

Research on the Synergistic Governance Mechanism and Path of Ecological Economy in Northwest Sichuan from the Perspective of the "Four-in-One" Framework

Xiaowen Zhang

School of Economics and Management, Sichuan Minzu College, Ganzi, Sichuan, China

Abstract: The synergistic governance of the ecological economy in Northwest Sichuan is crucial for implementing the concept of green and sustainable development. It is a significant measure for promoting this synergistic governance to enhance sustainable development in the region. The "Four-in-One" mechanism, centered on "carbon reduction, pollution reduction, green expansion, and growth," serves as a key tool for advancing the synergistic governance of the economy and ecology in Northwest Sichuan. Currently, the synergistic governance in the region still faces challenges. This paper analyzes the current status of the synergistic governance of ecology and the economy in Northwest Sichuan from the perspective of the "Four-in-One" framework. It finds that the region still faces problems such as insufficient financial and technological support, high costs and slow results of pollution reduction which are difficult to sustain, slow progress in ecological restoration, and inadequate scientific assessment. Based on these findings, this paper proposes measures such as strengthening top-level design and improving institutional guarantees, raising funds through multiple channels and utilizing them rationally, promoting technological innovation and the transformation of scientific research achievements, and cultivating and attracting talent to lay the foundation for synergistic governance. These efforts aim to build an "Ecology Plus" brand for regional high-quality development and form a green, sustainable development model.

Keywords: "Four-in-One"; Northwest Sichuan; Synergistic Governance of Ecological Economy; Synergistic Governance

1. Introduction

Against the backdrop of intensifying global climate change and ecological crises, "carbon

reduction, pollution reduction, green expansion, and growth" have become core issues for achieving sustainable development worldwide. China is actively advancing its "dual carbon" goals and ecological civilization construction, emphasizing the synergistic advancement of ecological protection and economic development. With its unique geographical environment, ethnic culture, and industrial foundation, the ethnic minority area in northwest Sichuan become a typical sample for studying multi-objective synergistic governance [1]. In this context, conducting research on the synergistic governance mechanism of the "Four-in-One" framework—carbon reduction, pollution reduction, green expansion, and growth—is not only a practical necessity for resolving the region's development dilemmas and achieving a green transition. Furthermore, it serves as an important exploration to provide replicable experiences for the construction of the Northwest Sichuan Ecological Demonstration Zone and similar regions across the country, holding significant theoretical value and practical significance for improving the theory of ecological-economic synergistic governance and promoting high-quality development in ethnic regions.

2. Internal Logic of Synergistic Governance of Ecological Economy in Northwest Sichuan from The Perspective of the "Four-in-One" Framework

2.1 Policy Logic

The 15th Five-Year Plan establishes accelerating the comprehensive transformation of socio-economic development and building a Beautiful China as its core strategic tasks. This plan points out the direction for the future development of Northwest Sichuan. Only by actively promoting the transformation and upgrading of industrial structures, reforming the energy system, and leveraging the dual-wheel drive of scientific and

technological innovation alongside institutional innovation can the region provide inexorable impetus for building a green and sustainable development model. As Northwest Sichuan has been designated as a National Ecological Civilization Construction Demonstration Zone and a key national clean energy base, higher requirements have been placed on regional ecological environmental protection and construction. Therefore, only by strengthening energy conservation and consumption reduction, and practicing a path of synergistic development between the economy and the environment, can the region enhance the demonstration effect of its ecological civilization construction, thereby transforming regional ecological resources into industrial resources. Furthermore, the Rural Revitalization Strategy is a policy aimed at narrowing the urban-rural gap and promoting balanced regional development. It requires the revitalization of industries, ecology, talent, culture, and organizations. Only by promoting the synergistic development of the ecological economy can the modernization level of agriculture and rural areas be truly improved, allowing rural revitalization to play a significant role in economic and social development.

2.2 Practical Logic

The ethnic minority area, located in the northwest of Sichuan Province, is the core area of distinctive ethnic minority culture. The region features complex terrain dominated by mountains and a generally high altitude, serving as a transition zone from the Yunnan-Guizhou Plateau to the Sichuan Basin. Blessed with abundant water resources, it is hailed as the "Water Tower of China." This ethnic minority area is also a global natural gene pool for species, harboring national first-class protected animals such as the black-necked crane and the snow leopard, as well as protected plants like the Chinese yew, dawn redwood, and cycads. Home to 41 ethnic groups including the prefecture has formed a unique regional culture. Due to its relatively remote geographical location and high altitude, economic development in has been relatively slow. In recent years, with the rise of online media, this area has gradually become familiar to the public, leading to closer ties with the outside world. This has promoted the development of its tourism, culture, and agriculture industries, but has also exerted certain impacts on the local ecological environment. Therefore, only by

constructing a synergistic governance mechanism for the ecological economy can the sustainable development of this area be promoted.

