



GREEN POLICY INNOVATION BASED ON REGIONAL AUTONOMY FOR SUSTAINABLE LOCAL ENVIRONMENTAL GOVERNANCE AND DEVELOPMENT

Cynthia Febri Sri Indarti^{1*}, Herson Simbolon², Muhammad Baharudin
Zubahrums Tjenreng³, Syahrir⁴

¹ Local Government Administration, Faculty of Management Government, Institut Pemerintahan Dalam Negeri, Sumedang, Indonesia

² Local Government Administration, Faculty of Management Government, Institut Pemerintahan Dalam Negeri, Sumedang, Indonesia, onesia

³ Local Government Administration, Faculty of Management Government, Institut Pemerintahan Dalam Negeri, Sumedang, Indonesia

⁴ Local Government Administration, Faculty of Management Government, Institut Pemerintahan Dalam Negeri, Sumedang, Indonesia

Email : cynthia_febri@ipdn.ac.id^{1*}, kenherson@gmail.com², zubahrums_tjenreng@ipdn.ac.id³, Syahrir.IPDN.86@gmail.com⁴

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Abstract :

This study examines how regional autonomy and decentralization shape green policy innovation and local environmental governance. It aims to identify major policy themes and the institutional, fiscal, and coordination conditions associated with implementation. A systematic literature review was conducted using Scopus as the principal database, while Watase UAKE supported keyword identification, screening, and PRISMA 2020 reporting. Eight keyword combinations were used to identify literature published between 2020 and 2026. The initial search produced 146 raw records. After duplicate removal and automated filtering, 86 records entered title-and-abstract screening; 14 were excluded and 72 reports were sought for retrieval. The PRISMA output subsequently recorded 49 reports assessed for eligibility and one additional report identified through another method. The thematic synthesis highlights fiscal and regulatory instruments, administrative capacity, policy learning and diffusion, multilevel coordination, and environmental outcomes. Exploratory VOSviewer maps show textual connections among pollution, decentralization, policy innovation, policy adoption, and administrative capacity. The review indicates that regional autonomy alone does not ensure effective green policy. Outcomes depend on the alignment of fiscal resources, institutional capacity, policy incentives, and intergovernmental coordination. Further comparative research is needed to clarify how these conditions shape environmental outcomes across different governance settings.

Keywords : Regional Autonomy, Green Policy Innovation, Fiscal Decentralization, Environmental Governance, Local Government.

INTRODUCTION

Environmental degradation and climate-related risks require policy responses that connect national commitments with decisions made by local and regional authorities. Local governments shape land use, transport, waste management, procurement, infrastructure, and climate adaptation; their decisions therefore influence how environmental objectives are translated into practice. Research on subnational climate action indicates that local policy can



help address wider governance gaps, although its contribution depends on policy design and coordination (Leffel et al., 2024; Zwick et al., 2024). Studies of climate-emergency declarations and local climate planning similarly emphasize the role of administrative capacity in translating policy signals into action (Dyson & Harvey-Scholes, 2022; J. He et al., 2023). In Indonesia, local policy integration has also been examined as a route to climate-change adaptation (Yulandari et al., 2023).

Green policy innovation includes climate adaptation, green procurement, renewable energy, sustainable food systems, and the adoption or modification of regulatory instruments. Local food-system studies show how local authorities address linked environmental, health, and equity concerns (Carrad et al., 2022), while research in Florida connects collaborative governance with green public procurement (Dimand, 2024). Studies of renewable-energy policy standards in Palestinian local government units and the European Green Deal illustrate the role of local authorities in energy-policy implementation and multilevel governance (Damayra & Khatib, 2022; Pūķis et al., 2023). Innovation also depends on how policies are adopted, adapted, and diffused across jurisdictions. Research on China's River Chief System examines central-government signals and local policy diffusion (B. He et al., 2024; Liu et al., 2021), while the Barcelona case indicates that political priorities may shape the adoption and modification of climate-policy instruments (Enguer & Schaub, 2025).

