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PATTERNS IN WORLDWIDE LITERATURE ABOUT GREEN PUBLIC PROCUREMENT: BIBLIOMETRIC ANALYSIS AND KNOWLEDGE MAPPING

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Abstract:

This paper proposes a bibliometric analysis of specialized literature related to green public procurement (GPP) and aims to identify thematic developments, significant contributions, and the main research directions in this field. GPP is a process whereby public authorities seek to procure goods, services, and works with a reduced environmental impact throughout their life cycle. The bibliometric analysis is conducted using 842 publications indexed in the Web of Science databases, applying rigorous selection criteria and utilizing specialized tools such as CiteSpace and Bibliometrix. The study involves the work of 5016 authors (Appolloni A. – the most productive author), affiliated with 200 research institutions (Tor Vergata University – the most productive university) from 121 countries (China – the largest number of publications). The results indicate the most collaborative authors in GPP (Appolloni A., Testa F.), the most co-cited papers (Brammer S. 2011, Walker H. 2009), but also the most used topics (green public procurement, sustainable procurement), respectively the most current topics of interest (green innovation, supply chain management). Although research in the field of GPP is in a consolidation phase, scientific interest is growing, and the integration of green aspects into public procurement policies is becoming increasingly frequent at the international level.

Key words: *green public procurement; sustainable procurement; bibliometric analysis; CiteSpace; Bibliometrix*

1. Introduction

In the context of the transition to a sustainable economy and the growing interest in environmental policies, green public procurement represents an essential strategic tool for promoting sustainable development through green purchases made by public institutions. Green public procurement is defined as a process whereby public authorities seek to procure goods, services, and works with a reduced environmental impact throughout their life cycle, compared to goods, services, and works with the same primary

function that would normally be procured. This definition is provided by the European Commission in the context of initiatives to promote sustainable practices in public procurement (European Commission, 2008). As major consumers, governments have significant purchasing power, and by integrating environmental criteria into procurement processes, they can stimulate innovation, support sustainable industries, and reduce greenhouse gas emissions. GPP can involve selecting products with higher energy efficiency, requiring suppliers to use eco-friendly materials, or prioritizing services that minimize waste and pollution. The approach not only helps to conserve natural resources but also sets a positive example for private markets, encouraging broader adoption of sustainable practices. Implementing GPP often requires clear guidelines, staff training, and collaboration between procurement officers and environmental experts to ensure that environmental goals are balanced with cost-effectiveness and technical requirements. By leveraging their role as large-scale buyers, public authorities can help drive the transition towards a greener economy and contribute to meeting national and international sustainability targets. In the context of current climate crises and the need for a transition to a green economy, world countries are encouraged to adopt environmentally responsible public procurement practices. This paper addresses the phenomenon from a bibliometric perspective, analyzing the evolution and trends of academic research on green public procurement at worldwide level.

The main challenges include the lack of a clear and deep understanding of the benefits and principles of GPP, resistance to change from some contracting authorities, as well as limited institutional capacity in some regions. This is due to multiple factors, including:

- *Lack of expertise and technical knowledge* – Many contracting authorities do not have sufficient technical knowledge to effectively include environmental criteria in tender documents and to evaluate bids based on them. (Testa et al, 2016) (European Court of Auditors, 2023)
- *Administrative and legislative barriers* – Complex bureaucratic processes and the unclear legislation can discourage the effective implementation of GPP. In some cases, authorities are reluctant to adopt new measures for fear of violating existing regulations or due to legal uncertainty. (OECS, 2019) (Caimi & Sansonett, 2023)
- *Budgetary pressures* – Although in the long term, green procurement can generate savings and economic advantages, the higher initial costs are often perceived as a barrier by public authorities facing budget constraints. (Amann, 2014) (Vejaratnam et al, 2020)
- *Resistance to change* – The transition to GPP involves a significant shift in the traditional approach to procurement, which may encounter resistance from the staff involved in public procurement processes, especially in the absence of proper training and incentive policies. (Testa, 2019) (OECD, 2024)

This paper contributes to the specialized literature by conducting a bibliometric analysis of research dedicated to green public procurement in the last 35 years. In simpler terms, bibliometric analysis is a method that uses statistical data to study scientific publications in a specific field. This method allows us to comply with the following objectives of the paper: identification of the evolution of the research on green public

procurement, identification of the most productive authors, institutions and countries, identification of the main publications and journals, identification of current trends and gaps in GPP research. The research questions are:

- RQ1 How has research on green public procurement developed over time?
- RQ2 Who are the researchers, institutions and countries that have contributed the most in this field?
- RQ3 What are the reference journals and the most relevant studies published in the field?
- RQ4 What topics are most frequently addressed in recent research?
- RQ5 What aspects of green public procurement have not yet been sufficiently studied?

The paper aims to identify answers to the above research questions for green public procurement. The objective is to offer a new complete perspective on how literature about green public procurements has developed all over the world.

The paper is structured into five main chapters. The theoretical framework establishes the conceptual basis of the study. The methodology describes the research methods, data sources and tools used for bibliometric analysis. In the Results chapter, publication trends, the most active authors, institutions and countries, frequently addressed subfields, and collaboration networks are analyzed. The Discussion chapter interprets these results, highlighting the implications for public policies, research gaps, and the challenges of implementing green procurement. The paper concludes with Conclusions, which synthesize the main findings of the bibliometric analysis and offer recommendations for improving public policies in the field of green public procurement. Future research directions are also proposed to deepen the field and support the transition to sustainable practices.

2. Literature review

Green public procurement represents a strategic public policy tool that integrates environmental considerations into the public sector procurement process. By prioritizing products and services with a low environmental impact, GPP contributes to sustainability by reducing resource consumption, lowering greenhouse gas emissions, and promoting responsible economic practices (Testa, 2016). Public authorities spend significant amounts, representing between 12% and 20% of the national GDP of many countries, which gives them important economic power to influence production and consumption patterns (OECD, 2019). By directing demand towards eco-friendly products, governments can stimulate the market's transformation towards sustainability. Governments, being major consumers of goods and services, have a significant influence on industry and can drive environmentally responsible practices (Grandia & Voncken, 2019). When public institutions impose environmental criteria in tenders, they create incentives for suppliers to develop environmentally friendly solutions. This leads to innovation (companies invest in research and development to produce more environmentally friendly alternatives), economies of scale (as the demand for sustainable products increases, production costs decrease, making them more competitive), long-term cost reduction (although eco-friendly

products may have higher initial costs, they generate long-term savings through energy efficiency and waste reduction) (Testa et al., 2012). For instance, Testa F. et al (2019) studied GPP's impact on firm-level innovation by examining the role of eco-labels and firm size as moderating factors. They conclude that GPP can indeed stimulate eco-innovation in firms, but the effect is contingent on contextual factors (Testa et al., 2019).

The European Union (EU) is a global leader in the implementation of GPP, integrating it into its environmental policies. The regulatory framework guiding GPP in the EU includes: the EU criteria for Green Public Procurement: a set of voluntary guidelines that help public authorities include environmental requirements in procurement processes (European Commission, 2016). These criteria cover various sectors, including construction, transportation, energy, and office IT equipment; The Circular Economy Action Plan: Part of the European Green Deal, this initiative promotes the transition from a linear economy (produce-use-dispose) to a circular model, where materials and products are reused, repaired, or recycled to extend their lifespan. The EAP plays an essential role in stimulating demand for circular economy-based solutions (European Commission, 2016) and Directive 2014/24/EU on Public Procurement: This legal framework allows EU member states to include environmental and social criteria in public tenders, encouraging sustainable procurement decisions (European Parlament and European Council, 2014).

Green public procurement not only supports environmental sustainability but also stimulates innovation by encouraging companies to develop more environmentally friendly products and services (Edler & Georghiou, 2007). By establishing stricter environmental requirements, public authorities create a demand for sustainable solutions, prompting suppliers to innovate and adapt to the new standards (Testa et al., 2016). This process is particularly evident in sectors such as construction, transportation, and energy, where GPP criteria often include life cycle assessments, energy efficiency standards, and eco-labeling requirements (Cheng et al., 2018). Studies suggest that well-designed GPP policies can lead to increased market competitiveness for sustainable suppliers, as well as long-term savings for public authorities through reduced resource consumption (Marron, 2003) (Lundberg et al., 2015). In addition, GPP can act as a catalyst for systemic change, driving the diffusion of eco-innovation across various industries and encouraging private sector firms to invest in research and development (R&D) for greener alternatives (Uyarra et al., 2020). Despite these benefits, challenges such as high initial costs, lack of technical expertise, and fragmented regulatory frameworks can hinder the full potential of GPP (Amann, 2014).

Across the literature on GPP, several persistent gaps limit both scholarly coherence and policy impact. First, monitoring and evaluation remain underdeveloped: studies frequently infer environmental benefits from the presence of "green" criteria but rarely measure realized outcomes with consistent methods or comparable indicators across jurisdictions and sectors. This hampers aggregation, benchmarking, and learning, and it complicates claims that GPP is a cost-effective decarbonization lever at scale. Recent reviews and policy papers call for standardized monitoring frameworks, better baselines, and clearer pathways to attribute changes in greenhouse gas emissions to procurement choices rather than parallel policies (IISD, 2025). Second, implementation research is rich on lists of barriers and enablers but thin on credible causal identification.

