

# *Research on the Development Strategies of Forestry Carbon Sink Economy in Ganzi Prefecture, Sichuan Province, China: Taking Daofu County as an Example*

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**Abstract:** This study uses Daofu County as a case to conduct an in-depth discussion on the development status and strategies of the forestry carbon sink economy in Ganzi Prefecture. Through detailed analysis of Ganzi Prefecture's geography, climate characteristics, and existing forest resources, this study enhances the understanding of the progress in forest resources and the forestry industry in the region. It further clarifies the importance and significance of promoting the forestry carbon sink economy. The results indicate that Ganzi Prefecture has rich forest resources and has made significant progress in the forestry industry, providing a solid foundation for deepening the development of the forestry carbon sink economy. However, challenges such as artificial forest construction, lack of forestry carbon sink economy, and shortage of talents in related fields persist. To ensure the healthy and sustainable development of the forestry carbon sink economy in Ganzi Prefecture, and better support the goals of sustainable growth, ecological protection, and rural revitalization, this study proposes a series of strategic suggestions. These include building and strengthening the forestry carbon sink economy and actively cultivating professional talents in related fields. Furthermore, considering the anticipated increase in China's carbon trading market price, the value of forestry carbon sink is expected to further rise, providing strong support for the sustainable development of the regional economy. The conclusions and strategies of this study offer valuable references and insights for the policy formulation and practice of forestry carbon sink economy in other regions.

## 1. Introduction

As a key participant in global climate change mitigation, China has clearly proposed the strategic goals of "carbon peak" and "carbon neutrality" to actively respond to the challenges posed by climate change [1,2,3]. In this context, Ganzi Prefecture, with its rich forest resources in southwestern China, plays a crucial role in the development of the forestry carbon sink economy. Facing multiple tasks of forest resource protection, carbon storage development, and carbon sink economy growth, it is essential to formulate and implement targeted strategies for promoting sustainable development in Ganzi Prefecture. This contributes to national carbon emission reduction goals, facilitates the smooth

implementation of “carbon peak” and “carbon neutrality” strategies, and drives sustainable development and rural revitalization. Effective management and utilization of Ganzi Prefecture's rich forest resources can improve the economic value of forest resources, promote the development of related industrial chains, provide more employment opportunities, and enhance local economic sustainability [4,5]. Therefore, in-depth research on the development trends and strategies of the forestry carbon sink economy in Ganzi Prefecture holds significant theoretical and practical importance for regional development.

## 2. The current situation and outlook of forestry resources in Ganzi Prefecture

### 2.1 Ganzi's geographical location and climate characteristics

Ganzi Prefecture is located in the southwestern plateau region of China, characterized by rich and diverse geological structures and complex terrain, forming distinct stepped topographical features. The region has an average elevation of 3,000 meters, providing high-quality soil and water conditions for forest growth [6]. The climate is mainly a combination of alpine monsoon and subalpine climates, exhibiting distinct vertical climatic differences. High-altitude areas have lower temperatures and higher precipitation, with mild summers and colder, drier winters, as shown in Table 1. These climatic conditions are favorable for vegetation growth and the accumulation of forest resources in the region.

Table 1: Ganzi Prefecture's climate

Season	Average temperature (°C)	Precipitation (MM)
Spring	5-15	100-200
Summer	15-25	300-500
Autumn	5-15	100-200
Winter	-10-0	50-100

### 2.2 Overview of forest resources in Ganzi Prefecture

Ganzi Prefecture is a major forest area in western China, covering 5.3765 million hectares, accounting for 31.02% of Sichuan Province's total forest area. It holds an important position in the southwest forest area [7]. The diverse vegetation includes coniferous forests, broad-leaved forests, and subalpine meadows. Coniferous forests constitute 70% of the forest area, while broad-leaved forests and subalpine meadows account for 25% and 5%, respectively, as shown in Figure 1. These ecosystems, distributed at different altitudes, create a stable ecological balance. Natural forests are mainly in high-altitude areas, with common species such as spruce, masson pine, and green hills. Artificial forests, found in low-altitude areas, include economically valuable species like Chinese fir and spruce.

