservation of Biological Diversity (CBD) (cbd.int/aichi-targets) and the UN SDGs (globalgoals.org/goals).

To observe the judicial practices relating to forest carbon sink enhancement taken by Chinese courts in 2015–2024, we conducted a full-text search on PKULAW and WKINFO and China Judgements Online (wenshu.court.gov.cn), with "forest carbon sink" and "buying forest carbon credits" as keywords. Since the SDGs were adopted in 2015, adopting this timeframe enables us to focus on recent progress in the judicial practice of forest ecological restoration and forest sink enhancement. We then obtained a total of 94 cases that included "forest carbon sinks" and 18 cases that included "buying forest carbon credits." During the initial screening, we excluded duplicate and irrelevant cases, such as contract disputes related to carbon sink project developers, bribery cases and disputes on private loans associated with buying forest carbon credits, and cases concerning organizing and leading pyramid schemes under the guise of buying carbon credits. Finally, we obtained 67 cases which were adjudicated by the Supreme People's Court and local courts at all levels, as shown in Appendix A Table A2.

3. Results

To address the environmental pollution and ecological degradation, the Chinese government has established a relatively comprehensive regulatory framework, encompassing legislation, administrative enforcement, and judicial mechanisms, among other components [43]. China's court system consists of four levels, the Supreme People's Court, Higher People's Court, Intermediate People's Court and Primary People's Court, corresponding to the national, provincial (including autonomous regions and municipalities), municipal, and county (district) administrative divisions. As the highest judicial organ of the PRC, in addition to the adjudicatory functions needed to hear cases, the Supreme People's Court of China is empowered to promulgate judicial interpretations, formulate guiding opinion and judicial suggestions, and issue guiding cases, participating in the formulation and implementation of public policies [44]. The judicial interpretation and guiding cases have a binding effect on the local courts at various levels, and the judicial suggestion and opinion are not legally binding documents [45]. There is no exception in the field of environmental protection. The Supreme People's Court has implemented and promoted judicial activism to protect the ecosystem, such as the expansion of environmental case classification, seeking advice from experts, and offering an ecological restoration plan [46]. Although the local courts do not have the power to issue judicial interpretation, they often publish documents to harmonize their judicial practices.

As a judicial organ, the primary function of the courts is to adjudicate cases based on existing legislation, with the judicial interpretation and guiding cases serving to elucidate the existing rules, rather than creating new rules. Clearly, given China's civil law tradition, all judicial interpretations and guiding opinions issued by the Supreme People's Court must be firmly grounded in statutory authorization. However, the protracted legislative procedure and the conflicting interests among different groups result in misalignment between the legislative progress and social change, creating ambiguity of legal provisions. This gap prompts the courts to engage in judicial innovation to address the emerging legal challenges. Furthermore, the courts of China are embedded in a broader system of governance and have been actively involved in the formation and regulation of public policy, with the growing incentive of judicial innovations [47].

While there exists legislation on forest management, the link between forest management and climate change remains remote; when adjudicating disputes related to forest resources, Chinese judges must integrate statutory provisions with non-binding materials to achieve regulatory objectives. However, the current legal framework has not kept pace with the growing emphasis on enhancing forest carbon sinks within sustainable forestry management. To address the legal ambiguities or gaps frequently encountered in judicial decisions, the Supreme People's Court of China has issued judicial interpretations, guiding opinions, and working documents relating to forestry carbon sequestration.

In general, the Chinese courts' forestry carbon sequestration innovations can be categorized into three main areas: (1) Textual innovations. Courts have actively engaged in judicial activism by issuing a series of judicial documents related to forest carbon sinks, which guide and influence specific judicial decisions. (2) Innovations in specific cases. (3) Innovations in daily judicial work.

3.1. Rule Development Concerning Judicial Innovation for Forest Carbon Sink Enhancement

While early Chinese forestry policy focused on the utilization of forest resources and afforestation efforts, after the SDGs were proposed in 2015, China's forestry policy emphasized ecological restoration for the achievement of the SDGs. Especially after the carbon peaking and carbon neutrality goals were proposed in China, the court accelerated the innovative process of forestry sink enhancement. The key features of textual innovation include

the following: (1) The broad integration of forest carbon sink requirements and measures into forest resource litigation, climate change cases, and general ecological restoration cases. (2) The adoption of joint documents by local courts and between courts and administrative authorities to enhance the effectiveness of forest carbon sink policies.

In April 2022, the SPC issued "the Interpretation of the Supreme People's Court on Several Issues Concerning the Application of Law to the Trial of Cases of Civil Disputes over Forest Resources" to regulate the rules for trading forest carbon sinks, allowing the parties to substitute for the fulfilment of their responsibility to pay compensation for damage to the forest ecosystem by subscribing to certified forest carbon credits. After that, in order to better provide judicial services for the goal of carbon peaking and carbon neutrality, in February 2023, the SPC further promulgated "the Opinions of the Supreme People's Court on the Complete and Accurate Comprehensive Implementation of the New Development Idea Providing Judicial Services for the Active and Steady Promotion of Carbon Peak and Carbon Neutrality." The opinion clarified that an infringer's voluntary purchase of certified emission reductions (CERs) and their write-off in the carbon emission trading market or the purchase of other products of carbon sinks could be used to offset the loss of carbon sinks and the loss of services during the period between the ecological damage to the completion of restoration. Although this opinion applies to general cases, it also provides guidelines for innovative judicial practice in forestry sink enhancement. In addition to the above judicial interpretations and guiding opinions directly related to forestry ecological restoration, there are also some judicial documents that do not directly provide for compensation following damage to forest resources or carbon sinks, but identify forestry sink enhancement as a form of ecological restoration through ecological restoration provisions, explicitly explore the judicial program for realizing the value of ecological products such as carbon sinks [48], and require the scientific and reasonable use of diversified ecological restoration methods such as afforestation and reforestation activities, buying forest carbon credits, participation in forest management and other restoration activities by offenders [49].

