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REVIEW ARTICLE

Bibliometric Analysis of Developing Sustainable Cities by Enforcement of Environmental Policies

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Abstract. This bibliometric analysis explores the scholarly background surrounding the development of sustainable cities through the enforcement of environmental policies. The study aims to provide a comprehensive overview of the existing body of literature on this subject, identifying key trends, relevant authors, and thematic clusters that have contributed to the scholarly dialogue on this topic. Through a bibliometric analysis of relevant academic publications, this research seeks to discover patterns and insights that have contributed to a deeper understanding of the evolution of research in this critical realm. The research question underlying this bibliometric literature review is how can cities develop sustainably through the enforcement of environmental policies? The formulation of the research question necessitates the objectives of the study. The objectives of this research are to: assess the volume and growth of literature addressing sustainable urban development through environmental policy enforcement, identify research works and influential authors shaping the scholarly conversation on this topic, uncover thematic clusters and the interdisciplinary nature of research in developing sustainable cities through environmental policies and identify research gaps to guide future direction of research. The study employs bibliometric techniques, including citation analysis, co-authorship analysis, and term co-occurrence analysis. Preliminary findings indicate a growing interest in the intersection of sustainable urban development and environmental policy enforcement. The analysis identifies key publications that have significantly influenced the field, along with prominent authors and collaborative networks. This bibliometric analysis provides a systematic overview of the scholarly contributions to the development of sustainable cities through environmental policy enforcement.

1. Introduction

Developing sustainable cities is a major concern to most countries as a result of climate change and its negative impact. Climate change is an environmental concern hence enforcement of environmental policies is key in protecting the city's environment from further degradation. This document explores the intricate relationship between environmental policies and the development of sustainable cities. Deforestation is reported to possess a vast and detrimental impact on the environment, economy, and social aspects of the community. In this context, the phenomenon should be assessed and analysed to inform the decision-maker overseeing issued policy and development strategies (Segah, Afentina, Fatkhurohman, Aguswan, & Takayama, 2023).

By examining effective case studies, regulatory frameworks, and creative initiatives, our goal is to clarify the innovative potential of implementing environmental regulations in urban settings. Zakka et al. (2025), postulate that, Smart cities leverage advanced technologies like Internet of Things (IoT) devices, Artificial Intelligence (AI), and large-scale data analytics for gathering and interpreting data for informed decision-making and improved service delivery. This study focuses on the nexus between smart city development initiatives and environmental sustainability geared towards enhancing a better human settlement in the South-west region, of Nigeria. One of the objectives is to identify and evaluate the factors contributing to the development of smart city initiatives and to evaluate their contributions towards environmental sustainability. As we discuss the complexity of urban growth in the twenty-first century, it is our shared duty to promote cities that are healthy ecosystems where people may live, work, and prosper sustainably in addition to being economically successful.

However, within cities, green space is not always equitably distributed. Access is often highly stratified based on income, ethno-racial characteristics, age, gender, (dis)ability, and other axes of difference (Wolch, Byrne, & Newell, 2014). Over the past two decades, the uneven accessibility of urban green space has become recognized as an environmental justice issue as awareness of its importance to public health has become

recognized (Newman & Jennings, 2012). The literature has focused on measuring access to urban green space, primarily parks; the relative access of socio-demographics to these spaces; and how lack of access affects public health. Most have originated from the United States, the United Kingdom, and Australia.

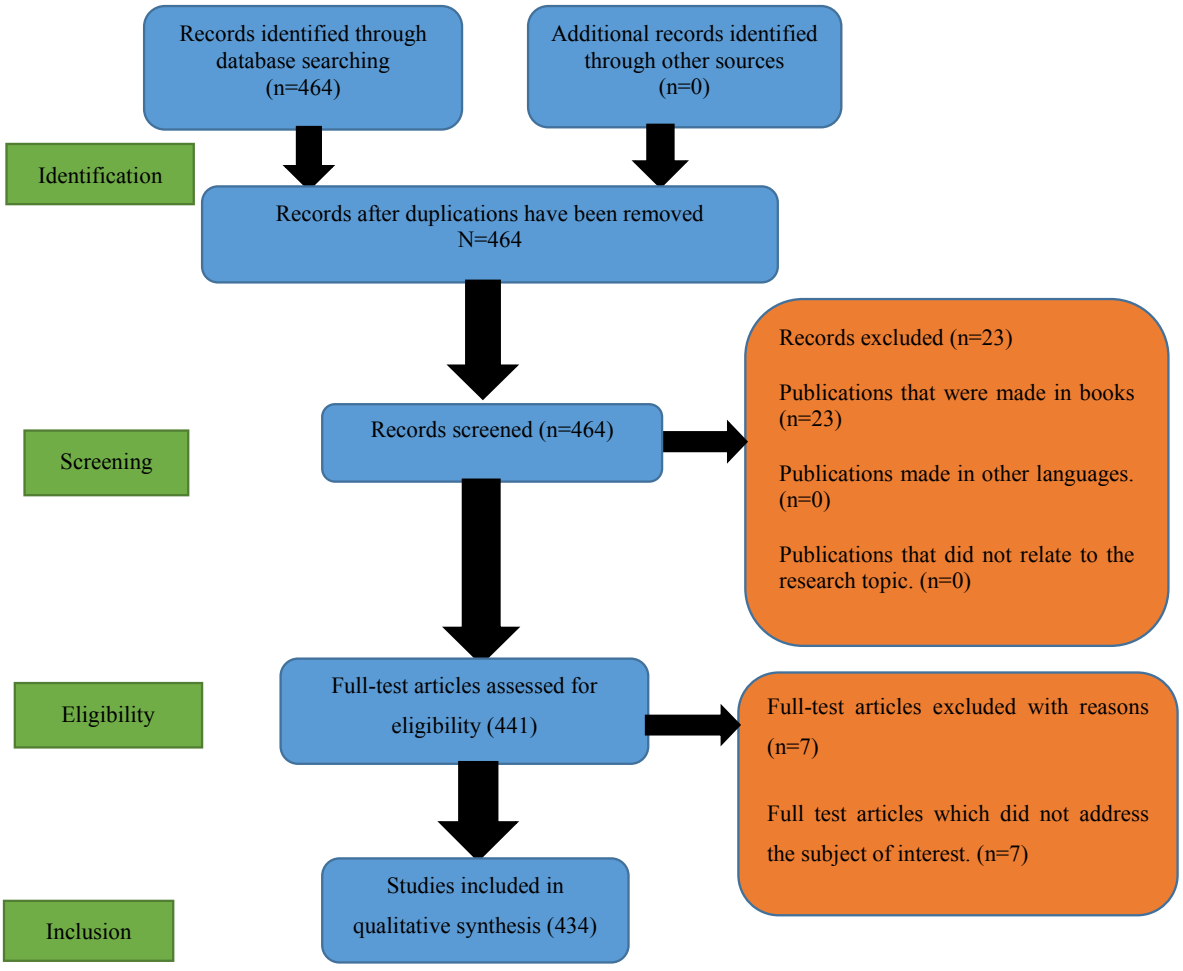
The world's population is undergoing a historic shift toward urbanization, making the significance of creating sustainable cities increasingly clear. Cities are essential to shaping our shared destiny because they are the areas of economic activity and cultural exchange. Rapid urbanization, however, has frequently resulted in issues with the general well-being of city people as well as resource depletion and environmental degradation. Strong environmental regulations must be put into place to solve these issues and encourage the development of sustainable cities. When properly used, these policies serve as heuristics that seamlessly integrate ecological considerations into the foundations of urban planning, infrastructure development, and governance to promote the growth of sustainable cities.

