

ESG IN PUBLIC ADMINISTRATION: A SYSTEMATIC REVIEW OF THE ENVIRONMENTAL PILLAR (2020–2025): STATE OF THE ART AND FUTURE TRENDS

ESG NA ADMINISTRAÇÃO PÚBLICA: UMA REVISÃO SISTEMÁTICA DO PILAR AMBIENTAL (2020–2025): ESTADO DA ARTE E TENDÊNCIAS FUTURAS

ESG EN LA ADMINISTRACIÓN PÚBLICA: UNA REVISIÓN SISTEMÁTICA DEL PILAR AMBIENTAL (2020–2025): ESTADO DEL ARTE Y TENDENCIAS FUTURAS



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ABSTRACT

The incorporation of the environmental pillar of ESG into public administration has progressed unevenly at the global level, despite the growing institutional recognition of governmental sustainability. This study presents a systematic literature review (SLR), conducted in accordance with the PRISMA 2020 protocol, aiming to map dimensions, indicators, methodologies, and trends related to the adoption of environmental ESG in the public sector. A total of 1,273 publications were retrieved from the Scopus, Web of Science, and IEEE Xplore databases (2020–2025), of which 1,006 were considered eligible after screening using the Rayyan platform. Bibliometric analysis, performed using VOSviewer and Bibliometrix/Biblioshiny, identified thematic clusters related to sustainable public procurement, green infrastructure, energy efficiency, environmental governance, and climate policies. The bibliographic analysis of 69 selected articles, organized into three thematic dimensions, revealed advances in the use of environmental indicators, composite frameworks (such as DPSIR and IPEEI), and innovative urban management practices. However, persistent challenges remain, including methodological standardization, the absence of robust regulatory frameworks, institutional gaps, and limited intersectoral integration, particularly in Latin American countries. This study proposes a research agenda focused on the development of integrated ESG assessment frameworks applicable to municipal management, with an emphasis on public engineering companies and urban infrastructure projects. The findings contribute to advancing discussions on governmental sustainability and to consolidating environmental ESG practices in the public sector. Overall, the results indicate a predominance of territorially oriented environmental indicators, a gap

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in the use of metrics applicable to public policies, and weak integration between ESG and urban governance.

Keywords: ESG. Public Administration. Sustainability. Sustainable Public Procurement. Government. Sustainable Policies. Systematic Review.

RESUMO

A incorporação do pilar ambiental do ESG na administração pública tem avançado de forma desigual em nível global, apesar do crescente reconhecimento institucional da sustentabilidade governamental. Este estudo apresenta uma revisão sistemática da literatura (RSL), conduzida de acordo com o protocolo PRISMA 2020, com o objetivo de mapear dimensões, indicadores, metodologias e tendências relacionadas à adoção do ESG ambiental no setor público. Um total de 1.273 publicações foi recuperado das bases de dados Scopus, Web of Science e IEEE Xplore (2020–2025), das quais 1.006 foram consideradas elegíveis após triagem utilizando a plataforma Rayyan. A análise bibliométrica, realizada com o uso do VOSviewer e do Bibliometrix/Biblioshiny, identificou clusters temáticos relacionados a compras públicas sustentáveis, infraestrutura verde, eficiência energética, governança ambiental e políticas climáticas. A análise bibliográfica de 69 artigos selecionados, organizados em três dimensões temáticas, revelou avanços no uso de indicadores ambientais, frameworks compostos (como DPSIR e IPEEI) e práticas inovadoras de gestão urbana. No entanto, persistem desafios, incluindo a padronização metodológica, a ausência de marcos regulatórios robustos, lacunas institucionais e limitada integração intersetorial, particularmente em países da América Latina. Este estudo propõe uma agenda de pesquisa voltada ao desenvolvimento de frameworks integrados de avaliação ESG aplicáveis à gestão municipal, com ênfase em empresas públicas de engenharia e projetos de infraestrutura urbana. Os achados contribuem para o avanço das discussões sobre sustentabilidade governamental e para a consolidação das práticas de ESG ambiental no setor público. De modo geral, os resultados indicam a predominância de indicadores ambientais orientados territorialmente, uma lacuna no uso de métricas aplicáveis às políticas públicas e uma fraca integração entre ESG e governança urbana.

Palavras-chave: ESG. Administração Pública. Sustentabilidade. Compras Públicas Sustentáveis. Governo. Políticas Sustentáveis. Revisão Sistemática.

RESUMEN

La incorporación del pilar ambiental del ESG en la administración pública ha avanzado de manera desigual a nivel global, a pesar del creciente reconocimiento institucional de la sostenibilidad gubernamental. Este estudio presenta una revisión sistemática de la literatura (RSL), realizada de acuerdo con el protocolo PRISMA 2020, con el objetivo de mapear dimensiones, indicadores, metodologías y tendencias relacionadas con la adopción del ESG ambiental en el sector público. Un total de 1.273 publicaciones fue recuperado de las bases de datos Scopus, Web of Science y IEEE Xplore (2020–2025), de las cuales 1.006 fueron consideradas elegibles tras el proceso de cribado utilizando la plataforma Rayyan. El análisis bibliométrico, realizado mediante VOSviewer y Bibliometrix/Biblioshiny, identificó clústeres temáticos relacionados con la contratación pública sostenible, la infraestructura verde, la eficiencia energética, la gobernanza ambiental y las políticas climáticas. El análisis bibliográfico de 69 artículos seleccionados, organizados en tres dimensiones temáticas, reveló avances en el uso de indicadores ambientales, marcos compuestos (como DPSIR e IPEEI) y prácticas innovadoras de gestión urbana. Sin embargo, persisten desafíos, incluyendo la estandarización metodológica, la ausencia de marcos regulatorios robustos, brechas institucionales y una limitada integración intersectorial, particularmente en países de América Latina. Este estudio propone una agenda de investigación orientada al desarrollo de marcos integrados de evaluación ESG aplicables a la gestión municipal, con énfasis en

empresas públicas de ingeniería y proyectos de infraestructura urbana. Los hallazgos contribuyen al avance de las discusiones sobre sostenibilidad gubernamental y a la consolidación de las prácticas de ESG ambiental en el sector público. En general, los resultados indican un predominio de indicadores ambientales con enfoque territorial, una brecha en el uso de métricas aplicables a las políticas públicas y una débil integración entre ESG y la gobernanza urbana.

Palabras clave: ESG. Administración Pública. Sostenibilidad. Contratación Pública Sostenible. Gobierno. Políticas Sostenibles. Revisión Sistemática.

1 INTRODUCTION

Since the publication of the Brundtland Report (1987), the concept of sustainable development has been consolidated as a foundation for global policies and strategies aimed at preserving natural resources and promoting social well-being. The United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro in 1992, reinforced the importance of integrating economic growth, social inclusion, and environmental protection, laying the groundwork for the UN 2030 Agenda and its 17 Sustainable Development Goals (SDGs).

In recent decades, the sustainability paradigm has also expanded into the corporate sphere, with the advancement of Environmental, Social, and Governance (ESG) criteria as a reference framework for measuring performance, risk, and transparency. In the public sector, however, the incorporation of these principles remains at an early stage, largely restricted to sector-specific programs or isolated environmental governance initiatives.

Public administration plays a strategic role in the transition toward a sustainable development model. The adoption of environmental criteria in public policies, procurement processes, and infrastructure projects represents an opportunity to align governmental investments with the international commitments undertaken by Brazil in relation to the SDGs and the Paris Agreement. In this context, public engineering and urban development companies—such as RIOURBE, within the Municipality of Rio de Janeiro—become central actors in translating environmental guidelines into concrete practices, particularly in the management of public works and urban regeneration initiatives.

Several authors highlight the role of local governments in consolidating sustainable policies and implementing ESG-oriented frameworks focused on environmental governance. Recent studies indicate that the effectiveness of such policies depends on administrative capacity, digital infrastructure, and institutional stability to operationalize sustainability indicators at the municipal level.

International literature also emphasizes that integrating ESG pillars into public management requires adaptive and responsive governance capable of articulating different levels of government, civil society, and the private sector. This multiscalar approach is essential for translating sustainability principles into tangible outcomes, particularly in cities marked by pronounced socio-environmental inequalities.

Nevertheless, there remains a significant gap in studies specifically addressing the application of the environmental pillar of ESG within public administration. To date, no systematic reviews have integrated environmental ESG and public administration with a focus on engineering and public works.

Most existing research concentrates on the corporate dimension of ESG, emphasizing business performance measurement and financial transparency, while overlooking the implementation of environmental indicators in public policies and infrastructure projects. In the public sector, ESG assumes distinct characteristics compared to the corporate environment, as it is not oriented toward maximizing economic value but rather toward generating public value, ensuring policy effectiveness, and serving the collective interest. While corporate ESG prioritizes financial metrics, reputational risks, and organizational performance, ESG in public administration is intrinsically linked to the formulation, implementation, and evaluation of sustainable public policies, institutional governance, and the provision of services and infrastructure with reduced environmental impact and greater social equity.

From this perspective, this study seeks to address the following research questions:

- a) How has the environmental pillar of ESG been incorporated into public administration policies and practices?
- b) What are the main challenges and barriers to implementing environmental criteria in public management?
- c) Which environmental indicators and metrics have been applied in studies focused on the public sector?

The overall objective of this article is to analyze the state of the art of the environmental pillar of ESG in public administration, identifying its main dimensions, indicators, and trends through a systematic review conducted in accordance with the PRISMA 2020 protocol. Specifically, the study aims to: map international scientific production on environmental ESG in the public sector between 2020 and 2025; identify and analyze recurring thematic clusters in the literature; examine methodologies and environmental indicators applied to public administration; compare international trends and approaches to ESG in public management; and propose a research agenda focused on the practical applicability of results for public engineering and urban development companies.

The originality of this article lies in presenting the first consolidated systematic review focused specifically on the environmental pillar of ESG within public administration and urban engineering. The study stands out for its robust database of over 1,200 articles and for integrating innovative tools such as Rayyan, VOSviewer, and Biblioshiny, which enabled in-depth bibliometric and bibliographic analyses. Furthermore, the work offers a relevant contribution by proposing practical recommendations for public administration, thereby expanding the applicability of its findings and addressing a significant gap in both national and international literature.

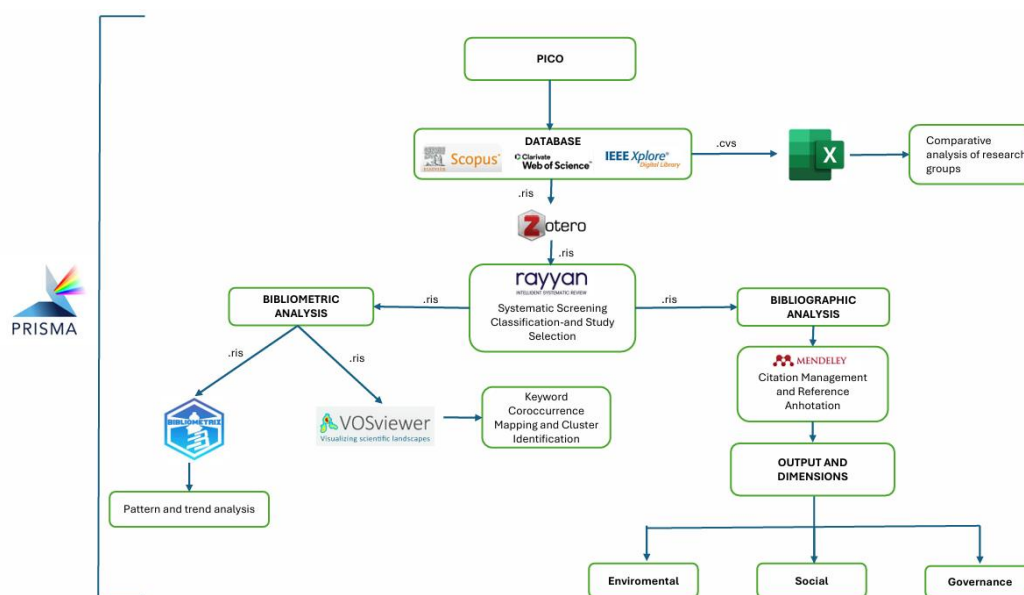
2 METHODOLOGY

The methodology adopted in this study integrates bibliometric and bibliographic approaches, guided by the principles of the PRISMA protocol (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), with the objective of ensuring rigor, transparency, and reproducibility in the analysis of scientific literature on the incorporation of environmental ESG criteria in Public Administration, particularly in public engineering companies such as RIOURBE.

The choice of this methodological strategy is justified by the interdisciplinary and emerging nature of ESG, which encompasses fields such as engineering, public management, urban sustainability, corporate governance, and environmental policy. In this context, a systematic review process capable of mapping the state of the art, identifying conceptual gaps, and recognizing international trends in the application of ESG practices in the public sector becomes essential.

Figure 1

Methodological framework of the systematic review on ESG in Public Administration



2.1 PICO

According to the eligibility criteria defined by PRISMA Research, it is essential to clearly specify all elements and characteristics that compose the study. A well-established way to carry out this definition is through the PICO strategy, which is used to define the design and context of eligible studies. The PICO acronym (Problem, Intervention, Comparison, and Outcomes) represents a methodological tool that guides the formulation and refinement of the research question, allowing for the systematic evaluation of the

effectiveness and relevance of an intervention addressing a given problem. Thus, this approach ensures a comprehensive and precise analysis of the object under investigation, constituting an essential step in the development of structured questions for systematic reviews. The main components of this strategy are presented in Table 1.

Table 1

PICO strategy adopted in the study

Acronym	Organizing Question	Organizational Response
P (Problem)	What is the study about?	ESG in Public Administration
I (Intervention)	What will be proposed?	Adoption of environmental criteria and sustainability indicators in engineering projects
C (Comparison)	What will be the comparison?	Traditional models of Public Administration in ESG
O (Outcomes)	What are the intended outcomes?	Identification of dimensions, indicators, and research trends on environmental ESG in public management

Thus, the definition of the PICO strategy established the methodological parameters that guide this study on the environmental pillar of ESG in public administration. With this stage completed, the next section presents the procedures adopted for data collection, detailing the databases used and the applied search criteria.

2.2 DATA COLLECTION

The data collection stage was planned to ensure breadth and methodological consistency in the selection of studies on the environmental pillar of ESG in public administration. For this purpose, information sources, thematic groups, and search strategies were defined with the aim of identifying relevant and representative publications (Table 2). Searches were conducted in the Scopus, Web of Science, and IEEE Xplore databases. The keyword combinations used encompassed different approaches within the scope of sustainability applied to public management and urban engineering, allowing the compilation of a diverse set of records for the subsequent stages of the systematic review.