Regional autonomy and decentralization can create room for locally tailored environmental action, but transferring authority does not automatically produce effective outcomes. Evidence from multiple economies suggests that local spending and environmental regulation may function as substitutes or complements depending on policy autonomy (de Mello & Jalles, 2026). Other studies link environmental outcomes under fiscal decentralization to performance evaluation, environmental fiscal design, and the distribution of responsibilities (Qi et al., 2022; Zang & Liu, 2020; Zhou & Zhang, 2020). Research in the United States and Pakistan further shows that regulatory choices, fiscal arrangements, and expenditure patterns are associated with differing environmental outcomes across institutional settings (Ahmed et al., 2023; Tunio et al., 2024, 2025). Accordingly, autonomy should be understood not merely as a transfer of authority, but as an institutional arrangement shaped by fiscal resources, administrative capacity, incentives, and coordination across government levels. In the context of regional autonomy, interregional cooperation provides an administrative mechanism for coordinating public responsibilities, mobilizing resources, and implementing joint programs. Effective cooperation requires appropriate planning, implementation arrangements, and evaluation mechanisms to support coordination across local governments. These administrative dimensions are relevant to green policy innovation because environmental challenges may extend beyond individual administrative boundaries and require collaborative approaches to policy implementation (Indarti et al., 2023).

The relationship between local governance and environmental

performance is not uniform. Fiscal decentralization and intergovernmental competition have been associated with environmental-governance efficiency, but their effects vary with public environmental concern, regional characteristics, and performance incentives (Gu & Liu, 2025; Sun et al., 2024). Research also connects green-performance assessment and green finance with industrial transformation and firms' green innovation (Li et al., 2025; X. Wang et al., 2023). Meanwhile, analysis of China's environmental powers shows that decentralization can coexist with continued central control, and models of central-local collaboration emphasize the importance of coordination for stable green-innovation arrangements (Huang et al., 2025). Studies of urbanization and environmental regulation likewise point to institutional and territorial variation in policy effects (Choi et al., 2023; Zhang & Wang, 2020).

Despite these contributions, the literature in the review corpus is spread across related but often separate discussions of fiscal decentralization and environmental performance, local policy adoption and diffusion, sector-specific instruments, and administrative or collaborative capacity. These strands are not always integrated to explain how regional autonomy interacts with resources, incentives, policy innovation, and implementation outcomes. For Indonesia, research on local climate-adaptation policy integration signals the importance of examining how national environmental objectives are translated through local processes (Yulandari et al., 2023). An integrated synthesis can clarify the conditions under which autonomy supports substantive green-policy innovation and when fragmented authority or capacity constraints may limit it.

This review synthesizes research on green policy innovation under regional autonomy and develops a context-sensitive framework for sustainable local environmental governance. It addresses four questions: (1) What forms and themes of green policy innovation are examined in the literature? (2) How do regional autonomy and decentralization shape policy design, adoption, and implementation? (3) Which fiscal, administrative, political, and collaborative conditions enable or constrain local green-policy innovation? and (4) What research gaps and policy implications emerge for future research on decentralized governance?

RESEARCH METHOD

Research Design

This study employed a systematic literature review (SLR) design to synthesize research on green policy innovation in the context of regional autonomy and local environmental governance. The review focused on identifying the main forms of green policy innovation, examining how decentralization and regional autonomy shape policy implementation, and determining the institutional, fiscal, and governance conditions associated with environmental policy outcomes. The review process was organized using Watase UAKE, while the selection process was reported according to the PRISMA 2020 framework (Hair et al., 2022). VOSviewer was used to explore the relationships among terms extracted from the literature and to visualize their network

structure, temporal patterns, and density.

Search Strategy and Information Sources

Scopus was designated as the principal bibliographic database, and the search process was managed through the Keyword Identification feature in Watase UAKE. The literature search was conducted using eight keyword combinations designed to cover green policy, environmental governance, policy innovation, regional autonomy, and fiscal decentralization. The publication period was restricted to 2020-2026, with the search date recorded as 24 October 2026.

