Precise pollution control in new urban development areas: a case study from China

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Abstract: To overcome the difficulty of pollution control, it is necessary to investigate and implement a more precise and effective pollution control model. This paper examines the implementation of precise pollution control in Beijing's Shunyi District. Through field research interviews and data collection, we conclude that the current implementation status of precise pollution control is a grid-based governance model with precise identification, accurate positioning, and refined management of environmental pollution. Certain technical difficulties in the precise identification of pollutants, the single structure of the main body for the precise location of pollution sources, and the need for the level of precise management to be strengthened are all part of the current problem analysis. Our suggestions include improving the scientific and technological capability of precise identification, improving the main structure of precise positioning, and fortifying the construction of a refined management system.

Keywords: precise pollution control; grid-based management; new urban development area; sustainable development; ecological environment.

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1   Introduction

The ecological environment is the basis of human existence, and a healthy ecological environment can improve people's well-being. Economic, human and social development have significant and complex relationships with environmental sustainability (Singh et al., 2019). Environmental protection and pollution control in China have evolved significantly over the past four decades, from exploring the establishment of a framework for improvement to upgrading development. The construction of an ecological civilisation has reached a critical moment: a period of heavy responsibility, a period of assault for high-quality enhancement, and a window of opportunity to address outstanding issues. In a speech to the United Nations General Assembly in 2020, China's national leaders stated that the country would increase its independent national contribution, adopt more robust policies and measures, strive to peak carbon dioxide emissions by 2030, and achieve carbon neutrality by 2060. This necessitates a more scientific and precise approach to governance.

   In recent years, urbanisation has accelerated, and new urban areas have flourished. The new urban development area is an essential place for industries with suitable functions in the central city to undertake, and it also has the functional positioning of taking over urban population out-migration, medical care, and education[1], which have characteristics of rapid urban construction, frequent economic activities, rapid population growth, and complex personnel structure. This could cause several environmental problems, including greenhouse gas emissions (Chang and Jeon, 2020; Alam and Islam, 2017). As a result, higher standards for precise pollution control are set, making it even more critical to conduct relevant research. In the case of Beijing's Shunyi District, which is adjacent to the city's urban subcentre, it is one of the city's vital new cities for development. According to the second national pollution source census data, Shunyi District has the highest number of industrial enterprises in the city, with an industrial structure dominated by traditional manufacturing industries such as automobile manufacturing, furniture manufacturing, and food and beverage processing. Shunyi District is also a major transportation hub in North Eastern Beijing, with the capital

airport, several major highways, and a thriving logistics and distribution transportation industry nearby. As a result, pollution control pressure is increasing, whether from industrial, mobile, or domestic sources. China's environmental management is in a critical transition period. The primary means of pollution source emissions control are gradually changing to the emission permit system and the tax and fee system. It is also important to explore the policy direction of environmental pollution management in the new period.

Precise pollution control is a way to reflect the science and precision of pollution control. To truly achieve precise pollution control, we must ruthlessly grasp the three key links of precise identification, precise positioning, and refined management. It is critical to study and implement a more precise governance model to break the bottleneck of environmental pollution management. In this paper, through field research, we comprehensively grasp the pollution situation in Shunyi District and the current status of pollution control and identify a new pollution control model that can be developed to achieve the goal of continuous improvement of ecological and environmental quality. The paper also hopes to develop a replicable 'Shunyi model' and obtain promotion.

2   Literature review

The research on environmental governance is mainly focused on the following three areas: pollution control technology, economic policy regulation and other aspects.

With the continuous rise of cloud computing, the internet of things (e.g., Kavitha and Mohanraj, 2019), big data, artificial intelligence and cognitive computing, remote sensing technology (e.g., Lei et al., 2021; Nisa et al., 2019; Wang and Xie, 2022), pollution management technology and other technologies continue to evolve. Sustainable development, which includes both economic and environmental factors, has received considerable attention in public and academic circles, as well as in macroeconomic policies (e.g., Škrinjarić, 2020). Several scholars have studied the relationship between economic development and atmospheric environmental quality, as well as the relationship between air pollution and economic development (e.g., Sarkar et al., 2019), and have proposed approaches to ecological governance from an economic perspective (Cole, 2000; Tietenberg and Lewis, 2021). Regarding studies on economic policy regulation, Jonathan et al. (2001) argues that the current approach to environmental management has a strong political dimension, which leads to inefficiency. Therefore, he suggests the establishment of a market system represented by property rights, weakening the central government sector's decision-making and regulating environmental resources through the market.

