

# Measurement and Optimization Strategy of Urban Environmental Governance Efficiency in Different Provinces of China

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**Abstract:** The urban environment has certain attributes of public products, and its governance activities are often led by the government. Since the 18th National Congress of the Communist Party of China, China has actively promoted the coordination of resources and the environment, steadily promoted the construction of socialist ecological civilization, and sought breakthroughs in urban environmental governance methods, governance scopes, and governance concepts. Studying the level and efficiency of urban environmental governance in different regions is conducive to the realization of coordinated urban and rural development and the improvement of regional comprehensive environmental conditions. This paper uses data envelopment analysis to measure the urban environmental governance efficiency of 31 provinces in China in 2019, and quantitatively analyze and compare comprehensive technical efficiency score, pure technical efficiency score, scale efficiency score, and return to scale. It is found that (1) the urban development in various regions is unbalanced, and the efficiency of environmental governance varies greatly; (2) the overall efficiency of urban environmental governance in Jilin, Liaoning, Ningxia, and Tibet is relatively good. The pure technical efficiency score of urban environmental governance in Guangdong, Hunan, and Shandong performed relatively well; The economies of scale in Guizhou, Hainan and Qinghai are relatively obvious, and the growth level of urban environmental governance output factors is higher than that of input factors. China should refine the investment direction of environmental governance, introduce advanced environmental governance technologies, explore comprehensive governance models involving all citizens, and formulate environmental governance plans that meet the actual conditions of the city, so as to improve the efficiency of urban environmental governance, optimize the level of urban environmental governance, and realize the sustainable development of economy, resources and environment.

**Keywords:** Urban Environment, Environmental Governance, Efficiency Measurement, DEA, Environmental Economy.

## 1. Introduction

The importance of cities as the core engine and space carrier of regional development is self-evident, and is closely related to the high-quality development of the national economy and society. As the largest developing country in the world, with the in-depth development of reform and opening up, the process of urbanization is accelerating. More and more rural populations are flocking to cities to enjoy the development dividends brought by cities. In 2019, China's urban permanent population accounted for The ratio has exceeded 60%. Urbanization has brought people convenient and rich material living conditions, but the ensuing environmental crisis and other negative effects have become increasingly apparent. In recent years, problems such as haze, water pollution, and travel congestion have severely affected the physical and mental health of urban residents, and caused many inconveniences to urban residents' daily production and life. At the Second Session of the Thirteenth National People's Congress held in 2019, General Secretary Xi Jinping pointed out that the development stage of China's economy is changing from rapid growth to high-quality growth, it is resolutely explore high-quality development guided by ecological priority and green development.

As the concept of energy saving and environmental protection is accepted by more and more people, the theory of environmental economics has gradually become one of the

basic theories of modern urban management planning. The living mode of population, economy, resources and the natural environment coordinated development has become the goal pursued by urban construction.

Compared with Western developed countries, China's urban environmental governance level is still immature, with large differences in governance efficiency. Since the 18th National Congress of the Communist Party of China, the government has been committed to promoting ecological civilization. The central and local governance methods of the urban environment have been continuously improved, and governance work has continued to increase. Urban environmental governance has increasingly demonstrated its reality and urgency.

## 2. Characteristics of China's urban environmental governance

### 2.1. Governance Method: Combination of Comprehensive Governance and Regional Strengthening

With the continuous development of China's economy, the process of urbanization is also advancing, and the scale of cities continues to expand, its influence on the surrounding urban-rural junctions and rural areas is gradually increasing. In this state, the urban-rural fringe and the rural areas close to the urban built-up area will assume part of the urban functions,

so that these areas will also have environmental problems that only occur in cities; At the same time, the expansion of cities will inevitably incorporate surrounding areas into the urban environmental system, which will affect the original rural ecosystems dominated by forest land, rivers, and farmland, and bring greater pressure to urban environmental governance. The improvement of China's socialist market economy system has allowed various regions of the country to form a closely connected organic whole, and the trend of regional economic integration has gradually emerged, in order to further promote the construction of socialist ecological civilization, in the process of environmental governance, focus on the overall situation, take a long-term view, and combine comprehensive environmental governance with strengthening of key areas. from point to area, fully integrate the current economic development in the primary stage of my country's socialism and regional economic operation status, and carry out work in accordance with local conditions. Due to the uneven regional development, there will be certain differences in the level and efficiency of urban environmental governance between different regions. Analyzing and studying the development characteristics and environmental governance of different regions will help each region learn from each other and learn from each other's strengths, thereby realizing the improvement of the overall environmental governance level.

