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Inter-regional Differences in Environmental Regulation Intensity Among Chinese Provincial Governments and the Overall Planning Countermeasures

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ABSTRACT

This research establishes a set of multi-layer comprehensive evaluation index system through global entropy method and conducts comprehensive evaluation of the environmental planning intensity among Chinese provincial governments. Based on the above, the inter-regional differences in environmental regulation intensity among 30 Chinese provincial governments are further analysed with methods of quartile analysis and coefficient of variance, revealing the status of spatial differences in environmental regulation level among provincial governments. In addition, corresponding overall planning countermeasures are proposed. Research results show that during 2006-2014, the environmental regulation intensity of various Chinese provincial governments had all seen certain improvement, but the inter-regional differences tended to be widening after experiencing certain amplitude of narrowing; and there was obvious difference in cognition of the importance of environmental governance investment among different provincial regions. To promote synergistic advancement of environmental regulation in Chinese provincial governments, the environmental regulation cooperation mechanism for cross-administrative regions has to be perfected, scientific and reasonable regional government performance examination mechanism has to be established, and muti-subject synergistic governance mechanism has to be set up as well.

INTRODUCTION

Government environmental regulation is a general term of various environmental laws, regulations, policies and measures formulated and implemented for environmental protection, and its intensity determines the effect of regional eco-environmental governance. At present, research on regional environmental regulation intensity is focused on the aspects of measurement method and inter-regional competition behaviours. Besides, the research on measurement methods of environmental regulation also displays the feature of diversity. Gray (1997) used the financial budget outlays for environmental and natural resources protection against America as the substitute index for environmental regulation. Levinson (1996) and Cole et al. (2008) respectively used the average number of staff in environmental organs and the number of environmental protection related cases of administrative penalty per enterprise as the substitute index for regional environmental regulation intensity. Pearce & Palmer (2001) advocated to combine government pollution treatment investment and corporate pollutants discharge reduction expenditures to measure the regional environmental regulation intensity. Zhang et al. (2011) used the regional pollutants discharge reduction expenditures per unit output valued to measure the regional environmental regulation intensity. Smarzynska & Wei (2004) used CO_2, lead and wastewaters to discharge reduction per output value as the measurement for environmental regulation intensity. Zhang et al. (2012) used industrial wastewater discharge standard-reaching rate and industrial sulphur dioxide removal rate to express environmental regulation intensity. Levinson (1996) believed that the evaluation of environmental regulation intensity should be handled from the three aspects of effort level, affordable cost and direct measurement. Sauter (2014) held that environmental regulation was a process of output-input, and the measurement should include three dimensions, namely input, process and result. The environmental regulation indexes built by Chen et al. (2012) include the four systems of environmental regulation law, environmental regulation supervision, environmental regulation methods and environmental regulation support. Li et al. (2011) studied the issue of undesirable output with directional environmental function model, and studied the environmental efficiency under four types of environmental regulation policies by selecting relevant indexes. Besides, there were also many scholars shaving explored the competition behaviours of environmental regulation in local governments. Yang et al. (2008) held that influenced by GDP-oriented government performance evaluation system and fiscal decentralization over the long run,

Table 1: Basic framework of evaluation index system for status quo of environmental regulation intensity in Chinese provincial governments.

Layer of Goal	Layer of Norm	Basic Indexes
Environmental regulation intensity level	Environmental Regulation Input	Ratio of environmental pollution treatment investment in GDP (‰) Ratio of industrial pollution treatment completion investment in industrial added value (%)
	Environmental Regulation Effect	Multipurpose utilization rate of industrial solid waste (%) Concentrated treatment rate of wastewater (%) Industrial soot discharge standard-reaching rate (%) Harmless treatment rate of domestic waste (%)

Table 2: Weight of evaluation indexes for status quo of environmental regulation intensity in provincial governments.

