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Article

Research on the Spatial Effects of Green Process Innovation, Environmental Regulation, and Precipitation on Environmental Air Pollution

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Abstract: In recent years, air pollution events have occurred frequently in China and have had serious impacts on people's work and life. The research objective of the article is to find out the spatial effects of green process innovation, environmental regulation, rainfall, and pollution from industrial development on air pollution by compiling a development index of the air pollution industry and constructing spatial autoregression and spatial Durbin models. The study found that green technology innovation significantly reduced sulfur dioxide emissions and fog haze pollution. The development of industrial air pollution is an important source of sulfur dioxide and pollutant haze and has significant spatial spillover effects. The strengthening of environmental regulations leads to a decrease in life pollution but causes a transfer of industrial pollution. Rainfall is conducive to reducing the concentrations of pollutants in the air, such as those from chimneys and smog. Policy recommendations are proposed, such as establishing different environmental policies for different green technological innovations to promote green technology innovation; constructing a joint defense control system for regional air pollution; increasing the construction of artificial wetlands in areas with serious air pollution; and creating scientific plans to coordinate the development of industry, technology, and the environment, to provide help for China to reduce the emission of atmospheric environmental pollutants.

Keywords: green process innovation; environmental regulation; precipitation; industrial air pollution; space effect

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1. Introduction

Since the reform and opening up period more than 40 years ago, China has adopted an extensive development plan for the treatment of pollution, and the economy has developed at a rapid pace, but the problem of environmental pollution has become increasingly serious. For example, since 23 January 2020, because of COVID-19, people have stayed at home. Most motor vehicles were parked in residential areas, factories and construction sites were shut down, coal was turned into gas, firecrackers were prohibited, and restaurants were closed. Despite these actions, heavy haze pollution still occurred in most areas of northern China from 25 to 28 January and 11 to 13 February 2020. The main reason for this pollution was because of thermal power and thermoelectricity enterprises for heating in winter, as well as iron and steel, petrochemical, and other enterprises, which did not stop working. Moreover, due to adverse weather conditions and the spatial spillover effect from the excessive agglomeration of pollution-intensive industries, the development of air pollution-intensive industries is an important source of environmental pollution. With increasingly tight environmental constraints and the continuation and expansion of sustainable development, green process innovation (GPI) and environmental regulation are crucial to maintaining regional competitiveness. This paper explores the spatial effects of GPI, environmental regulation intensity, precipitation, and the development of air pollution-intensive industries on China's air environmental pollution. This paper will help to construct a benign interactive relationship between the quality of the air environment and the development of pollution-intensive industries to realize a higher-quality development for China's economy.

2. Literature Review

2.1. Green Process Innovation (GPI)

The concept of GPI. Cao (2020) believes that GPI refers to the reduction in environmental pollution caused by manufacturing activities by improving on the original or using new process technologies to process products [1]. Alan Irwin and Paul D. Hooper (1992) point out that clean technology is a kind of process innovation that solves the environmental pollution problem from the root, which has a better effect than environmental governance, and it is easier to implement end-treatment technology than clean technology [2]. Özer (2012) believes that GPI is the interaction between manufacturing activities and their impact on natural ecosystems [3]. Cheng et al. (2014) believed that GPI refers to the improvement of existing production processes or the addition of new processes in order to reduce the negative impact on the environment [4]. Urmila M. Diwekar (2010) notes that the green process design includes design decisions in chemical and material selection periods and antecedent decisions in management and planning, including the sum of investment in technology transformation and the R&D expenditure of industrial enterprises [5]. Bi et al. (2013) divide GPI into end-treatment technology and clean production technological innovations [6]. Wang et al. (2021) argued that green process innovation, such as green product innovation, is a green technology innovation that can improve both the environmental and economic performance of firms [7]. Jin et al. (2022) point out the pathway through which green process innovation improves firm performance by affecting intellectual capital and its components (human capital, structural capital, and relational capital) [8].

2.2. Technological Innovation and Environmental Pollution

Grossman and Krueger (1991) believe that the factors affecting environmental pollution include technology, scale, and structural effects. Scale and structural effects may aggravate environmental pollution, and technology effects are of great importance in improving environmental quality. Because the more advanced technology is, the more environmentally friendly it tends to be [9]. Ju et al. (2008) put forward the concept that technological innovation is a strategic activity for organizations to be responsible for the environment, cultivate competitiveness, and fulfill their social responsibility. The construction of technological innovation is conducive to promoting the coordinated development of economic and environmental benefits [10]. In the study of the mechanism of the role of technological innovation on environmental pollution, Zhou (2022) shows that environmental pollution is spatially and positively correlated and that an increase in the level of technological innovation in the province and neighboring provinces reduces the level of environmental pollution in the province [11]. Lin and Lin (2022) argue that specialized industrial agglomeration has an indirect effect on environmental pollution through technological innovation, i.e., there is a mediating effect of technological innovation [12]. Antweiler et al. (2001) built a general equilibrium theoretical model on environmental pollution, including technology effects; they studied the relationship between technological innovation and environmental pollution and found that with an improvement in the level of technology, the pollution growth rate caused by the scale effect and structure effect slowed down slightly [13]. In a study on the mechanisms of the role of technological innovation in environmental pollution, Wei Weixian and Yang Fang (2010) conducted an empirical study on the panel data of Chinese provinces and cities from 1997 to 2007 and found that independent innovation had a significant effect on CO2 emission reduction in

China, and this effect had certain regional differences. The emission reduction effect in eastern China was significantly higher than that in central and western China [14]. Based on an analysis of China's provincial panel data from 2000 to 2012, Huang Juan and Wang Mingjin (2016) proved that technological innovation had a significant effect on the improvement of SO_2 emission intensity and amount. Compared with pollution control investments, technological innovation is more effective in improving environmental pollution [15]. He Xiaogang and Zhang Yaohui (2012) analyzed the panel data of different industries in China and found that technological innovation played a significant role in energy conservation and emission reduction [16].

