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Changes in Air Pollution Control Policy Instruments: Based on a Textual Analysis for Southwest China 2010–2021

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Abstract: An important task in the construction of China's ecological civilization, the selection and implementation of policy instruments fully reflect the actual effectiveness of the government's efforts to control air pollution. Based on the content analysis method, this study examines the changing process of air pollution control policy instruments in southwest China from 2010 to 2021 in terms of implementation, synergy, and integration of policy instruments. The results show that, in terms of the degree of mandatory, the frequency of using policy instruments generally increased with time, but the overall balance of the instrument portfolio was poor. In terms of the degree of synergy, a gradual shift occurred from government-led to government-society governance. However, the concept and modes of inter-governmental linkage and cross-regional collaborative governance need to be improved. As for the degree of systemic, a clear trend of instrument integration and more frequent information interaction was found. Emergency-oriented characteristics appear strong, but a regular governance mechanism is lacking. Therefore, this paper provides policy suggestions and academic considerations for further improving the effectiveness of air pollution management in southwest China from three aspects: optimizing the policy tool system, deepening the regional joint prevention and control mechanism of air pollution, and promoting intelligent air pollution management.

Keywords: air pollution control; southwest region; policy instruments; mandatory; synergy; integration

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1. Introduction

Since the reform and opening up, and with the implementation of the Western development strategy, the economic level of the southwest region of China has risen and infrastructure has been increasingly improved. The southwest region has assumed an important role in the overall development of China's economy. As an important energy base in China, major industries in the southwest mainly include iron and steel, chemical, construction materials, energy, machinery, and electronics, forming seven major industrial agglomeration development areas: Mianyang, Deyang, Chengdu, and Leshan Industrial Zone; Neijiang, Zigong, Yibin, and Luzhou Industrial Zone; Zunyi, Guiyang, and Anshun Industrial Zone; Qujing, Kunming, and Yuxi Industrial Zone; Panzhihua Industrial Development Zone; Zhaogao Industrial Development Zone; and Chongqing Industrial Development Zone. However, the regional distribution of heavy industries in the southwest is not balanced, is mainly concentrated in the economically developed areas along the transportation routes, and the industrial production activities have a greater impact on the air environment. In addition, the topographic environment and adverse meteorological conditions have a negative impact on atmospheric dilution and diffusion, which further aggravates the severity of air pollution in southwest China [1,2]. The prevention and control of air pollution is an important task in the construction of ecological civilization; the effectiveness of air pollution management is related to the sustainable development of the economy, but also the fundamental interests of people [3,4]. In recent years, the

local governments of Chongqing, Sichuan, Guizhou, and Yunnan provinces and the Tibet Autonomous Region have introduced corresponding policies to deal with regional air pollution problems under the planning and deployment of the central government. Due to the diversity of causes of air pollution, the complexity of management, and the diffusion of pollution, the traditional localized management model is likely to fail. Promoting cross-regional collaborative air pollution management has become an effective choice to deal with air pollution problems [5–7].

The rational selection and Innovation of policy instruments is an important means for the government to manage the air pollution problem. Moreover, it is the key to influence the effectiveness of air pollution management policies. Understanding and grasping the pulse, characteristics, and preferences of local governments' air pollution management policy instruments selection is vital for achieving effective regional air pollution management. Before selecting the appropriate environmental policy instruments, it is necessary to clarify the characteristics of the instruments and classify them scientifically. The different classifications reflect the classifier's understanding of the policy [8,9].

Existing studies have mainly classified environmental policy instruments from two perspectives. The first one is a dichotomous, trichotomous, and quadratic classification of policy instruments based on their degree of mandatory implementation. In the dichotomous approach, Fei Feng et al. classified environmental policy instruments into two types: incentive-based environmental instruments and punishment-based environmental instruments [10]. Danhe Liu categorized environmental policy instruments into the command-and-control approach and the market-based approach [11]. The dichotomous approach is based on the division of the degree of government dominance in environmental policy and focuses on the relationship between the government and the market. In the trichotomy, Yu Wei et al. classified environmental policy instruments into direct control, economic instruments, and "soft" instruments [12]. Gao Ge argued that environmental policy instruments can be divided into command-and-control, market-incentive, and voluntary policy instruments [13]. In discussing the role of environmental policy instruments on environmental quality, Zheng Shiming classified environmental policy instruments as direct control, market-based, and informal [14]. The criteria applied in this classification are the factors that influence the policy target to produce a particular behavior. As for the four divisions, the most influential one is the World Bank's classification of environmental policy instruments into four categories of using markets, creating markets, environmental regulation, and public participation. In 1997, Feng Yue et al. argued that China's environmental policy instruments mainly include four categories: administrative regulatory policy instruments, economic incentive instruments, social voluntary agreements, and information-based policy instruments [15]. This classification standard is based on the axis of the "mandatory and voluntary" relationship and focuses on the role of social actors in environmental protection. With the development of environmental governance theory and practice, policy instruments based on new governance mechanisms have emerged and achieved positive governance results. The second way of classifying environmental policy instruments is to complement and extend the existing instruments through technical and organizational innovations based on the intensity of government regulation. For example, Rothwell and Zegveld classified environmental policy instruments as supply side, demand-side, or environment-based depending on their functional macro-policy orientation [16].

In general, scholars have explored the classification of environmental policy instruments from different perspectives, and environmental policy instruments have gradually become the focus of governance for environmental pollution problems. However, the regional air pollution problem presents increasingly strong regional crossover and territorial overlap, and these characteristics further enhance the severity and complexity of regional air pollution management. Therefore, it is necessary to introduce synergy and integration into the scope of air pollution management policy instruments. Based on this, this paper uses content analysis to analyze the changes in air pollution control policy instruments in

southwest China in three dimensions: mandatory, synergistic, and systematic, and further discusses the possible improvement directions of air pollution control policies in southwest China in the future [17].