## **2.2. Governance Scope: Combination of Urban Environment and Rural Ecology**

Protecting the environment means protecting human beings, optimizing environmental governance capabilities and improving environmental governance are in the common interest of all mankind. In the past, human pollution prevention and control activities were mainly concentrated in the industrial field. As cities are industrial clusters, environmental governance have received more attention. The fiscal taxation created by cities is relatively high, and they can have more convenient conditions and more sufficient funds to carry out environmental governance. If environmental governance is judged purely in accordance with market mechanisms, environmental governance investment will be greatly inclined to cities. The superiority of my country's socialist market economy system lies in the fact that fiscal taxation is truly taken from and used by the people, and the country can implement powerful macro-control. Although rural areas do relatively little damage to the environment, they have a greater impact on residents' life experience and regional development. In recent years, the Party Central Committee and the State Council have repeatedly proposed to coordinate urban and rural development, strengthen unified deployment and comprehensive coordination in environmental governance, and integrate urban environmental governance with rural ecological protection. While realizing urban environmental governance, it will bring advanced technologies and cutting-edge concepts to rural ecological protection, avoiding rural areas from re-taking the old path of "pollution first, governance later", and laying a foundation for the improvement of regional environmental protection. Research on urban environmental governance can not only provide reference for urban development and environmental protection, but also provide reference for rural ecological protection and sustainable development.

## **2.3. Governance Concept: Combination of Pollution Reduction and Efficiency**

Environmental governance activities are complex, extensive, long-term and comprehensive. It is a public management activity with a complex system, various contents and a long duration. When the national economy develops to a certain stage, the development model of high energy consumption and high growth will inevitably bring environmental problems. The environmental pollution caused by human beings for economic development, especially industrial production, and the pollution caused by increasingly rich urban life will become increasingly serious. China's economy has developed rapidly after the reform and opening. Since modern times, China has not had a stage of full economic capitalism. Therefore, the concept of environmental protection and environmental governance has not kept pace with Western mainstream capitalist countries. Since the founding of the People's Republic of China, China's urban environmental governance has basically gone through the priority industrial development stage before the reform and opening, the comprehensive pollution prevention stage at the end of the 20th century, the environmental and ecological civilization construction stage at the beginning of the 21st century, and the current comprehensive urban environmental governance stage. An important feature of the current concept of comprehensive urban environmental governance is that it extends the concept of environmental governance. It is believed that in the process of urban development, a diversified and all-round environmental governance system should be established, not only to promote the reduction of emissions, but also to focus on proactively saving energy. Coordinate energy conservation and emission reduction. At the same time, it is necessary not only to restrict pollution and reduce pollutant discharge, but also to actively take measures to improve technology and management level, improve pollution control efficiency, realize the combination of increment and quality improvement.

## **3. Urban Environmental Governance Theory and Efficiency Measurement Mechanism**

### **3.1. Overview of Urban Environmental Governance**

The concept of urban environment was proposed and expanded with the development of market economy. In an economically underdeveloped feudal society, the means of production are relatively scarce, the basic life of the residents is not yet satisfied, the real city has not yet formed, not to mention the urban environment and its governance and improvement. As far as the current public perception is concerned, the urban environment is the sum of the external factors that affect the production and life of residents in the city. It mainly refers to the physical environment of the city, including the natural environment and the artificial intervention environment. Urban environmental governance refers to relying on public management methods to regulate and guide the behavior of organizations and individuals in the city, so as to optimize and improve the production and living environment [1]. Urban environmental governance is a special public service provided by the government to residents. When residents pay taxes and accept government management, they should enjoy the public products provided

by the government, including good ecology. The urban environment has an important impact on the production and life of residents. It is the common goal of all residents to strive to improve the urban environment. However, because the urban environment has the attributes of public products and cannot be occupied by specific people alone, any organization or individual's actions to improve their environment have a strong spillover effect. Therefore, they can only rely on the government to take the lead in carrying out urban environmental governance work for all. Only when residents improve the urban environment can they further optimize the urban environment in an orderly, planned, and efficient manner.