In addition to the Supreme People's Court, some local courts have also issued judicial documents related to forestry sink enhancement, such as the Higher People's Court of Jiangsu Province and the Higher People's Court of Guangdong Province, both of which explicitly use alternative forms of compensation such as carbon credits subscription [50,51]. The Anji Court of Zhejiang Province also issued the "Implementation Opinions on Strengthening the Judicial Protection of Carbon Sinks" in July 2022. The document standardizes carbon sink restoration and clarifies the need to subscribe to approved forest carbon sinks [52].

Considering the specialized character of forest carbon sink enhancement, courts across various regions in China have not only issued judicial documents, but also actively collaborated with administrative authorities to enhance the forest carbon sink. This collaboration effort includes joint issuance of working guidelines for forestry restoration, thereby facilitating a more integrated approach in forest carbon sink enhancement. This type of practice has mainly taken place in Fujian, Guizhou, Hebei, and Hubei Provinces, which are rich in forest resources. Fujian Province, in particular, has a more detailed forest carbon sink compensation mechanism that is jointly managed by its courts and forestry departments. In September 2022, the Higher People's Court of Fujian Province and the Fujian Provincial Forestry Bureau jointly issued the "Guidelines for the Implementation of Ecological Restoration and the Application of Forestry Carbon Sink Compensation Mechanisms in Ecological Environment Criminal Cases (Trial)" [53]. The guidelines clarified the scope of application for the subscription of forest carbon credits, standardized the subscription process, and established a methodology for quantifying the loss of carbon credits in damaged ecosystems and the method of compensation. As the practice of forestry sink enhancement has

grown, the administrative authorities collaborating with the courts have expanded from the forestry department to the ecology and environment department and the natural resource bureaus. For instance, the Guizhou Higher People's Court, in conjunction with the Guizhou Provincial People's Procuratorate, the Guizhou Provincial Public Security Department, the Guiyang Special Commissioner's Office of the National Forestry and Grassland Administration, the Guizhou Provincial Department of Ecology and Environment, and the Guizhou Provincial Forestry Bureau, issued the "Opinion on Carrying Out Ecological Restoration and Ecological Damage Compensation through the Subscription of Forestry Carbon Sinks in Cases of Forest Resource Destruction (Trial)" to guide offenders in forest-related cases to voluntarily subscribe to forest carbon credits as a substitute for fulfilling the responsibility of ecological environment restoration and ecological environment damage compensation in cases of the destruction of forest resources [54]. The Chengde Intermediate People's Court in Hebei [55] and the Yichang Intermediate People's Court in Hubei Province [56] have also made such attempts to explore the issue of guidance documents jointly with a number of departments, clearly identifying the process and requirements for the integration and cooperation between the courts and the administrative authorities in the work of increasing forest carbon sinks and strengthening the implementation of safeguards for the work of enhancing forestry sinks.

3.2. Scenarios for the Application of Court-Ordered Forestry Enhancement

Most of the judicial innovations for forest carbon sink enhancement have taken place since 2020, closely relating to the proposal of China's ecological civilization construction and the goals of peaking carbon emissions and subsequently reaching carbon neutrality. The Chinese courts have gradually introduced innovative approaches to enhance forest carbon sinks, especially in civil and criminal cases related to the destruction of forestry resources.

3.2.1. Forest Carbon Sink Enhancement in Criminal Cases

By typifying the statistics of cases involving forest carbon sinks in China, we found that criminal cases related to the destruction of forestry resources have become the primary scenarios for courts to introduce innovative approaches relating to forestry sink enhancement. Courts have tended to order or suggest that offenders take forestry enhancement measures primarily in the following four activities (see Figure 2).

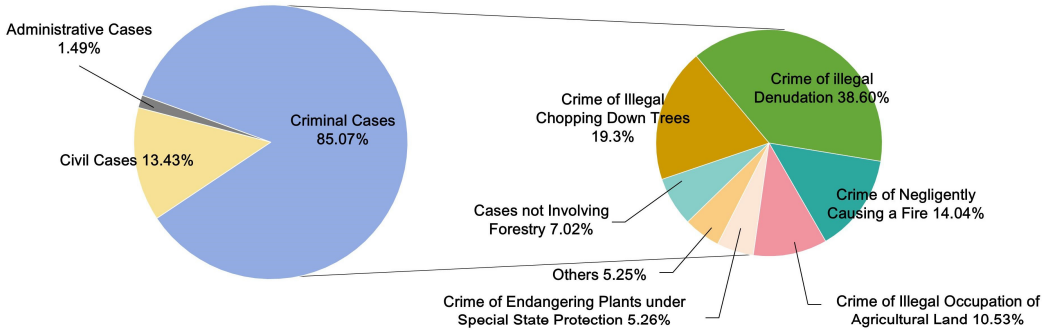


Figure 2. Statistics on specific offenses involving forest carbon sinks in criminal cases.

The first one is illegal logging and excessive deforestation. In this case, the offender violated the Forestry Law and other regulations on the protection of forests, felling the trees or other woods without approval issued by the competent forestry administrative department or felling the trees or other woods beyond the limits of the logging permit. The second is cutting down forests owned by the state, collectively or individually without permission and in large quantities for the purpose of illegal appropriation. The third is forest fires caused by illegal acts, which have destroyed forest resources and damaged the

regulation services of the ecosystem, such as carbon sequestration and oxygen release in local forests. The fourth is the unauthorized reclamation and occupation of forest land, leading to the alteration of the use of forest land and the serious destruction of forest land. Most subjects of these violations are individual farmers, and the activities are mainly concerned with their livelihood. However, all of them have resulted in the destruction of forestry resources and the loss of forest carbon sinks.

3.2.2. Forest Carbon Sink Enhancement in Civil Cases

Civil cases are also an essential scene for forest carbon sink enhancement by the courts. The Chinese courts have mainly taken into account forestry sink enhancement in scenarios where forestry resources are destroyed, where forest carbon sinks are impaired, and where the overall ecological value is diminished (see Figure 3).

