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Analysis on the Environmental Conditions for Economic Development in Central China

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Abstract

Using the data of year 2005 to 2009, quantitatively analyze central regional environmental conditions from the aspects of environmental support level, environmental governance capacity, environmental support capacity and coordination between economic development and environment. Main conclusions are as follows: environmental pollution and environmental improvement co-exist, but increasing pressure on environmental pollution is particularly evident; environmental governance efforts are enhanced greatly; environmental support capacity index shows an increasing trend in general; coordination between economic development and environment fluctuates acutely. some remarks and advices are given finally.

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Keywords: central region; environmental support level; environmental governance capacity; environmental support capacity

1. Introduction

With the rapid economic development of countries, the world feels increasing pressure on resources, energy and environment. The mankind must work with one accord to economize the use of the limited natural resources in the world and protect the global environment. China is now already taking the lead in building an REEF Society, striving to raise energy efficiency and reduce the intensity of resource consumption and pollutant discharge.

After the eastern coastal opening up, western development, and the revitalization of old industrial bases in Northeast China, the rise of central China has become an increasing public attention. On Sep. 23, 2009, *Plan For The Rise of Central Region* obtained pass in principle in the State Council executive

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meeting, which indicates that the central region has entered a new stage of development. Enhancing the capacity for sustainable development, effectively controlling emissions of major pollutants, improving ecological environment quality are important goals in the rise of Central China. Analyzing environmental conditions for economic development about central region has certain practical significance. [1]

There are many studies on economic development and ecological environment. For example, British economist Boulding [2] attempted to establish "circular economy" that would not cause resource depletion, and would not cause environmental pollution or ecological destruction. American economist Norgaad[3] proposed theory of coordinated development, thinking that the common development could be achieved in the social and ecological system through the feedback loop. In China, Liu Sihua[4] regarded ecological environment as endogenous variable. Lu Shuping[5] pointed out that the objective of coordinated development was to achieve a good level in environmental quality and harmonious development between man and nature. Li Yan[6] established mathematical model to evaluate the coordinated development between economy and environment. All these studies are good references. But studies on certain region through both time dimension and space dimension are not many. So analysing central regional environment conditions through two dimensions is of some theoretical meaning.

Central region locates in the hinterland of China, including Henan, Hubei, Hunan, Anhui, Jiangxi, and Shanxi six provinces, which plays an important role in the national economic development. The paper will discuss central regional environmental conditions from the following aspects: regional environmental support level, environmental governance capacity, environmental support capacity, and the coordination between economic development and environment, using the data of year 2005 to 2009.

2. Analysis of Environmental Support Level about Central Region

Environment is complex material conditions for human living and developing, including natural environment and social environment. The relationship between humans and the environment is mainly expressed through humans' production and consumption activities. Through productive activities, people gain material, energy and information in the form of resources; through consumption, people make emissions to the environment in the form of "three wastes". Production or consumption activities are not only influenced by environment, but also impact the environment. [7]

Table 1 Indicators for the central regional environmental support level

Indicators		Shanxi	Anhui	Jiangxi	Henan	Hubei	Hunan	Central Region
Density of Waste Water Discharge (t/km^2)	2005	2023.4	4553.8	3593.7	7179.2	5215.2	6082.0	4774.6
	2009	2534.6	5241.1	4026.0	8477.0	4912.9	4550.1	4956.9
	Change Rate(%)	25.3	15.1	12.0	18.1	-5.8	-25.2	3.8
Density of Waste Gas Emission ($10000m^3/km^2$)	2005	1024.8	456.2	293.5	878.5	560.8	298.6	585.4
	2009	1511.9	1089.9	496.5	1340.3	673.7	517.9	938.4
	Change Rate(%)	47.5	138.9	69.2	52.6	20.1	73.5	60.3
Density of Solid Wastes Produced (t/km^2)	2005	718.3	282.4	412.8	341.9	184.0	178.1	352.9
	2009	940.8	604.5	533.2	651.6	299.2	240.4	544.9
	Change Rate(%)	31.0	114.0	29.2	90.6	62.6	35.0	54.4
Fertilizer Use per Cultivated Land Unit(t/hm^2)	2005	0.2	0.5	0.6	0.6	0.6	0.5	0.5
	2009	0.3	0.5	0.5	0.8	0.7	0.6	0.6
	Change Rate(%)	23.3	15.8	-19.9	27.1	22.3	13.2	12.4
Forest Coverage Rate (%)	2005	15.1	30.3	42.1	18.0	31.6	45.0	30.3
	2009	14.1	26.1	58.3	20.2	31.1	44.8	32.4
	Change Rate(%)	-6.3	-14.0	38.7	12.0	-1.5	-0.5	6.9