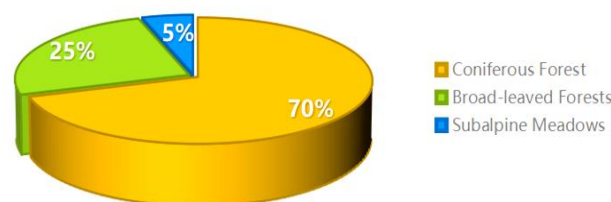


Figure 1: Forest Resources in Ganzi Prefecture

## 2.3 Development trends of forestry industry

In recent years, Ganzi Prefecture has consistently adhered to the development policy of “ecological priority and green development”, focusing on the three core themes of “base construction, brand leadership, and scientific and technological support”. The aim is to promote the forestry industry towards a new stage of high-quality development. In accordance with the principles of large-scale, well-breeding, and standardization, Ganzi Prefecture continues to promote the reconstruction of inefficient forests and the creation of modern forestry parks. As of 2022, the prefecture has successfully established a characteristic forestry industrial base covering a total area of 1.0326 million mu, including 549,000 mu of walnut base, 292,500 mu of peppercorns, 167,000 mu of Ese tea base, and 24,100 mu of other characteristic forest fruit bases. In particular, the Ese tea in Luhuo County, the plateau seedlings and medicinal materials in Baiyu County, the ecological tourism in Daofu County, and the walnuts in Luding County have led to the creation of several modern forestry parks. Through the implementation of diversified development strategies such as "forest medicine, forest mushroom, forest poultry, and forest animal husbandry," the forestry economy has continued to grow [8]. According to the 2022 national economic and social development statistics of Ganzi Prefecture, the forestry output value reached 298 million yuan in 2022, marking an increase of 28.3% compared to the previous year, fully reflecting the strong growth momentum of the forestry industry [9].

In Ganzi Prefecture, efforts are focused not only on traditional forestry industries but also on actively leveraging unique natural and ethnic cultural resources to develop forest tourism. Destinations such as Daocheng Yading, Kangding’s Love Song Resort, Xinduqiao Town, and Moshi Park Scenic Area have attracted numerous domestic and international tourists. These landscapes serve not only to showcase the natural beauty and rich culture of Ganzi Prefecture but also provide a platform for visitors to engage with nature and culture. Additionally, various tourist activities, including hiking, camping, bird watching, and photography, enable a deeper experiential appreciation of the natural scenery and cultural heritage of Ganzi Prefecture. This emerging industry contributes additional economic benefits to the region and fosters cultural exchange and heightened awareness of ecological conservation.

To ensure the long-term sustainable development of forestry resources, the Forestry and Grassland Bureau of Ganzi Prefecture enhanced the selection and management systems for ecological forest and grassland rangers in 2023. This enhancement aimed at effective protection and management of forestry and grassland resources. In the same year, the prefecture initiated a comprehensive survey and monitoring of forests, grasslands, and wetlands, highlighting the importance of real-time monitoring and management of these resources. These efforts reflect long-term planning for the protection and utilization of future forestry resources. By implementing these measures, Ganzi Prefecture has injected new vitality into local economic development and laid a solid foundation for achieving sustainable regional ecological development.

## 3. The importance and necessity of forestry carbon sink economy in Ganzi Prefecture

### 3.1 Challenge to climate change

Ganzi Prefecture is currently facing increasingly severe challenges due to climate change. As global warming intensifies, the region is experiencing an increase in natural disasters, such as rapid glacier melting, frequent earthquakes, and drought. These changes have profoundly impacted the ecological environment and agricultural production of Ganzi Prefecture.

To cope with these challenges, Ganzi Prefecture has formulated a variety of carbon neutrality and carbon reduction emission strategies, including increasing forest protection, leveraging technology for low-carbon applications, and exploring the development of a carbon sink economy. On 2<sup>nd</sup>

November 2023, the Ganzi Prefecture Development and Reform Commission announced that it has successfully promoted Kangding City and Seda Prefecture as pilot areas for grassland carbon sinks, which has facilitated the effective transformation of ecological products. Additionally, the “Implementation Plan for the Development of the Seda County Forest Carbon Sink Project (2022-2025)” and the “Implementation Plan for the Development of Kangding City Forestry Carbon Sink Projects (2022-2025)” were formulated. These two schemes invested a total of 1.2 million yuan in special pilot funds. According to statistics, the pilot project can carry out 3.651 million mu of afforestation carbon sink, 24.417 million mu of operating forest carbon sink, and 100 acres of afforestation. Furthermore, the “ShunFeng Carbon Neutrality Forest Project” was successfully introduced with a total investment of 20 million yuan. The project plans to implement 4,500 mu of carbon neutrality forest with a survival rate of 90% [10].

The advancement of the forestry carbon sink economy aims to combine the management of forest resources with carbon transactions. This not only brings sustainable development momentum to Ganzi Prefecture but also helps achieve its target of carbon neutrality.

### **3.2 The integration of forestry carbon sink economy and regional economy**

According to the National Carbon Emission Quota (CEA) Price Index published by the Center for Sustainable Development Research of Fudan University, the expected purchase price for the National Carbon Emission Allowance (CEA) in June 2024 is 94.71 yuan/ton, and the expected selling price is 100.12 yuan/ton, with a midpoint price of 97.41 yuan/ton. By 2025, the price is anticipated to rise to 139 yuan/ton. This data indicates that with the development of the forestry carbon sink economy, the value of forest resources will be significantly enhanced, thereby contributing to the economic advancement of Ganzi Prefecture and promoting the comprehensive revitalization of rural areas [11].