The applied criteria were:

Period: 2020–2025;

Languages: no restriction;

Document type: peer-reviewed articles, reviews, and proceedings;

Filters: only scientific publications within the scope of ESG, public policies, and sustainability.

The search strategies combined Boolean terms (AND/OR) across five thematic groups, representing ESG dimensions in public management.

Table 2

Definition of the Groups

Definition of the Group	
Group 1	Sustainability and Environmental Indicators
Group 2	ESG and Socio-Environmental Responsibility
Group 3	Public Management and Municipal Administration
Group 4	Urban Engineering and Public Works
Group 5	Planning and Sustainable Policies
Group 6	Urban Regeneration and Community

The data collection process was carried out systematically, applying the same keyword combinations across each of the selected databases. This strategy made it possible to identify significant variations not only among the thematic groups but also among the databases themselves. For example, Scopus presented the highest number of retrieved publications in virtually all groups, followed by Web of Science and, to a lesser extent, IEEE Xplore. These differences reflect both the profile and scope of each database as well as the level of scientific interest devoted to each topic, highlighting areas that are more consolidated and others that are still under development within the field of ESG in public administration. The following Table 3 presents the organization of the groups and the respective keyword combinations used at this stage of the research.

Table 3

Keywords defined by group and subgroups

Group	1	2	3	4
G1	"Sustainability"/ "public infrastructure"	"sustainability" / "environmental indicators"	"sustainable development" / "performance indicators"	"sustainability assessment" /"government"
G2	"social responsibility" / "public administration"	"public policy" / "ESG"	"ESG" / "Social responsibility"	"ESG" / "environmental responsibility"

G3	"municipal administration" / "sustainable development"	"local government" / "urban planning"	"public management" / "Municipal administration"	"public administration" / "policy implementation"
G4	"sustainability" / "infrastructure projects" / "public works"	"sustainable development" / "public works"	"urban infrastructure" / "sustainability" / "government"	"green infrastructure" / "public works"
G5	"sustainable development" / "public administration"	"sustainable urban planning" / "government"	"sustainability policy" / "government"	"urban planning" / "government" / "sustainability"
G6	"urban regeneration" / "social inclusion"	"urban renewal" / "community development"	"urban planning" / "community resilience"	"urban transformation" / "sustainable development" / "government"

During the first search stage, Boolean operators (AND, OR, NOT) were applied to combine the descriptors defined for each group, as presented in Table 2. This initial strategy resulted in 14,825 documents, as shown in Table 4, retrieved from the Scopus, IEEE Xplore, and Web of Science databases and exported in .ris format for bibliometric processing. However, the breadth of this search generated an excessive volume of records, many of which were duplicated, incomplete, or not aligned with the scope of the research, which would hinder systematic and precise analysis. In addition, during the screening phase in Rayyan, it was observed that approximately 15,000 records would require manual exclusion, making the screening process extremely time-consuming and prone to selection bias.

Table 4

Initial search results with six groups

Number of documents						
Database	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
Scopus Elsevier	2830	2000	986	173	1297	248
IEEE Explore	621	102	185	20	217	18
Web of Science	1509	3104	415	102	792	206
Total	4960	5206	1586	295	2306	472

This finding led to the need to refine the methodological design of the research, ensuring a balance between the breadth and relevance of the results. Therefore, a more selective approach was adopted, aimed at identifying keyword combinations that more accurately represented the intersection between sustainability, public management, and urban policies. The intention was to preserve the thematic depth of the review without

compromising its technical and analytical feasibility. Based on this revision of the strategy, the keyword combinations were redefined, seeking to eliminate redundancies and overlaps among the previously defined groups. The new keyword arrangement (Table 5) prioritized those with greater recurrence in international studies and stronger alignment with the objectives of this research, resulting in a more streamlined methodological structure that is more consistent with the reality of recent scientific production on ESG and sustainability in public administration. Thus, the original six groups were consolidated into five main groups, representing central analytical axes related to sustainability, governance, and public policies. The final keyword combinations applied to the databases and their respective results are presented in Table 6.

Table 5

Number of documents

Definition of the Group	
Group 1	“Sustainability”, “Environmental Indicators” and “Government”
Group 2	“ESG”, “Sustainability” and “Government”
Group 3	“Public Management”, “Municipal Administration” and “Environmental Sustainability”
Group 4	“Public Infrastructure” and “Sustainability”
Group 5	“Planning”, “Sustainable Policies” and “Government”

Table 6

Search results with five groups

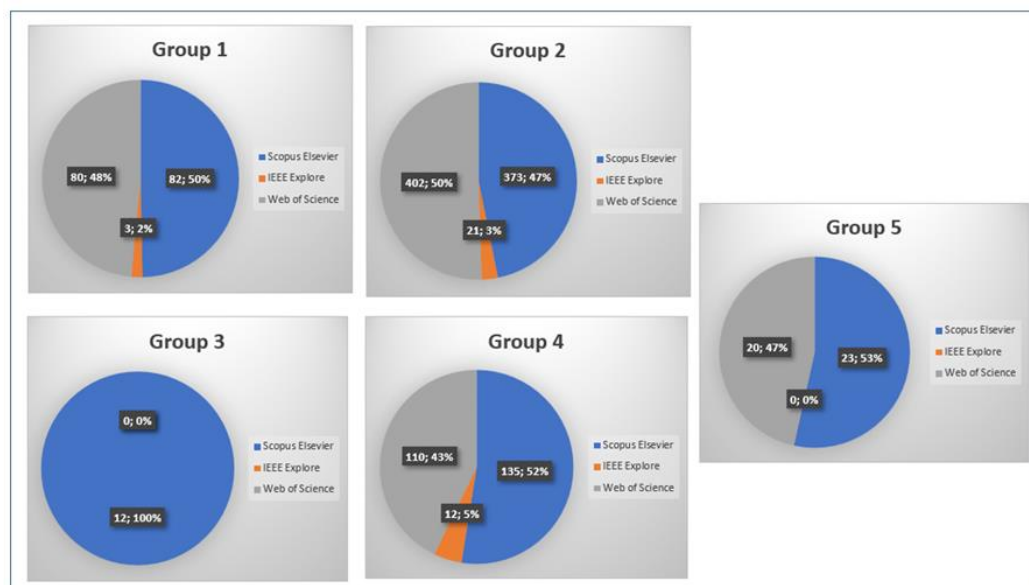
Database	Number of documents				
	Group 1	Group 2	Group 3	Group 4	Group 5
Scopus Elsevier	82	373	12	135	23
IEEE Explore	3	21	0	12	0
Web of Science	80	402	0	110	20
Total	165	796	12	257	43

Figure 2 presents the results obtained from the respective databases. It can be observed that Scopus was the database that returned the highest number of publications, followed by Web of Science and, to a lesser extent, IEEE Xplore. Among the tested keyword combinations, the set associating the terms “Sustainability”, “Environmental Indicators”, and

“Government” presented the largest volume of records, indicating a strong presence of studies linking sustainability and public management. A total of 1.273 documents were retrieved from the three databases.

Figure 2

Search results with five groups



Once the data collection stage was completed, it was possible to identify and compile the records necessary for the development of the systematic review on the environmental pillar of ESG in public administration. The procedures adopted allowed the publications to be organized according to the established criteria, enabling the initiation of the subsequent screening and analysis stages.

Before the beginning of the screening stage, explicit inclusion and exclusion criteria were defined in order to ensure methodological consistency and alignment of the set of analyzed studies with the objectives of the systematic review. Studies published in peer-reviewed scientific journals between 2020 and 2025 were included if they explicitly addressed the public sector or public policies and presented a direct relationship with the environmental pillar of ESG, environmental sustainability, or related frameworks applied to public administration, public works, or infrastructure. Studies with empirical, methodological, or review approaches that presented indicators, metrics, or analytical models related to the topic were also considered eligible.

Duplicate articles were excluded, as well as studies focused exclusively on the private or corporate sector without interface with public administration, publications that addressed ESG in a generic manner without an environmental focus, documents without access to full

text, non-peer-reviewed literature, and studies that did not demonstrate thematic alignment after reading titles and abstracts.

2.3 SCREENING

During the screening stage, the Rayyan software was used to organize and prepare the records collected in the previous phase (7). Initially, all retrieved articles were imported into the platform, which enabled a structured visualization of the material to be analyzed. Rayyan allows the automatic identification of duplicate records, facilitating the rapid and accurate exclusion of these items. After the removal of duplicates, the next step consisted of excluding studies that did not meet the scope defined for the research, based on the reading of titles and abstracts. Subsequently, the previously established eligibility criteria were applied, ensuring that only studies aligned with the objectives of the work were retained for the following stages. This entire process contributed to the systematization and refinement of the set of articles, making the subsequent analysis more efficient and focused. At the end of the screening process, the selected records were organized by thematic group.

The screening of studies was conducted independently by two reviewers, based on the reading of titles and abstracts, with support from the Rayyan platform. Any doubts regarding the eligibility of studies were discussed until consensus was reached, ensuring greater methodological rigor and reduction of selection bias.

As a result of this process, 523 duplicates and 265 records considered outside the scope of the research were eliminated. The final set, consisting of 1,006 unique articles, was then prepared for the subsequent stages of bibliometric and bibliographic analysis. The quantitative systematization of this refinement can be seen in Table 7, which details the processing of records in each thematic group, including the total number of identified documents, duplicates removed, excluded records, and the final number of articles selected for analysis.

Table 7

Detailed processing of records during the screening stage

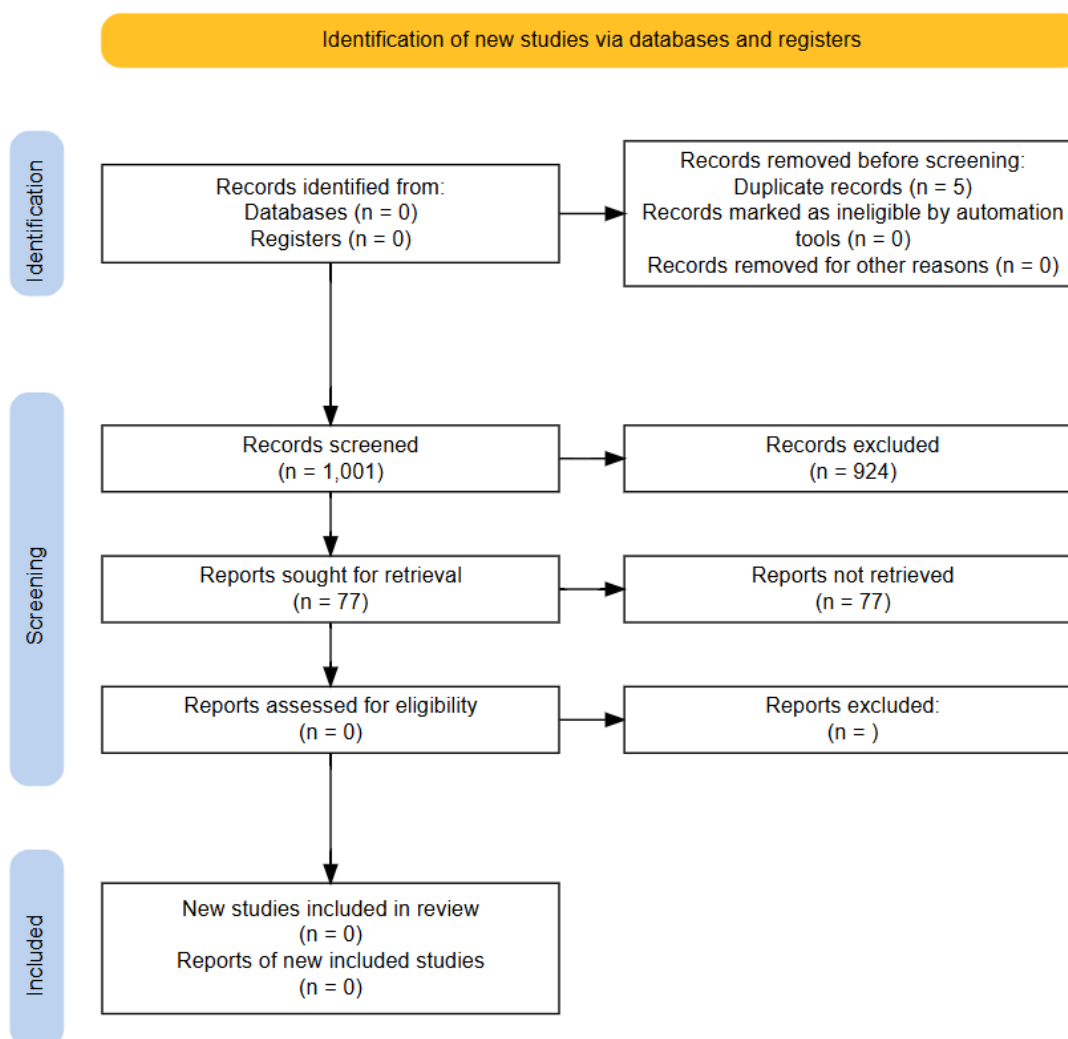
GROUP	Number of documents			
	Total	Duplicates	Deleted	Non-duplicates
1	165	54	27	137
2	796	328	165	630
3	12	0	0	12

4	257	133	69	188
5	43	8	4	39
TOTAL	1273	523	265	1006

At the end of the screening process, the PRISMA flow diagram presented in figure 3 (6) was automatically generated in Rayyan. This flow diagram describes the stages of identification, screening, eligibility, and inclusion of the analyzed studies, indicating the number of records identified in the databases, the records removed as duplicates, those excluded for not meeting the defined criteria, and the final number of articles included for bibliometric and bibliographic analysis.

Figure 3

PRISMA 2020 flow diagram



In summary, the screening process allowed for the careful selection of studies on the environmental pillar of ESG in public administration, according to the established criteria and

the methodological steps described. The result of this stage was the identification of a set of unique articles, duly organized for the bibliometric and bibliographic analyses that will be presented in the following chapters.

2.4 BIBLIOGRAPHIC ANALYSIS

The bibliographic analysis was conducted based on the set of 1,006 unique articles obtained after the screening stage. For this phase, criteria related to adherence to the central research topic, relevance to the proposed objectives, and an interdisciplinary approach involving engineering, public management, and urban sustainability were considered. After reading the titles, abstracts, and methodologies, a more in-depth qualitative assessment of the studies was carried out, considering as eligibility criteria the explicit focus on the public sector or public policies, the direct approach to the environmental pillar of ESG or equivalent environmental sustainability instruments, empirical or methodological application related to public management, public works, or infrastructure, and clarity in the definition of indicators, metrics, or analytical frameworks.