2. An Analytical Framework for the Change of Air Pollution Control Policy Instruments in Southwest China

2.1. Definition of Core Variables of Policy Instruments

The degree of mandatory refers to the degree of administrative control embodied in environmental policy instruments. According to the degree of administrative control, environmental policy instruments can be defined as "command-and-control policy instruments", "market-incentive policy instruments" and "public participation policy instruments". There are three types of environmental policy instruments. Command-and-control policy instruments take administrative orders as the main regulatory means to clarify environmental protection requirements through legislation or the formulation of rules and regulations. This imposes constraints on pollution behavior, thus achieving the goal of improving the environment. Command-and-control policy instruments mainly include emission standards, technical specifications, use restrictions, and non-tradable emission permits. Market-incentive policy instruments enable the market subject to obtain corresponding benefits from pollution prevention and environmental protection through economic incentives. Therefore, it guides market participants to voluntarily choose behaviors that are more beneficial for the environment. Market-incentive policy instruments mainly include sewage charges, emissions trading, taxes, and subsidies. Public participation policy instruments are those that allow the public to participate in regional environmental governance as individuals or teams. The main types of public participation environmental policy tools include information disclosure, environmental certification, publicity and education, as well as public participation.

The degree of synergy refers to the interaction and cooperation among policy-making subjects. The degree of synergy mainly includes three aspects: the first is the distribution of subjects engaged in making air pollution control policies; the second is the collaboration of subjects involved in making air pollution control policies; the third is the coverage of air pollution control policies and regulations.

The degree of systemic refers to the degree of systematization in the selection and use of policy instruments in air pollution control policies, mainly including organizational systems, information integration and sharing, fund management, and technical exchange and cooperation.

2.2. Measurement of Core Variables of Policy Instruments

In this study, policy texts were obtained from the Peking University Law Database, and the keywords "atmosphere" and "air" were used to retrieve the air pollution control policies issued by Chongqing, Sichuan, Guizhou, Yunnan, and the Tibet Autonomous Region from 2010 to 2021. In total, 257 valid texts were obtained after eliminating the low relevance and duplicate texts, including 20 texts from Chongqing, 169 texts from Sichuan, 42 texts from Guizhou, 23 texts from Yunnan, and 3 texts from the Tibet Autonomous Region.

The indicators of "degree of compulsion" and "degree of systematicity" were analyzed using content analysis. The policy text corresponding to the policy instrument was used as the unit of analysis and was coded with the query-text search function of NVivo qualitative analysis software, in which the keyword search and coding rules are shown in Table 1. The index of "degree of synergy" was mainly based on the content analysis of policy texts. If there were two or more policymakers in the policy text, it was regarded as the existence of policy collaboration.

Table 1. Examples of policy tool content analysis.

Index	Keyword	Reference Point Exemplar
Command-and-control policy instruments	Emission standards	Motor vehicles in use shall not exceed the national and municipal emission standards for pollutants, and shall not emit black smoke or other obvious visible pollutants.
	Ban	Prohibit the emission of air pollutants through the abnormal operation of air pollution control facilities and other ways to avoid supervision.
	License	The Pollution Discharge License should specify the name, type, quantity, emission method, treatment measures, and monitoring requirements of the pollutants allowed to be discharged.
	Approval	Sulfur dioxide, ammonia nitrogen, heavy metals, smoke (dust), and volatile organic emissions are in line with the total control requirements as a pre-condition for the approval of environmental impact assessment of construction projects.
	Supervision and accountability	Weekly comprehensive supervision of industrial air pollution prevention and control special inspection work.
	Rectification	The establishment of a "loose and messy" enterprise remediation list to conduct dynamic investigation and update mechanisms, and the implementation of the "responsibility system and list system" rectification and inspection system.
	Classification control	To prohibit the construction and expansion of new coal-fired thermal power, chemical, cement, quarry (crushed) stone, sintered brick kilns, coal-fired boilers, and other projects in the key control areas.
Market-incentive policy instruments	Emissions charges	For soot that is difficult to monitor, an emission charge may be levied on the basis of Ringelmann blackness. The levy rate per ton of fuel is 1 yuan for Class 1, 3 yuan for Class 2, 5 yuan for Class 3, 10 yuan for Class 4, and 20 yuan for Class 5.
	Environmental tax	The average cost of treatment of taxable air pollutants is 3.52 yuan/pollution equivalent.
	Subsidies	Increase energy conservation and environmental protection, new energy technology research and development investment, and new technology application of financial subsidies.
	Trading of emission rights	Through the adoption of effective emission reduction measures, if the internal transfer of enterprises and other ways still cannot meet the needs of the project, the shortfall can be purchased through emissions trading.
	Ecological compensation	Actively seek to establish ecological compensation policies and standards for natural gas extraction for local ecological restoration.
Public participation policy instruments	Information disclosure	Promote pollution reduction information disclosure. Release half-yearly and annual data on total emissions reduction of major pollutants.
	Green advocacy	Advocate green travel and encourage travel by public transportation or by electric vehicles.
	Social participation	Establish a social monitoring mechanism to widely accept social supervision.
	Publicity and education	Carry out various forms of publicity and education to popularize the scientific knowledge of air pollution prevention and control.