### **3.2. Economic Performance of Urban Environmental Governance Activities**

Although the awareness of urban environmental improvement and optimization has been popularized with economic development very early, urban environmental governance was proposed as an independent concept at the end of the 20th century. With the deterioration of the earth's ecological environment, more and more countries are beginning to realize that the earth's environmental carrying capacity is limited, and people must pay attention to environment issue and improve the ecological environment. Until the 21st century, the concept of energy conservation and environmental protection has gradually been widely accepted, and the academic community has begun to study and discuss the issue of urban environmental governance. Environmental management theory believes that the ultimate goal of people's environmental intervention is to achieve the coordination of ecological environment and social development. Urban environmental governance is an important part of urban governance and an important manifestation of urban environmental management. Most of it is led by the government and funded by government public finances. In order to further measure and evaluate the efficiency of urban environmental governance, academic circles often conduct research on urban environmental governance by measuring the resources invested by the government in urban environmental governance and the effects produced. The input and output of urban environmental governance are mostly manifested through changes in economic indicators such as investment in public infrastructure construction, landscaping, city appearance and environment, as well as sewage treatment, road cleaning, and green coverage. Studying the economic performance brought about by urban environmental governance activities is of great significance to the study of urban management, pollution control and governance efficiency.

### **3.3. Efficiency Measurement Mechanism of Environmental Governance**

From the literal meaning of efficiency, it can be understood as the power that produces an effect. The efficiency of economics is the ratio of the total output to the total input in a specific time [2]. Under certain conditions of input, the more output, the higher the efficiency. Under certain conditions of output, the more input, the higher the efficiency. The level of efficiency has nothing to do with the speed of production. In a broad sense, efficiency evaluation can be understood as the analysis and judgment of the production capacity of the evaluation object. Efficiency evaluation is widely used in economic analysis and business management. The efficiency

measurement discussed in this paper is the measurement and evaluation of the input-output capacity, that is, the study of how much output a single unit of input can have, or how many units of output can be increased by adding a unit of input.

Under the theory of public goods and regulatory economics, the efficiency of urban environmental governance is the environmental governance results that can be brought about by the city's investment in environmental improvement. Carry out research on the efficiency of urban environmental governance, data indicators generated by cities in different regions to deal with pollution and adopt governance methods are definite, recordable and cognizable, making quantitative analysis possible. And the efficiency measurement results can be used to analyze urban environmental governance optimization strategies in the context of energy conservation and emission reduction from the perspectives of applied economics and economic geography. these need to be based on scientific and rigorous analysis conclusions [3]. Therefore, this paper tends to choose a method that can be objectively and quantitatively evaluated for comprehensive efficiency measurement.

## **4. Measurement of Environmental Governance Efficiency in Chinese Provincial Cities**

### **4.1. Measurement Method**

The data envelopment analysis (DEA) method is widely used to study non-parametric technical efficiency score based on mutual comparison between evaluation objects, calculate by own data to empower input indicators and output indicators, it has obvious advantages to measure efficiency in the presence of multiple input-output variables. Charnes, Cooper, and Rhodes published a research paper titled "Measuring the Efficiency of Decision-Making Units" in the European Journal of Operations Research in 1978, they first proposed the DEA method to analyze the efficiency of standardization [4]. This method is widely used by experts and scholars, and on the basis of this theory, the DEA model and analysis methods are constantly expanded and innovated. Later, people named this typical DEA model, the CCR model, after three authors. This model uses comparable and measurable measurement objects as decision-making units (DMU), and assumes constant returns to scale (CRS). The efficiency level obtained by the analysis takes into account the impact of scale. Therefore, it is often used to evaluate the comprehensive efficiency score of DMU.