2.3. Environmental Regulation and Environmental Pollution

Based on the study of the environmental Kuznets curve relationship between income level and environmental pollution, Panayoutou (1997) considers the influence of policy systems and environmental regulations on the relationship between income level and environmental pollution. He found that environmental regulation could significantly slow down environmental deterioration at low-income levels and accelerate environmental improvement at high-income levels, as far as the content level of SO_2 in the surrounding air was concerned [17]. Li et al. (2022) argued that environmental regulation has a significant emission reduction effect and that enhanced environmental regulation increases FDI with a "pollution halo" effect and reduces FDI with a "pollution paradise" effect [18]. Guo et al. (2022) argued that environmental regulation and green innovation are key elements in the control of environmental pollution in Chinese provinces and cities and that there are both direct suppression and suppression spillover effects; environmental regulation strengthens the direct suppression and suppression spillover effects of green innovation on regional environmental pollution, but there is a threshold effect [19]. On the contrary, William (2004) finds that environmental regulation did not have a direct effect on the reduction in pollutants through the investigation of the pollutant emission data of 500 enterprises, which found that only when the intensity of environmental regulation affected the institutional change in companies, did the emission of pollutants reduce [20]. Jia Ruiyue et al. (2012) built an evaluation model by introducing norms in dimensional Euclidean space to measure the industrial pollution control performance of 30 provinces, autonomous regions, and municipalities in China from 2000 to 2010 [21].

The concept and influencing factors of GPI, the relationship between technology innovation and environmental pollution, and environmental regulation and environmental pollution have been examined in many studies. However, there are few studies on the impact of GPI on air environmental pollution, especially on the impact of factors such as GPI, environmental regulation, precipitation, and the development of air pollution-intensive industries on air environmental pollution. At present, an increasing number of scholars have paid attention to the impact of precipitation, GPI, and other factors on air environmental pollution. Therefore, this paper selects GPI, environmental regulation, precipitation, the development of air pollution-intensive industries, and other factors to carry out a relatively comprehensive study on the impact of air environmental pollution. We will explore the spatial effects of the above four factors on environmental pollution through the selection and analysis of different variables. With the help of different interpreted variables, core explanatory variables, and control variables, the relationship between these four factors and air environmental pollution can be fully explored.

The further material is divided into several sections. Section 3 focuses on the methods and materials of the article, Section 4 on the findings and discussion of the research analysis of the article, and Section 5 on the conclusions and policy implications of the article.

3. Methods and Materials

3.1. Methods

3.1.1. Spatial Autoregressive Model

Spatial autoregression (SAR) models are a special case of spatial econometric models, often used to analyze spatially correlated data [22], and are applicable to data sets containing geographically regional observations. As air pollution is an object of study that is influenced by multiple factors, spatial autoregressive models have the advantage of taking better account of spatial autocorrelation and are, therefore, better for atmospheric pollution to be explained in this study. The spatial autoregressive model formula in this article is specified as follows.

$$Pou = a + rho * W * Pou + \beta X + u_i + v_t + \delta_{it} \quad (1)$$

In the above formula, *Pou* is the air pollution, which is measured by SO_2 emissions, dust emissions, and haze pollution level. *W* is the spatial weight matrix, *X* is the explanatory variable matrix, and β is the correlation coefficient matrix.

3.1.2. Space Durbin Model

As the formation process of air pollution is not isolated, the existence of spatial correlations of sulfur dioxide emissions, smoke, dust emissions, and haze pollutant emissions has been somewhat agreed upon in previous studies. In addition, considering that atmospheric pollutants are extremely mobile and there are typical spatial spillover characteristics of atmospheric pollution, the spatial Durbin model is used in this study as follows.

$$Pou = a + rho * W * Pou + \beta X + WX\delta + u_i + v_t + \delta_{it} \quad (2)$$

In the above formula, *Pou* is air pollution, which is measured by SO_2 emissions, smoke, dust emissions, and haze level. *W* is the spatial weight matrix, *X* is the explanatory variable matrix, and β and δ are the correlation coefficient matrices.

3.2. Variable Selection and Description

The variables used in this article are mainly composed of interpreted variables, core explanatory variables, and control variables. The interpreted variables are SO_2, dust, and haze pollution ($PM_{2.5}$), and the core explanatory variables are the GPI, environmental regulation, precipitation, and development index of pollution-intensive industries. The industrial structure, economic development level, population density, per capita motor vehicle ownership, and energy efficiency are selected as control variables. The details are as follows:

3.2.1. Interpreted Variables

There are many sources of pollutants in air pollution, but the main pollutants are SO_2, nitrogen oxides, dust, haze pollution ($PM_{2.5}$), etc. In this paper, according to the importance of different pollutants in the air environment and the availability of collected pollutant data, SO_2, dust, and haze pollution ($PM_{2.5}$) are selected as the interpreted variables for air environmental pollution, in which SO_2 is measured by the emission of SO_2 in the exhaust gas in various regions, dust is measured by the emission of dust in the exhaust gas in various regions, and haze pollution ($PM_{2.5)}$ is measured by the geographical average of fine particulate matter ($PM_{2.5}$).

3.2.2. Core Explanatory Variables

Based on the relevant literature, the GPI, environmental regulation, precipitation, and development index of pollution-intensive industries are selected as the core explanatory variables for air environmental pollution. GPI is measured by the sum of R&D funds and the technical transformation funds of industrial enterprises (Zhang Qian, 2015 [23]; Urmila M. Diwekar, 2010 [4]). Environmental regulation is measured by investment in air pollution environmental control, precipitation is measured by annual average precipitation, and the development index of pollution-intensive industries is measured by the average value after the standardization of the industrial sales output value of pollution-intensive industries.

Air pollution-intensive industries refer to industries that directly or indirectly produce air pollutants during the production and processing process. In this study, based on the comprehensive consideration of the emission scale and emission intensity of air pollution-intensive industries, the pollution intensity index of the exhaust gas for each industry was calculated according to the National Industries Classification (GB/T 4754 -2017) to identify air pollution-intensive industries. The formula for calculating the pollution index for air pollution-intensive industries is as follows:

$$I_i = Q_i + G_i = \alpha \cdot \frac{E_i}{B_i} + (1-\alpha) \cdot \frac{E_i}{D} \tag{3}$$

where I_i represents the air pollution index of industry i, Q_i refers to the emission intensity of industry i, G_i indicates the emission scale of industry i, E_i is the pollution emission of industry i, B_i represents the total output value of industry i, D represents the total emission of pollutants, and the value α is 0.5. Based on the data from 2009, 2011, 2013, and 2015, the air pollution intensity indexes of different industries in China are calculated. Considering the availability of data for pollution-intensive industries and the level of the pollution intensity index, this study selects the air-pollution-intensive industries, including the ferrous-metal mining and dressing industry; nonmetal mining industry; other mining industries; agricultural and non-staple food-processing industry; food manufacturing industry; beverage manufacturing industry; wood processing and wood, bamboo, rattan, palm and grass products industry; paper and paper products industry; petroleum processing and coking industry; chemical raw-material manufacturing industry; chemical fiber manufacturing industry; rubber and plastic products industry; nonmetal mineral products industry; ferrous-metal smelting industry; nonferrous metal smelting and rolling processing industry; metal products industry; transportation equipment manufacturing industry; communication computer and other electronic equipment manufacturing industry; other manufacturing industry; and power, heat production, and supply industry.