Much of the evidence is cross-sectional or perceptual (surveys, case studies), which makes it difficult to separate the effect of GPP rules from context, selection, or time trends; where quasi-experimental designs do exist, they are often confined to single countries or sectors (Kundu et al., 2025) (Kou et al., 2024). Third, life cycle costing still faces operational hurdles: data gaps, capacity constraints in contracting authorities, and the transaction costs of verifying supplier claims. The result is a reliance on purchase price or simplified proxies, which can bias awards against the very options GPP seeks to favor (De Giacomo et al., 2019) (Orfanidou et al., 2023). Fourth, standardization issues persist. Heterogeneous definitions of "green," fragmented eco-labels, and varying product category rules impede comparability and raise supplier compliance costs (Rainville, 2017). Fifth, the geography of research is skewed: Europe (and, more recently, China) dominates the evidence base, with relatively little sustained analysis from low- and middle-income countries, where market structures, informality, and data availability shift both feasibility and impact of GPP. Sectoral, construction and energy-using products are overrepresented, while services, digital procurement, and maintenance/repair remain understudied despite large life-cycle footprints. Finally, even as some newer studies show firm-level innovation and ESG effects associated with GPP signaling, the heterogeneity of impacts across regulatory contexts and product categories is not well understood (Kou et al., 2024) (Tan et al., 2024). Addressing these gaps will require common measurement protocols tied to outcomes, more causal designs using administrative procurement data, stronger post-award contract management research, and expansion of studies beyond traditional regions and sectors to reflect the true footprint of public spending.

Bibliometric analysis is increasingly used to map the evolution of research on GPP, highlighting publication trends, influential authors, and dominant research themes. This method allows for an objective evaluation of the knowledge structure in the field, identifying citation networks and thematic clusters (Aria & Cuccurullo, 2017). Zheng J. et al (2021) carry out a bibliometric analysis on green public procurement and provide a mapping of the GPP research landscape by exploring co-citation networks, keyword co-occurrences, and country-level contributions. Their findings show that research is heavily clustered around themes of sustainability, policy instruments, and green supply chain integration, with European institutions leading much of the scholarly debate (Zheng et al., 2021). Torres-Pruñonosa J. et al. (2021) present a co-citation analysis of the intellectual structure of social and sustainable public procurement, mapping research traditions, disciplinary contributions, influential topics, and "burst" papers in the field (452 publications articles indexed in WoS, 2010-2020, Citepace). The paper identifies foundational works and thematic pathways, offering a roadmap for scholars entering the GPP domain (Torres-Prunonosa et al., 2021). El Baz J. and Iddik S. (2022) present green supply chain management (GSCM) and organizational culture in a bibliometric analysis of Scopus-indexed 46 publications from 2001 to 2020. They conclude that organizational culture is a key internal enabler of GSCM and thus indirectly supports GPP effectiveness where procurement is part of a wider supply chain strategy (El Baz & Iddik, 2022). Masudin I. et al. (2022) focus more narrowly on GPP implementation via supplier selection, providing a bibliometric review of the literature to understand how green procurement practices are applied in supplier evaluation and selection (220 publications indexed in Google Scholar,

1994-2022, VOSviewer). They underscore the growing attention on environmentally friendly procurement and suggest that supplier selection is a critical mechanism for embedding sustainability in procurement processes (Masudin et al., 2022). Kabra G., Srivastava S., and Ghosh V. (2023) perform a bibliometric analysis of sustainable procurement using Scopus-indexed 1294 publications (2000–2022, VOSviwer & Bibliometrix), aiming to map intellectual structure and research clusters within sustainable procurement. They focus on sustainable procurement at business level, not on green public procurements in public administration (Kabra et al., 2023).

In 2023, Rejeb et al. published a bibliometric analysis on all public procurement research using 640 publications indexed in Scopus from 1984 – 2022. They chart the structure and thematic dynamics of public procurement literature by Bibliometrix and document the evolution and growth of the field, identify major clusters (Rejeb et al., 2023). Next year, 2024, Rejeb A. et al continue their analysis by conducting a more targeted bibliometric analysis on green procurement (452 publications indexed in Scopus between 1994 - 2022, BibExcel & VOSviewer). They identify core topics such as sustainable development, sustainability, green supply chain management, and GPP, and provide a structured overview of the rapidly growing field and guidance for future research (Rejeb et al., 2024). A study done by Galán-Valdivieso F. et al. (2024) presents a comparative bibliometric analysis contrasting open-access and traditional journals in GPP research. They analyze the most influential journals, publishers, topical categories, recent trends and propose future research lines and highlight differences in accessibility, dissemination patterns, and emphasize the value of open-access publication for accelerating GPP scholarship and enhancing policy-relevance (Galan-Valdivieso et al., 2024). Lastly, Ortega Carrasco P. et al. (2025) published a systematic literature review and bibliometric analysis of GPP research spanning 2003–2023 (201 publications indexed in WoS, CitNetExplorer & VOSViewer*)*, aiming to map the evolution of themes, trends, drivers, barriers, and research gaps in this domain. They conclude that while GPP is widely regarded as a strategic tool for sustainable development, the precise drivers and barriers remain insufficiently clarified, and it calls for deeper integration of sustainability concepts to guide future research directions (Ortega Carraso et al., 2025).

This study differs from other previous bibliometric analyses in that it does not restrict the number of years analyzed (1990 is the year in which research in the field of sustainable procurement begins), uses WoS as a database (other studies use Scopus), has a considerable number of articles analyzed (842) and combines the strengths of two other analysis software (CiteSpace & Bibliometrix). By applying a bibliometric approach, this study aims to identify the academic landscape of research on GPP, tracing its historical development and emerging trends. The following methodological section details the data collection process, analysis techniques, and visualization tools used in this study.

3. Methodology

3.1. Research methods

This paper uses a bibliometric analysis to track the evolution and trends in the field of GPP. Bibliometric analysis is a recognized method in scientific literature for examining the structure and impact of research in a specific field, using metrics such as the number of

publications, citations, and collaboration networks (Donthu et al., 2021). This allows for the identification of influential authors, high-impact journals, emerging topics, and future research directions (Zupic & Cater, 2015). Bibliometric methods are widely used to analyze scientific production, providing an objective perspective on the distribution of knowledge and academic networks (Aria & Cuccurullo, 2017). Bibliometric studies are applied in various fields, including public policy (Hussain et al., 2024), environmental management (Letunovska et al., 2021), and sustainability (Nobanee et al., 2021), highlighting their usefulness in evaluating research trends. By applying bibliometric analysis to green public procurement, researchers can systematically map the intellectual structure of the field, identify knowledge gaps, and propose future research directions. This methodology offers an evidence-based approach to evaluating the scientific landscape, supporting informed decision-making and policy development in the field of sustainable procurement. As the field continues to evolve, bibliometric analysis remains a valuable tool for tracking progress and shaping the trajectory of research in green public procurement.

In this study, two research methods were used: bibliometric analysis and knowledge mapping. Regarding the first method, it is important to mention that bibliometric research methods are used to provide a quantitative analysis of textual works, in this case, publications on green public procurement. This method allows for obtaining bibliographic perspectives on the scientific production in the field. In the scientific community, this technique is increasingly used to provide details about the relationships between various groups (Zupic & Cater, 2015). Bibliometric analysis employs statistical tools and various metrics as part of the analysis, including frequency/number, co-citation, co-authorship, co-occurrence, betweenness centrality, citation burst, modularity, centrality, sigma, and Silhouette (Ninkov et al., 2022). Bibliometric analysis is used by scholars for a variety of additional reasons, such as identifying new trends in the performance of articles and journals, patterns of collaboration, and research components, as well as investigating the intellectual construction of a particular field within the body of current literature (Passas, 2024).

Regarding the second method, bibliometric analysis uses a large amount of information that needs to be transformed into knowledge. This is achieved using data visualization and knowledge maps. A visual map that serves as a knowledge base comprises a compilation of semantic propositions and logical predicates that form a body of knowledge structured as a map, in addition to the descriptive collection of data and design principles (Varanka & Usery, 2018). Among the most important attributes of a knowledge map is its ability to increase communication and share common practices across an entire organization (Balaid et al., 2016).

3.2. Data collection

A vast and complex collection of knowledge resources can be accessed and navigated more easily using knowledge mapping strategies (Novak & Canas, 2008). For conducting bibliometric analysis, it is essential to use a reliable, comprehensive, and internationally recognized data source. In this context, we selected the Web of Science database due to its extensive coverage of scientific literature and its ability to provide detailed data on publications, citations, and academic collaborations. This database is

considered one of the most relevant for conducting bibliometric analyses, providing access to a wide range of scientific works, including research articles, reviews, conference papers, and other types of publications relevant to the field of green public procurement.

