Analysis of the Correlation Between Provincial Environmental Performance and Economic Development Level in China Based on Big Data Research (2016-2018)

Chunxu Hao[1], Yuanhao Zhao[1], Chen Peng[1], Rui Hu[1*], Yingnan Shang[2], Zhanfeng Dong[1], Chazhong Ge[1]
Email: haocx@caep.org.cn; zhaoyuanhao@caep.org.cn; pengchen@caep.org.cn; hurui@caep.org.cn;

grace_shang@qq.com; dongzf@caep.org.cn; gecz@caep.org.cn

[1]Chinese Academy of Environmental Planning, Beijing, 100012, China

[2]Chengdu Academy of Environmental Protection Sciences, Chengdu, 610072, China

Abstract: The research is based on big data research, to build an objective and fair, efficient and accurate environmental quality performance system at the provincial level, and through the PEARSON test methods, the provincial GDP, per capita GDP, performance index, environmental quality and ecological environment protection measures such as bivariate correlation analysis, and put forward policy Suggestions to speed up the economic development and improve the management ability.

Keywords: environmental performance, economic development level, PEARSON test method

1 Introduction

Since the "Twelfth Five-Year Plan" clearly proposed the concept of ecological environment construction, China has paid more and more attention to it year by year, from the formation of the basic framework established at the 18th National Congress of the Communist Party of China, to the idea on institutional construction of ecological civilization proposed at the Third and Fourth Plenary Session of the 18th Central Committee, and then to the proposition of a systematic action program by "Opinions of the Central Committee of the Communist Party of China and the State Council on Accelerating the Promotion of Ecological Civilization", Central Committee's top-level design and strategic deployment for the construction of ecological civilization have been maturing. The ecological environment is the material basis of economic and social development while the relationship between human and nature determines whether economy can progress in a healthy way, which shows that environmental issues have become a bottleneck for a region or a country's economic development. Therefore, straightening out the historical context of China's environmental governance, establishing a performance system for provincial environmental quality, and evaluating the relationship between provincial environmental performance and economic development levels are of practical significance to promote the construction of a beautiful China.

MSIEID 2022, December 09-11, Chongqing, People's Republic of China

DOI 10.4108/eai.9-12-2022.2327563

2 Evaluation Results of the Correlation between China's Provincial Environmental Performance and Economic Development Level in the Mid-term of 13th Five-Year Plan Period

2.1 Correlation Analysis between Provincial Environmental Performance Index and Economic Development Level

The study uses the PEARSON test method to make bivariate correlation analysis on GDP, per capita GDP, environmental performance index, environmental quality, and ecological protection index of a total of 93 samples in 31 provinces in a consecutive period of three years from 2016 to 2018.

The results show that the provincial environmental performance index is moderately negative correlated with GDP and per capita GDP, indicating that regional socio-economic development has a certain negative impact on environmental performance, that is, regions with higher economic levels tend to have lower environmental performance. Among them, GDP and per capita GDP are both moderately negatively correlated with the ecological protection index, that is, regions with higher levels of economic development often have poor performance in ecological protection performance. Per capita GDP and environmental quality index are weakly negative correlated, that is, per capita GDP may have a certain negative impact on the performance of local environmental quality. GDP and environmental quality index are moderately negatively correlated, that is, regions with higher GDP tend to be low in environmental quality index.

Table 1 Correlation Analysis between Provincial Environmental Performance Index and Economic Development Level

Index		GDP	Per Capita GDP	EPI	Environmental Quality	Ecological Protection
GDP	Pearson Correlation	1	.458**	-.327**	-.262*	-.261*
	Significance (both sides)		.000	.001	.011	.011
Per Capita GDP	Pearson Correlation	.458**	1	-.269**	.184	-.389**
	Significance (both sides)	.000		.009	.077	.000
EPI	Pearson Correlation	-.327**	-.269**	1	.507**	.927**
	Significance (both sides)	.001	.009		.000	.000
Environmental Quality	Pearson Correlation	-.262*	.184	.507**	1	.145
	Significance (both sides)	.011	.077	.000		.164
Ecological Protection	Pearson Correlation	-.261*	-.389**	.927**	.145	1

	Significance (both sides)	.011	.000	.000	.164	

**. Significantly correlated at the level of 0.01 (both sides)
*. Significantly correlated at the level of 0.05 (both sides)

2.2 Analysis on Environmental Performance and Economic Development Level in East Region

The environmental performance index of East Region has a weak positive correlation with GDP, and the environmental performance index is not correlated with GDP per capita, indicating that for East Region, the overall economic development level has little effect on the performance of environmental performance. Among them, the environmental quality index has a strong positive correlation with per capita GDP, that is, for the East, the higher the per capita GDP is, the higher the environmental quality index will be. The ecological protection index has a moderate negative correlation with per capita GDP, indicating that for the East, per capita GDP has a negative impact on the performance of the ecological protection index. The ecological protection index and GDP are weakly positively correlated, that is, for the East, GDP may have a positive impact on the ecological protection index while the environmental quality index is irrelevant with GDP, which means that in the East, the level of GDP has no effect on the level of environmental quality index.