Globally, it is estimated that more than half of the world's population lives in cities, and the rate at which urbanization is advancing has a substantial impact on the planet's general sustainability. The dense population of cities necessitates creative approaches to environmental issues and improving urban living standards. Unplanned urban growth frequently leads to resource pressure, elevated pollution levels, and reduced ability to withstand environmental threats. The consequences transcend local boundaries and have an impact on ecosystems on a regional and global scale. Sustainable urban development is guided by effective environmental restrictions.

These policies address issues including waste management, energy efficiency, the preservation of green spaces, and air and water quality to lead cities toward a more resilient and ecologically conscious future. By tackling problems like the quality of the air and water,

2. Methods

Scientific research requires empirical data for analysis which informs the triangulation of results and findings for future direction of research. The Publish or Perish software is one of the world's largest and most comprehensive collections of scientific research resources. The search for data was conducted on 20th January 2024. The search engine applied in the Publish or Perish interface was Google Search. The search was done using the document Title Terms button. The search terms were: Sustainable Cities OR Environmental Policies. The development of the search terms was conducted in line with the Boolean Operative (Sokouti et al., 2017). The sample size limit adopted was 1000 publications. The search duration was set at 2000 to 2023. During the search, only 464 publications were obtained. The application of the inclusion and exclusion criteria, resulted as follows: 23 of the publications were books, 7 as conference papers. The final results obtained were 434 publications on articles.



Source: (Page et al., 2021)
Figure 1: PRISMA Framework

PRISMA 2020 is intended for use in systematic reviews that include synthesis (such as pairwise meta-analysis or other statistical synthesis methods) or do not include synthesis (for example, because only one eligible study is identified) (Page et al., 2021).

The scope of the review focuses on all related articles published on "Developing Sustainable Cities by Enforcement of Environmental Policies". The website search platforms such as Publish or Perish. In describing eligible research publications for each synthesis identification, the PRISMA framework was applied. This is illustrated in Figure 1.

Screening of the results was based on the inclusion and exclusion criteria. Inclusion criteria may include relevance to the research question, publication date, and language. Exclusion criteria may include irrelevant topics, publication type, and study design.

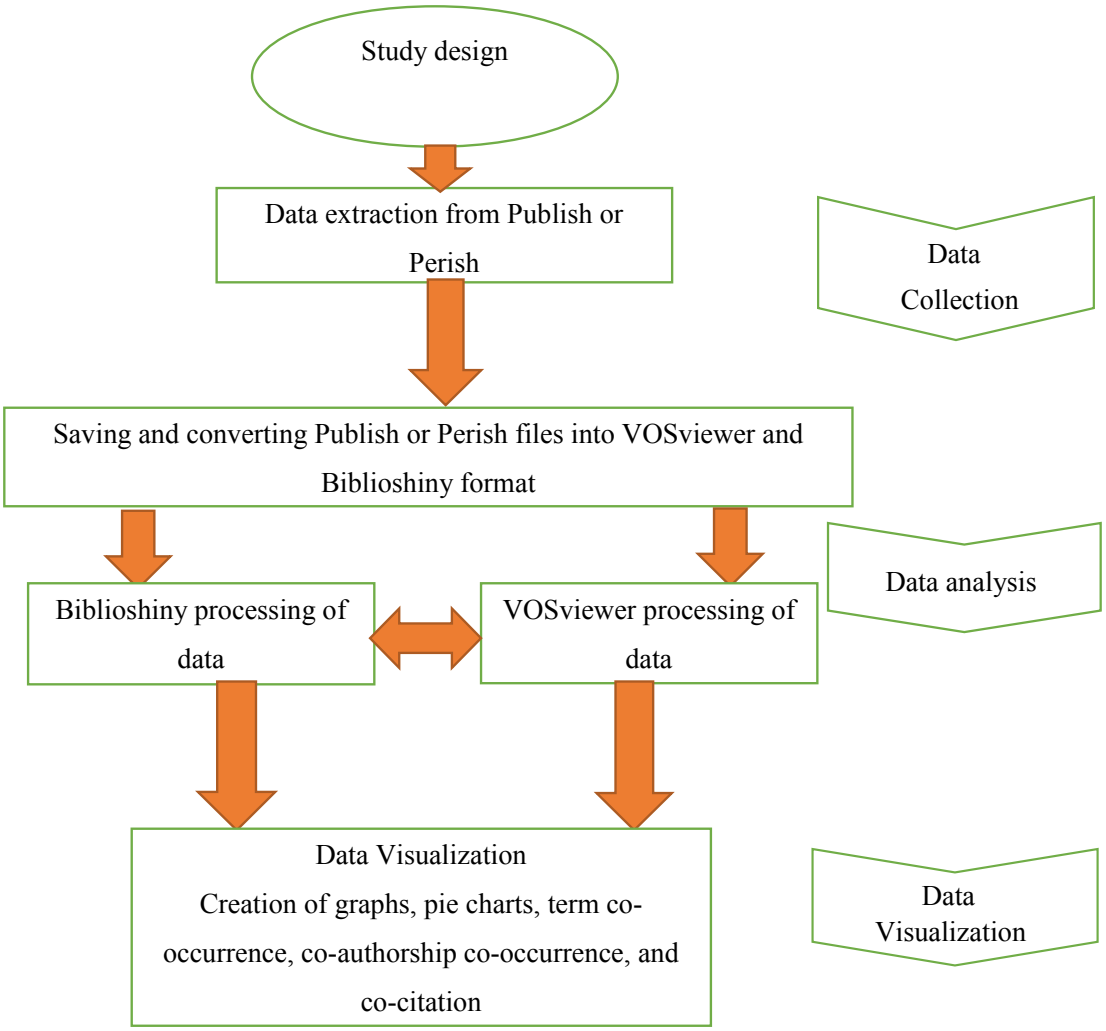
Extract data: Extract data from the selected studies. This may include study design, sample size, data collection methods, and key findings.