Based on these qualitative criteria, 69 articles were selected to compose the final set of analyzed studies. These articles were then organized and categorized according to the analytical dimensions of ESG (environmental, social, and governance), allowing for deeper discussion of indicators, methodologies, and trends related to the incorporation of ESG principles in public administration. The objective of this stage was to identify the main recurring themes, advances, and challenges present in the literature, as well as to support the reflections and recommendations presented in the following chapters.

The qualitative assessment of the studies was conducted independently by two reviewers, considering criteria of thematic adherence, methodological relevance, and analytical contribution, with final consolidation by consensus.

For the analysis of thematic clusters, the VOSviewer software was used, adopting the keyword co-occurrence analysis method, which allows the identification and visualization of relationships among the main terms present in the selected literature (8). The counting method employed was full counting, in which each keyword occurrence is fully counted for each publication in which it appears. To ensure greater relevance and robustness of the results, a minimum threshold of three occurrences was established for a term to be included in the generated co-occurrence maps.

The complementary bibliometric analysis carried out with the support of the Bibliometrix package, through the Biblioshiny interface, allowed detailed exploration of the collected data (9). Indicators such as scientific production by country, most relevant sources,

most frequent terms, and thematic maps were used, enabling the identification of trends, research hubs, and emerging themes. For the construction of the thematic model, parameters such as keyword clustering, degree of centrality, and theme development were considered, which allowed the classification of topics as motor, basic, emerging, and niche themes, according to their relevance and maturity in the literature.

This systematic review was not previously registered on specific protocol registration platforms, nor was a formal protocol developed prior to the beginning of data collection and analysis. The methodological steps were defined iteratively, based on the PRISMA 2020 guidelines, due to the exploratory and interdisciplinary nature of the study.

3 RESULTS

This chapter presents the main results obtained from the analyses carried out on the incorporation of the environmental pillar of ESG in public administration. Initially, the findings of the bibliometric analysis are presented, including graphs, tables, and maps that illustrate scientific production, recurring themes, and trends identified in the field of study. Subsequently, the results of the bibliographic analysis are detailed, organized according to the three ESG dimensions (environmental, social, and governance), highlighting the most frequent themes, observed advances, and challenges identified in the literature. This approach aims to provide a comprehensive and structured overview of the state of the art, supporting the discussions and recommendations presented in the following chapters.

3.1 THEMATIC CLUSTER ANALYSIS

This section presents the results of the thematic cluster analysis identified from the processing of the search groups defined in the bibliometric stage. For this analysis, the VOSviewer software was used, which enabled the development of keyword co-occurrence maps, author networks, and the identification of recurring thematic clusters in the literature on ESG in public administration. The use of this tool made it possible to visualize the connections between concepts, research areas, and trends, offering a structured understanding of how the different ESG axes are addressed in the analyzed studies. The generated maps and networks serve as the basis for the discussion of the main themes and relationships identified throughout the research. The individual analyses of each group are presented below:

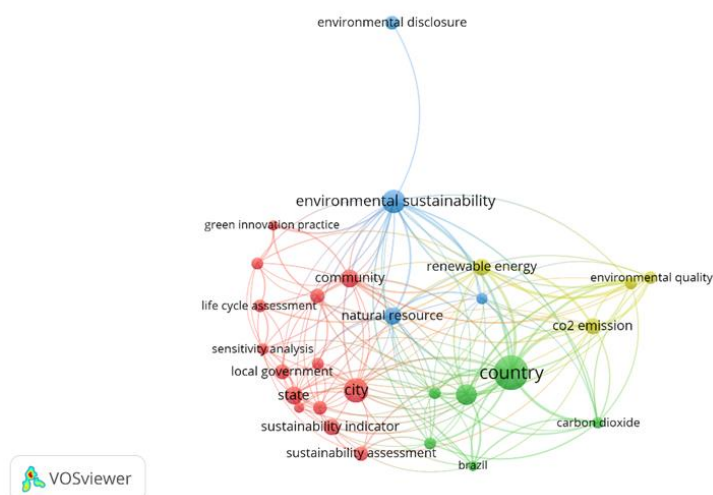
Group 1 – “Sustainability”, “Environmental Indicators” and “Government”

Group 1 brings together studies that address the standardization of metrics and the assessment of environmental performance in public policies. The works grouped within this thematic axis focus on topics such as environmental sustainability, performance indicators, innovative management practices, and the integration between government and environmental policies. This categorization allows the identification of the main trends and approaches adopted by the scientific literature when addressing the incorporation of the environmental pillar of ESG in public administration (10).

Figure 4 presents the keyword co-occurrence network of Group 1, highlighting “country” as the central term of the cluster. This node concentrates the highest number of connections, serving as a link between different themes related to environmental sustainability in public policies. Around “country,” terms such as “CO₂ emission,” “carbon dioxide,” “environmental quality,” and “Brazil” are grouped, composing a thematic axis focused on technical and environmental issues, especially those related to gas emissions and environmental quality. The red cluster, on the left, includes terms such as “city,” “state,” “local government,” “community,” “natural resource,” “sustainability indicator,” and “sustainability assessment,” forming a set associated with institutional and territorial themes. The yellow cluster, more peripheral, includes “renewable energy” and “environmental quality,” connecting to both the green and red clusters through “country.” The blue cluster, more isolated, contains “environmental disclosure,” with few direct connections to the central core.

This configuration shows that discussions on environmental sustainability in public administration within this group are strongly anchored in national-level approaches (“country”), while also articulating local and institutional dimensions, as well as technical aspects related to energy and emissions (10).

Figure 4



Group 2 – “ESG”, “Sustainability” and “Government”

Group 2 brings together studies that explore the integration of ESG criteria with sustainability and governmental action. The works within this cluster mainly address themes related to ESG performance in public organizations, transparency, ethical governance, and policies aimed at promoting sustainable practices in the public sector. The analysis of this group makes it possible to identify how ESG concepts have been incorporated into governmental strategies, highlighting the importance of performance measurement, information disclosure, and the transition toward more responsible management models aligned with environmental and social demands (11).

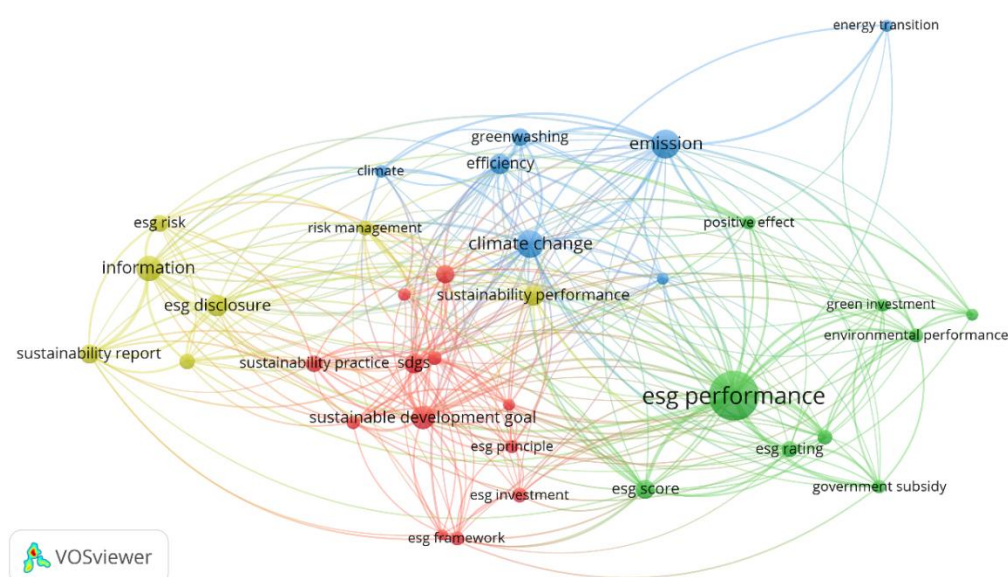
Figure 5 shows that the term “ESG performance” occupies the central position in the network, acting as the main articulator of discussions within Group 2. This node presents the highest number of connections, especially with terms such as “ESG score,” “environmental performance,” “government subsidy,” “ESG rating,” “ESG principle,” and “ESG investment,” forming a high-density green cluster. This indicates that ESG performance is the central axis of the publications, reflecting the focus on measurement, evaluation, and the impact of ESG practices in the public sector. On the left, the red cluster brings together terms such as “sustainability performance,” “sustainable development goal (SDG),” “ESG framework,” “ESG disclosure,” “sustainability report,” and “sustainability practice,” all strongly connected to “ESG performance” and “climate change.” This grouping highlights the importance of transparency, information disclosure, and the adoption of sustainable practices as fundamental elements for the consolidation of ESG in governmental organizations. In the upper part, the blue cluster connects terms such as “climate change,” “emission,” “efficiency,” “greenwashing,” “energy transition,” and “positive effect,” evidencing the relationship

between energy performance, mitigation of environmental impacts, and the transition to more sustainable models. The yellow cluster, more dispersed, includes terms such as “risk management,” “ESG risk,” “information,” and “climate,” linked to the red core, indicating the relevance of risk management and information flow for the effectiveness of ESG policies.

The network evidences a strong correlation between ESG performance, corporate sustainability, and energy transition, with “climate change” functioning as a link between the main groupings. This configuration reveals that discussions on ESG in public administration are centered on performance evaluation, transparency, and the integration of sustainable practices, while also addressing challenges such as risk management and adaptation to climate change (11).

Figure 5

Keyword co-occurrence network (VOSviewer) – Group 2



Group 3 – “Public Management”, “Municipal Administration” and “Environmental Sustainability”

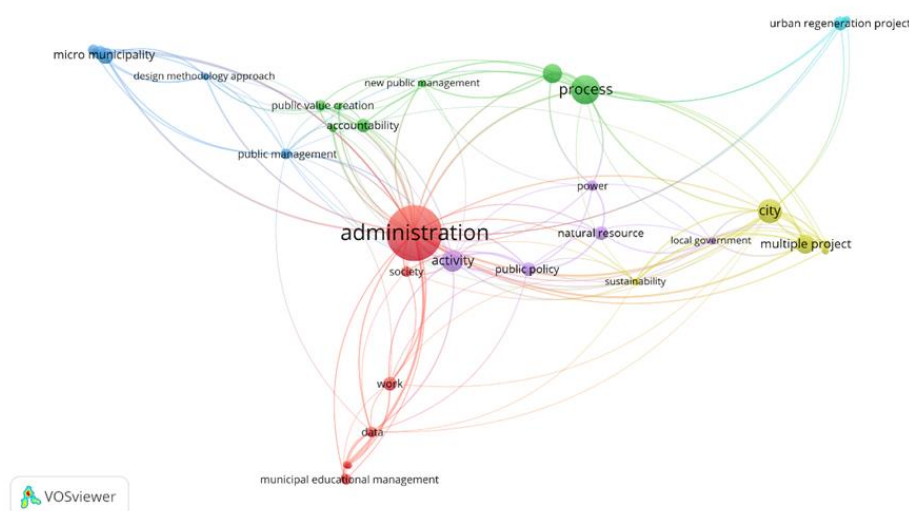
Group 3 brings together studies focused on municipal public management, social participation, transparency, and urban renewal. The works grouped within this thematic axis address administrative practices, accountability processes, public value creation, and the implementation of environmental policies at the local level. The analysis of this group allows for an understanding of how sustainability and governance strategies are operationalized within the context of municipal administrations, highlighting the role of cities and local governments in consolidating innovative and sustainable public policies (12).

Figure 6 presents the keyword co-occurrence network of Group 3, in which the term “administration” occupies the center of the network, being the largest node and the one with the highest number of connections. The red cluster, denser, brings together terms such as “administration,” “society,” “activity,” “work,” “care,” and “municipal educational management,” indicating a strong association between administrative practices and social dimensions. The green cluster, located at the upper part, groups terms such as “process,” “accountability,” “new public management,” and “public value creation,” connecting directly to the central core and to the yellow cluster, forming the managerial and public governance axis. The yellow cluster, on the right, contains terms such as “city,” “local government,” “multiple project,” and “urban regeneration project,” composing the segment focused on urban management and the implementation of local public policies. The lilac cluster, smaller and located below and to the right of the center, presents terms such as “public policy,” “sustainability,” “power,” and “natural resource,” functioning as a transition zone between the social and urban axes. The blue cluster, more dispersed, includes “municipality,” “micro municipality,” and “design methodology approach,” with low-density links to the center of the network.

The network reveals the strong centrality of the term “administration,” which connects themes of public management, social participation, and institutional sustainability. This configuration shows that, within the context of Group 3, discussions on ESG in public administration are strongly related to the operationalization of sustainability strategies at the municipal level, the valorization of social participation, and the implementation of innovative policies in cities and local governments (13).

Figure 6

Keyword co-occurrence network (VOSviewer) – Group 3



Group 4 – “Public Infrastructure” and “Sustainability”

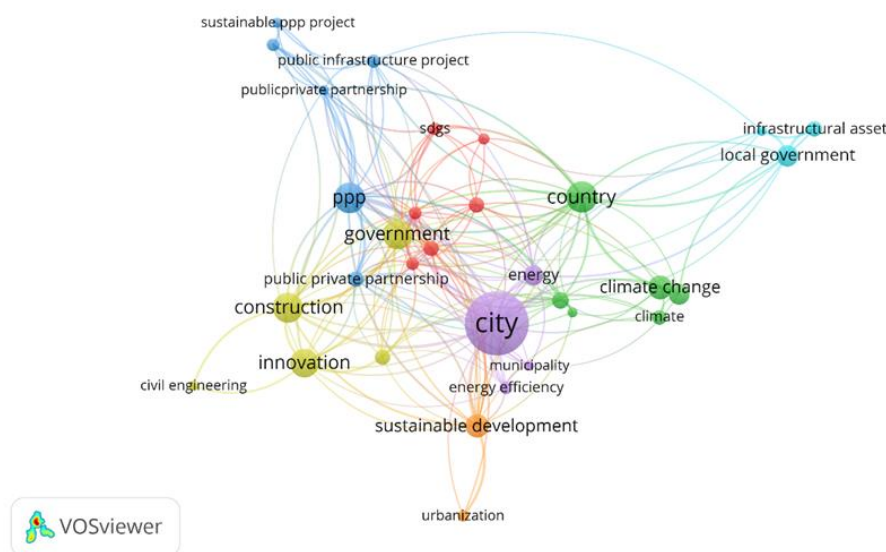
Group 4 brings together studies that address themes related to public infrastructure, energy efficiency, and environmental innovation. The works grouped within this thematic axis explore the role of government as a driving agent of sustainable practices, highlighting initiatives such as public–private partnerships, green infrastructure projects, and policies aimed at sustainable urban development. The analysis of this group allows for an understanding of how sustainability strategies are incorporated into public works and engineering projects, evidencing the importance of integrating technological innovation, public management, and adaptation to climate change (14).