Table 2 Correlation Analysis between Provincial Environmental Performance Index and Economic Development Level in East Region

Index		GDP	Per Capita GDP	EPI	Environmental Quality	Ecological Protection
GDP	Pearson Correlation	1	.110	.254	-.205	.342
	Significance (both sides)		.542	.153	.253	.051
Per Capita GDP	Pearson Correlation	.110	1	-.180	.548**	-.443**
	Significance (both sides)	.542		.315	.001	.010
EPI	Pearson Correlation	.254	-.180	1	.150	.871**
	Significance (both sides)	.153	.315		.403	.000
Environmental Quality	Pearson Correlation	-.205	.548**	.150	1	-.354*
	Significance (both sides)	.253	.001	.403		.043
Ecological Protection	Pearson Correlation	.342	-.443**	.871**	-.354*	1
	Significance (both sides)	.051	.010	.000	.043	

**. Significantly correlated at the level of 0.01 (both sides)
*. Significantly correlated at the level of 0.05 (both sides)

2.3 Analysis on Environmental Performance and Economic Development Level in Central Region

The central region's GDP is strongly negatively correlated with the environmental performance index while per capita GDP is not correlated with it, indicating that for the Central Region, a higher level of GDP often means a lower level of environmental performance. Specifically, GDP is negatively correlated with environmental quality index and ecological protection index, indicating that regions with higher GDP may have lower environmental quality and ecological protection index. Per capita GDP is not related to environmental quality index and ecological protection index, which shows that in the Central Region, the level of per capita GDP has no effect on environmental quality index and ecological protection index.

Table 3 Correlation Analysis between Provincial Environmental Performance Index and Economic Development Level in Central Region

Index		GDP	Per Capita GDP	EPI	Environmental Quality	Ecological Protection
GDP	Pearson Correlation	1	.391	-.643**	-.486*	-.546**
	Significance (both sides)		.059	.001	.016	.006
Per Capita GDP	Pearson Correlation	.391	1	-.150	-.135	-.120
	Significance (both sides)	.059		.484	.529	.576
EPI	Pearson Correlation	-.643**	-.150	1	.444*	.953**
	Significance (both sides)	.001	.484		.031	.000
Environmental Quality	Pearson Correlation	-.486*	-.135	.444*	1	.153
	Significance (both sides)	.016	.529	.031		.477
Ecological Protection	Pearson Correlation	-.546**	-.120	.953**	.153	1
	Significance (both sides)	.006	.576	.000	.477	

**. Significantly correlated at the level of 0.01 (both sides)
*. Significantly correlated at the level of 0.05 (both sides)

2.4 Analysis on Environmental Performance and Economic Development Level in West Region

The Western Region's GDP and its environmental performance index are moderately negative correlated while the per capita GDP is not correlated with its ecological protection index, indicating that for the West Region, the higher the level of economic development is, the worse the environmental performance will be. Specifically, GDP and ecological protection index are moderately negatively correlated, indicating that for the West Region, regions with higher GDP tend to have lower ecological protection index. GDP and environmental quality index are weakly negatively correlated, meaning that in the West, the level of GDP has little effect on

environmental quality index. Per capita GDP and environmental quality index are moderately positive correlated, which means that the increase in per capita GDP has a positive impact on the performance of environmental quality index. Per capita GDP is not related to ecological protection, indicating that for the Western Region, the level of per capita GDP has no impact on the ecological protection index.

Table 4 Correlation Analysis between Provincial Environmental Performance Index and Economic Development Level in West Region

Index		GDP	Per Capita GDP	EPI	Environmental Quality	Ecological Protection
GDP	Pearson Correlation	1	.261	-.441**	-.299	-.375*
	Significance (both sides)		.124	.007	.077	.024
	N	36	36	36	36	36
Per Capita GDP	Pearson Correlation	.261	1	.044	.414*	-.154
	Significance (both sides)	.124		.800	.012	.370
	N	36	36	36	36	36
EPI	Pearson Correlation	-.441**	.044	1	.559**	.911**
	Significance (both sides)	.007	.800		.000	.000
	N	36	36	36	36	36
Environmental Quality	Pearson Correlation	-.299	.414*	.559**	1	.168
	Significance (both sides)	.077	.012	.000		.328
	N	36	36	36	36	36
Ecological Protection	Pearson Correlation	-.375*	-.154	.911**	.168	1
	Significance (both sides)	.024	.370	.000	.328	
	N	36	36	36	36	36

**. Significantly correlated at the level of 0.01 (both sides)
*. Significantly correlated at the level of 0.05 (both sides)