The standard bibliometric analysis process involves specific guidelines (Donthu, Kumar, Mukherjee, Pandey, & Lim, 2021): The research design, study data collection, data screening, data analysis and synthesis, and, data visualization. These stages are outlined in Figure 2. Software dubbed R and Rsdudio which utilizes add-ons such as library(bibliometrix) and biblioshiny() to run Biblioshiny was installed and applied. Also, VOSviewer software was installed to process data for visualization. The data extracted from the Publish or Perish website (McGrail, Rickard, & Jones, 2006) was saved in the file format of BiB, CSV, RIS, and EndNote to enable migration unto Biblioshiny and VOSviewer for data processing, analysis, and synthesis.

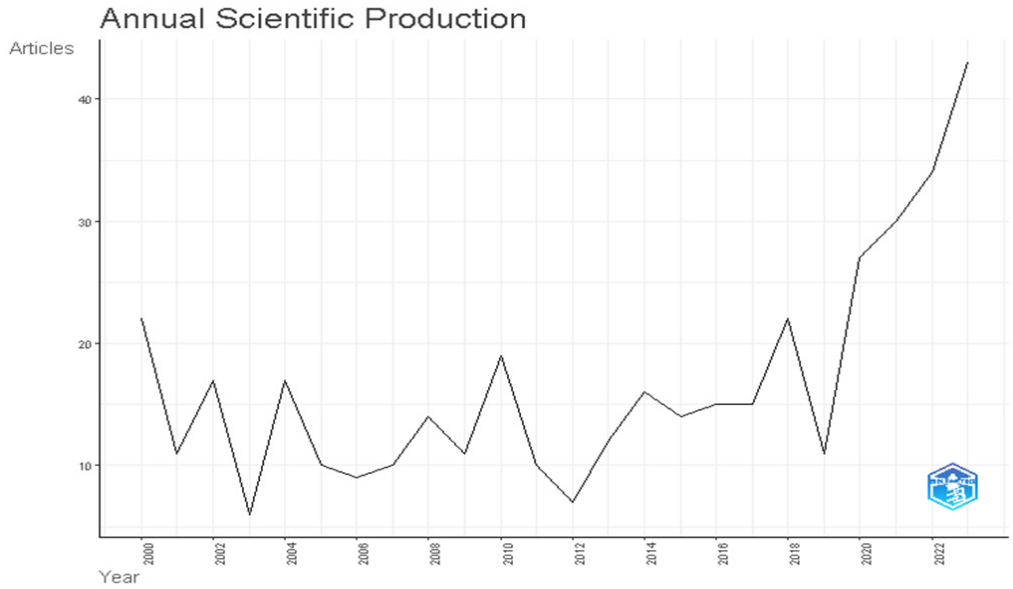
3. Results and Discussion

The output from the processed data is presented in the following findings, discussions, and conclusions to inform the future direction of research. The purpose of this research is to identify research gaps in existing literature on managing urban areas using environmental policies.

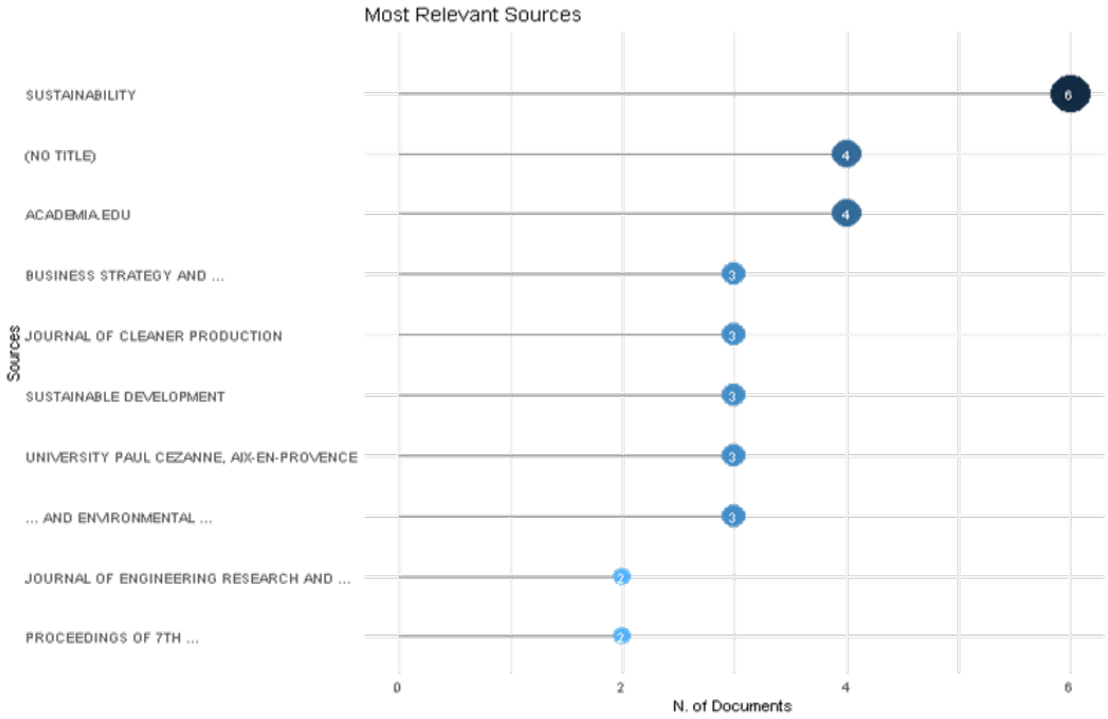
The Bib file derived from the extraction of 434 publications using Publish or Perish was utilized to create a line graph, as illustrated in Figure 3. An examination of the data through the biblioshiny software revealed a trend in the line graph, indicating that publications declined from 2000 to 2001. However, there was a slight increase in 2002. Subsequently, there was no notable change until 2019, when a significant upsurge in publications was observed, continuing up to 2020. This increase was sustained until 2022. The findings suggest a growing trend among authors in publishing content related to sustainable cities, possibly driven by the imperative to address climate change, as depicted in Figure 3.