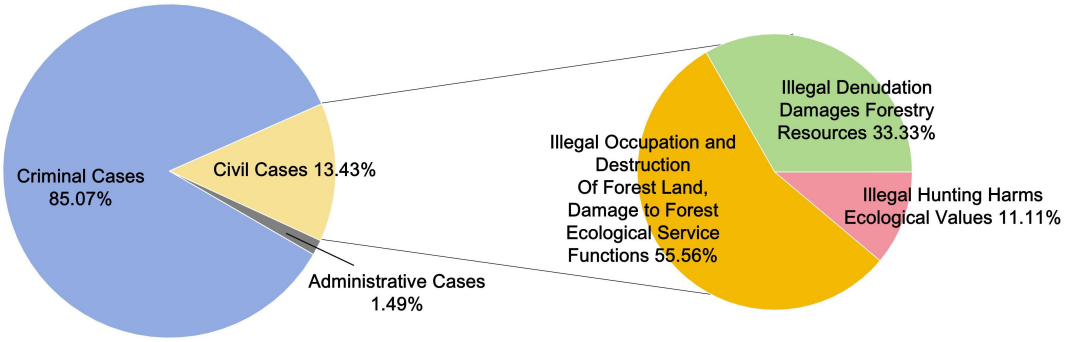


Figure 3. Statistics on types of cases involving forest carbon sinks in civil cases.

Compared to criminal cases, the forestry sink enhancement measures taken by the courts in civil cases are mostly in response to larger-scale ecological damage resulting from by some companies, especially when the offenders have illegally occupied forest land, resulting in the destruction of vegetation and carbon sequestration in forest land.

3.3. Innovations of Forest Carbon Sink Enhancement in Specific Cases

Currently, the innovative approaches for forest carbon sink enhancement taken by courts include afforestation and reforestation, subscription to forest carbon credits, and forest management. The following statistical analysis presents the primary innovative methods for enhancing forest carbon sinks in legal proceedings (see Figure 4). In practice, the above three approaches are occasionally employed individually [57], and at other times in combinations of two or more [58].

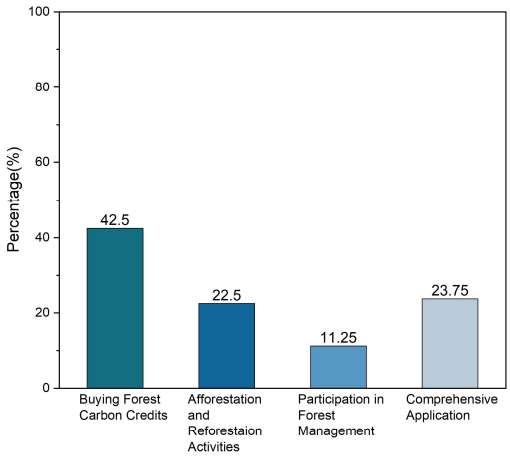


Figure 4. Approaches of forest carbon sink enhancement in specific cases.

Judicial innovations in rulings can be observed in four main ways: (1) incorporating forest carbon sink loss compensation into the legal responsibility evaluation system, encouraging offenders to actively participate in restoring forest carbon sink functions; (2) allowing offenders to purchase certified forestry carbon credits to fulfill their obligation to compensate for environmental damage; (3) developing reforestation plans in collaboration with experts and forestry authorities, ensuring that specific tree species and quantities are explicitly included in the court's ruling; (4) introducing forest management as an alternative remedy for violators unable to afford direct forest restoration.

3.3.1. Link Forestry Sink Enhancement Practice and Legal Responsibility

In criminal cases, subscription to carbon credits, reforestation, and other forestry sink enhancement practices by offenders have been considered by the court as important factors in determining legal responsibility. Because these ecological restoration efforts would result in the mitigation and exemption of criminal liability, the offenders would have the motivation to carry out reforestation efforts or subscribe to carbon credits. As a result, the number of damaged trees or amount of damaged forest land would be restored to a certain extent, and the demand side of increasing forest carbon credits would also expand from conventional emission reduction enterprises to specific forest resource destroyers. Moreover, this kind of innovation in sentencing causes the offenders to recognize that they should earnestly restore the damaged forestry resources and make up for the loss of forest carbon sinks to obtain a lesser criminal liability, achieving the effect of correction and deterrence.

Compared to criminal cases, the forestry sink enhancement measures in civil cases are mostly in response to larger-scale ecological damage resulting from some companies, especially when the offenders have illegally occupied forest land, resulting in the destruction of vegetation and carbon sequestration in the forest land. In these cases, the courts have often taken afforestation and reforestation, subscription to carbon credits, and participation in forest management as important forms of liability for the parties to repair damaged forestry resources and compensate for the loss of ecological function. Unlike forestry sink enhancement measures in criminal cases, which are more focused on punitive deterrence, forestry sink enhancement innovations undertaken by the courts in civil cases are more aimed at compensating for the loss of forest carbon sinks. Overall, the innovative measures taken by the courts, on the one hand, provided an expanded source of funding for forest carbon sinks, such as a case in which CNY 137,000 of subscription money in a carbon sink case was issued to forest farmers for afforestation and forest protection, involving 58.274853 hectares of forests with carbon sinks [59]. On the other hand, these measures have also become an important means to make up for the loss of value of the carbon sequestration function of forest land and restore the ecological service function of forests. In a case decided by the Jiangxi Provincial Court, an agricultural company that did not apply for a forest land-use permit and carried out earth-moving construction, reclamation, and leveling of the forest land without permission not only had to restore the destroyed 22.96 hectares of forest land on its own and nurse it for two years, but also had to compensate for the loss of the ecosystem function value of CNY 5,259,900, of which the value of the carbon sink in the forestry industry lost CNY 11.99 million [60].

3.3.2. Design Mechanisms for Subscribing to Forestry Carbon Credits

The subscription of forest carbon credits is the most common innovative approach of forestry sink enhancement in court cases involving forests. As a form of alternative remedy for ecological damage, the purchase of forestry carbon credits generally refers to businesses or other entities acquiring forestry carbon credits. When an individual or entity

violates forestry regulations and causes ecological damage, the court would suggest the defendant take alternative restoration if applicable. Then, the defendant might pay a sum equivalent to the lost carbon sequestration value into the designated account for forestry restoration, or purchase certified forest carbon credits from a carbon trading platform [61]. At present, the forestry carbon credits used for market transactions in China mainly include forestry carbon credits under the China Certified Emission Reduction (CCER) program in the voluntary carbon trading market, as well as voluntary emission reductions certified at the local level. These carbon credits are generally categorized into two main types: forest management carbon credits and afforestation carbon credits [62]. Forest management carbon credits refer to the additional carbon sequestration achieved through unusual methods such as structural modifications, ecological restoration, and the replacement of tree species. On the other hand, afforestation carbon credits refer to the additional carbon sequestration generated by converting non-forest land into forest land through natural or artificial methods [63].