Layer of Goal	Layer of Norm	Basic Indexes	Weight of Index Layer
Spatial Differences in Environmental Regulation among Provincial Governments	Environmental Regulation Input	Ratio of environmental pollution treatment investment in GDP (‰)	0.2655
		Ratio of industrial pollution treatment completion investment in industrial added value (%)	0.3616
	Environmental Regulation Effect	Multipurpose utilization rate of industrial solid waste (%)	0.1494
		Concentrated treatment rate of wastewater (%)	0.0839
		Industrial soot discharge standard-reaching rate (%)	0.0648
		Harmless treatment rate of domestic waste (%)	0.0747

provinces were more likely to keep up with regions with a relatively weak regulation intensity, leading to comparing competition. Cui et al. (2009) found out that local governments would lead their environmental regulation to deviate from the goal of overall social welfare, so as to obtain a competitive edge of economic growth. Zhang et al. (2010) utilized two-zone Durbin fixed effects model to discuss the relations among features of environmental regulation strategy interaction.

Through retrieval of literature, it can be known that although there is a plenty of literature involving the area of environmental regulation intensity, little focuses on comparing the spatial differences in environmental regulation among Chinese provincial governments. To this end, this paper proposes to establish a set of multi-layer comprehensive index system using global entropy method and analyse the inter-regional differences in environmental regulation among 30 Chinese provincial governments using methods of quartile analysis and coefficient of variance. Furthermore, based on the above, corresponding overall planning countermeasures are put forward, which are of great referable value of planning the environmental regulation in Chinese provincial governments.

MATERIALS AND METHODS

Construction principles of evaluation index system: To evaluate the status quo of environmental regulation in Chinese provincial governments, an evaluation index system for environmental regulation level of Chinese provincial governments has to be firstly established. This paper follows three major principles. The first one is the principle of being scientific. Whether the design of the evaluation index system is reasonable and scientific, it will directly affect the quality of results, so the index system has to be able to objectively and comprehensively evaluate the status quo of environmental regulation level in Chinese provincial governments. The second one is the principle of being economical. It mainly refers to that the evaluation index system needs to be coordinated, complete, concise and clear, so the indexes to be selected should be advisable, large information-containing, representative and summarizing. The third one is the principle of being comparable. The content and meaning of evaluation indexes can be clearly defined, the indexes are comparable both horizontally and vertically, and the index system can objectively reflect the status quo of environmental regulation intensity level in Chinese provincial governments.

Selection of measurement indexes for environmental regulation intensity: After dissecting the existing research results, the contents involving environmental regulation mainly include public environment policy, environmental governance input and law enforcement effort, so environmental regulation intensity level can be measured from the two aspects of input and output. On the basis of existing research results, this paper selects indexes like ratio of environmental pollution treatment investment in GDP, ratio of industrial pollution treatment completion investment in industrial added value, concentrated treatment rates of wastewater, harmless treatment rate of domestic waste, industrial soot discharge standard-reaching rate, and multipurpose utilization rate of industrial solid wastes. Besides, it also establishes comprehensive evaluation index system containing the two dimensions of environmental regulation input and environmental regulation effect. The specific index system is as shown in Table 1.

Global entropy method: On the basis of building a comprehensive evaluation index system, this paper adopts the global entropy method that features objective weighting and dynamic comparability to obtain data on the level of environmental regulation intensity in provincial governments (Sun et al. 2009). The steps are as follows:

Build a global evaluation matrix and standardize it. n indexes are used to evaluate the science popularization resource development of m provincial regions over a duration of T years and ultimately build an initial global evaluation matrix for the evaluation system, which is recorded as X:

$$X = \left(x_{ij}^{t}\right)_{mT*n} = \begin{bmatrix} x_{11}^{1} & x_{12}^{1} & \cdots & x_{1n}^{1} \\ x_{21}^{1} & x_{22}^{1} & \cdots & x_{2n}^{1} \\ \cdots & \cdots & & \cdots \\ x_{m1}^{1} & x_{m2}^{1} & \cdots & x_{mn}^{1} \\ \cdots & & \cdots & \\ x_{11}^{T} & x_{12}^{T} & \cdots & x_{1n}^{T} \\ x_{21}^{T} & x_{22}^{T} & \cdots & x_{2n}^{T} \\ \cdots & \cdots & \cdots & \\ x_{m1}^{T} & x_{m2}^{T} & \cdots & x_{mn}^{T} \end{bmatrix} \quad ...(1)$$