Because the improvement of the ecological environment and the improvement of residents' living convenience are non-exclusive as the result of environmental governance, often only the government has the motivation and ability to govern the environment, the efficiency of urban environmental governance is essentially the efficiency of government environmental input. Therefore, this paper adopts the input-oriented CCR model to evaluate the efficiency of urban environmental governance, which makes the evaluation process of urban environmental governance efficiency between different provinces in China more rigorous and the analysis results more scientific and effective. Assuming that our evaluation object can form  $t$  DMUs, we need to evaluate the comprehensive efficiency score of these DMUs  $DMU_t$  ( $t=1,2,3\dots b$ ), each DMU has  $m$  types of inputs, denoted as  $x_i$  ( $i=1,2,3,\dots m$ ), the weight of inputs is denoted as  $Invi$ ;  $n$  types of outputs, denoted as  $y_j$  ( $j=1,2,3,\dots n$ ), the weight of the output

is recorded as  $Outp_j$ , The current comprehensive efficiency score of DMU to be evaluated  $DMU_k$  is an investment-oriented CCR model planning based on CRS, as shown in Equation 1.

$$\max \frac{\sum_{j=1}^n Outp_j y_{jk}}{\sum_{i=1}^m Inv_i x_{ik}} \quad (1)$$

At the same time, Equation 4.1 needs to obey the conditions shown in Equation 2:

$$\sum_{j=1}^n Outp_j y_{ja} - \sum_{i=1}^m Inv_i x_{ia} \leq 0; \quad Inv \geq 0; \quad Outp \geq 0 \quad (2)$$

The important significance of the input-oriented CCR model (Equation 1) is to maximize the comprehensive efficiency score of the DMU to be evaluated under the premise that the output of all DMUs is less than the input, that is, the efficiency of all DMUs is less than or equal to 1. The efficiency score measured by the CCR model is the relative efficiency score include DMU to be evaluated and higher efficiency DMU. This evaluation method is relatively more conservative, In the case of unbalanced economic and social development and large differences in environmental governance activities across my country, it makes the measurement results of urban environmental governance efficiency in various regions more representative and comparable. The comprehensive efficiency score obtained by the CCR model includes the scale efficiency score part, In 1984, Banker, Charnes and Cooper published an article "Several Models for Estimating Technical and Scale Inefficiency in Data Envelopment Analysis" in the Journal of Management Science. They added constraint formula 3 on the basis of the CCR dual model, and proposed a DEA model for evaluating scale efficiency score, which was named the BCC model after the three authors [5]. The BCC model assumes that the variable returns to scale (Variable Returns to Scale,

VRS), the calculated technical efficiency score excludes the influence of scale, and proposes the calculation method of scale efficiency score, as shown in Equation 4. The CCR model and BCC model laid the foundation for DEA, and reserved room for reference and analysis for further research on the overall efficiency of urban environmental governance in this paper.

$$\sum_{a=1}^b \lambda_a = 1 (\lambda \geq 0) \quad (3)$$

$$\text{Scale efficiency score} = \frac{\text{Comprehensive technical efficiency score}}{\text{Pure technical efficiency score}} \quad (4)$$

## 4.2. Sample Selection

When selecting input-output indicators, we should focus on whether the indicators can scientifically reflect the input-output behavior of DMU, and the relevance direction of each element indicator and environmental governance behavior should be consistent. The opinions of some experts and scholars on the theoretical basis of economics, the framework of input-output indicators and the angle of choice are worthy of reference [6]. According to the theoretical foundation formed in the previous paper, the input elements of urban environmental governance need to be able to measure the investment in improving the urban environment, optimizing the living experience of residents, and promoting the construction of public environmental facilities. The output elements of urban environmental governance need to be able to reflect the actual effects of environmental improvement and the impact on the city. This paper selects the completed investment in urban public facilities construction, landscaping investment, city appearance and environmental sanitation investment as input element indicators, selects sewage treatment volume, green coverage area, and road cleaning area as output element indicators (Table 1).

**Table 1.** The input-output factor index for measuring the efficiency of urban environmental governance

Element	Index	Explain
Input elements	Urban public facilities construction investment	Measure investment in the construction of comprehensive public infrastructure for environmental governance
	Landscaping investment	Measure investment in improving the city's natural environment
	City appearance and environmental sanitation investment	Measure investment in improving the overall urban environment and residents' life experience
Output elements	Sewage treatment volume	Reflecting sewage treatment capacity, essential for urban life
	Green coverage area	Reflect the quality of the city's natural environment and affect the residents' living experience
	Road cleaning area	Intuitive reflection of the improvement of urban surface environment