3.2.3. Control Variables

Based on the relevant literature, this paper selects industrial structure, economic development level, population density, per capita motor vehicle ownership, and energy efficiency as the control variables. The industrial structure is measured by the proportion of the added value of the secondary industry in the GDP, the economic development level is measured by the per capita national income, the population density is measured by the natural logarithm of the population per square kilometer, the per capita motor vehicle ownership is measured by the ratio of the motor vehicle ownership to the total population, and the energy efficiency is measured by the electricity consumption per unit GDP.

3.3. Data Sources and Descriptive Analysis of Variables

Relevant data from 2000 to 2017 were chosen for the indicators. The variables of sulfur dioxide, smoke (dust), haze pollution ($PM_{2.5}$), and rainfall were obtained from the China Environment Statistical Yearbook, the polluting industry development index, and environmental regulations from the China Industrial Statistical Yearbook; energy efficiency from the China Energy Statistical Yearbook, industrial structure, economic development level, and population density; and motor vehicle ownership per capita from the China Statistical Yearbook, green process innovation from the EPS database, and $PM_{2.5}$ data from Columbia University's Chinese provincial $PM_{2.5}$ concentration data, with linear interpolation to fill in the missing values. In addition, to avoid statistical errors, human control heteroskedasticity was used in the models of the control variables in the form of natural logarithms. The results of the descriptive statistics for each variable are shown in Table 1.

Table 1. Model variable selection and descriptive analysis.

Variables		Number of Samples	Mean Value	Standard Error	Minimum Value	Maximum Value
Interpreted Variables						
SO_2	Amount of Sulfur Dioxide Emissions(tons)	558	66.66	44.96	0.1	200.2
$PM_{2.5}$	Haze Pollution Level (μg/m3)	558	38.106	16.348	4.7	84.3
Dust	Emission of Dust (million tons)	558	37.96	29.65	0.1	179.77
Core explanatory Variables						
ERI	Environmental Regulation: Investment in environmental management of air pollution (billion yuan)/GDP (billion yuan)	527	0.0017	0.0015	0	0.0115
GPI	Green Process Innovation (RMB million)	527	26.764	35.963	0	230.35
Epc	Precipitation: average annual precipitation (mm)	572	911.64	508.77	149	2393.706
IDI	Development Index of Pollution-intensive Industries: Average of industrial sales value by polluting industry	527	0	1.000	−1.638	230
Control Variables						
ins	Industrial Structure: Value added of secondary industry (million yuan)/Gross regional product (million yuan)	572	0.457	0.083	0.190	0.615
pgdp	Level of Economic Development: GDP per capita (RMB)	527	1.480	1.195	0.266	7.594
parc	Car Ownership Per Capita: number of people (10,000)/area (10,000 km^2)	527	0.118	0.099	0.009	0.498
pen	Population Density: number of cars (10,000)/population (10,000)	527	4.383	0.617	0.021	38.265
ene	Energy Efficiency: Electricity consumption (billion kWh)/GDP (billion RMB)	527	0.131	0.086	0.037	0.587

4. Results and Discussion

4.1. Multicollinearity and Spatial Autocorrelation Test

4.1.1. Multicollinearity Test of Core Explanatory Variables

The multicollinearity test of the core explanatory variables is shown in Table 2.

Table 2. Multicollinearity of core explanatory variables.

Dimension	Eigenvalue	Conditional Index	Variance Ratio				
			Constant	Green Process Innovation	Environmental Regulation Intensity	Self-Cleaning Capacity	Industry Development Index
1	0.295	1.000	0.01	0.01	0.02	0.02	0.00
2	1.473	1.415	0.00	0.02	0.03	0.00	0.10
3	0.405	2.700	0.00	0.00	0.45	0.20	0.02
4	0.098	5.481	0.02	0.78	0.21	0.31	0.73
5	0.074	6.300	0.97	0.18	0.29	0.47	0.14

Before the correlation regression analysis, it is necessary to carry out the multicollinearity test of the relevant independent variables, especially the core explanatory variables. The multicollinearity test among the core explanatory variables (GPI, environmental regulation, precipitation, and the development index of pollution-intensive industries) is performed, and the results are shown in Table 2, which indicates that the characteristic roots of multiple dimensions are not significantly zero. There is multicollinearity, and the conditional index is less than 10, which indicates that the above indicators have no significant multicollinearity. In addition, from the meaning of the indicators, GPI, environmental regulation, precipitation, and the development of pollution-intensive industries involve the aspects of science and technology development, government policy, natural environment, and economic development, respectively, and in theory, there is no obvious multicollinearity relationship.

4.1.2. Spatial Autocorrelation Test of Core Explanatory Variables

The results of the spatial autocorrelation test of the core explanatory variables are shown in Table 3.

Table 3. Spatial autocorrelation index.

	The Emission of SO_2 (ton)	**Dust Pollutants (10,000 tons)**	**Haze Pollutants**
2000	−0.902	0.122	0385 ***
2001	−0.993	0.120	0.378 ***
2002	0.169 *	0.099	0.371 ***
2003	0.192 **	0.114 *	0.362 ***
2004	0.373 **	0.284 ***	0.355 ***
2005	0.219 **	0.325 ***	0.363 ***
2006	0.217 **	0.370 ***	0.387 ***
2007	0.216 **	0.385 ***	0.379 ***
2008	0.215 **	0.401 ***	0.373 ***
2009	0.208 **	0.382 ***	0.382 ***
2010	0.200 **	0.353 ***	0.386 ***
2011	0.231 **	0.362 ***	0.392 ***
2012	0.262 ***	0.352 ***	0.400 ***
2013	0.257 ***	0.344 ***	0.407 ***
2014	0.251 **	0.375 ***	0.395 ***
2015	0.200 **	0.441 ***	0.391 ***
2016	0.182 **	0.308 **	0.389 ***
2017	0.135 *	0.250 **	0.384 ***

Standard errors in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Based on the spatial autocorrelation indexes of the three air pollution indexes, namely, the emissions of SO_2, dust, and haze pollutants, the spatial autocorrelation indexes of the emissions of SO_2 and dust show the spatial correlation in 2004 from the spatial uncorrelation in early 2000, which continued to the end of the study period. Although the significance of the spatial autocorrelation of the emissions of SO_2 and dust has decreased in recent years, the spatial correlation is still an indisputable fact. The spatial correlation of haze-pollutant emissions is always at a high level, and the spatial correlation is significant. The existence of the spatial correlation of spatial pollution is the basis of related spatial regression analysis by using the following spatial autoregressive model and spatial Durbin model.