Table 1. *Cont.*

Index	Keyword	Reference Point Exemplar
Degree of systematicity	Organizational system	Identify the responsible parties and responsible persons, establish a pressure transmission mechanism, and form a responsibility system for air pollution prevention and control.
	Information system	Timely establishment of key sources of pollution discharge status real-time monitoring information system, radiation event warning information system.
	Funds management	The rewarded funds are used for air pollution prevention and control scientific research and treatment projects, air environmental supervision capacity building and township (street) environmental protection agencies work.
	Exchange and cooperation	Establish an information and communication platform for all parties to communicate and exchange information.

2.3. Assignment of Core Variables of Policy Instruments

Firstly, to assign the mandatory degree of policy instruments, regional air pollution control policy instruments were classified into "command-and-control policy instruments", "market-incentive policy instruments", and "public participation policy instruments". During the validity period of the policy, if the keyword of the policy instruments appeared once in the policy text, the value of one was assigned, and the cumulative value of the number of appearances was then calculated.

Secondly, for the degree of synergy of policy instruments, if multiple policy subjects collaborated in a policy text during the policy period, the degree of synergy was assigned a value of one, and the final value was the cumulative value of the number of synergies in the policy text.

Thirdly, the systemic degree of the policy tool was assigned: if the keywords "system construction", "information system", "fund management", and "exchange and cooperation" appeared N times in the policy text during the policy period, a value of N was assigned to the systemic degree. Finally, the cumulative value of the number of times the above keywords appeared was calculated.

2.4. A Research Framework on the Change of Air Pollution Control Policy Instruments in Southwest China

In summary, the analytical framework of this study is: to examine the changes in the mandatory degree of air pollution control policy instruments by comparing the changes of command-and-control, market-incentive, and public participation policy instruments; to reflect the changes in the synergistic degree of air pollution control policy instruments by using the joint issuance status of policy subjects; and to reflect the changes of the systemic degree of air pollution control policy instruments by using the indicators of "organizational system", "information system", "fund management" and "communication and cooperation" (Figure 1).

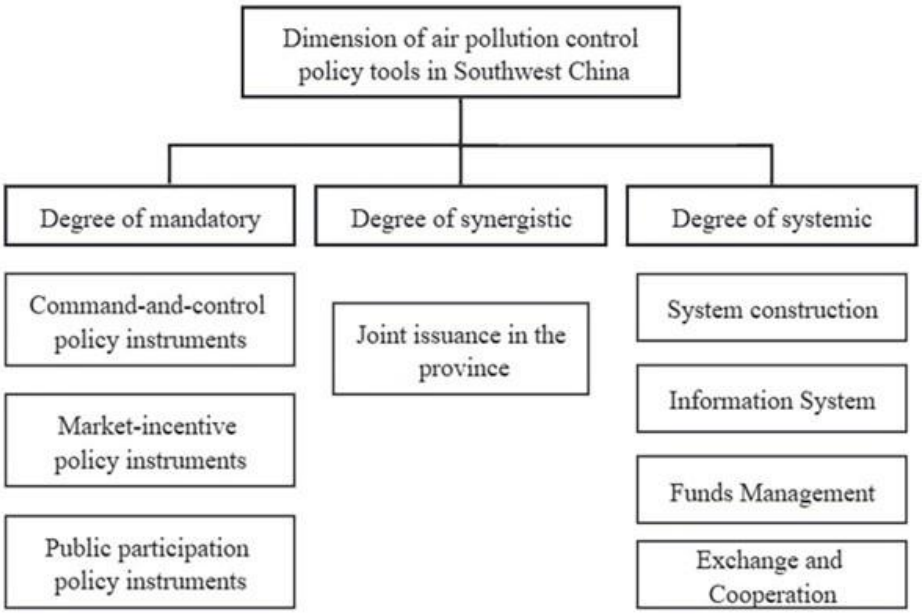

Figure 1. Analysis framework of the change of air pollution control policy instruments in southwest China.

3. Policy Text Analysis of Changing Policy Instruments for Air Pollution Control in Southwest China (2010–2021)

3.1. The Overall Change of Air Pollution Control Policies in the Southwest

Based on the number of policy texts, air pollution control policies in southwest China have some similar characteristics over time, as shown in Table 2. First, air pollution control policies in southwest China have roughly gone through three stages: development, peak, and stability [18]. Before 2013, with rapid urbanization and industrialization, the GDP (Gross Domestic Product)-centered rough industrial development model increasingly aggravated the air pollution in southwest China. Chongqing, Sichuan, Guizhou, and Yunnan provinces began to pay attention to the air pollution problem, but were limited by the financial capacity of local governments, and so the number of air pollution control policies introduced was relatively small. In September 2013, the State Council promulgated and implemented the Action Plan for the Prevention and Control of Air Pollution, which arranged and deployed the national air pollution governance work in many aspects, such as adjusting industrial structure, eliminating backward production capacity, and air environment management. Since then, local governments have responded to the call; Chongqing, Sichuan, Guizhou, Yunnan, and the Tibet Autonomous Region have increased their regional air pollution control policies. The number of policies issued reached a historical peak in 2017 and remained stable afterward. Second, Chongqing, Sichuan, Guizhou, Yunnan, and the Tibet Autonomous Region differed significantly in the number of air pollution control policies issued. Among them, Sichuan Province issued the most air pollution control policies, the number of which was higher than the total number of policies in the other regions of southwest China. This coincided with the industrial development in the southwest, where the growth rate of secondary industry in Sichuan and Chongqing was higher than that in Guizhou and Yunnan provinces. In contrast, due to the fragile ecological environment, the Tibet Autonomous Region insisted on ecological protection in its economic development, as some air environment pollution mainly comes from outside the country instead of being caused by local human activities. Therefore, the number of air pollution control policies there is quite small.

Table 2. Numbers of air pollution control policy texts in southwest China.