### **3.3 Forestry carbon sink economy promotes sustainable development**

Through the rational management and utilization of forest resources, Ganzi Prefecture has the potential to achieve coordinated development among economic, ecological, and social aspects [12].

From an economic perspective, the advancement of the forestry carbon sink economy can optimize the use of forest resources and aid in the transformation to a green economy.

In the ecological dimension, the forestry carbon sink economy holds significant importance for environmental protection and ecological recovery [13, 14]. As a core component of the ecosystem, the health and stability of forests play a critical role in preventing soil erosion, maintaining ecological balance, and protecting biodiversity. The development of the forestry carbon sink economy can enhance the protection of forests, thereby curbing forest degradation caused by illegal logging and other improper activities.

At the social level, the forestry carbon sink economy brings new economic growth points to rural communities, especially agriculture-based regions such as Ganzi Prefecture. It not only provides farmers with more income opportunities but also helps reduce their excessive dependence on traditional agriculture, offering them more stable and sustainable ways of living.

## **4. Problems in forestry carbon sink economic development in Ganze Prefecture -- taking Daofu County as an example**

### **4.1 The development barrier of artificial planting forests**

Due to specific geographical conditions and a severe climate environment, the development of artificial planting forests in Daofu County has been significantly restricted. This is specifically

manifested as an extended growth cycle and low survival rate, as described in detail in Table 2. In the context of carbon sink trading, this slow growth mode may lead to an insufficient carbon absorption rate, thereby weakening its carbon sink capacity and further affecting transaction benefits. Additionally, the issue of land sandification facing Daofu County has imposed further restrictions on the healthy growth of artificially planted forests. The quality degradation and sandification of the soil create adverse conditions for the growth of plants and the development of their root systems, which undoubtedly have a negative impact on the overall quality and growth of artificially planted forests.

Table 2: Daofu County's difficulty in planting forest development

Problem	Indicators
The long -term growth cycle of artificial forest	The average growth cycle is more than 20 years
Low artificial forest survival rate	The survival rate in the first 3 years of new planting is low
Low artificial forest carbon absorption	The carbon absorption of the unit area is about 2-3 tons/hectares
Limitation of artificial forest carbon exchange capacity	The carbon reserves of the unit area are about 10-15 tons/hectares

#### 4.2 The lack of understanding of forestry carbon sink economy

In Daofu County, the forestry carbon sink economy is not well understood, particularly among local residents. This lack of awareness presents significant challenges to the promotion and implementation of forestry carbon sink projects. The deficiency in understanding manifests in several key areas:

(1) Insufficient conceptual grasp: Most residents lack a basic understanding of the term "forestry carbon sink economy." While this concept has garnered global attention, local residents remain unclear about specific terms such as carbon sink exchange and emission reduction. This hampers their full understanding of the importance of climate and economy integration.

(2) Limited appreciation of its benefits: Alongside their unfamiliarity with basic concepts, local residents do not grasp the potential benefits such as addressing climate change, protecting ecology, and fostering economic growth through the forestry carbon sink economy.

(3) Inadequate knowledge of practical operations: Even residents willing to participate may encounter challenges due to limited understanding of carbon sink application, evaluation, monitoring methods, processes, and mechanisms. This results in decreased enthusiasm and benefits from participation.

To enhance the promotion of the forestry carbon sink economy in Daofu County, it is essential to increase public awareness and participation.

#### 4.3 The shortage of forestry carbon sink economic talents

With the increasing global attention to climate change, the forestry carbon sink economy has emerged as a key strategy to address this issue. This economic model integrates traditional forestry's theoretical foundation and contemporary carbon exchange technology, aiming to absorb carbon dioxide from the atmosphere through effective forest management and utilization strategies to slow down global temperature rise. Despite the growing importance of this strategy, Daofu County faces a shortage of professional talents needed to implement this model.

Firstly, Daofu County lacks forestry higher education institutions, forcing the county to rely on external resources for training and education related to forestry and carbon sink. While higher

education institutions in other regions offer professional training in this field, the remote geographical location of Daofu County presents challenges in attracting professional talents. Additionally, the county lacks training institutions specifically focusing on carbon sink, further complicating local residents' access to systematic professional training.

Moreover, the interdisciplinary nature and technical complexity of the forestry carbon sink economy require individuals in this field to possess extensive knowledge and skills. However, due to the lack of professional training and related experience among Daofu County residents, they may struggle with understanding related technologies and policies, as well as encountering various challenges in practical operations.