Figure 7 presents the keyword co-occurrence network of Group 4, in which the term “city” occupies the center of the network, with high connection density and the highest number of links. To its left, the yellow cluster concentrates terms such as “innovation,” “construction,” “civil engineering,” “sustainable development,” “urbanization,” and “energy efficiency,” forming a block strongly associated with technological innovation and sustainable infrastructure. The light-blue cluster, in the upper left part, groups “PPP,” “government,” “public private partnership,” “public infrastructure project,” and “sustainable PPP project,” connecting to the central core and representing the axis of public policies and governmental partnerships. The green cluster, to the right of the center, includes “country,” “climate change,” “climate,” and “infrastructural asset,” composing the thematic group related to energy and climate adaptation. The red cluster, smaller and located between the blue and green clusters, brings together “SDGs,” “energy,” “government,” and “public private partnership,” functioning as a convergence zone between the political, energy, and environmental axes.

The map highlights the strong interconnection among “city,” “PPP,” “innovation,” “energy,” and “climate change,” emphasizing urban infrastructure and public–private partnerships as central elements in discussions on sustainability and energy efficiency (14).

Figure 7

Keyword co-occurrence network (VOSviewer) – Group 4



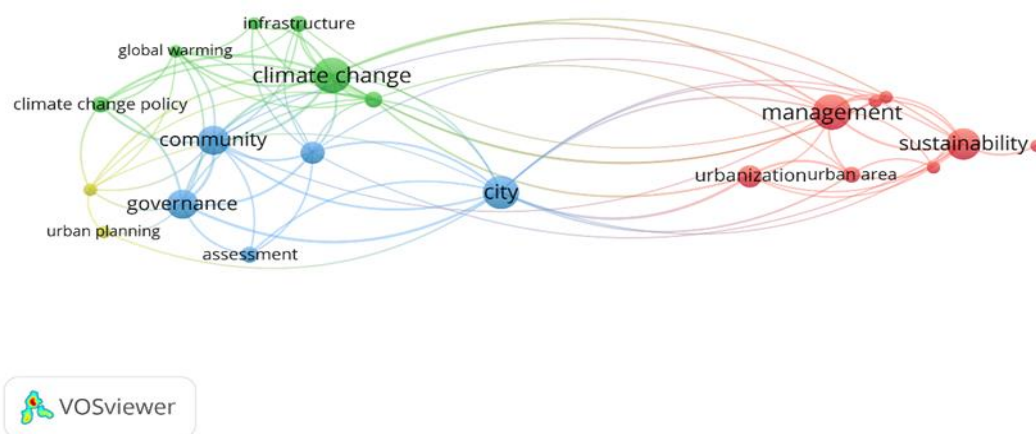
Group 5 – “Planning”, “Sustainable Policies” and “Government”

Group 5 aims to analyze how urban planning, sustainable policies, and governmental action are articulated to promote sustainability in cities. Based on the review of studies grouped within this thematic axis, the objective is to understand how strategic planning and public policy formulation have been used as tools to address challenges such as climate change and accelerated urbanization, highlighting the integration of different actors and levels of government, as well as the role of innovative instruments in this context (15,16).

Figure 8 shows the keyword co-occurrence network of Group 5, illustrating how central concepts are connected in discussions on urban planning, sustainable policies, and government. The term “climate change” occupies the central position in the network, connecting directly to thematic clusters such as “city,” “community,” “governance,” “urban planning,” and “assessment,” which form the public management and urban planning axis. Other groupings highlight “infrastructure,” “global warming,” and “climate change policy,” creating an interface between territorial planning and climate policies. Terms such as “management,” “sustainability,” “urbanization,” and “urban area” also appear, reinforcing the administrative and operational role of sustainable policies. The strongest links between “city,” “governance,” and “climate change” indicate the centrality of cities in the formulation of strategies aimed at addressing climate change. The graph presents a more open and less dense network, with long and dispersed connections, revealing the conceptual fragmentation still present in publications on sustainable planning and climate governance.

Figure 8

Keyword co-occurrence network (VOSviewer) – Group 5



The comparison among clusters reveals important differences regarding thematic focus and term centrality. It is observed that, while some groups strongly emphasize concepts related to sustainability, performance, and governance, others show a predominance of terms associated with the corporate context, such as “ESG performance” and “sustainability report,” highlighting the weight of corporate approaches in the literature. On the other hand, there is a low direct connection between ESG and public works, with few terms and links relating ESG practices to the execution of infrastructure and urban engineering projects, which indicates a relevant gap and reinforces the need to deepen research in this segment. The dominance of certain terms within the clusters, such as “city,” “country,” and “administration,” reflects the centrality of discussions on public policies and urban management. In addition, the keyword analysis highlights not only the centrality of cities and the strategic role of government in promoting innovative practices and sustainable policies, but also shows that there is still little integration among different approaches to the topic. This underscores the need for new perspectives, highlighting emerging themes such as smart cities and climate resilience, which have been gaining space in recent discussions on environmental ESG in public administration. This comparative analysis makes it possible to identify opportunities for future investigations, especially those aimed at expanding dialogue between ESG, public works, and governmental management policies.

This integrated view of the thematic clusters provides support for deepening the quantitative and qualitative analysis of the articles, which will be carried out using the bibliometric tools of Bibliometrix/Biblioshiny, allowing a more detailed exploration of trends,

advances, and challenges present in scientific production on environmental ESG in the public sector.

3.2 COUNTRY SCIENTIFIC PRODUCTION

The “Country Scientific Production” analysis aims to identify and present the geographical distribution of scientific production on ESG in public administration. Through this indicator, it is possible to visualize which countries stand out in terms of number of publications, revealing research hubs, regional trends, and potential gaps in the international literature. This approach contributes to understanding the global landscape of the topic, highlighting where discussions are more consolidated and pointing to opportunities for strengthening studies in less represented contexts.

Figure 9 presents the geographical distribution of scientific production on ESG in public administration, showing a significant concentration of publications in countries in North America, Europe, and Asia, with emphasis on more developed economies and those with a tradition in research on governance and sustainability. It is observed that these countries act as consolidated hubs of scientific production, reflecting greater institutional maturity, data availability, and incentives for research on ESG-related topics. In contrast, regions such as Latin America, Africa, and parts of Southeast Asia show a lower volume of publications, indicating relevant gaps in the literature and reinforcing the need to expand studies in diverse institutional contexts. This pattern highlights a geographical imbalance in knowledge production and points to opportunities for strengthening research applied to the public sector in developing countries, especially in the field of public policies and sustainable infrastructure.

Figure 9

Country Scientific Production

Country Scientific Production

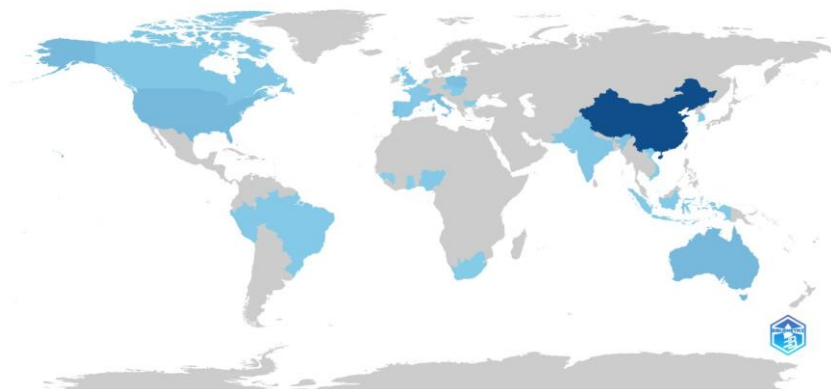


Table 8 details the distribution of scientific production by country, complementing the visualization presented in Figure 9. A strong leadership by China is observed, with 67 publications, highlighting the country's prominence in academic production related to ESG in public administration. Australia and the United States follow, each with 11 publications, followed by Italy, Poland, and Portugal, with 8 studies each. These results reinforce the concentration of scientific production in countries with greater institutional research capacity and a tradition in studies on governance, sustainability, and public policies. At the same time, the presence of countries from Latin America, Africa, and Southeast Asia with a lower number of publications—such as Brazil, Nigeria, Peru, Vietnam, and Ghana—highlights regional asymmetries in knowledge production, indicating relevant gaps and opportunities for the development of applied research on ESG in the public sector in emerging contexts.

Table 8

Country Scientific Production

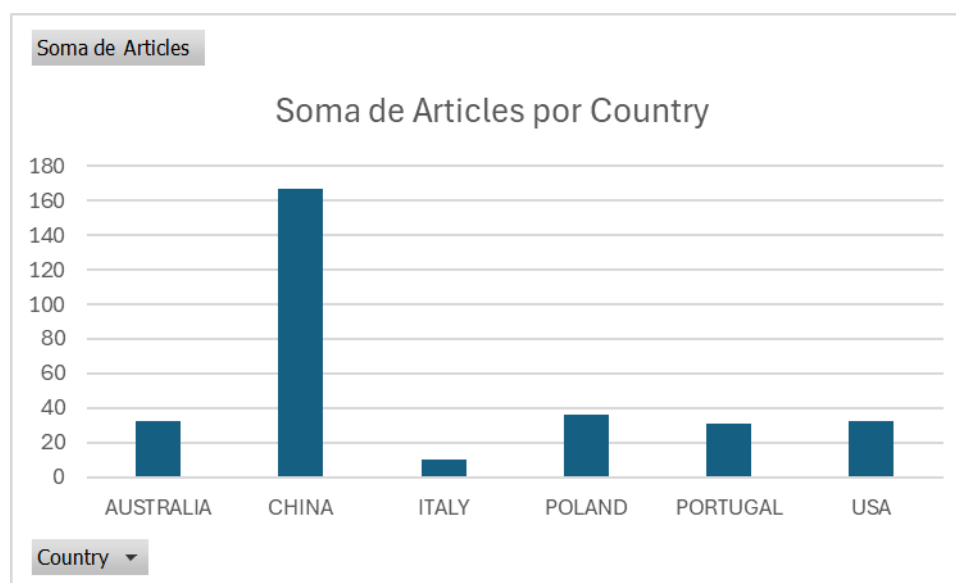
Country	Freq
CHINA	67
AUSTRALIA	11
USA	11
ITALY	8
POLAND	8
PORTUGAL	8
CANADA	5
INDIA	5
UK	5
PAKISTAN	4
SPAIN	4
BRAZIL	3
CZECH REPUBLIC	3
FRANCE	3
INDONESIA	3
NETHERLANDS	3
NIGERIA	3
PERU	3
SLOVAKIA	3
BULGARIA	2
HUNGARY	2
SOUTH AFRICA	2
SOUTH KOREA	2
VIETNAM	2
GHANA	1
GUINEA	1

The analysis of the “Country Scientific Production” chart and table reveals that scientific production on ESG in public administration is mainly concentrated in Asian and European countries. China clearly leads in the number of publications, followed by Australia, the United States, Italy, Poland, and Portugal, which also show significant participation. Countries such as the United Kingdom, Spain, Germany, and Italy stand out as important research hubs, while Brazil and other Latin American countries appear with low representativeness. This distribution indicates that discussions on environmental ESG are more consolidated in regions with greater investment in sustainable public policies and institutional innovation, while also pointing to opportunities to strengthen studies in less represented contexts, especially in Latin America.

3.3 COUNTRIES PRODUCTION OVER TIME

The “Countries Production Over Time” analysis (Figure 10) aims to present the evolution of scientific production on ESG in public administration over the years, highlighting how different countries have contributed to the advancement of research in this field. Through this indicator, it is possible to visualize temporal trends, identify periods of greater growth, and compare the prominence of each country in generating knowledge on sustainability and public governance.

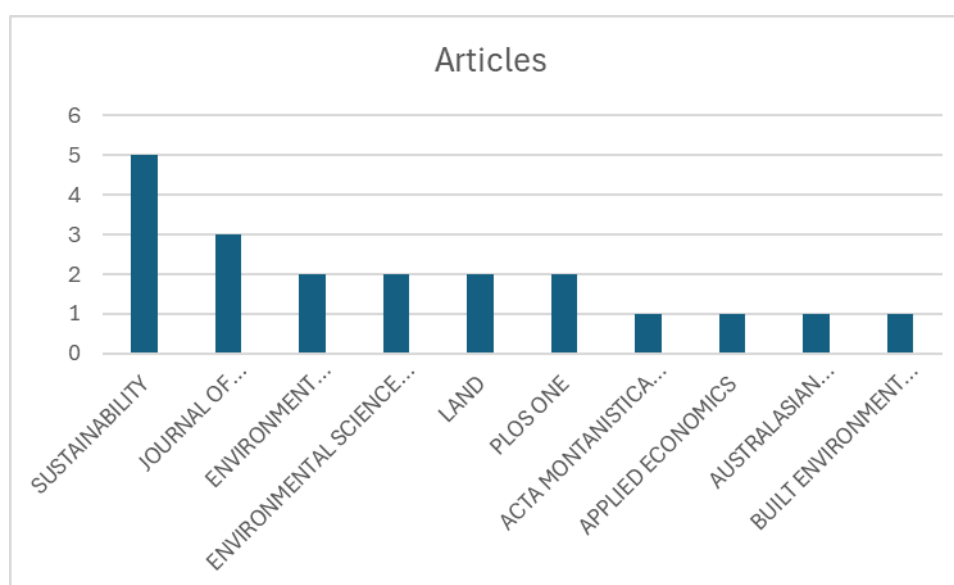
The analysis of the results from the “Countries Production Over Time” graph shows that China leads scientific production on ESG in public administration, with a significant number of publications throughout the analyzed years. European countries, such as Italy, Poland, and Portugal, also show relevant participation, followed by the United States and Australia. This distribution indicates that the discussion on environmental ESG is more consolidated in Asian and European countries, where there is greater investment in sustainable public policies and institutional innovation. On the other hand, a low representativeness of Brazil and Latin America is observed, which reinforces the need to expand regional research and studies applied to the Brazilian context. This scenario highlights opportunities for the development of local investigations, especially in public companies and urbanization projects, such as those conducted by RIOURBE.