Year \ Region	Chongqing City	Sichuan Province	Guizhou Province	Yunnan Province	Tibet Autonomous Region	Total
2010	2	4	0	1	0	7
2011	1	5	0	0	0	6
2012	0	4	0	0	0	4
2013	1	16	0	2	0	19
2014	1	25	10	7	1	44
2015	1	25	11	3	0	40
2016	4	27	4	3	0	38
2017	6	28	9	1	0	44
2018	2	17	6	3	2	30
2019	2	7	0	1	0	8
2020	0	4	1	1	0	6
2021	2	7	1	1	0	11
Total	20	169	42	23	3	257

3.2. The Degree of Mandatory Air Pollution Control Policy Instruments in Southwest China

Regarding the degree of mandatory policy instruments, shown in Figure 2, it can be seen that, firstly, Chongqing, Sichuan, Guizhou, Yunnan, and the Xizang Autonomous Region all preferred to use command-and-control policy instruments. The use of command-and-control policy instruments was significantly more frequent than that of market-incentive and public participation policy instruments. From 2010 to 2021, command-and-control policy instruments were used more often than market-incentive and public participation policy instruments of the policy text. Secondly, the peak use of command-and-control policy instruments, market-inspired policy instruments, and public participation policy instruments were all concentrated from 2015 to 2018. Finally, from the perspective of the stability of the use of policy instruments, the volatility of command-and-control policy instruments is higher, followed by public participation policy instruments. Since market-incentive policy instruments are used relatively less frequently, their volatility is the most stable.

In terms of command-and-control policy instruments (Figure 3), first, the use of command-and-control policy instruments for air pollution control in southwest China from 2010 to 2021 shows a fluctuating upward trend in general. Specifically, Chongqing has gradually used command-and-control policy instruments such as punishment, ban, rectification, approval, and classification control in 2010; then added command-and-control policy instruments such as inspection and accountability in 2011; and included emission standards in the command-and-control policy toolbox in 2013. The frequency of use of command-and-control policy instruments in Sichuan Province gradually increased from 2011, and command-and-control policy instruments such as environmental access and technical specifications were added in 2011 and 2012, respectively; in 2013, command-and-control policy instruments such as zoning control were added; and in 2015, command-and-control policy instruments such as inspection and accountability were added. The frequency of using command-and-control policy instruments in Guizhou Province increased after 2014, and Guizhou Province added command-and-control policy instruments for environmental access in 2015. Yunnan Province started to use command-and-control policy instruments, including bans, penalties, emission standards, and categorization control in 2010, and added command-and-control policy instruments such as environmental access, rectification, and approval in 2014. The Tibet Autonomous Region was the last to use command-and-control policy instruments. Since 2014, the Tibet Autonomous Region has been gradually using command-and-control policy instruments; in 2018, it added command-and-control policy

instruments such as emission standards and zoning controls. Second, from 2010 to 2021, Sichuan Province had the highest frequency of use of command-and-control policy instruments, followed by Chongqing city, Guizhou Province, and Yunnan Province, and the Tibet Autonomous Region had the lowest. From 2010 to 2013, there was no significant difference in the frequency of use of command-and-control policy instruments in Chongqing city, Sichuan Province, Guizhou Province, Yunnan Province, and the Tibet Autonomous Region. During 2014 to 2018, the use of command-and-control policy instruments in the southwest region all increased significantly, with Sichuan Province showing a much higher increase than the other regions and peaking in 2016. It is worth noting that the State Council issued the Notice of the Action Plan for the Prevention and Control of Air Pollution in September 2013; the newly revised Environmental Protection Law was formally implemented in 2015; and the Environmental Protection Tax Law of the People's Republic of China was formally introduced in 2018. This indicates a strong link between the frequency of use of command-and-control policy instruments and the national policy system.

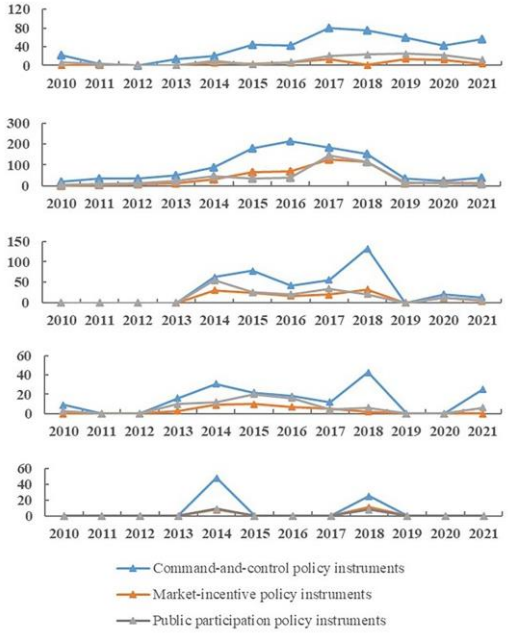

Figure 2. The use of air pollution control policy instruments in southwest China. From top to bottom are Chongqing, Sichuan, Guizhou, Yunnan, and the Tibet Autonomous Region. Where the Y-axis indicates the frequency of use, the X-axis indicates the year.