Where, x_{ij}^{t} is the assigned value of the j[th] evaluation index of the i[th] provincial region at the t[th] year, and $n = 24$, $m = 30$, $T = 5$. Given that the dimension, magnitude and positive and negative assignment of each index vary, X has to be standardized to make $x_{ij}^{t} \in [0, 100]$, as shown in formula (2) and formula (3), $(x_{ij}^{t})'$ is the equally standardized index value, $x_{j\min}$ is the minimal value of the j[th] index, $x_{j\max}$ is the maximal value of the j[th] index. Formula (2) and formula (3) are respectively for the standardization of the positive index and negative index.

$$(x_{ij}^{t})' = \frac{x_{ij}^{t} - x_{j\min}}{x_{j\max} - x_{j\min}} \times 99 + 1 \quad (i = 1,2,...,m;\ j = 1,2,...,n;\ t = 1,2,...,T) \quad ...(2)$$

$$(x_{ij}^{t})' = \frac{x_{j\max} - x_{ij}^{t}}{x_{j\max} - x_{j\min}} \times 99 + 1 \quad (i = 1,2,...,m;\ j = 1,2,...,n;\ t = 1,2,...,T) \quad ...(3)$$

The formula for measuring the information entropy of the j[th] index is as follows:

$$e_j = -K \sum_{t=1}^{T} \sum_{i=1}^{n} y_{ij}^{t} \ln y_{ij}^{t} \quad ...(4)$$

Where $y_{ij}^{t} = \frac{(x_{ij}^{t})'}{\sum_{t=1}^{T} \sum_{i=1}^{m} (x_{ij}^{t})'}$, constant $K = \frac{1}{\ln mT}$, which is related to the number m of samples in the system. When the information in the system is distributed disorderly, then the degree of order is 0 and information entropy e_j=1. When samples are all in a disorderly state, y_{ij}^{t}=1.

According to information entropy index, the weight w_j of the j[th] index can be calculated. When $0 \le w_j \le 1$, $\sum_{j=1}^{n} w_j = 1$ as follows:

$$w_j = \frac{1 - e_j}{n - \sum_{j=1}^{n} e_j} \quad ...(5)$$

After obtaining the results of the index weight, formula (6) can be used to calculate the comprehensive evaluation score:

$$s_i = \sum_{j=1}^{n} w_j (x_{ij}^{t})' \quad ...(6)$$

Data source: According to related materials like China Statistical Yearbook (2006-2014), this paper builds the index datasheet for status quo of environmental regulation intensity in Chinese provincial governments. Following the implementation steps of comprehensive evaluation in global entropy method, the original data involved in evaluation go through forward and standardization processing. Then the non-dimensional data obtained are used to calculate the

Table 3: Comprehensive evaluation scores for the overall environmental regulation intensity level in provincial governments.

