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RECEIVED 07 June 2025

ACCEPTED 09 September 2025

PUBLISHED 25 September 2025

CITATION

Su Y and Wu M (2025) Multiple institutional pressures, government attention allocation, and regional environmental performance: a fuzzy-set qualitative comparative analysis study across (FSQCA) 30 provinces in China.
Front. Environ. Sci. 13:1642985.
doi: 10.3389/fenvs.2025.1642985

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Multiple institutional pressures, government attention allocation, and regional environmental performance: a fuzzy-set qualitative comparative analysis study across (FSQCA) 30 provinces in China

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Introduction: Environmental performance is a fundamental metric for assessing the efficacy of environmental management systems and a critical determinant of regional sustainable development. Existing research has consistently identified institutional pressures as pivotal exogenous drivers of regional environmental performance, while the strategic allocation of government attention serves as its primary endogenous driver. However, a significant theoretical gap persists in understanding the synergistic mechanisms and coordinated pathways through which these two forces interact. This study, grounded in institutional logic theory and attention allocation theory, constructs an “institutional pressureattention allocation” analytical framework tailored to China’s unique institutional context and governmental practices.

Method: The Fuzzy-Set Qualitative Comparative Analysis (fsQCA) method can reveal complex causal pathways resulting from multiple conditional combinations. Therefore, this study takes 30 provincial-level regions in China as samples and employs the fsQCA method to systematically investigate how institutional pressures and government attention allocation jointly shape regional environmental performance through synergistic mechanisms and heterogeneous driving paths.

Results: Findings reveal that regulatory, (1) Institutional pressure is a critical factor shaping how local governments allocate their attention to environmental governance. (2) No single conditional factor independently qualifies as a necessary determinant for achieving high regional environmental performance. (3) The analysis led to the identification of four distinct high-performance pathways, namely: the Strong Institutional Pressure-Driven path, the Attention-Responsive path, the Central-led Policy-Coordination path, and the Peer Competition-Regulatory Strengthening path. (4) Multiple factors exhibit both complementary and substitutive relationships. This interplay reveals the complexity of regional environmental governance and the presence of equifinality.

Discussion: This study identifies four pathways to high environmental governance performance using fsQCA, demonstrating that external

institutional pressure and internal attention response together form the core mechanism driving performance improvement. The “institutional pressure-attention allocation” framework developed in this study challenges the single-determinism approach, revealing local governments’ proactive strategic choices and path innovation under multiple pressures, and deepening the understanding of the collaborative governance mechanism in multi-level governance.

KEYWORDS

environmental performance, institutional pressures, government attention allocation, fuzzy-set qualitative comparative analysis (fsQCA), regional governance, China

1 Introduction

With the growing severity of global environmental issues, environmental governance has increasingly become a focal concern for governments and societies worldwide. Under the theoretical framework of governance theory, research on environmental performance has progressively transitioned from a micro-level focus on enterprises to a macro-level perspective on nations and governments. This shift is attributed to the fact that governments, with their administrative authority and resource control, are uniquely positioned as the central force in environmental governance within a country or region (He et al., 2024). Regional environmental governance performance serves not only as an objective measure of local governments’ capacity for environmental management and the effectiveness of their environmental policies (Chen et al., 2024) but also as a critical indicator of their governance proficiency. It has profound implications for promoting regional sustainable development, optimizing resource utilization, and enhancing overall environmental governance capabilities. Existing research indicates that improvements in regional environmental performance are influenced by multiple factors. Therefore, this study employs the fsQCA method to reveal the complex causal mechanisms of achieving high environmental performance in China’s 30 provinces from the interaction perspective of institutional pressures and government attention allocation, aiming to extract environmental governance strategies adapted to regional characteristics.

In China, the central government has explicitly delineated the environmental governance responsibilities of local governments through a series of policy measures spanning the 11th to the 14th Five-Year Plans. These measures require the integration of environmental protection goals into local development plans and mandate the establishment of performance evaluation mechanisms. Driven by a comprehensive set of fundamental, innovative, and long-term pollution prevention and control initiatives, China has achieved remarkable progress in environmental governance, with significant improvements in ecological quality (Cai and Guo, 2023; Niu et al., 2022). However, environmental pollution remains prevalent in key industries and critical sectors (Hao et al., 2021; Wang et al., 2020). Against this backdrop, further enhancing regional environmental performance has become a pressing priority for both local governments and academic researchers. Given China’s unique national conditions—characterized by geographical complexity, disparities in resource endowments (He et al., 2024), and uneven economic development (Fan et al., 2021)—environmental conditions vary significantly across provinces. This

heterogeneity necessitates that policymakers identify and understand the multiple conditional factors influencing environmental performance.

As the dominant actor in environmental governance, the government directly shapes regional environmental performance, which reflects its effectiveness in fulfilling environmental governance responsibilities (Ruan et al., 2022). Existing studies on governmental environmental governance and regional environmental performance have identified multiple institutional pressure elements that influence performance, including coercive, normative, and mimetic pressures (Xie and Wang, 2024). For instance, existing studies have confirmed that central government-led coercive pressures—such as green performance assessments (Liu H. et al., 2023; Qi, 2014; Wu and Wang, 2023), central environmental supervision (Jia and Chen, 2019; Lin et al., 2021), and implementation of environmental regulations—effectively enhance environmental performance. Other research has explored the role of mimetic pressures in environmental performance, including intergovernmental environmental competition under political tournaments (Li, 2018) and strategic imitation (Latif et al., 2020). Additionally, scholars have examined the impact of normative pressures on environmental performance using public opinion (Yang et al., 2018) and media attention (Zhang et al., 2024) as indicators.

The aforementioned literature predominantly focuses on single institutional pressures, examining their marginal net effects on regional environmental performance. Such unidimensional pressure analyses suffer from fundamental limitations, failing to reveal the interactive effects among multiple pressures. To overcome this limitation, recent studies have introduced the fsQCA method to explore the configurational effects of multiple institutional pressures (Jin and Ye, 2024; Zhang et al., 2021; Zhang and Xing, 2025), further deconstructing combinations of multi-condition elements affecting environmental performance. It is commendable that this approach breaks through the constraints of single-factor analysis and validates equifinal pathways of pressure interactions. However, such research still simplistically attributes institutional pressures as decisive factors of environmental performance, failing to incorporate the endogenous decision-making mechanism of government attention allocation into the configurational analytical framework. Specifically, although institutional pressures from the external environment constitute an important factor influencing decisions, they can only take effect in the decision-making process when captured by decision-makers’ attention. Therefore, it is essential to systematically probe into the

configurational pathways through which the synergistic driving mechanism of institutional pressures and attention allocation impacts regional environmental performance.

This study is grounded in China's environmental governance institutional context and develops an analytical framework for regional environmental governance performance by drawing on organizational institutionalism theory and attention allocation theory. At the methodological level, the research follows the fsQCA configuration analysis paradigm, exploring from a configurational perspective the combination paths between multiple institutional pressures and the allocation of governmental attention to environmental protection. The study draws the following conclusions: 1. Institutional pressures can drive local governments to direct greater attention to environmental protection; 2. No single conditional factor independently qualifies as a necessary determinant for achieving high regional environmental performance, underscoring the need for multi-factor synergies; 3. There exist four distinct pathways leading to high environmental performance; 4. Some conditional factors exhibit both substitutive and complementary relationships.

2 Theoretical framework

2.1 Institutional pressures

Organizational institutionalism theory posits that institutions exert a deterministic influence on the structure and behavior of organizations, shaping their emergence, survival, capabilities, and performance (Dimaggio and Powell, 1983; Meyer and Rowan, 1977). Institutional pressures refer to the constellation of rules, social norms, values, and regulations that collectively shape organizational behavior and decision-making (Yiu and Makino, 2002). In recent years, an increasing number of scholars have introduced neoinstitutionalism and resource-based theory into public sector research, aiming to elucidate how institutional pressures shape governmental actions (Chu et al., 2018; Nurdin et al., 2012; Pan and Fan, 2023). DiMaggio and Powell's foundational work identified three primary mechanisms of institutional isomorphism: coercive, mimetic, and normative pressures. In China, local governments, as institutionalized organizations, face coercive pressures from higher-level governments, mimetic pressures from peer governments, and normative pressures from social organizations and the public. These pressures intertwine and jointly shape regional environmental performance.

A distinctive feature of China's environmental governance system lies in the principle of "state authorization and local implementation." For local governments, coercive pressures primarily originate from hierarchical authorities or external organizations that impose binding requirements. The core mechanism of coercive pressures is the enforcement of compliance through reward-punishment policies, which supervise, constrain, and standardize organizational behavior (Dimaggio and Powell, 1983). In the context of ecological and environmental governance, coercive pressures manifest in the form of performance evaluation mandates from higher-level governments. For instance, between the 11th and 14th Five-Year

Plans, the central government assigned differentiated energy-saving and emission-reduction targets to provincial authorities, integrated compliance into political performance assessments, and implemented a "one-vote veto" system for unmet objectives (Yan et al., 2024). Such mechanisms ensure that local governments align their actions with national environmental goals, creating a top-down pressure structure. Therefore, central assessment pressure is one of the most critical forms of coercive pressure.

Mimetic pressure arises from an organization's perception of competitors' behaviors within its field. When confronted with uncertain and complex environmental factors, organizations tend to observe the responses of other competitors and use them as reference models to shape their own behavioral strategies and organizational structures (Dimaggio and Powell, 1983). For provincial governments, mimetic pressure originates from peer governments and is typically manifested through rankings that reflect the competitive landscape. Governments that achieve higher rankings may receive policy incentives, fiscal support, or opportunities for political promotion, while lower-ranked governments may face accountability measures or resource reductions (Howlett, 1994). Consequently, provinces with lower rankings experience higher levels of mimetic pressure. Since the inclusion of environmental indicators in the political performance evaluation system for local governments under the 11th Five-Year Plan, intergovernmental competition has evolved from a single-dimensional GDP focus to a multi-objective system centered on the "dual pillars" of GDP growth and environmental performance. Consequently, environmental governance has exhibited characteristics of tournament-style competition or quasi-tournament mechanisms (Du et al., 2023). The operation of this tournament mechanism relies on quantitative rankings and reward-punishment systems designed by the central government. By regularly publishing provincial environmental quality rankings, the central government places local governments' environmental performance into an open and transparent horizontal comparison, thereby creating a powerful source of pressure. Moreover, this ranking system is embedded into the incentive structure of local officials, linking directly to their promotion prospects and strongly motivating local governments to engage in environmental governance.