The quality of environmental in a region relates to many factors, such as the regional environment background, human activities and the regional self-purification capacity. Considering the system integrity and data availability, the paper selects density of waste water discharge, density of waste gas emission, density of solid wastes produced, fertilizer use pre cultivated land unit, and forest coverage rate, five indicators to quantitatively descript the central regional environmental support level(see table 1).

First, on the overall sense, central regional environmental pollution and environmental improvement co-exist, but increasing pressure on environmental pollution is particularly evident, mainly exhibiting the increasing discharge of "three wastes" in unit area, especially waste gas emission and solid waste produced per unit which average annual growth rates were up to 12.06% and 10.88% separately during last 5 years, while fertilizer use per cultivated land unit increased significantly, 2.48% annually. The environmental improvement mainly due to increasing forest coverage, which average annual growth was 1.38%. Secondly, judging from the province condition, central six provinces' environmental pressures have been increasing since recent five years. As for the density of waste water discharge, Hunan and Hubei province both decreased, but other four provinces showed rising tendency, especially Shanxi had an obvious increase while Jiangxi smallest. As for the waste gas emission per unit land area and the solid wastes produced, growth is very significant in every province. Thereinto, Anhui increased 138.95% in the density of waste gas emission, and 114.03% in the solid wastes produced; in Shanxi, Jiangxi, Henan and Hunan, growth rate of the density of waste gas emission was all above 50%; the growth rate of the density of solid wastes produced in Henan and Hubei was both above 60%. It can be concluded that the industrialization and urbanization in central region have polluted the atmospheric environment and soil environment seriously. For example, Hunan, Hubei, Jiangxi are import acid rain controlled areas, and Shanxi, Henan are import SO_2 controlled areas. As for the fertilizer use per cultivated land unit, just Jiangxi showed significant downward trend (19.88%), while other five provinces had clear rose range. As for the forest coverage, during recent five years, Jiangxi increased most significantly with 16.27 percentage points improvement and 38.69% growth range; Henan also had an improvement; other four provinces all had decrease trend, especially Anhui most seriously.

Using weighting function to calculate the index changes of environmental support level about the whole central region and each province (see figure 1).