Figure 10*Countries Production Over Time*

3.4 MOST RELEVANT SOURCES

The “Most Relevant Sources” analysis (Figure 11) aims to identify the journals and scientific periodicals that published the highest number of articles on ESG in public administration during the analyzed period. This indicator makes it possible to visualize which academic outlets concentrate discussions on sustainability, governance, and public policies, highlighting the international recognition of the topic and identifying the main channels for scientific dissemination in the field.

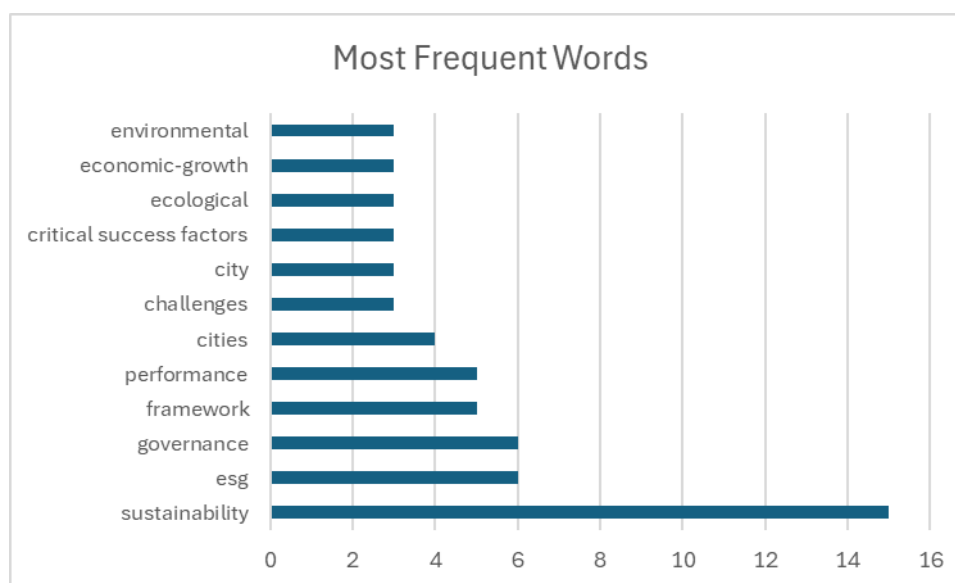
The analysis of the results from the “Most Relevant Sources” chart shows that the journal Sustainability leads in the number of articles published on ESG in public administration, followed by periodicals such as Journal of Environmental Science, Land, PLOS One, among others. This concentration in high-impact journals highlights the international recognition of the topic and the relevance of discussions on sustainability, governance, and public policies. It is observed that the predominance of international journals reinforces the consolidation of environmental ESG as a global agenda, while also highlighting the need to expand the presence of Latin American and Brazilian journals in this debate, which may contribute to the dissemination of local experiences and to the development of indicators adapted to the national context.

Figure 11*Most Relevant Sources*

3.5 MOST FREQUENT WORDS

The “Most Frequent Words” analysis (Figure 12) aims to identify the most recurrent terms in publications on ESG in public administration. This indicator makes it possible to visualize which concepts, themes, and approaches receive the greatest emphasis in the scientific literature, facilitating the understanding of trends, priorities, and research focuses in the field.

The analysis of the “Most Frequent Words” chart reveals that the most recurrent terms in publications on ESG in public administration are “sustainability,” “ESG,” “governance,” “performance,” “framework,” and “environmental,” indicating that the concepts of sustainability and environmental governance occupy a central position in the scientific literature on the topic. Other relevant terms, such as “cities,” “challenges,” and “economic growth,” point to a focus on urban policies, overcoming barriers, and economic impacts. This visualization reinforces the importance of sustainability as a conceptual axis and shows that academic debates are strongly linked to performance measurement, the structuring of frameworks, and the search for solutions to environmental and urban challenges.

Figure 12*Most Frequent Words***3.6 TREEMAP**

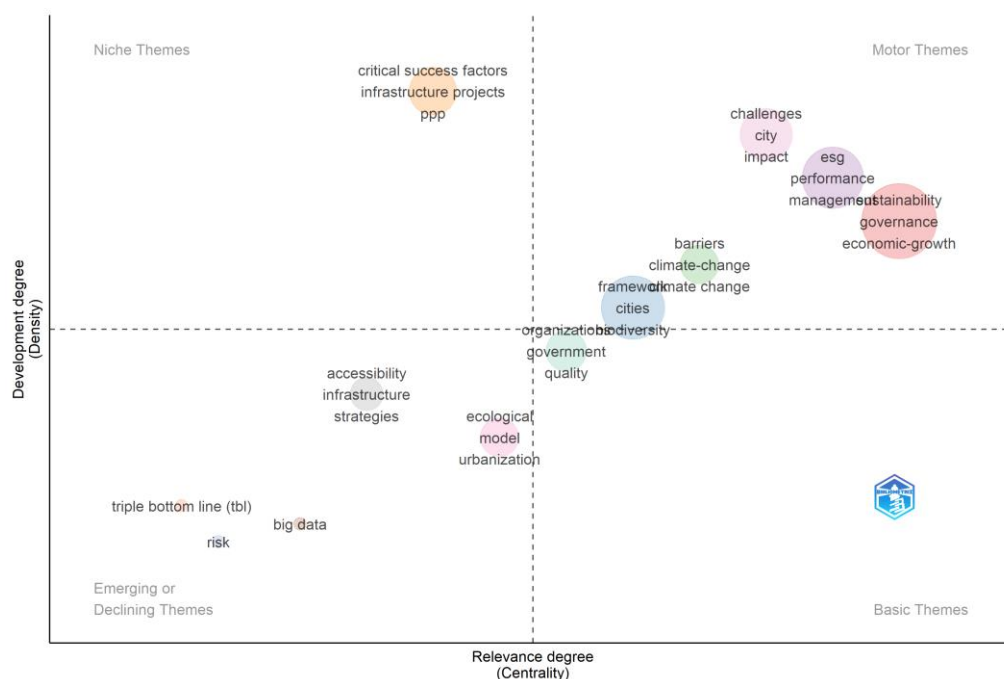
The “Treemap” analysis aims to visually and hierarchically present the most recurrent terms in publications on ESG in public administration. Through this tool, it is possible to quickly identify the central concepts and thematic groupings that dominate the field, facilitating the perception of relationships among the main themes, research trends, and opportunities for further exploration in specific areas.

Figure 13 (Treemap) shows that “sustainability” is the central and most recurrent concept in publications on ESG in public administration, followed by key themes such as “governance,” “framework,” “ESG,” and “performance,” which reflect the literature’s focus on performance measurement, methodological structuring, and environmental assessment. The chart also highlights the presence of emerging themes, such as “energy efficiency,” “climate resilience,” and “big data,” as well as challenges and barriers to the implementation of ESG practices, indicating that the field is expanding and seeking to integrate innovation, adaptation, and multidimensionality into public policies. This hierarchical visualization facilitates the identification of the main axes of discussion and points to opportunities for deeper investigation in specific areas.

Figure 13*Treemap***3.7 THEMATIC MAP**

The thematic map presents a visual and structured overview of the main research axes on ESG in public administration, organizing the themes into four groups: motor, basic, emerging, and niche themes. This approach makes it possible to quickly identify which topics drive the field, which are consolidated, which are on the rise, and which have high potential for specialization. The map facilitates the understanding of the relationships among sustainability, governance, public policies, and institutional innovation, serving as a basis for in-depth discussions on priorities, challenges, and research opportunities in the context of environmental ESG in the public sector (Figure 14).

The thematic map shows the distribution of the main topics researched on ESG in public administration across four quadrants. In the motor themes quadrant are “challenges,” “city,” “impact,” “ESG performance,” “management,” “framework,” “governance,” “economic growth,” and “climate change,” indicating that these topics are central and drive the development of the field. The basic themes, located in the lower-right quadrant, include “organization,” “government,” “quality,” “assessment,” “urbanization,” and “ecological model,” representing broadly discussed and consolidated conceptual foundations. In the upper-left quadrant appear niche themes, such as “critical success factors,” “infrastructure projects,” and “PPP,” which are more specialized and less central approaches, but with potential for further development. In the lower-left quadrant are emerging or declining themes, such as “accessibility,” “infrastructure strategies,” “triple bottom line (TBL),” “risk,” and “big data,” which reflect areas that are growing or still seeking greater relevance and development within the scientific literature on environmental ESG in the public sector.

Figure 14*Thematic Map*

3.8 SYNTHESIS OF BIBLIOMETRIC FINDINGS

Scientific production on the environmental pillar of ESG in public administration is recent and has shown accelerated growth since 2020, with a higher concentration of studies in Asian and European countries, especially China, Italy, Poland, Portugal, the United States, and Australia. Brazil and other Latin American countries still have low representativeness, indicating a regional gap. The central themes identified are sustainability, governance, performance, frameworks, and environmental indicators, which appear with high frequency in the publications. International journals lead the dissemination of studies, with emphasis on the journal Sustainability. Keyword co-occurrence maps and thematic clusters show that sustainable public procurement, green infrastructure, energy efficiency, and environmental governance are drivers of research and institutional innovation. Emerging themes such as smart cities, digital transition, and climate resilience are beginning to gain prominence, while areas such as urban planning and low-carbon policies still present conceptual dispersion. The data reveal the need for indicator standardization, institutional integration, and adaptation of methodologies to local realities, especially to strengthen the environmental ESG agenda in the Brazilian public sector.

3.9 BIBLIOGRAPHIC ANALYSIS

Based on the analysis of the 69 articles selected for in-depth qualitative analysis, recent literature on ESG in public administration demonstrates that sustainability in public

policies results from the balance between actions aimed at environmental protection, promotion of social inclusion, and strengthening of institutional governance. The three ESG dimensions—environmental, social, and governance—are addressed in an integrated and complementary manner and are fundamental to the effectiveness of sustainable and innovative public policies (1,2).

Environmental Dimension

The environmental dimension of ESG in public administration is mainly related to energy efficiency, waste management, green infrastructure, reduction of carbon emissions, and adoption of clean technologies. Practices such as sustainable public procurement, inclusion of environmental criteria in bidding processes and infrastructure projects, and the use of specific frameworks and indicators, such as DPSIR and IPEEI, are highlighted. These strategies are essential to align public policies with international sustainability commitments and to promote sustainable urban development, although challenges remain regarding the standardization of indicators and methodological adaptation to local realities, especially in public works and engineering companies (10,17–22).

Social Dimension

In the social aspect, studies emphasize the importance of community participation, social inclusion, quality of life, and social cohesion for the success of sustainable public policies. International experiences show that social mobilization, the enhancement of public spaces, and the promotion of adequate social infrastructure are decisive for strengthening social capital and promoting collective well-being. Inclusive and participatory public policies are essential to ensure equity and social justice, especially in urban and rural contexts marked by inequalities (13,23–26).

Governance Dimension

The governance dimension is mainly addressed in terms of transparency, ethics, accountability, administrative capacity, and institutional innovation. The literature highlights that integrating ESG criteria into public management strengthens governance, improves the attraction of responsible investments, and promotes more resilient cities. Practices such as sustainable public procurement, public–private partnerships, and the adoption of performance systems are identified as strategic to enhance administrative efficiency and stimulate innovation. Nevertheless, challenges such as the need for regulatory frameworks, technical capacity building, and intersectoral integration remain central to the effectiveness of sustainable policies in the public sector (12,22,26–28).

The analysis of the studies shows that the integration of environmental ESG with public works and engineering companies is fundamental to the effectiveness of sustainability

policies in the public sector. Practices such as the adoption of environmental frameworks (DPSIR, IPEEI), the use of specific indicators, and the implementation of sustainable public procurement (Table 9) have proven essential to align infrastructure projects with environmental requirements and international commitments (10,18,19,22,26,29–31). However, the literature indicates that this integration is still incipient, making it necessary to expand methodological standardization and adapt indicators to local realities in order to enhance results and the practical applicability of ESG in public works.

Table 9

Main environmental methodologies and frameworks applied to public administration

Methodology / Framework	Brief Description	Application in Public Works / ESG	References
DPSIR	Model that structures analysis into Driving Forces, Pressures, State, Impact, and Response.	Integrated assessment of environmental impacts in infrastructure projects and public policies.	(29–32)
IPEEI	Integrated Ecological Perception Index, combining environmental and institutional variables.	Measurement of sustainability in public works and urban planning.	(10,32)
Specific Environmental Indicators	Metrics such as energy efficiency, waste management, and use of renewable energy.	Monitoring of environmental performance in bidding processes, contracts, and execution of works.	(18,19,33)
Sustainable Public Procurement	Inclusion of environmental criteria in bidding and contracting processes.	Guidance of works and services toward sustainable and innovative practices.	(22,26,34,35)

Table 10 synthesizes the main topics frequently addressed in each ESG dimension, along with the references of the articles that discuss each theme:

Table 10

The three ESG dimensions and the topics commonly addressed within each of them

Dimensions	Frequent Topics	References
Environmental	Energy efficiency, waste management, green infrastructure, renewable energy, environmental indicators, emission reduction, regenerative territorial planning	(1–5,10,11,16–21,25,29–33,36–62)
Social	Community participation, social inclusion, quality of life, health, education, social cohesion, e-participation, social innovation	(13,23–25,27,57,58,63–72)

Governance	Transparency, ethics, accountability, administrative capacity, institutional innovation, public–private partnerships, performance systems, adaptive governance, sustainable procurement	(3,4,11,14,15,22,26–28,34–36,41,54,67,72–81)
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The table of ESG dimensions presented at the end of this chapter synthesizes the main recurring themes in the analyzed literature, allowing a clear visualization of how studies are distributed across the environmental, social, and governance dimensions. It shows that sustainability in public policies results from a balance between actions aimed at environmental protection, promotion of social inclusion, and strengthening of institutional governance. By bringing together the frequent topics and references of each dimension, the table serves as a guide for the subsequent chapters, which will further deepen the discussion of each ESG axis. Thus, this closing section reinforces the importance of an integrated and multidimensional approach, without exhausting the debate, as the issues raised will be detailed and addressed throughout the remainder of the work.

4 DISCUSSION

In this chapter, the main results obtained from the bibliographic analysis of the 69 articles selected for in-depth qualitative analysis are presented and discussed, following the methodological pathway detailed in the previous sections. The discussion is structured to address the three central questions that guide this study:

How has the environmental pillar of ESG been incorporated into public administration policies and practices?

What are the main challenges and barriers to the implementation of environmental criteria in public management?

Which environmental indicators and metrics have been used in studies applied to the public sector?