The literature search was conducted using a rigorous query strategy, which included relevant keywords and Boolean operators to refine the dataset. Thus, the terms circular public procurement, government green procurement, green public procurement, ecological public procurement, socially responsible public procurement, sustainable public procurement was used in combination with operators such as IN, OR, and NOT to narrow or expand the search results as needed. To ensure that all relevant studies are included, the search was applied to the Topic; Author; Title; Abstract; Keyword Plus fields of the articles indexed in the database. The initial dataset was downloaded on 01.03.2025 and included a total of 1099 documents. Subsequently, a selection process was applied, which involved the removal of duplicate articles, the exclusion of irrelevant documents, and the application of specific inclusion and exclusion criteria. Among the inclusion criteria were:

- Articles published in recognized scientific journals and indexed in the selected database.
- Studies that directly address the subject of green public procurement, either from a theoretical perspective or through empirical case studies.
- Papers written in English to ensure the accessibility and comparability of the results.

Regarding the exclusion criteria, the following were eliminated:

- Articles that do not directly address the topic of green public procurement but only make marginal references to it.
- Incomplete studies or those that do not provide sufficient information to be included in the analysis.
- Duplicates of the articles.
- The language in which they were written/published.
- Documents published in the form of letters, book reviews, or editorial notes that do not contain empirical data or in-depth analyses.

Following the application of these filters, the final dataset was reduced to 842 articles, which were used in the bibliometric analysis. These publications span a time frame from 1990 to 2025, allowing for the observation of trends in the evolution of research in the field of green public procurement. The distribution of the types of publications included in the analysis revealed that 69% of the documents are scientific articles, followed by 10% conference papers, 14% reviews, and 7% other types of publications, such as book chapters or technical reports. This distribution highlights the academic interest in the subject and allows for a better understanding of how research on green public procurement has been structured over time. Through this data search and selection strategy, we ensured that the bibliometric analysis provides a representative and relevant picture of the research in the field of green public procurement, thus contributing to a better understanding of the evolution of this topic in scientific literature.

Figure 1 graphically presents the data collection strategy of this study following the PRISMA methodology. The PRISMA methodology provides a standardized set of guidelines and a checklist to ensure transparency and completeness in the reporting of research syntheses.

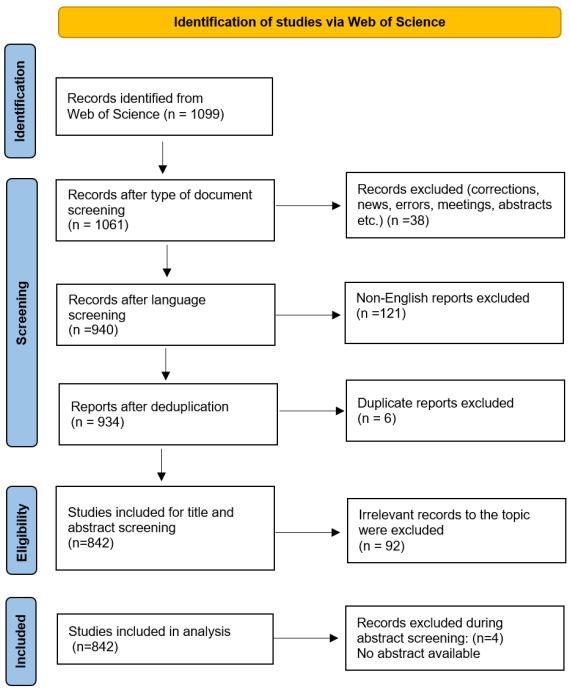

Figure 1. PRISMA Diagram
Source: Web of Science, processing carried out by the author

3.3. Visualization software

CiteSpace is software dedicated to the analysis and visualization of bibliometric data, recognized for its ability to highlight emerging trends, turning points, and certain structures within a scientific field. Developed by Professor Chaomei Chen from Drexel University, CiteSpace is free and can be downloaded from https://citespace.podia.com/. It allows the creation of complex networks of co-citation, co-occurrence of keywords, and collaboration between authors or institutions, using advanced community detection techniques and centrality analysis. CiteSpace stands out for its ability to identify informational "bursts" and to construct temporal maps that highlight the evolution of research in a particular field. The main parameters used include the selection of the time, the criteria for cutting networks (such as g-index or top-n), normalization methods, and temporal segmentation options. Its chronologically oriented interface and functions for highlighting innovative contributions make it an essential tool for the evolutionary analysis of scientific literature.

Bibliometrix is an open-source R package designed for quantitative research in bibliometrics and scientometrics (https://bibliometrix.org/biblioshiny/biblioshiny1.html). It provides a comprehensive set of tools for analyzing scientific publications and their citations, including data importing, data processing, and visualization. Bibliometrix allows researchers to import data from various sources, offers tools for bibliometric analysis, including citation analysis, co-citation analysis, co-word analysis, and more. Bibliometrix can generate various maps and graphs to illustrate research trends and relationships.

Bibliometrix is a powerful tool for researchers who want to quantitatively assess scientific literature and its impact (Aria & Cuccurullo, 2017).

4. Results

The first step in scient metric analysis consists of examining the evolution of the number of publications in the researched field. The way they are distributed over the years reflects the interest given to green public procurement and the pace at which this concept has developed. The first three articles dedicated to green public procurement were published in 1990, marking a minimum number of annual publications (1), but also demonstrating the existence of this concept for over three decades.

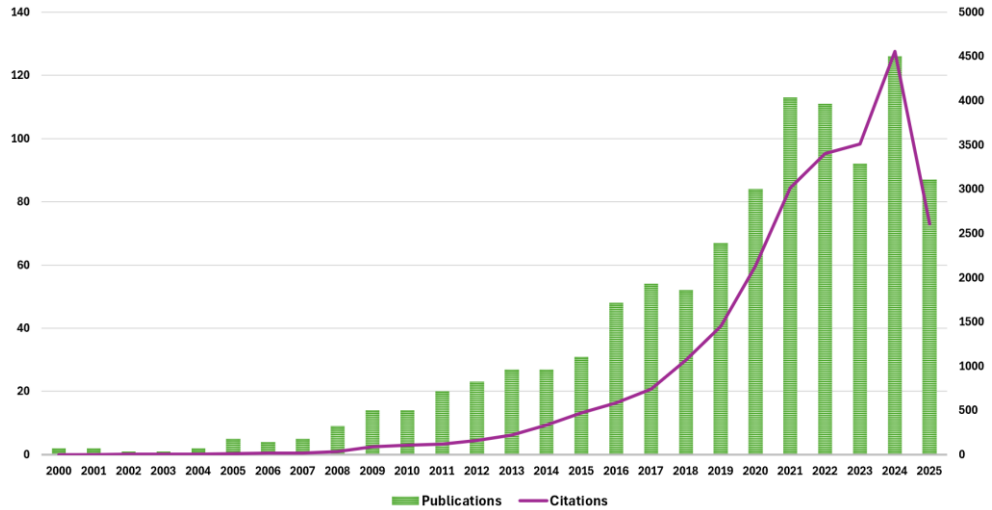

Figure 2. Evolution of publications in the field of green public procurement from 2000 to 2025

Source: Web of Science, processing carried out by the author

The analysis of the data presented in Figure 2 highlights a general trend of increasing publications dedicated to green public procurement, reflecting a growing academic and institutional interest in this field. However, the evolution was not linear, but marked by significant fluctuations, suggesting the existence of recurring cycles of interest and conceptual development. In the first stage of the analyzed period, namely between 1990 and 2010, an extremely low number of published works was recorded, indicating that the field of green public procurement was still in an early stage of development. During this period, only 47 articles were published, authored by 112 individuals, over a span of 20 years, thus representing only 5.55% of the total publications analyzed. This trend can be attributed both to the lack of clear regulations and policies regarding sustainable public procurement and to a reduced awareness of the importance of integrating environmental criteria into the public procurement process. This initial stage is therefore characterized by a low level of research and documentation in the field, possibly due to limited interest from decision-makers and the academic environment. As concerns about sustainability and environmental protection began to gain momentum globally, the number of publications

started to gradually increase, signaling a paradigm shift and an increasingly evident recognition of the role that green public procurement can play in promoting a sustainable economy.

The evolution of the number of citations also follows the trend previously presented by the increase in the number of publications. The upward trend is maintained, adhering to the previously presented distribution. The increase in the number of citations reflects the growing interest of specialists in researching this field, especially after 2017, when a constant and accelerated growth in annual citations begins. The last 8 years indicate a particular interest from researchers and the academic environment in green public procurement, reaching a peak in 2024 with over 4375 citations, an evolution driven by the increased interest in the conceptualization and development of this field, anticipating a deepening and expansion of research in the future.

Geographical analysis provides a detailed perspective on the distribution of publications at the international level, highlighting the concentration of research in certain regions and the degree of involvement of different states in the development of this field. In total, the 842 publications analyzed reflect the contributions of authors from 121 countries, thus demonstrating the global interest in green public procurement, as well as the existence of significant discrepancies regarding academic and institutional involvement. Among these countries, the top 10 states with the most significant contributions in the field are: China, which leads the ranking with 107 works, followed by Italy with 100 publications, and the United States of America with 91 publications. In the following positions are England, with 82 publications, Spain, with 71, Sweden, with 63, as well as Germany, the Netherlands, and Australia, which complete the list of countries with intense activity in this field. Together, these 10 countries produced 579 publications, which represent 68% of the total publications, highlighting a strong concentration of research in a few geographical areas.

