

Examining the Construction Model of Ecological Civilization in Counties—Taking Wuyuan County in Jiangxi Province as an Example

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Abstract: Ecological protection is critical for the harmonious development of humanity and nature, and ecological civilization construction is fundamental for the sustainable development of China. Wuyuan County in Jiangxi Province, a typical county in central China, has its own characteristics and advantages in ecological civilization construction. This study constructs a "five-dimensional analysis method" for analyzing the ecological civilization construction in counties. The five dimensions include economic construction, political construction, cultural and social construction, ecological service values, and the index system for ecological civilization construction. This method is adopted to summarize the achievements in ecological civilization construction in Wuyuan as well as its successful model. Corresponding development directions and related policy suggestions are also proposed to promote ecological civilization development. Wuyuan's experience in ecological civilization construction can provide guidance for counties in the whole country.

Keywords: counties; ecological civilization; ecotourism; five-dimensional analysis method; index system

1 Research background

In recent years, the rapid growth and development of China's economy and society have resulted in high rates of resource consumption and pollutant emission, seriously affecting the natural environment and restricting the country's modernization process. Since the 17th National Congress of the Communist Party of China (CPC) put forth the strategy of ecological civilization, the 18th National Congress of CPC included ecological civilization in the overall layout of "Five-in-one," which promotes socialism with Chinese characteristics. This established a prominent position for ecological civilization in the political sphere [1]. Further, the 19th National Congress of CPC pointed out that China is building an ecological civilization that will benefit future generations and is vital to sustaining China's development [2].

In general, the literature on the construction of ecological civilization is complex, and conclusions are influenced by several factors such as development level, research time, and statistical data [3]. Therefore, ecological civilization needs a comprehensive evaluation methodology that incorporates economic, political, cultural, and social aspects in addition to the ecological environment. Hence, this research examines the progress toward ecological civilization in a representative county by using a "five-dimensional analysis method." This

Received date: August 9, 2019; **Revised date:** September 9, 2019

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Funding program: CAE Advisory Project "Several Strategic Issues on Eco-Civilization Construction (Phase III)" (2017-ZD-09)

Chinese version: Strategic Study of CAE 2019, 21 (5): 087–092

Cited item: Lin Minsong et al. Examining the Construction Model of Ecological Civilization in Counties—Taking Wuyuan County in Jiangxi Province as an Example. *Strategic Study of CAE*, <https://doi.org/10.15302/J-SSCAE-2019.05.010>

method is based on a country's structure and economic status [4] and combined with an analysis of the measures promoting the construction of an ecological civilization [5], a comprehensive nature–economy–society (NES) composite benefit assessment [6], an ecosystem service value assessment [7], and an evaluation index system (EIS) [8]. Wuyuan County is famous for its cultural and ecological tourism. Taking it as a case study, this study examines the county's progress toward the construction mode of ecological civilization. By analyzing the practices and achievements of Wuyuan County's efforts and developing a characteristic model for the construction of ecological civilization, this research benefits the development of an ecological civilization in counties across China. Finally, suggestions for policy and development directions are proposed.

2 Methods of evaluating construction of ecological civilization

Ecological civilization is a new form of the social development approach and chronologically follows primitive civilization, agricultural civilization, and industrial civilization. It aims to promote harmonious coexistence and prosperity between humans & humans, humans & nature, and humans and society. The construction of ecological civilization necessitates extraordinary measures such as transforming the mode of economic development, comprehensively treating and managing environmental pollution control, conserving and restoring natural ecosystems, conserving and utilizing resources, and improving the system of ecological civilization. Further, ecological civilization requires measures, including ecological engineering, energy saving and emission reduction, urban and rural development, and environmental protection within the circular economy system. These measures must be implemented holistically on the regional and global levels to realize the goal of ensuring harmony between human and nature.

The study of ecological civilization involves economics, politics, culture, society, and the ecological environment. Herein, the pattern of comprehensive development and sustainable economic prosperity are treated as preconditions for the construction of a high-quality ecological civilization; therefore, the structure of a county's economy and its development status is adopted as the basic index. In addition, because integrating the construction of ecological civilization into the political system and establishing an institutional mechanism are essential for the construction of ecological civilization, the analysis of relevant metrics is used as another indicator. Moreover, the successful construction of ecological civilization is reflected in the coordination and unification of environmental protection efforts, social development, and economic prosperity; therefore, the NES composite benefit evaluation system is included in the evaluation criteria. Furthermore, differences in ecological resources and economic development of different regions can complicate comparisons between those regions. Ecological service value is used to monetize natural assets, calculate the economic value of a county's ecosystem, and facilitate comparison. Finally, the EIS is used to quantify the extent of a county's ecological civilization development (Fig.1).