2.3 Theoretical Logic

Hermann Haken first proposed the concept of "synergy" in the 1970s, advocating for the realization of a "1+1>2" effect through internal collaboration. This concept has since been gradually applied to various fields, including public management and education. American scholars Chris Ansell and Alison Gash constructed an integrated model of collaborative governance. Their framework relies on the solid support of leadership and institutions to ensure the smooth implementation of policies, with core concepts centering on multi-subject cooperation, subsystem synergy, inter-organizational competition and cooperation, and the formulation of common rules. The mechanisms of synergistic governance include dialogue, competition, cooperation, and compromise, ensuring the decision-making power of each participating subject. With the aim of maximizing public interest, it forms a governance structure characterized by shared responsibility, shared resources, and shared benefits. China began research on synergistic governance in the late 20th century, with studies mainly focusing on subject relationships, mechanism construction, and technological support. Research achievements on synergistic governance, both domestic and international, provide theoretical support for the study of synergistic governance of the ecological economy in Northwest Sichuan from the perspective of the "Four-in-One" framework.

3. Analysis of the Current Status of Synergistic Governance of Ecological Economy in Northwest Sichuan from the Perspective of the "Four-In-One" Framework

3.1 Carbon Reduction

To implement the national and Sichuan Provincial "dual carbon" strategic deployments, the Bureau of Statistics for the ethnic minority area has innovated carbon emission statistical methods around the goal of building a National Ecological Civilization Construction Demonstration Zone. It has constructed a full-chain carbon emission data monitoring system, focusing on strengthening monitoring of industrial enterprises and energy-consuming

units, providing timely warnings, and enhancing collaboration with environmental protection departments to reduce carbon emissions. The region is actively promoting the popularization of clean energy equipment such as hydropower, solar energy, and wind energy, planning and constructing five major clean energy bases to drive the development and utilization of clean energy. Efforts are being made to upgrade traditional industries, promote equipment renewal, and popularize green energy-saving equipment, while increasing financial subsidies and tax reductions for clean energy and green-certified enterprises. Low-carbon and energy-saving publicity campaigns are being carried out across society. During the 14th Five-Year Plan period, the energy consumption per unit of added value of industrial enterprises above designated size cumulatively decreased by 56.8%. Clean energy installed capacity exceeded 20 million kilowatts, with the scale under construction surpassing 25 million kilowatts. The prefecture's power generation increased from 50.395 billion kWh in 2020 to 70.835 billion kWh in 2025, with hydropower and photovoltaic power accounting for 99.96% of the total. This has replaced approximately 650 million tons of coal energy and reduced carbon dioxide emissions by about 1.6 billion tons. Energy conservation training was conducted for over 110 person-times.

Table 1. Growth of Power Generation in the Ethnic Minority Area in Northwest Sichuan (2020-2025)

Year	Annual Growth	Average Annual Growth
2020-2021	6.1%	
2021-2022	6.1%	
2022-2023	6.1%	7%
2023-2024	8.4%	
2024-2025	8.4%	

Although the installed capacity of clean energy has exceeded 20 million kilowatts, with the annual growth rates for the past five years shown in Table 1, the local energy consumption in the ethnic minority area is limited. A significant portion of the energy needs to be transmitted outward, which affects the region's deep decarbonization. The upgrading of traditional industries still faces constraints in funding and technology, affecting the enthusiasm for industrial upgrading. Although the statistical department has constructed a full-chain carbon emission statistical system, the wide variety of industrial types and the vast geographical areas

involved make it susceptible to differences in statistical methods, thereby affecting the accuracy of statistical results.