According to DEA analysis experience, the number of input-output indicators needs to be coordinated with the number of DMUs. The number of DMUs needs to be greater than the product of the number of input elements and output elements, or more than three times the sum of the number of input elements and output elements (Equation 5,  $G_{DMU}$  Is the number of DMUs,  $m$  and  $n$  are the number of input and output elements respectively), If this condition is not met, it is likely that the results of most DMUs or even all of the DMUs are consistent, and the efficiency of DMUs cannot be compared and distinguished. The analysis results are likely to be distorted, or lose representative significance, and cannot provide scientific guidance for practice.

$$G_{DMU} \geq \max\{mn, 3(m+n)\} \quad (5)$$

To analyze the level of pollution control in inter-provincial cities, measure and analyze the comprehensive technical efficiency score, pure technical efficiency score and scale efficiency score of urban pollution control in different provinces, while taking into account the operability of data collection and the scientific nature of data sources. The article chooses 31 provinces (autonomous regions and municipalities directly under the Central Government) in mainland China and the whole country as the DMU. The DMU quantity formula is 5, which can ensure the scientific

of efficiency measurement. Retrieving data through the database can make data collection more accurate and efficient, this paper uses the total input of 31 provinces (autonomous regions and municipalities directly under the Central Government) and the whole country in 2019 compiled in the EPSDATA database to generate factor index data. A total of 32 sets of 162 sample data were used to measure the efficiency of inter-provincial urban pollution control.

### 4.3. Efficiency Measure

In order to more intuitively judge and analyze the overall

situation of the sample data, the overall grasp of the input and output elements of urban environmental governance in different provinces in China is convenient for subsequent calculations using computer analysis software. This paper uses Microsoft Excel 2016 spreadsheet software to sort, classify and preprocess the sample data, uses SPSS Statistics 21 statistical software to perform descriptive statistics on the sample data, and the results are shown in Table 2.

**Table 2.** Descriptive statistical results of input and output elements of China's inter-provincial urban environmental governance

	Urban public facilities construction investment (10,000RMB)	Landscaping investment (10,000RMB)	City appearance and environmental sanitation investment (10,000RMB)	Sewage treatment volume (10,000 m3)	Green coverage area (hectares)	Road cleaning area (10,000 m3)
Mean	6484047	594490	179513	172849	117555	29644
Median	4336395	284558	125274	130759	81462	21652
Standard deviation	5502458	734203	194800	154029	113693	23836
Minimum	21599	5000	1839	9130	6415	1949
Max	19684223	3504425	844674	782028	584449	118646

**Note:** The descriptive statistical results in this table are rounded to integers

It can be seen from Table 2, In the sample data, there are three input indicators of urban public facility construction investment, landscaping investment, and city appearance and environmental sanitation investment, and three output indicators of sewage treatment volume, green coverage area, and road cleaning and cleaning area, there is a big difference between their maximum and minimum. The maximum investment in urban public facilities construction is 19,694,223, which is nearly 911 times the minimum of 21,599; The standard deviation is relatively high, and the input and output of urban environmental governance in 2019 between different provinces in China are quite different. The average value of the input and output indicators of urban environmental governance in different provinces is greater than the median, and the sample data is relatively large. It can be seen that the overall level of environmental governance in various regions in China is relatively high. Although there are large differences between regions, low-level regions are still a small number, and some regions have relatively better performance.

Since efficiency measurement through DEA requires complex calculations on large amounts of data, and it also requires a certain linear programming basis. This paper uses the MaxDEA Basic 8.3 Chinese analysis software developed by Dr.Cheng Gang to measure the efficiency of inter-provincial urban environmental governance, which can try to avoid data processing errors due to operational errors and ensure the scientific of the analysis results, the efficiency measurement results are shown in Table 3. The comprehensive technical efficiency score, pure technical efficiency score and scale efficiency score are between 0-1. The higher the efficiency value, the higher the relative efficiency. When the efficiency value of the DMU is 1, it means that the DMU has the least investment and the most output in the efficiency comparison, and has realized the full implementation of

environmental governance; When the efficiency value of multiple DMUs is 1, it means that the relative efficiency of these DMUs is the highest, and the input-output level of urban environmental governance is at the front of DEA, reaching DEA effectiveness.