Normative pressure arises from the process of professionalization, referring to the pressure exerted on organizations by professional norms, shared cognitions, or industry associations related to specialization (Du et al., 2023). Such pressure influences organizations through social responsibility and binding constraints (Gao et al., 2019). In the context of China's environmental governance, normative pressure presents a dual driving pathway. On the one hand, professional institutions such as environmental NGOs can push relevant environmental issues onto the government agenda, thereby promoting regional environmental improvement. On the other hand, public opinion can exert continuous pressure on local governments' environmental governance. The golden rule of modern government requires actions to align with societal expectations, which ensures that local governments are persistently subjected to normative pressure from society (Jianhan and Heng, 2025). In this context, information disclosure and social oversight serve as key mechanisms linking government

actions with public expectations. According to the Environmental Protection Law of the People's Republic of China, the environmental governance capacity and outcomes of local governments must be transparent and subject to extensive public scrutiny.

2.2 Attention allocation

Amid these multiple institutional pressures, the allocation of government attention emerges as a critical mechanism for local governments to navigate these pressures and achieve environmental governance objectives. Scholars such as Herbert A. Simon and James G. March were among the first to emphasize the pivotal role of attention in organizational decision-making, laying the foundation for research on attention within organizational contexts. Simon's seminal contribution highlighted attention as a critical element of decision-making analysis, emphasizing its limited capacity as a defining factor in understanding organizational choices. Subsequently, William Ocasio formally defined attention allocation as the process by which organizational decision-makers notice, encode, interpret, and focus time and effort on specific issues and solutions (Peirong et al., 2024). Since then, scholars have begun to analyze government decision-making from the perspective of attention allocation.

Due to constraints in resources and capacity, governments cannot address all tasks and objectives simultaneously (Ocasio, 1998). They must prioritize competing demands, determining which issues receive focused attention and which are deprioritized (Chun and Rainey, 2005). Within institutional contexts, organizations reinterpret and rationalize diverse institutional logics to select strategic choices most conducive to their development (Klüver and Spoon, 2014; Smets et al., 2015). In the domain of environmental governance, existing research has shown that government attention allocation toward ecological and environmental issues significantly impacts local environmental quality. Many scholars employ the dictionary method, utilizing keyword frequency ratios to measure government attention (Quinn et al., 2010). For instance, government work reports and other official documents—outlining the prioritization of governmental tasks during specific periods—can partially reveal the patterns of attention allocation (Liu X. et al., 2023). However, using textual references alone as a standard for measuring attention allocation risks conflating superficial textual emphasis with the deeper focal points of decision-making. Therefore, examinations of governmental attention should adopt a more comprehensive perspective that takes into account the distribution of concrete resources—for example, how funding, time, and political capital are prioritized across public issues.

In the field of environmental governance, government attention primarily encompasses three aspects: fiscal expenditure on environmental protection, adjustments to environmental policies, and the strength of environmental law enforcement. The intensity of environmental fiscal expenditure is a direct manifestation of government attention allocation, reflecting the prioritization of environmental protection and the strategic distribution of financial resources in policy agendas. Existing studies demonstrate that higher environmental protection expenditures

are significantly associated with enhanced pollution abatement outcomes (Mauro et al., 2018), contributing positively to regional environmental performance. High-intensity environmental spending signifies a government's commitment to allocating resources toward pollution control, ecological restoration, environmental infrastructure development, and green technology innovation (Liu X. et al., 2023). Moreover, rational allocation and dynamic adjustments in environmental fiscal expenditures can optimize resource allocation efficiency, driving comprehensive improvements in regional environmental quality.

Adjustments in environmental policy represent another critical dimension of governmental attention allocation (Mauro et al., 2018). Attention is a prerequisite for any issue to enter the governmental agenda-setting process, ultimately driving policy formulation and implementation (Li et al., 2023). Consequently, when local governments prioritize environmental governance, this prioritization is inevitably reflected in their policy outputs. Provincial government work reports, as programmatic documents, provide insights into the strategic layout of administrative priorities during specific periods. By systematically analyzing the intensity of environment-related keywords in these reports, such as “environmental protection,” “pollution,” “emission reduction,” “green development,” and “carbon emissions,” the allocation intensity of governmental attention in this domain can be systematically quantified.

A positive correlation exists between the intensity of administrative penalties and government attention allocation (Tang et al., 2024). The strength of administrative penalties directly reflects a government's prioritization of environmental governance and its resolve in pollution control. When governments allocate heightened attention to environmental protection, they typically intensify the deterrent and regulatory effects of environmental enforcement through measures such as increasing penalty amounts, enhancing inspection frequency, expanding regulatory scope, and strictly enforcing sanctioning criteria. Notably, while existing studies often classify administrative penalties as a form of coercive pressure within institutional frameworks (He et al., 2023), where polluting enterprises serve as passive recipients, this study focuses on local governments as the active decision-makers and enforcers of administrative penalties. Although such decisions must comply with legal stipulations, local governments retain administrative discretion to flexibly adjust penalty intensity. Prevailing scholarly consensus holds that stronger administrative penalties demonstrate greater governmental commitment to addressing environmental issues (Tang et al., 2024).

2.3 Institutional pressure–attention allocation

Research has suggested that organizational behavior may appear to align with institutional pressures at the surface level. In reality, however, actual organizational behavior may either align with these pressures—referred to as coupling—or diverge from them, known as decoupling (Hallett, 2010). Recent studies in the field of organizational institutions largely support the concept of a loosely coupled relationship between institutional pressures and

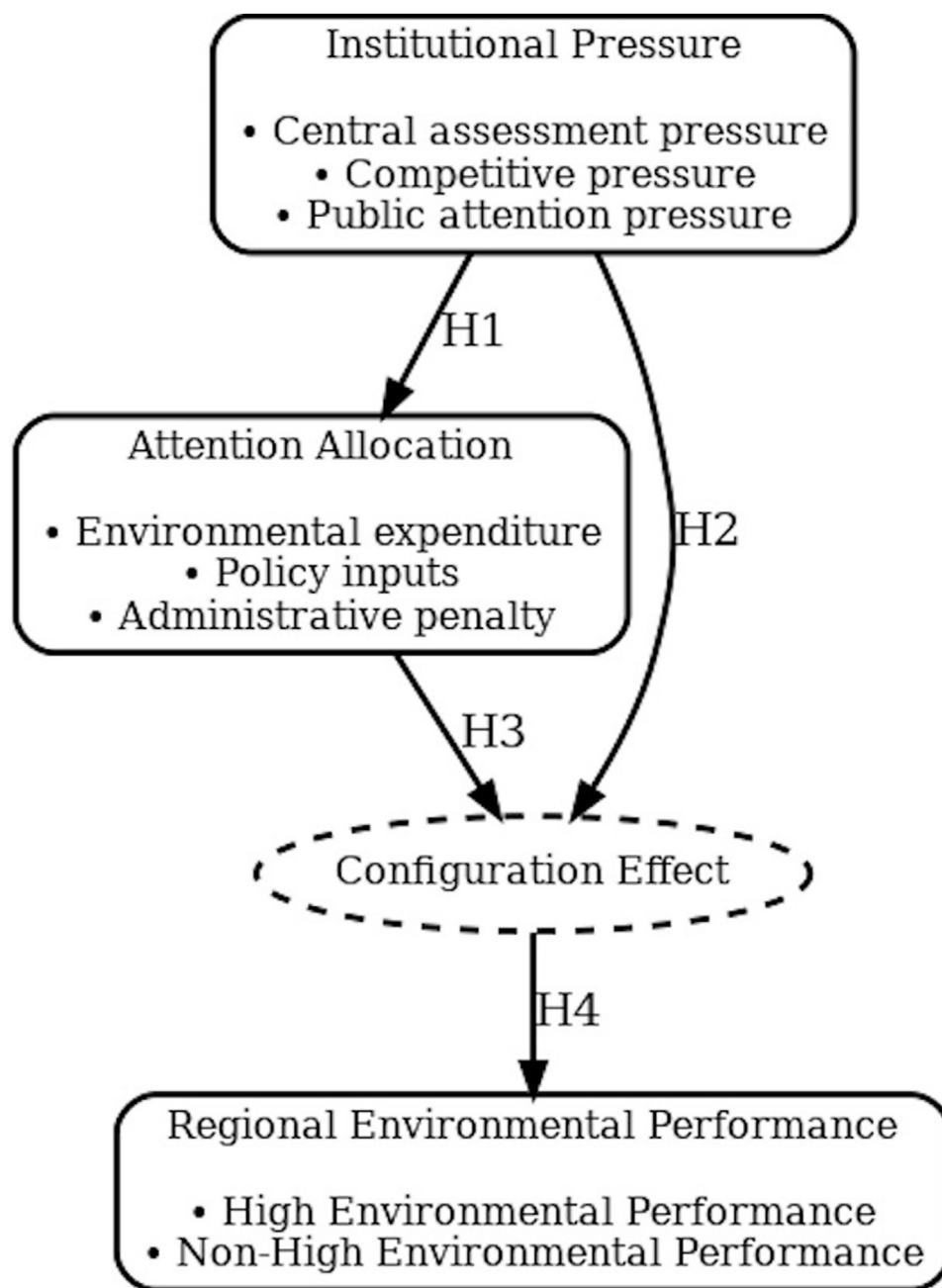


FIGURE 1
Research framework.

organizational behavior. This perspective challenges traditional theories that posit institutional pressures as simple determinants of organizational behavior, indicating a more complex interplay between the two. Therefore, it is crucial to explore the mechanisms that connect institutional pressures with organizational behavior. The “Pressure–Response” framework provides a useful theoretical lens. It suggests that response behavior reflects an organization’s strategic choices under institutional and resource constraints, where organizations are compelled to adopt effective responses under pressure. Complementing this perspective, the theory of government attention allocation offers an important foundation

for understanding how governments identify, prioritize, and respond to external pressures.