2.1   Research on the causes of environmental pollution

In recent years, air pollution topics such as haze have become popular in academia. In the early days, some scholars pointed out that the increasing severity of haze was mainly due to public policies and economic development stages. For example, during the extensive economic development mode of high energy consumption in the traditional 'industrialisation route' and the wave of 'heavy industrialisation' (Ru and Lei, 2014), there has been a lack of a legal system for air pollution prevention and control (Bai and Liu, 2013). In studies on the causes of haze, the main view is that the leading reasons for

haze are multifaceted (Liu and Li, 2014; Waseem et al., 2020). They include not only the effects of human activities, such as industrial emissions (Soleiman et al., 2003; Ye et al., 2021; Feng et al., 2020), but also unfavourable weather conditions (Cai et al., 2017; Tao et al., 2016; Ment et al., 2014; Zhang et al., 2016). Indeed, some studies have shown that climate change can have an impact on not only urban air pollution (José et al., 2019) but also water quality management (Islam et al., 2017).

2.2   Research on environmental regulatory models

In addition to the traditional regulatory model, technological means have been added to enhance the accuracy of ecological protection. A modular grid-based management system is utilised to improve governance. Implementing 'internet + environmental supervision and enforcement' could strengthen grid-based environmental supervision and enforcement (Li, 2019). It reflects the environmental supervision mode's grid and emphasises the effect of refined, precise, and all-encompassing environmental governance.

2.3   Research on environmental pollution control strategies

At present, China's environmental pollution governance shows its evolutions from 'authority-submission/confrontation' to coregulation and from 'government–market' to cooperative governance (Feng, 2016). Some scholars have stressed that the government should fully play the role of convener, organiser, coordinator and supervisor in environmental pollution control (Feng, 2022). Simultaneously, academics debate the advantages and disadvantages of command- and market-based environmental regulation, arguing that government decision-makers should scientifically select environmental regulation tools based on local conditions and local core development objectives (He, 2020) and encourage and guide the public to participate in pollution prevention and control (Li et al., 2016). The supporting role of environmental protection technology has also been emphasised (Li, 2018).

Collectively, the existing studies imply the importance of cooperative management. One of the most important aspects of environmental pollution is its regional transmission, which occurs both in the atmosphere and water and is characterised by mobility. As a result, in addition to local emission factors, transmission from surrounding areas influences the environmental pollution problem to some extent. For this reason, pollution control cannot rely entirely on one government department to solve the problem. Thus, the power of multiple parties at all levels of government, society and the public must be strengthened so they can work together to improve the level of refined management and solve the environmental pollution problem through the development of policies that meet the characteristics of the entire region.

However, there have been few studies on precise pollution management, and this study uses it as the research object, which can provide not only proposals for improving environmental quality in one location but also references for other regions. Second, from the perspective of regional collaborative governance, we comprehensively analyse the problems in the implementation of precise management in Shunyi District under the background of the unfinished institutional reform and propose effective countermeasures. At the same time, the structure of governance subjects is enriched from the perspective of

stimulating public participation, which has a certain positive significance for promoting and improving the construction of relevant policies at the grassroots level.

3 Analysis of precise pollution control process in Shunyi District

3.1 The distribution of pollution source types in Shunyi District

The first step in pollution control is to prevent and control pollution at the source, so understanding and mastering the distribution of pollution sources can aid in pollution identification and improve identification accuracy. Pollution sources are classified differently depending on the source, and this paper examines the distribution of pollution sources in Shunyi District from two perspectives: human activities and environmental factors.

First, human activities are the standard for classification, and environmental pollution can be divided into industrial environmental pollution, agricultural environmental pollution, living environment pollution, etc. Industrial environmental pollution mainly comes from industrial enterprises, as their production and operation processes produce all kinds of contaminants and discharge them into the external environment. Agricultural environmental pollution reflects the farming, planting and other agricultural production activities involved in pollutants. Living pollution sources mainly derive from people's daily living, as the pollutants generated by life are discharged into the natural environment. According to the results of the second national pollution source census study in Shunyi District, industrial pollution sources account for 60.37%, home pollution sources account for 31.64%, and agricultural pollution sources account for just 7.99% of the district's pollution total.

Figure 1 Distribution of pollution source types (human activity perspective) (see online version for colours)
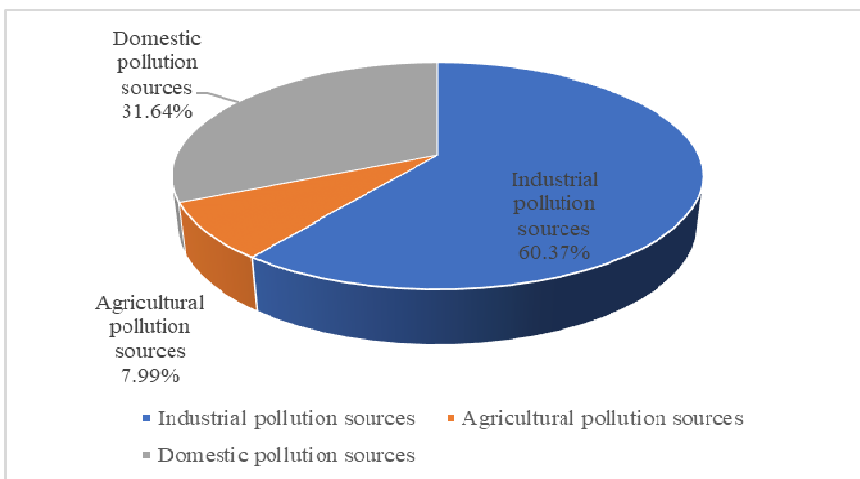