In terms of relative distribution, according to statistics, the most active nation in the field of green public procurement is China, generating 12.70% of all analyzed documents. This percentage is 0.93 times higher than that recorded by Italy, the country in second place, and 0.85 times higher than the contribution of the United States of America, ranked third. These data indicate a minor difference in the level of interest and academic investments in this field between different regions. On the other hand, at the opposite end, there is a considerable number of countries where research in the field of green public procurement is still at an early stage. In 69 countries, the number of publications is at most 5, which suggests limited engagement either due to differing academic and economic priorities or due to the lack of clear policies regarding the implementation of sustainable procurement. This discrepancy underscores the need to expand research and promote this field globally to ensure a broader adoption of sustainable principles in public procurement.

In our study, 5016 different authors were identified, each having individually published between one and 13 works. This diversity of contributions reflects both the existence of renowned researchers with prolific activity and the occasional participation of authors interested in specific aspects of green public procurement. However, only 8 authors contributed to more than 5 articles, thus highlighting a small group of specialists who focused their efforts on this field.

Table 1. Top 10 authors with the most publications in the field of research on green public procurement

No.	Author	Pubs	%	H-index	Topics addressed	Reference
1	Appolloni A.	13	1.54%	31	Bibliometric analysis, critical reviews, systematic reviews, future trends in green public procurement, green procurement practices, circular procurement, e-procurement, sustainable procurement	(Cheng et al., 2018) (Appolloni et al., 2014)
2	Liu J.Q.	9	1.07%	15	Green training for public procurement, firms' environmental certification, efficiency of procurement	(Liu et al., 2020) (Ma et al., 2021)
3	De Boer L.	8	0.95%	18	Greener supplier selection, green procurement, selecting green criteria, public procurement reform in EU	(Igarashi et al., 2013) (Michelsen & de Boer, 2009)
4	Iraldo F.	7	0.83%	10	Opportunities for GPP, factors of GPP, content analysis in GPP, GPP and life cycle costing	(Testa et al., 2016, 2019, 2012)
5	Rosell J.	7	0.83%	40	Macro and meso determinants of GPP, EU institutions as green actors, GPP during COVID-19	(Rosell, 2021) (Badell & Rosell, 2021)
6	Testa F.	7	0.83%	39	Opportunities for GPP, factors of GPP, content analysis in GPP, GPP and life cycle costing	(Testa et al., 2016, 2019, 2012)
7	Bohari A.A.M.	6	0.71%	6	Green construction procurement, green procurement implementation, green procurement in construction, e-procurement	(Bohari et al., 2020, 2024)
8	Xia Bo.	5	0.59%	39	Green construction procurement, green procurement implementation, green procurement in construction, e-procurement	(Bohari et al., 2020, 2024)
9	Iossa E.	5	0.59%	14	Procurement of innovative solutions, procurement cartels, pre-commercial procurement	(Iossa & Latour, 2025) (Iossa et al., 2017)
10	Malatinec T.	5	0.59%	4	Local barriers in GPP, green products	(Malatinec, 2019)

Note: Topics addressed by authors were identified by screening the title of the articles published by them over time.

Source: CiteSpace, processing performed by the author

Table 1 presents the top 10 authors with the most publications in the field of green public procurement and their research themes in the field. The leader of this ranking is Appolloni A.. The 10 most prolific authors have together produced 63 articles, representing 7% of the total publications. This concentration of scientific production suggests that research in the field of green public procurement is not dominated by a group of experts whose works are reference points for the academic community, but rather indicates a broader distribution of contributions, with a diverse participation of authors from different

corners of the world and various fields of specialization. This diversity may indicate extensive and interdisciplinary involvement, where researchers from economics, law, public policy, and environmental science collaborate to develop innovative knowledge and solutions for the implementation of green public procurement.

On the other hand, it is observed that most researchers (83% of the total) have contributed with fewer than two papers, which indicates either sporadic participation in this field or an interdisciplinary approach, where green public procurement is integrated into broader studies on sustainability, economic policies, or governance. An important aspect is the ratio between the number of authors and the number of publications, which is 5016 to 842, reflecting a pronounced trend of collaboration among researchers, likely favored by the complex and multidimensional nature of this field.

From an institutional perspective, the 5016 authors are affiliated with 200 different institutions, demonstrating a wide network of research centers interested in green public procurement. The top 10 organizations with the highest number of publications in this field are Tor Vergata University, with 21 papers, followed by the Bucharest University of Economic Studies, with 16, the University of London, with 16, as well as Norwegian University, Lund University, Scuola Superiore Sant Anna, and the Royal Institute of Technology. The list is dominated by 59 institutions, which confirms a trend observed at the national level as well: research on green public procurement is concentrated in a few prestigious regions and universities.

In total, the top 10 organizations contributed 140 articles, which represents 17% of the total publications analyzed. This concentration of research in a few centers of excellence suggests the existence of well-defined academic groups that play an essential role in the development and dissemination of knowledge in this field. Additionally, this distribution may indicate a need for diversification and expansion of research to other institutions and regions, to ensure better implementation of sustainability principles in public procurement globally.

Finally, it is essential to identify the academic publishers that have published the most articles on green public procurement, as they represent the main channels for disseminating research results in this field. Regarding the titles of the publications, a total of 149 distinct academic publishers included the 842 analyzed documents related to green public procurement in their pages.

Table 2 presents the top 10 journal with the most publications in the field of green public procurement. Together, the first three journals have published 21% of the papers analyzed. The journals with the most published papers about GPP and related topics are Sustainability and Journal of Cleaner Production. This concentration of articles in a few prestigious journals suggests that the field of green public procurement is beginning to be recognized as a topic of interest in international scientific literature.

Table 2. Top 10 journals by the number of publications in GPP field

No.	Journals	Pubs	%	Category	JIF	Quartile
1	Sustainability	93	9.100	SCIE - Environmental sciences	3.3	Q3
2	Journal of Cleaner Production	92	9.002	SCIE - Environmental sciences	10	Q1
3	Journal of Public Procurement	30	2.935	ESCI – Public Administration	2.3	Q2
4	Journal of Environmental Management	15	1.468	SCIE - Environmental sciences	8.4	Q1
5	Environment Development and Sustainability	11	1.076	SCIE - Environmental sciences	4.2	Q2
6	Journal of Purchasing and Supply Management	10	0.978	SSCI - Management	8.7	Q1
7	Ecological Economics	9	0.881	SCIE - Environmental sciences	6.3	Q1
8	International Journal of Life Cycle Assessment	9	0.881	SCIE - Environmental sciences	5.4	Q1
9	Amfiteatru Economic	8	0.783	SSCI - Economics	2.0	Q2
10	Buildings	7	0.685	SCIE – Engineering, civil	3.1	Q2

Note: Pubs = publications, % = share in total analysed documents, JIF = Journal Impact Factor according to Journal Citation Reports 2024, Quartile = category ranking by JIF

Source: Created by authors using the analyzed database

Co-authorship networks and social network analysis are becoming increasingly effective techniques for evaluating collaboration patterns and identifying the most important researchers and institutions in the field of green/public procurement. The authors' collaboration network can help identify authors with significant contributions and highlight the cooperative relationships between them. Using CiteSpace, the co-authorship network was created without performing the pruning of segmented networks. The co-authorship network contains 296 nodes and 307 links. Figure 3 presents the network of the most collaborative authors in the field of green/public procurement, all having at least 2 published works as co-authors. As indicated by the node names, each node represents a different author, and the size of the node corresponds to the number of publications by each author. The connections made by the collaboration of authors are represented by the interconnections between each pair of nodes. The degree of cooperation between authors is indicated by the thickness of the connection.

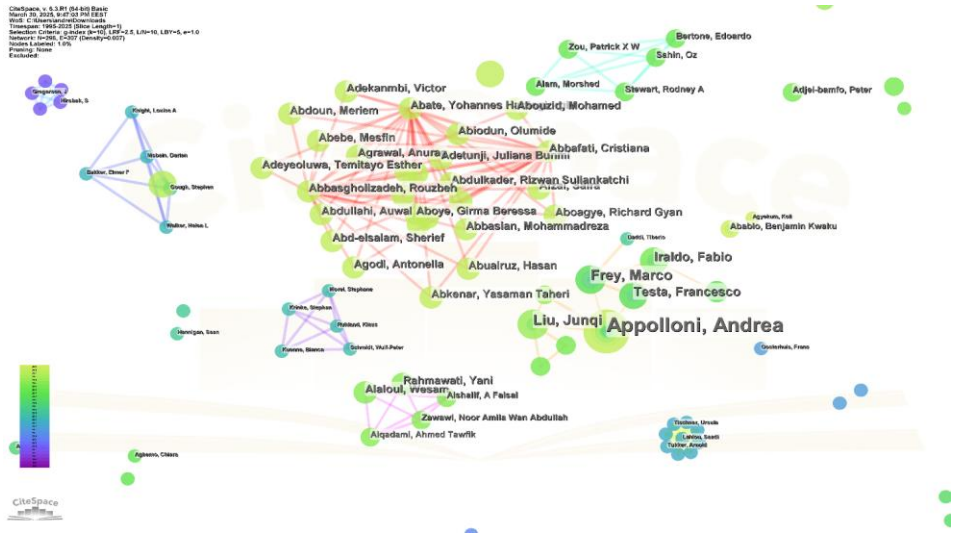

Figure 3. The co-authorship network in the field of green public procurement
Source: Web of Science, processing carried out by the author

The co-authorship map shows that there are no strong collaborative relationships between authors, with the network density level being 0.007. Moreover, they are divided into small research groups, and cooperation for research in the field of green/public procurement is insignificant. The first five collaborative authors are Appolloni A., Testa F., Abbasian M., Gough S., and Alaloul W. In Figure 4, the cooperation between 8 research teams can be observed. These research teams are formed around key authors in the field of green/public procurement and are integrated as the most collaborative. The first research team is formed around Appolloni A. and Testa F., who have published works on various aspects of green public procurement between 2013 and 2024.