Environmental performance is ultimately the outcome of the interplay of multiple conditions. It depends not only on the external drivers of institutional pressures but also on the proactive responses of local governments in environmental governance and the rational allocation of attention resources to achieve positive outcomes. This study advances existing theorization by moving beyond the deterministic assumption that institutional pressures alone dictate governance outcomes. While institutional complexity theory emphasizes external constraints and the attention-based view

highlights cognitive resource allocation, few studies have systematically integrated these perspectives to explain environmental governance effectiveness.

At the same time, insights from multi-level governance theory enrich this framework by recognizing that environmental governance unfolds within an institutional architecture characterized by vertical and horizontal interdependencies (Newig and Fritsch, 2009). Central government directives, local government implementation, and societal participation operate across multiple levels, creating both pressures and opportunities for coordination. These multi-level interactions not only intensify institutional complexity but also condition how governments allocate attention in balancing economic growth with environmental protection.

By constructing the “Institutional Pressure–Attention Allocation” model, this research positions attention allocation as a key mediating mechanism that connects institutional pressures with governance performance. Furthermore, adopting a configurational perspective enables the analysis of how different forms of institutional pressure, attention allocation, and multi-level governance arrangements interact nonlinearly, producing multiple equifinal pathways to high environmental performance. In doing so, the study not only enriches institutional complexity theory with a more dynamic explanatory mechanism but also extends the attention-based view and integrates multi-level governance insights into the domain of regional environmental governance, thereby offering a novel theoretical framework with distinctive academic value.

In summary, this study overcomes the limitations of the deterministic view of environmental performance imposed by institutional pressure. By constructing the “Institutional Pressure–Attention Allocation” theoretical model, it establishes attention allocation as a key mediating mechanism that connects external institutional constraints with environmental governance effectiveness. Within this theoretical framework, the study further adopts a configurational perspective, analyzing how different forms of institutional pressure and attention allocation interact nonlinearly. It reveals how these factors, through differentiated combinations, form multiple equivalent pathways that jointly drive the achievement of high environmental performance. Its underlying mechanism is illustrated in Figure 1.

3 Research design

3.1 Research methods

Organizational elements often interact with each other and jointly influence the outcome. However, traditional regression analysis is based on the assumption of independent predictors and corresponding causal relationships. It excels at assessing the net effect of individual variables but struggles to address complex causal mechanisms, such as interdependencies among variables (Kraus et al., 2018). Configurational theory and Qualitative Comparative Analysis (QCA) provide an excellent methodology. They adopt a systematic analytical perspective, viewing the research object as a configuration of different combinations of condition variables. Through set-theoretic analysis, they reveal the set-

theoretic relationship between element configurations and outcomes. Its core strength lies in its ability to integrate qualitative and quantitative approaches, emphasizing the conjunctural effects of conditions and the existence of multiple causal pathways (Tan, 2018).

However, traditional QCA methods primarily handle binary data and struggle to effectively address the continuity and ambiguity inherent in practical problems, which constitutes an inherent limitation. To overcome these limitations, Ragin introduced fuzzy logic into QCA in 2000, resulting in the development of the FSQCA method. This method allows for the representation of “partial membership” states, capturing the nuanced and continuous nature of conditions in practical contexts. Therefore, this study is grounded in configurational theory and employs the fuzzy-set Qualitative Comparative Analysis (fsQCA) method, using FSQCA 4.0 software to conduct configurational analysis on cross-sectional data. This approach effectively captures the complex interactive mechanisms and multi-causal synergies underlying environmental governance performance across different provinces, thereby ensuring that the findings better reflect the complexity and multidimensionality of practical contexts.

3.2 Sample selection and data sources

This study selects 30 provincial-level administrative units in China, including provinces, autonomous regions, and municipalities, while excluding Tibet and Taiwan due to data availability constraints. These 30 regions serve as case samples for the analysis. Both outcome conditions and antecedent conditions are represented by annual indicators, with the temporal baseline set at 2021. The decision to focus on 2021 cross-sectional data is driven by the unique significance of this year in China’s environmental governance trajectory. Specifically, 2021 marked the inaugural year of the 14th Five-Year Plan, during which the central government assigned new binding energy conservation and emission reduction targets to provincial governments. These quantified targets explicitly defined the environmental responsibilities of local governments, making institutional pressures more explicit and measurable. Furthermore, 2021 also coincided with the formal introduction of China’s “carbon peaking and carbon neutrality” strategic objectives, subjecting local governments to unprecedented pressures in balancing economic growth and environmental protection. These pressures were not only reflected in the rigid constraints of environmental governance targets but also manifested in the dynamic adjustments of environmental attention allocation by local governments.

By anchoring the analysis in 2021, this study aims to accurately capture the behavioral logic of environmental governance and the mechanisms of attention allocation under the dual pressures of institutional mandates and strategic policy transitions. The data for this study are primarily derived from authoritative and reliable sources, including the China Statistical Yearbook (2021), China Environment Statistical Yearbook (2021), China Energy Statistical Yearbook (2021), and provincial government work reports (<https://www.stats.gov.cn/sj/ndsj/>). These sources provide comprehensive and up-to-date information on both the outcome and antecedent

conditions, ensuring the robustness and reliability of the empirical analysis.

3.3 Variable measurement

3.3.1 Outcome variable

The environmental performance of provincial governments serves as the primary outcome variable in this study. Building upon prior research, this study applies the Super Slack-Based Measure model in Data Envelopment Analysis to measure local environmental performance from both input and output perspectives (Wu and Wang, 2023). Compared to the radial-oriented CCR/BCC models, the core of the super-SBM model lies in its adoption of a non-radial relaxation-based optimization framework. Specifically, traditional radial models force inputs or outputs to adjust in fixed proportions, and by neglecting the relaxation terms, this assumption often disconnects from practical realities in environmental governance (Lee, 2022). In addition, the super-SBM model also overcomes the homogenization dilemma of effective decision-making units inherent in the traditional SBM model (Liu et al., 2022). Specifically, the efficiency value in the traditional SBM model is constrained to 1.0, whereas the super-SBM model allows the efficiency value to exceed this upper limit, enabling a more refined ranking of effective units.

For input indicators, local governments' environmental governance inputs include labor, capital, and energy. Consequently, this study selects fixed asset investment, urban year-end employment numbers, and total energy consumption as primary measures. Regarding output indicators, the desirable output is provincial GDP, while undesirable outputs comprise the "three industrial wastes": specifically, chemical oxygen demand emissions in industrial wastewater, SO₂ emissions, and industrial solid waste generation. Input the variables into Equations 1–6.

$$\min \rho = \frac{\frac{1}{m} \sum_{i=1}^m \frac{s_{i0}^-}{x_{i0}}}{\frac{1}{s_1 + s_2} \left(\sum_{r=1}^{s_1} \frac{s_r^+}{y_{r0}} + \sum_{p=1}^{s_2} \frac{s_p^-}{b_{p0}} \right)} \quad (1)$$

subject to

$$\sum_{j=1}^n j \neq k \lambda_j x_{ij} \leq x_{i0} + s_i^-, i = 1, 2, \dots, m \quad (2)$$

$$\sum_{j=1}^n j \neq k \lambda_j y_{rj} \geq y_{r0} - s_r^+, r = 1, 2, \dots, s_1 \quad (3)$$

$$\sum_{j=1}^n j \neq k \lambda_j b_{pj} \leq b_{p0} - s_p^-, p = 1, 2, \dots, s_2 \quad (4)$$

$$\lambda_j \quad j = 1, 2, \dots, n, j \neq k \quad (5)$$

$$s_i^- \geq 0, s_r^+ \geq 0, s_p^- \geq 0 \quad (6)$$

In this formula, ρ represents the efficiency score of the decision-making unit (DMU), while m denotes the number of input indicators; The parameters s_1 and s_2 indicate the quantities of desirable and undesirable outputs, respectively. The term x_{ij} refers to the i -th input of the j -th DMU, y_{rj} denotes the r -th desirable output of the j -th DMU, and b_{pj} signifies the p -th

undesirable output of the j -th DMU. The slack variables s_i (input redundancy), s_r (desirable output shortfall), and s_p (undesirable output surplus) correspond to inefficiencies in input utilization, s_i and s_r denote the slack variables for inputs and outputs respectively, s_i and s_r represent the i -th input and r -th output indicators. λ_j signifies the weight variable, and k indicates the DMU under evaluation. This analytical framework effectively quantifies the environmental performance of provincial units, providing a comprehensive assessment of their efficiency in converting environmental governance inputs into desirable outcomes while minimizing undesirable outputs.

To enhance the robustness of the research findings, this study replaced the original input indicator "total energy consumption" with "coal consumption per unit output value" when using the super-SBM model to measure environmental performance. The results indicate that the regional environmental performance rankings derived in this study are consistent with existing conclusions, thereby further confirming the robustness and reliability of the findings.