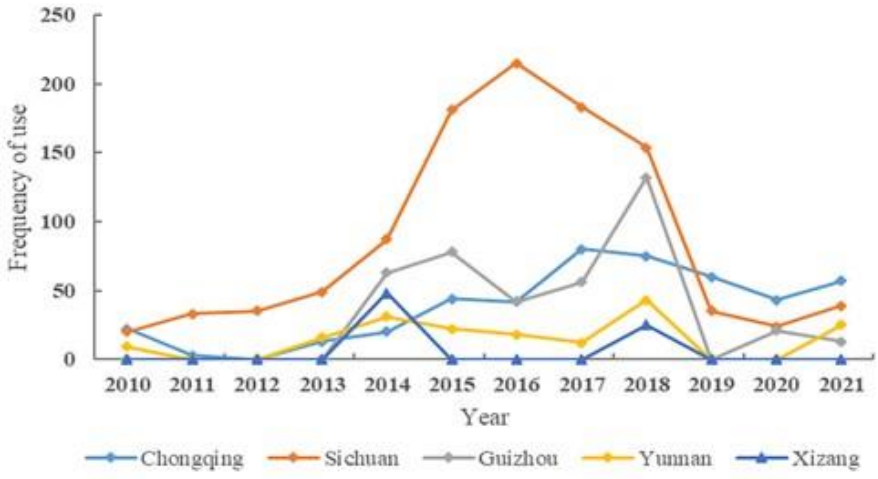

Figure 3. The use of command-and-control policy instruments in southwest China.

With respect to market-incentive policy instruments (Figure 4), first, the frequency of using market-incentive policy instruments for air pollution control in southwest China overall shows an increasing trend. Among them, Chongqing started to use economic-based policy instruments such as emissions trading and subsidies before 2010, added market-incentive policy instruments such as emissions charges and financial support in 2014, and included an environmental protection tax into the market-incentive policy toolbox in 2017. Sichuan Province included ecological compensation and emissions trading among market-incentive policy instruments in 2011 and added market-incentive policy instruments such as subsidies in 2014. Guizhou Province focused on using market-incentive policy instruments such as emission charges and subsidies in 2014 and added financial support and an environmental protection tax in 2015 and 2017, respectively. Yunnan Province focused on using market-incentive policy instruments such as emission charges, emissions trading, and scientific and technological research and development from 2010, and added ecological compensation policy instruments in 2014. The Tibet Autonomous Region started to use market-incentive policy instruments such as emission charges and subsidies in 2010, and added science and technology R&D and an environmental protection tax to the policy instruments in 2018. Second, from 2010 to 2021, the frequency of using market-incentive policy instruments in Sichuan Province was slightly higher than in other regions in general. The frequency of using market-incentive policy instruments in southwest China was significantly higher after 2014. Chongqing used market-incentive policy instruments even more frequently than Sichuan Province from 2019 to 2021.

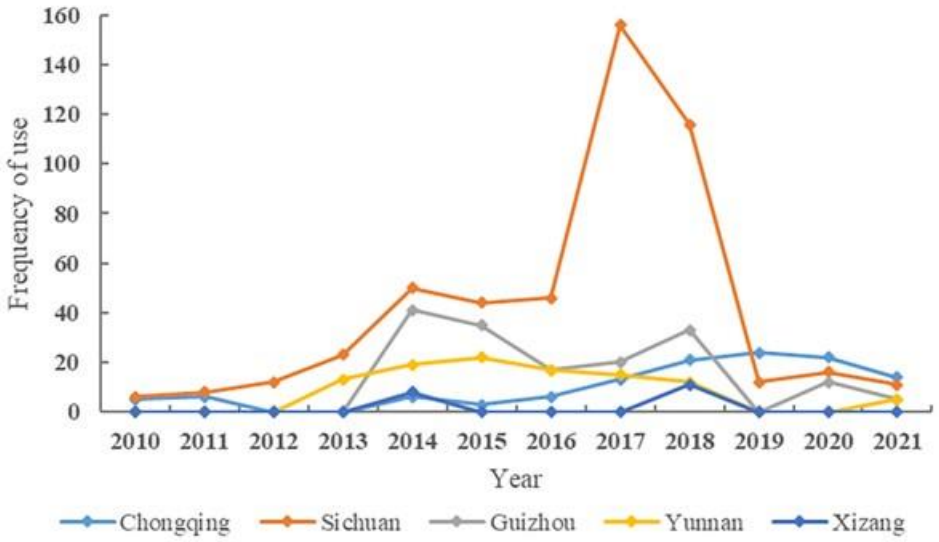

Figure 4. The use of market-incentive policy instruments in southwest China.

Regarding the frequency of public participation policy instruments (Figure 5), firstly, the frequency of public participation policy instruments in air pollution control in southwest China from 2010 to 2021 showed an increasing trend. As for the frequency of use of public participation policy instruments, Sichuan Province had the most with 465 times, Guizhou Province with 178 times, Chongqing Municipality with 131 times, Yunnan Province with 77 times, and the Tibet Autonomous Region with at least 17 times. In particular, Chongqing started to widely use public participation policy instruments such as publicity and education and social participation in 2010, and increased social investment, green advocacy, and other public participation policy instruments in 2015 and 2016, respectively. Sichuan Province has increased the frequency of using public participation policy instruments since 2010; added public participation policy instruments such as green advocacy, publicity and education, and social participation in 2011; and added social investment policy instruments in 2014. Guizhou Province started to use public participation policy instruments such as social participation, information disclosure, and green advocacy in 2010, and added social investment policy instruments in 2016. Yunnan Province started to increase the

frequency of using public participation policy instruments such as advocacy and education and information disclosure in 2010, and included social investment in public participation policy instruments in 2015. The Tibet Autonomous Region was the last to use public participation policy instruments and started to use public participation policy instruments such as green advocacy, information disclosure, and publicity and education in 2014. Second, from 2010 to 2013, there was no significant difference in the frequency of use of public participation policy instruments in Chongqing, Sichuan, Guizhou, Yunnan, and the Tibet Autonomous Region. From 2014 to 2019, the frequency of use of public participation policy instruments in Sichuan increased significantly, and both Guizhou and Chongqing increased the frequency of use of public participation policy instruments.

