

A Literature Review on the Impact of National Ecological Civilization Pilot Zone Construction on Regional Green Development

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Abstract: Establishing National Ecological Civilization Pilot Zones is a strategic initiative for China's ecological reform. This paper reviews the zones' background and goals, defines green development, and summarizes research on their impact from theoretical, perspective, and methodological dimensions. Current studies focus on the relationship between environmental regulation and green development, identifying "compliance cost," "innovation compensation," and non-linear effects. Empirically, scholars use quasi-natural experiments like DID and SCM to assess policy effects on economic structure, carbon efficiency, and Green Total Factor Productivity (GTFP), revealing significant heterogeneity across zones like Fujian, Jiangxi, and Guizhou. Finally, the paper highlights gaps in multidisciplinary integration, long-term tracking, and international comparison, offering an outlook to support future ecological construction.

Keywords: National Ecological Civilization Pilot Zone; Green Development; Environmental Regulation; Policy Effect Evaluation; Literature Review.

1. Introduction

Since the beginning of the 21st century, ecological and environmental issues have become a global focal point, profoundly affecting human survival and development. With the acceleration of industrialization and urbanization, problems such as resource shortages, environmental pollution, and ecosystem degradation have become increasingly severe, posing major challenges to the sustainability of human society. Against this backdrop, China has actively explored the path of ecological civilization construction, and the National Ecological Civilization Pilot Zones came into being. The establishment of the first batch of National Ecological Civilization Pilot Zones serves as a pioneering area for the implementation of decisions regarding the reform of the ecological civilization system, aiming to explore a set of institutional models for ecological civilization construction that match local realities, summarize a replicable and promotable path for high-quality development of these pilot zones, open up the conversion channel between "lucid waters and lush mountains" and "invaluable assets," transform ecological endowment advantages into development advantages, accelerate a high-quality economic development model of green, low-carbon, and circular development characterized by shifting drivers, adjusting structures, and improving quality, and establish a green development pattern where economic and social development advances in tandem with ecological civilization construction. This study aims to deeply explore the impact of the construction of National Ecological Civilization Pilot Zones on regional green development, and through a comprehensive analysis of the construction measures, achievements, challenges faced, and response strategies of the pilot zones, provide valuable experience and inspiration for ecological civilization construction in China and even the world, helping humanity move towards a greener and more sustainable future.

2. Overview of the Construction Status of Ecological Civilization Pilot Zones

2.1. Background and Development History of the Pilot Zones

With global environmental issues becoming increasingly severe, ecological civilization construction has become a global consensus. In the process of rapid economic development, China also faces problems such as tightening resource constraints, serious environmental pollution, and ecosystem degradation. The 18th National Congress of the Communist Party of China (CPC) incorporated ecological civilization construction into the "Five-sphere Integrated Plan" for the cause of socialism with Chinese characteristics. Subsequently, the CPC Central Committee and the State Council issued the Opinions on Accelerating the Promotion of Ecological Civilization Construction and the Overall Plan for the Reform of the Ecological Civilization System, providing the general direction for ecological civilization construction. The Fifth Plenary Session of the 18th CPC Central Committee took advantage of the momentum to propose the establishment of unified and standardized National Ecological Civilization Pilot Zones, aiming to accumulate experience for improving the national ecological civilization institutional system through pilot trials.

In 2016, the General Office of the CPC Central Committee and the General Office of the State Council issued the Opinions on Establishing Unified and Standardized National Ecological Civilization Pilot Zones and the Implementation Plan for the National Ecological Civilization Pilot Zone (Fujian), marking the official launch of pilot zone construction[1]. Fujian became one of the first pilot zones by virtue of its sound ecological foundation and early exploration results in ecological protection. In 2017, the Implementation Plan for the National Ecological Civilization Pilot Zone (Jiangxi) and the Implementation Plan for the National

Ecological Civilization Pilot Zone (Guizhou) were issued successively. Jiangxi and Guizhou joined the ranks of pilot zones, and with the approval of all implementation plans for the first batch of three ecological civilization pilot zones, the construction of pilot zones entered a stage of comprehensive rollout and accelerated promotion. In 2019, to promote a higher level of integration between ecological protection and economic development in Hainan, the General Office of the CPC Central Committee and the General Office of the State Council issued the Implementation Plan for the National Ecological Civilization Pilot Zone (Hainan). Hainan became an important member of the pilot zones, and each pilot zone has actively carried out ecological civilization system reform practices under different development stages and ecological backgrounds.

