

Evaluation of Rural Environmental Governance Efficiency and Influencing Factors in the Yangtze River Delta Region under the Goal of “Dual Carbon”

Mengjiao Chen *, Yusang Pan, Wenjia Ma, Kai Wang

School of Economics, Anhui University of Finance and Economics, Bengbu, China

*Corresponding Author: 3042863464@qq.com

ABSTRACT

In the face of deteriorating ecological problems such as pollution from agricultural production, pollution from farmers' lives, and pollution from township industries in the Yangtze River Delta region, as well as the plight of an imperfect rural environmental governance system and insufficient governance capacity, there is an urgent need to set up a comprehensive assessment system for the efficiency of rural environmental governance, improve the rural environmental governance system, and modernize the capacity of environmental governance. This project will firstly sort out the research results of rural environmental governance at home and abroad, and systematically analyze the theory of rural environmental governance; secondly, analyze the spatial changes of environmental pollution in rural areas during different periods, and analyze the efficiency of environmental governance in the rural areas of the Yangtze River Delta in different dimensions; finally, analyze the influencing factors of the efficiency of rural environmental governance under the constraints of the target of “double carbon”, and analyze the factors of economic development, economic development, and the impacts on the efficiency of rural environmental governance. Finally, we analyze the influencing factors of rural environmental governance efficiency under the constraint of the “double carbon” goal, and analyze the impacts of economic development, policy formulation, villagers' motivation and other factors on rural environmental governance efficiency. The results of this study provide an important reference for further promoting the realization of the dual-carbon goal and scientific environmental governance in the Yangtze River Delta region, and also provide a strong case study and reference for environmental governance strategies in other regions.

KEYWORDS

Dual Carbon Targets; Rural Environment; Influencing Factors; Yangtze River Delta Region

1. INTRODUCTION

1.1. Background of the Study

Rural environmental governance is both a necessary path for ecological revitalization in the strategy of rural revitalization and the core essence of building ecological civilization and beautiful China. Since the 18th National Congress, the Party Central Committee has paid great attention to the issue of rural ecological environmental governance, and the report of the 20th National Congress of the Party proposes to comprehensively promote rural revitalization, adhere to the ecological civilization concept that green water and green mountains are golden silver mountains, sustainable development strategy and green low-carbon development concept. The CPC Central Committee has incorporated “carbon peak and carbon neutrality” into the overall layout of ecological civilization construction, and at the same time, agriculture and rural areas are also important areas for realizing “carbon peak

and carbon neutrality”, and are important areas for ecological civilization construction and environmental protection.

1.2. Research Status at Home and Abroad

Rural environmental management pollution status research in our academic community on this issue in different periods, in the face of different environmental pollution conditions, different scholars from different perspectives to carry out in-depth analysis. Min Jisheng (2014) and others [1] believe that the pollution of the rural environment can be divided into two major components: living pollution and production pollution. Liang Hailong, Zhang Qiang [2] (2022) argued that environmental problems such as heavy metal pollution of farmland soil, ground subsidence, coastal erosion, cross-contamination of new pollutants and composite pollutants, and serious deterioration of air quality are becoming more and more prominent in the Yangtze River Delta region. Foreign scholars Kulig, Edge [3] (2014) found through research that training well-educated rural nurses can reduce the impact of rural environmental disasters and can help post-disaster reconstruction.

Rural Environmental Governance Efficiency Research China's research on rural ecological and environmental governance efficiency is still in its infancy, mainly centered on cross-sectional data to carry out research on the measurement of rural ecological and environmental governance efficiency. Huang Ying et al [4] (2015) based on the 2011 inter-provincial panel data using super-efficient DEA on the rural ecological environmental governance input-output indicator system for efficiency evaluation, and combined with the level of rural economic development to build a comprehensive evaluation matrix on the 31 provinces and regions for cluster analysis. Sun Yu et al [5] (2019) used the BCC model at the time of the DEA method to construct the rural ecological environmental governance input-output indicator system, and assessed the efficiency of China's rural ecological environmental governance with the 2016 cross-sectional data of 31 provincial villages across the country as the research object. Foreign scholars Mandal, Madheswaran [6] (2010) selected carbon dioxide in rural industrial pollutants as the research object, using data envelopment analysis and Directional Distance Function (Directional Distance Function) to study the impact of how much of its emissions on the efficiency of rural environmental pollution management.