3 Conclusion

From a national perspective, economic indicators have varying degrees of impact on the environmental performance index, environmental quality index, and ecological protection index. According to the results, GDP and GDP per capita both have an obvious impact on the environmental performance index, environmental quality index, and ecological protection index. The better the economic development is, the lower the environmental performance index, environmental quality index, and ecological protection index will be. From a regional perspective, the improvement of the overall economic level of the Eastern Region has little effect on its environmental performance, but it may improve the environmental performance

index. The results show that the higher the per capita GDP is, the higher the environmental quality will be and the lower the ecological protection index will be. The Central Region's GDP has a strong negative impact on environmental performance, but the increase in per capita economic level will basically have no impact on the level of environmental performance. Moreover, the results also show that the higher the GDP is, the lower the environmental quality and ecological protection index will be, while the per capita GDP has merely no impact on environmental quality and ecological protection index. Western Region is similar to Central Region. The higher the GDP the region has, the worse its environmental performance will be, while the average economic level basically has no effect on the environmental performance. In addition, the results tell that the higher the GDP is, the lower its environmental quality and ecological protection index will bem but the improvement of average economic level will have a positive impact on the performance of ecological protection.

4 Policy Recommendations

Strengthen the construction of ecological civilization and improve the quality of economic development. The provincial environmental performance index is moderately negative correlated with GDP and per capita GDP, indicating that the level of regional socio-economic development has a certain negative impact on environmental performance, that is, regions with higher economic levels tend to have lower environmental performance. Among them, GDP and per capita GDP are both moderately negative correlated with ecological protection index, that is, regions with higher levels of economic development often have poorer performance in ecological protection. Per capita GDP and environmental quality index are weakly negative correlated, meaning that per capita GDP may have a certain negative impact on the performance of local environmental quality. GDP and environmental quality index are moderately negative correlated, which means that regions with higher GDP tend to have lower environmental quality index. Therefore, it is necessary to improve the quality of economic development in the East, Central and West regions, pay more attention to the construction of ecological civilization, improve the environmental quality and ecological protection, and then strengthen environmental performance.

Strengthen the construction of ecological protection and improve the environmental performance in Eastern Region. The performance of ecological protection index is the shortcoming of the East Region. For example, the ecological water replenishment in Shanghai and Zhejiang, the disposal rate of industrial solid waste, the proportion of natural reserves, and the average CO2 emission are lower than the national average level in 2016 and 2018. Therefore, the East Region should increase ecological water replenishment, disposal rate of industrial solid waste, proportion of nature reserves and reduce the CO2 emissions per unit of land area, so as to improve the environmental performance in the East Region.

Strengthen environmental quality management and improve the environmental performance level in the Central Region. For the Central Region, the overall environmental quality performance is lower than that in the West and East. It is necessary to strengthen environmental quality. The factor that lead to its low performance are multifaceted, involving four single or multiple sub-index under secondary indicators, especially indicators related to urban greening and pollution control. This also shows that in the promotion of urbanization in

the central region, it is necessary to strengthen the management on environment, urban construction planning, and at the same time invest heavily in manpower, material resources and funds to control and harness pollution.

References

[1] Dong Zhanfeng, Hao Chunxu, Yuan Zengwei, Xu He, Wang Ting. Dynamic Research on China's Provincial Environmental Performance Evaluation[J]. *Science and Technology Review,* 2018, 36(02): 67-80.

[2] Hao Chunxu, Zhao Yike, Dong Zhanfeng, Hu Rui, Li Zan. Environmental Performance and Economic Development Coupling Analysis in “Twelfth Five-Year Planning" Period [J]. *Ecological Economy,* 2019,35(03):181-186+205.

[3] Zhao Siyuan, Shen Yang. Analysis of China's Inter-provincial Environmental Performance Evaluation based on DEA-Tobit Model [J]. *China Collective Economy,* 2020(32):83-86.

[4] Weng Zhixiong, Ge Chazhong, Cheng Cuiyuan, Ma Zhongyu, Hu Rui. Research on Urban Comprehensive Environmental Performance Evaluation Based on Environmental Quality Management [J]. *Environmental Protection Science,* 2017,43(04):7-16.

[5] Dong Zhanfeng, Hao Chunxu, Liu Qianqian, Yan Xiaodong, Ge Chazhong. Research on China's Provincial Environmental Performance Index Based on Entropy Method[J]. *Environmental Pollution and Control,* 2016,38(08):93-99.

[6] Zhang Junli, Yan Gufen. Research progress of China's Macro-Regional Environmental Performance Evaluation [J]. *Environmental Protection and Circular Economy,* 2015,35(04):64-69.

[7] Cao Ying, Cao Guozhi. Construction of China's Provincial Environmental Performance Evaluation Index System [J]. *Statistics and Decision,* 2012(22):9-12.

[8] Cao Ying, Cao Dong. Research on China's Environmental Performance Evaluation Index System and Evaluation Methods [J]. *Environmental Protection,* 2008(14):36-38.

[9] Hao Chunxu, Weng Junhao, Dong Zhanfeng. China's Provincial Environmental Performance Evaluation Based on Principal Component Analysis[J]. *Recourse Development and Market,*2016，32 (1): 26-30.

[10] Hsu, A. and W. Miao. (2014, April 3). China’s performance on the 2014 Environmental Performance Index: What are the key takeaways? Yale Environmental Performance Index[EB/OL], The Metric. Available: http://epi.yale.edu.