Source: Shunyi District Second National Pollution Source Census)

Second, classified by the standard of environmental elements, environmental pollution can be divided into air pollution, water pollution, soil pollution, noise pollution, and

radiation pollution. According to the statistical results of the 2018 Shunyi District Environmental Status Bulletin, water pollution ranked first, accounting for 61.22%; air pollution ranked second, accounting for 27.83%; noise pollution ranked third, accounting for 8.90%; and radiation pollution and soil pollution accounted for small percentages. At the same time, according to the statistics of the environmental disputes category of letters and visits, ranked first is the category of air pollution, the second is water pollution, the third is noise pollution, and other environmental pollution types of reporting complaints are not apparent. Combined with the distribution of pollution source types, the top three are water pollution, air pollution, and noise pollution, and the types of rights and interests the masses are actually concerned about and likely to be infringed on by involve the same three categories.

Figure 2   Distribution of pollution source types (environmental elements perspective) (see online version for colours)
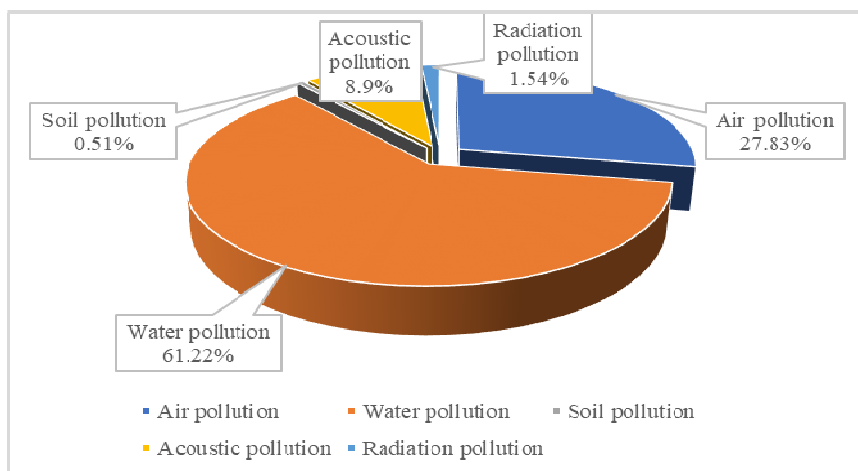
3.2   *Scientific and technological means to accurately identify pollutants*

In terms of precise contaminant identification, it primarily combines key pollution factors, key regions, key areas, and other key factors, relying on science and technology to improve pollutant identification accuracy, as well as real-time uploading of monitoring data to the data platform for accurate analysis to guide the next step.

In terms of crucial pollution factors, Shunyi District formulated the 'Shunyi District Three Year Action Plan to Win the Blue-Sky Defense' in 2018, and the plan specifies that the focus of treatment is fine particulate matter (PM2.5). Pollution factors can be accurately identified and must be monitored through relevant instruments and equipment. To this end, Shunyi District implemented and built a small microstation for air quality monitoring covering the entire district through this high-precision, portable monitoring equipment to achieve real-time monitoring of PM2.5 concentrations.

In terms of key areas, restaurant fumes have been one of the problems plaguing people's lives, especially in residential areas. Nevertheless, due to the industry characteristics of the restaurant industry, it is difficult to solve the problem by daily regulatory means alone. Shunyi District conducted a comprehensive study based on the

delineation of the restaurant problem, which included the installation of a restaurant industry fume online monitoring system to ensure that illegal emissions are detected in a timely manner, as well as effective restaurant business supervision.

The research results of the latest round of PM2.5 source analysis in 2021 show that mobile sources account for the largest share of pollution emissions (46%)[2]. With rising car ownership, the problem of motor vehicle emissions has become a crucial issue to be solved. As the largest pollution contributor in the key areas, mobile sources, as the name suggests, have as their most prominent characteristic being 'mobile', so artificially set up check power is too weak. Mobile motor vehicles must operate on the road; as a result, fixed motor vehicle exhaust monitoring equipment has been installed near the main road and the territory of the major freight routes and logistics channels, allowing car exhaust to be tested and qualified in a fraction of a second.

Table 1 Comparison of the annual average number of pollutants identified (2015–2020)

Pollutant categories	Conventional manual monitoring	Technology grid monitoring
PM2.5		125,000
Fumes by catering	3,636	52,000
Dust from construction sites	160	2,387
Vehicle exhaust	61,000	183,000
Main pollutants at exit section	432	79,000

3.3 Formation of environmental supervision team and accurate positioning of pollution sources

In the precise positioning of pollution sources, mainly through the establishment of a sound environmental supervision team, this team mainly consists of environmental protection grid members and law enforcement officers through their daily inspections of pollution sources for precise positioning.