Rural environmental governance path research. Accompanied by people's attention to the rural ecological environment and the deepening of the theory of ecological construction, China's rural environmental governance research has also been deepened from the initial focus on investment and financing, model, restoration, countermeasures, etc., to the aspects of governance capacity, mechanism, etc., but its research in general is still confined to the following three perspectives: the first one is the institutional perspective, which mainly highlights the role of the government's institutional supply. Zhang Rui, Qin Shusheng [7] (2010) and others believe that ecological environmental governance mainly relies on institutional construction, taking corresponding measures from the political, policy and legal levels. The second is the cultural perspective. Ma Yongqing [8] (2012) and others discussed ecological environmental governance from the perspective of cultural construction, and proposed that ecological governance relies on a variety of means, such as economy, science and technology, law, administration and ethics. Third, the behavioral perspective. Lv [9] (2019) argued that increasing investment, and ultimately realizing the good governance effect of proper garbage disposal, effective sewage treatment, and substantial improvement of village appearance.

2. ANALYSIS OF THE CURRENT SITUATION OF RURAL ENVIRONMENTAL POLLUTION

2.1. Soil Heavy Metal Pollution

Soil heavy metal pollution in the Yangtze River Delta region is serious, mainly manifested in the excessive accumulation of heavy metals such as Cd, Cu, Hg and Pb. According to research data in recent years, industrial “three wastes” (wastewater, waste gas, waste residue) emissions, exhaust from transportation, long-term application of agricultural fertilizers and pesticides, as well as the widespread use of agricultural production materials, such as agricultural films, are the main causes of soil heavy metal pollution. The problem of compound heavy metal pollution has emerged in some areas of Jiangsu, Zhejiang and Anhui, especially in Taizhou, Zhejiang and Tongling, Anhui, where there are serious exceedances of a variety of heavy metals such as Cd, Pb and Cu. This pollution not only affects the quality and yield of agricultural products, but also poses a serious threat to human health and ecological environment.

2.2. Pollution Caused By Backward Agricultural Production Methods

Some rural areas in the Yangtze River Delta region still follow backward agricultural production methods, such as high pesticide and chemical fertilizer application and unreasonable straw disposal, which aggravate the problem of agricultural surface pollution. The excessive use of pesticides and chemical fertilizers leads to a decline in soil quality, causes eutrophication of water bodies, and even affects human health through the food chain. In addition, a large amount of soot and harmful gases produced by straw burning have also seriously polluted the atmospheric environment.

2.3. Improper Treatment of Domestic Garbage

With the development of rural economy and the improvement of farmers' living standards, the amount of domestic garbage generated grows. However, many rural areas have a weak sense of garbage classification and outdated treatment facilities, resulting in garbage being arbitrarily piled up and burned, polluting the soil, waters and air. This problem is particularly prominent in some rural areas in the Yangtze River Delta region, seriously affecting the quality of the rural human environment.

3. EVALUATION OF THE EFFICIENCY OF RURAL ENVIRONMENTAL MANAGEMENT IN THE YANGTZE RIVER DELTA REGION UNDER THE DUAL-CARBON OBJECTIVE

Data Envelopment Analysis (DEA) method is a non-parametric evaluation method with wide application in efficiency assessment. It analyzes the efficiency level of each decision-making unit by comparing the input and output data of different decision-making units. In this study, the DEA method is used to evaluate the efficiency of rural environmental governance in the Yangtze River Delta region.

First, a DEA evaluation model applicable to rural environmental governance was constructed based on the actual situation in the Yangtze River Delta region. A number of input and output indicators were selected for the model. The input indicators include the investment of environmental governance funds, the investment of governance manpower, and the application of governance technology, while the output indicators include the reduction of environmental pollutant emissions and the improvement of ecological environment quality. The selection of these indicators takes into full consideration the actual needs and objectives of rural environmental governance.

In practical application, the super-efficiency SBM (Super-Slack Based Model) model is used for efficiency calculation, which can deal with non-desired outputs (e.g., emissions of environmental pollutants) and more accurately reflect the efficiency level of environmental governance.

The data selection is based on the data related to rural environmental governance in the Yangtze River Delta region over the years, including data on financial input, human input, technology application and other aspects, as well as combining with the measurement data of environmental pollutant emissions for a comprehensive assessment. The sources of data are mainly the statistical data released by relevant government departments and the primary data obtained from field research. During the data processing, the data were standardized to eliminate the differences in magnitude between different indicators, while the consistency test of the data and the treatment of outliers were carried out to ensure the accuracy and validity of the data.

Overall, rural environmental governance in the Yangtze River Delta region has achieved certain results. By analyzing the environmental governance data over the years and the field research, it is found that with the proposal and implementation of the dual-carbon goal, governments at all levels in the YRD region have continuously increased their investment in rural environmental governance, while the governance technologies and means have also been significantly improved. This has effectively safeguarded and improved the quality of the rural environment in the YRD region and laid the foundation for future green development.

Within the YRD region, there are significant differences in the efficiency of environmental governance among different provinces. This is due to the greater heterogeneity of economic, social and natural environmental conditions in the YRD region. In a specific comparison, Anhui Province has relatively high efficiency in rural environmental governance, thanks to its rational policy guidance and efficient implementation of governance measures. On the other hand, some provinces with higher levels of economic development have relatively low efficiency in environmental governance due to possible historical problems, structural problems and outdated governance technologies, and need to further increase their governance efforts and investment in order to improve the overall level of environmental governance.