4.2. Spatial Autoregressive Analysis Results and Discussion

The collected statistics and the spatial autoregressive model formula constructed above are used for spatial autoregressive analysis. The specific analysis results are shown in Table 4:

Table 4. Results of the spatial autoregressive model analysis.

	(1)	(2)	(3)	(4)	(5)	(6)
	SO_2	SO_2	Dust	Dust	$PM_{2.5}$	$PM_{2.5}$
Main						
GPI	−0.125 ***	−0.124 ***	0.198 ***	0.246 ***	−0.101 ***	−0.089 ***
	0.029	0.031	0.071	0.077	0.025	0.027
ERI	0.021	0.021	0.045	0.040	0.002	0.001
	0.018	0.018	0.043	0.043	0.016	0.015
EPC	0.018	0.019	−0.117	−0.089	−0.023	−0.016
	0.037	0.038	0.090	0.092	0.032	0.033
ins	0.084 ***	0.084 ***	−0.036	−0.033	0.002	0.004
	0.025	0.025	0.062	0.062	0.022	0.022
pgdp	0.155 ***	0.155 ***	−0.126	−0.112	0.128 ***	0.132 ***
	0.058	0.058	0.139	0.139	0.050	0.050
parc	−0.073	−0.073	0.272 **	0.261 **	0.080 *	0.083 **
	0.051	0.051	0.117	0.117	0.042	0.042
pen	−0.199	−0.200	0.116	0.093	0.262 ***	0.257 ***
	0.104	0.104	0.253	0.253	0.090	0.090
ene	0.038	0.038	0.208 **	0.208 **	0.041	0.041
	0.037	0.037	0.090	0.090	0.032	0.032
IDI	0.092 ***	0.089 **	0.363 ***	0.272 ***	0.115 ***	0.142 ***
	0.033	0.041	0.081	0.100	0.029	0.036
IDI*EPC		−0.006		−0.148		−0.040
		0.037		0.093		0.032
Spatial						
rho	0.683 ***	0.682 ***	0.571 ***	0.555 ***	0.805 ***	0.806 ***
	(0.036)	(0.036)	(0.045)	(0.046)	(0.030)	(0.030)
Variance						
sigma2_e	0.258 ***	0.258 ***	0.630 ***	0.630 ***	0.225	0.224 ***
	(0.008)	(0.036)	(0.020)	(0.046)	(0.007)	(0.007)
N	530	530	530	530	530	530
With_R2	0.186	0.190	0.170	0.169	0.149	0.148

Standard errors in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

From the model results (Table 4), it can be seen that the statistical test of the estimated values of the spatial lag parameters of SO_2, dust, and $PM_{2.5}$ is significant, indicating that the air pollution of 30 provinces, municipalities and autonomous regions (except for incomplete data in Tibet) has significant spatial correlation characteristics, which indicates that the air pollution level of a province and city is affected by the air pollution level of its neighboring provinces and cities. Previous studies have shown that there is a threshold effect on the impact of green technology innovation on haze pollution, and the inhibitory effect of green technology innovation on haze pollution is significant when regional environmental regulations, R&D investment, and marketization are relatively high [24], which is consistent with the results in this study. The results show that GPI has a significantly negative correlation with SO_2 and $PM_{2.5}$, while GPI has a significantly positive correlation with dust, which indicates that GPI plays an important role in SO_2 and $PM_{2.5}$ emissions. Through the development and progress of green technologies, such as air purification, energy conservation, environmental protection, and a circular economy, the SO_2 and $PM_{2.5}$ produced during industrial production and their length of time in the atmosphere can be significantly reduced. For example, the methods of "Environmental Coal + Environmentally friendly Stove" and "Biomass Briquette + Special Stove" to replace bulk coal heating, which is vigorously promoted in northern China, can significantly reduce the concentrations of SO_2 and $PM_{2.5}$ in the air. However, there is a significantly positive correlation between GPI and dust emissions, which may be because there is no significant relationship between dust emissions and industrial coal utilization. Dust mainly comes from flying dust in the air, dust from urban construction, road dust, automobile exhaust, etc. The development of GPI is often closely related to the development of local cities, and urban construction will lead to an increase in local dust emissions. There is no significant correlation between the intensity of environmental regulation and precipitation.

Sulfur dioxide, which is widely monitored as an indicator of atmospheric emissions, is an important component source of $PM_{2.5}$ pollution factors, of which industrial SO_2 emissions occupy a large proportion. The continuous transformation and upgrading of the industry structure will certainly provide greater assistance to SO_2 emission reduction, and the industrial sector has a greater negative driving factor for SO_2 emission reduction [25]. The results of this study show that there is a significant positive correlation between industrial structure and SO_2, which indicates that SO_2 is more closely related to the development of local industries than the emission of dust and haze pollutants, and the development of industries emit a large amount of SO_2, aggravating the local pollution level. The economic development level has a significantly positive correlation with SO_2 and haze-pollutant emissions, and the improvement of China's economic development level in recent years is often closely related to the increase in energy consumption and the rapid development of private cars, which are important sources of SO_2 and haze-pollutant emissions. There is a significantly positive correlation between per capita private car ownership and the amount of dust and haze-pollutant emissions, which indicates that automobile exhausts are an important source of haze pollutants in the air, and a large amount of dust caused by automobile driving also aggravates haze pollution. Population density has a significantly positive correlation with haze-pollutant emissions, and human activities have a close relationship with haze formation. Because the main source of electricity in China is thermal power, there is a significantly positive correlation between energy efficiency and fine-dust emissions. The coal combustion used in the thermal power industry emits a large number of haze pollutants and air environmental pollutants such as SO_2, and after chemical reactions, substances in the air, including SO_2, turn into haze pollutants. Moreover, with the rapid development of China's economy in the past 40 years, energy use efficiency has been continuously improved, and the overall thermal power generating capacity has increased significantly. The development of pollution-intensive industries has a significantly positive correlation with the amount of SO_2 and dust and haze-pollutant emissions, which indicates that the development of pollution-intensive industries is an important source of air pollutant emissions.

4.3. Spatial Durbin Model Analysis Results and Discussion

The collected statistics and the spatial Dubin model formula constructed above are used for the spatial Dubin analysis. The specific analysis results are shown in Table 5:

Table 5. Results of spatial Durbin model analysis.