Region	Comprehensive evaluation score for the overall environmental regulation intensity level									
	Province	2006	2007	2008	2009	2010	2011	2012	2013	2014
Eastern region	Beijing	49.17	45.75	40.79	40.61	37.7	34.97	43.13	44.07	50.18
	Shanghai	35.14	40.14	39.76	40.01	37.82	36.89	38.31	38.63	43.18
	Tianjin	43.99	45.08	44.51	47.4	45.28	46.59	44.48	45.2	49.52
	Zhejiang	37.76	37.02	47.29	38.24	40.41	37.57	41.23	43.38	45.13
	Jiangsu	42.97	43.34	42.01	39.44	39.21	40.04	41.98	44.32	42.93
	Guangdong	30.05	29.46	28.62	31	50.11	32.05	32.83	34.94	34.32
	Shandong	42.55	44.58	45.92	45.13	43.47	44.9	46.35	48.07	49.82
	Fujian	34.35	32.01	33.11	35.33	36.85	37.89	41.59	43.08	39.77
	Liaoning	39.94	26.5	27.47	28.23	27.42	30.6	39.67	31.84	31
	Hebei	30.5	31.73	33.41	35.76	36.39	42.59	34.84	40.39	42.96
	Hainan	37.96	34.69	32.28	32.36	31.85	37.67	45.68	41.96	44.25
Central region	Heilongjiang	23.81	22.95	26.48	27.66	28.84	29.48	32.34	40.79	34.86
	Jilin	21.83	25.5	25.35	26.69	32.13	28.5	28.72	29.55	30.92
	Hubei	30.41	30.25	30.31	36.97	36.01	34.86	36.39	37.38	38.82
	Henan	29.09	31.06	31.32	31.55	32.37	33.27	33.33	30.87	38.27
	Hunan	30.83	26.39	28.86	31.93	31.87	30.52	33.02	35.91	34.33
	Anhui	29.72	34.01	38.14	37.35	37.09	39.39	45.32	54.36	46.86
	Jiangxi	20.33	21.56	20.77	25.51	33.08	35.52	40.09	35.29	33.35
	Shanxi	40.16	44.4	49.16	48.6	46.57	44.59	50.99	55.08	48.23
Western region	Shanxi	23.56	24.3	25.87	35.73	42.01	33.95	38.19	40.02	40.89
	Sichuan	29.42	26.89	31.23	27.19	24.77	26.83	26.14	29.24	30.99
	Inner Mongolia	37.77	32.37	34.53	34.41	37.65	45.17	41.87	52.06	55.95
	Guangxi	29.59	35.53	34.2	37.11	36.55	33.45	38.39	37.79	35.82
	Yunnan	25.83	26.81	29.8	33.98	36.85	36.6	37.44	40.89	37.73
	Xinjiang	21.67	22.79	26.6	37.45	27.97	33.02	43.81	52.19	58.77
	Ningxia	53.9	58.2	60.76	41.58	42.66	45.35	51.38	66.18	79.83
	Gansu	33.98	35.46	26.7	30.27	34.65	27.42	43.46	43.26	39.93
	Guizhou	28.36	20.17	25.86	26.58	29.58	36.5	36.37	38.18	40.39
	Qinghai	15.64	19.09	22.09	23.23	19.11	23.65	26.44	27.38	30.71
	Chongqing	34.03	41.84	40.33	42.15	45.67	46.89	40.37	39.72	37.36

weight of corresponding evaluation indexes (as given in Table 2).

Analyses result based on global entropy method: According to the Formula (6) for integrated score calculation, we can work out the comprehensive evaluation scores for the overall environmental regulation intensity status in provincial governments across the country as shown in Table 3.

According to the evaluation scores of environmental regulation intensity level for provincial governments 2006-2014, the average for national environmental regulation intensity during this period can be calculated for histogram as shown in Fig. 1.

From Table 3, it can be seen that for the progress of environmental regulation in provincial regulation, there is certain imbalance in overall current status evaluation scoring. Take the overall current status score as an example. From 2006 to 2014, the evaluation score for status quo of environmental regulation intensity in provincial governments displayed the development trend of stable growth; the average score increased from 32.81 in 2006 to 42.24 in 2014, with an increase of 9.43 in integrated score, indicating that the overall environmental regulation level in provincial governments during that period showed a sound development trend. From 2006 to 2014, the current status evaluation scores of environmental regulation in east, middle and west provincial governments increased with the same trend of national average score. Within the evaluation range, the average scores in east region over the years were obviously higher than national average and those of middle and east regions; while the average scores of middle and west regions were always slightly lower than national average.

Based on the above, it can be known that there were relatively obvious differences in environmental regulation level in provincial governments across the country. The score in east region was far higher than those of middle and west regions; the scores of middle and west regions were close; and the score in middle region was slightly higher than west region. However, seen from the growth amplitude