4. ANALYSIS OF FACTORS AFFECTING THE EFFICIENCY OF RURAL ENVIRONMENTAL GOVERNANCE

Under the dual-carbon goal, the efficiency of rural environmental governance in the Yangtze River Delta region is not only directly affected by the level of technology and management, but also constrained by a variety of complex factors. This paper will analyze in detail the factors affecting the efficiency of rural environmental governance from three aspects: policy guidance, scientific and technological support and socio-economic aspects.

4.1. Policy Guidance

Policy is an important guide and guarantee for rural environmental governance. The difference and implementation effect of national and local policies directly affect the efficiency and results of environmental governance.

Policies at the national level are usually global and guiding, such as the proposal of the double carbon target, which aims to promote green and low-carbon development nationwide. However, the concrete implementation of these policies in the YRD region requires the refinement and supplementation of local policies. As one of China's most economically developed regions, the YRD's rural environmental governance policies tend to be more specific and detailed, aiming to address the region's particular environmental problems. For example, Shanghai Municipality and Jiangsu Province have issued a number of local regulations and policies on agricultural waste treatment and

rural sewage treatment, which have effectively promoted the in-depth development of rural environmental governance.

The effectiveness of policy implementation is an important basis for evaluating the effectiveness of policies. In the YRD region, the effectiveness of policy implementation is affected by a variety of factors, including the scientific nature of the policy itself, the strength of policy implementation and the regulatory mechanism. Some policies have been implemented in a “one-size-fits-all” manner, failing to fully consider the actual situation and differences of different regions, resulting in unsatisfactory policy effects. In addition, the strength of policy implementation and the regulatory mechanism are also key factors affecting the effectiveness of policies. In some regions, there are problems such as ineffective supervision and lax law enforcement in the process of policy implementation, which makes it difficult to effectively implement the policy.

4.2. Role of Scientific and Technological Support

Science and technology are an important means to promote the efficiency of rural environmental management. The application of clean energy and green technology and the improvement of agricultural modernization have provided strong support for rural environmental management.

The application of clean energy and green technology is an important direction for rural environmental management. In the Yangtze River Delta region, some rural areas have begun to experiment with the use of clean energy such as solar energy and wind energy to reduce their reliance on traditional fossil energy. At the same time, the promotion and application of green agricultural technologies have also achieved remarkable results, such as the promotion of organic agriculture, ecological agriculture and other modes, which not only improves the quality and safety of agricultural products, but also effectively reduces environmental pollution in the agricultural production process.

The improvement of agricultural modernization level has an important impact on the efficiency of rural environmental management. With the promotion of agricultural modernization, agricultural production methods are gradually changing from traditional to modern, and agricultural production efficiency has been significantly improved. At the same time, the improvement of agricultural modernization level also promotes the resourceful utilization and harmless treatment of agricultural waste, reducing environmental pollution in the process of agricultural production. For example, some regions have realized the precise collection and treatment of agricultural waste through the promotion of intelligent agricultural equipment and technology, effectively improving the efficiency of environmental management.

4.3. Socio-economic Constraints

Socio-economic factors are also one of the important factors affecting the efficiency of rural environmental governance. The level of economic development, farmers' environmental awareness and participation all have an important impact on the efficiency of environmental governance.

The level of economic development is an important factor affecting the input of environmental governance. As one of the most economically developed regions in China, the Yangtze River Delta region has a high level of economic development and relatively large investment in environmental governance. However, there are differences in the level of economic development of different regions, leading to differences in environmental governance inputs. In some economically backward regions, insufficient investment in environmental governance has led to lower environmental governance efficiency.

Farmers' environmental awareness and participation is one of the key factors affecting the efficiency of rural environmental governance. The stronger the farmers' environmental awareness and participation, the higher the efficiency of environmental governance. However, in some rural areas in the Yangtze River Delta region, farmers' environmental awareness is relatively weak and their

participation is low. This is mainly due to farmers' insufficient awareness of environmental protection and lack of environmental knowledge and skills. Therefore, strengthening farmers' environmental protection education and training, and improving their environmental protection awareness and participation are important ways to enhance the efficiency of rural environmental management.

To summarize, policy guidance, scientific and technological support and socio-economic factors are important factors affecting the efficiency of rural environmental governance in the Yangtze River Delta region. In order to enhance the efficiency of environmental governance, it is necessary to formulate more scientific and reasonable policies, strengthen scientific and technological research and application, and improve farmers' environmental awareness and participation, so as to jointly promote the in-depth development of rural environmental governance in the Yangtze River Delta region.

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