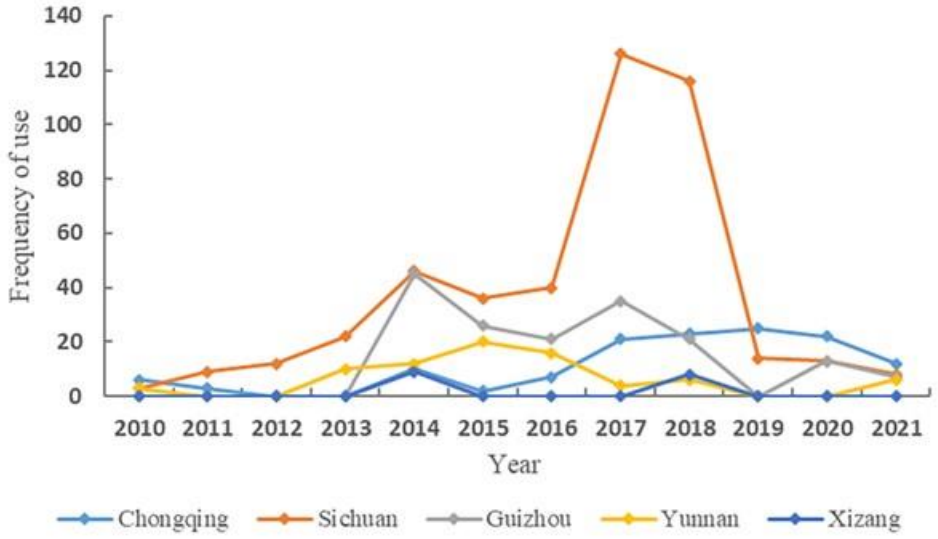

Figure 5. The use of public participation policy instruments in southwest China.

3.3. The Degree of Synergy of Air Pollution Control Policy Instruments in the Southwest

From the perspective of the synergy between policy-making subjects, the collaboration of air pollution management policy subjects in southwest China from 2010 to 2021 occurred within the provincial scope. The collaborative subjects were mainly concentrated in Chongqing city, Sichuan Province, and Guizhou Province. no provinces have jointly issued documents so far.

The joint issuance of documents within the administrative division of Chongqing is shown in Figure 6, and the figures in the graph are the number of joint issuances between departments. In joint effort with other Chongqing governmental departments, the Chongqing Ecological Environment Bureau issued the "Emission Standards for Air Pollutants in Packaging and Printing Industry" in 2017; in 2018, it issued the "Chongqing Diesel Truck Pollution Control Battle and Transportation Air Pollution Prevention and Control Action Plan"; in 2019, it issued the "Notice on Strengthening the Management of the Air Environment around Schools"; and in 2020, it issued the "Notice on Strengthening Atmospheric Environment Management Work in the Funeral Field".

The joint issuance in Sichuan Province is shown in Figure 7. In 2019, the office of the Sichuan Ecological Environment Department, jointly with other governmental departments, issued the "Notice on Strengthening the Prevention and Control of Air Pollution in Public Places such as Hospitals, Schools and Kindergartens, Nursing Homes and Transportation Stations"; in 2021, the Chengdu Municipal Bureau of Ecology and Environment issued the "Technical Guidelines for Air Pollution Prevention and Control at Construction Sites in Key Control Areas in Chengdu" with other governmental departments in Chengdu.

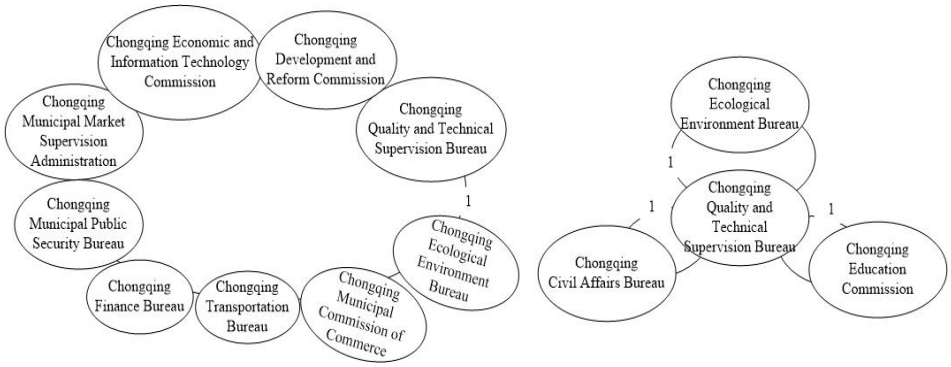

Figure 6. Joint issuance within the administrative division of Chongqing.

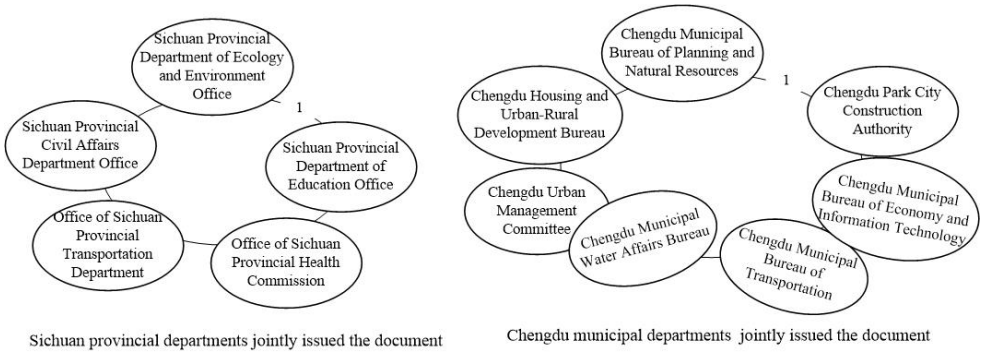

Figure 7. Joint issuance within the administrative division of Sichuan Province.