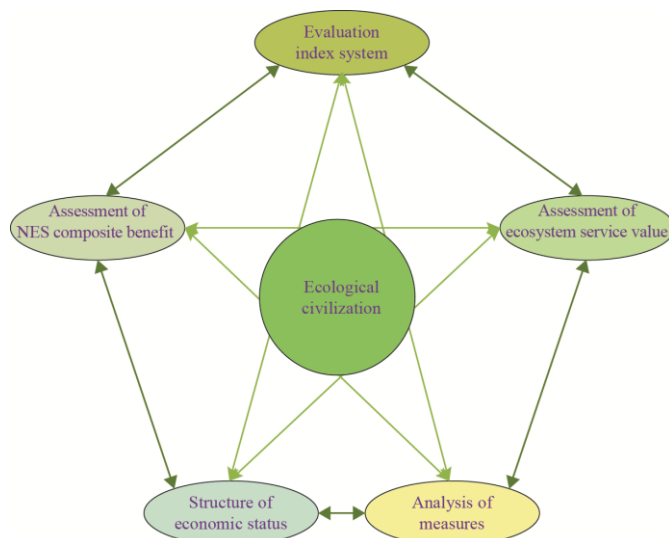


Fig.1. Method to examine county ecological civilization construction mode.

The structure of the economic status refers to the proportion of agriculture, industry, and service industries in the economic structure. Analysis of an economy's status structure is used to promote economic and social

development and improve material and cultural life to integrate the construction of ecological civilization with economic development. Next, an analysis of measures clarifies the objectives, overall thinking, guarantee measures, and implementation path of ecological civilization, thus promoting the construction of ecological civilization from the political construction field. The assessment of NES composite benefit captures the impact of the construction of ecological civilization on the local environment, economy, and society for improvement in social and cultural construction.

The assessment of ecosystem service value explains the development potential of ecological environment in typical counties, providing a means to evaluate the construction of ecological civilization from an environmental perspective. Our research adopts ecosystem service value as the metric, based on the standard of optimized system value [9] and the gross domestic product (GDP) growth rate of the National Bureau of Statistics as the conversion benchmark (Table 1) [10].

Table 1. Valuation of ecosystem services.

Biome	Forest	Grass/Rangeland	Cropland	Wetland	Lake/River	Desert
Unit price (2008) (yuan·hm ⁻² ·a ⁻¹) [9]	12 628.69	5241.00	3547.89	24 597.21	20 366.69	624.25
Unit price (2017) (yuan·hm ⁻² ·a ⁻¹)	32 455.73	13 469.37	9118.08	63 214.83	52 342.39	1604.32

Current evaluation of the construction of ecological civilization in demonstration cities and counties is primarily based on its index system. Based on the *Green Development Index System* and *Eco-civilization Construction Assessment Objectives System* formulated by the National Development and Reform Commission as well as an index system proposed in previous research [11], this study constructed a new EIS for the construction of ecological civilization at the county level. Because of important differences between counties, such as unequal levels of infrastructure and large economic gap between urban and rural areas, this EIS considered the particular attributes of each county (Table 2). Evaluation of the index system provides technical support for models used in the construction of ecological civilization.

Compared with normalization methods such as range standardization, the double-benchmark progressive method is more scientific and can reflect the current practical situation more accurately [8]. The weighted average method provides a means to balance the indicators and ensure comprehensiveness while minimizing interference from human factors [12]. Therefore, in this study, the indicators are normalized using the double-benchmark progressive method and weighted using the weighted average method. Finally, holistic evaluation is calculated by using the comprehensive weighted index method. This research investigation is based on data obtained from government statistics and academic research in Wuyuan County from 2015 to 2016.

3 Construction of ecological civilization in Wuyuan County

Wuyuan County is located in Jiangxi Province and known as the “Land of Calligraphy” and “Land of Tea”. It is a county famous for cultural and ecotourism in China and referred to as “the most beautiful village in China.” The county has an area of 2 967 km², with a permanent population of approximately 340 000 and 199 village committees. In recent years, Wuyuan County has successfully established a national ecological protection and construction demonstration area, a national key ecological functional area, a national ecological civilization construction demonstration county, a national Huizhou cultural and ecological protection experimental area, a national rural tourism and holiday experimental area, and a “China’s Natural Oxygen Bar.”