Although the subscription of forest carbon credits by offenders does not directly increase the volume of carbon sinks, it serves to stimulate the demand for forest carbon credits and indirectly encourages the supply side to take measures to enhance forestry carbon sinks. In such instances, the courts have either characterized this innovation as a form of compensation for the loss of forest carbon sinks, as a means of compensating for ecological losses [64], or as a process of establishing carbon sinks for the purpose of alternative restoration [65].

With regard to the amount of forest carbon credits subscribed to by the offender, judicial practice varies across the regions in China. In most cases, the amount of compensation or subscription is equal to the amount of carbon sinks lost, while in a few cases, the amount of compensation and subscription for the loss of forest carbon credits has been exceeded; for example, in one case, the party concerned voluntarily subscribed and wrote off 96 tons of certified forest carbon credits at twice the number of carbon sinks lost due to deforestation, instead of fulfilling its responsibility to compensate for the loss of carbon sinks [66]. The forestry carbon credits purchased by defendants in judicial practice may be certified either under the CCER or by local authorities, or they may be forestry carbon credits filed with the forestry departments in various provinces, even if they have not been formally certified. The methods to subscribe to the forest carbon credits mainly include three categories: (1) direct monetary contribution to the special bank account of the court which was designated for purchasing forest carbon credits for alternative restoration [60,66]; (2) direct monetary contribution to the bank account managed by the Forestry Bureau which was designated for subscribing to forest carbon credits [67]; (3) subscribing to forest carbon credits through existing trading platforms. For instance, the offenders signed the “Forestry Carbon Sink Purchase and Cancellation Service Agreement” with the Fujian Straits Resources and Environment Transaction Center Co. Forestry Carbon Sink Purchase and Cancellation Service Agreement”, paid CNY 33,262.82 for carbon sink compensation, and subscribed to 482 tons of forest carbon credits [68]. In some specific cases in Fujian Province, the offender also voluntarily subscribed to carbon credits in the Shunchang County “One Dollar Carbon Sink” project [69].

3.3.3. Explore the Depth Application of Afforestation and Reforestation

Afforestation and reforestation are also commonly used in judicial practices as important methods to enhance forest carbon sinks, encompassing both on-site and off-site replanting and afforestation. The former refers to planting trees in situ or restoring the original forest land [70], and the latter refers to the alternative restoration of forest resources by planting trees or creating forest land in other places [71]. The courts have used restoration

funds to carry out the forestry restoration plan, with the main goal to enhancing carbon sinks. In practice, the afforestation and reforestation required by the judicial bodies can be broadly categorized into two types. The first one is the restoration of damaged forest resources of equal amount, in which the loss is more likely to be filled, and the role of forest carbon sinks is not obvious, such as the equal planting of trees in some criminal cases [72]. The other is compensatory afforestation and reforestation, which means reforestation of the damaged forest resources at an excessive level, which is of a stronger nature for the purpose of foreign exchange enhancement. For example, in some cases, the courts have ruled that the defendant should plant and reforest five times the number of trees in the same place or in a designated area [73].

Reforestation remains the most faithful and direct method for enhancing forest carbon sinks, but this approach carries the risk of unhealthy propagation material and poor-quality trees. In some cases, the person responsible for reforestation may ignore the forest stewardship due to cost considerations or a lack of technical expertise. After evaluating the risks mentioned above, the Chinese courts have innovatively adapted this approach in line with their unified guidance system. In practice, for cases in which the court orders the offender to undertake reforestation, the Chinese courts typically consult expert opinions to form a specific restoration plan before issuing a judgment. They explicitly specify the species and number of trees in the ruling to minimize the appearance of low-quality trees. In cases where courts impose financial penalties for reforestation and use the funds to establish restoration bases for enhanced forest carbon sinks, the Chinese courts cooperate with the relevant administrative bodies responsible for forests to jointly develop a reforestation plan, ensuring the selection of high-quality tree species that are better suited to the local ecological environment [74]. In some cases, it can even be seen that, alongside forest carbon sinks, efforts are made to protect rare vegetation [75]. These restoration plans are often more transparent, with the Chinese courts releasing basic plans and progress updates via court news on widely used social apps in China.

3.3.4. Introduce a Forest Management Mechanism

Forest management is mainly concerned with the protection of forest resources through participation in management activities, including mountain patrols and forest fire prevention. This approach is also an innovation produced by the courts to unify the legal, social, and ecological effects of forestry restoration. In some cases of the destruction of forestry resources, the courts have actively used this method to compensate for the damaged natural resources. Although this approach does not directly augment the volume of forest carbon sinks, its protection of forest resources is conducive to increasing forest sinks in the end. Based on the scope and specific requirements of the forest management, court judgements may be broadly classified into two types. In the first case, the courts generally require the offender to participate in mountain patrols, forest protection, and other related work on a regular basis and order the perpetrator to refrain from engaging in activities damaging to forest resources during the probationary period. In the second category, the courts order the offender to carry out forest stewardship in a specific location. For example, in one case, the court set up an environmental justice forest carbon sink observation base at the site of the crime, to continuously track and dynamically observe the planting and regreening carried out by the company that had illegally occupied the forest land in the first place. The company also placed 22 warning signs at 16 points on the planting site, set up special posts for regular inspections by staff, and carried out pest control on a regular basis to ensure the effectiveness of the restoration [76].