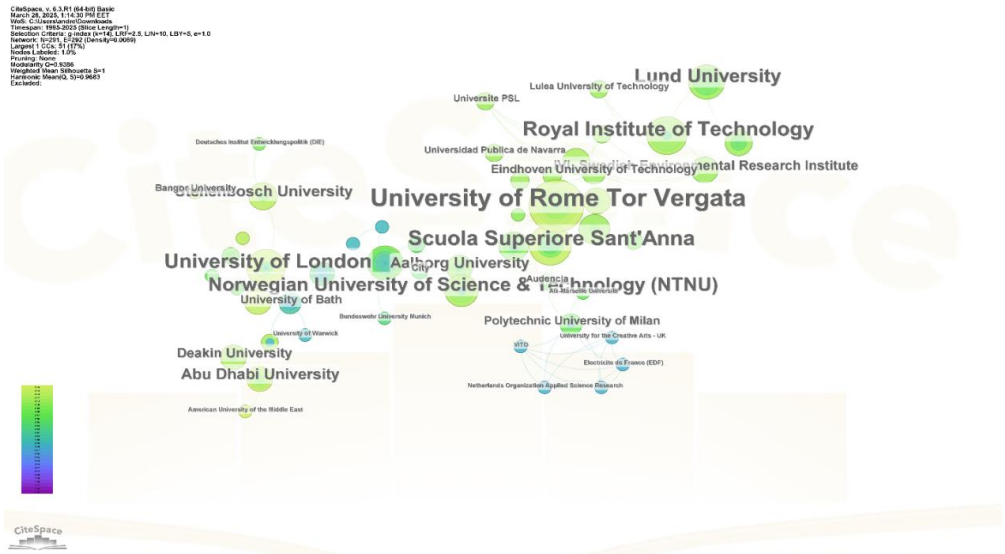

Figure 4. The collaboration network between institutions in the field of green public procurement
Source: Web of Science, processing carried out by the author

To complete the co-authorship analysis, we studied the level of cooperation between institutions. For this purpose, we generated a network where the nodes represent institutions, without applying data removal methods. The level of cooperation is indicated by the thickness of the connections between nodes. The network contains 291 nodes, 292 links, and a density of 0.0069. The institutions that have published more than 3 collaborative papers are labeled, with the label size depending on the number of collaborative publications. None of the analyzed institutions exhibit a high centrality value, indicating weak cooperation among them, and the connections are very transparent due to the insignificant number of publications resulting from collaboration between organizations or universities. As can be seen in Figure 4, the top 10 institutions with the most collaborations in the field of green public procurement are: Tor Vergata University, with 21 papers, University of London with 16, Bucharest University of Economic Studies with 16, followed by Norwegian University, Lund University, Scuola Superiore Sant Anna, and Royal Institute of Technology.

Progress in a field is achieved only through effective communication and collaboration. The analysis of collaboration between authors from various countries can help identify the top countries in green public procurement research. The map illustrates collaboration between countries reveals a network of 79 nodes, 385 links, and a density of 0.125. It is important to mention that the co-authorship network between countries has a density 1.83 times greater than the institutional collaboration network. The map was generated in CiteSpace without applying cleaning parameters. In Figure 5, the countries with more than 2 collaborative publications on the topic of green public procurement are highlighted.

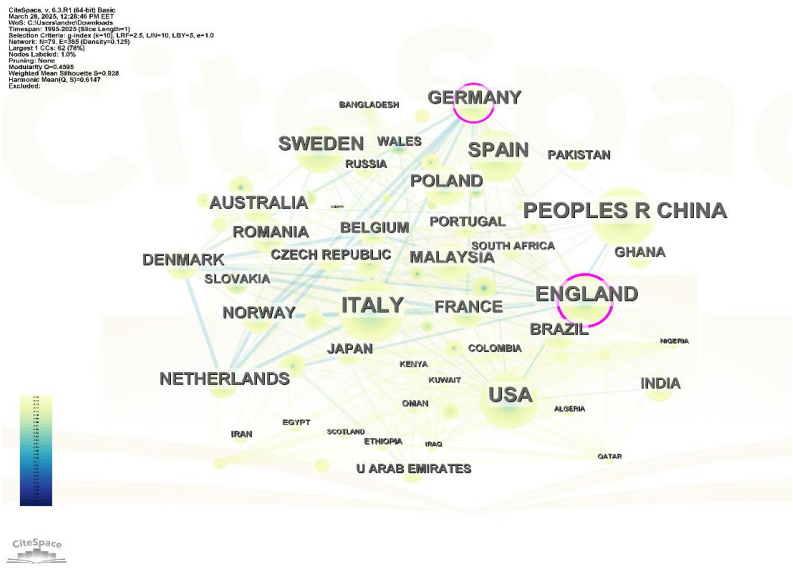

Figure 5: The collaboration network between countries in the field of green public procurement

Source of data: Web of Science, processing performed by the author

As can be observed, the largest nodes represent the most involved nations with a high degree of collaboration. The collaboration between the institutions of these countries is illustrated by the connections between the nodes. The significant differences between the first two countries and the rest of the nations are evident. The network of the most collaborative country, China, includes 107 publications. Next is Italy, with 100 works. These two countries have had a major impact on global academic exchanges related to green public procurement. The other two countries with notable collaboration are England, with 82 publications, and the United States of America, with 91 works, which suggests a level of cooperation 1.3 times lower than that of the leading country. The list of the top 10 most collaborative countries continues with: Sweden, with 63 publications, the Netherlands, with 39 works, Australia, with 37 publications, Poland, with 35 works, Malaysia, with 34 publications, and France, with 29 works. A significant surge in citations has been identified for four countries: United States of America 2023-2024, England 2023-2024, Italy 2023-2024, and China 2022–2024; this surge suggests considerable interest and a rapid increase in the impact of research in the field of green public procurement. This phenomenon may indicate a significant change in the perception or application of research, signaling that the topics addressed are current and highly relevant to the scientific community. Additionally, such an increase in citations suggests that new works are being quickly adopted and cited, which may reflect a shift in research trends or a rapidly expanding field.

In the continuation of the analysis, we investigated the most cited works in the field of green/public procurement. Co-citation analysis was used to identify the most relevant references in this sector. Out of a total of 19,919 references related to green public procurement, we constructed a co-citation network with 284 nodes and 1,158 links, having a density of 0.0288. The network map was generated without applying the elimination parameter. In Figure 6, the works that have accumulated more than 5 co-citations are labeled. Table 3 presents top 10 the most influential publications in GPP field, the most co-cited papers and the themes addressed by them. The most influential work, according to the analysis, is published by Stephen Brammer in 2011. In this paper, the author focuses on the analysis of sustainable public procurement at the international level, comparing different countries and approaches. The main objective of the study is to understand how sustainable procurement practices are integrated into the public sector in various regions and to evaluate their impact on the environment, economy, and society. The paper was essential in defining the concept of public procurement.