Source: (Aria & Cuccurullo, 2017)
Figure 2. Bibliometrix Science Mapping Workflow.



Source: Authors' construct, 2023
Figure 3. Annual scientific production

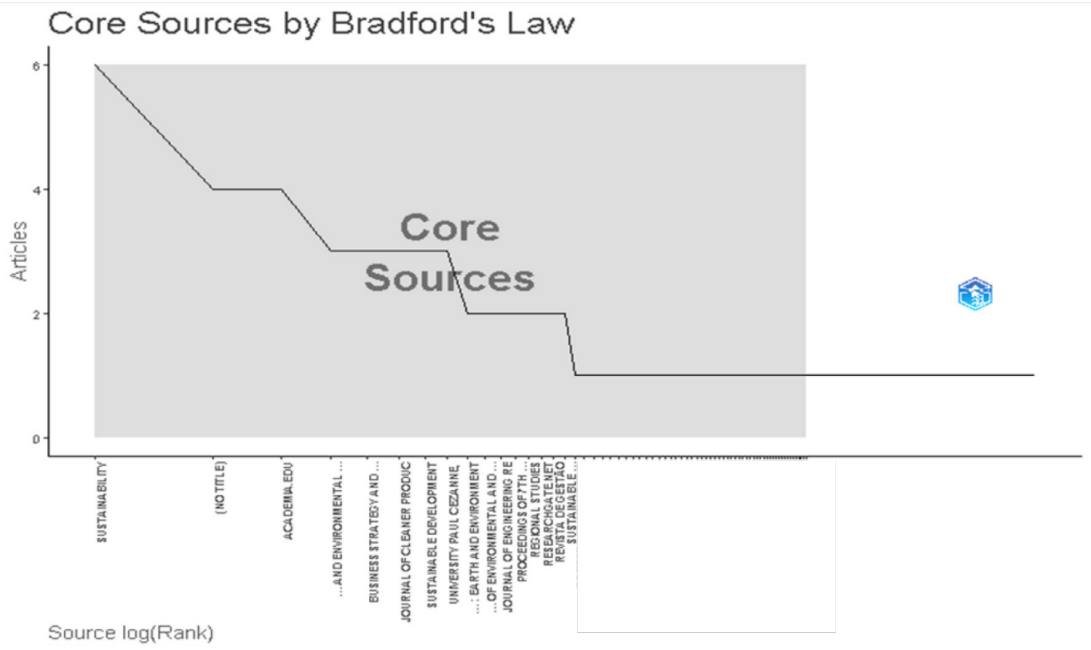


Source: Authors' construct, 2023
Figure 4. Most relevant sources

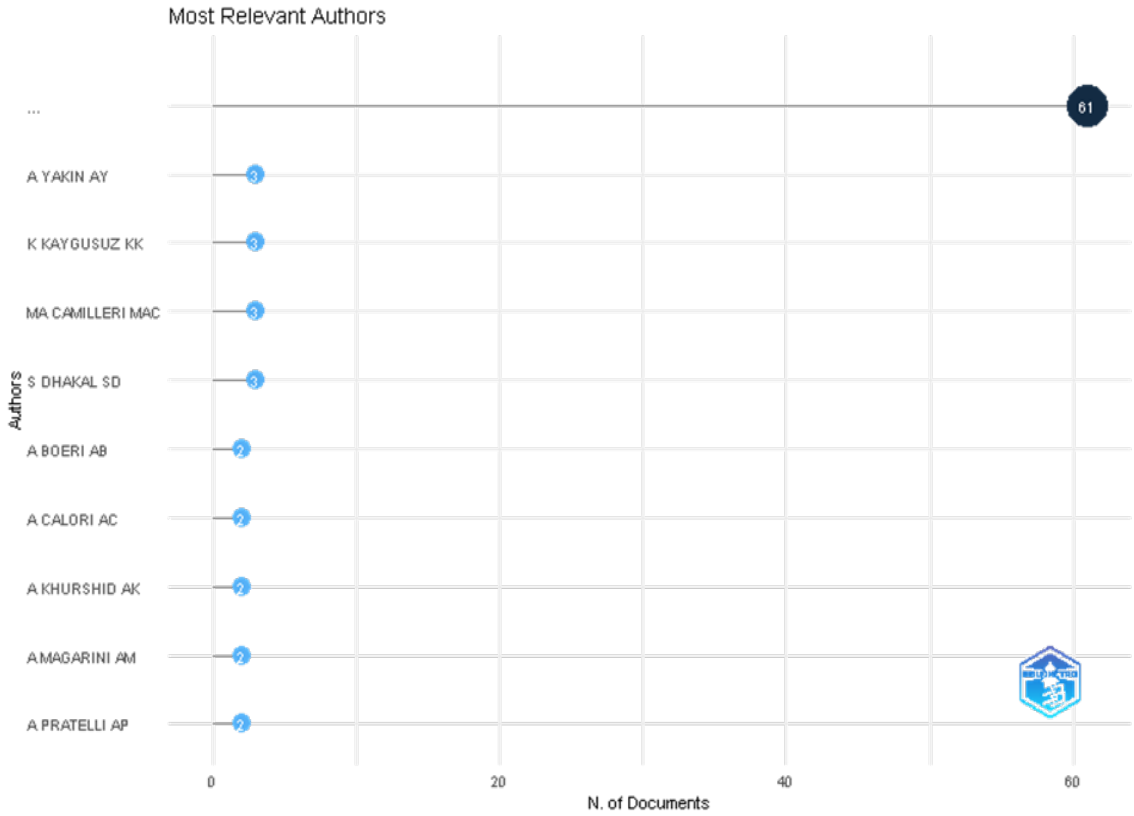
The primary sources contributing to the creation of the 434 publications during the chosen timeframe include journals such as Sustainability, Academic Edu, Business Strategy, Journal of Cleaner Production, Sustainable Development, University Paul Cezanne, AIX-EN-Province Journal of Environmental, Journal of Engineering Research, and Proceedings of 7TH Conference. These journals were identified as significant publishers through the use of the biblioshiny software. Figure 4 illustrates the annual production sources, offering insights into the publication trends over the years. This information aims to inspire future research publications and enhance the understanding of the current state of literature on Sustainable Cities and Environmental Policies.