2.2. Distribution and Construction Goals of the Pilot Zones

Currently, China's National Ecological Civilization Pilot Zones cover four regions: Fujian, Jiangxi, Guizhou, and Hainan, distributed across the southeast, central, southwest, and southern coastal areas. They span a large geographical area and possess diverse ecological types and levels of economic development. Fujian has a high forest coverage rate and a relatively complete ecosystem, possessing unique advantages in forestry ecological protection and the realization of the value of ecological products. It has pioneered reforms in the property rights system of natural resource assets, such as incorporating natural resource assets into the audit of leading officials upon leaving office and canceling hard GDP assessment targets for certain counties (cities and districts) in favor of focusing on the assessment of ecological environment quality. Jiangxi is located in the Yangtze River Economic Belt and plays a key role in watershed ecological protection and the construction of ecological compensation mechanisms. In the comprehensive renovation of the "Five Rivers, Two Banks, One Lake, and One River" entire river basin, it has developed green industries, established pilot projects for the regulation of natural ecological space usage, and constructed a "One Map" for provincial territorial spatial planning, exploring a distinctive model for the coordinated development of ecological protection and the economy in the central region. As a representative of the western region, Guizhou features significant Karst landforms and a relatively fragile ecological environment, achieving outstanding results in the coordinated promotion of rocky desertification control, ecological poverty alleviation, and green development. For example, it has launched reform pilots such as the "River Chief System" for environmental protection, ecological compensation mechanisms, and third-party governance of environmental pollution, integrating the "green" concept into all aspects of economic and social development to promote the sustainable development of ecologically fragile areas. Hainan is China's largest special economic zone and only tropical island province, possessing a unique marine ecosystem and rich tropical biological resources. In the process of building a National Ecological Civilization Pilot Zone, it focuses on the goal of ensuring that the quality of the ecological environment can only get better, not worse, and explores areas such as marine ecological protection, green tourism development, and responding to climate change, such as strengthening marine ecological restoration and promoting the use of clean energy, providing a model for ecological civilization

construction in island regions.

The general goal of the pilot zone construction is to take the lead in building a relatively complete ecological civilization institutional system by 2020 and to form a batch of major institutional achievements that can be replicated and promoted nationwide. Specifically, this includes substantially improving resource utilization levels, continuously improving ecological environment quality, significantly enhancing development quality and efficiency, achieving a win-win situation for economic and social development and ecological environmental protection, and forming a new pattern of modernization where humanity and nature develop in harmony. Its main tasks cover several key areas: First, in terms of institutional innovation, it explores the establishment of a natural resource asset property rights system with clear ownership, defined rights and responsibilities, and effective supervision; improves the natural resource asset management system and compiles natural resource asset balance sheets; and promotes "multi-plan integration," improving the functional zoning system to achieve unified planning, orderly development, and rational utilization of natural ecological spaces. In terms of solving prominent environmental problems, it establishes a unified, efficient, joint prevention and control, and lifelong accountability mechanism for ecological environment supervision; improves resource paid-use and ecological protection compensation mechanisms that reflect ecological environmental value and benefit the protectors, focusing on solving atmospheric, water, and soil pollution problems.

To promote supply-side structural reform, it constructs mechanisms for ecological protection and restoration investment and scientific and technological support guarantees, develops a green financial system, promotes green industry development, promotes green consumption, and provides more ecological and green products for enterprises and the public. In the aspect of realizing the modernization of the national governance system and governance capacity, it establishes total resource management and saving systems, implementing dual control actions for the total amount and intensity of energy and water resource consumption and construction land; establishes an ecological civilization target evaluation and assessment system and reward and punishment mechanism, implementing audits of leading officials responsibility for environmental protection and natural resource assets upon leaving office; and improves the judicial protection mechanism for environmental resources. At the same time, pilot zones are encouraged to explore systems with local pioneering spirit and reference significance for other regions based on their actual conditions.