3.4. Establishment of the Court-Driven Forest Restoration Centers

In addition, the courts will also pool restoration funds and establish forest restoration centers to work with administrative departments and other entities to complete restoration of forestry projects and enhancement sinks. Unlike specific cases in which the main body of forest restoration varies, after the establishment of forest restoration centers, the main body responsible for restoration shifts from the person responsible for restoration in each case to the government forestry department or third-party agencies consigned by the court. In this search for restoration at scale and uniformity, the courts have shown more active initiative. As early as 1994, the Basic Court of Heilongjiang's Reed River Forest District explicitly used ecological restoration funds to plant 40.4686 hectares of "compensation forests" [77]. In 2018, the Heilongjiang Forest District Central Court established the first court-driven forestry restoration centers in Heilongjiang Province in Reed River, where the defendant paid ecological restoration funds, and the court commissioned the forestry authorities to plant 33,411 red pine saplings [78]. With the proposed model of "carbon sinks + justice", there has been a rapid rise in the practice of courts pooling restoration funds and establishing forest restoration centers. For example, the Daxinganling District Intermediate People's Court established a "forestry carbon sink + ecological justice" ecological environment restoration base in 2024 in conjunction with the Daxinganling Forestry Group Company and used all the funds from the ecological environment damages of the judicial trial for ecological environment restoration. At present, 1305 spruce trees aged 22 years have been successfully planted, covering an area of 1.6 hectares. In addition, the base has reserved an area of 12.14 hectares for the second phase of restoration, which can be planted with 1600 trees [79].

In addition to establishing forest restoration centers within their own jurisdictions, some courts have also established forest restoration centers across regions. The Jiangsu Provincial Court has broken the limitations of administrative borders and, relying on the local reform of the ecological judgement system, which takes the whole ecosystem as a unit, explored the model of forest restoration and forest carbon sink enhancement under a complex ecological environment in light of the local ecological situation [80]. For example, the Jiangyin Court in Wuxi transferred CNY 200,000 of compensation for civil public interest litigation on pollution of the environment to a restoration center outside the area where the pollution occurred, to be used by a third-party agency for the ecological restoration of reforestation [81]. The courts in Suzhou have also set up ten ecological restoration centers across the region in key areas such as the Yangtze River, Taihu Lake, the Grand Canal, and the Yangtze River Delta Ecological Green Integrated Development Demonstration Zone since 2022, to meet restoration needs [82].

4. Discussion

This paper attempts to monitor China's progress in enhancing forest carbon sinks, in particular, how judicial innovation practices can complement China's laws and policy documents to better promote forestry ecological restoration and achieve the SDGs. Therefore, our observational studies focus on two aspects: first, whether current judicial innovations are effective in balancing as well as achieving the SDGs; and second, how to strengthen the implementation of policies and mitigate obstacles in responding to the challenges of forestry restoration to achieve the SDGs, if the current judiciary's explorations are not contributing accordingly to the SDGs. Clarifying the innovative practices and challenges faced by the Chinese judiciary in enhancing the carbon sink capacity of forests is valuable, as efforts to channel multi-party participation through the judiciary will play an important role as ecological restoration in forestry develops.

4.1. Valuing the Role of Subscription to Forest Carbon Credits in the Sustainable Management of Forests

Subscribing to carbon credits has always been recognized as an important measure to combat climate change. In the European Union and the United States, where the carbon trading market is relatively mature, carbon credits have a certain institutional basis and practical experience. For example, the EU Emissions Trading System (EU ETS), as one of the largest carbon markets in the world, limits corporate emissions through a "cap-and-trade" system, allowing companies to buy and sell allowances or use carbon credits (such as certified emission reductions, CERs, from international offset projects). This system encourages companies to invest in emission reduction technologies or purchase carbon credits to comply with regulations, indirectly boosting the demand for carbon credits [83]. Furthermore, the EU's Regulation 2024/3012, the Carbon Removal Certification Framework (CRCF), sets out the standards for carbon credits, requiring them to be quantified, additional, long-term, and sustainable. This provides legal support and a rigorous certification system to help achieve the EU's carbon neutrality goals while maintaining a stable carbon credit market [84]. As one of the measures under the European Green Deal [85], the Carbon Border Adjustment Mechanism aims to extend the role of carbon credits in international markets [86].

In the United States, the voluntary carbon market initiative has established a certification system under the Department of Agriculture, helping farmers and landowners to participate in the carbon market and encouraging the private sector to engage in carbon credit purchases, thus boosting market demand [87]. Both the EU and the US promote carbon credits as a key tool for increasing carbon sequestration through a combination of mandatory carbon markets, voluntary markets, and technological innovation incentives.

However, it is important to note that, while forestry projects are generally eligible to generate carbon credits and sell them on emissions trading markets, their inclusion in carbon trading systems around the world has been complex for various reasons. For instance, EU Regulation 2024/3012 limits the certification of certain forest projects, excluding those that involve deforestation and projects that may harm biodiversity, such as single-species forestry plantations, from certification. Beyond China, few other countries or regions incorporate carbon credit purchases as a method for forest restoration and management in judicial rulings. While Indian courts have promoted forest protection policies through rulings and continuous enforcement, emphasizing the value of forest carbon credits in litigation [88], and while some state courts in the US support state governments' use of national forests for carbon credit programs [89], both countries primarily recognize the value of forest carbon credits at a macro level or endorse government authority to protect forest carbon credits. They lack a more detailed, case-by-case approach to translating the enhancement of forest carbon credits into tangible judicial actions.

Despite the difficulties of integrating forest carbon credits into the carbon emissions trading system, we cannot deny the enormous potential of carbon markets to promote large-scale forest restoration [90]. One of the primary barriers to forest restoration is the lack of funding for restoration and maintenance [91]. Native species planting, afforestation, and secondary forest restoration often take more than 30 years to generate economic benefits. Without financial support from the carbon market, the funding for restoration, maintenance, and payments to stakeholders would be a significant burden. Requiring offenders to purchase forest carbon credits not only stimulates the growth of the carbon credit market but also provides financial incentives for landowners and businesses to invest in sustainable forestry practices. Additionally, assigning tangible value to forest carbon sinks encourages improved forest health and biodiversity conservation. For example, reforestation projects can not only sequester carbon but also restore ecosystems, improve soil quality, and support wildlife habitats. China's judicial practice has shown us that the subscription

of forestry carbon credits can be fully integrated with forest restoration, and that the compensation mechanism for forestry carbon sinks can not only make the destroyers of forest resources pay a corresponding price, but also enable the protectors of forest resources to obtain a reasonable return, as well as providing financial support for forest restoration. In addition, advances in technology, such as remote sensing, are improving the accuracy and transparency of carbon credit verification. These innovations can reduce costs. Thus, the forestry carbon credit mechanism is likely to become an important tool for the future sustainable management of China's and the world's forestry system.

