



Green Policies in Higher Education Institutions: A Bibliometric Review



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Abstract: This study aims to investigate the academic community's engagement with research on green policies within higher education institutions. The study examines the evolving landscape of green policy research in universities, seeking to elucidate trends in academic interest, key contributors, and thematic developments. Employing bibliometric analysis, this research scrutinizes publications indexed in the Web of Science database from 1994 to 2024, with a particular focus on keywords, co-authorship networks, and institutional affiliations. The findings indicate a notable increase in publications, particularly post-2016, reflecting a transition from broad conceptual themes to more specific applications of green policies, including sustainable management practices and performance evaluation. Central themes identified include “green”, “sustainability”, “performance”, and “management”, highlighting a shift from theoretical exploration to practical implementation. Prominent contributors, such as Wang Y and Zhang Y, alongside institutions like Tsinghua University, have significantly advanced the field. Furthermore, the study underscores a robust correlation between the growth in scientific output and the emergence of specialized sustainability journals, indicating an escalating academic demand for focused publication platforms. The results suggest that research on green policies in universities is increasingly characterized by interdisciplinary collaboration and the integration of innovative technologies and methodologies to effectively address sustainability challenges. The field of green policy application in higher education is rapidly expanding, with a well-connected, collaborative research community generating impactful work that harmonizes modern technologies and methodologies to confront sustainability issues at both global and local levels.

Keywords: Green; Policies; Higher education; Sustainability; Institutions

1. Introduction

Higher education institutions play a crucial role in educating the next generation. The specialized literature introduces a new mission for higher education institutions, namely the social one - through which universities contribute to the well-being of the communities in which they are located. The “third mission” refers to active societal engagement. In addition to education and research, it plays a crucial role in the effective development of modern universities (Klemeshev et al., 2019). In the education system, there are plenty of challenges, which should be addressed one by one because it is a known fact that higher education provides the graduates with a guide for their future actions. One of the current challenges is to be responsible in the context of sustainable development, and the path that universities in the area choose can influence the future of those communities and beyond. Thus, these actions must lead to a sustainable future (Barth & Rieckmann, 2012; Gao et al., 2006). In order to stimulate the sense of responsibility, educational institutions can play an important role in this regard. Graduates are the future of society, and their practical application of learned lessons is crucial for building a safe and sustainable world (Hassan et al., 2019).

In recent years, there has been an increasing emphasis on green policies and universities in the academic environment (Barth & Rieckmann, 2012). These are addressed and promoted to incorporate environmental protection and sustainable development in subjects such as social and natural sciences, furthermore in all aspects of campus life (Ferrer-Balas et al., 2009). According to Sima et al. (2019), sustainability topics are predominantly emphasized and implemented in faculties specializing in earth and technical sciences because the strong theoretical

background of the former and the experimental, innovation-driven focus of the latter encourage the development of green technologies. In this sense, building the green curriculum may be the hardest part, but it can be considered a secret weapon in raising students' environmental awareness and developing green universities (Boks & Diehl, 2006; Lozano, 2010). Specifically, Dagiliūtė et al. (2018) anticipated that green universities, as they become more prevalent, would make the greatest contribution to sustainability outcomes.

According to Cuesta-Claros et al. (2022), the significance of universities is underscored within Agenda 2030, particularly concerning their role as pivotal partners in the achievement of the Sustainable Development Goals (SDGs), with specific emphasis on Goal 4-quality education. This goal specifically emphasizes the importance of higher education in fostering sustainable development. Although not all universities have adopted formal green policies or sustainability strategies, many are taking various actions to move in this direction and contribute meaningfully to sustainability efforts. These institutions are striving to play a significant role by aligning their practices with global sustainability goals. Dagiliūtė et al. (2018) reveals that, from the students' perspective, green and non-green universities in Lithuania exhibit only slight differences in sustainability practices, except in crucial areas such as environmental information and student engagement. This suggests that green universities need to go beyond mere declarations and implement consistent, tangible actions to truly stand out from non-green ones.