Shunyi District investigates the creation of an environmental protection grid management system, which is an administrative grid divided into district-level, town-level, and village-level grids, with environmental protection grid members at all levels carrying out daily inspections and other work in their areas of responsibility. On the one hand, technological means were used to obtain alarm information to investigate and lock in the source of pollution; on the other hand, as a flexible action, comprehensive coverage of 'mobile probes' was used to capture the hidden sources of pollution. Once the work process found pollution sources, it immediately pointed to their information and pollution status through the environmental protection inspection app for reporting and accurate pollution sources for location lock.

In terms of law enforcement officers, Shunyi District, based on the weakness of grassroots law enforcement and uneven distribution of law enforcement areas and other issues, initiated the recruitment of environmental protection agents in batches of full-time supervisors, motor vehicle enforcement comanagers and comprehensive law enforcement support staff to further strengthen the environmental law enforcement team. To open up the 'last mile' of environmental supervision and to avoid missing any source of pollution, environmental protection supervisors after professional training utilised the towns, streets, economic zones, etc., for the formation of a full-time professional team to solve

the problem of the lack of grassroots government personnel in the management of the environment. The main work, on the one hand, according to the three levels of environmental protection grid member feedback pollution problems, begins with the point information and carrying out on-site law enforcement checks; on the other hand, it continues through the establishment of local environmental supervision ledgers to carry out accurate point-to-point law enforcement checks. The sinking and aggregation of law enforcement forces can more accurately locate the sources of pollution, while under the high pressure of inspection by higher-level departments and further stimulation from the grassroots workforce, pollution control will not have blind spots.

Table 2   Changes in the structure of the environmental regulatory team

Personnel structure		2016	2019
Environmental Protection Gridman		–	1,803
Law enforcement personnel	Licensed law enforcement	52	74
	Full-time environmental supervisor	–	120
	Motor vehicle enforcement coordinator	–	47
	Comprehensive law enforcement assistant	–	270

Source: Shunyi District Ecological Environment Bureau and Atmospheric Office

3.4   Multiple measures to achieve refined management

Refined management mainly focused on formulating suitable laws and standards, establishing a dynamic update mechanism, joint prevention and control, education and training, and public awareness and mobilisation.

The 'win the blue-sky action plan,' 'fight the battle of clean water action plan,' and 'fight the battle of clean land action plan' were formulated in the development of policy measures to resolutely win the three major battles of pollution prevention and control, the implementation of local responsibility, and refining governance tasks. While a 'comprehensive management of air pollution in autumn and winter action plan' has been developed to further implement the precise fight against pollution, to promote refined air environment management, a refined program and management standards and requirements were developed to demarcate the strict control area and control area, respectively. 'One factory, one policy' emergency emission reduction solutions for important emission reduction firms have been established and upgraded to strengthen the ability to deal with heavy air pollution weather and more accurate river management.

In terms of the dynamic update mechanism, water pollution traceability survey work was carried out over six months to update the pollution sources. Shunyi District constructs a connection between the river outfall and pollution sources, updates and improves the traceability of pollution source standing books, emphasises important discharge enterprises and establishes key supervisory standing books. The problem with 'scattered pollution' management is that it is very straightforward to 'resurface.' A 'clean-up and rectification work program' has been devised to maintain a 'dynamic zero' work program, allowing the problem of 'scattered pollution' in firms to be eliminated.

The main reason for calling environmental pollution management the problem is that it has the characteristics of diffusion and interregional interaction. To improve environmental management accuracy, Shunyi District focused on the 'one microgram'

action, established a regional air quality joint forecast and consultation mechanism, formed a forecast consultation emergency assessment system, and gave full play to the synergy between departments. Eight comprehensive law enforcement stations composed of environmental protection, transportation, urban management, highways, traffic detachment, and other departments were set up to ensure 24-hour full-time law enforcement and highlight the precise law enforcement in key periods such as 20:00 to 2:00 a.m. to solve the problem of mobile source pollution. At the same time, following the principle of 'connecting lines and protecting areas with lines', the combination of the fixed postcard and mobile patrol inspection was adopted to radiate around the site, covering the key roads, intersections and sections near the area.