3.2 Pollution Reduction

Monitoring platforms for dust (and noise) at construction sites have been established, and the "six 100%" dust suppression measures have been implemented. Remote sensing technology has been used to monitor vehicle exhaust for over 22,000 vehicle-times. The "Thousand Village Demonstration Project" for rural sewage treatment has covered 369 administrative villages, raising the sewage treatment rate to 35%. The daily urban sewage treatment volume reaches 75,000 cubic meters. Sewage treatment pipelines have been laid, and sewage treatment plants have been built, bringing the daily sewage treatment capacity at the grassroots level to 49,800 cubic meters. The air quality excellence rate, surface water quality excellence rate, and drinking water source quality compliance rate have remained at 100% for seven consecutive years. Sixty-two urban garbage treatment facilities have been built, with a daily treatment scale of 641.4 tons/day and a harmless treatment rate of 96.79%, achieving 100% coverage of 2,181 administrative villages. A garbage treatment payment mechanism has been promoted in rural areas, with a coverage rate of 75.56%, strengthening domestic waste management at the source. To further consolidate the effectiveness of pollution control, a responsibility mechanism involving governments at all levels—covering counties and townships—has been constructed, adopting a method of "online video scheduling + offline unannounced inspections." A special reward fund of 4.5 million yuan for sewage treatment has been established to reward the first, second, and third-place municipal or county governments in assessments. As shown in Table 2, although the ethnic minority area in Northwest Sichuan pollution reduction capabilities are constantly improving, it still faces challenges. First, despite large investments in pollution reduction funds, some projects are difficult to sustain. Second, the capacity for harmless disposal of garbage is insufficient. Third, environmental supervision and law enforcement capabilities are inadequate; the monitoring network is incomplete, and the law enforcement team suffers from a shortage of personnel, uneven quality, and outdated equipment. Finally, the regional joint prevention and control mechanism is unsound, cooperation

with surrounding areas is not tight, and information sharing and collaborative work mechanisms are imperfect.

Table 2. Table of Pollution Reduction Achievements in the Ethnic Minority Area in Northwest Sichuan

Project	Measures
Dust (Noise)	Established monitoring platforms for dust (noise) at construction sites, etc.
Air Pollution	Monitored vehicle exhaust for over 22,000 vehicle-times.
Water Pollution	Laid sewage pipelines and built sewage treatment plants. Grassroots daily sewage treatment capacity reached 49,800 cubic meters. Urban daily sewage treatment reached 75,000 cubic meters.
Domestic Waste	Built 62 urban garbage treatment facilities with a daily treatment scale of 641.4 tons/day and a harmless treatment rate of 96.79%. Promoted the garbage treatment payment mechanism.

3.3 Green Expansion

In 2025, 60 types of land greening projects were implemented, completing 34,500 mu of artificial afforestation, 115,800 mu of degraded forest restoration, 55,900 mu of mountain closure for afforestation, 80,000 mu of sand prevention and control, 51,500 mu of degraded grassland governance, and 2.7 million mu of rodent pest control. As shown in Table 3, since the "14th Five-Year Plan," 1.69 million mu of afforestation, 649,500 mu of sand prevention and control, and 6.3563 million mu of degraded grassland governance have been completed, achieving "ten consecutive increases" in forest area, stock volume, and coverage rate, with the comprehensive grassland vegetation coverage stably maintained at over 85%.

Adhering to comprehensive, systematic, and source governance, the region continues to promote major projects for ecological protection and restoration in key areas. Through artificial afforestation, mountain closure for afforestation, degraded forest restoration, degraded grassland restoration and governance, and engineering sand fixation, the region continuously enhances the water conservation and soil retention capabilities of the ecosystem, improving ecosystem quality. Ecological restoration faces difficulties and funding shortages. In some areas with harsh natural conditions, restoration projects have long cycles and high investments, with a single source

of funding. The development level of the forestry and grass industry is low, dominated by primary products with short industrial chains and a lack of leading enterprises to drive growth. There are contradictions between ecological protection and the production and livelihood of farmers and herdsmen; measures such as grazing bans and mountain closures for afforestation affect the income of some farmers and herdsmen, leading to low cooperation.

Table 3. Achievements of Green Expansion in the Ethnic Minority Area in Northwest Sichuan

Project	Quantity
Afforestation	1.69 million mu
Sand Prevention and Control	649,500 mu
Degraded Grassland Governance	6.35639 million mu