3.1 Analysis of the economic structure of Wuyuan County

In 2017, Wuyuan County’s regional GDP reached 10.078 billion yuan, and the ratio between the three main industrial sectors reached 9.27:34.42:56.31. The tourism-oriented tertiary industry contributed 61.4% to economic growth, driving economic growth by 4.92%, a 2.17% rise over that in the previous year. Further, 21 788 000 tourists visited throughout the year, an increase of 24.5%; comprehensive tourism revenue was 16.85 billion yuan, an increase of 52.7%; and ticket sales income was 5.1 billion yuan, an increase of 19.9%. Tourism promoted the development of industry and agriculture and accelerated the service industry. Additionally, the rollout of the “Ecotourism +” initiative facilitated the integration and development of primary, secondary, and tertiary industries.

Table 2. Ecological civilization index system of a county.

Targets	Areas	Indexes	Indicators		
Ecological civilization index	Eco-environment (0.25)	Ecological environment index (0.33)	Ecological environment index (1)		
		Ecological carrying capacity (0.33)	Biomass carrying capacity (1)		
		Environmental quality index (0.33)	Air quality (0.5) Surface water quality (0.5)		
	Green production (0.25)	Economic development index (0.33)	Economic development index (0.33)	Per capita GDP (0.33) Engel's coefficient (0.33) Contribution rate of scientific and technological progress (0.33)	
			Industrial structure index (0.33)	Proportion of tertiary industry added value in GDP (0.33) Proportion of strategic emerging industry added value in GDP (0.33) Proportion of cultural industry added value in GDP (0.33)	
			Resource and energy consumption index (0.33)	Unit construction land GDP (0.2) Freshwater consumption of Unit industrial added value (0.2) Unit GDP energy consumption (0.2) Output rate of major resources (0.2) Non-fossil energy as a proportion of primary energy consumption (0.2)	
		Green living (0.25)	Urban habitat index (0.33)	Urban habitat index (0.33)	Per capita green land of parks (0.25) Urban domestic sewage treatment rate (0.25) Decontamination rate of urban domestic refuse (0.25) Rural sanitary latrines penetration (0.25)
				Urban-rural coordination index (0.33)	Urbanization (0.25) Ratio of income between urban and rural residents (0.25) Basic endowment insurance coverage (0.25) Residents' happiness (0.25)
			Green consumption index (0.33)	Green consumption index (0.33)	Per capita ecological footprint (1)
			Green governance (0.25)	Institutional innovation index (0.33)	Institutional innovation index (0.33)
		Green investment index (0.33)			Proportion of expenditure on environmental protection in financial expenditure (0.25) Proportion of expenditure on science and technology and education in fiscal expenditure (0.25) Proportion of expenditure on medical and health expenditure in fiscal expenditure (0.25) Proportion of expenditure on R&D expenditure in GDP at the same period (0.25)
		Information sharing index (0.33)		Information sharing index (0.33)	Environmental information disclosure rate (1)

3.2 Analysis of relevant measures of ecological civilization construction in Wuyuan County

Wuyuan County disassembled various assessment indicators into relevant units by strengthening mechanism and system construction, formulating relevant policies, and improving the assessment and accountability system to promote the construction of ecological civilization. First, Wuyuan County promoted green development and constantly created opportunities for economic development through a series of initiatives that strengthened ecological agriculture, low-carbon industry, and ecotourism. Additionally, the introduction of many high-level

talents in line with the needs of ecological development could provide guidance and suggestions related to economic development to further rural revitalization. The strong economic development provided favorable conditions for the development of the “ecotourism +” initiative in Wuyuan County. Furthermore, the ecological environment was effectively protected by implementing the forest chief system, the river chief system, the pond-reservoir contracting system, and prohibition on logging the natural forest. The establishment of the demonstration area laid a satisfactory environmental foundation for the development of the local “ecotourism +” industry model.