	(1)	(2)	(3)	(4)	(5)	(6)
	SO_2	SO_2	Dust	Dust	$PM_{2.5}$	$PM_{2.5}$
Main						
GPI	−0.170 ***	−0.162 ***	0.214 **	0.170 **	−0.122 ***	−0.109 ***
	0.034	0.036	0.084	0.087	0.030	0.032
ERI	0.018	0.017	0.049	0.038	0.001	0.000
	0.017	0.017	0.043	0.042	0.015	0.015
EPC	0.045	0.047	−0.201 *	−0.218 **	0.024	0.028
	0.046	0.046	0.113	0.111	0.040	0.040
ins	0.050 *	0.057 **	−0.095	−0.071	0.034	0.037
	0.027	0.027	0.067	0.066	0.024	0.024
pgdp	0.142 **	0.158 ***	−0.203	−0.096	0.153 ***	0.159 ***
	0.059	0.059	0.145	0.143	0.052	0.052
parc	0.033	0.024	0.269 **	0.208 **	−0.020	−0.023
	0.056	0.056	0.137	0.135	0.049	0.049

Table 5. *Cont.*

	(1)	(2)	(3)	(4)	(5)	(6)
	SO_2	SO_2	Dust	Dust	$PM_{2.5}$	$PM_{2.5}$
pen	0.302 ***	0.311 ***	0.156	0.120	0.199 **	0.188 **
	0.105	0.105	0.258	0.254	0.092	0.092
ene	−0.106 ***	−0.118 ***	0.148 **	0.230 **	0.012	0.015
	0.040	0.041	0.098	0.097	0.035	0.035
IDI	0.105 ***	0.093 *	0.201 **	0.386 ***	0.166 ***	0.196 ***
	0.039	0.050	0.096	0.122	0.034	0.044
IDI*EPC		−0.022		0.243 **		−0.047
		0.048		0.115		0.042
Wx						
GPI	−0.063	−0.037	−0.042	0.266 *	−0.067	−0.060
	0.060	0.063	0.150	0.158	0.053	0.056
ERI	0.115 ***	0.106 ***	−0.184 **	−0.254 ***	0.073 **	0.067 *
	0.039	0.039	0.094	0.094	0.035	0.035
EPC	−0.107	−0.069	0.194	0.436 **	−0.135 *	−0.117 *
	0.087	0.089	0.214	0.215	0.077	0.078
ins	0.012	0.023	−0.743 ***	−0.785 ***	−0.074	−0.066
	0.065	0.065	0.161	0.159	0.057	0.057
pgdp	0.577 ***	0.643 ***	1.403 ***	1.722 ***	0.254	0.286 *
	0.188	0.190	0.455	0.452	0.162	0.163
parc	−0.581 ***	−0.616 ***	−1.241 ***	−1.438 ***	−0.208 *	−0.217 *
	0.147	0.148	0.352	0.346	0.126	0.126
pen	−0.916 **	−1.035 **	−1.681 *	−2.859 ***	−0.625 *	−0.659 *
	0.401	0.407	0.993	0.998	0.353	0.358
ene	0.089	0.137	−0.557 **	−0.348	0.211 ***	0.245 ***
	0.094	0.097	0.231	0.236	0.082	0.085
IDI	0.205 **	0.294 ***	0.442 **	0.366	0.022	0.034
	0.084	0.109	0.216	0.265	0.075	0.097
IDI*EPC		−0.123		−1.136 ***		−0.023
		0.087		0.216		0.076
Spatial						
rho	0.563 ***	0.549 ***	0.513 ***	0.440 ***	0.791 ***	0.792 ***
	0.048	0.049	0.050	0.053	0.034	0.034
Variance						
sigma2_e	0.247 ***	0.246 ***	0.608 ***	0.595 ***	0.217 ***	0.216 ***
	0.008	0.008	0.019	0.019	0.007	0.007
N	530	530	530	530	530	530
With_R2	0.091	0.096	0.060	0.064	0.138	0.113

Standard errors in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

As seen in Table 5, the results of the spatial Durbin model and the spatial autoregressive model are generally similar. The analytical results of the spatial spillover items of the explanatory variables are mainly analyzed below. The spatial spillover items of environmental regulation intensity in the emission models of SO_2 and haze pollutants are significantly positive. This may be because the increase in the local environmental regulation intensity could lead to the relocation of pollution-intensive industries to the surrounding areas, thus aggravating the pollution level in these surrounding areas.

Due to factors such as capital intensity, relocation costs, and the environmental compliance costs of pollution-intensive industries, when faced with environmental regulatory constraints, they often choose to relocate to areas that are close to economic development, and this relocation is largely a transfer of pollution, which if left unchecked, may lead to the wide spread of pollution sources [26]. This may be because current environmental regulations play an obvious role in the control of domestic pollution, and the emission of dust is significantly negative; however, the effect on industrial air pollutants is limited.

Since China's dust emissions are mainly closely related to urban construction and residents' lives, local environmental regulations lead to the migration of surrounding populations to the local area, resulting in an increase in dust emissions. In the dust emission model, the spatial spillover item of precipitation is significantly positive, which may be because the relative range of precipitation is large. When there is local precipitation, there is precipitation in the surrounding areas, and precipitation has a significantly positive effect on the reduction of dust concentration in the air. In the haze-pollutant model, the spatial spillover of precipitation items is significantly negative, which indicates that the precipitation in local areas has an obvious purification ability to haze in the surrounding areas. The spatial spillover items of the industrial structure, economic development level, and population density show a significant positive correlation in the emission model of SO_2 and haze pollutants, which may be because the above factors play an important role in the formation of SO_2 and haze pollutants and the spatial diffusion of pollutants has a positive correlation. Energy efficiency has a significantly positive relationship with the spatial spillover of dust emissions, which may be due to the spatial agglomeration of local dust emissions, which leads to the innovation of enterprises in neighboring areas and the continuous adoption of technology to improve energy efficiency. As the excessive pollution problem in one region will also trigger an increase in the intensity of pollution emissions in its neighboring regions and conversely causes an increase in the pollution emissions of neighboring regions, which also cause an increase in the intensity of pollution emissions in the region, which is not conducive to the management of pollution reduction in the region [27]. The spatial spillover of pollution-intensive industries in this study shows a significantly positive correlation, which indicates that pollution enterprises lead to an increase in the emission of pollutants not only in the region but also in the surrounding areas. This may be due to the strong fluidity of air pollutants, and the pollutants that are produced in the region might drift to the surrounding areas along with the airflow, which can be proven by the significantly positive spatial spillover of air pollutants.