The search strategy combined general environmental policy terms with local-government and decentralization terms. This approach was intended to capture studies examining both the substantive content of environmental policies and the institutional arrangements through which local governments formulate and implement them.

KEYWORD IDENTIFICATION								
No	Keyword	Raw	ABS	x	Act	View	SNA	Tag
1	Green Policy Local Government	11	No	*	Update	View	SNA	Tag
2	Environmental Policy Local Government	36	No	*	Update	View	SNA	Tag
3	Policy Innovation Local Government	23	No	*	Update	View	SNA	Tag
4	Green Governance Local Governance	21	No	*	Update	View	SNA	Tag
5	Climate Policy Local Government	27	No	*	Update	View	SNA	Tag
6	Environmental Governance Decentralization	18	No	*	Update	View	SNA	Tag
7	Regional Autonomy Environmental Governance	3	No	*	Update	View	SNA	Tag
8	Fiscal Decentralization Environmental Policy	7	No	*	Update	View	SNA	Tag

Figure 1. Keywords Used for Literature Identification

Raw records represent the counts reported for the keyword combinations before the subsequent screening and deduplication process. The total does not necessarily represent 146 unique articles because records may overlap across searches.

Eligibility Criteria

The selection criteria were established to ensure that the retained literature addressed the relationship between green policy and local or regional governance. Articles were considered potentially eligible when they examined environmental or green policy, policy innovation, climate governance, or related policy instruments in connection with local government, regional autonomy, decentralization, or multilevel governance. The review focused on journal articles published between 2020 and 2026.

Table 1. Literature Eligibility Criteria

Criterion	Inclusion criteria	Exclusion criteria
Publication	2020–2026	Outside the specified period

period		
Document type	Journal research articles	Corrections, retractions, editorials, and non-research documents
Language	English	Publications that could not be assessed reliably under the review protocol
Policy focus	Green policy, environmental policy, climate policy, or environmental governance	Environmental or green topics without substantive policy relevance
Governance context	Local government, regional autonomy, decentralization, or multilevel governance	Studies without a meaningful connection to local or regional public governance
Information availability	Sufficient metadata and information for relevance assessment	Records lacking essential information for screening

Articles were assessed according to their relevance to the review questions rather than their publication prestige alone. Journal quartile information was recorded where available. Any exclusion based on journal ranking or other automated filters must be consistent with the stated eligibility criteria and documented transparently.

Screening and PRISMA Reporting

The identification and selection process was managed in Watase UAKE. Following the initial identification of 146 records, the platform reported six duplicate records removed, 49 records flagged under the automated year-filter category, four records removed under the other eligibility or tier-filter category, and one record without an abstract. These steps resulted in 86 records entering title-and-abstract screening. Fourteen records were subsequently excluded, leaving 72 reports sought for retrieval.

The PRISMA report records 23 reports as not retrieved and 49 reports assessed for eligibility. No full-text exclusions were recorded in the displayed report. In addition, one report was identified through another method and assessed separately.