Informing students and making them aware of the coincidences of their behavior towards the environment can have a long-term beneficial effect of increasing their moral commitments to sustainability by reducing unsustainable consumption. For example, in terms of the use of technology, there are many documented cases where students have become aware of the negative effects of their certain behaviors, which promotes them to adopt green, pro-environmental behavior (Popescu et al., 2020). In other words, higher education institutions can positively influence the behavior and attitude of students towards the environment through both the activities carried out within the ecological campus and the content of courses and seminars on green policies, sustainability and sustainable development (Dagiliūtė et al., 2018). In addition, research programs can be made, for example, in the field of energy, such as sustainable energy use or energy efficiency, because each person should have a responsible attitude in order to save the environment (Ribeiro et al., 2021).

The United Nations Educational, Scientific, and Cultural Organization (UNESCO) is entitled to lead the "Education 2030 Agenda", which aims to eradicate poverty through 17 SDGs in order to achieve a sustainable future and generally a better life worldwide. A recent report of UNESCO stipulates that teachers need to be prepared to teach students with varied backgrounds and abilities (UNESCO, 2020).

With this regard, the purpose of this study is to explore the academic community's interest in green policies in higher education institutions through a bibliometric analysis using the Web of Sciences database. The research question is: What are the emerging trends, thematic areas, and key contributors in the academic literature on the implementation of green policies in universities, as revealed through a bibliometric analysis? The analyzed period is between 1994 and 2024 with many research documents, more precisely 1,062. Regarding the structure of this study, it is divided into five parts. The first part presents the introduction and the literature review. The second part focuses on the methodology used in this study, namely bibliometric analyses. The third part presents the results obtained by conducting bibliometric analyses and analyzing 1,062 research documents. The fourth section engages in a discussion of the results, contextualizing them within the framework of previous works and broadening the perspective of the research findings. The last part, namely conclusions, summarizes the findings and the future research directions which could be addressed in this research area.

2. Methodology

A bibliometric analysis involves an empirical analysis of publications in one or more databases based on various criteria established by the researcher. It also includes a qualitative analysis of documents using software tools such as VOSViewer or RStudio. Bibliometric analysis can be conducted to uncover thematic trends, identify collaborations between authors and countries, and detect relationships between different fields of activities (Passas, 2024).

The Web of Science database was used to analyze the research on green strategies adopted by higher education institutions. The database was queried based on the topics "green strategy" and "green university" by searching titles, abstracts, keywords, and author keywords without imposing any other selection criteria. The downloaded dataset included the full records and cited references, resulting in a total of 1,062 publications indexed in the Web of Science database according to the aforementioned criteria.

The bibliometric analysis for this study was conducted using the "biblioshiny for bibliometrix" application, which is an R 4.0.3 software tool established in the 1960s by (Aydm et al., 2024). This application can generate maps, graphs, figures, and more based on the criteria established by the author to determine relationships, developments, or collaborations on the researched topic.

3. Results

From the main information on the data in Figure 1, it can be observed that the field of applying green policies

in universities is of interest to the international scientific community. The presented data highlights an increasing academic interest in the application of green policies in universities, as reflected by extensive and diverse literature in this field. Between 1994 and 2024, 1,062 documents were published across 677 diverse sources, indicating a well-established research topic. With an annual growth rate of 16.18%, this field has experienced rapid development, suggesting a growing interest in recent years.

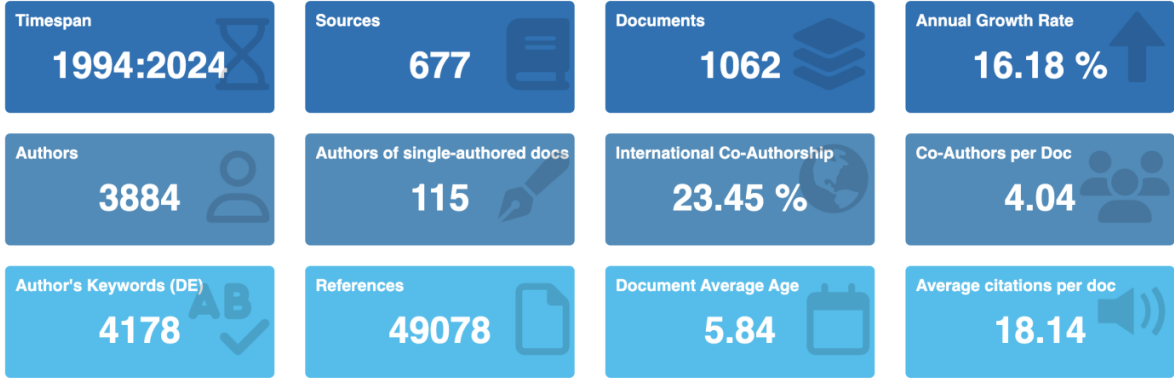


Figure 1. Main information on the data

The research community is active, involving 3,884 authors, of whom only 115 have published individual works. This points to a strong trend toward collaboration, both nationally and internationally, with 23.45% of documents being internationally co-authored and an average of 4.04 co-authors per document.