Bradford's Law, a principle in library and information science introduced by (Viju & Ganesh, 2013), outlines the distribution pattern of journal articles within a particular field. This principle aids in pinpointing the pivotal sources or journals that make significant contributions to the literature in a specific subject area. As per Bradford's Law (Dormuth et al., 2023), a small number of journals, referred to as the "core," are responsible for a substantial portion of the published articles in the field. These core journals are highly concentrated in the first few titles, while subsequent groups contribute fewer articles.

Figure 5 often graphically represents Bradford's Law in three zones known as Bradford zones: Zone 1 (Core):



Source: (Dormuth, Liu, Xu, Pauly, & Ditzhaus, 2023)
Figure 5. Core sources by Bradford's Law



Source: Authors' construct, 2023
Figure 6. Most Relevant Authors

Comprising a few highly productive journals publishing a significant number of articles on the subject. Zone 2 (Near-Core): Encompassing more journals than Zone 1 but with fewer articles than the core journals. Zone 3 (Peripheral): Involving a larger number of journals with fewer articles than Zones 1 and 2.

In practical terms, Bradford's Law is a valuable tool for researchers, librarians, and information scientists, serving the following purposes: Identifying the most influential journals or sources in a specific field. Efficiently managing and selecting sources for literature reviews or research. Understanding the distribution of articles and focusing efforts on the most relevant journals.

By applying Bradford's Law, rather than reviewing all 434 publications on the research topic, only these nine most impactful publications are reviewed. The research themes of these most relevant authors aids in identifying research gaps and determining the direction of future research.

The most relevant authors and number of research documents published from 2000 to 2023 is indicated in figure 6. David Harvey, A geographer and urban theorist, Harvey's critical perspectives on capitalism and urbanization have influenced discussions on social justice and the right to the city. Notable Work: "The Condition of Postmodernity" (Castree, 2007), N. (2007). David Harvey) Saskia Sassen: Contributions: A sociologist and economist, Sassen's work explores the complex dynamics of global cities, including issues of globalization, immigration, and the role of cities in the global economy. Notable Work: "The Global City: New York, London, Tokyo" (Robinson, 2009).

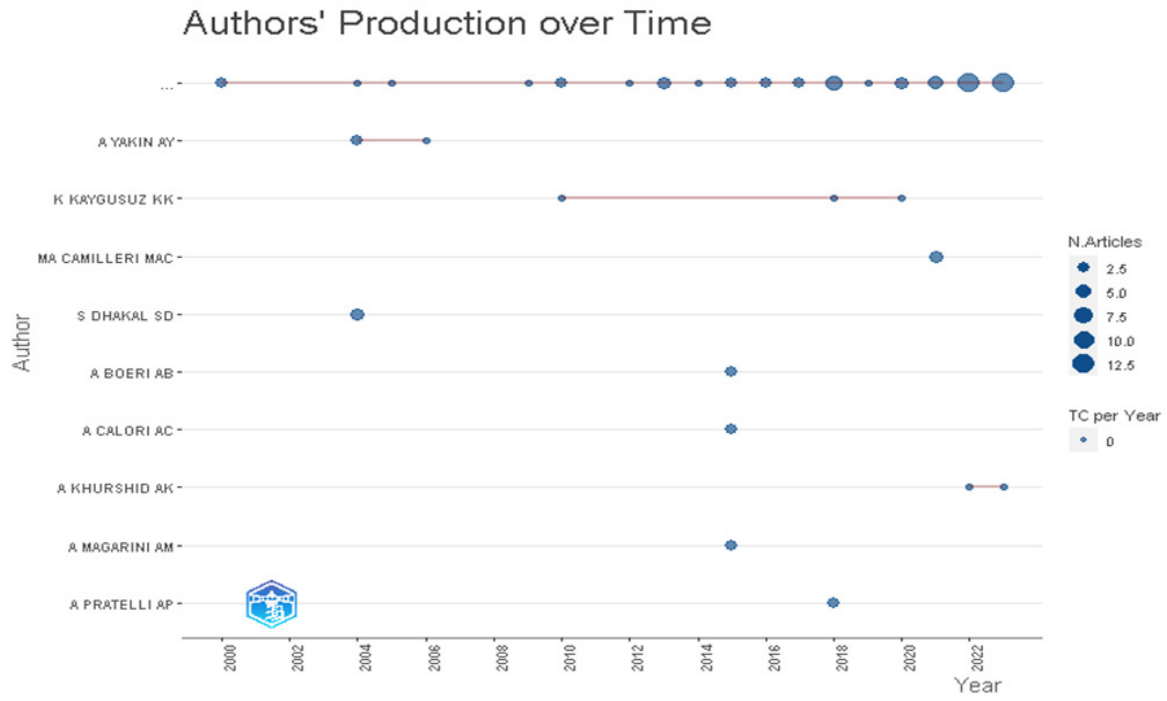
Edward Glaeser, An economist focusing on urban issues, Glaeser's research explores the economics of cities, urbanization, and the role of cities in fostering innovation and economic growth—notable Work: "Triumph of the City" (Peck, 2016). Ellen Dunham-Jones: Contributions: An architect and urban design researcher, Dunham-Jones focuses on retrofitting and revitalizing suburbs for sustainability, resilience, and improved quality of life. Notable Work: "Retrofitting Suburbia: Urban Design Solutions for Redesigning Suburbs"(Dunham-Jones & Williamson, 2011).