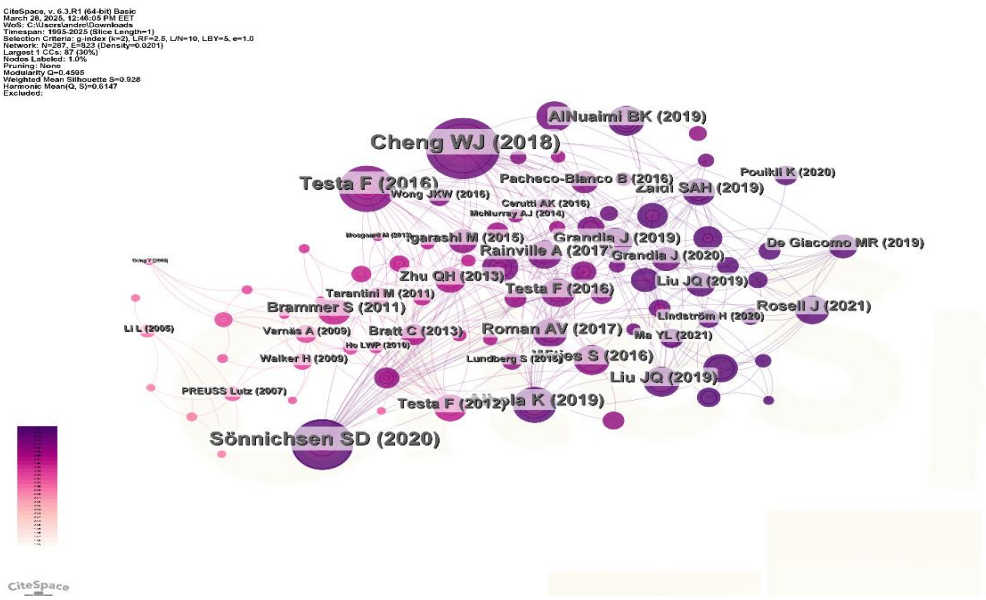

Figure 6. The co-citation network of references in the field of green public procurement
Source: Web of Science, processing performed by the author

Table 3. Top 10 the most influential publications in green public procurement research

No.	Reference	Journal	Year	Betweenness	DOI	Topic addressed
1	Brammer S.	International Journal of Operations & Production Management	2011	58.467	https://doi.org/10.1108/01443571111119551	International comparative study of sustainable public procurement drivers, barriers, and adoption patterns.
2	Walker H.	Supply Chain Management: An International Journal	2009	20.932	https://doi.org/10.1108/13598540910941993	Survey of UK public authorities; conceptual framework of influences on sustainable procurement adoption.
3	Testa F.	Ecological Economics	2012	36.483	https://doi.org/10.1016/j.ecolecon.2012.07.011	Analysis of determinants of green public procurement uptake; role of organizational resources, knowledge, and perceived risks.
4	Zhu Q.H.	Soil and Tillage Research	2013	18.174	https://doi.org/10.1016/j.still.2013.01.013	Soil carbon sequestration dynamics in different farming systems; scientific evidence supporting sustainability criteria.
5	Michelsen O.	Journal of Environmental Management	2009	13.051	https://doi.org/10.1016/j.jenvman.2009.08.001	Survey of Norwegian municipalities/counties on green procurement; links between organizational capability and practice.
6	Preuss L.	Supply Chain Management: An	2009	8.538	https://doi.org/10.1108/13598540	English local government procurement and sustainable

		International Journal			10954557	development; typology of practices, enablers, and institutional barriers.
7	Varnäs A.	Journal of Cleaner Production	2009	9.233	https://doi.org/10.1016/j.jclepro.2009.04.001	Swedish construction procurement practices; environmental criteria in tenders, competition and verification challenges.
8	Mccrudden C.	Natural Resources Forum	2004	4.550	https://doi.org/10.1111/j.1477-8947.2004.00099.x	Legal analysis of public procurement as a tool for social policy; historical and regulatory backdrop for sustainable procurement.
9	Thomson J.	Journal of Environmental Planning and Management	2007	6.369	https://doi.org/10.1080/09640560701261695	Policy analysis of UK sustainable procurement implementation; impact of national reforms and local authority practices.
10	Bratt C.	Journal of Cleaner Production	2013	5.917	https://doi.org/10.1016/j.jclepro.2013.02.007	Evaluation of national GPP criteria development using the Framework for Strategic Sustainable Development (FSSD); recommendations for stronger sustainability linkages.

Source: CiteSpace, processing performed by the author

Drawing across the works from Table 3, the literature traces a clear evolution from mapping sustainable/green public procurement (GPP/SPP) practice to interrogating its enabling conditions, scope, and performance—and even the scientific baselines that inform “what to buy.” Taken together, these studies map four recurring themes: (1) uneven implementation shaped by organizational capability and policy consistency; (2) the need for standardized, life-cycle-based criteria and dependable verification; (3) sector-specific complexities (notably in construction) that demand tailored guidance and stronger post-award oversight; and (4) a broadened conception of “green” that intersects with social aims and with the scientific metrics necessary to credibly measure environmental performance.

In Figure 7 are highlighted the authors and institutions with the greatest impact in the analyzed research network, where the size of the nodes reflects the frequency of co-citations, and the highlighted names correspond to the most influential entities in the field. A remarkable element of the analysis is the presence of a node labeled "unknown," which is the largest in the network, indicating an issue of incomplete data in the database or the existence of a frequently co-cited anonymous author.

In such cases, verifying the database and sources becomes essential to determine whether it is a technical error or a real author whose identity has not been correctly indexed. Besides this anomaly, another important node in the network is the "European Commission," which suggests that the policies and research promoted by the European Commission are frequently co-cited, reflecting a significant impact on the analyzed topic.

Additionally, the authors Walker H., Brammer S., Cheng W.J., Grandia J., and Uyarra E. stand out due to the size of their nodes, indicating that their works are strongly

integrated into specialized literature. The network illustrated in the graph is dense and interconnected, with multiple links between authors and institutions, suggesting an extensive academic influence of the main identified entities. The large nodes are connected to multiple smaller nodes, indicating a significant propagation of ideas and a well-developed academic ecosystem. This co-citation network suggests that certain works and institutions play an essential role in shaping the field, while the presence of an anonymous author raises methodological issues related to the completeness and accuracy of the database.

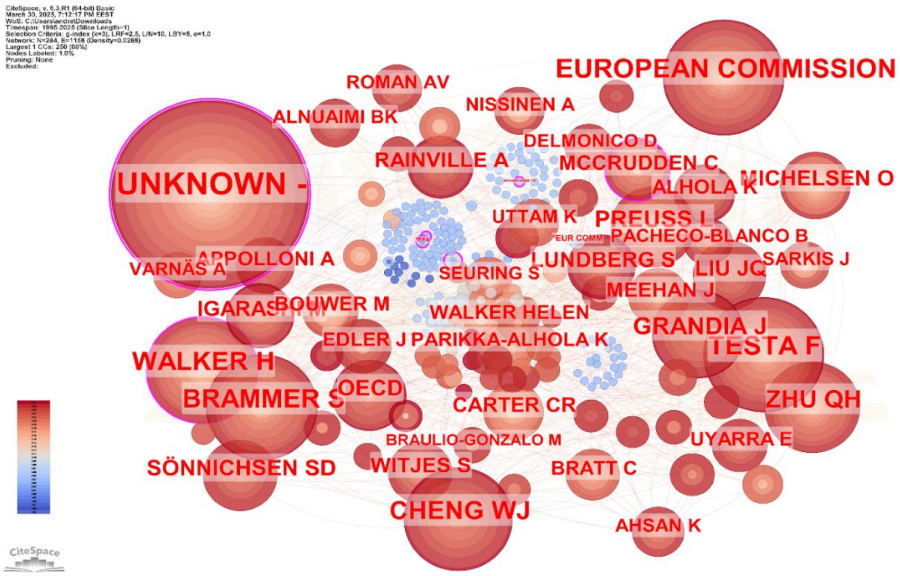

Figure 7. The co-citation network of authors in the field of green public procurement
Source of data: Web of Science, processing performed by the author

Co-occurrence networks and the analysis of relationships between terms are increasingly used to identify the main research directions and topics of interest in the field of green public procurement. Keywords play an essential role in highlighting the main themes studied, providing a perspective on the conceptual structure of the field.

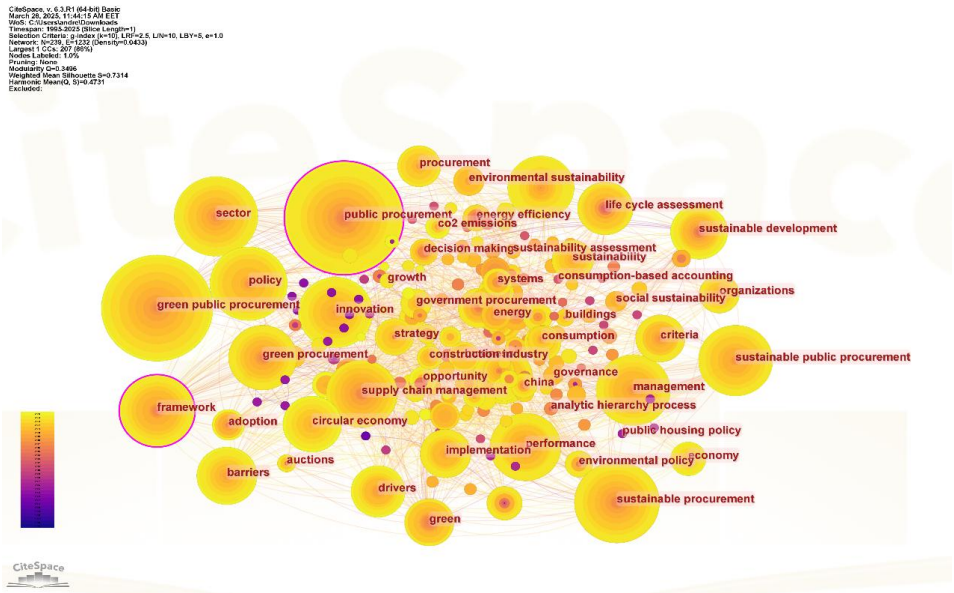

Figure 8. The co-occurrence network of keywords in the field of green public procurement
Source of data: Web of Science, processing performed by the author

Without the application of filtering techniques, the network of associated terms is represented in Figure 8. It contains 239 nodes and 1232 connections, with a density of 0.0433. The keywords that appear at least 20 times are labeled. Table 4 presents the 30 most frequently used keywords from the 842 analyzed articles. Among these, "green public procurement" and "sustainable procurement" are the most frequent, being associated 193 and 106 times, respectively. The next term with a high frequency is "sustainable public procurement," appearing 87 times. An essential indicator in the analysis of the co-occurrence network of keywords is centrality, which reflects the influence and importance of a term within the field. In this analysis, all keywords have a null betweenness centrality.