4.4. Spatial Durbin Model Effect Decomposition Results and Discussion

The collected statistics and the spatial Dubin model formula constructed above are used to decompose the spatial Dubin effect. The specific analysis results are shown in Table 6:

Table 6. Effect decomposition of the spatial Durbin model.

LR_Direct	SO_2	SO_2	Dust	Dust	$PM_{2.5}$	$PM_{2.5}$
GPI	−0.190 ***	−0.177 ***	0.221 ***	0.200 **	−0.165 ***	−0.148 ***
	0.034	0.035	0.082	0.085	0.032	0.034
ERI	0.034 *	0.031 *	0.032	0.018	0.021	0.018
	0.019	0.018	0.045	0.043	0.019	0.019
EPC	0.035	0.041	−0.191 *	−0.188 *	−0.007	0.002
	0.043	0.043	0.106	0.105	0.040	0.040
ins	0.055 *	0.063 **	−0.181 **	−0.142 **	0.022	0.027
	0.031	0.031	0.075	0.071	0.034	0.035
pgdp	0.224 ***	0.246 ***	−0.062	0.050	0.252 ***	0.269 ***
	0.065	0.065	0.156	0.151	0.073	0.075
parc	0.038	0.049	−0.150	−0.091	0.079	0.086
	0.059	0.059	0.142	0.137	0.062	0.062
pen	−0.438 ***	−0.456 ***	−0.018	−0.124	0.075	0.051
	0.129	0.128	0.299	0.281	0.153	0.154
ene	0.124 ***	0.142 ***	0.096	0.208 **	0.071	0.084 *
	0.044	0.045	0.106	0.103	0.048	0.049
IDI	−0.086 **	−0.064	−0.260 ***	−0.369 ***	0.207 ***	0.246 ***
	0.038	0.048	0.094	0.115	0.037	0.045
IDI*EPC		−0.039		0.154		−0.062
		0.045		0.109		0.041

Table 6. *Cont.*

LR_Direct	SO_2	SO_2	Dust	Dust	$PM_{2.5}$	$PM_{2.5}$
LR_Indiret						
GPI	−0.268 ***	−0.206 **	0.103	0.458 **	−0.566 ***	−0.509 ***
	0.091	0.092	0.200	0.182	0.166	0.171
ERI	0.211 ***	0.189 ***	−0.243 *	−0.317 ***	0.258 **	0.233 **
	0.065	0.063	0.143	0.124	0.118	0.119
EPC	−0.139	−0.071	0.138	0.457 *	−0.402 *	−0.330
	0.125	0.125	0.281	0.254	0.218	0.224
ins	0.067	0.089	−1.209 ***	−1.095 ***	−0.164	−0.126
	0.116	0.112	0.265	0.226	0.218	0.219
pgdp	1.112 ***	1.197 ***	1.983 ***	2.253 ***	1.301 **	1.435 **
	0.317	0.311	0.699	0.608	0.595	0.610
parc	0.952 ***	0.989 ***	1.683 ***	1.807 ***	0.775 *	0.819 *
	0.240	0.234	0.538	0.467	0.437	0.442
pen	−1.837 **	−1.978 ***	−2.445	−3.764 ***	−1.622	−1.778
	0.734	0.721	1.533	1.338	1.312	1.341
ene	0.252	0.331 **	−0.735 ***	−0.331	0.767 **	0.897 ***
	0.166	0.167	0.367	0.323	0.329	0.349
IDI	0.247 *	0.399 **	−0.833 ***	0.263	0.534 **	0.657 **
	0.134	0.163	0.291	0.322	0.236	0.296
IDI*EPC		−0.222 *		−1.380 ***		−0.207
		0.121		0.247		0.219
LR_Total						
GPI	−0.458 ***	−0.384	0.324	0.658 ***	−0.732 ***	−0.657 ***
	0.098	0.099	0.213	0.191	0.179	0.185
ERI	0.245 ***	0.220	−0.212	−0.299 *	0.279 **	0.251 *
	0.074	0.072	0.163	0.141	0.131	0.133
EPC	−0.104	−0.030	−0.053	0.269	−0.409 *	−0.328
	0.124	0.125	0.274	0.244	0.228	0.234
ins	0.122	0.152	−1.390 ***	−1.237 ***	−0.142	−0.099
	0.137	0.133	0.311	0.268	0.246	0.247
pgdp	1.337***	1.443	1.921**	2.303***	1.554 **	1.705 ***
	0.351	0.344	0.773	0.672	0.649	0.666
parc	0.990***	1.038	1.534***	1.716***	0.854 *	0.905 *
	0.265	0.258	0.593	0.513	0.478	0.483
pen	−2.275***	−2.434	−2.462	−3.888***	−1.547	−1.726
	0.819	0.805	1.712	1.490	1.439	1.470
ene	0.376**	0.474	−0.639	−0.122	0.838 **	0.981 **
	0.190	0.191	0.422	0.374	0.364	0.385
IDI	0.160	0.335	−1.093***	−0.106	0.741 ***	0.903 ***
	0.142	0.166	0.307	0.318	0.253	0.312
IDI*EPC		−0.260		−1.226***		−0.270
		0.121		0.239		0.230

Standard errors in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

The analytical results in Table 6 show that in terms of direct effects, the GPI shows a significantly negative correlation with SO_2 and $PM_{2.5}$ and a significantly positive correlation with dust, which is consistent with the results from spatial autoregression. This shows that GPI plays an important role in the emission of SO_2 and $PM_{2.5}$, and through the development and progress of green craft technologies, such as air purification, energy conservation, environmental protection, and circular economy, the SO_2 and $PM_{2.5}$ generated during industrial production and their time in the atmosphere can be significantly reduced. However, there is a significantly positive correlation between GPI and dust emissions, which may be because the development of GPI is often closely related to local urban development and the improvement of people's living standards, and urban construction and the improvement of people's living standards lead to an increase in local dust emissions. Moreover, there is no significant relationship between dust emissions and coal utilization. Dust mainly comes from flying dust in the air, dust from urban construction, road dust, automobile exhausts, etc. The development of GPI is often closely related to the development of local cities, and urban construction leads to an increase in local dust emissions.

In contrast to previous studies that suggested a significant and robust double threshold effect between the intensity of environmental regulation and SO_2 emissions [28], this study shows a significant positive coefficient of environmental regulation on SO_2, which could be because of the government's large investment in environmental governance to deal with smoke, dust, and haze pollution in the air, but it has a limited role in reducing SO_2 emissions. The impact of precipitation on dust is significantly negative, which indicates that precipitation can alleviate the impact of dust on the air environment to a certain extent. The coefficient between the development of pollution-intensive industries and dust emissions is significantly negative, and the coefficient between the development of pollution-intensive industries and haze emissions is significantly positive, which may be due to the close relationship between haze emissions and the development of local pollution-intensive industries. Dust emissions come from urban construction, automobile exhausts, and road dust, while the development of pollution-intensive industries accelerates the development of urban construction, local economic development, and the improvement of people's living standards.