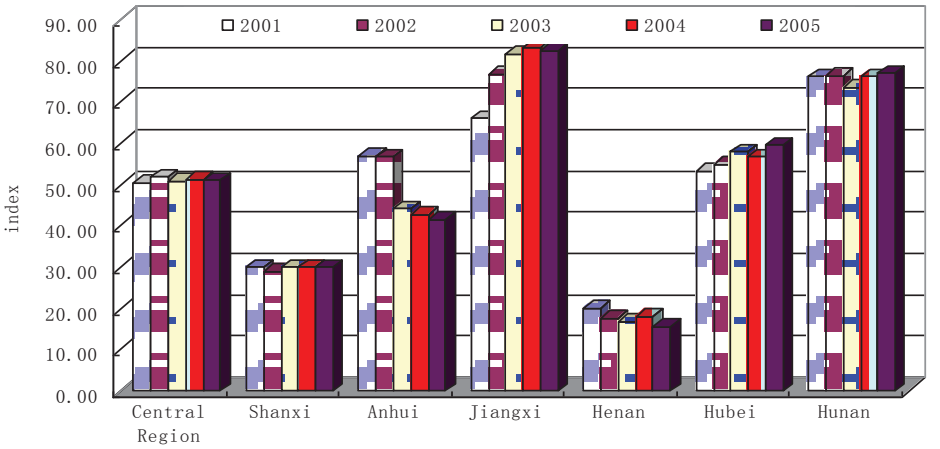

Fig. 1 Index changes of central regional environmental support level

According to figure 1, we can conclude that, the environmental support level of the whole central region develops steadily, with a little ascending trend. The mean was 51.05, and the variation coefficient was 0.01. From the angle of province, differences are great. Accordingly the six provinces can be divided

into three levels: Jiangxi and Hunan belongs to the first level for the high environmental support level; Anhui and Hubei belongs to the second level for the moderate environmental support level; Shanxi and Henan belongs to the third level because of the low environmental support level. But in recent five years, Jiangxi and Hubei showed a rising trend, especially Jiangxi had a bigger growth range; Anhui and Hunan showed a downward trend, especially Anhui had a bigger descending range; Shanxi and Hunan were relatively stable. The descending order according to the mean of environmental support level index during five years is Jiangxi(78.06), Human(75.89), Hubei(56.45), Anhui(48.46), Shanxi(29.78), Henan(17.70).

3. Analysis of Environmental Governance Capacity about Central Region

Environmental governance capacity includes two main aspects: capital investment in governance and effect of environmental governance. So we can use proportion of environmental protection to GDP, waste water discharge per 10000 GDP, waste gas emission per 10000 GDP, solid wastes produced per 10000 GDP to analyse the environmental governance capacity of central region (see table 2).

Table 2 Indicators for the central regional environmental governance capacity

Indicators		Shanxi	Anhui	Jiangxi	Henan	Hubei	Hunan	Central Region
Proportion of Environmental Protection to GDP(%)	2005	0.87	0.13	0.53	0.19	0.17	0.19	0.35
	2009	0.95	0.36	0.67	0.67	0.85	0.43	0.66
	Change Rate(%)	9.20	176.92	26.42	252.63	400.00	126.32	88.94
Waste Water Discharge per 10000 GDP (t/10000 yuan)	2005	19.99	11.87	14.79	11.28	14.95	7.69	13.43
	2009	5.40	7.30	8.78	7.20	7.05	7.38	7.18
	Change Rate(%)	-73.00	-38.52	-40.65	-36.14	-52.87	-4.02	-46.50
Waste Gas Emission per 10000 GDP (m^3/10000 yuan)	2005	3.90	1.19	1.21	1.38	1.61	0.98	1.71
	2009	3.22	1.52	1.08	1.14	0.97	0.84	1.46
	Change Rate(%)	-17.44	27.54	-10.55	-17.47	-39.99	-14.26	-14.65
Solid Wastes Produced per 10000 GDP (t/10000 yuan)	2005	2.73	0.74	1.70	0.54	0.53	0.59	1.14
	2009	2.00	0.84	1.16	0.55	0.43	0.39	0.90
	Change Rate(%)	-26.61	13.76	-31.62	2.53	-19.04	-33.90	-21.22

We can conclude that environmental governance efforts throughout central region are enhanced greatly as environmental damage per unit of economic output has been reducing and environmental efficiency has improved significantly. From 2005 to 2009, proportion of environmental protection to GDP increased 0.31 percentage points which meant 88.94% growth range and 17.79% annual growth, while "three wastes" produced per 10000 GDP declined significantly, especially waste water discharge per 10000 GDP declined most significantly, about 9.3% average annually. From the angle of province, their environmental management efforts have been increasing since 2005 while environmental loss per unit of economic output declining, although there are differences among central regional provinces. In the aspect of environmental governance investment, Shanxi and Hubei had greatest input, while Anhui and Hunan smallest. However, the annual growth rate of environmental protection investment got to 80% in Hubei province and 50.53% in Henan, while Jiangxi and Shanxi had smallest growth, just 5.28% and 1.84%.