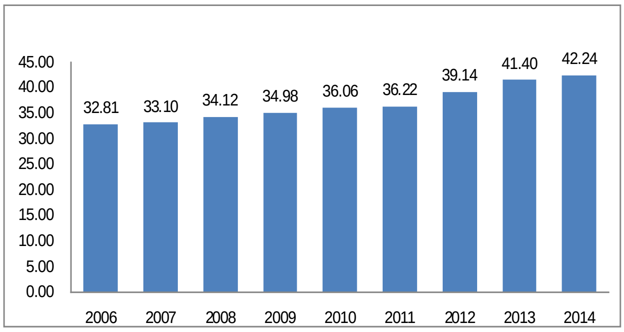

Fig. 1: The average evaluation scores of environmental regulation intensity level for provincial governments 2006-2014.

of regions, the growth amplitude of west region took the lead of middle and east regions, and that of east region with the highest score was the least. It can be deducted that the differences in environmental regulation level among provincial governments are narrowing, but the overall imbalance remains obvious.

ANALYSIS OF INTER-REGIONAL DIFFERENCES IN ENVIRONMENTAL REGULATION INTENSITY AMONG CHINESE PROVINCIAL GOVERNMENTS

Overview of quartile method: Quartile method, as an important method in analysing data set distribution features in statistics, takes the median as the mean value for estimation and interquartile range (IQR) as the standard deviation for estimation. The median and IQR can be used to describe the features of any distribution data like skewed distribution, unknown distribution, no determined value of the terminal of distribution. Besides, they can exempt from the influence of large number, and show more stability than mean value and standard deviation, with the formula shown below.

Assume that one set of observation data is X, X =X (x_1, x_2,...,x_N), and X is arranged in a small-to-large order. When N is odd, the data in the center is called median (M) as shown in Formula (7); when N is even, the average of the two numbers in the center is taken as median (M) as shown in Formula (8).

When N is odd, $$M = x_{\left(\frac{N+1}{2}\right)} \quad \text{...(7)}$$

When N is even, $$M = \frac{1}{2}\left(x_{\left(\frac{N}{2}\right)} + x_{\left(\frac{N}{2}+1\right)}\right) \quad \text{...(8)}$$

Quartile method arranges all values in order and divides them into 4 equal parts, and the data at the third break point will be the quartile. The minimal quartile is called lower quartile or the 1st quartile (Q1). In all values, 25% are smaller than lower quartile, and 75% larger than quartile. The quartile at the midpoint is the median or the 2nd quartile (Q2). The largest quartile is called upper quartile or the 3rd quartile (Q3). In all values, 75% are smaller than upper quartile, and 25% are larger than upper quartile. The IQR is obtained through Q3 minus Q1 as shown in Formula (9).

$$IQR = Q_3 - Q_1 \quad \text{...(9)}$$

IQR is normally taken with the median to describe the distribution features of data.

This paper takes the comprehensive evaluation scores (average for 2006-2014) of environmental regulation level in Chinese provincial governments as the set of observation data, which can be obtained from Table 3. N=30, i.e., it is even.

Analyses result based on quartile method: In order to further dissect the overall level of environmental regulation intensity in 30 provincial governments of China, we divide Chinese provinces into four classes according to their scores adopting quartile analysis method based on the comprehensive evaluation scores (average for 2006-2014) of environmental regulation intensity level in Chinese provincial governments (Table 4). Among them, there are 8 provinces and municipalities directly under the Central Government at the fourth class, namely Inner Mongolia, Ningxia, Shanxi, Beijing, Tianjin, Shandong, Jiangsu and Chongqing, which are the regions with the highest comprehensive score in government environmental regulation within the country and mostly located at the east region; there are 7 provinces and municipalities directly under the Central Governmental the first class, namely Heilongjiang, Jilin, Liaoning, Jiangxi, Sichuan, Chongqing and Qinghai, which are the regions with the lowest comprehensive score in government environmental regulation within the country and mostly located at the middle and west regions. It can be seen that there have been relatively obvious spatial differences in environmental regulation level among inter-regional governments of China.

From 2006 to 2014, when the end of term (2014) is compared with the start of term (2006), there is no obvious change in the number of provinces in the first to the fourth class, but there are slight changes in the structure. When the end of term is compared with the start of term, Beijing, Tianjin, Shanxi, Shandong and Ningxia are still in the fourth class, which are the regions with the highest scores for status quo in environmental regulation of Chinese provincial governments. Jiangsu and Hainan recedes into the third class, and Liaoning into the first class, which means that the score for environmental regulation status quo drops when compared with the start of term. And the provinces that newly move into the fourth class are Xinjiang, Inner Mongolia

Table 4: quartile analysis results of environmental regulation status quo evaluation score in chinese provincial governments 2006-2014 coefficient of variance based inter-regional differences measurement.