In terms of the indirect effect, the coefficient of GPI is similar to the direct effect, which may be caused by the diffusion effect of craft innovation. The coefficients of environmental regulation on SO_2 and $PM_{2.5}$ are significantly positive, which indicates that the local strengthening of environmental regulations leads to the migration of pollution enterprises to the surrounding areas, thus leading to the aggravation of environmental pollution in the surrounding areas. The coefficient of dust emissions is significantly negative, which may be because dust mainly comes from urban construction and land dust, which cannot avoid environmental regulations through migration. Investment in environmental governance can effectively deal with dust diffusion and can reduce dust emissions in the surrounding areas, and the coefficient of pollution-intensive industries can also prove this point. The role of rainfall in reducing atmospheric pollutant concentrations has long been of interest [29]. However, it is worth noting that the coefficient on the moderating effect of precipitation and on the development of polluting industries is significantly negative, indicating that the curbing effect of precipitation on dust decreases as the number of dust increases along with it.

From the perspective of the direct and indirect effects of control variables, in the model of SO_2 and fine-particle emissions, the direct effects of the economic development level and industrial structure are significantly positive, and the indirect effects of the economic development level are also significantly positive, indicating that industrial structure has a significant impact on the emission of air pollutants in this region, and the economic development level has a significant impact on the emission of pollutants in the surrounding areas. The direct and indirect effects of the industrial structure on dust emissions are significantly negative, which may be because dust mainly comes from agricultural dust, road dust, automobile exhausts, and cooking smoke from the catering industry; therefore, there is a negative correlation between industrial structure and dust emissions. The coefficients of car ownership per capita for the three kinds of air pollution are significantly positive, indicating that automobile exhaust is an important source of air pollution and affects the air quality of surrounding areas through diffusion.

From the overall effect, the coefficient of GPI is significantly positive, which indicates that GPI can effectively cope with air pollution, especially SO_2 and $PM_{2.5}$. The coefficients of environmental regulation on SO_2 and $PM_{2.5}$ are significantly positive because, under the effect of environmental regulation, pollution-intensive industries can be avoided through industrial transfer, which indicates that there may be a pollution paradise hypothesis in the unbalanced development of different regions in China, and the overall pollution level increases due to environmental regulation. The coefficient of pollution-intensive industry development on dust is significantly negative, which may be because dust mainly comes from agricultural dust, road dust, automobile exhaust, and cooking smoke in the catering industry. The level of economic development and car ownership are significantly positive for the three kinds of air pollution, which shows that economic development and car exhausts are the important causes of air pollution, and the important strategy to deal with air pollution is to explore sustainable development paths and green transportation methods. The coefficient of energy efficiency on haze-pollutant emissions is significantly positive, which may be because China mainly uses coal, fuel oil, and other forms of high haze-pollutant emission energy leading to the rapid development of the economy and the massive use of energy. Energy efficiency is continuously improving, and the total amount of haze-pollutant emissions is also continuously increasing. The coefficient of the development of air pollution-intensive industries to the emission of haze pollutants is significantly positive, which shows that the development of pollution-intensive industries is an important cause of air pollution, and for areas with serious air pollution, the proper relocation of pollution-intensive industries and improvement of the technical level of pollution-intensive industries are effective measures to address air pollution.

5. Conclusions and Policy Implications

5.1. Conclusions

5.1.1. GPI Is Conducive to Significantly Reducing the Emissions of SO_2 and PM2.5

GPI has a significantly negative correlation with SO_2 and $PM_{2.5}$, which indicates that GPI plays an important role in the emissions of SO_2 and $PM_{2.5}$. Through the development and progress of green craft technologies, such as air purification, energy conservation, environmental protection, and a circular economy, the SO_2 and $PM_{2.5}$ produced during industrial production and their time in the air can be significantly reduced.

5.1.2. The Development of Pollution-Intensive Industries Is an Important Source of PM2.5 and SO_2, with Significant Spatial Spillover Effects

The development of pollution-intensive industries has a significantly positive correlation with the amount of SO_2 and $PM_{2.5}$ emissions, which indicates that the development of pollution-intensive industries is an important source of SO_2 and $PM_{2.5}$ emissions. The spatial spillover of pollution-intensive industries shows a significantly positive correlation, indicating that the development of pollution-intensive industries not only leads to an increase in pollutant emissions in the area but also leads to an increase in pollutant emissions in the surrounding areas.

5.1.3. The Strengthening of Environmental Regulation Leads to a Reduction in Domestic Pollution but Also Leads to the Transfer of Industrial Pollution

The coefficients of environmental regulation on the emissions of SO_2 and $PM_{2.5}$ are significantly positive because, under the effect of environmental regulation, pollution-intensive industries can be avoided by industrial transfer. The coefficient of environmental regulation on dust emissions is significantly negative, mainly because dust comes from urban construction and land dust, which cannot avoid environmental regulation through migration; environmental governance investment can effectively deal with dust diffusion and reduce dust emissions in surrounding areas.

5.1.4. Precipitation Is Conducive to Reducing the Concentration of Dust and Haze Pollutants in the Air

The impact of precipitation on dust is significantly negative, which indicates that precipitation can alleviate the impact of dust on the air environment to a certain extent. The spatial spillover item of precipitation is significantly positive because the relative range of precipitation is large. When there is local precipitation, there is precipitation in the surrounding areas, and precipitation has a significantly positive effect on the reduction of dust concentration in the air. In the haze-pollutant model, the spatial spillover of precipitation items is significantly negative, which indicates that the precipitation in local areas has an obvious purification ability on haze in the surrounding areas.

5.2. Policy Implications

5.2.1. Developing Differentiated Environmental Policies for Different GPI Activities

GPI activities include cleaner production-technology innovation activities to reduce the generation of pollutants and end-treatment technology innovation activities to reduce the emission of pollutants that are generated, and the adoption of differentiated environmental policies according to the different GPI activities is conducive to improving its efficiency. First, the use of mandatory environmental policies is conducive when supporting end-treatment technology innovation activities. Strict emission standards for air pollutants should be formulated, punishment for enterprises that do not meet the standards should be increased, sewage enterprises should be increased, a stricter environmental protection supervision system should be established, a one-vote veto system for environmental protection should be implemented, enterprises that do not meet the standards to participate in public project bidding should be prohibited, etc. On the other hand, due to the high failure rate of innovation, high investment, and high innovation cost, it is suitable to adopt a market-incentive environmental policy for the purpose of reducing pollutant generation in cleaner production technology innovation. This policy should give tax relief to GPI enterprises, reduce nontax expenses, and increase innovation subsidies. This policy should guide enterprises toward cleaner production technology innovation, encourage them to increase their investment, strengthen the protection of intellectual property rights, and help strengthen the transformation of innovative technological achievements.