The joint issuance of documents in air pollution management in Guizhou Province is shown in Figure 8. In 2014, the Department of Environmental Protection of Guizhou Province jointly with other governmental departments issued the "Emission Standards for Air Pollutants in Cement Industry in Guizhou Province"; in 2015, the "Notice on the Implementation of the Fourth Stage National Emission Standards for Air Pollutants from Motor Vehicles" was issued.

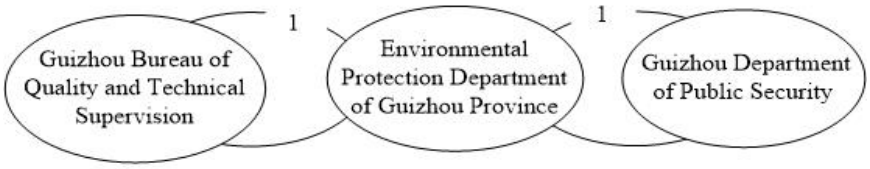

Figure 8. Joint issuance within the administrative division of Guizhou Province.

3.4. The Degree of Systematicity of Air Pollution Control Policy Instruments in Southwest China

As can be seen from the degree of systematicity of policy instruments (Figure 9), firstly, the degree of systematicity in the use of air pollution control policy instruments in southwest China has been increasing. In particular, Chongqing added policy integration in terms of organizational system and fund management in 2010, and added policy integration measures in terms of exchange and cooperation in 2016. Sichuan Province focused on policy integration measures including fund management and exchange and cooperation in 2010, and added policy integration measures such as organization and coordination and information networks in 2012 and 2013, respectively. Since 2014, Guizhou Province has focused on policy integration in terms of organizational systems, fund management, and exchange and cooperation, and added policy integration measures in terms of information systems and information networks in 2015. Yunnan Province increased its focus on policy integration in organizational systems and fund management in 2010, and added policy integration measures for exchange and cooperation in 2014. The Tibet Autonomous Region

has attached importance to policy integration in terms of fund management, exchange and cooperation, and organizational systems since 2014, and added policy integration of information systems in 2018. Second, from the overall situation, from 2010 to 2021, Sichuan Province had the highest degree of systematization of air pollution control policy instruments, followed by Chongqing, Guizhou, Yunnan, and the Tibet Autonomous Region. The systematicity of air pollution management policy instruments in southwest China showed a stable trend from 2010 to 2011, and began to increase significantly after 2013, with Sichuan Province being particularly prominent. After 2018, the degree of systematicity of air pollution control policy instruments in Chongqing exceeded that in Sichuan Province.

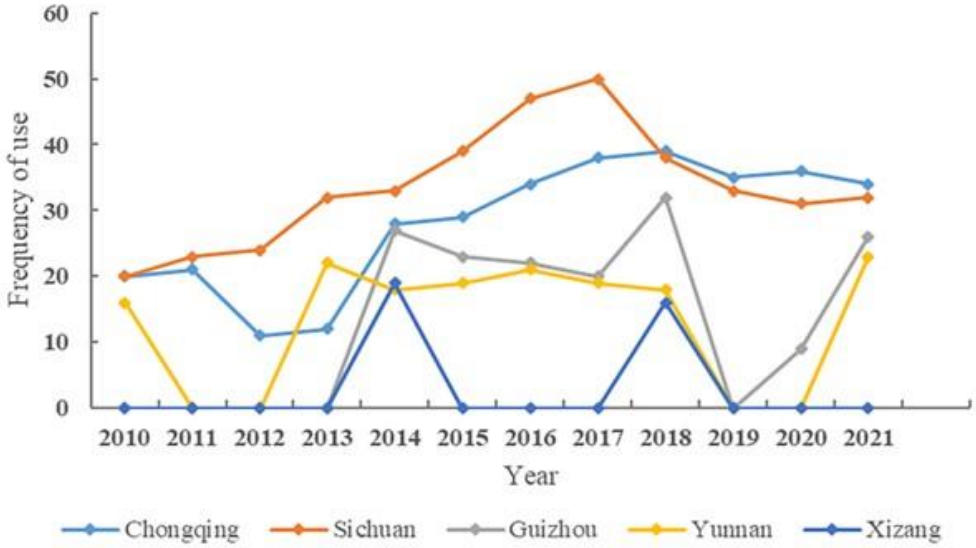

Figure 9. Degree of systematic use of policy instruments in the Southwest.

4. Research Conclusions and Recommendations

4.1. Research Findings

Since 2010, the regional and compound characteristics of air pollution in China have gradually emerged. To effectively manage the air pollution problem, Chongqing, Sichuan, Guizhou, Yunnan, and the Tibet Autonomous Region have issued a total of 257 air-pollution-management-related policies from 2010 to 2017. Based on an in-depth analysis of the contents of these policy texts, this paper summarizes the use and changes of air pollution control policy instruments in the southwest region.

Firstly, from the perspective of the number of policies, the air pollution control policies in southwest China showed different characteristics over time during 2010 to 2021, roughly experiencing three stages of development (2010–2013), peak (2014–2017), and stability (2018–2021). Due to regional differences in the level of economic development, industrial structure, and environmental quality, the number of air pollution control policies introduced in each region is varied. Sichuan Province introduced the largest number of air pollution control policies, followed by Chongqing City, Guizhou Province, and Yunnan Province, with the Tibet Autonomous Region introducing the least number of policies.