3.3.2 Condition variables central government assessment pressure

3.3.2.1 Central government assessment pressure

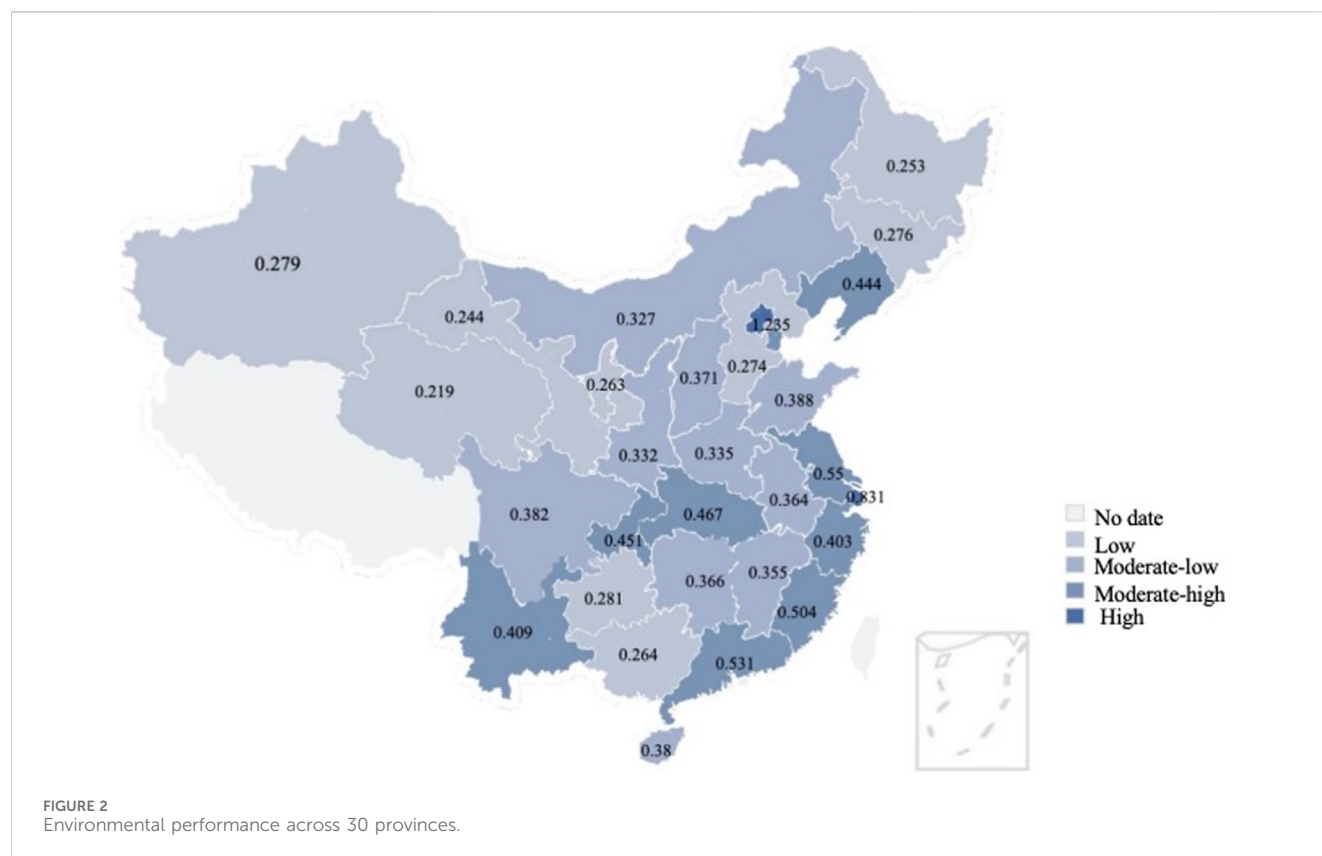
The Five-Year Plans for energy conservation and emission reduction constitute the most stringent system of emission reduction responsibilities assigned by the central government to local authorities. Consequently, this study adopts the energy intensity reduction targets assigned to provincial governments under the *14th Five-Year Plan Comprehensive Work Plan for Energy Conservation and Emission Reduction* as the core metric for measuring central government assessment pressure.

3.3.2.2 Peer competition pressure

Compared to water and soil pollution, air pollution is more readily perceived by the public. Real-time reporting of air quality indicators facilitates comparison across regions. In terms of indicator selection, this study, drawing on prior research, uses the proportion of days with compliant air quality in each province to represent horizontal competitive pressure. Specifically, a higher proportion of compliant days indicates better air quality and, consequently, lower competitive pressure; conversely, a lower proportion reflects greater competitive pressure. Figure 2 presents the environmental performance across all provinces in China.

3.3.2.3 Public attention pressure

Compared to traditional survey data, internet search records offer significant advantages in terms of real-time responsiveness, broad coverage, and continuous data availability, providing a timely and accurate reflection of public concern regarding environmental pollution incidents. As the largest Chinese search engine, Baidu offers extensive coverage and high data accessibility. It should be noted that the Baidu Index, as a proxy variable for public attention, has certain limitations. On the one hand, it exhibits validity bias in that it cannot capture the underlying motivations behind individuals' attention; on the other hand, it is subject to contextual sensitivity, with search volumes being easily influenced by media coverage. Nevertheless, owing to its advantages of strong



temporal-spatial continuity, public accessibility, and broad coverage, the Baidu Index remains the most operationally feasible indicator currently available for measuring public search attention at the provincial level. By analyzing search frequency and geographical distribution, it is possible to assess the data situation across different regions of China (Wu et al., 2022). Drawing on previous studies, this study employs pollution-related search indices from the Baidu Index platform as a proxy variable for measuring public environmental attention.

3.3.2.4 Environmental protection fiscal expenditure

To assess governmental investment in environmental protection, this study selects provincial environmental protection fiscal expenditures as the core metric, accurately reflecting the financial commitment of local governments to environmental governance.

3.3.2.5 Policy input intensity

This study constructs a policy intensity indicator by quantifying the frequency of environment-related keywords in local government work reports. Specifically, 12 core thematic terms are selected, including “environmental protection,” “pollution,” “emission reduction,” “green development,” “energy consumption,” “ecology,” “carbon emissions,” and “carbon trading.”

3.3.2.6 Number of administrative penalty cases

The annual count of environmental administrative penalty cases at the provincial level is adopted as the key explanatory variable,

effectively capturing the enforcement intensity and regulatory frequency of actions against environmental violations.

4 Data analysis and empirical results

4.1 Variable descriptive statistics and calibration

The fsQCA method requires calibration of research variables before analysis. Based on the numerical characteristics and distribution of the variables, three key thresholds—full membership, the crossover point, and full non-membership—are determined, transforming the raw data into fuzzy membership scores within the [0-1] range. Given that the core of the fsQCA method lies in capturing configurational causal relationships between conditions and outcomes through fuzzy-set membership scores, and that this study focuses on the relative positions of provinces within the sample set rather than their absolute levels, the 75th percentile, 50th percentile, and 25th percentile are adopted as calibration anchors.

This choice is grounded in three main considerations: (1) From the perspective of external sample characteristics (Table 1), Chinese provinces exhibit substantial heterogeneity in terms of natural resource endowments, industrial structures, and stages of development, which directly translates into differentiated performance in environmental governance. Using percentile-based anchors effectively reflects each province’s relative position within the national sample, mitigates the undue influence of extreme

TABLE 1 Descriptive statistics and calibration.

Variable	Descriptive statistics				Calibration		
	Mean	Standard Deviation	Maximum	Minimum	Full non-membership	Crossover point	Full membership
Environmental performance	0.404	0.201	1.235	0.219	0.45	0.369	0.278
Central Government Assessment Pressure	139.567	7.006	15.5	12.5	145	140	136
Peer Competition Pressure	0.869	0.101	0.994	0.645	0.947	0.898	0.781
Public Attention Pressure	109.679	33.006	169.81	30.5	127.228	113.27	90.62
Environmental Protection Fiscal Expenditure	174.797	98.705	493.55	47.135	213.69	165.424	98.176
Policy Input Intensity	89.433	23.105	126	42	106.75	91.5	70.25
Number of Administrative Penalty Cases	4,451.5	5,050.11	19,810	178	4,493	2,499.5	1,363

TABLE 2 Analysis of necessary conditions.

Condition variables	High environmental h-performance		Non-high environmental performance	
	Consistency	Coverage	Consistency	Coverage
Central Government Assessment Pressure	0.682	0.641	0.534	0.505
~Central Government Assessment Pressure	0.473	0.502	0.621	0.663
Peer Competition Pressure	0.571	0.546	0.584	0.562
~Peer Competition Pressure	0.541	0.564	0.528	0.553
Public Attention Pressure	0.756	0.732	0.377	0.367
~Public Attention Pressure	0.347	0.356	0.726	0.749
Environmental Protection Fiscal Expenditure	0.676	0.65	0.452	0.438
~Environmental Protection Fiscal Expenditure	0.416	0.43	0.638	0.665
Policy Input Intensity	0.50	0.481	0.609	0.595
~Policy Input Intensity	0.582	0.6	0.469	0.484
Number of Administrative Penalty Cases	0.714	0.719	0.412	0.418
~Number of Administrative Penalty Cases	0.421	0.416	0.722	0.717

~ indicates the logical NOT operation in set theory.

values on calibration results, and thereby enhances the robustness and comparability of configurational analysis. (2) From the policy perspective, China's 14th Five-Year Plan sets differentiated ecological and environmental goals and development pathways for each province, emphasizing tailored policies aligned with local conditions. A calibration approach based on unified relative standards rather than absolute values better reflects provinces' relative performance within their own resource conditions and developmental positioning, and is also consistent with the policy orientation of advancing regionally adaptive ecological governance. (3) Theoretically, Ragin and other scholars advocate the use of

empirically operationalizable calibration standards in fsQCA to ensure that set boundaries are neither overly permissive nor overly restrictive, thus securing sufficient discriminability between "high membership" and "low membership" cases. Accordingly, this study follows this methodological convention and selects the 0.75, 0.5, and 0.25 percentiles as calibration anchors (Du et al., 2020; Schneider, 2018).

To evaluate the robustness of the calibration, we conducted a sensitivity analysis based on the original calibration setup. Specifically, the anchor points were adjusted upward and downward by 0.05, respectively, and the calibration process was

TABLE 3 Configurations for regional environmental performance.

Condition variables	High environmental performance			
	S1	S2	S3	S4
Central Government Assessment Pressure	•		●	
Peer Competition Pressure	●	●	⊗	●
Public Attention Pressure	●	●	⊗	⊗
Environmental Protection Fiscal Expenditure	●	●	⊗	⊗
Policy Input Intensity	⊗	•	●	•
Number of Administrative Penalty Cases		●	U	●
Case	Shanghai Zhejiang	Guangdong Hunan	Hubei Neimenggu	Yunnan
Consistency	0.99	0.96	0.84	0.86
Raw Coverage	0.20	0.22	0.13	0.12
Unique Coverage	0.14	0.11	0.07	0.03
Solution Consistency	0.91			
Solution Coverage	0.48			

Large ● and ⊗ indicating the presence and absence of core condition, small ● and ⊗ indicating the presence and absence of peripheral conditions, a blank indicates either the presence or the absence.

repeated. The results remained consistent under both adjusted conditions.

4.2 Univariate necessity analysis

Prior to conducting configurational analysis, it is essential to determine whether any individual variable constitutes a necessary condition for the outcome variable (Lee, 2022). If a necessary condition is identified, it indicates that the variable is a critical factor in achieving either high or low environmental governance performance. Such a condition should consistently appear in all configurations associated with both high and low environmental performance outcomes (Liu et al., 2022). In general, a condition is considered necessary if its aggregate consistency score exceeds the threshold of 0.9 (Li et al., 2025).