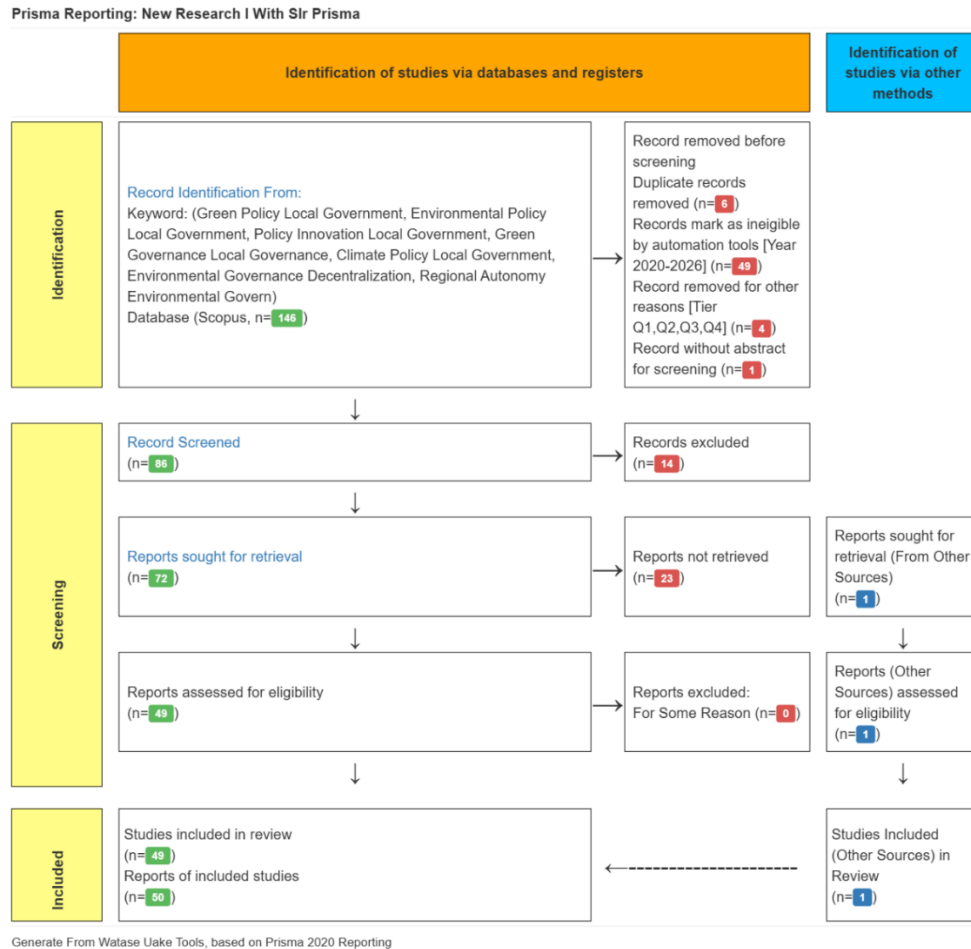


Figure 2. PRISMA 2020 Flow Diagram of the Literature Identification and Selection Process

The PRISMA counts were taken from the displayed Watase UAKE report. Before final submission, the automated year-filter category and the 23 reports recorded as not retrieved should be checked against the final retrieval log. The diagram also distinguishes 49 studies in the main pathway from 50 included reports and one report identified through another method. These counts should be reconciled by checking whether the additional report represents a distinct study or another report of an already included study.

Data Extraction and Thematic Synthesis

Data extraction was structured around the review questions and the substantive relationships between environmental policy and regional autonomy. For each eligible article, the extraction framework covered author and publication year, country or geographical context, level of government, policy domain, theoretical or conceptual framework, research method, form of policy innovation, decentralization or autonomy arrangements, enabling factors, implementation barriers, major findings, and research limitations.

The extracted information was organized into thematic categories to identify recurring patterns and differences across studies. The synthesis focused on five analytical dimensions: (1) fiscal and regulatory instruments; (2) administrative capacity and performance incentives; (3) policy innovation and

intergovernmental learning; (4) multilevel coordination and collaborative governance; and (5) environmental outcomes and sectoral transitions. These categories served as an initial analytical framework and were to be refined when necessary based on the evidence reported in the included articles.

AI-assisted extraction and classification, where used, were treated as supporting tools rather than substitutes for reading the original publications. Information about methods, findings, theories, and limitations was checked against the available full text. Missing or ambiguous information was recorded as unavailable or requiring verification rather than inferred without sufficient evidence.

VOSviewer Text Mapping

VOSviewer was used to conduct an exploratory text-based mapping analysis. The corpus was prepared from the titles and abstracts available for 72 records that received a positive decision during the initial title-and-abstract screening. A corresponding scores file containing publication-year and citation information was prepared for use in the text-mapping procedure. A thesaurus file was also prepared to standardize selected spelling variants and equivalent terminology.