It can be seen from Table 3 that the comprehensive technical efficiency score and scale efficiency score of Jilin, Liaoning, Ningxia, and Tibet are 1, and the pure technical efficiency score of Guangdong, Hunan, Jilin, Liaoning, Ningxia, Shandong, Tibet, and the whole country is 1. The number of DMUs with a technical efficiency score of 1 did not exceed half of the total number. From the perspective of the effectiveness of DEA, the purpose of judging DMUs with excellent relative technical efficiency score was achieved. The calculation method and element selection of this measurement are scientific and can realize effective efficiency measurement. The returns to scale in Guizhou, Hainan, and Qinghai are increasing, while the returns to scale in Jilin, Liaoning, Ningxia, and Tibet remain unchanged, while the returns to scale in other regions are decreasing. In particular, the overall technical efficiency score of urban environmental governance across the country is 0.2387, the pure technical efficiency score is 1, and the scale efficiency score is 0.2387. The overall technical efficiency scores of 13 regions and the pure technical efficiency scores of 24 regions are lower than the overall national level, and the scale efficiency score of all regions is higher than the overall national level. As a whole, the scale of urban environmental governance activities in the country must be greater than the scale of urban environmental governance activities in various regions, and its scale efficiency score is affected by poorly performing areas and will lag behind each individually measured area, the result of this measurement is in line with the actual situation and public perception.

**Table 3.** Measured results of China's inter-provincial urban environmental governance efficiency

DMU	TES(CRS)	PTES(VRS)	SES	RTS	DMU	TES(CRS)	PTES(VRS)	SES	RTS
Anhui	0.1913	0.3330	0.5746	Decreasing	Liaoning	1.0000	1.0000	1.0000	Constant
Beijing	0.1145	0.1214	0.9426	Decreasing	Inner Mongolia	0.4073	0.7662	0.5316	Decreasing
Fujian	0.1641	0.1682	0.9753	Decreasing	Ningxia	1.0000	1.0000	1.0000	Constant
Gansu	0.3417	0.4711	0.7253	Decreasing	Qinghai	0.2338	0.2885	0.8104	Increasing
Guangdong	0.3913	1.0000	0.3913	Decreasing	Shandong	0.2669	1.0000	0.2669	Decreasing
Guangxi	0.2891	0.3353	0.8623	Decreasing	Shanxi	0.2183	0.3567	0.6121	Decreasing
Guizhou	0.5192	0.5279	0.9835	Increasing	Shaanxi	0.2528	0.2660	0.9502	Decreasing
Hainan	0.6380	0.6982	0.9138	Increasing	Shanghai	0.3947	0.4173	0.9459	Decreasing
Hebei	0.2764	0.4131	0.6691	Decreasing	Sichuan	0.1620	0.4190	0.3867	Decreasing
Henan	0.1741	0.3123	0.5575	Decreasing	Tianjin	0.1918	0.1966	0.9758	Decreasing
Heilongjiang	0.7678	0.7731	0.9932	Decreasing	Tibet	1.0000	1.0000	1.0000	Constant
Hubei	0.1852	0.2675	0.6924	Decreasing	Xinjiang	0.4060	0.5091	0.7974	Decreasing
Hunan	0.5936	1.0000	0.5936	Decreasing	Yunnan	0.3278	0.4328	0.7575	Decreasing
Jilin	1.0000	1.0000	1.0000	Constant	Zhejiang	0.1996	0.4527	0.4408	Decreasing
Jiangsu	0.2319	0.7543	0.3074	Decreasing	Chongqing	0.2284	0.4500	0.5077	Decreasing
Jiangxi	0.0770	0.1366	0.5635	Decreasing	Nationwide	0.2387	1.0000	0.2387	Decreasing

Note:TES is short for Technical Efficiency Score,PTES is short for Pure Technical Efficiency Score,SES is short for Scale Efficiency Score,RTS is short for Return to Scale.The efficiency measurement result of this table retains four decimal places.

## 5. Result Evaluation

### 5.1. Urban Development in Various Regions Is Uneven, And the Efficiency of Environmental Governance Varies Greatly

The difference between the maximum and minimum investment in urban public facilities construction in various regions of the country is nearly 910 times, and the difference between the maximum and minimum road cleaning area is nearly 60 times; The efficiency value of Jiangxi, where the overall technical efficiency score of urban environmental governance is the lowest, is only 0.077, which is still a huge gap with areas with relatively good efficiency. This is because the social environment and economic development levels of China are not balanced between regions, and the economic foundation, urban development traditions, customs and habits of different regions, as well as residents' life consciousness are quite different. It is true that urban environmental governance needs to be implemented by the government, but environmental governance activities need to be adapted to local conditions. In the process of environmental governance, local residents must be fully mobilized. Therefore, urban environmental governance must be combined with the local economic and social development status to achieve the expected results.