Based on the qualitative analysis, the aim is to deepen the understanding of the environmental, social, and governance dimensions, highlighting advances, limitations, and opportunities for the consolidation of ESG in public administration. The results presented below directly dialogue with the objectives of the article and contribute to the debate on governmental sustainability, public policies, and institutional innovation.

How has the environmental pillar of ESG been incorporated into public administration policies and practices?

The incorporation of the environmental pillar of ESG in public administration, as evidenced by the analysis of the 69 selected articles, occurs in a gradual and multifaceted manner, reflecting both advances and challenges. The studies show that public

administration has sought to align its policies and practices with ESG environmental principles mainly through the adoption of sustainable criteria in public procurement, the implementation of green infrastructure projects, and low-carbon policies. Initiatives such as the inclusion of environmental requirements in bidding processes, the prioritization of nature-based solutions in urban works, and the promotion of energy efficiency have gained increasing prominence, especially in cities committed to international sustainability goals.

In addition, transparency and environmental governance have been strengthened through the use of digital platforms for monitoring indicators and disclosing environmental data, promoting greater accountability and integrity in public management. The literature also highlights the strategic role of public engineering and urbanization companies, such as RIOURBE, in translating environmental guidelines into concrete practices, particularly in the execution of urban projects and public works.

Another relevant aspect is the effort to develop and adopt environmental frameworks and indicators specific to the public sector, enabling the measurement of environmental performance in governmental policies, programs, and institutions. Composite models, such as DPSIR and IPEEI, have been used to integrate environmental and institutional variables, supporting a more comprehensive assessment of sustainability in public actions.

In summary, the incorporation of the environmental pillar of ESG in public administration is marked by advances in sustainable procurement, innovation in infrastructure, strengthening of environmental governance, and the development of dedicated indicators. However, the process still faces challenges related to the standardization of practices, institutional integration, and adaptation of strategies to local realities—issues that are further explored in the following discussions.

b. What are the main challenges and barriers to the implementation of environmental criteria in public management?

The analysis of the articles reveals that, despite the advances observed in incorporating the environmental pillar of ESG into public administration, significant challenges and barriers persist in consolidating environmental policies based on these criteria. These barriers can be grouped into four major dimensions: normative and methodological; technical and operational; institutional and political; and symbolic and reputational.

In the normative and methodological sphere, the lack of standardization of environmental indicators and divergence among evaluation methodologies stand out, making it difficult to compare results and adopt best practices across different governmental contexts. From a technical and operational perspective, the shortage of teams trained in

environmental assessment and ESG limits the effective implementation of these policies, especially in municipalities with weaker administrative structures.

Institutional and political barriers include administrative discontinuity, resistance from internal actors to the adoption of new procedures, and lack of integration among sectors and levels of government. Symbolic and reputational barriers refer to greenwashing practices and the discursive use of ESG without technical backing, which may compromise the credibility of initiatives and hinder stakeholder engagement.

These challenges are similar to those identified in international contexts such as Malaysia, Italy, and China, where the lack of integrated governance and comparable indicators also undermines the effectiveness of public policies. To overcome them, the literature recommends the creation of regulatory frameworks and binding instruments, strengthening technical and institutional capacity, and expanding transparency and environmental accountability, fostering an organizational culture guided by results and evidence.

c. Which environmental indicators and metrics have been used in studies applied to the public sector?

The reviewed studies identify four major groups of ESG environmental indicators applicable to public management. The first group refers to emissions and energy, including greenhouse gas inventories, energy consumption, and the use of renewable sources. The second group covers natural resources, with indicators related to water quality, land use, and vegetation cover. The third group is related to waste and materials, including metrics for recycling and reuse of construction materials. Finally, the fourth group involves urban and social indicators, such as sustainable mobility, walkability, and air quality.

In addition to these groups, composite models such as DPSIR (Driving Forces, Pressures, State, Impact, Response) and IPEEI (Integrated Ecological Perception Index) have been applied to combine environmental and institutional variables, strengthening the integrated measurement of sustainability in public actions. In the Latin American context, the importance of using indicators adapted to municipal planning is emphasized, aiming to integrate urban policies, public works, and climate goals.

To conclude the results and discussion chapter, it is important to reflect on the main findings and their implications for advancing the ESG agenda in public administration. The analysis of the articles shows that, although there has been significant progress in incorporating the environmental pillar of ESG, the process is still marked by methodological, institutional, and operational challenges. The lack of standardized indicators, fragmentation of evaluation methodologies, and the need for integration among different sectors and levels

of government remain central obstacles to the consolidation of effective environmental policies. In addition, the literature indicates that strengthening environmental governance depends on expanding transparency, technical capacity building, and the adoption of binding frameworks capable of promoting an organizational culture guided by results and evidence.

Another relevant point is the importance of adapting environmental indicators to local realities, especially in the Latin American context, where the specificities of municipal planning and public works require flexible and integrated solutions. The discussion also reveals that the involvement of public engineering and urbanization companies, such as RIOURBE, can be decisive in translating environmental guidelines into concrete and replicable practices.

The comparative analysis between China and European countries reveals marked differences in approaches to environmental ESG in public administration. While China leads in publication volume and focuses strongly on technological innovation, energy efficiency, and climate transition policies, Europe stands out for its emphasis on governance, social participation, and integration of public policies. This difference reflects distinct institutional contexts: greater centralization and state investment in China, and robust regulatory frameworks and multistakeholder participation in Europe. These contrasts highlight opportunities for mutual learning, especially for developing countries such as Brazil, which can adapt best practices from both contexts.

For Brazilian municipalities, the study results point to the need to adapt environmental indicators and international frameworks to local realities, considering resource constraints, technical capacity, and urban specificities. In this context, public engineering and urbanization companies, such as RIOURBE, linked to the City of Rio de Janeiro, can play a strategic role in operationalizing environmental guidelines in public works and urban projects. International experience suggests that the adoption of sustainable public procurement, strengthening of environmental governance, and use of integrated indicators can drive the ESG agenda, provided there is capacity building and sectoral integration. Furthermore, Brazil's low representation in international scientific production reinforces the importance of fostering research and pilot projects in Brazilian cities, promoting innovative and replicable solutions, particularly those led by companies such as RIOURBE.

The study directly contributes to the advancement of public policies by offering a consolidated overview of methodologies, indicators, and innovative practices related to environmental ESG. By mapping international trends and identifying gaps in national literature, the work supports public managers in decision-making, regulatory framework development, and implementation of sustainable projects. The systematization of

frameworks such as DPSIR and IPEEI, along with the analysis of international experiences, provides inputs for the construction of more effective, transparent, and globally aligned sustainability policies.

Finally, the results suggest that the consolidation of ESG in public administration requires a multidimensional approach that articulates the environmental, social, and governance pillars, promoting integration between technical, political, and ethical dimensions of public action. This perspective opens the way for future research focused on the development of integrated frameworks, international comparative analysis, and practical application of ESG indicators in public projects—topics that will be further explored in the conclusions and directions for future work.

5 CONCLUSION AND FUTURE WORK

This study presents the first consolidated systematic review on the environmental pillar of ESG in public administration, covering different types of public bodies and state-owned enterprises. By integrating innovative methodologies and analyzing a robust database of more than 1,200 articles, the research contributes to the advancement of discussions on governmental sustainability and to the consolidation of environmental ESG practices in the Brazilian public sector.

The main gap addressed by this work lies in its focus on the application of environmental ESG in public works and municipal management, a topic that has been scarcely explored in both national and international literature, which has traditionally concentrated on the corporate dimension. By providing practical recommendations and frameworks adapted to the reality of Brazilian public bodies, the study broadens the debate and offers support for managers at different levels of public administration.

Based on the findings, it is recommended that Brazilian public administration bodies adopt environmental frameworks (such as DPSIR and IPEEI), specific indicators, and sustainable public procurement practices to align projects, policies, and administrative processes with environmental requirements and international commitments. It is essential that managers promote technical capacity building among teams, encourage integration between sectors, and seek to adapt international methodologies to local realities, considering urban, institutional, and regional particularities.

In the municipal context, public engineering and urbanization companies, such as RIOURBE, linked to the City of Rio de Janeiro, can play a strategic role in operationalizing environmental guidelines in public works and urban projects. The development of case studies and pilot projects within these organizations is recommended in order to analyze, in

a practical and contextualized manner, the challenges, opportunities, and outcomes of implementing ESG principles in local policies, projects, and administrative processes. Such an approach contributes to the advancement of academic knowledge and may serve as a reference for other Brazilian municipalities interested in adopting sustainable and integrated public management practices.

In this sense, this work directs the research agenda toward the development of in-depth case studies on the applicability of environmental ESG principles in municipal public administration, with particular attention to the experience of public companies such as RIOURBE. The analysis of adapted indicators, institutional integration, and the replicability of innovative solutions will be essential to strengthen the ESG agenda in the Brazilian public sector and will serve as the basis for the master's dissertation topic, expanding the impact of sustainability policies and promoting innovative and replicable solutions in different contexts.

Among the limitations of the study, the low representativeness of Brazilian research in international scientific production stands out, as well as the need for greater integration between sectors and levels of government. In addition, it is noted that the adaptation of international frameworks and indicators to the Brazilian context still requires further development, especially to reflect local specificities and to strengthen the practical application of ESG principles in public administration.

In summary, the results reinforce the importance of a multidimensional and integrated approach to consolidating environmental ESG in the public sector. Future research should further explore the practical application of ESG indicators in urban and administrative projects, expanding the impact of sustainability policies and promoting innovative and replicable solutions across different municipal and institutional realities.

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APPENDIX

Table 11

Ref.	Objective	Methodology	Results
(15,22)	Investigar como classificações externas de áreas desfavorecidas influenciam a formulação de políticas públicas sustentáveis locais na Suécia.	Estudo qualitativo baseado em entrevistas com representantes de governos locais, utilizando análise de conteúdo interpretativa.	Classificações externas limitam políticas locais autênticas. O estudo propõe abordagens mais sensíveis ao território, contribuindo para planejamento sustentável em regiões desfavorecidas.
(22)	Investigar se a contratação pública estimula a inovação em tecnologias de energia renovável nas empresas chinesas.	Estudo quantitativo com modelo de efeitos fixos bidirecional (TWFE), utilizando dados de patentes em energia renovável e registros de compras públicas.	Contratações públicas impulsionam inovação em energia renovável, especialmente em empresas menos politizadas, com baixo estoque de conhecimento, em setores poluentes e regiões pró-mercado.
	Desenvolver um modelo de integração ESG para governos locais, visando equilibrar crescimento econômico, justiça social e preservação ambiental.	Revisão sistemática da literatura sobre práticas ESG em governos locais, com análise crítica de estudos teóricos e casos bem-sucedidos.	A integração dos critérios ESG pode fortalecer a sustentabilidade urbana, melhorar a governança pública e atrair investimentos responsáveis, desde que haja apoio institucional e regulamentação adequada
(21)	Avaliar o impacto da política de cidades-piloto de baixo carbono (LCCP) sobre o desempenho ESG das empresas na China.	Estudo quantitativo com modelo de diferenças em diferenças (DID), usando dados corporativos e ambientais para avaliar impactos da política LCCP no desempenho ESG.	A política LCCP melhora significativamente o desempenho ESG das empresas em áreas com alta intensidade de emissões, ao aumentar a pressão ambiental de governos e sociedade; porém, há efeito de de crowding out com empresas localizadas nas cidades vizinhas.
(18)	Avaliar o impacto da política de cidades de demonstração de energia nova (NEDC) sobre o desempenho ESG das empresas na China.	Estudo quantitativo com abordagem de diferenças em diferenças (DID), utilizando a NEDC como experimento quase-natural.	A política NEDC teve efeito positivo significativo no desempenho ESG corporativo, especialmente em grandes empresas e setores de baixo carbono; empresas menores e de setores intensivos em carbono enfrentam desafios adicionais
	Avaliar a sustentabilidade de pequenas centrais hidrelétricas (SHP) nas Montanhas Qin-Ba, na China, sob a perspectiva ESG.	Estudo de caso com três estações SHP, utilizando 18 indicadores ESG e métodos de decisão multicritério: conjuntos linguísticos hesitantes fuzzy (HFLTS) e modelos de nuvem.	Todas as estações apresentaram nível “bom” de sustentabilidade, com maior contribuição da dimensão ambiental (E); indicadores como qualidade da água e manutenção da morfologia fluvial tiveram maior peso na avaliação

(34)	Explorar como comportamentos de liderança ética em organizações públicas influenciam a cultura organizacional e a conformidade com princípios ESG.	Pesquisa quantitativa com 155 servidores públicos na Malásia, utilizando questionário validado e análise com Smart PLS para testar relações entre liderança ética, cultura organizacional e violações de integridade.	A liderança ética reduz violações de integridade e fortalece a adesão aos princípios ESG, embora não tenha sido encontrada relação direta estatisticamente significativa entre cultura ética e conformidade ESG, indicando necessidade de estudos futuros.
(56)	Investigar o comportamento do índice ESG macroeconômico em países produtores de petróleo da OPEP e não-OPEP, e suas implicações para o desenvolvimento sustentável.	Estudo quantitativo com testes avançados de estacionariedade em painel, cobrindo o período de 1990 a 2020.	Nossa pesquisa sugere que os governos devem usar intervenções políticas para neutralizar choques externos ao comportamento macro ESG, de modo a alcançar o desenvolvimento sustentável e a estabilidade do desempenho a longo prazo
(55)	Analisar a regulamentação atual sobre pegada de carbono digital na Indonésia e propor medidas legais para sua redução.	Abordagem normativa e comparativa, com análise de políticas nacionais (ENDC, Net Zero Emission 2060) e estudo de práticas internacionais.	A pesquisa propõe a criação de regulamentações específicas para reduzir a pegada de carbono digital e exige que empresas elaborem relatórios ESG, alinhando-se aos compromissos climáticos da Indonésia até 2045 e 2060
(36)	Avaliar se as divulgações sobre edifícios verdes feitas por empresas na Indonésia estão sendo comunicadas de forma eficaz aos stakeholders.	Estudo quantitativo com análise de conteúdo de 94 observações entre 2020 e 2022, utilizando dados de websites, relatórios anuais e relatórios de sustentabilidade.	Websites lideram a divulgação ESG. Empresas platinum são mais transparentes. O estudo recomenda maior fiscalização e orientação governamental para ampliar práticas de divulgação no setor.
(82)	Investigar como fundos governamentais, especialmente o fundo de seguridade social da China, influenciam o desempenho ESG das empresas.	Estudo quantitativo com dados de 4.251 empresas listadas entre 2009 e 2020, utilizando métodos de Propensity Score Matching (PSM) e diferenças em diferenças empilhadas (stacked DID).	Empresas em fundos governamentais melhoraram no desempenho ESG, especialmente as não estatais. Os fundos promovem reputação e acesso a financiamento sustentável de longo prazo.
(53)	Examinar como as iniciativas ambientais dos governos locais influenciam as práticas de divulgação e investimento ambiental das empresas na China.	Análise textual dos relatórios de trabalho dos governos provinciais chineses, utilizando frequência e variação de palavras-chave ambientais como indicadores de iniciativa governamental.	Iniciativas ambientais moldam a divulgação empresarial, mas pouco influenciam investimentos. O estudo alerta para práticas oportunistas e recomenda estratégias eficazes para estimular ações ambientais reais.
	Propor um modelo de relatório ESG para governos, especialmente no contexto de cidades inteligentes, e explorar como dados urbanos podem apoiar essa prática.	Utiliza abordagem qualitativa e exploratória, com exemplo prático de dados de mobilidade de Nova York para ilustrar como tecnologias urbanas podem apoiar práticas de sustentabilidade pública.	Tecnologias urbanas, como big data e sensores, ampliam a transparência e eficácia na gestão pública, permitindo monitoramento e divulgação avançada de indicadores ESG.