Table 3   Summary of the refinement of policy measure development

Focus area	Policies and measures
Refinement of air quality classification	It is divided into three levels according to territorial characteristics: 46μg/m³, 49μg/m³, 52μg/m³
Refinement of enterprise pollution reduction	182 key enterprises have formulated emergency emission reduction measures of 'one factory and one policy'
Refinement of river pollution control	District – and township-level rivers to establish a 'one river one policy' management program

Source: Shunyi District Atmosphere Office, Ecological Environment Bureau and Water Authority

Figure 3   Changes in annual average concentrations of air pollutants (2013–2020) (see online version for colours)
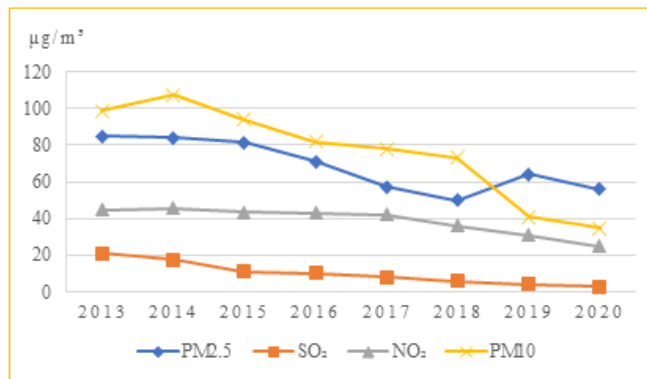
In terms of education and training and mobilisation, one goal was to enhance the professional skills of law enforcement officers and environmental protection grids through education and training. In pollution management, law enforcement officers and environmental protection grid members play key roles. Their professional ability dramatically affects the accuracy of pollution control, the application of scientific and technological means, the familiarity with the region in the positioning process, and the sensitivity to pollution sources in daily inspections. The second goal was to use publicity and mobilisation to raise business entities' and residents' awareness of their responsibilities. This involved the use of slogans and banners, new media platforms, the

'ecological and environmental protection caravan' in the community, industrial parks, environmental protection policies, knowledge, and other transports to the people, on the one hand, so that the people with a certain level of knowledge of environmental protection would support the work of government departments, and on the other hand, so the concept of 'who pollutes, who governs' becomes deeply rooted.

As shown in Figure 3, with the continuous progress of pollution control means, from the crude treatment method to the precise treatment method, the air quality has shown a trend of improvement in successive years.

4   Analysis of precise pollution control problems in Shunyi District

After field visits to relevant government departments, key enterprises in the region, and in-depth interviews with relevant persons in charge, we concluded that three primary problems exist: imprecise identification of technical difficulties, accurate positioning for the subject is too singular, and an inadequate refinement management system.

4.1   Technical dilemma for precise identification of pollutants

Shunyi District began to establish a 'smart environmental protection' platform using information technology, but it does not meet the growing need for environmental management and decision support. The degree of the application of technology for big data is relatively lagging.

4.1.1   Insufficient investment in science and technology for pollutant identification

Shunyi District's financial investment in pollution prevention and control is increasing year by year, with a financial expenditure on pollution prevention and control of 699 million yuan in 2019, but no investment in science and technology is visible, and the shortage of environmental protection science and technology funds will become more prominent with the increasing financial funds review.

First, the monitoring elements are not comprehensive enough. The earliest and most widely used station is the air microstation. Although microstations have been installed in all villages and key enterprises throughout the district, their pollutant monitoring indicators are too singular to achieve basic geographical coverage and real-time monitoring. There is data on only fine particulate matter (PM2.5), and no respirable particulate matter (PM10), sulfur dioxide, or other major indicators are included. Second, the scope of monitoring does not achieve full coverage. With the increase in the number of motor vehicles, automobile exhaust for atmospheric pollution is not to be underestimated. On the region's main roads, six sets of fixed exhaust telemetry equipment were installed, but the coverage was too small. Third, the environmental quality is not achieved by real-time monitoring. The region has 6 outbound cross-sections and 122 cross-town boundary cross-sections, but automatic online monitoring equipment is installed only in the six outbound cross-sections, and the internal cross-sections cannot realise real-time monitoring of water quality. Cross-town boundary cross-sections are manually sampled and tested once a month. Due to the impact of monitoring frequency,

the excessive concentration of pollutants cannot be locked in time, which makes it easy to miss more sudden pollution events.

4.1.2 The intelligent environmental protection platform is slow to progress

At the end of 2017, Shunyi District began to integrate the construction of a 'smart environmental protection' platform based on a comprehensive command platform for air pollution supervision. The ultimate goal of the 'smart environmental protection' platform is to form a closed-loop system from pollution source identification, location, and management to assessment. The first step needs to be to achieve the function of accurately discovering pollution sources. Due to the lack of experience in building the 'smart environmental protection' platform, the construction progress is slow, and the corresponding functions are limited to a certain extent and cannot play a role.

4.1.3 The level of pollution source identification technology must be improved

Regarding the development and application of identification technology, those with higher levels of knowledge are research-based institutions of higher learning or highly sophisticated science and technology enterprises. However, due to the influence of regional positioning, Shunyi District is relatively weak in both research-based fields and highly sophisticated fields. At the moment, pollutant identification technology is only at the 'discovery' stage, and discovered pollutants are not analysed with multiple factors, such as source, meteorology, and components, to improve pollutant identification accuracy.