4.2. Fairness in the Application of Forest Carbon Sink Strategy

While the courts' consideration of forestry sink enhancement measures as an important factor in determining legal liability in both criminal and civil cases may motivate offenders to restore damaged forestry resources and compensate for the loss of the forest's carbon sequestration function, it also faces several challenges, such as the fairness of its application. Firstly, in most criminal cases, the courts regarded the defendant's actions of "afforestation and reforestation" and "subscribing to carbon credits" as mitigating factors. At a time when China's carbon sink trading market is not yet mature, if the court excessively pushes the defendant to purchase forest carbon credits in order to reduce their legal responsibility, it may raise concerns that judicial authorities are leveraging judicial power to interfere with the supply, demand, and pricing dynamics of carbon sink market transactions [92]. Secondly, in some civil cases, the courts regarded "subscribing to carbon credits" as an alternative remediation method undertaken by the defendant, and solidified and promoted it as a way of bearing environmental judicial responsibility. In this process, the courts did not explain the prerequisites for the application of the carbon sink subscription measures, nor did it adjudicate whether the ecological damage caused by the actor could be directly repaired. Although this innovation has expanded the funding channels for forest restoration to a certain extent, it has also cast doubt on the innovative significance and practical value of "subscribing to forest carbon credits". Thirdly, it is well known that the implementation of FERPs requires a large amount of financial, land, and other resources [93]. The large cost investment makes monitoring and managing the project during and after implementation a concern. In forestry ecological restoration projects led by the government or enterprises, whether it is afforestation, reforestation, or forest management, the project design, implementation process, and results are subject to the supervision and management of the (higher) government and the community. This has ensured, to some extent, the quality and fairness of the enhancement of sinks. However, judicial innovations in forest carbon sink enhancement lack unified supervision and management, both in terms of application scenarios and project design and implementation. The courts are not fully equipped with expertise in forestry remittance enhancement, and the innovative remittance enhancement measures they carry out do not necessarily lead to optimal results. Taking reforestation as an example, forests are affected by ecosystems and climatic systems, and the sequestration effect of afforestation is affected by tree species, the age of the forest, and extreme climatic disturbances, so where to replant and reforest, and which tree species to choose, are issues that need to be carefully considered, and if the court decides that the forest carbon sink enhancement measure lacks specialization, it will be faced with fairness doubts, both in the process and the results.

In order to solve the abovementioned problems, the courts need to improve the regulations on the enhancement of forest carbon sinks, determine the corresponding prerequisites and the order of application of the measures, and harmonize the judicial standards, so that the same types of cases can be dealt with to the same extent. Meanwhile, the courts may also consider improving the professional support role intervention system to promote

the use of professional support roles in the process of forest sink enhancement. The use of the supporting role system can fully consider the local ecosystem and possible future climate change scenarios in the selection of tree species, tree species matching, and stand structure design, thereby enhancing the professionalism of forest carbon sinks and comprehensively supporting the achievement of the SDGs. In addition, the court may also consider joint supervision with the administrative authorities, such as the forestry and grassland departments, to undertake the work of guiding the specific sink enhancement program, supervising the subscription of carbon sinks, and judging the results of sink enhancement, etc., while the judicial authorities are mainly responsible for procedural supervision, so as to ensure the procedural justice and efficiency of forest sink enhancement.

4.3. Relations Between Sink Gains from Forestry Sink Enhancement Measures and Forest Carbon Sink Losses

Although judicial innovations in forestry sink enhancement are in favor of the achievement of the SDGs objectively, the existing practice is faced with a lack of data on the loss of carbon sinks in forestry, the effect of sink enhancement, and the unclear relationship between sink enhancement and sink loss. The calculation of carbon sink loss is the basis for carbon sink subscription and reforestation. The actual increment of carbon sinks is also an important reference standard for the effect of forest carbon sinks on the achievement of the SDGs. The lack of these data affects the accurate monitoring of the effectiveness of forest carbon sinks in the implementation of judicial innovations. In addition, the assessment of the effect of SDG achievement is not perfect, whether it is afforestation, reforestation, subscribing to forest carbon credits, or carrying out forest management. In the majority of cases, there is no uniform conversion standard between the subscription amount of forest carbon sinks and the volume of damaged trees. The courts have not explicitly delineated the specific assessment process for forest carbon sink losses. They also have not clearly elaborated on the specific assessment process for determining the amount of forest carbon sinks that the responsible party should subscribe to. This leads to a lack of authoritative standards for both assessing forest carbon sink losses and calculating forest carbon sink increments. In addition, there is no unified regulation on whether the damaged forest resources and carbon sink losses should be restored with equivalent value or in a compensatory manner. Thus, in cases where forest carbon sinks suffer losses, the equivalence of subscription compensation raises certain doubts as to whether it constitutes an enhancement of carbon sinks.

In the future, the courts must clearly define and assess the specific circumstances of the loss of forest carbon sinks, and also ensure that the method of calculating carbon sink enhancement is scientific and reasonable, when promoting the innovation of forest sink enhancement. To achieve the above goals, it is particularly important to establish a set of objective and clear identification criteria. This set of criteria should cover everything from the methodology for assessing the loss of carbon sinks to the formula for calculating and evaluating the increase in carbon sinks, in order to ensure that there are clear guiding principles and operational procedures for each link and to provide a clear reference for relevant stakeholders, thereby promoting the healthy development of the forest carbon sink market.