The progress toward an “ecotourism +” industry model of social development is also assessed. Through the “ecotourism + sports” model, more than 200 major sports events were hosted. The county has also been designated a national mass sports advanced county and the only national sports industry demonstration base in Jiangxi Province by the General Administration of Sports of China. The development of “ecotourism + culture” furthered the dissemination of Zhuzi culture and increased the protection and inheritance of intangible cultural heritage. In 2017, more than 5000 traditional cultural enterprises and shops focused on tourism commodities in the county, with annual sales revenue of 600 million yuan. In order to drive innovative strategies for enforcing laws related to tourism, Wuyuan County established a joint law enforcement-dispatching center for the tourism market (Tourism 110) to renovate unreasonable, low-cost tourism and other special remediation activities. All the effective measures ensured a satisfactory cultural atmosphere for the development of the “ecotourism +” industry in the county.

3.3 Evaluation of the NES composite benefit in Wuyuan County

With the steady development of the “ecotourism +” industry model, Wuyuan County has achieved benign natural, economic, and social benefits. The forest coverage rate continues to increase, environmental quality remains at a satisfactory level, and the number of tourists and income received from tourism continues to increase, which has directly or indirectly led to steady increase in the employment rate. The forest coverage rate steadily increased to 82.64%, the air and surface water compliance rate is 100%, the negative oxygen ion concentration is as high as 7×10^4 – 1.3×10^5 , and more than 80 species of national first- and second-level key protection of animals and plants live in Wuyuan County. The excellent ecological environment also provides a satisfactory habitat for wild animals such as *Garrulax courtoisi*. In 2015, *Garrulax courtoisi* had three populations, with a total size of approximately 200.

The improvement in the ecological environment further promoted the development of the “ecotourism +” industry. In 2017, the number of tourists received and total income from tourism reached 21.78 million yuan and 16.8 billion yuan, an increase of 8.94 times and 47.2 times, respectively, over that in 2005. Nearly 4000 individual, industrial, and commercial entities engaged in tourism commodities, catering, and accommodation, which indirectly employed 80 000 people. The per capita income of urban and rural residents was 20 500 yuan. The tertiary industry, dominated by tourism, accounted for 56% of the GDP. These developments verify the successful transformation of ecological assets into economic assets and social assets.

3.4 Evaluation of ecological service value in Wuyuan County

Table 3 summarizes the ecological service value of ecosystems in Wuyuan County. The forest land area of Wuyuan County exceeds 2.45×10^5 hm², and the cultivated land area is more than 2.15×10^4 hm². The area of grass/rangelands, lakes/streams, and wetlands is 4998, 7867, and 5298 hm², respectively. The remaining area, used for industrial, mining and transportation activities, is 7526 hm². According to preliminary calculations, the total value of ecological services in Wuyuan County is approximately 8.99 billion yuan, with a per capita value of 23 911 yuan. Adding per capita ecosystem service value to per capita GDP yields a result of 53 296 yuan, roughly on par with many middle-income countries. The substantial advantages of ecosystem ecological service value demonstrate that Wuyuan County could benefit greatly from the “ecotourism +” industry model.

3.5 Evaluation of the index system for construction of ecological civilization in Wuyuan County

The scores of each layer of the index system used in the construction of ecological civilization in Wuyuan County are shown in Fig. 2. Each index layer is normalized and weighted by the indicator layer. The scores are mostly distributed between 60 and 100, among which the scores of four indexes—environmental quality index, green consumption index, institutional innovation index, and information sharing index—are above 90, reaching a satisfactory level. Only the ecological carrying capacity index score is less than 60 points, because it is mainly composed of the biomass carrying capacity in the indicator layer. Wuyuan County is located in the north temperate

deciduous forest zone, which is susceptible to environmental factors such as precipitation and its relatively fragile ecological carrying capacity. The area scores of eco-environment and green governance in Wuyuan County are higher than the average for the entire province, and scores for green production and green living are lower. Overall, the ecological civilization index in Wuyuan County is slightly weaker than the provincial average in Jiangxi Province. Therefore, the construction of ecological civilization in Wuyuan County must further strengthen the ecological carrying capacity.

Table 3. Ecological service value of the ecosystem in Wuyuan County.