4.2 The main structure of precise positioning needs to be optimised and integrated

4.2.1 The ecological and environmental law enforcement system has a single authority and responsibility

At present, government departments at all levels are responsible for environmental pollution control, which often leads the public to point the spearhead of public opinion at government departments after pollution incidents. They believe that the occurrence of these pollution phenomena is entirely attributable to the inadequate supervision and incomplete treatment of government departments. In contrast, the real 'culprit' of pollution discharge hides behind the 'no one cares' label. There is no sound, comprehensive ecological and environmental enforcement system in Shunyi District, and the enforcement authority of environmental protection is scattered among agriculture, nature, and marine departments in addition to the ecological and environmental departments. Therefore, the environmental protection department, as the leading force in ranking and locating pollution sources, to a large extent will lead to a blind spot in the face of environmental pollution problems in law enforcement, resulting in a decrease in the accuracy of pollutant location.

4.2.2 The main structure of environmental governance is relatively homogeneous

Shunyi District currently relies heavily on administrative grid power for pollutant positioning in environmental governance work. Although over 1,000 grid members are involved in environmental governance, they are divided into two categories: government-related staff and government employees. The administrative attributes of the administrative grid have become an obstacle to the progress of pollution governance work. This model lacks the diversity of governance subjects and the participation and supervision of enterprises, social organisations, and the masses. In this way, it is easy for grid members to slack off and deal with their work, and as a result the pollution control work is significantly reduced.

4.3 The refined management system is not sound enough

4.3.1 Regional collaborative governance mechanism is not sound

It was found that Shunyi District did not establish an effective collaborative governance mechanism in conjunction with the actual work process of achieving precise positioning. The main problem is reflected in two aspects. First, the coordinated governance mechanism within the region is not sound. A large number of villages and towns, streets, economic functional areas, and administrative divisions means significant differences in governance difficulties and governance levels. At the same time, there are overlapping rights and responsibilities, a situation that is more likely to cause some problem areas to become 'enclaves' that no one cares about. This leads to regulatory loopholes due to unclear rights and responsibilities and no grid member positioning, even if pollutants are accurately identified. Although the leading group for comprehensive air pollution control and the leading group for comprehensive water pollution control have been established to highlight the concept of collaborative management, these are temporary institutions and they lack specific authority. Meanwhile, the office was set up under the District Ecology and Environment Bureau, resulting in the heavy burden of pollution control still being borne by environmental protection departments at all levels. Due to the status and function of environmental protection departments, the implementation process of collaborative governance is bound to have many difficulties. Second, there is a lack of interregional cooperative management mechanisms. Environmental pollution problems are often affected by regional transmission. Shunyi District and its surrounding areas cannot accurately locate, warn of and take the initiative on 'potential' pollution sources due to the lack of an interregional collaborative governance mechanism.

4.3.2 Public participation and supervision mechanism must be improved

This question still often arises among the masses: 'What exactly is environmental protection?' According to statistics, the problems reflected through various channels, such as convenient telephones, 12369, letters, and visits, are often individual citizens whose rights and interests may have been violated, rather than because the ecological environment has been harmed. Therefore, from the perspective of environmental pollution management, the public is only the supporter of government decision-making behaviour, not an actual participant and supervisor.

5 Suggestions for promoting precise pollution control

5.1 Enhance the scientific and technological capabilities of accurate identification

5.1.1 Accelerate the construction of the big data 'wisdom' platform

The first step is to develop high-level design and planning concepts for the integration and effective use of various types of information resources, which will aid in pollution management and environmental decision-making. It should also be committed to seeking regional and industry breakthrough innovations in intelligent environmental protection, as well as to accelerating the role, promotion, feedback, enhancement, and organic regulation of key management elements, both within and outside the environmental protection system, to improve the effectiveness of environmental protection work. The second is to improve the monitoring network and management platform. Shunyi District will develop a daily air quality management platform that will integrate air quality, pollution sources, and meteorological data, as well as achieve air quality management performance assessment through the development of multiple applications, such as air quality and water environment quality. Concurrently, water environment supervision should be improved, a fully covered automatic monitoring system for river water quality should be built, the automated monitoring system for the water quality of cross-regional river evaluation sections should be promoted, and pollution source traceability and ranking over standards should be achieved. Emergency monitoring capacity for the water environment should be built, automatic emergency water quality monitoring vehicles should be outfitted, and mobile monitoring, site monitoring, and pollutant traceability ranking should be implemented.

5.1.2 Promote the application of pollution source identification technology

Shunyi District is a suburban area; not only are industry and agriculture relatively developed, but the transportation network is also well connected. As a result, the combination of point and surface sources and fixed and mobile sources results in a very complex form of environmental pollution composition. The application of pollution source identification technology provides a more precise direction for pollution prevention and control, develops more targeted treatment measures, and establishes a long-term pollution prevention and control mechanism.