The most relevant Authors' production over time as shown in Figure 7 indicates their research publications from 2000 to 2023. Within this timeframe; the following most relevant Authors were able to publish articles indicated against their names: A Yakin AY 3, K Kaygusuz KK 3, MA Camilleri MAC 3, S Dhakal SD 3, A Boeri AB 2, A Calori AC 2, A Khurshid AK 2, A Magarini AM 2 and A Pratelli AP 2: All these are presented in figure 7.

The relevant Authors' articles' titles, abstract, research themes, and how they relate to the chosen topic for review are captured in Table 1. This clearly shows their research themes and focus. Out of the 9 most relevant Authors, all of them focused on developing sustainability measures that will protect the environment. The specific research theme is Environmental Policies for Sustainable Development as postulated by Yakin 2004. Renewable and Sustainable Energy Policies (Avci & Kaygusuz, 2020) are also geared towards protecting the environment through building designs that reduce energy consumption and its impact on the environment.

Virtually all the other authors also posit for Sustainable Production and consumption of food, Urban energy use and greenhouse gas emissions, Public policies on business for sustainable development, Food policies for sustainable cities, Green innovation and carbon emissions, and Sustainable mobility in cities. The contributions made by the most relevant authors in this area focus on sustainable development and environmental policies. However, this research topic put forward the need to develop sustainable cities through the enforcement of environmental policies. None of these 9 authors wrote directly on the research topic and other searches conducted outside the Publish or Perish platform, search on Google Scholar has proven that the research topic for conducting this study does not exist in the available literature.

Considering the relationship of the research topic with the themes of the 9 relevant Authors as indicated in Table 1, it indicates that the research themes by the authors was highly related to the chosen research topic. The implications are that: there was limited bias in the search for literature on the research topic. Also, the reliability of the outcome of the 434 selected literature is very high for triangulation that, the research topic is non-existent in available literature. Conclusively, developing sustainable cities through enforcement of environmental Policies research gap for researchers to explore for further research in the quest to enhance sustainable cities.

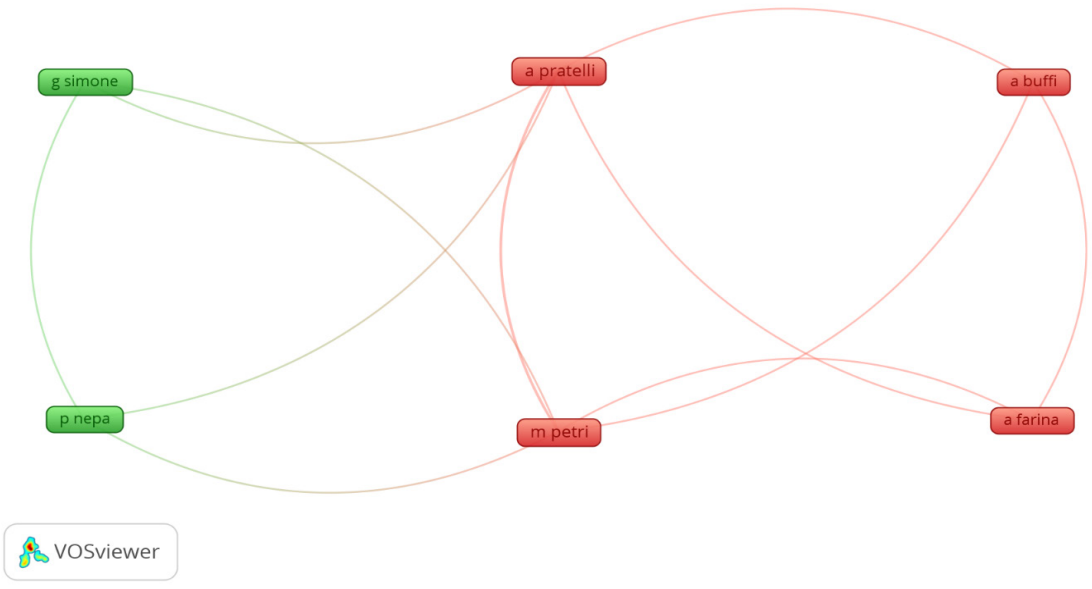


Source: Authors' construct, 2023.
Figure 7. Authors Production over Time

Table 1. Relevant Research Themes

NO.	Author	Title	Abstract	Research Themes
1	(Yakin, 2004)	Implementation and enforcement of environmental policies in promoting sustainable development in Asia: Learning from Malaysia and Japan.	Asia in the last few decades has immensely influenced global environmental change and raised concerns about this change.	Environmental Policies for Sustainable Development
2	(Avci & Kaygusuz, 2020)	Renewable and sustainable energy policies in Turkey after the Paris Agreement: economic and environmental analysis	In this context, buildings that are efficiently designed and configured will provide energy savings.	Renewable and Sustainable Energy Policies
3	(Camilleri, 2021)	Sustainable production and consumption of food. Mise-en-place Circular economy policies and Waste Management Practices in tourism Cities	This contribution implies that there is scope for regulatory authorities and policymakers to encourage hospitality practitioners to engage in circular economy approaches.	Sustainable Production and consumption of food.
4	(Dhakal, 2004)	Urban energy use and greenhouse gas emissions in Asian mega-cities: policies for a sustainable future	The deteriorating environmental situation there has health and welfare implications for urban dwellers.	Urban energy use and greenhouse gas emissions
5	(Testoni & Boeri, 2015)	Smart cities: public policies and business models for sustainable development.	The paper in particular analyses public-private partnerships from two different perspectives: within a strategic planning process and innovative public procurement.	Public policies on business for sustainable development
6	(Calori & Magarini, 2015)	Food and the cities. Food policies for sustainable cities.	The article outlines the general structure of these tools and describes their role as new political spaces for a public debate about food policies.	Food policies for sustainable cities
7	(Khurshid, Rauf, Qayyum, Calin, & Duan, 2023)	Green innovation and carbon emissions: the role of carbon pricing and environmental policies in attaining sustainable development targets of carbon mitigation.	The results show that innovation and environmental policies help in reducing emissions both in the long and the short run.	Green innovation and carbon emissions
8	(Calori & Magarini, 2015)	Food and the cities. food policies for sustainable cities	This topic is important since a systemic approach to food requires integration between different areas of policy	Food policies for sustainable cities
9	(Petri, Pratelli, Nepa, & Simone, 2018)	Its technologies and rewarding policies to improve sustainable mobility in cities.	The study involves a detailed intermodal network model that compares monetary costs and travel times from all relevant origins.	Sustainable mobility in cities

Source: Authors' construct, 2023



Source; Authors' construct, 2023
Figure 8. Co-authorship Network

A co-authorship network refers to a network of collaboration among researchers or authors who have jointly authored academic papers, articles, or publications (Fagan et al., 2018). It visualizes the relationships between authors based on their collaborations within academic or research endeavors.