We get the fluctuation of environmental governance capacity about central region and each province through hierarchical weighted method. The index changes are as follows (see figure 2).

According to figure 2, we can conclude that the central regional environmental governance capacity have enhanced continuously with the mean 56.13 and variation coefficient 0.05 in recent five years. From the angle of province, differences are visible as well as the fluctuations. Specifically, Shanxi shows a rising trend; Anhui and Hunan show a descending trend in general; Henan and Hubei show a ascending first and then descending trend; Jiangxi shows a descending first and then ascending trend, just like "V".

The descending order of the six provinces according to the mean of environmental governance capacity index is Hubei, Henan, Hunan, Shanxi, Anhui, Jiangxi. And the descending order according to the variation coefficient is Jiangxi(0.35), Hubei(0.29), Shanxi(0.20), Henan(0.16), Anhui(0.15), Hunan(0.08).

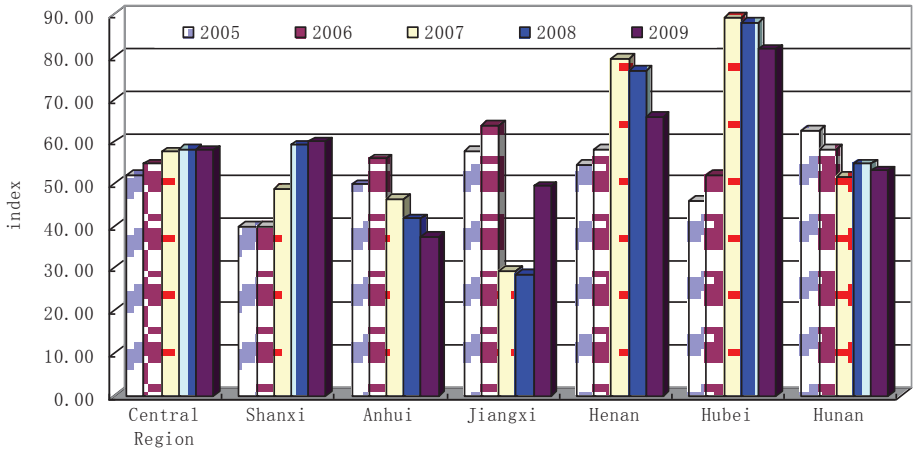

Fig. 2 Index changes of central regional environmental governance capacity

4. Analysis of Environmental Support Capacity about Central Region

The paper selects percent of waste water meeting standard, ratio of solid wastes utilized and percentage of natural reserve to analyse the central regional environmental support capacity (see table 3).

Table 3 Indicators for the central regional environmental support capacity

Indicators		Shanxi	Anhui	Jiangxi	Henan	Hubei	Hunan	Central Region
Percent of Waste Water Meeting Standard(%)	2005	91.3	97.5	95.9	95.6	86.6	87.0	92.3
	2009	82.3	96.2	93.8	96.1	95.9	91.4	92.6
	Change Rate(%)	-9.8	-1.3	-2.2	0.6	10.8	5.0	0.3
Ratio of Solid Wastes Utilized(%)	2005	48.1	78.1	25.8	68.6	73.4	71.4	60.9
	2009	60.7	85.3	41.6	74.8	75.7	78.7	69.5
	Change Rate(%)	26.2	9.3	61.2	9.1	3.1	10.2	14.1
Percentage of Natural Reserve(%)	2005	7.0	4.3	5.3	5.6	7.0	5.6	5.8
	2009	7.3	4.1	6.6	4.5	5.3	5.3	5.5
	Change Rate(%)	5.0	-3.5	23.8	-20.1	-24.3	-4.8	-4.7