## 5. Forestry carbon sink economic development strategy -- a case study of Daofu County

### 5.1 Development strategy for artificial forests

The development of artificial forests in Daofu County currently faces challenges such as long growth cycles, slow growth rates, and land sandization. To effectively address these issues, the following strategies warrant attention and implementation:

#### (1) Introduction and Application of Innovative Technology

Daofu County should consider introducing advanced technical means, such as genetic improvement, advanced seedling breeding technology, and remote growth monitoring, to accelerate tree growth and optimize quality. Genetic improvement of specific tree species can cultivate varieties that adapt to high altitudes and harsh climates, thereby enhancing resistance and accelerating growth [15]. Optimized seedling technology can significantly improve the survival rate and growth of young trees, supporting the healthy growth of artificial forests. Remote monitoring can not only observe tree growth in real time but also respond to environmental changes in a targeted manner, implementing timely management and intervention.

#### (2) Comprehensive Governance of Land Sandization

Faced with land desertification, Daofu County needs to formulate a comprehensive governance plan to improve the land environment affected by sand through a series of measures. These measures include, but are not limited to, the reasonable use of windproof sand, soil and water conservation, and land management. Figure 2 shows the governance effect of Ruoergai County, Aba Prefecture, Sichuan Province. By strengthening ecological protection and land fixation in sandy regions, it further protects and improves soil quality, creating a favorable land environment for the healthy development of artificial forests [16].



Figure 2: Governance of land sandization

### 5.2 Enhancing public awareness of forestry carbon sink economy in Daofu County

Currently, public understanding of the forestry carbon sink economy in Daofu County is inadequate, and this lack of awareness is a significant barrier to further progress in this sector. To effectively raise public consciousness regarding the forestry carbon sink economy, Daofu County

must proactively engage in outreach and educational initiatives through diverse channels and formats. This should encompass organizing informational lectures, training workshops, and exhibitions that elucidate the fundamental concepts, operational mechanisms, and intrinsic benefits of the forestry carbon sink economy to the populace. Employing visual aids such as diagrams, photographs, and multimedia presentations can make the significance and function of the forestry carbon sink economy more immediately apparent and engaging.

Moreover, to ensure that the message reaches a wider audience and garners public interest, Daofu County should amplify its promotional activities on digital and social media platforms, thereby broadening the scope of information dissemination.

### **5.3 Strengthening Talent Development Strategies for the Forestry Carbon Sink Economy in Daofu County**

The healthy development of the forestry carbon sink economy in Daofu County is significantly dependent on the cultivation of talent. To ensure an adequate supply of professionals with the requisite quality, Daofu County must implement proactive and strategic measures. The following outlines several targeted talent development strategies:

#### **(1) Establishing Specialized Training Programs**

To address the unique requirements of the forestry carbon sink economy, Daofu County should establish cooperative relationships with prestigious higher education institutions and research organizations to collaboratively design and implement specialized training programs. These courses and seminars are intended to furnish participants with comprehensive technical and managerial expertise.

#### **(2) Providing Practical Opportunities for Talents**

As practice is often considered the most effective form of learning, Daofu County ought to offer its professionals a plethora of hands-on opportunities. This could involve engagement in live forestry carbon sink economy projects for direct research and operational experience. Such partnerships with actual projects can refine the practical skills of the professionals and also nurture their capacity to address specific challenges.

#### **(3) Attracting Industry Experts**

Luring industry experts with extensive professional knowledge and practical experience is vital for accelerating the growth of the forestry carbon sink economy in Daofu County. By offering enticing recruitment packages and incentive schemes, Daofu County can draw in these valuable resources to provide essential technical and strategic direction for local projects. This initiative is expected to foster more robust development of the forestry carbon sink economy.

## **6. Conclusion**

An in-depth analysis of the development of forestry carbon sinks in Daofu County serves as a reflective mirror, showcasing the immense potential of the Ganzi Prefecture within the realm of the forestry carbon sink economy. Blessed with abundant forest resources and a unique set of geographical and climatic conditions, the Ganzi Prefecture has cultivated a conducive environment for the growth of the forestry carbon sink economy. The advancements in timber processing, trade, and forest tourism substantiate this potential, establishing a robust foundation for the sector.

To bolster the continued development of the Ganzi Prefecture's forestry carbon sink economy, several pivotal measures are essential. Firstly, it is crucial to adopt and propagate sophisticated technologies, including genetic enhancement and seedling cultivation methods, to foster the swift and healthy development of plantation forests. Secondly, elevating public awareness and understanding of the forestry carbon sink economy is vital, achievable through targeted publicity and educational

initiatives. Thirdly, reinforcing the professional training and practical experience of talent is imperative to ensure ongoing advancements in both technological and managerial aspects of the forestry carbon sink economy.

In conclusion, the future of the forestry carbon sink economy in the Ganzi Prefecture appears promising. By harnessing resources, technology, and skilled personnel, and by drawing on the experiences of Daofu County, it is anticipated that the Ganzi Prefecture will emerge as a frontrunner in this domain.

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