As shown in Table 2, the aggregate consistency scores of all conditional variables are below 0.9. This finding indicates that none of these six factors individually serves as a necessary condition for either high environmental performance or its absence, effectively ruling out the existence of individual necessity effects. These results highlight the complexity of local environmental governance systems and further emphasize the importance of examining the synergistic effects generated by combinations of different conditional factors.

4.3 Configurational sufficiency analysis

4.3.1 Summary of results

In FSQCA analysis, configurational analysis is a critical step to examine how different condition combinations produce outcomes. When constructing the truth table, this study sets the consistency

threshold at 0.8, the case frequency threshold at 1, and the PRI threshold at 0.7 as truth table construction criteria (Fiss, 2011; Ragin, 2008). Following Garcia-Castro et al.’s approach, enhanced standard analysis was applied to exclude contradictory configurations (Bhattacharya, 2023). Given the lack of consensus in existing research regarding the directional relationship between condition variables and the outcome variable, this study makes no directional assumptions. Both the presence and absence of individual conditions may influence environmental performance. Through standard analysis procedures, the complex solution, intermediate solution, and parsimonious solution are derived. In terms of the solution composition, the analysis is based on the intermediate solution, with core condition assessment conducted using the parsimonious solution, ultimately leading to the results of the sufficient conditions analysis for the configuration,as shown in Table 3.

In Table 3, large ● and large ⊗ represent core conditions, small ● and ⊗ denote peripheral conditions, and blank spaces indicate that the presence or absence of the condition has no impact on the outcome. Core conditions are the necessary factors determining whether the outcome occurs, while peripheral conditions are auxiliary factors that appear in specific solutions and rely on the interaction with other conditions. In sum, core conditions establish the inevitability of the outcome, whereas peripheral conditions shape how the outcome manifests in particular contexts.

The analysis reveals four distinct configurations capable of generating high environmental performance. Each configuration demonstrates a consistency score exceeding 0.8, confirming their sufficiency as causal pathways. The aggregate consistency of 0.91 indicates that 91% of cases adhering to these configurations achieve high environmental performance. Moreover, the aggregate coverage of 0.48 suggests that these configurations collectively explain approximately 48% of high-performance cases.

4.3.2 Configurational analysis

This study identified four configurations that lead to high environmental governance performance in the preceding sufficiency analysis. Next, the paper analyzes each pattern for achieving high environmental governance performance, along with the corresponding cases.

4.3.2.1 Strong institutional pressure-driven

The distinctive feature of the S1 configuration is the comprehensive drive of institutional pressure, which can be labeled as Strong Institutional Pressure-Driven. The presence of public attention pressure and peer competition pressure are core conditions, while central government assessment pressure serves as an effective auxiliary condition that further strengthens the overall institutional pressure. Public environmental demands create external oversight for local governments, and, together with the competitive dynamics of the horizontal environmental political race among local governments, shape an environment of high institutional pressure. In such an environment, local governments are compelled to allocate their attention to environmental governance in response to institutional pressure. In terms of attention investment, increasing environmental financial expenditure becomes a priority choice for local governments. This response can be attributed to two main reasons. First, fiscal expenditure has significant visibility and signaling functions, directly addressing public demands and demonstrating a proactive governance attitude in horizontal competition. It also signals to higher-level governments the commitment to environmental governance, serving as a “visible investment” political signal. Second, this response method carries lower execution risks and higher controllability. Compared to measures such as increasing administrative penalties, which might affect business interests, fiscal investment involves internal resource allocation decisions within the government, offering higher autonomy and relatively lower resistance.

A typical case explained by this configuration is Shanghai Municipality and Zhejiang Province. Taking Shanghai as an example. In the S1 configuration, Shanghai exhibits a membership score of 0.77 in the relevant condition set, indicating a strong alignment with peer competition pressure, public attention pressure, and environmental protection fiscal expenditure as key components of the high-performance pathway. Its membership in the outcome set of “high environmental performance” reaches 1, signifying complete inclusion in the set. This demonstrates that the identified configuration pathway provides a valid explanation for the factors underpinning Shanghai’s achievement of high environmental performance. From the practical standpoint, within the framework of the 14th Five-Year Plan for energy conservation and emission reduction, the central government mandated a 14% reduction target for Shanghai. In the national context, this target is not among the most stringent levels, indicating that Shanghai faces relatively limited assessment pressure from the central government. However, Shanghai’s position at the core of the Yangtze River Delta economic zone exposes it to competitive pressures from neighboring provinces like Jiangsu and Zhejiang, which boast advanced economies, similar industrial structures, and notable achievements in ecological investment and green

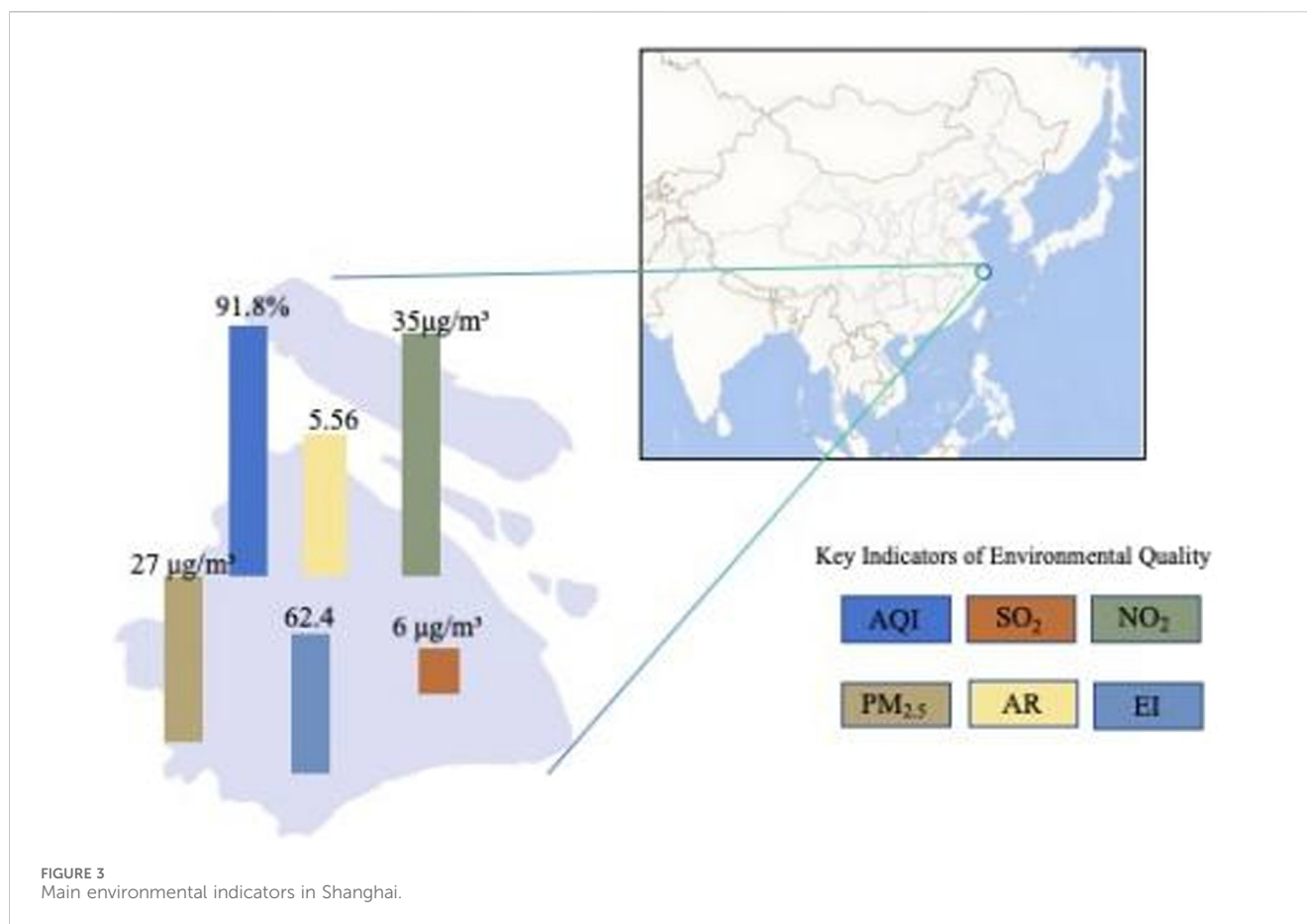
innovation. To maintain regional leadership and avoid lagging in development, Shanghai must continuously enhance its environmental governance. Additionally, as a pioneer in municipal waste sorting, Shanghai benefits from relatively high public environmental awareness. Residents actively advocate for stronger environmental governance through complaints, participatory decision-making, and online oversight, further amplifying institutional pressures.

Under the influence of institutional pressure, Shanghai chose to respond by increasing environmental financial expenditure. In 2007, Shanghai became the first municipality to establish “environmental protection” as a separate fiscal expenditure category. This expenditure grew from 2.003 billion RMB in 2007 to 18.93 billion RMB in 2021, with an average annual growth rate exceeding 16%. The continued expansion of environmental financial expenditure has laid a foundation for the overall improvement of Shanghai’s environmental governance capacity. The sustained increase in such expenditures has been directly translated into the improvement of environmental infrastructure, enhanced monitoring and enforcement capabilities, and the implementation of pollution control projects, thereby driving overall environmental performance improvements. The tangible results are reflected in the increase in Shanghai’s air quality compliance rate, from 81.1% in 2018 to 91.8% in 2021. The six air quality indicators have consistently met the national secondary standard for ambient air quality, leading to a significant improvement in environmental performance rankings. The environmental governance outcomes of the municipality are illustrated in [Figure 3](#).

4.3.2.2 Attention-responsive

The prominent feature of the S2 configuration lies in the local government’s comprehensive response to external pressures, which justifies labeling this configuration as Attention-Responsive. In this configuration, the combined pressures of public environmental concern and peer competition serve as core drivers for local government action. Faced with dual external pressures, local governments adopt two key response strategies: on one hand, they increase environmental financial expenditure to strengthen environmental governance infrastructure; on the other, they enhance supervision of polluting enterprises. Furthermore, the strengthening of environmental policies serves as an auxiliary condition, providing institutional support and policy guidance for governance actions, collectively promoting the improvement of environmental governance outcomes.