3. Definition and Connotation of Green Development

Regarding the definition of green development, the earliest formulation was "Green Economy," proposed by economist David Pearce. He believed that society should build an economy that the natural environment and human beings themselves can endure. Hou Weili (2004) believed that green development means replacing environmental and natural capital with man-made capital as much as possible under the premise of satisfying the carrying capacity of natural capital, relying on technology to make economic growth lower in consumption and higher in efficiency^[2]. Ma Pingchuan et al. (2011) proposed that green development means relying on

technological innovation, improving resource utilization rates, adjusting industrial structure, and ultimately achieving low-carbon, efficient, and sustainable development^[3]. Ma Hongbo (2011) believed that green development is a high-level summary of circular economy, green economy, sustainable development, and low-carbon economy, and is a high degree of coordination between economic development, social progress, and ecological construction^[4]. Hu Angang and Zhou Shaojie (2014) argued that in terms of functional definition, the concept of green development is a second-generation concept of sustainable development, emphasizing the systemic, holistic, and coordinated nature among the economic system, social system, and natural system^[5].

As an important way to support the realization of global sustainable development goals, green development has profound theoretical connotations and practical directions. A longitudinal review of the interpretations of the connotation of green development by the academic community and relevant international organizations can be condensed into two levels: narrow and broad. First, the narrow level understands green development from the perspective of economic growth, viewing green development as a new development mode that incorporates ecological environmental constraints into the framework of economic growth and pursues the coordinated unity of economic development and environmental protection^[5](Hu Angang, 2014). Second, the broad level views green development as a development concept dominated by ecological values and ecological ethics (Wang Lingling et al., 2012)^[6]. Thus, it is believed that many aspects of economy, society, politics, culture, and lifestyle can be "greened" (Jiang Nanping et al., 2013)^[7]. Green development is a process of continuous evolution from a lower level to a higher level, and the main contradictions and key tasks faced by green development in various countries differ (Wang Haiqin et al., 2016)^[8]. According to the interpretation of green development in research findings such as China 2030: Building a Modern, Harmonious, and Creative Society by the joint task force of the World Bank and the Development Research Center of the State Council, and China Sustainable Development Strategy Report—Green Development and Innovation by the Sustainable Development Strategy Research Group of the Chinese Academy of Sciences, the key task of green development in China's current context is to achieve a win-win situation for economic development and environmental protection^[9-12] (Tong Yun, Ma Yong et al., 2019).

4. Analysis of Current Research Status

4.1. Analysis of Research Directions

Currently, literature related to this study primarily focuses on the impact of environmental regulation on regional green development. Existing literature branches into two main areas. The first branch examines the relationship between environmental regulation and green development, presenting three inconsistent viewpoints. The first is the "Compliance Cost Effect" based on neoclassical economic theory. This suggests that the implementation of environmental regulations increases corporate pollution control costs and may even squeeze out R&D funds, thereby suppressing the improvement of corporate performance and Green Total Factor Productivity (GTFP). Early scholars like Gray argued that environmental regulation inhibits green development through a "crowding-out effect," where enterprises increase

costs to meet environmental requirements, affecting profits and hindering green development. Xie (2017), using Chinese provincial panel data, found that the direct impact of environmental regulations on GTFP was negative in the short term because the "congestion effect" of non-environmental technological innovation on production resources might not promote GTFP^[13]. Additionally, Yuan and Xiang (2018), using manufacturing panel data from 2003–2014, found that environmental supervision crowded out R&D investment and hindered GTFP growth in the short term^[14]. Wu and You (2019), based on provincial data from 2004–2015, found that environmental regulations suppressed technological innovation at the national level, thereby inhibiting GTFP^[15].

The second viewpoint is the "Innovation Compensation Effect". In 1995, Porter & Van Der Linde, in their research on the positive impact of environmental regulation on economic development, advocated paying attention to environmental protection during economic development to achieve coordinated growth, formally proposing the "Porter Hypothesis". They argued that reasonable environmental regulation can stimulate technological innovation, generate an innovation compensation effect, and promote green development. Many studies support this view. For instance, Chen et al. (2018) calculated the GTFP of 36 industrial sectors in China and found that environmental regulation indeed improved GTFP and promoted green development^[16].

The third viewpoint suggests an uncertain or non-linear relationship between environmental regulations and green development. Regarding "U-shaped" relationships, Meng Dabin et al. found that environmental regulation and green technology innovation exhibit a "U-shaped" relationship, where low-intensity regulation offers insufficient incentives while high-intensity regulation promotes innovation. Regarding inverted "U-shaped" relationships, Mu Hongliang et al. tested and found that environmental regulation first promotes and then suppresses green technology innovation. Xue Yawei et al. showed that environmental regulation and the green development of resource-based cities present an inverted "U-shaped" curve relationship^[17].