Secondly, in terms of the mandatory degree of policy instruments, the southwest region preferred to use command-and-control policy instruments in air pollution control during 2010 to 2021. The number and frequency of these policy instruments have been increasing; the number of market-incentive policy instruments has been lower than the number of command-and-control policy instruments and public participation policy instruments; and the frequency of public participation policy instruments has been growing. The growth trend shows that the frequency of use of all three types of policy instruments has risen over time. By further analyzing the frequency of the three types of policy instruments (command-and-control, market-incentive, and public participation), it is obvious that in the early times, southwest China relied heavily on the use of disciplinary instruments such as bans,

rectification, and inspection to control air pollution. The governance of air pollution was mainly conducted through administrative means. The essence of this governance mindset is the government's decisions are made based on different social–economic–environmental goals, which leads to the characteristics of campaign-style governance for regional air pollution management [19,20]. Since campaign-style governance is often attached to specific goals, such as holding major events, conferences, or eliminating the consequences of major environmental events, ultimately, this makes it difficult to normalize the air pollution governance goals, and the effects of treatment are prone to rebound [21,22].

Thirdly, considering the degree of synergy of policy instruments before 2014, since the ecological compensation mechanism in the Southwest was imperfect and the regional emissions trading system was unformed, market-incentive policy instruments were not emphasized. Moreover, the use of public participation policy instruments such as information disclosure and publicity and education were lacking, and the participation of social subjects in air pollution control has faced a lot of difficulties. Along with the frequent occurrence of air pollution problems in the Southwest, the policy instruments of local governments to control air pollution have been improving. On the one hand, subsidies, emission charges, environmental taxes, emissions trading, and other market-incentives have been applied to air pollution management, which has significantly improved the effectiveness of air pollution governance. On the other hand, the government is embracing the concept of green development and emphasizing social participation of air pollution governance and the widespread use of public participation policy instruments, which shows the composite governance characteristics of compatibility. As air pollution control gradually moves from government-led to government-society governance, the focus of future work needs to be on "inter-governmental linkage" and cross-regional collaborative governance among local governments. From the number of policy documents issued in southwest China, we can see that from 2010 to 2021, 257 policy documents were issued in the four regions, but joint documents were rare. The existing cross-regional cooperation was fragmented in terms of both content and form, lacking systemic and forward-looking policies. This shows that the local government has failed to abandon the traditional "inward-looking administration" model in air pollution management, and the "fragmented" governance characteristics of air pollution needs to be changed.

Fourthly, in terms of the systematic degree of policy instruments, with the increasingly serious air pollution problem, the government pays greater attention to the governance of air pollution and promulgates relevant policies to strengthen air pollution control efforts. Facing the top-down policy requirements, information interactions between local governments at all levels are becoming more frequent. From 2010 to 2021, the degree of integration of policy instruments regarding air pollution governance in southwest China has increased annually, such as establishing leading groups, improving information systems, and strengthening fund management. However, due to structural factors, a prominent contradiction seems to exist between the public's "social demand" and the government's "governance capacity". The local government has shown "event-emergency" characteristics in managing the air pollution problems, focusing on "treating the symptoms" rather than "treating the root cause" [23].

4.2. Policy Recommendations

1. Optimizing the system of policy instruments and increasing the frequency of market-incentive and public participation policy instruments

The current air pollution control in the southwest region attaches more emphasis on the use of command-and-control policy instruments, and thus the overall improvement of air quality can be achieved in the short term. Nevertheless, this kind of "campaign-style" governance is difficult to achieve the normalization of air pollution control, and faces the dilemma of high cost and low efficiency. Therefore, local governments should construct a scientific and reasonable policy instrument system in the process of air pollution control; appropriately reduce the frequency of command-and-control policy instruments such as

bans, rectification, and accountability; and on this basis, further exploit the advantages of permitting, approval, environmental access, and environmental assessment systems in air pollution control. In addition, the government should encourage enterprises to reduce pollution by improving the policy system of emission charges, ecological compensation, and transfer of emission rights. Finally, the government needs to disclose timely information about regional air pollution governance and actively explore new methods and ideas for public participation and social supervision in the process of air pollution governance [24,25].

2. Deepening the regional air pollution joint prevention and control mechanism, and enhancing the degree of collaboration in regional air pollution management

At present, the collaborative behavior of governmental air pollution control in the southwest region mainly occurs within the provincial area, without regional collaborative control. Moreover, the existing cooperation among local governments is mostly driven by political or economic interests, which may lead to an unsustainable effect on air pollution control. Therefore, in the first place, it is necessary to impose rigid constraints on the behavior of air pollution governance in the southwest region through central government legislation. The power and responsibility of local governments at all levels in the process of regional air pollution governance should be clearly defined so as to improve the actual effectiveness of regional air pollution governance [26,27]. Furthermore, it is necessary to establish a formal official regional coordination institution instead of temporary organizations in order to coordinate air pollution governance, and to mediate the obstacles and problems of relevant departments in the process of cross-regional collaboration [28]

3. Promoting intelligent governance of air pollution and accelerate the realization of normalized prevention and control

The advent of the big data era has changed the way of information and data dissemination, effectively promoted the intelligent management of data, as well as brought intelligent management opportunities for dealing with the air pollution problems in southwest China. To some extent, the performance of air pollution control depends on the implementation of laws, regulations, and environmental policies by local governments at all levels [29]. However, the "event-emergency" characteristic of local governments in the process of air pollution control causes the policies and regulations to be "selectively" implemented, and the air pollution control has a certain randomness. To avoid the waste of the previous management effects, the southwest region needs to continuously improve the construction of data platforms in the process of air pollution management. It is proposed that local governments at all levels make efforts to strengthen data sharing and cooperation, rely on the air pollution source information system and grid-based management platform to realize the normalized treatment of air pollution, and improve the refinement level of air pollution governance [30].

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