Classes	Provinces 2006	Provinces 2014
The first class	Xinjiang, Qinghai, Yunnan, Shanxi, Jiangxi, Heilongjiang, Jilin	Qinghai, Sichuan, Hunan, Jiangxi, Jilin, Liaoning, Guangdong
The second class	Hebei, Henan, Hebei, Anhui, Sichuan, Guizhou, Guangxi, Guangdong	Ansu, Yunnan, Guangxi, Chongqing, Hunan, Fujian, Henan, Haerbing
The third class	Inner Mongolia, Ansu, Chongqing, Hunan, Zhengjiang, Fujian, Shanghai	Hebei, Shanxi, Jiangxi, Zhengjiang, Shanghai, Guizhou, Hainan
The fourth class	Liaoning, Beijing, Tianjin, Shanxi, Ningxia, Shandong, Jiangsu, Hainan	Xinjiang, Inner Mongolia, Ningxia, Shanxi, Beijing, Tianjin, Shandong, Anhui

Table 5: Coefficient of variance for evaluation score of environmental regulation intensity in chinese provincial governments

Year	Coefficient of variance for evaluation score of environmental regulation intensity		
	The mean value	The standard deviation	CV
2006	32.81	8.76	0.27
2007	33.10	9.22	0.28
2008	34.12	9.12	0.27
2009	34.98	6.54	0.19
2010	36.06	6.91	0.19
2011	36.22	6.29	0.17
2012	39.14	6.36	0.16
2013	41.40	8.58	0.21
2014	42.24	10.21	0.24

and Anhui. And the provinces in the first class are still 7, but there are changes in specific provinces: apart from Jiangxi, Qinghai and Jilin that remain in the first class, other provinces that used to be in the first class drop into other classes. And the provinces that newly rise into the first class are Sichuan, Hunan, Liaoning and Guangdong. The provinces in the second and third class also see changes in evaluation range. Gansu, Fujian, Hunan and Chongqing recede from the third class into the second class, and Hebei and Guizhou rise from the second class into the third class. Results show that the provinces contained in the fourth class with the highest score for environmental regulation status quo by Chinese provincial governments shift from major distribution in the east region (6/8) in 2006 to even distribution across the country in 2014, and the provinces in the first class with the lowest score for environmental regulation status quo by Chinese provincial governments are all located in middle and west regions, showing that the environmental regulation level of provincial governments at the east region is commonly higher while that at the middle and west regions is low, so there has been relatively obvious development gap in environmental regulation level of provincial governments between east region and middle and west regions.

Coefficient of variance, also called coefficient of variation, is a common statistical magnitude in measuring the variation degree of observation values in data, marked as coefficient of variance (CV) as shown in Formula (10). CV can eradicate the influence of different units and/or average upon comparison of variation on two or more data.

$$CV = \delta / \mu \qquad ...(10)$$

Where, δ is the standard deviation, and μ is the mean value.

From Table 5, it can be seen that there were certain spatial differences in environmental regulation level among different provincial governments in China; from 2006 to 2014, it displayed the development trend of narrowing followed by widening, with imbalance in spatial distribution. The specific changing trends were basically stable for the three years of 2006, 2007 and 2008; to 2009, the CV dropped to below 20%, and kept this way to 16% in the following three years; to 2013, the CV of evaluation score for environmental regulation intensity in provinces some how rose to above 20%. Further measurement results show that among the six indexes, the one with the largest spatial differences in provinces is the ratio of industrial pollution treatment completion investment in industrial added value, with the

CV exceeding 60% over the years; the CV for ratio of environmental pollution treatment investment in GDP also exceeds 50%. This means that there are obvious differences in the cognition of the importance of environmental governance investment of provinces.