From table 3 we can get that, in the investigation, the variation difference of every single item of environmental support capacity in the whole central region is quite large. There is a significant rising trend of the ratio of solid wastes utilize and the percent of waste water meeting standard increase slightly, while percentage of natural reserve has declined 4.69%. In terms of percent of waste water meeting standard, except Shanxi province, the other 5 provinces arrived 91% above. As for the variation of this indicator, Hubei rose fastest which arrived 2.16% per year, while Shanxi province showed a significant declining trend, about 1.96% per year. In terms of ratio of solid wastes utilized, gap among provinces is very big. Anhui, Henan, Hubei and Hunan had higher rates, above 74%, belonging to the first level; Shanxi was 60.75%, belonging to the second level; Jiangxi was lowest, only 41.61%, lower 43.71% than the highest province, belonging to the third level. However, as for the variation of this item, Jiangxi rose

fastest, about 61.16%, as its base was the lowest; Shanxi rose secondly, above 20%. In terms of percentage of natural reserve, difference among provinces is small. Shanxi was the highest; the second was Jiangxi; Anhui and Henan got the lowest, both about 4%. As for the variation of this item, Jiangxi rose fastest which growth rate arrived 23.83%. However, Henan, Hubei showed a significant declining trend, the falling depth got to 20.07% and 24.29% respectively.

We get the fluctuation of environmental support capacity about central region and each province through hierarchical weighted method. The index changes are as follows (see figure 3).

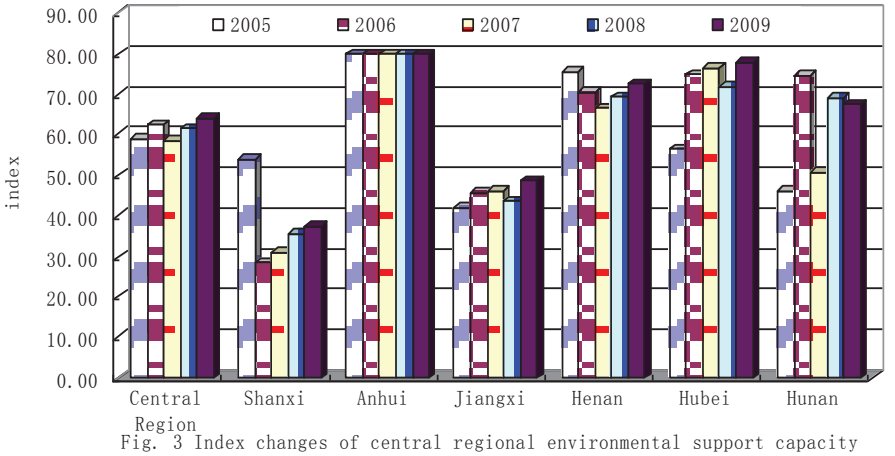

Fig. 3 Index changes of central regional environmental support capacity

The mean value of the index of central regional environmental support capacity is 61.10, and the coefficient of variation is 0.04 in recent five years. As for the condition of each province, Anhui has the strongest and steadiest environmental support capacity; Shanxi and Jiangxi have a weak environmental support capacity, especially the former is the weakest and its variation range is the largest, showing a dropping suddenly and then upgrading slowly tendency; The environmental support capacities of Henan, Hubei, and Hunan are similar, all in middle level. Thereinto, Henan shows a downgrading first and then upgrading tendency, while Hubei, Hunan reveal a lasting fluctuating trend. Counting the mean value of the index of environmental support capacity in recent five years, and ordering them from high to low, we get a sequence of provinces: Anhui、Hubei、Henan、Hunan、Jiangxi and Shanxi. And the 5-year coefficients of variation of them in turns are as follows: Shanxi (0.27), Hunan (0.20), Hubei (0.12), Jiangxi (0.06), Henan (0.05), and Anhui (0.0002).