Biome	Area (hm ²)	Value (million yuan)
Forest	245 688.60	7974.0035
Grass/Rangeland	4998.11	67.3214
Cropland	21 522.38	196.2428
Wetland	5298.36	334.9349
Lakes/rivers	7867.55	411.8064
Desert	3876.74	6.2195
Industrial, mining, and transportation	7526.00	—
Total	296 777.84	8990.5285

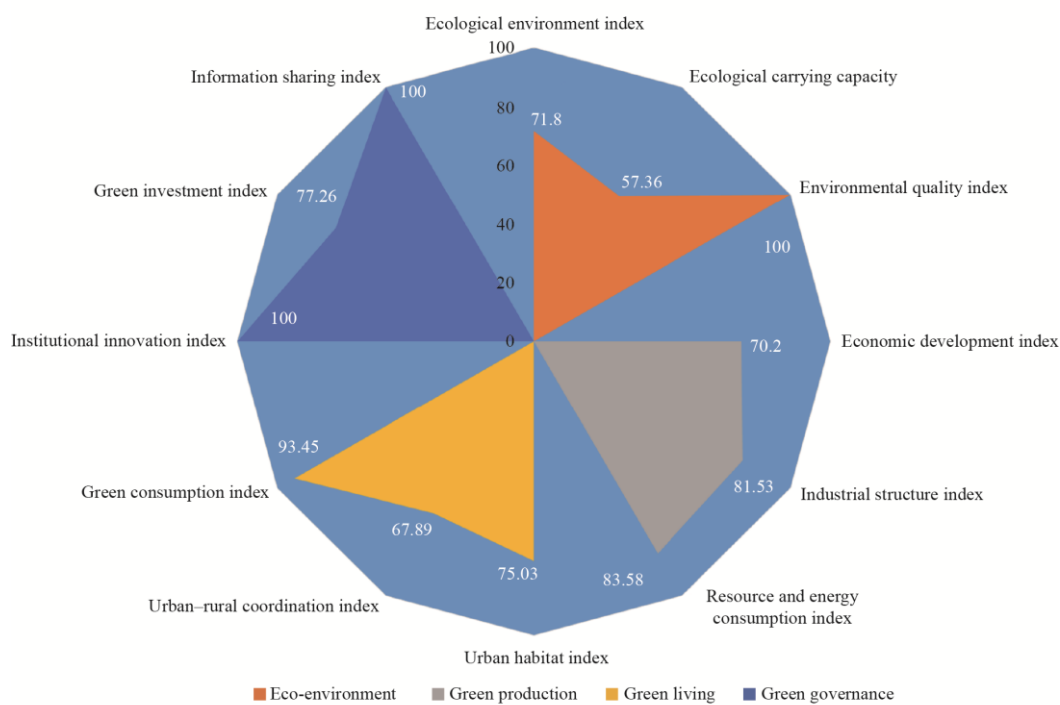


Fig. 2. Score rose chart of each layer of index system for construction of ecological civilization in Wuyuan County.

4 Conclusions

The construction of ecological civilization is not only indispensable to reduce pressure on resources and environment but also a key approach for the government to realize the comprehensive and sustainable development of China’s social economy. It is of great practical significance to have a robust means of accurately evaluating the status of construction of ecological civilization in various regions in China. Based on a model of construction of ecological civilization in counties, this paper constructs a “five-dimensional analysis method” to analyze the construction of ecological civilization in counties. The five dimensions are economic construction, political construction, cultural and social construction, ecological service values, and the index system for ecological civilization construction.

Taking Wuyuan County in Jiangxi Province as an example and case study, this research identifies and evaluates the construction of ecological civilization according to the model of individuals and society in harmony with each other, comprehensive development, and sustained prosperity by using the analysis and verification of the

“five-dimensional analysis method.” The main goal of this model is to “develop all-around tourism and build the most beautiful villages” dominated by the “ecotourism +” industry.

However, as a county with a satisfactory endowment of natural, ecological environment, Wuyuan County must improve and strengthen the construction of ecological civilization. Also necessary is to accelerate the development of the “ecotourism +” industry model and formulate a diversified “ecotourism +” model; increase the level of urban and rural development and improve the quality of development; strengthen the management of red lines for ecological protection; and enhance the direct and indirect value of ecological resources.

China is rich in tourism resources. The model used in the construction of ecological civilization defined by the “ecotourism+” industry model in Wuyuan County serves as an important point of reference for the construction of ecological civilization in similar counties with natural resource endowment and location advantages. The “five-dimensional analysis method” can also effectively highlight the unique problem areas in the construction of ecological civilization for different counties. This method is of great significance to further promote the construction of ecological civilization. To some extent, the “five-dimensional analysis method” does not consider the time series of the construction of ecological civilization; thus, it has limitations on the guidance of the construction of ecological civilization in counties.

Acknowledgments

The authors would like to acknowledge Dr. Abhishek Kumar Awasthi and Eva Albalghiti for their valuable suggestions on language issues. This work is financial supported by the Advisory Project of Chinese Academy of Engineering (2019-ZD-19).

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