Table 4. Top 30 keywords

No.	Keyword	No.	Keyword	No.	Keyword
1	green public procurement	10	green procurement	20	criteria
2	sustainable procurement	11	impact	21	procurement
3	sector	12	sustainable development	22	sustainability
4	management	13	barriers	23	model
5	sustainable public procurement	14	circular economy	24	organizations
6	policy	15	challenges	25	strategy
7	innovation	16	green	26	construction
8	performance	17	life cycle assessment	27	climate change
9	framework	18	drivers	28	design
10	supply chain management	19	implementation	29	auctions

Source: CiteSpace, processing performed by the author

The evolution over time of the terms relevant to the field of green public procurement can be observed in Figure 10, which presents their structure by clusters. The temporal analysis conducted with the help of CiteSpace is limited to the period 1995 – 2025, which allows for the observation of the dynamics of terms and significant changes in the specialized literature. This temporal analysis allows for the identification of emerging trends in the research on green public procurement, highlighting how certain concepts and terms have evolved and adapted in response to global economic, political, and social changes. For example, in the early years of the period (1995-2005), terms related to "green procurement" and "sustainability" began to gain ground in the specialized literature, reflecting a growing concern for environmental protection and resource efficiency. During this period the research is also focused on topics such as “green economy” and “climate change”.

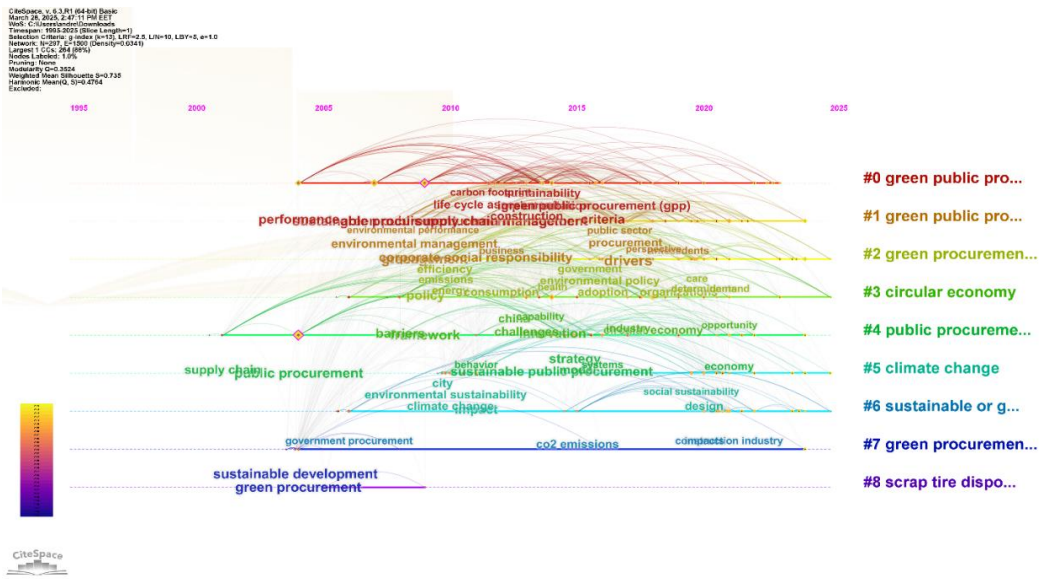

Figure 10. The evolution of keyword clusters between 1990 and 2025
Source of data: Web of Science, processing carried out by the author (CiteSpace)

As time progressed (2005-2015), the concept of "green public procurement" became a central term, especially within the European Union, which introduced specific policies and regulations in the field of green public procurement. This period was marked by a greater emphasis on integrating sustainability principles into public procurement, as well as on the use of innovative methodologies for assessing ecological impact. Other frequent related topics studied by researchers during the period are “eco-design”, “public transport” and “environmental justice”.

Starting from the more recent period (2015-2025), research has focused more on the practical implementation of GPP, with an emphasis on developing tools and policies that facilitate their adoption by public authorities. Terms such as "ecological impact assessment," "green innovation," and "social responsibility in public procurement" have begun to be increasingly encountered, reflecting the need to address challenges related to

climate change and to support the transition to circular and sustainable economies. Figure 11 also presents a thematic evolution of terms used in the GPP publications. This thematic evolution is focused on the last 5 years topics researched by authors in GPP (last two columns). It can be noticed the researchers are also interested in studying “carbon reduction”, “life-cycle assessment”, and “renewable energy”, topics of interest in the context of global warming and pollution reduction. The intensification of research in the field of GPP from 2020 to the present is also due to the fact that the European Union launched the European Green Deal in 2019, which is intended to transform the EU into a modern, resource-efficient and competitive economy and to transform Europe’s economy, energy, transport, and industries for a more sustainable future. In this context, terms such as “electric vehicles”, “environmental product declarations”, “green construction”, “life-cycle assessment”, and “green innovation”, continues to by hot research topics at the present (2024-2025).

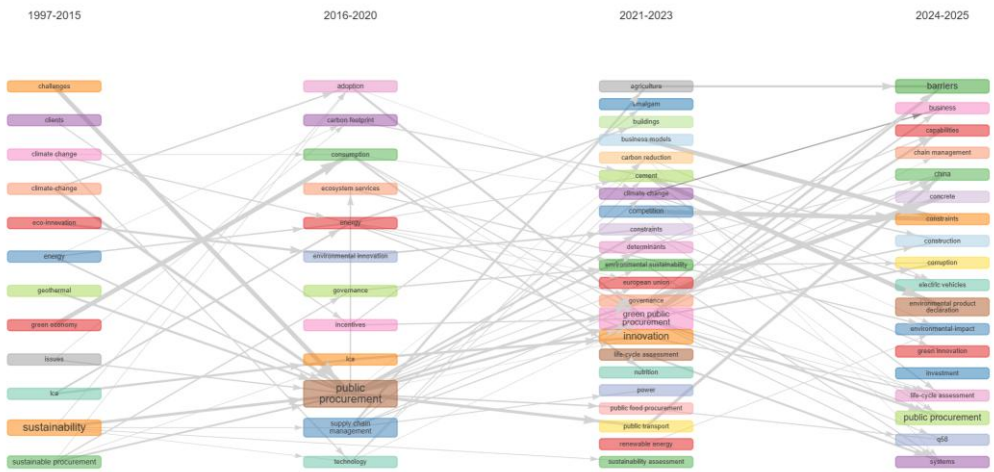

Figure 11. Thematic evolution of keywords in green public procurement research
Source of data: Web of Science, processing carried out by the author (Bibliometrix)

It should be added that there is an intensification of research in the field of GPP in China. For example, in the first 6 months of 2025, approximately 30 articles (43%) were published and indexed in WoS presenting various studies in the field of GPP with applicability in China, compared to 10 articles referring to GPP in the European Union. Among the current research topics studied by Chinese authors are government procurement and climate change perceptions (Li, 2025), corporate green innovation influenced by government green procurement (Zou et al., 2025), enterprise green transition under the pressure of GPP (Gao & Lu, 2025), GPP as a public policy (Zhang et al., 2025).

Thus, the temporal analysis of terms in the field of green public procurement highlights the transition from theory to practice and the continuous adaptation of research in the face of new global challenges and regulations. Figure 12 presents a thematic map, a visual tool for exploring the landscape of GPP field and understanding research topic dynamics. The map uses two dimensions, usually centrality and density, to categorize themes into four quadrants, each representing a different type of theme. Centrality

indicates the importance of a theme within the research field, based on how frequently it appears in literature and its connections to other themes. Density reflects the internal development and specialization of a theme, based on the frequency of keywords within the theme's cluster.