The analysis generated three complementary visualizations: network visualization to examine the co-occurrence relationships among terms, overlay visualization to explore the distribution of terms by average publication year, and density visualization to identify areas of greater term concentration. These visualizations were interpreted descriptively and compared with the substantive findings from the literature extraction.

Because the text corpus contained 72 screening-positive records rather than only the final full-text-eligible studies, the resulting maps were treated as exploratory. They were not interpreted as definitive representations of the final included-study corpus. For the final manuscript, the mapping should be repeated using the reconciled set of included studies if the objective is to describe the bibliometric structure of the final review corpus. The procedures follow the general principles of text-based bibliometric mapping described by van Eck and Waltman (2010).

FINDINGS AND DISCUSSION

Overview of the Reviewed Literature

The literature extracted for this review covers several interconnected dimensions of green policy innovation, including fiscal decentralization, environmental regulation, local government capacity, policy diffusion, green finance, climate governance, and intergovernmental collaboration. The extracted records represent diverse geographical contexts, although China is prominently represented in the corpus. Other studies examine environmental governance in Indonesia, Pakistan, the United States, Australia, India, and several European jurisdictions.

The reviewed studies employ different methodological approaches, including panel-data analysis, quasi-experimental designs, spatial econometric

models, qualitative case studies, comparative policy analysis, and mixed-methods research. Quantitative studies examine relationships between decentralization, policy incentives, and environmental outcomes, while qualitative and policy-oriented studies investigate institutional capacity, policy adoption, and coordination across levels of government. This methodological diversity provides opportunities to connect measurable environmental outcomes with the institutional processes through which green policies are formulated and implemented.

The bibliographic extraction worksheet contains 50 entries, whereas the PRISMA diagram reports 49 studies in the principal database pathway and one report identified through another method. These figures should be reconciled against the final included-study list to ensure consistency in the reported number of studies and reports.

Thematic Findings

The thematic synthesis identifies two broad analytical dimensions. The first concerns the institutional and fiscal conditions that enable green policy innovation, while the second concerns the processes through which policies are adopted, coordinated, and translated into environmental outcomes.

The first dimension concerns the relationship between regional autonomy, fiscal decentralization, administrative capacity, and the selection of environmental policy instruments. The reviewed literature indicates that decentralization does not automatically generate positive environmental outcomes. Its implications depend on the distribution of fiscal responsibilities, the availability of resources, administrative competence, and the incentives governing local decision-making.

Research on environmental policy spending and regulation across advanced economies suggests that local governments may substitute regulatory instruments for public expenditure when their policy autonomy is limited (de Mello & Jalles, 2026). Studies of fiscal decentralization and local environmental governance similarly indicate that policy outcomes depend on institutional incentives and performance evaluation (Chen & Long, 2024). These findings suggest that formal authority must be accompanied by appropriate financial resources, clear responsibilities, and accountability mechanisms.

The fiscal dimension is further illustrated by research examining environmental quality and fiscal decentralization in Pakistan (Tunio et al., 2024, 2025). These studies distinguish between different components of fiscal arrangements and demonstrate the importance of considering how revenue mobilization, public expenditure, and intergovernmental transfers interact with environmental objectives. Research on green finance also identifies local government fiscal pressure as a relevant condition for clean-energy policy effectiveness (Jiang & Li, 2026).

Administrative capacity is equally important. Local governments need qualified personnel, appropriate organizational structures, monitoring systems, and implementation resources to translate environmental commitments into operational programs. Research on climate-policy adoption emphasizes that

government capacity may facilitate the adoption of climate adaptation measures under different combinations of public support and climate risk (J. He et al., 2023). Similarly, analysis of local government responses to green-credit policies indicates that implementation and environmental outcomes may differ across administrative levels (Yan et al., 2025).