The typical provinces for this configuration are Guangdong, Hunan, and others. Using Guangdong Province as an example, we find that it has a membership value of 0.84 in the relevant condition configuration, indicating a high degree of consistency with key elements of the high-performance path, namely peer competition pressure, public concern, environmental fiscal expenditure, and administrative penalties. Its membership in the outcome set of high environmental performance reaches 1, signifying complete inclusion. These results suggest that the identified pathway provides a robust explanation for Guangdong’s attainment of high environmental performance. From the perspective of Guangdong’s environmental governance practices, the province, as a leading frontier of industrialization and economic development in China, is characterized by a manufacturing-



intensive industrial structure and high levels of energy consumption, and has therefore long been confronted with severe environmental pollution challenges. Guangdong environmental pollution issues have been extensively reported by media outlets such as Southern Metropolis Daily. Confronting intense political and public scrutiny, the Guangdong Provincial Department of Finance significantly increased environmental funding, prioritizing the remediation of urban water bodies and regulating high-pollution, energy-intensive industries.

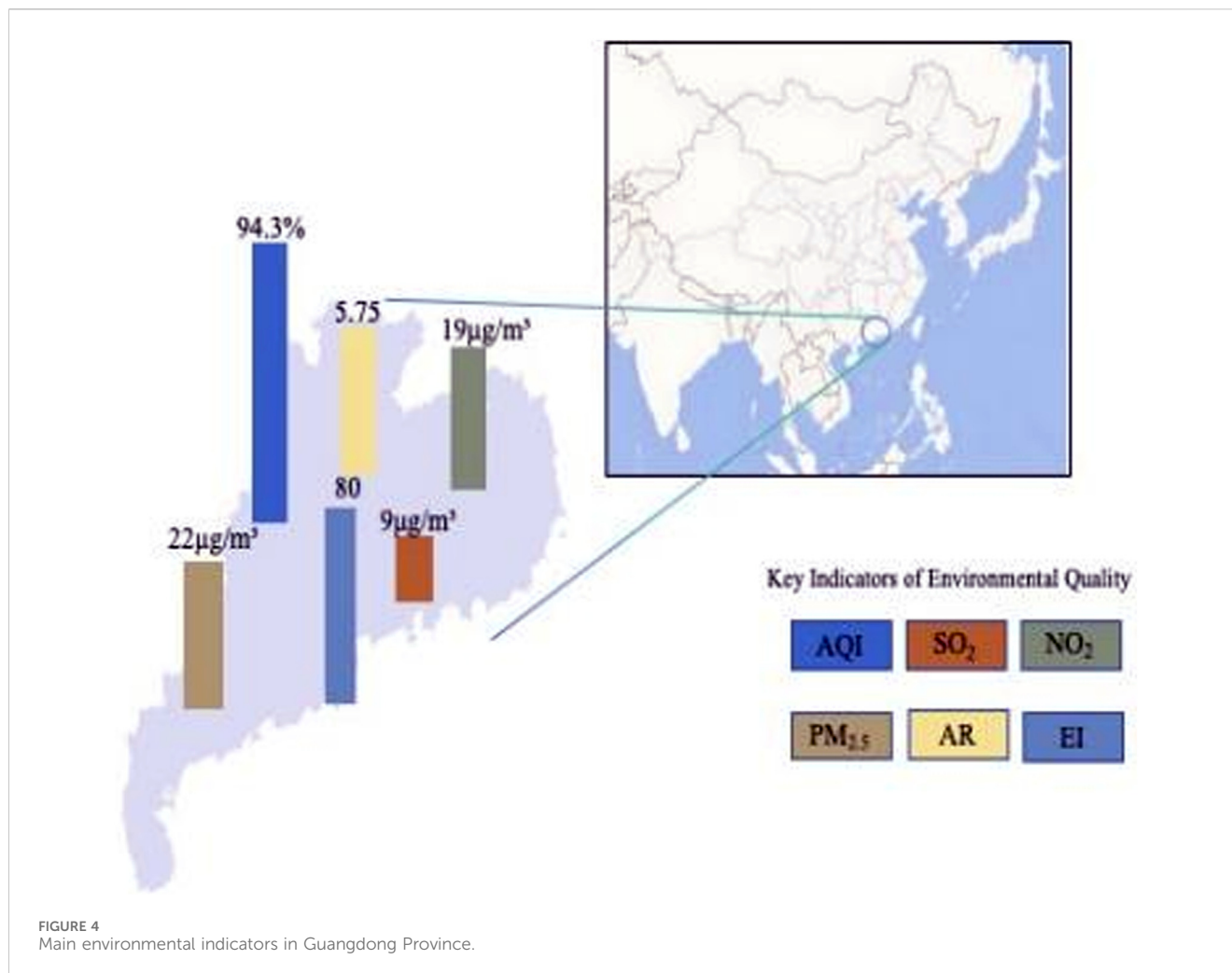
In response to the continuous growth of public environmental demands and the competitive pressure from neighboring provinces in green development, the local government of Guangdong has actively adjusted its attention allocation, increasing investment and regulatory efforts in environmental governance. In terms of environmental financial investment, Guangdong has continuously expanded its environmental budget. Since 2010, with the exception of 2016 and 2017, when its environmental financial expenditure ranked second nationally, the province has ranked first in other years. These funds are primarily allocated to support industrial pollution source remediation, watershed management, and ecological restoration projects. Regarding regulatory investment, Guangdong ranked third nationally in 2021 for environmental administrative penalties, reflecting its strong enforcement of environmental laws. As a major industrial province, Guangdong has numerous and complex polluting enterprises. According to the rational economic man theory, enterprises naturally aim to maximize

profits and often attempt to bypass environmental costs to achieve economic gains. Therefore, relying solely on policy advocacy or partial pollution source remediation is insufficient to curb illegal emissions by enterprises. Strict and regularized regulatory enforcement must be implemented, and by raising the cost of violations, an effective deterrent is created to effectively drive enterprises to fulfill their environmental responsibilities.

Through these measures, Guangdong achieved sustained ecological improvements in 2021, with the AQI (Air Quality Index) compliance rate reaching 94.3%, consistently leading the country. The excellent water quality rate of surface water and the proportion of high-quality coastal waters have reached the highest levels since the implementation of national assessments. In terms of environmental regulation, all regions in the Pearl River Delta have participated in the construction of “zero-waste pilot zones” and systematically promoted comprehensive solid waste management. Overall, the strategies adopted by Guangdong have made substantial progress, resulting in significant improvements in environmental performance. The environmental governance outcomes of the province are illustrated in Figure 4.

4.3.2.3 Central-led—policy coordination

In the S3 configuration, the core conditions include the presence of central assessment pressure and environmental policy investment, along with the absence of peer competition pressure. The absence of other conditions serves as auxiliary factors. Together,

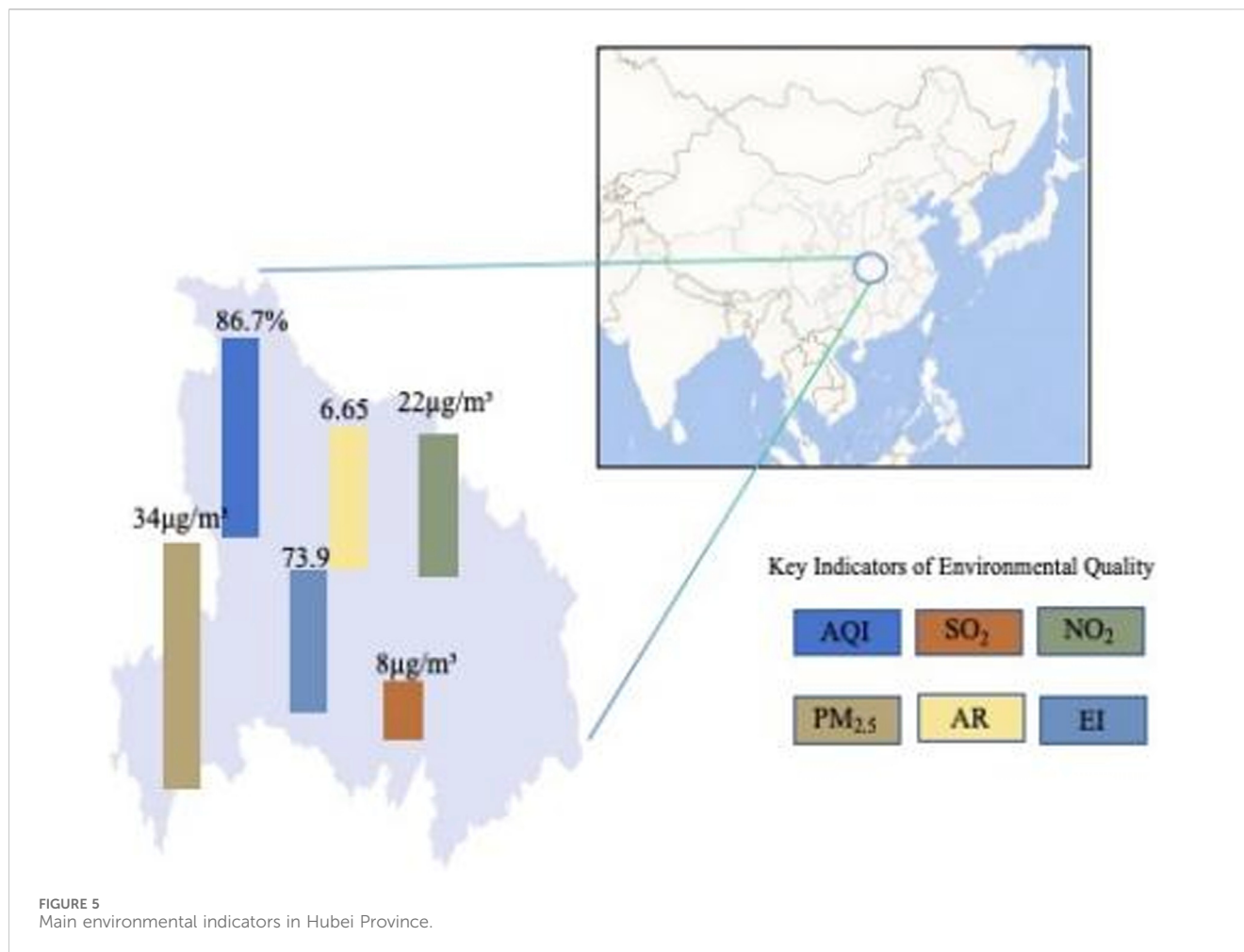


these elements contribute to the improvement of regional environmental performance. The notable feature of this configuration is that under a low-competition environment, central assessment pressure can effectively drive local governments to allocate attention toward the formulation of environmental policies, thereby enhancing environmental performance. Accordingly, this pathway can be labeled as “Centrally-Driven—Policy Synergy Model.”