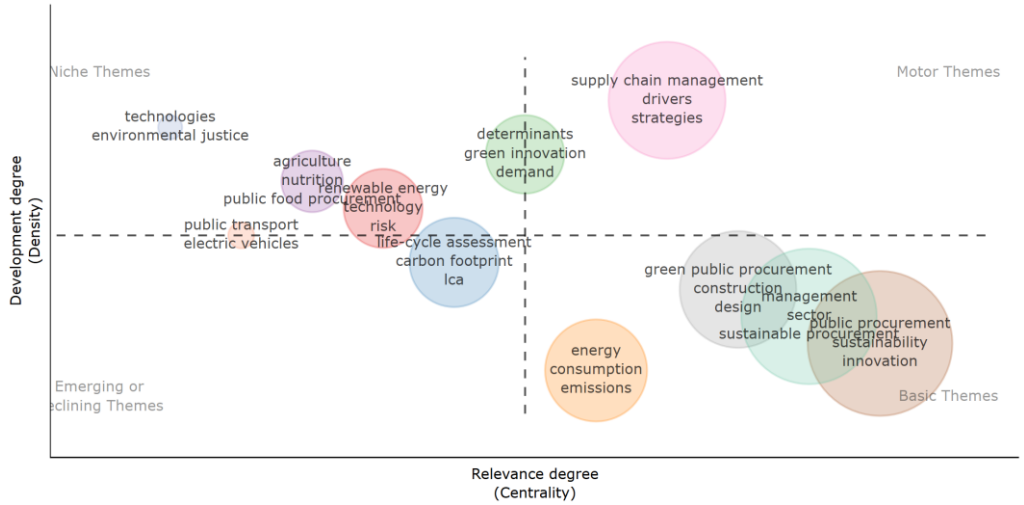

Figure 12. Thematic map in green public procurement research
Source of data: Web of Science, processing carried out by the author (Bibliometrix)

As it can be seen, “green innovation” and “supply chain management” are motor themes and represent well-developed and important research themes in GPP. “Green public procurement”, “sustainable procurement”, “construction”, “consumption”, and “sustainability” are basic themes, they are important but less developed themes. Niche themes, such as “green technology”, “renewable energy”, “environmental justice”, and “agriculture” are specialized and well-defined themes. Emerging themes, such as “electric vehicles”, “life-cycle assessment”, “carbon footprint” and “public transport” are representing new research areas.

5. Discussions

This bibliometric analysis was conducted on the specialized literature regarding eco public procurement, with the aim of evaluating the evolution of knowledge globally and determining the academic interest in this field. The study provides a clear perspective on the authors who have significantly contributed to the theoretical development of the field, as well as on the most influential cited works. By examining 842 articles published between 1990 and 2025 and indexed in WoS, a mapping of the main authors, publications, institutions, countries, and key concepts that have shaped the field of green public procurement was conducted. The results obtained provide a detailed picture of the emerging research trends and directions. The results obtained in this analysis are like those obtained by Ortega Carrasco P. et al. (2025). China and Italy are the most productive countries in the field of publications on GPP, and this is correlated with the most productive authors: the Italian Appolloni A. and the Chinese Liu J.Q. They have formed

research groups around them. Appolloni A. and the co-authors of his articles (e.g. Testa F.) dominate the top of the most collaborative authors and position the Tor Vergata University of Rome as the institution with the most research on GPP. Journal of Cleaner Production, Journal of Public Procurement and Sustainability are top journals in their indexing category and have the greatest openness to publishing analyses on GPP. There are two reference works in the field of GPP that are the most cited: Brammer S. and Walker H (2011) and Lindgreen A. et al (2009), the authors Brammer S. and Walker H. being co-authors in both publications. Among the most debated research themes are "green public procurement" and "sustainable procurement", followed by "sustainable public procurement", but the current most important research themes are "green innovation" and "supply chain management", followed by new research ideas such as "electric vehicles", "life-cycle assessment", "carbon footprint" and "public transport".

The study highlighted a significant increase in academic interest in green public procurement, reflected both in the growing number of publications on this topic and in the diversification of the subjects addressed. In recent years, there has been a shift from general studies on the economic efficiency of public procurement to more detailed research on the integration of sustainability and digitalization criteria in procurement processes. Bibliometric analysis has allowed for the identification of the main authors contributing to the development of the field, the most influential journals in which reference studies are published, and the academic institutions that play a central role in research on green public procurement. This mapping of the field provides a clear perspective on the current research landscape and helps identify future directions for investigation.

The results of the study have significant implications both theoretically and practically. From a theoretical perspective, the analysis confirms and complements the existing literature, highlighting emerging areas of interest and the directions in which research is heading. Comparing the results with previous studies has shown that some traditional themes, such as cost efficiency and transparency in public procurement, continue to be relevant, but are increasingly integrated into broader discussions about sustainability, social impact, and technological innovation. The research also highlighted certain gaps in literature, such as the lack of comparative studies between different national public procurement systems and the influence of legislative regulations on economic efficiency. From a practical standpoint, the results can be used by decision-makers, public institutions, and procurement practitioners to improve the implemented strategies and policies. Identifying the most influential journals and authors can guide researchers in more effectively disseminating their own studies, while the analysis of international collaborations offers opportunities for academic partnerships and joint projects. At the same time, the conclusions regarding emerging trends, such as the digitalization of the procurement process and the use of artificial intelligence for bid evaluation, can contribute to the modernization and efficiency of public procurement at a global level.

This bibliometric analysis makes an original contribution by integrating an updated perspective on the field and highlighting emerging trends that have not been systematically detailed before. Identifying active research clusters, mapping international collaborations, and conducting a detailed analysis of the most influential publications add value to the

understanding of the dynamics of this field. Moreover, the use of specific bibliometric indicators to assess the impact of authors and institutions allows for a more granular approach to understanding academic influence in this sector.

6. Conclusions

Although bibliometric analysis and data visualization have provided valuable insights into the field of green public procurement, the methodology used has certain limitations. These constraints are mainly related to the bibliometric nature of the study and the limitations of the database used. Although the quantitative approach minimizes the influence of subjective judgments, manual intervention was necessary at some stages due to incomplete or erroneous information. A more detailed analysis, using a systematic review, could provide additional clarifications on some fundamental aspects of the field. A primary limitation of the study is represented by the publication selection strategy, which may lead to the omission of relevant works that do not contain the search terms in their titles. Thus, the conclusions must be interpreted in relation to the selection criteria adopted. Additionally, the exclusive use of the WoS database can be considered a limitation, and a multi-source approach could improve the accuracy of the results. Moreover, works published in languages other than English were not included in the analysis, which may limit the global perspective on the field. Another encountered issue was the omission of essential details, such as the names of some authors, which can affect the accuracy of collaboration networks. Moreover, certain journals have changed their names over time, which can lead to an incorrect classification of publications. Finally, the analyzed sample is heterogeneous due to the diversity of the types of works included (scientific articles, conferences, reviews, etc.), which can influence the interpretation of the results. An additional limitation is that the analysis did not consider contextual factors, such as the specific public procurement regulations of each country, which can significantly influence research trends. Moreover, the dynamics of research funding and the editorial policies of journals can influence the visibility and impact of certain works, which was not evaluated in this study.

Future research can delve deeper into these trends and include alternative analysis methods to gain a more complex understanding of the field. Qualitative studies that combine bibliometric analysis with interviews with field experts could provide a more nuanced perspective on the real impact of new practices and technologies on the procurement process. Additionally, expanding the analysis to include more scientific databases and incorporating literature published in other languages could contribute to a more comprehensive understanding of the subject. This study deepens the understanding of the evolution and progress of research in the field of green public procurement, providing a detailed and comprehensive perspective on the main emerging trends in this sector. Through bibliometric analysis, a clear dynamic of the addressed subjects, utilized methodologies, and the evolution of public policy has been highlighted, clearly revealing the development directions of this field both within the European Union and in other regions.

Research must shift toward more policy-relevant insights to shape the future of green public procurement. It is needed to investigate how GPP promotes eco-innovation

across a variety of business types and situations, particularly to comprehend how demand-side policy tools might actively boost SMEs or larger organizations. Research shows that securing procurement contracts with environmental requirements raises the likelihood of introducing green products. Comparative and causal studies that differentiate between business sizes, industries, and locations should be used in future research. As facilitators of innovation and environmental performance, researchers must investigate the dynamics between stakeholders and cooperative procurement procedures. The conflict between internal and external stakeholders in GPP design and execution is highlighted by a new viewpoint based on stakeholder theory. More collaborative and creative procurement results can be achieved by involving these varied groups through more process-oriented, outcome-driven public procurement. This encourages more research into the ways that participatory procurement methods or multi-actor involvement may reduce competing interests while increasing environmental value. A crucial path for the future is to overcome the financial and other obstacles faced by SMEs in GPP. Although GPP contracts have the potential to promote innovation, they also increase the financial strain on participating companies. Governments should make GPP more accessible for releasing the innovative potential of SMEs. This can be a topic for future research. Standardization, harmonized monitoring procedures, and GPP alignment with more general sustainability objectives should all be embraced in future study. Significant differences exist among EU member states in the adoption and application of environmental standards. Coherence and policy alignment can be promoted by standardized indicators for a more accurate assessment of GPP's contribution to global sustainability goals. Future research should develop standardized cross-sectoral indicators.

By concentrating on the above areas (innovation dynamics, stakeholder-centered procurement design, SME financial access, and standardized impact measurement) future GPP research can deliver more robust, equitable, and actionable insights. These directions reflect the evolving challenges and opportunities in deploying public purchasing as a strategic lever for sustainability transformation. The results obtained are significant, having applications both for the academic environment, which can expand and deepen research in this field, and for practitioners and decision-makers, who can use this information to implement more efficient and sustainable policies. The study thus provides a solid starting point for future research, contributing to the development of initiatives that support the continuous improvement of the efficiency and sustainability of the public procurement process, considering their impact on the environment and society.

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