4.4. The Interconnection Between Climate Actions and Other SDGs

It can be observed that the innovation of the Chinese judiciary to increase the amount of forest carbon sinks has mainly contributed to climate action (SDG 13). At the same time, other SDGs have been neglected to some extent. The current practice of judicial forest carbon sink enhancement is aimed at repairing damage to a particular forestland and forest resource, punishing offenders, and responding to carbon peaking and carbon neutrality goals. This leads to the practice being ineffectively utilized and exploited in realms such as

life on land (SDG 15), no poverty (SDG 1), reduced inequalities (SDG 10), decent work and economic growth (SDG 8), and partnerships for the goals (SDG 17). However, according to the 2023 Sustainable Development Report completed by the Sustainable Development Solutions Network (SDSN), from the analysis of the 17 sustainable development goals (SDGs), China has basically achieved the set goals in SDG 1 (no poverty) and SDG 4 (quality education), but there are still 12 SDGs whose progress is slow or stagnant, especially SDG 15 (life on land) which shows a trend of regression [94]. In addition, given that the SDGs cover the three major dimensions of economy, society, and environment, both synergistic effects of mutual enhancement and trade-offs of mutual constraint may arise within the three realms. Therefore, the interconnections among the SDGs present an inherent complexity, which poses a significant challenge to accelerating the achievement of the SDGs through ecological restoration in forestry [95]. While judicial innovations in forest sinks can be beneficial to addressing climate action (SDG 13), the form of subscription to forest carbon sinks used may place a financial burden on less wealthy parties, which may have a negative impact on reducing poverty (SDG 1) and inequality (SDG 10) and promoting decent work and economic growth (SDG 8).

Although climate action (SDG 13) has urgency in sustainable development, forestry ecological restoration and judicial innovations in forestry sink enhancement should be fully synergized with different sustainable development goals. In comparison, government-led forest restoration projects are better positioned to improve ecological functions [96], increase terrestrial biodiversity [97,98], and address employment and poverty goals [99,100]. Therefore, the courts' actions should be based on specific cases, resource conditions, development needs, and capacity for change in different regions, while collaborating with multiple entities, such as the government and the public, to enhance forest carbon sinks. The court should also make appropriate adjustments to the priority development goals of forestry ecological restoration, ensuring the consistency of local and overall goals, as well as the coordination and unity of short-term and long-term goals.

5. Conclusions

This paper provides insights into the practice of the Chinese courts in applying innovative approaches to enhancing forest carbon sinks and their contribution to the SDGs. With the support of laws and national policies, as well as the active practice and exploration of the courts at all levels, China has made remarkable achievements in the field of judicial innovation in forest carbon sink enhancement. Criminal and civil cases related to damage to forestry resources are the main scenarios in which the Chinese courts apply forestry sink enhancement measures. In specific cases, the Chinese courts have ordered and guided offenders to adopt methods such as afforestation and reforestation, subscription to forest carbon credits and participation in forest management, so as to enhance the capacity of forest carbon sinks. In addition, the Chinese courts have joined forces with other administrative organs and regions to pool restoration funds and establish forestry restoration centers. Innovations in forest carbon sink enhancement introduced by the Chinese courts also face certain challenges, particularly the fair application of forest carbon sink mechanisms, the comparability of ecosystem services between damaged forestry resources and compensatory measures, and the interconnections within the various sustainable development goals.

If the Chinese courts are to play a better role in enhancing forest carbon sinks in the future and to promote the achievement of the SDGs, the following efforts are needed: (1) the court must establish methodologies for assessing the loss of forest carbon sinks and calculating the incremental gains in carbon sequestration, promoting the positive role of professional auxiliary roles in the process. (2) The court should ensure the legality of the

procedure, the legitimacy of judicial acts, the openness and transparency of information, and the extensive participation of the public and adopt a joint judicial and administrative supervision model to ensure the actual effect of increasing forestry sinks. (3) The court should take full account of the synergies and trade-offs between different SDGs when taking measures. Meanwhile, they need to unite multiple stakeholders such as the government and the public to appropriately adjust the priority of forestry ecological restoration goals.

This study encourages us to observe the role played by courts other than the government and project developers on forest sink enhancement and the sustainable management of forests. However, this study also has several limitations. First, this study hopes to demonstrate the practice of forest sink enhancement in the Chinese courts by analyzing more cases, some of which are not publicly available for several reasons, and those that are publicly available do not cover all court cases in China, thus potentially affecting statistical significance. Second, observed judicial practice is inevitably embedded in China's evolving policies and actions on carbon peaking and carbon neutrality. Cross-jurisdictional applications should take into account differences in the regulatory priorities and environmental governance models of countries. This study provides a comprehensive analysis of judicial innovation in the context of forestry carbon sink enhancement. Future research should focus on investigating specific restoration methodologies, including carbon sink subscription and reforestation, with particular attention to their practical implementation within judicial frameworks. Furthermore, it is imperative to conduct an in-depth exploration of the interplay between judicial intervention, administrative measures, and market-based mechanisms in sustainable forest management. Such research should aim to establish optimal strategies for harmonizing and integrating diverse efforts in forest protection and restoration initiatives.

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Appendix A

Table A1. Index numbers of judicial cases covered by the study.

Types	Case Index Number
Criminal cases	(2024) Zhe 0822 Criminal No. 18; (2024) Yun 0821 Criminal No. 89; (2024) Min 0825 Criminal No. 8; (2024) Min 0825 Criminal No. 53; (2024) Min 0825 Criminal No. 46; (2024) Min 0703 Criminal No. 81; (2024) Min 0703CriminalNo. 136; (2024) Min 0521 Criminal No. 273; (2023) Yun 0828 Criminal No. 312; (2023) Yun 0824 Criminal No. 215; (2023) Yun 0824 Criminal No. 212; (2023)Yun 0802 Criminal No.290; (2023) Shan 7101 Criminal No. 2; (2023) Min 05 Criminal No. 660; (2023) Min 0421 Criminal No. 166; (2023) Chuan 1823 Criminal No. 12; (2022) Shan 7101 Criminal No. 4; (2022) Shan 7101 Criminal No. 3; (2022) Qian 2634 Criminal No. 148; (2021) Min 0981 Criminal No. 492; (2021) Min 0783 Criminal No. 193; (2021) Min 0723 Criminal No. 14; (2021) Min 0428 Criminal No. 88; (2021) Min 0428 Criminal No. 112; (2021) Min 0428 Criminal 106; (2020) Min 0721 Criminal No. 99; (2020) Min 0721 Criminal No. 225; (2020) Min 0721 Criminal No. 216; (2020) Min 0721 Criminal No. 207; (2020) Min 0721 Criminal No. 170; (2020) Min 0721 Criminal No. 123; (2020) Min 0721 Criminal No. 100; (2020) Gan 0803 Criminal No. 161; (2022) Chuan 7102 Criminal No. 20; (2022) Chuan 1827 Criminal No. 5; (2020) Gan 7506 Criminal No. 11
Civil cases	(2023) E 03 civil No. 56;

(Accessible at https://www.pkulaw.com, accessed on 29 November 2024).