5. Analysis of Coordination between Economic Development and Environment

The environment is not only the economic development condition but also the economic development result. The environmental problem is the certain inevitable product as economy develops, which is caused by unsuitable economic activities on one hand and solved on the certain economic development level on the other hand, because protecting and improving environment needs the distribution of resources, in other words needs certain economic power. So there are the close intrinsic relations between the economic development and environment. In order to indicate coordinated degree between economy development and environment, the article adopts arithmetic mean of ratio of "three wastes" growth rate and GDP growth rate to construct the coordinated coefficient. Through calculating, we get the variation of coordinated coefficient about central region and each province (see figure 4).

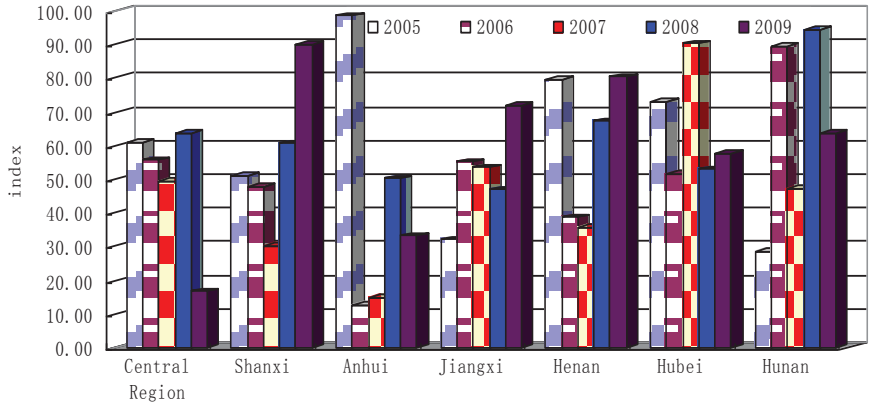

Fig. 4 Changes of coordination between economic development and environment

From figure 4, the following conclusions can be got, first, coordination degree between economic development and environment about the whole central region fluctuates acutely, with the mean coordination degree 49.35 and variation coefficient 0.386 during year 2005 to 2009; secondly, from the angle of each province, through calculating the annual mean of coordination coefficient during 5 years and ordering them from high to low, the sequence is Hubei, Hunan, Henan, Shanxi, Jiangxi, Anhui. And the descending order of variation coefficient is Anhui(0.839), Hunan(0.431), Shanxi (0.393), Henan (0.361), Jiangxi (0.278), Hubei (0.254). Except Hubei and Jiangxi, the coordination degrees of other provinces are all unsteady, especially Anhui the most acutely.

6. Conclusion and Final Remarks

In this paper we quantitatively analyse the environmental conditions for economic development about central region from four angles. On the overall sense, central regional environmental pollution and environmental improvement co-exist, but increasing pressure on environmental pollution is particularly evident; environmental governance efforts throughout the whole central region are enhanced greatly as environmental efficiency has improved significantly; Environmental support capacity is enhancing in general; however, coordination between economic development and environment fluctuates acutely.

Despite the significant achievement gained in the environmental governance in central region, some disadvantages are still very extensive in the long run. Sparing no effort to protect the environment is a long and arduous task. First, one of the important aspects is that to improve policy designs, making full use of mandatory means and economic incentives package. Most of our fiscal and tax policies are direct at the production area and there are few incentive policies in the area of consumption. In reality, fiscal and tax policies concerning demand management can have the results of achieving twice the result with half the efforts. Secondly, scientific and technological progress is an important propelling force for environmental protection and economic development. Intensifying independent innovations in REEF technologies and improving technologies of integrated pollution control are powerful technical support to environmental protection and economic development. Last but not the least, to enhance publicity and education, encourage public participation and build a good interaction system among the governments, enterprises and the general public in order to stimulate harmony between man and nature but also between man and man.

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Data Resources

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