### 5.2. The Comprehensive Efficiency Scores of Urban Environmental Governance in Jilin, Liaoning, Ningxia, And Tibet Are Relatively Well, While the Pure Technical Efficiency Scores of Urban Environmental Governance in Guangdong, Hunan, And Shandong Are Relatively Well

The comprehensive technical efficiency scores, pure technical efficiency scores, and scale efficiency scores of urban environmental governance in Jilin, Liaoning, Ningxia, and Tibet are all 1, and their resource allocation capabilities and utilization efficiency have achieved technical effectiveness under comprehensive measurement. It shows that the urban environmental governance of the four places is relatively good, and their governance systems, governance capabilities, and governance concepts perform well. This may be due to the fact that Jilin and Liaoning are located in the old industrial bases in Northeast China, and the cities developed earlier and have the resource conditions for urban environmental governance; The development of state-owned enterprises in the Northeast region has social environmental advantages, which have already involved all aspects of urban operation, enabling Jilin and Liaoning regions to utilize the huge influence of state-owned enterprises to quickly promote urban environmental governance. Ningxia and Tibet are areas where ethnic minorities live in concentrated communities. There are large areas of nature reserves and natural conditions are superior. However, because they are inland, the economic foundation is poor and the urban development is relatively backward. However, this has created more convenient conditions for urban environmental protection and governance from another perspective. In the process of urban development, more scientific planning can be realized, and a more forward-looking environmental protection concept can

be formed, laying a foundation for the optimization of urban environmental governance efficiency, Solid foundation.

The pure technical efficiency scores of urban environmental governance in Guangdong, Hunan, and Shandong is 1, indicating that the urban environmental governance system in the three places is relatively scientific and the management level is relatively high, and a relatively scientific urban environmental governance system has been established. This may be because Guangdong's economy is relatively developed, it is at the forefront of reform and opening up, its urban planning is relatively rigorous, and its urban environmental protection governance mechanism is more complete; Shandong is located in the eastern coastal area, and has a higher sensitivity to the environment, a stronger awareness of environmental protection, and a higher enthusiasm for the development and utilization of energy saving and emission reduction technologies; Dongting Lake in Hunan Province is an important water source in the central and southern regions, and is the focus area of the Central Ecological Environmental Protection Supervision Team. Its urban environmental governance is also facing greater policy and public opinion pressure, making it compelling to pay attention to urban environmental governance, actively improve the level of ecological and environmental protection management.

### **5.3. The economies of Scale in Guizhou, Hainan, And Qinghai Are Relatively Obvious, And the Growth Level of Output Factors of Urban Environmental Governance Is Higher Than That of Input Factors**

In general, the return to scale of DMU will go through three stages of increasing return to scale, constant return to scale, and diminishing return to scale. When the return to scale is constant, it often means that it is at a critical point between increasing and decreasing, at its best. Guizhou's comprehensive technical efficiency score is 0.5192, pure technical efficiency score is 0.5279, and scale efficiency score is 0.9835; Hainan's comprehensive technical efficiency score is 0.6380, pure technical efficiency score is 0.6982, and scale efficiency score is 0.9138; Qinghai's comprehensive technical efficiency score is 0.2338, and pure technical efficiency score is 0.2885, the scale efficiency score is 0.8104. The comprehensive technical efficiency scores of the three places are quite different and the overall level is not high, especially Qinghai is even lower than the national overall level, but they are all in the stage of increasing returns to scale. This shows that the three places have great potential in optimizing the efficiency of urban environmental governance. Measures are being taken to improve the level of urban environmental governance, improve resource allocation and management capabilities, and show a trend of increasing returns with its strong accumulation of scale.