Figure 8 indicates Co-authorship after analyzing the data through VOSviewer software. It indicated that 6 of the Authors were working together or collaborating in publishing articles together. This implies that they were strongly connected and collaborated in publishing some of the 434 articles under consideration. In the VOSviewer platform, when the cursor is placed on a particular circle or point it shows the linkages or the network of authors that collaborated at that particular circle or point. Also, from the VOSviewer interface, there were 2 clusters, 11 links, and a link strength of 12. Since the production of academic papers needs efforts and inputs from other professionals in that discipline it requires a concerted effort to publish impactful papers that are high-quality materials to add to the body of knowledge.

Co-authorship Co-occurrence refers to the occurrence or frequency of collaboration between authors across multiple publications or research projects within a specific field or topic (Qiu, Dong, & Yu, 2014). It represents instances where two or more authors collaborate or co-author papers together, indicating shared contributions to scholarly work.

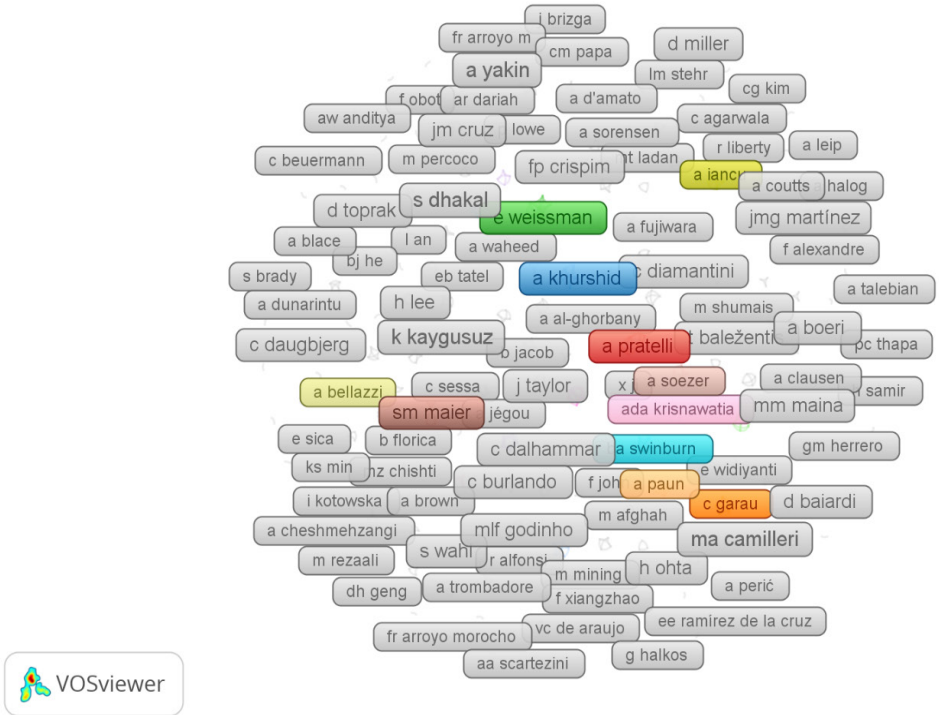
In Figure 9, the Co-author Co-occurrence of the 434 articles indicates that 741 Authors were cited in this study. 383 clusters and 563 links. The link strength is 594. This implies that in this study, 741 authors contributed to the production of the articles and the journals involved. However, 383 clusters of them were in separate groups working together. 563 links across them and having a strength of 594.

Term co-occurrence refers to the appearance or frequency of two or more terms appearing together within a specific context, document, or corpus. It is a measure used in text analysis and natural language processing to identify the simultaneous appearance of words or phrases within a certain proximity of each other (Sun, Luo, & Chen, 2017). Term co-occurrence shows the most frequently used terms in the journals and articles selected for the review.

As indicated in Figure 10, in the VOSviewer platform, there were 161 items, 32 clusters, 308 links, and a total link strength of 694. This shows the most frequently used terms in the journals and articles selected for the review on the research topic; Sustainable Cities OR Environmental Policies. A careful study of Figure 10 shows that Sustainable development, sustainable future, environmental regulatory policy, sustainable energy policy, sustainable development goal, housing policy, innovative policy, and local adaptation policy have been used frequently, however, environmental policies are completely missing on this diagram. The implication is that all the 434 publications did not focus much attention on developing sustainable cities through environmental policies.

The reviewed literature indicates that environmental policies impact on sustainable cities research is still evolving and future research needs to be further expanded in the following aspects: Research on the application of environmental policies in cities or urban areas is limited. Urban areas are growing rapidly which requires the enforcement of policies to control the emerging challenges. One of the features of sustainable or smart cities is the rigorous enforcement and compliance of environmental laws. Research on the evaluation of environmental policies in urban areas is paramount in the 21st century to inform future interventions to promote environmental interventions that are sustainable such as (Avci & Kaygusuz, 2020).

The authors also posit Sustainable Production and consumption of food as postulated by (Calori & Magarini, 2015). Urban energy use and greenhouse gas emissions can be compared to (Khurshid et al., 2023), Public policies on



Source; Authors' construct, 2023
Figure 9. Co-authorship Co-occurrence

business for sustainable development, Food policies for sustainable cities, Green innovation and carbon emissions, and Sustainable mobility in cities. The contributions made by the most relevant authors in this area focus on sustainable development and environmental policies. However, this research topic put forward the need to develop sustainable cities through the enforcement of environmental policies. None of these 9 authors wrote directly on the research topic and other searches conducted outside the Publish or Perish platform, search on Google Scholar has proven that the research topic for conducting this study does not exist in the available literature.