This pathway indicates that China’s environmental governance process is consistently characterized by a pressure-driven system. Vertical coercive pressure between government levels is a key factor driving local environmental governance. This pressure creates strong political incentives, prompting local governments to frequently include environmental protection references in their work reports and to intensively issue a series of local environmental regulations and policy documents, in order to meet assessment targets and avoid being held accountable by the central government. Actions driven by this pressure further enhance local governments’ sense of responsibility and execution in environmental protection. This model is applicable to two types of regions: one, ecologically sensitive areas with important ecological functions; and two, regions primarily driven by traditional industries with significant transformation. A typical representative of the

former is Inner Mongolia, while a typical representative of the latter is Hubei Province.

Taking Hubei Province as an example. In the S3 configuration, Hubei Province exhibits a membership score of 0.89 in the condition set, indicating that its high-performance pathway is primarily driven by the presence of central government influence, the absence of peer competition pressure, and the allocation of policy input intensity. These conditions are highly consistent with the characteristics of the pathway. Meanwhile, the province’s membership in the outcome set of “high environmental performance” reaches 0.9, reflecting a strong degree of inclusion. This evidence suggests that the S3 configuration provides a compelling explanation for the factors underlying Hubei’s achievement of high environmental performance. Hubei Province, located in central China, has long faced the challenge of balancing economic development with environmental protection. Due to the relatively low level of competitive pressure from peer governments, Hubei’s environmental governance has been more dependent on the assessment pressure and policy guidance from the central government. In 2021, the Third Central Ecological and Environmental Protection Inspection Team carried out the second round of inspections in Hubei Province. During this inspection, problematic enterprises were identified, and responsible officials were held accountable. According to data



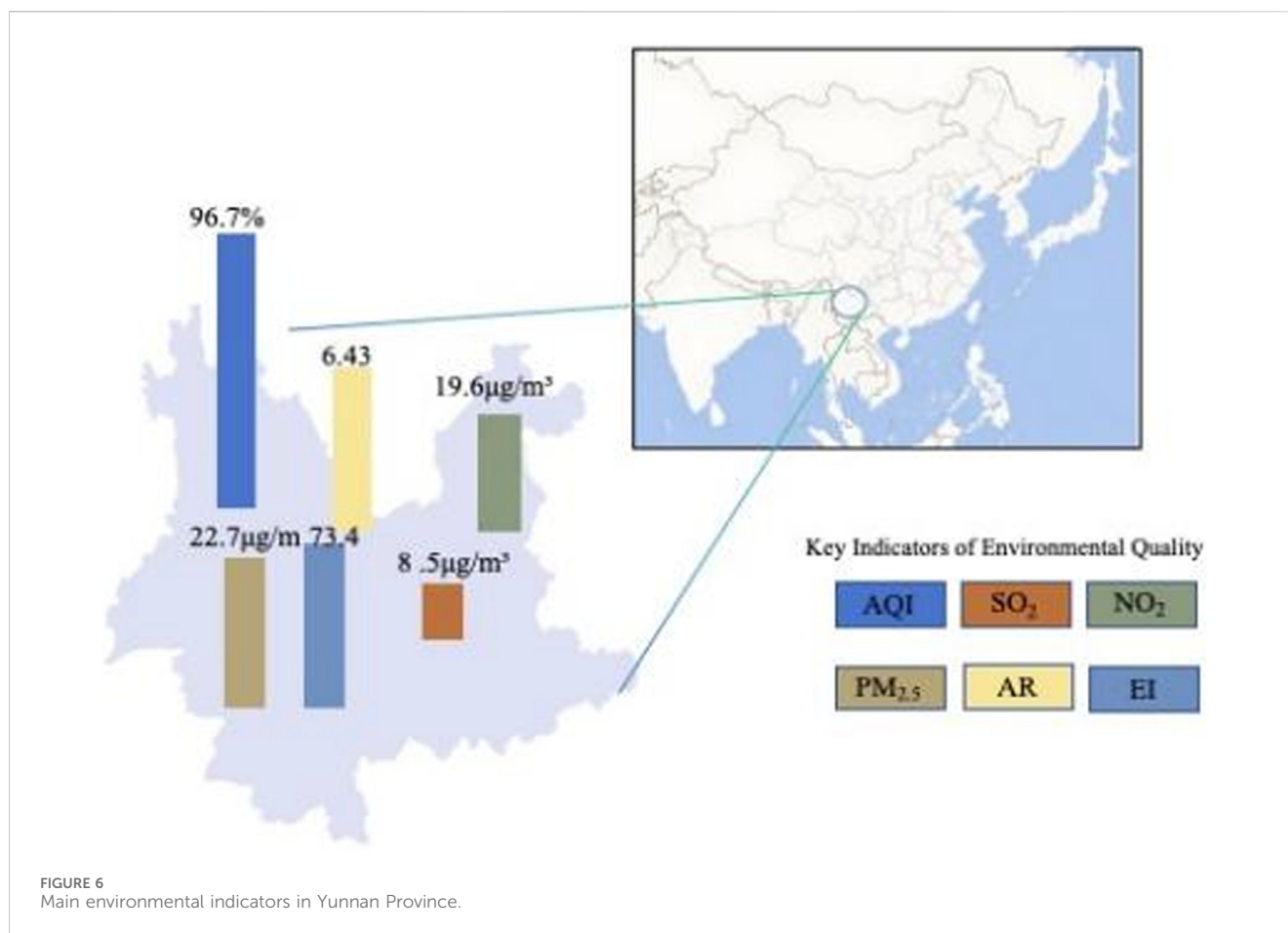
released by the Ministry of Ecology and Environment, the inspection resulted in accountability measures for 33 responsible entities and 72 individuals. This significant accountability pressure compelled the Hubei provincial government to introduce a series of policy documents and regulations aimed at further refining environmental protection measures. In 2021, Hubei Province established a “1+1+1+N” rectification framework—one overall implementation plan, one task decomposition plan, one accountability mechanism, and In review multiple specialized action plans to ensure the full implementation of corrective measures. Simultaneously, Hubei revised its “Ecological and Environmental Administrative Penalty Discretion Benchmark Regulations,” which specified the scope of application, methods of discretion, and penalty ranges for each type of violation, thereby expanding enforcement coverage to ensure that all environmental violations received appropriate punishment.

Driven by the interplay of institutional pressures and the strategic allocation of attention, Hubei province achieved substantial environmental improvements. Notably, ambient air quality surpassed the targets set for the 14th Five-Year Plan ahead of schedule, the remediation of water bodies classified as inferior to Class V was completed in advance of the plan’s objectives, and drinking water sources at the county level and above

consistently maintained 100% compliance. These accomplishments underscore the province’s effective response to the central government’s directives, demonstrating the significant role that top-down pressures can play in local policy formulation. Moreover, they reflect the successful implementation of the “Central Leadership-PolicyCoordination” pathway, wherein central mandates and local policy actions are aligned to accelerate environmental progress, enhancing both institutional compliance and environmental outcomes. The environmental governance outcomes of the province are illustrated in Figure 5.

4.3.2.4 Peer competition—regulation intensification

The core conditions of the S4 configuration include peer competition pressure and administrative penalties, with environmental policy investment serving as an auxiliary condition, and the absence of other conditions as additional auxiliaries. In this configuration, peer competition pressure is the key factor driving local governments to allocate more attention to environmental protection. During the attention allocation process, local governments tend to focus on increasing regulatory and enforcement efforts, particularly in the form of administrative penalties, as a response to competition pressure. This approach effectively enhances regional environmental performance. Therefore, this pathway



can be labeled as the “Peer Competition – Enhanced Regulation Model.”

A typical region corresponding to this configuration is Yunnan Province. Yunnan exhibits an overall membership score of 0.76 in the relevant condition configuration, indicating a strong alignment with the pathway characteristics of peer competition pressure and administrative penalties. Its membership in the outcome set of high environmental performance is 0.65, signifying substantial inclusion. This suggests that the identified pathway provides a reasonable explanation for Yunnan’s achievement of high environmental performance. Compared to national key governance areas such as Beijing-Tianjin-Hebei, the Yangtze River Delta, and the Pearl River Delta, Yunnan faces relatively weak central assessment pressure. This may be attributed to its location in the southwestern region, where geographical constraints limit economic development, and its industrial structure is relatively simple, resulting in lower overall environmental pollution risks. However, Yunnan faces significant peer competition pressure. Dianchi Lake, one of the most challenging lakes to manage in China, has long been subject to social and policy comparisons with other lakes such as Taihu and Chaohu. Even a slight delay in governance efforts often leads to negative public opinion. In this competitive environment, the Yunnan provincial government has focused its attention on strengthening law enforcement and regulatory oversight to avoid “falling behind” in regional competition. To address peer competition and maintain a competitive edge over regions with

comparable watersheds, the Yunnan Provincial Government voluntarily enacted a fishing ban, incorporating relevant provisions into the Yunnan Province Dianchi Lake Protection Regulations and imposing administrative penalties for violations. Furthermore, by 2021, cumulative investments in Dianchi remediation projects reached 10.719 billion yuan. Compliance rates for 25 surface water monitoring sections improved from 80% to 100%, and the region was designated a National Model City for Black-Odor Water Remediation, transforming Dianchi from a “polluted lake” into the “Plateau Pearl.” The environmental governance outcomes of the province are illustrated in Figure 6.