	Investigar se a implementação de compras públicas sustentáveis (SPP) na China influencia positivamente o desempenho ESG das empresas.	Estudo quantitativo com regressão linear e testes de robustez, cruzando dados de 42.369 projetos públicos e 20.125 empresas para avaliar desempenho ESG.	A SPP melhora o desempenho ESG corporativo, especialmente em regiões centrais da China e empresas maduras, com efeitos duradouros e papel estratégico do governo.
	Analisar a relação entre o desenvolvimento do governo eletrônico (e-government) e os fatores ESG (ambientais, sociais e econômicos) em 26 países europeus.	Estudo quantitativo com dados da Eurostat (2003–2020), utilizando TOPSIS, índice de Perkal e método de Hellwig para ordenação e seleção de preditores.	O EGDI correlaciona-se positivamente com indicadores ambientais, sociais e econômicos. Infraestrutura digital e serviços eletrônicos geram benefícios sustentáveis duradouros para a gestão pública.
(83)	Discutir como a Teoria Monetária Moderna (MMT) e as empresas públicas podem contribuir para a sustentabilidade econômica, especialmente no contexto da União Europeia.	Estudo conceitual com análise normativa da MMT e sua aplicação em políticas públicas voltadas à sustentabilidade financeira e ambiental.	A MMT fundamenta a atuação estatal direta via empresas públicas para promover sustentabilidade econômica, suprimindo falhas do setor privado em metas ambientais e sociais.
(20)	Investigar as tendências de pesquisa sobre infraestrutura verde (GI) na Coreia do Sul e internacionalmente, sob a ótica ESG, visando fortalecer políticas públicas sustentáveis.	Revisão sistemática de 98 artigos acadêmicos publicados nos últimos 10 anos, com análise de palavras-chave, temas e funções da infraestrutura verde em conexão com ESG.	A pesquisa aponta foco crescente em sustentabilidade e diversidade ecológica, recomendando ampliar estudos técnicos e sociais para fortalecer a gestão ESG via infraestrutura verde pública.
(11)	Analisar os desafios de governança dos conselhos locais na Austrália e os impactos da Lei de Governo Local de 2020 na gestão pública municipal.	Estudo qualitativo e exploratório com análise documental de relatórios do VAGO e revisão de literatura sobre ESG, ética, cultura organizacional e governança pública.	Conselhos locais enfrentam falhas éticas e de transparência. O estudo propõe práticas ESG e inclusão comunitária como pilares para governança pública sustentável e responsável.
(84)	Avaliar os benefícios de investimentos públicos em edifícios inteligentes voltados para instalações esportivas comunitárias, no contexto da sustentabilidade urbana.	Estudo de caso comparativo entre um centro esportivo inteligente e um tradicional em New Taipei City, Taiwan, medindo externalidades positivas por meio da disposição a pagar por residências próximas.	Instalações esportivas em edifícios inteligentes geram valorização imobiliária e acessibilidade, justificando investimentos públicos sustentáveis mesmo sob restrições orçamentárias, devido às externalidades positivas geradas.
(52)	Analisar o desenvolvimento do eixo urbano Bistrița–Beclean na Romênia, destacando sua conformação espacial como vetor de transição para a sustentabilidade urbana regional.	Estudo de caso comparativo com modelagem espacial urbana, análise histórica e uso de GIS, Vertical Mix e rede em estrela para diagnosticar e estruturar territórios sustentáveis.	A transformação urbana sustentável exige articulação entre infraestrutura verde, planejamento espacial e cultura local, com foco em qualidade de vida e integração cidade–subúrbio via eixo geográfico.
(51)	Avaliar o envolvimento da comunidade no desenvolvimento de infraestrutura pública em Yewa South, Ogun State, Nigéria.	Estudo transversal com amostragem aleatória e múltiplas etapas. Aplicou questionários a 195 moradores e analisou correlações entre participação comunitária e infraestrutura rural sustentável via SPSS.	A participação comunitária fortalece a sustentabilidade dos projetos, mobiliza recursos e garante continuidade. Recomenda-se ampliar orientação local e aprimorar a gestão para acelerar o desenvolvimento.

(59)	Investigar os padrões de apropriação do espaço em áreas verdes urbanas (UGSs) em Xangai, considerando seu papel na sustentabilidade e coesão social.	Estudo de métodos mistos com mapeamento comportamental, observações qualitativas e análise estatística em três parques urbanos, focando apropriação do espaço e padrões de uso.	Identificaram-se 60 atividades em parques urbanos de Xangai. A apropriação foi moderada, com vitalidade ligada à diversidade. Espaços verdes demandam melhor design e gestão.
	Investigar se os atrasos em projetos públicos de infraestrutura afetam negativamente o desenvolvimento sustentável das comunidades.	Estudo quantitativo com survey de 325 especialistas da construção no Paquistão, usando PLS-SEM para analisar seis fatores de atraso e impacto no desenvolvimento sustentável.	Atrasos em projetos públicos afetam educação, saúde e qualidade de vida. O modelo confirma impacto direto e recomenda planejamento estratégico focado em sustentabilidade comunitária.
(77)	Identificar medidas gerenciais críticas para mitigar riscos financeiros em projetos sustentáveis de Parcerias Público-Privadas (PPPs).	Revisão sistemática da literatura conforme protocolo PRISMA, com análise de 56 artigos acadêmicos relevantes.	Identificaram-se 41 medidas para mitigar riscos financeiros em PPPs sustentáveis. O estudo propõe modelo de maturidade e recomenda foco em riscos climáticos e sanitários.
(33)	Analisar como a gestão energética contribui para cidades verdes, integrando estratégias sustentáveis em diferentes domínios do planejamento urbano.	Revisão sistemática de literatura interdisciplinar entre 2000 e 2021, cobrindo sete áreas do planejamento urbano sustentável.	Gestão energética eficiente é essencial para descarbonização urbana, exigindo políticas integradas, planejamento estratégico e monitoramento contínuo.
	Analisar os efeitos da microrrenovação urbana em Wuhan, considerando o valor posicional dos bairros e seus impactos sociais e espaciais.	Estudo de caso com entrevistas, análise espacial, e aplicação dos métodos AHP e FCE para avaliar impactos urbanos e percepção comunitária.	Microrrenovações elevam valor posicional, promovem inclusão social e melhoram qualidade urbana quando adaptadas ao contexto local e às necessidades da comunidade.
	Revisar modelos de economia circular aplicados a infraestrutura em parcerias público-privadas (PPP), identificando fatores críticos para o sucesso sustentável desses projetos.	Revisão de literatura com análise temática de estudos sobre economia circular e PPPs, destacando práticas sustentáveis e critérios de desempenho.	Fatores como gestão eficaz, financiamento, materiais de baixo carbono, cadeia de suprimentos e estratégias de aquisição facilitam a implementação da economia circular em PPPs.
(85)	Propor uma estrutura integrada para melhorar sustentabilidade e resiliência de infraestrutura pública frente aos riscos das mudanças climáticas.	Revisão crítica das práticas atuais e proposta de um modelo que combina estratégias de mitigação e adaptação com métodos de pensamento de ciclo de vida: LCP, LCA, LCCA e S-LCA.	A estrutura combina mitigação e adaptação climática, apoiando decisões sustentáveis em projetos públicos com foco em segurança, equidade e conservação ambiental.
(50)	Analisar como governos locais da África Austral financiam infraestrutura pública e os impactos sobre sua sustentabilidade financeira.	Revisão de literatura e análise de dados financeiros, com foco em práticas de financiamento, gestão fiscal e implicações para governos locais.	Gestão eficaz, financiamento adequado e alinhamento com metas sustentáveis facilitam a sustentabilidade fiscal em projetos públicos de infraestrutura.
(65)	Investigar como o marketing social voltado ao anticonsumo pode apoiar políticas públicas na promoção dos Objetivos de Desenvolvimento Sustentável (ODS).	Revisão sistemática de 42 artigos científicos, com análise temática multinível sobre anticonsumo, políticas públicas e stakeholders envolvidos.	O anticonsumo promove mudanças comportamentais e sistêmicas, exigindo políticas participativas, transparência e articulação entre governos, mídia, empresas e cidadãos para alcançar metas sustentáveis.

(16)	Investigar práticas de coleta de dados ambientais em contextos urbanos por meio do urbanismo participativo, com foco na qualidade dos espaços públicos.	Análise de melhores práticas envolvendo sensores fixos e iniciativas participativas em cidades como Viena; estudo qualitativo com foco em redes densas de sensores e envolvimento cidadão.	Práticas participativas ampliam a coleta de dados ambientais, promovem transparência e fortalecem decisões municipais alinhadas à sustentabilidade e ao engajamento comunitário.
(49)	Propor uma plataforma cognitiva digital pública para apoiar decisões urbanas inteligentes, sustentáveis e resilientes em cidades de diferentes escalas, com estudo em Semarang.	Desenvolvimento de arquitetura digital com IA, análise de anomalias urbanas, integração de dados urbanos e avaliação empírica da plataforma em contexto municipal.	A plataforma melhora decisões públicas, detecta anomalias urbanas, promove engajamento cidadão e fortalece a resiliência e sustentabilidade urbana por meio de inteligência proativa.
(48)	Explorar os desafios e soluções para garantir a segurança da infraestrutura de Internet das Coisas (IoT) em cidades inteligentes.	Revisão técnica e conceitual sobre riscos cibernéticos em IoT urbano, com propostas de frameworks baseados em blockchain, machine learning e criptografia.	Infraestruturas seguras de IoT exigem colaboração entre governo, indústria e sociedade, além de adaptação contínua para enfrentar ameaças emergentes em ambientes urbanos inteligentes.
(86)	Avaliar a caminhabilidade dos bairros de Sofia, Bulgária, com base no conceito da cidade de 15 minutos, relacionando acessibilidade urbana com sustentabilidade.	Aplicação de um Índice de Acessibilidade baseado em 4000 Pontos de Interesse (POIs), com uso de métricas de diversidade (índices de Shannon e Simpson) e análise espacial via GIS.	Bairros planejados mostraram alta diversidade e acesso a serviços essenciais, enquanto áreas novas revelaram lacunas. O estudo destaca o papel do design urbano na mobilidade, saúde e coesão.
(14)	Examinar criticamente o papel das parcerias público-privadas (PPPs) no desenvolvimento sustentável de infraestrutura em Gana, propondo recomendações estratégicas.	Revisão sistemática da literatura sobre PPPs em infraestrutura ganesa, com análise de fatores críticos de sucesso, desafios e práticas sustentáveis.	Estudos concentram-se em temas dominantes, mas há lacunas críticas em clima, energia e finanças. Recomenda-se ampliar pesquisas e orientar gestores para sustentabilidade em PPPs.
(17)	Investigar a relação de longo prazo entre capital público, crescimento econômico e consumo de energia renovável e não renovável em 48 países.	Modelo econométrico PMG (grupo de média agrupada) aplicado a dados de painel, avaliando relações de longo prazo entre capital público, energia e crescimento.	Capital público impulsiona o crescimento, mas eleva o consumo de energia não renovável. Recomenda-se integrar políticas energéticas sustentáveis à gestão fiscal para mitigar impactos ambientais.
	Analisar como requisitos de aquisição pública podem ser projetados e aplicados para reduzir emissões de carbono em infraestrutura pública na Austrália, Suécia, Reino Unido, EUA e Países Baixos.	Estudo comparativo com análise documental e entrevistas sobre práticas de contratação pública sustentável em cinco países líderes em infraestrutura.	Requisitos eficazes incluem metas claras, métricas verificáveis e engajamento com fornecedores. Estratégias variam conforme contexto institucional, modelo de entrega e maturidade do mercado.
	Avaliar a eficácia do programa Portugal 2020 na melhoria da eficiência energética de infraestruturas públicas e seu alinhamento com o modelo Triple Bottom Line (TBL).	Análise documental e quantitativa das propostas submetidas por municípios portugueses, com foco em investimentos em energia renovável, iluminação pública e edifícios públicos.	Apenas 46% dos municípios aprovaram projetos; 4,2% dos recursos foram destinados a edifícios públicos. Falta equilíbrio entre dimensões ambiental, social e econômica.