5.2 Improve the precise positioning of the main structure

5.2.1 Accelerate the construction of a comprehensive ecological and environmental law enforcement team

In March 2019, following the latest version of the reform program, Shunyi District officially established a comprehensive ecological and environmental law enforcement brigade, which is an essential part of promoting the modernisation of the governance system and governance capacity. During the same period, Beijing developed and issued a reform implementation plan following the relevant requirements of the State Council on the reform of the vertical management system of the monitoring, supervision, and enforcement of ecological and environmental agencies. This initiative, to a large extent,

ensures the smooth operation of the administrative system of environmental protection, with part of the authority designed to get rid of the local government for the environmental protection department's excessive interference to improve the efficiency of the administrative work. The construction of a comprehensive law enforcement team for the ecological environment is conducive to breaking through the boundaries of the existing administrative grid, organically combining block and horizontal principles, and developing in depth. Under the premise that the implementation of the reform is not clear, the Shunyi District government, on the one hand, should plan and design in advance according to the spirit of the superior documents. On the other hand, the public security, road administration, taxation, and other vertical management departments should research the establishment of a standardised, unified and professional ecological environmental protection team as soon as possible.

5.2.2   Create the main structure of multigovernance

The environmental governance system in Shunyi District is not perfect, mainly because the structure of the main body of governance is not sound enough. In the future, under government leadership, the private sector, such as enterprises, should be included in the scope of governance subjects, and social organisations and the public should be encouraged to participate together. Based on the technology grid and administrative grid, the function of the social governance grid is added to realise the diversified governance of environmental protection in grassroots communities and grids. The government should coordinate and consider the interests of all parties and adequately incorporate each interest into environmental governance. It also should establish a good communication and coordination mechanism involving the government, enterprises, society, and other forces, improve the information communication and disclosure mechanism, jointly develop relevant norms, and bring together the strength of all parties to respond to environmental pollution incidents jointly. In the process of environmental pollution management, one goal is to include the market in the structure of the main body of governance. The government supports and serves the market, and the development of the market plays a response and feedback role to the government. The second goal is the inclusion of the public and social organisations in the structure of governance subjects, where the government regularly consults and interacts with social organisations, and social organisations communicate with the government through certain forms and express their expectations. Third, by including enterprises in the main governance structure, the government assumes not only a regulatory but also a service role for enterprises. Enterprises can take the initiative to fulfill their primary responsibility for environmental protection, which is their response and recognition for the government.

5.3   Strengthen the construction of a refined management system

First, complete legal norms should be formulated. Only when there are laws to follow can there be rules to follow. The implementation of precise pollution control mainly uses scientific and technological means. However, due to the lack of corresponding specifications, the data from various automatic online monitoring equipment cannot currently be used as the basis for law enforcement and punishment. They can be supplemented only qualitatively, through subsequent administrative means to form closed-loop supervision. The wide use of information technology indicates the arrival of

the big data era. The new era needs new missions, new rules, and corresponding systems and norms around technological innovation to meet the needs of current refined management.

Second, strict access standards and emission standards should be developed. In the implementation of superior policies, we should avoid rote copying. We need to formulate more stringent source access and emission standards in combination with local environmental capacity and emission reduction potential, refine the implementation of measures by classification in combination with the concept of differentiated pollution control, and timely delimit key areas. From the perspective of environmental impact assessment, we will fully formulate the list of ecological environment access, continue to expand the coverage of pollutant discharge permits, and strictly control the total amount of pollutants discharged.

Third, the assessment and accountability mechanism should be established and improved. Regarding whether the environmental pollution problem has been solved and the environmental quality has reached the expected set goals, the assessment and accountability mechanism is one of the crucial means of inspection. Shunyi District has incorporated the patrol grid into the normalised environmental supervision system. Based on the results of patrol inspections, a more robust assessment and accountability mechanism must be established in the future. The first step is to strengthen the inspection of the implementation of the responsibilities of the Party and government organs. The second step is to enhance the supervision and inspection of enterprises and other business entities' implementation of the duties of pollution subjects and the existence of illegal sewage discharge. Simultaneously, the assessment and accountability mechanism will help clarify the system of rewards and punishments, acting as both incentives and deterrents. For example, the party and government organs that have well implemented their responsibilities will be given extra points in the annual performance appraisal; otherwise, points will be deducted, and the severe cases will be handed over to the corresponding legal department for handling. If businesses and other entities take the initiative to reduce pollution, they can use economic means such as establishing a green credit system and simplifying the loan approval process. In contrast, they will increase penalties and even link up with the enterprise credit reporting system.

Fourth, the industrial structure should be adjusted and optimised and a green economy should be developed. Administrative and economic means should be combined to seek a fit between ecological environment improvement and high-quality economic growth. From the perspective of adapting to economic development, policy measures conducive to industrial structure transformation should be formulated, such as subsidies for production equipment upgrading and transformation, environmental tax and fee reductions, ecological compensation funds, and maximum penalties. While fully mobilising market forces, it is also necessary to establish a mechanism to prevent and resolve the risks that exist in pollution management based on the characteristics of the market so that the green economy cycle can operate.