Considering the relationship of the research topic with the themes of the 9 relevant Authors as indicated in Table 1, it indicates that the research themes by the authors was highly related to the chosen research topic. The implications are that: there was limited bias in the search for literature on the research topic. Also, the reliability of the outcome of the 434 selected literature is very high for triangulation that, the research topic is non-existent in available literature. Conclusively, developing sustainable cities through the enforcement of environmental Policies research is a gap for researchers to explore for further research in the quest to enhance sustainable cities.

Considering the relationship of the research topic with the focus of the 9 relevant Authors as indicated in Table 1, it indicates that the research focus by the authors was highly related to the chosen research topic. The implications are that: there was limited bias in the search for literature on the research topic. Also, the reliability of the outcome of the 434 selected literature is very high for triangulation that, the research topic is non-existent in available literature. Conclusively, developing sustainable cities through the enforcement of environmental Policies is a research gap for researchers to explore for further research in the quest to enhance sustainable cities.

The dominant finding identified is the fact that none of the 434 publications had a research theme on the impact of environmental policies on sustainable cities especially the evaluation of environmental policies on the management of urban areas. Conceptualizing the application of environmental policies in promoting sustainable cities is paramount as integration of environmental policies in all sectors of the urban area is indispensable. The core research objective for formulating this review of developing sustainable cities through environmental policies is accomplished for future research attention with research theme on the enforcement of environmental policies era in promoting sustainable cities.

Figure 10 focus on Term Co-occurrence which indicates climate change and sustainable development goals as some of the key terms under the research topic. Based on these terms, a sustainable city's theme usually centres on fundamental ideas and objectives meant to improve the standard of living for its citizens while preserving the environment. Here are some of the progress theme of a sustainable city:

Promotion of environmental sustainability through integration of natural areas, encouraging biodiversity, and making sure resources are used responsibly. Programs for recycling, waste reduction, and energy efficiency should be included. Enhancing economic development by promoting innovation in sustainable technology, helping small companies in the community, and creating green employment as a means of promoting sustainable economic growth. Ensuring social equity by actively attempting to lessen inequality by guaranteeing that all citizens have access to basic services, reasonably priced housing, and opportunities to participate in communal decision-making.

Encouraging climate smart transportation by encouraging eco-friendly modes of mobility including walking, bicycling, and public transportation while lowering reliance on fossil fuels. Ensuring community engagement through encouraging a sense of ownership and responsibility by including locals in the planning and development processes to make sure their needs are addressed and their opinions are acknowledged. Promote city's resilience constructing systems and infrastructure that are resilient to and able to withstand many difficulties, including economic fluctuations, natural catastrophes, and climate change. Finally the application of technology and innovation through using smart city technology to boost productivity, cut down on pollutants, and improve city life in general.

A sustainable city seeks to provide a harmonious and balanced living space that is socially inclusive, economically successful, and ecologically sound by emphasising the above sustainable city themes.

The following are some important areas of research direction that will be pursued in future study on Bibliometric Analysis of Developing Sustainable Cities by Enforcement of Environmental Policies:

Analysing Environmental Policy Impact on Sustainability Metrics. Future research may focus on examining how particular environmental regulations affect sustainability metrics including waste management, carbon footprint reduction, air and water quality, and the growth of green spaces. Improving Urban Governance through Local Environmental Policy Enforcement. In order to create sustainable cities, research may increasingly look at how local governments enforce environmental laws. Enhancing Community Engagement and Public Support in Environmental Policy Implementation. The function of community and public involvement in upholding urban environmental regulations may be the subject of future research. Exploring Emerging Environmental Themes on Climate Adaptation and Resilience. The literature that addresses urban climate resilience and adaptation strategies may be the focus of bibliometric study due to the urgency of climate change.

In order to ensure that cities can continue to grow sustainably while safeguarding the environment and public health, the above future directions of research represent the rising demand for data-driven insights into the effects of environmental policies, enforcement difficulties, and sustainable urban growth paths.

4. Conclusion

Scientific research requires empirical data for analysis and synthesis which informs the triangulation of results and findings for future direction of research. The Publish or Perish software is one the world's largest and most comprehensive collection of information resources. The search for data was conducted on 8th January 2024. The search engine applied in the Publish or Perish interface was Google Search. The search was done using document Title Terms. The search terms were: Sustainable Cities OR Environmental Policies. The development of the search terms was conducted in line with the Boolean operators.

This shows the most frequently used terms in the journals and articles selected for the review on the research topic; Sustainable Cities OR Environmental Policies. A careful study

of Figure 10 shows that Sustainable development, sustainable future, environmental regulatory policy, sustainable energy policy, sustainable development goal, housing policy, innovative policy, and local adaptation policy have been used frequently, however, environmental policies are completely missing on this diagram. The implication is that all the 434 publications did not focus much attention on developing sustainable cities through environmental policies.

Leveraging the enforcement of environmental policies is an intervention to proactively deal with environmental consequences that have the potential to destroy ecosystems in comparison with (Yakin, 2004). Composite or inter-sectorial environment policies in urban areas will reduce the negative impact on the environment if not completely eradicated. Researching environmental policies in the context of developing sustainable cities has not been accorded much research attention. Various entities governing their jurisdiction should focus attention on promulgating policies directed towards concerns and regular assessment through scientific research for measurement of the impact of those policies.

The research topic remains a research gap in the existing literature as none of the 434 available literature has been published on it. All the Authors focused on environmental issues in the realm of sustainable food production, reduction in carbon emission and footprint, and reduction in energy consumption through innovative building design. These thematic evolutions by the authors emphasize the need to research into developing sustainable cities through a synergy of enforcing environmental policies for a sustainable future of cities.

Consequently, the paper concludes with research directions on rigorous assessment of environmental policies in urban areas. Research into compliance with environmental policies in terms of building regulations, protection of green areas, and buffer zones should be encouraged for sustainability drive into the future. Efforts towards zero emissions such as biking, solar farms electronic vehicles, circular economy, and environmentally friendly production methods should be encouraged as innovative interventions towards sustainable cities.

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