3.4 Growth

The ethnic minority area in Northwest Sichuan is vigorously developing advantageous and characteristic industries such as walnuts, E-sea buckthorn tea, and traditional Chinese medicinal herbs. It has cumulatively established 728,100 mu of characteristic industry bases and 2.4 million mu of standardized collection bases for forest mushrooms, and built 8 modern forestry industrial parks. In 2024, the output of "forest grain" exceeded 20,000 tons, with an output value of 1 billion yuan. The prefecture has cumulatively introduced 33 million yuan in social donation funds, created 7,580 mu of carbon neutrality forests, and planted 1.0096 million spruce trees, sequestering nearly 3,000 tons of carbon annually. The "high appearance" of the ecology is accelerating its transformation into "new value" for the economy. Led by the regional brand "Holy Ethnic Minority Area" and relying on forestry enterprises and forestry industry groups, the region is cultivating characteristic forestry brands, obtaining 8 geographical indication protected products, 13 organic foods, 4 green foods, and 59 forest wellness brands. To promote the development of the regional tourism industry, a one-time subsidy of 30 yuan per person is provided by the prefecture-level finance to travel agencies registered in the prefecture that organize inbound tour groups with a cumulative total of over 500 person-times and overnight stays of more than 2 nights between October 1, 2024, and March 31, 2025. The region has launched the "Top 10 Actions to Pamper Tourists" and improved infrastructure such as transportation

and medical services to meet tourist needs. The region is orderly developing two pillar industries—clean energy and green minerals—accelerating the development of three characteristic industries—food and beverage, traditional ethnic medicine, and ethnic handicrafts—and vigorously developing emerging industries and the digital economy to build a green modern industrial system with manufacturing as the core and the digital economy as the driver.

The industrial structure is mono-structural, with the economy mainly relying on a few industries, resulting in weak risk resistance. Bottlenecks in infrastructure such as transportation are obvious; low highway grades and slow development of railways and aviation increase logistics costs and restrict industrial and tourism development. There is a shortage of talent and technology; the remote geographical location and backward economic development level lead to insufficient talent attraction and serious brain drain. Enterprises have weak technological innovation capabilities and lack cooperation with universities and research institutions.

4. Paths for Synergistic Governance of Ecological Economy in Northwest Sichuan from the Perspective of the "Four-in-One" Framework

4.1 Improving Top-Level Design and Strengthening Institutional Guarantees

To achieve the synergistic development of the ecological economy in the ethnic minority area in Northwest Sichuan, it is essential to first strengthen institutional guarantees. Guided by the concepts of green economy, sustainable development, and the "Two Mountains" theory in the new era, specific systems and laws should be formulated around the four dimensions of "carbon reduction, pollution reduction, green expansion, and growth." Existing regulations should be refined, and targeted systems should be developed for key areas such as clean energy, industry, and agriculture to ensure the effective implementation of policies and institutions [2]. Government departments should be urged to implement various policies, with detailed departmental responsibilities and obligations defined to construct a grid-based functional system. Social sectors should be encouraged to supervise government work and industrial activities, participating in governance

assessments related to carbon reduction, pollution prevention, green expansion, and growth. Assessment results should be linked to government performance and corporate social responsibility. The roles of government fiscal budgets, corporate fiscal policies, tax policies, and financial policies in assessment incentives should be enhanced to strengthen the administrative capacity of the prefecture government and promote enterprise transformation and upgrading. Collaboration between government departments, social third-party institutions, financial institutions, and the public should be strengthened to promote synergy among subjects [3]. When formulating policies and systems, the government should solicit suggestions from industries and social experts through argumentation meetings to optimize detailed rules for carbon reduction, pollution reduction, green expansion, and growth, ensuring the unity of ecological protection and regional economic development. Administrative boundaries should be broken to carry out cross-regional, cross-county, and cross-provincial cooperation. Discussions should be held on key ecological and economic issues affecting common interests to reach consensus. Responsibilities should be detailed to promote the sharing of advantageous resources and continuously consolidate the results of synergistic governance. The role of regional cultural systems, religious customs, and village conventions in constraining local residents' behavior should be deeply explored to enhance people's identification with green and sustainable development [3]. The concept of green and sustainable development should be integrated into educational curricula to enhance the environmental awareness of the grassroots population, solidify the grassroots foundation, continuously implement the "Four-in-One" concept, and promote high-quality development in the ethnic minority area in and whole Northwest Sichuan.