Table A2. Index of typical cases covered by the study.

Names of Typical Cases	Sources of Typical Cases
Li Mougui and others abusively logging forests, Liang Moufu and others illegally transporting abusively logged forests; criminal incidental civil public interest litigation case	The Supreme People's Court issued a typical case of People's Court hearing cases of abusive logging in accordance with the law
The case of the application for enforcement of administrative penalties by the Beijing Miyun District Landscaping and Greening Bureau	The Supreme People's Court released typical cases of indiscriminate deforestation tried by People's Courts in accordance with the law
Jianhe County People's Procuratorate of Guizhou Province v. a water investment company in Qiandongnan Prefecture; illegal occupation of forest land civil public interest litigation case	The Supreme People's Procuratorate released 10 typical cases of procuratorial organs serving and guaranteeing carbon peak and carbon neutrality
The Case of Jiang Mouzi and Sheng Moubin's Indiscriminate Logging of Forest Trees in Suzhou City, Jiangsu Province; a criminal incidental civil public interest lawsuit	The Supreme People's procuratorate released 10 typical cases of procuratorial organs serving and guaranteeing carbon peak and carbon neutrality
Zunyi Municipal People's Procuratorate of Guizhou Province v. a company in Guizhou Province; civil public interest litigation for ecological damage	The Supreme People's Court and the Supreme People's Procuratorate jointly released 10 typical cases of procuratorial public interest litigation for ecological environmental protection
Lu Mouzhou and others endangering plants under state key protection	The Supreme People's Court released 6 typical cases of punishing crimes against forest resources according to the law
Qiu Moubiao's deforestation case	Fujian Higher People's Court released 5 typical cases of compensation for loss of forestry carbon sinks
Deng Mouchan's deforestation case	Fujian Higher People's Court released 5 typical cases of compensation for loss of forestry carbon sinks
Tang Moufu and Zeng Mourong's case of indiscriminate logging of forest trees	Fujian Higher People's Court released 5 typical cases of compensation for forestry carbon sink losses
Xu Moushou's illegal acquisition of indiscriminately deforested timber case	Fujian Higher People's Court released 5 typical cases of compensation for forestry carbon sink losses
Zhang Mouquan's case of indiscriminate logging of forest trees	Fujian Higher People's Court released 5 typical cases of compensation for loss of forest carbon credits
Guo Moyan's criminal collateral civil public interest litigation case of indiscriminate logging of forest trees	Fujian Higher People's Court released 9 typical cases of applying eco-technical investigation officers, No. 3
Defendant Yu Mouniang committed the crime of misfire	The Intermediate People's Court of Sanming City, Fujian Province, released 7 typical cases involving judicial protection of forest resources, No. 3
Chen Moumou and others' indiscriminate logging of forest trees criminal incidental civil public interest litigation case	Guangdong Provincial High People's Court released 6 typical cases of judicial guarantee for ecological environment restoration, No. 2
Chen Moumou's criminal collateral civil public interest litigation for illegal occupation of agricultural land	Guangdong Higher People's Court releases 10 typical cases of high-quality judicial services to guarantee ecological construction in Green Guangdong
Feng Moyun's case of indiscriminate logging of forest trees	Guangxi Zhuang Autonomous Region Higher People's Court, in 2023, released 5 typical cases of environmental resource trials, No. 2
Defendant Luo Mousong's case of indiscriminate logging of forest trees	Guizhou Higher People's Court released the 2nd of the top 10 typical cases of environmental resource trials in 2021–2022
Hainan Provincial People's Procuratorate Branch No. 1 v. Qionghai Certain Building Materials Co.; ecological destruction civil public interest litigation	Hainan Provincial Higher People's Court released the 7th of the top 10 typical cases in 2023
Wang Moumou's deforestation case	Jilin Higher People's Court released 11 typical cases on environmental resource trials, No. 2
Jiang Moumou and Sheng Moumou; indiscriminate logging of forest trees case	Jiangsu Suzhou Intermediate People's Court released examples of the top 10 typical cases of environmental resource trials in 2019–2024, No. 3
Jiangxi Province Pingxiang City People's Procuratorate v. an agricultural limited company; ecological destruction civil public interest litigation case	Jiangxi Provincial Higher People's Court, in 2023, issued 8 of the province's typical environmental resource protection cases
Ge Moumou; civil public interest litigation on ecological environmental protection	Inner Mongolia Autonomous Region Higher People's Court released 10 typical cases of environmental resource trials, No. 3
Wen Mou; first-class criminal collateral civil public interest litigation case of deforestation	Shanghai Railway Transportation Court released 9 typical cases of environmental resource trials, No. 4
Chun'an County People's Procuratorate v. Chen Mou et al.; illegal occupation of agricultural land criminal collateral civil public interest litigation case	Zhejiang Higher People's Court released 15 typical cases of environmental resource trials

Table A2. *Cont.*

Names of Typical Cases	Sources of Typical Cases
Chen Mou and others illegally occupying agricultural land; criminal incidental civil public interest litigation case	Hangzhou Intermediate People's Court of Zhejiang Province and Huangshan Intermediate People's Court of Anhui Province jointly released 8 typical cases of judicial protection of environmental resources in the Xin'anjiang River—Qiandao Lake Basin: I
Chongqing Municipal People's Procuratorate Branch No. 2 v. Zhang Mouping, Yang Mou, and Xie Mouping; civil public interest litigation for ecological damage	The Second Intermediate People's Court of Chongqing Municipality and the Intermediate People's Court of Dazhou City, Sichuan Province, jointly released 5 typical cases of environmental resource protection in northeast Chongqing and northeast Sichuan, No. 2
Chongqing Municipal People's Procuratorate Branch No. 5 v. Yuan Mou, Long Moukui; eco-destruction civil public interest litigation case	Chongqing Higher People's Court released 2022's top 10 typical cases of environmental resource trials, No. 2

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