	Propor um modelo adaptativo de infraestrutura inteligente que integre tecnologias digitais à gestão urbana, respeitando contextos locais e promovendo sustentabilidade econômica.	Estudo conceitual com revisão de iniciativas de cidades inteligentes e proposta de um modelo baseado em Master Data Management (MDM), integrando IoT, big data e plataformas em nuvem.	Infraestruturas inteligentes exigem adaptação institucional e cultural. O modelo MDM mostrou potencial para melhorar eficiência, segurança e resiliência urbana com base em dados integrados.
(28)	Investigar se a informação contábil melhora a compreensão e a tomada de decisão sobre ativos de infraestrutura pública nos governos locais da Nova Zelândia.	Estudo empírico com entrevistas e análise documental em conselhos locais, avaliando o uso da contabilidade patrimonial na gestão de ativos públicos.	A contabilidade pública aumenta a transparência, mas favorece ativos visíveis. Isso compromete ativos invisíveis, exigindo políticas que equilibrem visibilidade e relevância estrutural para sustentabilidade.
(47)	Propor um novo método para definir requisitos de proteção populacional no planejamento territorial, com foco na segurança urbana na República Tcheca.	Análise comparativa internacional, indução e dedução de dados normativos, seguida da proposição e aplicação de um novo método de ordenamento territorial voltado à proteção civil.	O novo método reduz ambiguidades normativas, define requisitos gerais e específicos por risco territorial, e fortalece segurança e sustentabilidade no planejamento urbano da República Tcheca.
	Investigar como a modernização da infraestrutura pública, aliada à hospitalidade urbana, pode impulsionar o desenvolvimento sustentável das cidades ucranianas.	Estudo de caso com análise documental e indicadores urbanos, focando políticas públicas de infraestrutura e práticas de hospitalidade em cidades da Ucrânia.	A modernização conjunta da infraestrutura e hospitalidade melhora sustentabilidade urbana. O estudo propõe PPPs e gestão integrada de recursos para implementar projetos sustentáveis com impacto social positivo.
(24)	Investigar como os espaços públicos contribuem para a sustentabilidade social em assentamentos tradicionais em Kuala Terengganu, Malásia.	Estratégia de métodos mistos: observação direta e aplicação de questionários a 400 residentes para identificar os elementos mais valorizados da infraestrutura pública.	Moradores valorizam comodidades adequadas, espaços públicos multifuncionais e acessíveis. Tais espaços fortalecem comunidade, preservam patrimônio cultural e promovem coesão social em assentamentos tradicionais.
(76)	Avaliar como os marcos constitucionais, legais e políticos do Zimbábue influenciam a adoção de PPPs por autoridades locais urbanas para alcançar o ODS 11.	Análise jurídica e institucional dos frameworks nacionais, com foco na capacidade das autoridades locais de implementar PPPs para infraestrutura urbana.	Apesar das restrições fiscais, PPPs têm alto potencial para sustentabilidade urbana. Requerem marcos legais mais específicos e cidades inclusivas, seguras e resilientes para serem eficazes.
(23)	Desenvolver um modelo conceitual que relacione infraestrutura social com qualidade de vida, como base para a sustentabilidade social no ambiente construído.	Pesquisa documental com revisão crítica multidisciplinar (sociologia urbana, políticas habitacionais, infraestrutura pública), categorização conceitual e construção de rede teórica sobre sustentabilidade social no ambiente construído.	O estudo propõe um modelo conceitual que conecta infraestrutura social à qualidade de vida, destacando vínculos entre ambiente construído, inclusão, saúde e bem-estar urbano.

(66)	Avaliar o impacto dos fatores de sustentabilidade na determinação dos gastos públicos em 26 países africanos.	Aplicação de múltiplos métodos econométricos robustos: Mean Group (MG), Feasible Generalised Least Squares (FGLS), Generalised Linear Mixed Effects Model (GLMM) e o inovador Method of Moments Quantile Regression (MMQREG), com dados de 1990 a 2022.	Fatores sociais ganham protagonismo nos gastos públicos, superando os ambientais e econômicos. O estudo recomenda abordagem abrangente de sustentabilidade, ajustada ao perfil fiscal de cada país.
	Comparar os impactos de CO ₂ , pegada ecológica e fator de capacidade de carga na Tailândia, testando a validade da hipótese do paraíso poluidor (PHH).	Aplicação do teste de causalidade quantílica de Fourier com dados trimestrais (1975–2018), considerando variáveis econômicas e ambientais como energia renovável e investimento estrangeiro direto.	A hipótese do paraíso poluidor é válida para CO ₂ e capacidade de carga, mas não para pegada ecológica. Energia renovável melhora a qualidade ambiental.
(25)	Propor estratégias ecológicas para promover a sustentabilidade de comunidades rurais na China, com base em estudos de caso e indicadores ambientais.	Pesquisa longitudinal na comunidade rural ecológica Yanhe, com sistema de avaliação ambiental baseado em indicadores criativos: RES, PES e NES.	O estudo propõe estratégias ecológicas focadas em água, resíduos e energia renovável. Recomenda otimizar sistemas limpos, melhorar ambientes hídricos e ampliar participação comunitária sustentável.
	Estimar a pegada ambiental da comunidade urbana de Bath e North East Somerset (BANES), Reino Unido, e avaliar sua sustentabilidade em relação à biocapacidade local.	Estudo de caso com análise de fluxos materiais, consumo energético e uso da terra, integrando dados locais e regionais com indicadores de sustentabilidade ecológica.	A pegada urbana excede a capacidade da biorregião. O estudo recomenda planejamento territorial regenerativo, redução de consumo e articulação entre escalas urbana e ecológica.
(37)	Desenvolver um sistema de apoio à decisão ambiental (EDSS-SSCI) para orientar e avaliar o desempenho das cidades inteligentes sustentáveis na Índia.	Análise documental das diretrizes da Missão Cidades Inteligentes do governo indiano, cruzada com critérios do World Bank Environment Development (WBED) e City Key Indicators.	O estudo valida 24 indicadores ambientais para o framework EDSS-SSCI, integrando parâmetros oficiais, literatura especializada e recomendações do MoUD, BIS e JICA.
(31)	Avaliar a sustentabilidade ambiental de Xangai por meio de um sistema de indicadores de co-benefícios, considerando sinergias entre políticas de redução de gases de efeito estufa e poluição atmosférica.	Aplicação do framework DPSIR (Driver-Pressure-State-Impact-Response) com 23 indicadores, análise de dados de 2005 a 2018 usando método de entropia e média ponderada para calcular o Co-benefit Index (CBI).	O estudo propõe quatro estratégias: transição energética, reestruturação industrial, investimentos ambientais e cooperação regional para mitigar chuva ácida. Aborda também aplicabilidade e agenda futura.
(32)	Criar e validar o indicador IPEEI para avaliar a sustentabilidade ecológica urbana de forma integrada, considerando água, solo e ar.	Desenvolvimento do IPEEI via modelo DPSIR e associação Domain–Theme–Element, com análise geoespacial baseada em entropia ponderada e classificação Jenks para dados urbanos.	O IPEEI mostrou consistência com o Índice Ecológico e planos locais, validando sua eficácia para orientar políticas públicas sustentáveis em cidades inteligentes.
	Investigar como políticas fiscais e inovação tecnológica podem impulsionar o desenvolvimento sustentável e fortalecer a ação climática em economias emergentes.	Análise de dados em painel de 16 países usando o método Fourier-based ARDL e o teste de causalidade Toda-Yamamoto com frequência única.	Impostos ambientais fortalecem a resiliência climática; proteção de recursos reduz emissões. Tecnologia verde tem efeito limitado. Políticas robustas apoiam os ODS 9 (infraestrutura) e 13 (clima).

(45)	Avaliar o grau de “inteligência urbana” de cidades europeias com base na norma ISO 37120, destacando lacunas nos indicadores ambientais.	Aplicação de métodos estatísticos multivariados (MSA) para analisar dados de cidades que adotaram o padrão ISO 37120, com foco em aspectos sociais, econômicos e ambientais.	Cidades inteligentes contribuem para a sustentabilidade urbana, mas carecem de indicadores ambientais. Estruturas atuais priorizam dimensões sociais e econômicas, revelando lacunas na avaliação ecológica.
	Avaliar como critérios ambientais estão sendo incorporados em licitações públicas de obras civis e identificar os principais fatores que influenciam essa inclusão.	Análise de 343 documentos de licitação de 11 países, usando estatísticas descritivas, técnicas não paramétricas e regressões logísticas para mapear 4.500 instâncias de critérios ambientais.	Nove critérios ambientais e 22 subcritérios foram identificados. Gestão ambiental é o único usado na seleção. Inclusão varia conforme obra, contrato e infraestrutura.
	Investigar como governos locais nos EUA estão avaliando e gerenciando o desempenho de suas iniciativas de sustentabilidade.	Estudo empírico com coleta de dados sobre sistemas de gestão de desempenho ambiental em municípios, análise institucional e categorização de indicadores utilizados.	Governos locais dos EUA adotam avaliações de sustentabilidade, mas enfrentam dificuldades com indicadores e suporte institucional. A maturidade dos sistemas varia, revelando potencial de aprimoramento.
(44)	Analisar a relação entre o PIB e os indicadores ambientais — gastos públicos com proteção ambiental e receitas fiscais verdes — nos países da União Europeia.	Aplicação de análise discriminante e regressão logística, comparando os indicadores espanhóis com os do Financial Trends Monitoring System (FTMS) da ICMA.	Os indicadores ICMA sobre receitas, despesas e dívida classificam corretamente a condição financeira dos municípios espanhóis, validando sua confiabilidade como ferramenta internacional.
(35)	Examinar como os gastos públicos com proteção ambiental e as receitas fiscais verdes influenciam o PIB per capita nos países da União Europeia.	Análise estatística descritiva e modelos de regressão com efeitos fixos, utilizando dados per capita do banco de dados Eurostat para todos os países da UE a partir de 2014.	Gastos ambientais promovem sustentabilidade e crescimento econômico. Já receitas fiscais verdes exigem cautela, pois podem refletir aumento de atividades prejudiciais ao meio ambiente.
(61)	Avaliar o desenvolvimento do setor de gestão de resíduos sólidos urbanos na Jordânia sob a perspectiva do crescimento verde, com foco na meta de redução de 33% até 2025 estabelecida pela Jordan Vision 2025.	Aplicação da ferramenta Sustainability Window para o período de 2010–2015, comparando três cenários: tratamento mecânico-biológico com digestão anaeróbica, tratamento mecânico-biológico com compostagem e incineração.	O modelo atual não atende aos critérios de sustentabilidade. Cenários com tratamento biológico mecânico são mais eficazes, sendo a compostagem a opção mais econômica para mitigação de GEE.
(43)	Avaliar o grau de coordenação entre crescimento econômico e proteção ambiental nas províncias chinesas, visando promover desenvolvimento sustentável regional entre 2013 e 2019.	Aplicação de modelo de acoplamento-coordenação com dados estatísticos provinciais sobre PIB e indicadores ambientais. Análise comparativa regional e temporal para medir equilíbrio entre economia e ecologia.	A coordenação entre economia e meio ambiente melhorou, mas permanece desigual. Regiões mais desenvolvidas apresentam maior equilíbrio; áreas menos desenvolvidas enfrentam desafios estruturais e ambientais.

(12)	Investigar os fatores de gestão pública que influenciam a eficiência no uso de recursos financeiros em municípios da área metropolitana de Monterrey, México.	Revisão de literatura atualizada e aplicação de questionário a 47 servidores públicos. Os dados foram analisados por meio de componentes principais e regressão fuzzy para identificar variáveis não correlacionadas que afetam a eficiência financeira.	Os fatores de controle interno e fiscalização mostraram relação positiva significativa com a eficiência no uso dos recursos financeiros. O estudo reforça a importância da transparência, ética e prestação de contas na administração pública municipal.
(42)	Investigar como gestores públicos lidam com os desafios de participação e restrições administrativas em projetos de regeneração urbana em Reggio Emilia, Itália.	Estudo qualitativo baseado na perspectiva de “estratégia como prática”, com análise de um projeto público de pequena escala em Reggio Emilia, Itália.	Gestores municipais atuam estrategicamente ao equilibrar participação cidadã e restrições institucionais, adotando práticas concretas que viabilizam projetos colaborativos de regeneração urbana.
	Identificar os fatores que limitam o desenho e a formulação de políticas públicas voltadas à conservação de recursos naturais nos governos locais da Amazônia peruana.	Estudo qualitativo com amostragem não probabilística, utilizando entrevistas não estruturadas, grupos focais e análise documental. A análise seguiu o modelo de saturação teórica da grounded theory.	A conservação ambiental é negligenciada por falta de vontade política. Conflitos, corrupção e baixa capacidade decisória comprometem a gestão. Recomenda-se governança participativa e articulação multiescalar.
(73)	Realizar uma revisão sistemática sobre micro-municípios e propor um framework em rede para sua administração eficaz.	Revisão sistemática da literatura sobre administração pública em micro-municípios, com abordagem de análise de redes para identificar os nós de influência, fluxos de autoridade e relações entre atores.	O estudo propõe um framework em rede com liderança responsiva, participação cidadã e articulação multinível, destacando a complexidade e necessidade de governança adaptativa local.
(13)	Avaliar os mecanismos utilizados para melhorar a participação comunitária no processo de Planejamento de Desenvolvimento Integrado (IDP) na África do Sul.	Estudo empírico com abordagem de métodos mistos, realizado na municipalidade de Tzaneen, província de Limpopo. Baseado na teoria da Nova Gestão Pública (NPM), com entrevistas, análise documental e observações.	Mecanismos tradicionais de participação tornaram-se obsoletos após a COVID-19. O estudo recomenda e-participação e tecnologias da 4ª Revolução Industrial para inclusão cidadã efetiva.
(62)	Apresentar múltiplos projetos aplicados em cidades com base no conceito original de Cidade Digital Estratégica (SDC), visando à gestão urbana sustentável.	Revisão sistemática da literatura sobre o modelo SDC, com destaque para 11 teses de doutorado e projetos de ação aplicada.	Os projetos originais aplicados em diversas cidades promovem avanços interdisciplinares em gestão urbana sustentável, fortalecendo inovação pública e estudos urbanos com foco democrático e estratégico.
	Investigar como governos locais integram os ODS em suas estratégias, destacando o papel da capacidade administrativa na implementação de políticas sustentáveis.	Abordagem configuracional com fsQCA aplicada a 44 municípios italianos, identificando combinações de fatores que favorecem a integração eficaz dos Objetivos de Desenvolvimento Sustentável.	Capacidade administrativa, estabilidade política e sistemas de desempenho são cruciais para localizar os ODS. Arranjos internos diversos geram caminhos alternativos para cidades mais sustentáveis.

	Investigar a aplicação de critérios ESG na gestão municipal, considerando os municípios como unidades sociais voltadas à promoção da sustentabilidade local.	Abordagem qualitativa com síntese, comparação e análise financeira. Critérios ESG foram adaptados e aplicados a municípios de Beskydy, agrupados por classificação ESG.	Critérios ESG funcionam como indicadores de sustentabilidade municipal. O estudo propõe melhorias na gestão local e sugere novas pesquisas sobre ESG no setor público.
	Identificar o papel de entidades públicas e autoridades locais na implementação de práticas sustentáveis e os indicadores utilizados para avaliar seu desempenho institucional.	Revisão bibliográfica com Proknow-C e construção de modelo avaliativo baseado na metodologia Multicritério de Apoio à Decisão Construtivista (MCDA-C).	A administração municipal prioriza a dimensão social da sustentabilidade. O modelo proposto é replicável, permitindo identificar padrões decisórios em diferentes contextos locais.