4.2 Raising Funds through Multiple Channels and Promoting Rational Fund Utilization

Funding has become a key factor affecting industrial transformation and upgrading, as well as the sustainable development of pollution control [4]. Fiscal funds play an important role in promoting the synergistic governance of the economy and ecology. The government should improve the quality of fiscal fund utilization,

increase support for clean energy, green industries, and ecological agriculture, and provide financial backing for these sectors. The regulatory role of taxation and fiscal subsidies should be utilized effectively. Fiscal subsidies for clean energy, digital industries, ecological agriculture, and cultural tourism should be increased to promote the growth and strengthening of these industries. Preferential tax policies for traditional high-pollution and high-energy-consuming industries should be reduced, while preferential tax policies for low-energy-consuming and low-pollution industries should be increased to promote the transformation and upgrading of the regional industrial structure [5]. Secondly, characteristic ecological industry brands should be created and strengthened to attract social capital. Cooperation with financial institutions should be enhanced to formulate targeted financial policies for green industries, emerging industries, and sunrise industries, thereby promoting regional economic development through financial support [6]. Key ecological projects within the region should be opened to public bidding to invite capable enterprises to participate, expanding project funding sources. Regular assessments of project progress, ecological benefits, economic benefits, and social benefits should be conducted to improve overall project quality and optimize the allocation of financial resources. Cooperation with enterprises outside Northwest Sichuan should be strengthened through projects to enhance the resilience of the regional ecological economy.

4.3 Promoting Technological Innovation and Facilitating the Transformation of Scientific Research Achievements

Technology has become a key factor affecting industrial change, transformation, and upgrading. To further promote the level of synergy between the economy and ecology in the ethnic minority area in Northwest Sichuan, cooperation between industries, research institutions, and universities should be actively promoted. Special research should be conducted on key and difficult issues in the green and digital transformation of industries. The application of new technologies and patent achievements in industries should be promoted to drive industrial transformation and upgrading [7]. Vigorous efforts should be made to promote the development of emerging industries, such as digital industries, artificial intelligence, cultural

creativity, and traditional Chinese medicine. The integration of industries with new quality productive forces should be promoted to enhance sustainable industrial competitiveness and drive technological innovation [8]. Technology-led demonstration projects should be created. The application of new technologies in areas such as pollution control, seedling cultivation, and agricultural management should be promoted to form a batch of leading demonstration projects, providing technical support for carbon reduction, pollution reduction, green expansion, and growth in the region. Efforts to declare and transform scientific and technological innovation projects should be increased to promote the incubation of scientific achievement projects. Platforms for promoting scientific research innovation achievements should be built to guide industries in understanding R&D progress and application status, providing information and technical support for the introduction and application of scientific innovations. Modern information technology should be leveraged to develop and promote online tourism, customized tourism, and characteristic cultural tourism projects to meet public experience needs [9]. Tourism scenarios should be enriched by integrating shopping, cultural experiences, and ecological landscapes, laying a good foundation for shaping the regional cultural tourism brand and promoting the "Four-in-One" concept in the ethnic minority area in Northwest Sichuan.

4.4 Cultivating and Attracting Talent to Solidify the Foundation for Synergistic Governance

Talent is a precious social resource that can be transformed into productivity [10]. The construction of a synergistic governance system for the economy and ecology under the "Four-in-One" concept has increased the demand for high-level, specialized talent. First, expert teams should be invited to the ethnic minority area in Northwest Sichuan to conduct training and seminars, providing guidance on regional ecological agriculture, cultural tourism, and e-commerce industries. Secondly, cooperation between industries and universities should be promoted. Major settings should be optimized based on frontier and characteristic industries of green economic development, such as clean energy, agriculture and animal husbandry, tourism, and e-commerce. The integration of industry and education should be promoted, and

talent practice bases should be established relying on regional ecological demonstration zones to improve the quality of talent cultivation and reserve talent for regional development. Talent introduction policies should be formulated to leverage geographical and local advantages, attracting outstanding talents from the Sichuan-Chongqing region to work in Northwest Sichuan. Talent recruitment standards should be established, and supporting measures such as special talent allowances and subsidies should be introduced to empower regional scientific innovation and industrial upgrading through talent aggregation. Opportunities for industrial personnel to participate in external training and learning should be provided. Regional restrictions should be broken by strengthening cooperation with frontier industries in other regions and conducting regular personnel interaction and inspections, reserving excellent talent for the high-quality development of regional industries and the construction of new projects.

5. Conclusion

The promotion of a coordinated governance system for the economy and ecology in the ethnic minority area in Northwest Sichuan under the "Four-in-One" framework aligns with national strategic development needs and is conducive to promoting high-quality regional development. However, the region still faces shortcomings such as technological and financial bottlenecks in the low-carbon transformation of traditional industries, as well as the absence of a regional joint prevention and control mechanism. Based on this analysis, this paper proposes improvement paths focusing on policy, funding, technology, and talent. These measures aim to further promote coordinated ecological development, transform ecological assets into economic value, and create new economic growth points.

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