The other branch of relevant literature mainly involves evaluating the economic impact of environmental policies or regulations. The main methods for policy effect evaluation in existing literature include the Difference-in-Differences (DID) method, Propensity Score Matching (PSM), Synthetic Control Method (SCM), Regression Discontinuity Design (RDD), and Regression Control Method (RCM), each with specific prerequisites^[20]: Evaluating policy effects using DID requires random selection of treatment and control groups, a condition often hard to achieve in reality due to the strong targeting of policy implementation (Chen Lin et al., 2015)^[18]. PSM is suitable for cross-sectional data, but policy evaluation generally uses panel data, which can easily cause mismatches in regions and time (Luo Shihua et al., 2022)^[19]^[22]. RDD requires identifying the threshold used by policymakers when determining policy intervention (Liu Shenglong et al., 2016)^[23]. SCM requires that weights in the model design cannot be negative, which may lead to ignoring the negative impacts of the control group, resulting in lower synthesis accuracy (Abadie et al., 2010; Shen Yan et al., 2022)^[24]. RCM, proposed by Hsiao et al. (2012), is applicable to various data types but cannot solve the endogeneity problem and is relatively sensitive to weight settings.

4.2. Analysis of Research Perspectives

Existing scholars such as Chen Chang and Gu Hong have analyzed from an economic perspective, concluding via the Synthetic Control Method that the establishment of National Ecological Civilization Pilot Zones has a significant effect on promoting high-quality economic development, providing valuable experience for current and future ecological civilization construction in China[25,26]. Other scholars, such as Hu J, have focused on the innovation effects of the pilot zones, pointing out that their construction helps promote both corporate green innovation and the improvement of provincial-level green technology innovation[27].

In terms of the environmental perspective, Xu Manqian et al. used the Synthetic Control Method to find that the construction of pilot zones has a positive effect on reducing agricultural carbon emission intensity, which is significant for realizing China's "Dual Carbon" goals (Carbon Peaking and Carbon Neutrality)[28]. The article also proposed policy recommendations to promote the further development of China's ecological civilization construction. Zhang Mingdou et al. examined the impact of pilot zone construction on carbon emission efficiency from an environmental policy perspective and, starting from individual provinces, concluded that construction helps improve carbon emission efficiency in Fujian and Jiangxi, with the improvement in Fujian being greater than that in Jiangxi[29]. Hu Jianbo, Xiang Gang, et al., using the Regression Control Method, concluded that pilot zone construction significantly improved the carbon productivity of the zones, identifying the improvement of energy structure, promotion of technological progress, and increase in labor productivity as the main influence paths[30].

In addition, more scholars have conducted analyses from a comprehensive perspective. For instance, Shu Cheng et al. measured the spatiotemporal changes in Jiangxi's green development level by constructing green development measurement indicators, finding that its green development level exhibits spatial benefits and is gradually tending towards equilibrium[31]. Xin Baogui and Gao Feifei used the Synthetic Control Method to fit the comprehensive impact of the pilot zone policy on economic, ecological, and social benefits[33]. Chen Jiayou et al., based on provincial-level data, examined the policy and spatial effects of the pilot zone policy on Green Total Factor Productivity (GTFP) and explored the influence mechanism through four channels: reducing energy intensity, optimizing industrial structure, innovating low-carbon technology, and developing green credit[34]. They found that the improvement in Fujian and Guizhou was superior to that in Jiangxi. Fan Zhenggen et al. statically analyzed regional green development efficiency and its evolutionary characteristics by constructing an SE-SBM model, further dynamically analyzed the change trend using the GML index and its decomposition index, and explored influencing factors using the Tobit regression model[35]. They concluded that the construction of ecological civilization demonstration zones helps improve green efficiency in the pilot zones. Chen Hongfei and Huang Shunchun used the variation coefficient-principal component method and the synergy measurement model to measure the high-quality ecological environment index, high-quality economic development index, and the synergy between the two for the first batch of National Ecological Civilization Pilot Zones (Fujian, Jiangxi, and Guizhou) and their jurisdiction cities from 2016 to 2019[36].