## **6. Optimization Path of Urban Environmental Governance Efficiency**

### **6.1. Refine the Investment Direction of Environmental Governance to Ensure That the Special Funds Are Used Exclusively**

Financial investment at all levels is the main source of funds for urban environmental governance. Formulating scientific financial investment directions and rigorous financial capital use planning, and the government's financial investment is relatively inclined to environmental governance, which has a positive effect on improving the efficiency of urban environmental governance [7]. Sufficient capital investment is an effective guarantee for realizing scientific environmental governance. When formulating fiscal budgets related to urban environmental governance, all regions should refine the specific investment directions for environmental governance, use fiscal funds in real ways, and guide urban environmental governance through fiscal funds. Urban environmental governance involves a wide range of areas and requires coordination and cooperation among multiple departments. Only by detailed capital investment can the division of powers and responsibilities be clearly defined and the efficiency of environmental governance can be improved. In the context of the current downward trend in the global economy and the new normal in China's economic and social development, the idea of emphasizing economic development and neglecting environmental governance should be corrected, and the audit of fiscal funds, especially environmental governance funds, should be strengthened, use information technology to monitor and record the performance of fiscal expenditures, ensure that fiscal funds are earmarked for use, and resolutely put an end to irregularities such as failing to allocate environmental governance funds on time and embezzling funds for other purposes.

### **6.2. Actively Absorb Advanced Environmental Treatment Technologies to Realize the Optimization of the Overall Environmental Governance Efficiency**

Local governments should actively absorb and introduce advanced environmental governance technologies, not only to promote the application of advanced science and technology in energy conservation and emission reduction, but also to actively introduce cutting-edge management models and advanced practical experience [8]; It is not only necessary to promote the promotion of existing technologies in the process of local environmental governance, but also to formulate preferential policies to encourage the development of new technologies, so as to encourage the public to gradually recognize and accept the best economically feasible technologies. In cases where direct government action may have an impact on the healthy development of the market economy, local governments can invest government funds into public welfare funds, environmental protection social organizations or public welfare NGOs, and indirectly guide enterprises and individuals to improve resource conservation and pollution emission levels through market economic means [9]. Due to the differences in the development model

and level of cities in different regions, the application models of related environmental governance technologies in different regions are different. While applying environmental governance technologies, all localities should pay attention to sorting out and summarizing experience and lessons, and form a typical environmental governance model to be promoted throughout the country, so that regions with relatively advanced efficiency can play a radiating and leading role in regions with relatively backward efficiency, ultimately realize the optimization and improvement of the overall environmental governance efficiency across the country.

### **6.3. Exploring A Governance Model Led by The Government and Participation of All Citizens to Promote Residents' Environmental Protection Awareness**

The government-led development of urban environmental governance has become the mainstream idea of the global urban planning and public management, but the improvement of urban environmental governance efficiency cannot rely solely on government actions. All localities should mobilize the public to participate in environmental protection, strengthen the publicity of environmental knowledge, and promote residents to establish environmental protection awareness, actively exploring a comprehensive governance model led by the government and participation of all citizens. The government can purchase services to carry out environmental governance, and fully mobilize social organizations, enterprises and individuals to participate in environmental protection and urban management. In addition to the government, companies have strong financial strength, and for their own development needs, there is a stronger need to improve the surrounding environment. The government should attach importance to the positive role of enterprises in improving the urban environment and create good conditions for enterprises to fulfill their social responsibilities. At the same time, the government should regulate the economic behavior of the public, explore the establishment and regulation of environmental markets, form a diversified input system, and promote enterprises, individuals and social organizations to spontaneously protect and govern the environment through market regulation.

### **6.4. According to the Level of Urban Development to Formulate Environmental Governance Planning to Adapt to Local Conditions**

Under the transmission effect of the economy, there will be temporal and spatial differences between the urban economic and social development and its environmental governance behavior. Optimizing the efficiency of urban environmental governance requires promoting the coordination of economic and social development and environmental governance, correctly understanding and analyzing urban economic and social development trends, and scientifically formulating environmental governance plans [10]. It is not only necessary to analyze the current urban development situation, but also to predict the urban development space in a certain period in the future to make the planning more forward-looking. Only by combining urban environmental governance planning with

urban development planning, can the urban environmental governance truly play its full role. Local governments are not only the main body of environmental governance, but also efficiency evaluation and planning formulation parties, They are both "athletes" and "referees." this is not conducive to self-evaluation and efficiency optimization of urban environmental governance from a fair and objective perspective, Third-party professional efficiency evaluation agencies and planning agencies should be introduced to provide constructive opinions on the evaluation of government behavior from the perspective of the public and professional cognition, and provide decision-making reference for the formulation and implementation of environmental governance plans.

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