5.2.2. Effectively Strengthen GPI

Through the following four aspects, GPI can be strengthened. First, the government formulates policies conducive to GPI, clearly defining the meaning of industrial green technology and the scope of green industrial technology, and increasing the punishment of pollution-intensive industries. Forcing regions to strengthen technological innovation in pollution-intensive industries can help to reduce pollution emissions and lower environmental costs by improving their own processes [30]. The government can encourage and support enterprises in carrying out green industrial technology innovation activities. Preferential measures such as tax incentives and fund subsidies should be given to enterprises that carry out GPI, the types of subsidies and the proportion of incentives for innovation projects should be increased, and the proportion of incentives for non-innovation projects should be reduced. The investment environment for green industrial infrastructure should be improved to ensure that green technology can be promoted and applied in areas where pollution is concentrated. Second, the government should establish a diversified fund investment system to encourage enterprises, universities, and R&D institutions to increase their investment. It should improve preferential policies for GPI; stimulate the R&D enthusiasm of enterprises, universities, and other entities; and increase the investment of social funds. It should increase investment in professional teams, cultivate technical talent, and continuously introduce high-level talent at home and abroad. Third, enterprises should improve the conversion rate of green industrial innovation achievements. It should establish an evaluation system for the commercialization of green innovation achievements; conduct a scientific evaluation of the commercialization of innovation achievements of enterprises, universities, and research institutions; and reward those institutions that have made outstanding contributions. Large enterprises are encouraged to cooperate with research institutions to carry out on-the-spot simulation experiments on scientific research achievements to promote scientific research and innovation in order to better meet the needs of enterprise production. Fourth, society should strengthen the publicity of GPI. Through the news media, the relevant knowledge that GPI is conducive to promoting environmental protection should be publicized to the public and enterprises; by letting them know the benefits of GPI, this will continuously enhance a sense of responsibility in the public and enterprises for environmental protection, promote the public and enterprises to actively participate in environmental protection, environmental supervision, and other activities, and promote enterprises to continuously carry out GPI.

5.2.3. Systematic Construction of a Joint Prevention and Control System for Regional Air Pollution

The joint prevention and control system for regional air pollution can be constructed from the following aspects. First, interregional air pollution prevention and control institutions can be established for cooperation; establish a regional cooperation air pollution prevention and control committee; clear its power and functions; equip with professional personnel; build a complete internal structure; change from an informal operation to the daily operation of governance organization; give full play to the role of the committee; and plan the tasks for regional cooperation as a whole. Second, the formulation of regional cooperation air-pollution control laws and the regulation and strengthening of law enforcement should be carried out. The contents, funds, personnel, and other contents of local government cooperation in preventing and controlling air pollution should be clearly stipulated in the form of laws. The powers and responsibilities of various governments in the region should be scientifically planned, and regional cooperation should be institutionalized. In addition, it is necessary to establish unified implementation standards in the region, strengthen the construction of law enforcement teams, and carry out joint law enforcement. Third, it is necessary to encourage multiple subjects to participate in the prevention and control of air pollution, build a platform for public participation in regional air pollution coordination and control, and improve their awareness of air pollution control. Furthermore, the government should also strengthen cooperation with enterprises, rationally distribute air pollution-intensive industries, reduce excess production capacity, and encourage enterprises to participate in regional cooperation air-control mechanisms. Finally, a cross-regional supervision mechanism for regional cooperation and prevention should be established. It should establish an online supervision platform, strengthen public supervision over pollution prevention and control by the government and enterprises, and enhance the transparency of their implementation.

5.2.4. Increasing the Construction of Artificial Wetlands in Areas with Serious Air Pollution

Wetlands are an important part of the human living environment. They have huge environmental functions and benefits, such as climate regulation, flood storage, the maintenance of geochemistry, pollution control, reduction in soil erosion, and maintenance of biodiversity; furthermore, long-term large-scale wetlands are conducive to increasing regional precipitation. First, it is necessary to rapidly increase the number and area of artificial wetlands such as urban reservoirs, lakes, marshes, and rivers in areas with serious air pollution in a planned way according to the water-source conditions such as river-wet periods, rainwater collection, sewage treatment, Tibetan water flow to Xinjiang and south-to-north water transfer, to gradually increase urban precipitation, improve the urban air environment, beautify the urban landscape, and enhance the high-quality development-level of the urban economy. Second, it is necessary to increase the number of artificial wetlands such as marshes, lakes, reservoirs, tidal flats, and rice fields near both sides of the rivers in areas with serious air pollution in a planned way according to water-source conditions such as river-wet periods, to increase the wetland area, which affects the water and gas environment in the area with serious air pollution, and gradually improve the self-purification ability of air pollution in this area. Third, when conditions are ripe, according to the water sources of the Yangtze River, Yellow River, and other rivers in river-wet periods and other artificial water diversion projects, it should speed up the diversion of water from deserts in areas with serious air pollution in a planned way, build wetlands in deserts, and gradually change the arid climatic conditions of deserts.

5.2.5. Scientifically Plan the Coordinated Development of Industry, Technology, and the Environment

The following four aspects show the coordinated development of industry, technology, and environment in China. First, China should change the concept of economic development and establish the green development concept. It should continuously develop a green economy, establish the concept of protecting the environment and developing the economy at the same time, realize the coordinated development of the economy and environment, and build an environmentally friendly society. Second, it should change the mode of economic development, continue to optimize the industrial structure, change the extensive mode of economic development to a green mode of development with low pollution, low emissions, and high efficiency, improve the quality of economic development, and promote coordinated industrial development. Third, it should encourage enterprises to adopt green technologies. Enterprises should help by using clean production technologies in the production process, continuously transforming and upgrading production equipment, and reducing the amounts of pollutants discharged in the production process. Green technologies should also be used in packaging, assembly, sales, and other links to minimize the amount of pollution discharged. Finally, it should strengthen publicity among the public. For example, it can carry out in-depth reports on outstanding issues of environmental protection to make the public aware of the importance of environmental protection and to enhance their sense of social responsibility. It should also innovate publicity methods and make full use of the internet, creating a new platform for online publicity.

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