The literature therefore supports a conditional interpretation of regional autonomy. Decentralized authority can create opportunities for locally tailored policy innovation, but the realization of those opportunities depends on fiscal capacity, administrative competence, institutional incentives, and the suitability of policy instruments for local conditions. Where responsibilities are transferred without sufficient resources or coherent performance criteria, policy adoption may not result in substantive environmental improvements.

The second analytical dimension concerns how green policy innovations emerge, diffuse, and produce environmental outcomes within multilevel governance systems. Policy innovation includes the development of new instruments, the adaptation of existing regulations, and the transfer of policy practices between jurisdictions. Such processes are shaped by political priorities, central-government directives, peer learning, and local institutional conditions.

Research on China's River Chief System demonstrates the importance of central-government policy signals and intergovernmental dynamics in environmental policy diffusion (B. He et al., 2024; Liu et al., 2021). These studies suggest that local adoption is influenced by changing relationships between central directives, peer-government pressure, and local circumstances. Policy innovation therefore occurs within a multilevel political system rather than through isolated local decision-making.

Local climate-policy research also demonstrates how political priorities and institutional settings influence the adoption and modification of environmental instruments (Enguer & Schaub, 2025). In the transportation-for-hire sector, local greenhouse-gas regulation illustrates how policy learning and broader regulatory frameworks may create opportunities for local governments to introduce context-specific measures (Zwick et al., 2024). These findings show that policy innovation involves not only introducing new regulations but also adapting and implementing instruments in accordance with local needs.

Intergovernmental collaboration is another important condition. Environmental problems frequently cross administrative boundaries, while responsibility for regulation, finance, infrastructure, and implementation may be distributed across central, regional, and local institutions. Research on collaborative governance and green innovation emphasizes the importance of coordination among governmental levels and the role of incentives in shaping cooperation (Huang et al., 2025). Studies of environmental governance in China also demonstrate that decentralization can coexist with central oversight, suggesting that different governance functions may require different allocations of authority (Xu et al., 2026).

The ultimate significance of these institutional arrangements lies in their environmental consequences. The reviewed studies examine carbon intensity,

The overlay visualization displays publication-year patterns spanning approximately 2021–2026. Terms associated with transition, capacity, policy adoption, and administrative competence appear in relatively recent colors, whereas other terms are associated with earlier average publication years. This distribution suggests temporal variation in the emphasis of the literature, particularly around implementation capacity and the adoption of environmental policies.

The visualization represents the average publication year associated with terms in the selected corpus; it does not establish that a topic is objectively increasing across the entire research field or that it will remain a future research trend. Its interpretation is also limited by the exploratory corpus and the quality of the term-cleaning process. The observed pattern should therefore be treated as a direction for further investigation rather than definitive evidence of a field-wide research transition.

The density visualization provides a complementary view of the term structure by highlighting areas of greater concentration on the map. Rather than emphasizing individual links, it helps identify the spatial areas where terms occur more densely in the selected corpus. This perspective can support the interpretation of prominent topics identified in the network visualization.