5. Analysis summary

In summary, since the establishment of the first batch of National Ecological Civilization Pilot Zones, many scholars have regarded this policy as a quasi-natural experiment and analyzed its policy effects from multiple aspects[36]. It has been found that the establishment of National Ecological Civilization Pilot Zones has had a positive impact on the ecological, economic, and social development of the pilot areas. For example: it improved eco-tourism efficiency (Wen Juan et al., 2018)[37], promoted the improvement of corporate green technology innovation levels (Hou et al., 2022)[38], reduced air pollution and had positive spillover effects (Wang et al., 2021)[39], improved air quality (Xie Hanjin et al., 2021)[40], enhanced ecological efficiency (Liang Qi et al., 2022)[41], reduced carbon emission intensity (Wang Keliang et al., 2022; Hu Jianbo, 2022)[42], and so on. Some scholars have studied the impact of the establishment of National Ecological Civilization Pilot Zones on the relationship between the environment and the economy by constructing a multi-dimensional evaluation index system for ecological environment and economic development (Chen Hongfei, 2022; Liu et al., 2022)[36]. In addition, starting from the details of ecological civilization construction, scholars found that water ecological civilization city pilots have a promoting effect on regional emission reduction and green innovation (Yang et al., 2021; Fan et al., 2021)[43], helping to reduce water pollution intensity (Lyu et al., 2022)[44]; however, the implementation of this policy suppressed the improvement of urban green total factor productivity, squeezed government technical expenditure, and while increasing corporate compliance costs, did not exert the innovation compensation effect.

Secondly, research is mostly concentrated on the evaluation of policy effects, and the methods used are concentrated as follows. For example, Song et al. (2019) used the Difference-in-Differences method to study the impact of low-carbon city construction on air quality and found that this policy significantly reduced urban air pollution[45]. Chen Hong et al. concluded through the Synthetic Control Method that the establishment of National Ecological Civilization Pilot Zones plays a significant role in promoting high-quality economic development[25].

Xin Baogui and Gao Feifei fitted the comprehensive impact of the National Ecological Civilization Pilot Zone policy on economic, ecological, and social benefits through the Synthetic Control Method[33]. Hu Jianbo, Xiang Gang, et al. used the Regression Control Method to conclude that the construction of National Ecological Civilization Pilot Zones significantly improved the carbon productivity of the pilot zones. Xie Hanjin et al. used the Propensity Score Matching method to conclude that the establishment of ecological civilization cities significantly improved the health level of residents[40].

Finally, in terms of research scale, due to limitations in research methods and policy implementation time, most studies conduct a comprehensive comparative analysis of the three provinces of Jiangxi, Fujian, and Guizhou together. For example, Xin Baogui et al. (2012) found that the construction of demonstration zones could also improve the ecological total factor productivity of Fujian and Guizhou provinces, but the improvement magnitude for Jiangxi province was not obvious. Zhang Mingdou et al. (2023) used the Synthetic Control Method to measure the carbon emission intensity of

Guizhou, Jiangxi, and Fujian. Since the fitting effect of the control group for Guizhou was poor, it was excluded from the study, and further analysis concluded that the carbon emission efficiency of Fujian Province improved more relative to Jiangxi Province. Secondly, some scholars also conduct separate studies on individual regions. For example, You Jianmin and Zhang Wei (2018) conducted a study on the influencing factors of green manufacturing performance in Guizhou Province from four aspects: economy, society, resources, and openness[46]. Shu Cheng et al. (2012) mainly conducted measurement and spatial differentiation research on the green development level of 11 prefecture-level cities in Jiangxi Province. Zhang Yingwu, Tan Jin, et al. (2024) calculated the green economic development efficiency of various cities and counties in Hainan Province using the undesirable output SBM model[47].

6. Research Deficiencies and Outlook

Currently, research mostly focuses on a single disciplinary perspective; future research should comprehensively apply theories and methods from multiple disciplines such as economics, ecology, sociology, and law. For example, by combining cost-benefit analysis from economics with ecosystem service assessment from ecology, the economic and ecological benefits of the construction of ecological civilization pilot zones can be more precisely quantified, providing a scientific basis for policy formulation.

Secondly, dynamic tracking and a long-term assessment system should be constructed. Since existing studies are mostly stage-based results with limited acquired research data, a long-term dynamic tracking mechanism needs to be established subsequently. For instance, technologies such as big data and the Internet of Things can be utilized to monitor changes in indicators regarding the ecological environment, economic development, and social livelihood of the pilot zones in real-time, improving the evaluation index system and deeply analyzing the long-term impacts and development trends of the policies.

Finally, regional synergy and international comparative research can be conducted, such as strengthening comparative research between different pilot zones and with other ecological demonstration zones internationally. By exploring the commonalities and characteristics of ecological civilization construction models under differences in ecological backgrounds, economic foundations, and social cultures across different regions, and drawing on advanced international experience, the construction of China's ecological civilization pilot zones can be promoted to align with international standards.

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