OVERALL PLANNING COUNTERMEASURES

Improving environmental regulation cooperation mechanism for cross-administrative regions: The holistic nature of eco-civilization construction determines that the boundary of environmental regions cannot be divided by administration regions, which then requires the cooperation of local governments for environmental governance, especially cross-regional environmental regulation. Firstly, the law system for regional environmental pollution treatment has to be improved. The Environmental Protection of Law has to be based on to establish the law system for cross-regional environmental pollution governance, remove or abolish laws and regulations conflicting with regional eco-environmental governance cooperation, and specify the limits of authority on local governments in ecoenviron-mental governance cooperation with law, so as to form a binding cooperation mechanism and realize legalization and standardization of regional environmental governance. Secondly, the mechanism of joint negotiation for decision-making has to be set up to solve the contradictions and conflicts among regions in environmental governance schemes and goals, and timely deal with prominent cross-regional environmental events. Thirdly, information coordination mechanism has to be put in place. Within the regions, environmental management information application system and environment basic information database have to be established to realize information sharing about environmental governance, make effective communication, exchange and coordination, and ultimately properly handle eco-environmental issues amid cooperation.

Establishing scientific and reasonable regional government performance examination mechanism: A scientific and reasonable performance examination mechanism has to be established to overcome the problem of excessive stress on economic growth by local government officials to the neglect of eco-environmental protection. Firstly, the multidimensionality of examination indexes has to be held on to. The performance examination of local governments by central government has to shift from being singular to multidimensional, that is, shift from economic growth of multidimensional index system covering economic development index, social development index, eco-environmental protection index, etc. Secondly, differentiated examination methods have to be adopted according to the division of main functions. The resources and environment of different main functional areas is varying, so different function orientation determines that the weight of indexes like economic growth and eco-environmental protection has to be differentiated. Thirdly, the mechanism of reward and punishment has to be put in place. Examination results will be taken as the foundation for reward or punishment for related government officials. For cadres with sound performance, promotion will be granted; for cadres who make blind decisions and thus cause waste of resources and eco-environmental destruction, they will be held accountable. Moreover, the reward and punishment procedures and results will be made public.

Establishing multi-subject synergistic governance mechanism: Firstly, marketized eco-compensation mechanism has to be improved by considering protection against eco-environment and holding on to the principle of sharing benefit and spreading risk. This requires putting in place horizontal eco-compensation mechanism across regions, adhering to the principle of “whoever pollutes the environment must pay, and whoever profits from it must compensate”, and perfecting the relationship between ownership and management to give full play to the role of market in allocating eco-resources. Meanwhile, it also requires offsetting the problem of less vertical compensation and enhancing compensation efforts in regions with fragile ecology and restricted development. Secondly, the public engagement system has to be better. Public engagement on environmental protection mainly includes three means, namely engagement on environmental decision-making, environmental management and environmental relief. Public engagement on environmental decision-making is the legal right of citizens. Through engaging in collecting, collating and releasing environmental governance related information, the public can provide references to the government in formulating environmental protection laws and regulations as well as policies, thereby guaranteeing individual interests through the means of environmental relief. This requires the government to enhance the promotion of environmental protection against one hand, and devise one set of open and transparent engagement mechanism on the other hand for environmental protection that can more gather the wisdom of the people, express the will of the people.

CONCLUSIONS

The research used global entropy method to conduct comprehensive evaluation of the environmental planning intensity among Chinese provincial governments, then combining methods of quartile analysis and coefficient of variance to further analyse the China 30 provincial government environmental regulation level of inter-regional differences. The results show that during 2006-2014, the differences in environmental regulation level among provincial governments are narrowing, but the overall imbalance remains obvious. This is also verified by the analysis of the quartile method. Meanwhile, further measurement results show that there are obvious differences in the cognition of the importance of environmental governance investment of provinces. Therefore, the environmental regulation cooperation mechanism for cross-administrative regions has to be perfected, scientific and reasonable regional government performance examination mechanism has to be established, and muti-subject synergistic governance mechanism has to be set up as well. All above measures are conducive to the promotion of the cooperation of provincial government environmental supervision.

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