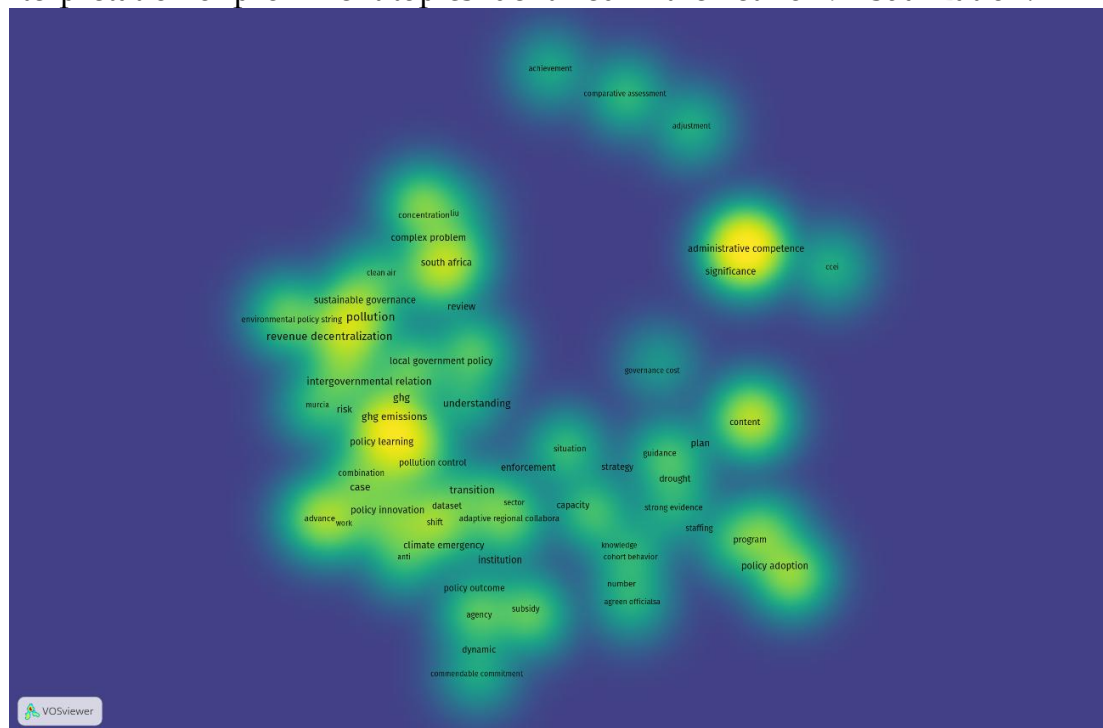


Figure 5. Density Visualization of Green Policy and Local Environmental Governance Terms

The density visualization highlights areas with greater concentrations of terms, particularly around administrative competence, policy adoption, policy innovation, pollution, and GHG emissions. The concentration around environmental problems and local policy processes is consistent with the connected structure identified in the network visualization.

The map also highlights areas surrounding organizational capacity and policy implementation. These patterns support further examination of administrative competence and policy adoption as dimensions of green-policy research. Nevertheless, density colors represent spatial concentration in the map and should not be interpreted as direct measures of research quality, environmental impact, or causal importance. The remaining generic or weakly connected terms indicate that further refinement of the thesaurus and term-selection procedure may improve the precision of the mapping.

Taken together, the three visualizations suggest that the exploratory corpus connects environmental challenges with decentralized governance, policy learning, implementation capacity, and policy adoption. These relationships are consistent with the thematic synthesis, although the maps alone cannot establish causal relationships or prove that a particular governance arrangement improves environmental outcomes. The visualizations should therefore be interpreted alongside the substantive findings from the articles rather than as independent evidence.

Integrative Discussion

The thematic synthesis and VOSviewer visualizations suggest that green policy innovation under regional autonomy is best understood as a conditional governance process. Fiscal decentralization, administrative capacity, policy learning, and multilevel coordination are interconnected dimensions rather than independent explanations of environmental performance.

First, fiscal autonomy can give local governments flexibility in selecting and financing environmental instruments. Its effectiveness, however, depends on the alignment of expenditure responsibilities, revenue sources, and performance incentives (Chen & Long, 2025; Tunio et al., 2025). Decentralization should therefore be assessed not only through the formal transfer of authority but also through the financial and institutional resources available for implementation.

Second, innovation requires administrative capacity and organizational learning. Local experimentation can generate new approaches, but these approaches must be translated into enforceable regulations, operational programs, and monitoring arrangements. Research on climate-policy adoption, environmental policy diffusion, and green-credit implementation highlights the importance of institutional competence and implementation quality (B. He et al., 2024; J. He et al., 2023; Yan et al., 2025).

Third, green policy innovation depends on coordination across governmental levels. Local authorities can tailor environmental initiatives to territorial priorities, but climate change, pollution, and industrial transformation often involve externalities that exceed municipal boundaries. Multilevel governance must therefore combine local discretion with broader environmental standards, intergovernmental coordination, and mechanisms for sharing implementation knowledge (Huang et al., 2025; Pūkis et al., 2023; Xu et al., 2026).