Fifth, there should be a sound grid-based management system. Grid management is based on the idea of refinement management and establishing an innovative management model. The smaller the delineation of the unit grid is, the finer the problem governance. It is suggested that the 'science and technology grid + administrative grid + inspection grid' approach implemented at present, based on integrating the three network governance models, should incorporate the letter and visit problem into the grid management model. As the 'eye' to find problems, the letter and visit grid reflects the concept of precise

pollution control, fundamentally solves the problems of people's livelihoods, and tests the effect of governance.

5.4   Establish a regional collaborative governance mechanism

5.4.1   Strengthen the joint prevention and control between administrative regions

A cross-regional collaborative governance mechanism should be established to strengthen joint prevention and control between administrative regions. For example, in terms of air pollution management, the capital airport is located in Shunyi District. The air pollution caused by this vast transportation hub should not be underestimated. However, due to administrative divisions, although the capital airport is surrounded by Shunyi District, the actual jurisdiction is in Chaoyang District, resulting in the embarrassing situation of 'being polluted and having no right of control.' It is necessary to take the initiative to establish a cross-regional joint prevention and control mechanism with Chaoyang District. In terms of water pollution control, the Chaobai River runs through the eastern and northern parts of Beijing and is also one of the most important water sources in Shunyi District. During the 2008 Beijing Olympics, to guarantee the water quality and resupply of the water stadiums, a supporting project was built to divert the Wenyu River into the Chaobai River to achieve the optimal allocation of water sources. To ensure stable water quality standards in the Chaobai River, a synergistic management mechanism needs to be established with the upstream Huairou District and the downstream Tongzhou District to increase cross-regional environmental pollution management efforts. The implementation of joint prevention and control mechanisms, the establishment of a regular meeting system, and the sharing of river basin information can improve the overall river basin management scheme's accuracy and effectiveness.

5.4.2   Strengthen the joint prevention and control within administrative regions

Faced with the dilemma of grassroots social governance, Beijing has launched the mechanism of 'street and township whistle blowing and departmental reporting', which has led to the establishment of a joint law enforcement mechanism between localities and functional departments. The main feature of this mechanism is to empower the street and township and sink the departmental law enforcement force. For environmental pollution control, as the environmental enforcement force has not yet fallen to the grassroots, it cannot realise the whistle to report immediately. This necessitates continuously strengthening the joint prevention and control between the grassroots government and functional departments, establishing a deliberative and coordinating body, and improving the body's systems, including the full-time staff selection and recruitment system, the joint law enforcement system, the regular scheduling and regular meeting system, and the supervising system. Such institutions are temporary and must be transformed into a long-term mechanism to ensure the continuity of environmental pollution control work. In the solutions for key outstanding problems, such institutions can be a precise force, providing reliable experience for future pollution control work.

5.4.3 Broaden the ways of public participation and supervision

In terms of public participation and supervision, the following three points should be achieved. First, the scope of information disclosure should be increased, which will primarily improve the transparency of the government's work and further deepen the public's awareness of their rights. Second, previous studies found that environmental concern and environmental knowledge are important for environmental attitudes to cultivate environmentally responsible behaviour (Seow et al., 2020). Strengthening the ability and policies related to the environmental protection of science and technology and increasing the popularisation of science and technology can be effective, which is conducive to breaking the negative mood of citizens to produce the neighbourhood effect and then increasing the accuracy of citizen participation. It is necessary to create good environmental facilitating conditions to motivate the public to engage in environmentally responsible behaviour (Seow et al., 2020). Third, the breadth and depth of environmental protection publicity should be strengthened, with the realisation that environmental protection awareness is deeply rooted in people's hearts through publicity. By regularly exposing environmental violations through the media, the public can 'actively' participate in environmental pollution control to prevent future offenses.

6   Conclusions

Shunyi District and China's pollution prevention and control battle have entered a critical period. The quality of the ecological environment has improved. Nevertheless, pollution control is increasingly complex, and more precise control measures must be sought. In recent years, Shunyi District has begun to explore and implement a more accurate and effective pollution management model, for example, with the full use of technology to establish 'intelligent environmental protection' and other big data platforms to accurately identify the sources of pollution. Shunyi District also has developed and built a grid-based work model; one is to manage the grid, and the other is to check the grid. The administrative grid is used to solve the problems found and achieve the effect of precise pollution control. The inspection grid consolidates the effect of supervision and governance through management means. Shunyi District has achieved specific results by applying precise measures to environmental pollution problems. However, there are still some problems: the construction of grassroots policies is not yet perfect, the concept of collaborative governance is not clear enough, the level of precise management needs to be strengthened, and the precision of scientific and technological pollution control needs to be improved. This paper puts forward the corresponding suggestions.

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Notes

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