4.4 Comparative analysis of configurations

The four configurations demonstrate a clear pattern of multiple coexisting pathways, reflecting both substitution and synergy among conditions. Although each individual pathway has limited explanatory coverage, they are complementary and jointly account for the variation in environmental governance performance. This indicates that performance improvement does not rely on a single pathway but rather results from the coupled effects of diverse institutional pressures and attention allocation mechanisms. Moreover, certain conditions exhibit substitution effects across different configurations.

A comparison between configurations S1 and S2 reveals that when both peer competition pressure and public attention pressure are present, local governments tend to increase environmental financial expenditure to strengthen governance. In S1, even in the absence of environmental policy investment, high environmental performance can still be achieved. In S2, the simultaneous presence of environmental policy investment and administrative penalties also leads to high environmental performance. This suggests that when both public attention pressure and peer competition pressure are present, the marginal effect of policy investment is weakened. Furthermore, high environmental performance can still be attained even without the presence of administrative penalties.

Further comparison between configurations S1, S2, and S3 reveals that central assessment pressure, peer competition pressure, and public attention pressure can all stimulate local governments' attention allocation, exhibiting equivalent effects and forming a substitutional relationship. When both peer competition pressure and public attention pressure are weak, the central government should increase its focus on local governments and apply greater pressure to effectively stimulate local environmental governance efforts.

A comparison between configurations S2 and S4 reveals that both pathways face peer competition pressure and choose administrative penalties as the attention allocation strategy. The distinction lies in the fact that S2 also faces high public attention pressure and responds by increasing environmental financial expenditure, indicating that public attention pressure can prompt local governments to invest funds in environmental governance.

A comparison between configurations S3 and S4 shows that in regions with weak peer competition pressure, under strong central assessment pressure, local governments tend to choose to increase environmental policy investment to raise public awareness of environmental pollution. In contrast, under strong peer competition pressure, local governments are more likely to focus on enhancing regulatory and enforcement efforts to constrain polluting behaviors.

In summary, although the configurations differ in their condition combinations, they all ultimately lead to high levels of environmental governance performance, reflecting the characteristic of "different paths leading to the same goal."

4.5 Robustness test

Given that FSQCA is a set-theoretic method, this study conducts robustness tests by adjusting the consistency threshold. Based on existing research (Garcia-Castro and Ariño, 2016), the consistency threshold was increased by 0.05—from 0.80 to 0.85—to re-examine the sufficiency of the configurations under stricter criteria. Notably, the configurational results remained consistent before and after the threshold adjustment, thereby affirming the robustness of the findings. Additionally, this study conducts robustness tests using alternative variables. Specifically, in the baseline regression, the intensity of administrative penalties is measured by the monetary value of penalties imposed by each province, while in the robustness test, the number of administrative penalty cases is used as a measure. Furthermore, the original indicator representing peer competition

pressure—proportion of days with compliant air quality in each province—is replaced with the indicator for pollutant reduction completion rates, and the model is re-estimated. The configuration results before and after the modification of the indicators remain unchanged, indicating that the findings of this study are highly stable.

5 Discussion and policy implications

5.1 Discussion

This study identifies four conditional pathways for achieving high environmental governance performance through fsQCA analysis: Strong Institutional Pressure-Driven (S1), Attention-Responsive (S2), Central-led—Policy Coordination (S3), Peer Competition—Regulation Intensification (S4). The main findings and theoretical contributions are as follows:

1. External pressure and internal response jointly drive high environmental performance. Although the four pathways differ significantly in their condition compositions and sources of pressure, they all share the characteristic of being driven by both external institutional pressure and internal attention allocation. This study breaks away from the single logic that institutional pressure alone determines environmental performance, and instead constructs the "Institutional Pressure–Attention Allocation" theory and comprehensive analytical framework.
2. There Is an Inherent Connection Between Institutional Pressure and Attention Allocation: The institutional pressures faced by local governments are a key factor in increasing environmental attention. External pressures such as central assessment pressure, peer competition pressure, and public attention, as various levels of institutional forces, enter the local governance process through diverse combinations, and are transformed into effective policy actions under the influence of local governments' internal attention mechanisms. Within this framework, local governments are not merely passive recipients of external institutional pressures; rather, they actively choose and combine different governance pathways in a complex institutional environment to achieve environmental governance goals.
3. Institutional Complexity and Equivalence: Substitutive and Complementary Relationships Between Institutional Pressure Elements and Attention Allocation: From the perspective of institutional complexity and equivalence, this study reveals the substitution relationship between institutional pressure elements and the complementary relationship between attention allocation mechanisms. This suggests that, on one hand, external pressure can drive local governments to take action when governance motivation is lacking, and on the other hand, local governments have greater freedom in choosing attention allocation strategies when striving to improve environmental governance performance. This allows them to actively select and combine different governance pathways within a complex institutional environment to achieve environmental objectives.

4. “Institutional Pressure–Attention Allocation” Aligns with Multi-Level Governance Logic: Multi-level governance theory emphasizes the vertical and horizontal interactions between different levels of government and social actors, which are key to policy implementation and performance outcomes. The “Chinese National Governance Theory in Multi-Level Governance” has already been applied to study environmental governance-related issues. For instance, a study comparing 47 cases found that more factors and decision-making levels can improve environmental outputs, with environmental preferences remaining the primary determinant of environmental outcomes (Newig and Fritsch, 2009). Additionally, the scale politics theory suggests that environmental decisions are constructed within and between networks of different scales (Bulkeley and Betsill, 2005). Environmental governance is increasingly shaped by interactions between formal and informal “spheres of power” (Birke et al., 2003). Building on previous research, this study further identifies key drivers for regional environmental performance improvement, highlighting that such improvements are achieved through the synergistic efforts and collaborative governance of higher-level governments, peer governments, public participation, and local governments. This finding deepens our understanding of the interactions among various levels and social forces in multi-level governance mechanisms, emphasizing the core role of linkages and co-governance among different governance actors in driving environmental governance.

5.2 Policy implications

This study reveals four key combinations of conditions contributing to high environmental governance performance through fsQCA analysis, offering significant insights for policymakers, particularly when facing complex environmental governance challenges. Local governments should adopt a holistic perspective, integrating multiple conditions collaboratively and selecting performance improvement pathways that best suit their circumstances.

Specifically, when local governments face high public attention and intra-level competition pressures, if financial resources are relatively sufficient, priority should be given to increasing fiscal investment in environmental protection to directly improve environmental quality and address societal demands. In cases of dual pressures without adequate funding, local governments may strengthen environmental law enforcement to impose stricter constraints on polluting behaviors, compensating for the lack of financial investment. When faced with intense central government assessment pressure, local governments should focus on formulating precise environmental policies and local regulations, enhancing the targeting and effectiveness of environmental governance through institutional development and detailed standards. Additionally, in regions with fierce intra-level competition, strengthening law enforcement not only helps control pollution at its source but also significantly enhances the region’s environmental governance effectiveness and competitiveness.

From the perspective of regional differences, differentiated environmental governance strategies should be implemented. For resource-based regions, ecological functional zones, and areas with a high concentration of traditional energy-intensive industries, it is necessary to strengthen the central government’s environmental assessment constraints, using mandatory assessments to drive local governments to fulfill environmental governance responsibilities. For economically developed regions dominated by manufacturing and services, even in the absence of intense central assessments, public environmental demands and inter-regional competition pressures have created intrinsic incentives. These regions should focus on increasing environmental fiscal expenditure, improving environmental infrastructure, and guiding the transformation and upgrading of green industries. In contrast, for regions with relatively low economic development, given their limited environmental fiscal capacity, the primary strategy should be to strengthen environmental supervision and law enforcement, intensifying administrative penalties for environmental violations to enhance governance effectiveness.

6 Conclusion and research limitations

6.1 Conclusion

Institutional pressures and governmental attention allocation are primary factors influencing local environmental governance. The key to enhancing regional environmental performance lies in synergizing diverse conditional elements and leveraging their interconnected effects. This study employs the FSQCA method to analyze configurational pathways across 30 provincial-level cases in China, examining how multiple institutional pressures and attention allocation mechanisms drive environmental outcomes. The empirical findings lead to four key conclusions:

1. External pressures constitute a critical determinant of how local governments allocate their attention to environmental governance. In response to varying regional characteristics, local governments selectively devote their attention resources to specific environmental concerns.
2. No single condition independently constitutes a necessary or sufficient condition for high environmental performance, indicating that performance improvement relies on multi-factor synergies rather than isolated drivers. This finding also highlights the diverse configurational characteristics of environmental governance pathways across Chinese regions.
3. In most regions, achieving high performance requires synergistic interactions between institutional pressures and governmental attention allocation. This synergy embodies the organic integration of top-down institutional constraints and bottom-up local governmental autonomy.
4. The study identifies complementary and substitutive relationships among certain conditions. These dynamics enable local governments to optimize environmental performance by flexibly adjusting attention allocation strategies when facing multiple institutional pressures.

6.2 Research limitations

This study has two main limitations.

1. The fsQCA analysis is based on cross-sectional data, which inherently limits causal inference. Although it identifies combinations of conditions sufficient to produce the outcome, it cannot accurately capture the dynamic evolution of these conditions or the causal mechanisms that change over time.
2. This study uses the Baidu Search Index to measure public attention pressure, with two limitations: first, possible validity bias; second, contextual sensitivity of the indicator. Future research may construct a composite index of public attention across multiple platforms, subject to data availability, to improve measurement validity and reliability.
3. The study does not fully explore the potential moderating role of economic heterogeneity. We acknowledge that regions at different stages of economic development vary significantly in terms of resource endowment, industrial structure, and fiscal capacity—factors that may influence the effectiveness of environmental governance.

In light of these limitations, future research will aim to incorporate temporal dimensions by using panel data to uncover the evolutionary patterns of environmental governance pathways. Additionally, we plan to classify regions by economic development levels to examine the heterogeneous characteristics of their governance strategies in greater detail.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

YS: Formal Analysis, Data curation, Supervision, Methodology, Visualization, Writing – review and editing, Funding acquisition,

Software, Conceptualization, Writing – original draft, Investigation, Resources. MW: Methodology, Visualization, Resources, Writing – review and editing.

Funding

The author(s) declare that financial support was received for the research and/or publication of this article. The National Social Science Fund of China: “A Study on the Integration and Synergistic Relationship between the Environmental Impact Assessment System and the Pollution Discharge Permit System (20BFX170).”

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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