Finally, the effectiveness of green policy innovation should be evaluated through environmental outcomes rather than policy announcements alone.

Evaluations should distinguish institutional or regulatory changes from measurable improvements in emissions, pollution, energy efficiency, or resource use. This distinction is particularly important when assessing green finance, industrial transformation, and environmental regulation (Jiang & Li, 2026; Sun et al., 2024; Y. Wang & Zhang, 2024).

Research Gaps and Conceptual Implications

Three research gaps emerge from the synthesis. First, further research is needed to integrate fiscal decentralization, administrative capacity, and measurable environmental outcomes within a common analytical framework. Although individual studies address these dimensions, they are often examined through separate policy domains or methodological approaches.

Second, comparative evidence remains important. The current extraction worksheet is heavily concentrated on China, while institutional arrangements in other countries are less extensively represented. Comparative studies could examine how regional autonomy, fiscal arrangements, political incentives, and intergovernmental coordination influence green policy adoption and implementation.

Third, researchers should distinguish policy adoption, implementation capacity, and environmental outcomes rather than treating them as interchangeable indicators of innovation. Such distinctions would help explain why some jurisdictions translate policy initiatives into substantive environmental improvements while others experience implementation constraints.

Based on these findings, the review proposes a conditional conceptual framework in which regional autonomy creates institutional space for local policy innovation; fiscal resources and administrative capacity support implementation; intergovernmental coordination and policy learning facilitate policy adaptation; and environmental outcomes provide the basis for evaluating effectiveness. This framework is a synthesis derived from the current corpus and requires further empirical testing.

CONCLUSION

This review examined green policy innovation in the context of regional autonomy, focusing on the institutional, fiscal, and governance conditions that shape the formulation and implementation of environmental policies. The synthesis indicates that regional autonomy can provide local governments with opportunities to develop context-specific environmental initiatives, but the transfer of authority alone does not guarantee effective policy implementation or improved environmental outcomes. The effectiveness of green policy innovation depends on the alignment of fiscal resources, administrative capacity, institutional incentives, and coordination across levels of government. These conditions influence not only the adoption of environmental policies but also the capacity of local governments to translate policy commitments into operational programs and measurable results.

The review also highlights the importance of policy learning,

intergovernmental collaboration, and implementation quality. Local governments can adapt existing policy instruments, learn from other jurisdictions, and respond to territorial environmental challenges. However, differences in administrative competence, fiscal capacity, political priorities, and institutional arrangements may produce uneven implementation outcomes. Consequently, green policy innovation should be understood as a process involving institutional adaptation and continuous evaluation rather than merely the introduction of new regulations or programs. The VOSviewer visualizations further illustrate the textual connections among environmental governance, fiscal decentralization, policy innovation, policy adoption, and administrative capacity. These maps provide exploratory insights into the reviewed literature and should be interpreted alongside the substantive evidence from the articles.

This review contributes a conditional conceptual perspective in which regional autonomy provides the institutional space for green policy innovation, fiscal and administrative capacity support implementation, and intergovernmental coordination facilitates policy adaptation. Environmental outcomes then provide an essential basis for assessing policy effectiveness. Nevertheless, the review has limitations. The identified literature is concentrated in China, while evidence from several other institutional contexts, including Indonesia, is comparatively limited. In addition, the exploratory VOSviewer maps were generated from records that passed initial title-and-abstract screening rather than exclusively from the final full-text-eligible studies. Future research should therefore employ comparative designs to examine how different arrangements of regional autonomy, fiscal decentralization, and administrative capacity influence environmental policy outcomes. Further research should also distinguish policy adoption from implementation quality and measurable environmental performance. Addressing these issues would strengthen the evidence base for designing context-sensitive green policies and improving sustainable environmental governance at the local level.

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