Thematic diversity is reflected in the 4,178 keywords used by authors, while the substantial number of references (49,078) shows that these works are well-grounded in existing literature. The average age of the documents is 5.84 years, suggesting that the field is current and relevant.

The academic impact of these works is significant, with an average of 18.14 citations per document, indicating that the published studies have a considerable influence on the continued research and development of green policies in universities.

3.1 Publication Distribution by Years and Most Relevant Sources

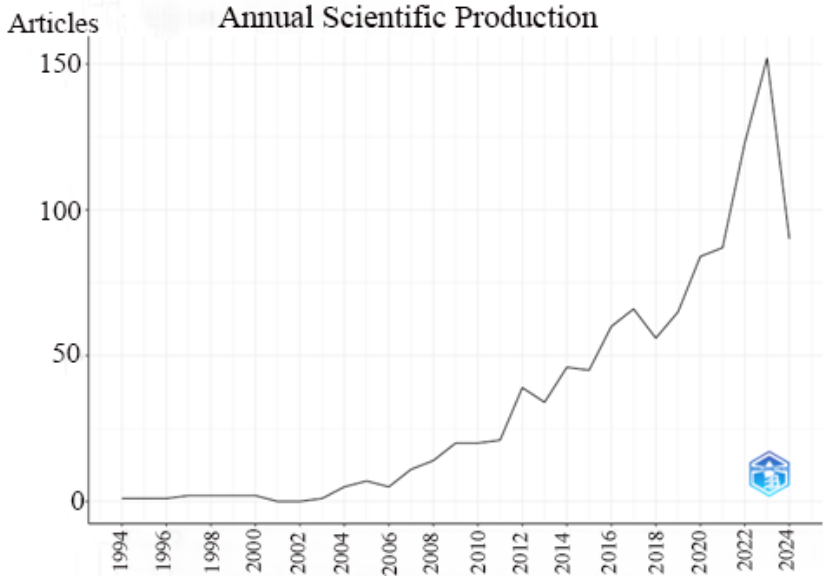


Figure 2. Annual scientific production

In the field of applying green policies in universities, the scientific production indexed in the Web of Science database is recent, with the first document published in 1994, which is 30 years ago. At the beginning of this period, the number of articles was extremely low, suggesting limited interest in this topic. Starting in 2010, there has been an accelerated increase in the number of publications, with a major peak in 2023, when the number of published articles slightly exceeds 150. This sharp increase indicates that the topic of green policies in universities has

become increasingly important, attracting growing interest from the academic community. Moreover, this sharp increase coincides with the global momentum around sustainability efforts, particularly the implementation of Agenda 2030 and its 17 SDGs. These goals, which emphasize sustainability across various sectors, including education, likely spurred greater academic interest and research activities related to green policies in universities, contributing to the field's expansion and relevance. While Agenda 2030 has been a critical driver, a combination of international climate agreements, public awareness, policy mandates, funding, technological advances, university rankings, activism, and the pandemic may have collectively influenced the sharp increase in research on green policies in higher education.

The main journals and publications where most of the works related to this topic have been published are *Sustainability*, which is the most prolific source with 65 articles, followed by the *International Journal of Sustainability in Higher Education* and the *Journal of Cleaner Production*, with 34 and 33 articles, respectively. These data suggest that the journals focusing on sustainability and clean production are the primary platforms for disseminating research on green policies for universities.

The growth in scientific production coincides with the emergence and development of journals dedicated to sustainability and environmental issues, such as *Sustainability*. These journals have become key hubs for research in this field, facilitating the increase in the number of articles published annually. Moreover, the surge in publications from 2020 to 2022 reflects intensified interest in sustainability discussions, particularly in the context of the global climate crisis and the movements among universities to become more sustainable. Figure 2 shows the annual scientific production. Figure 3 shows the most relevant sources.

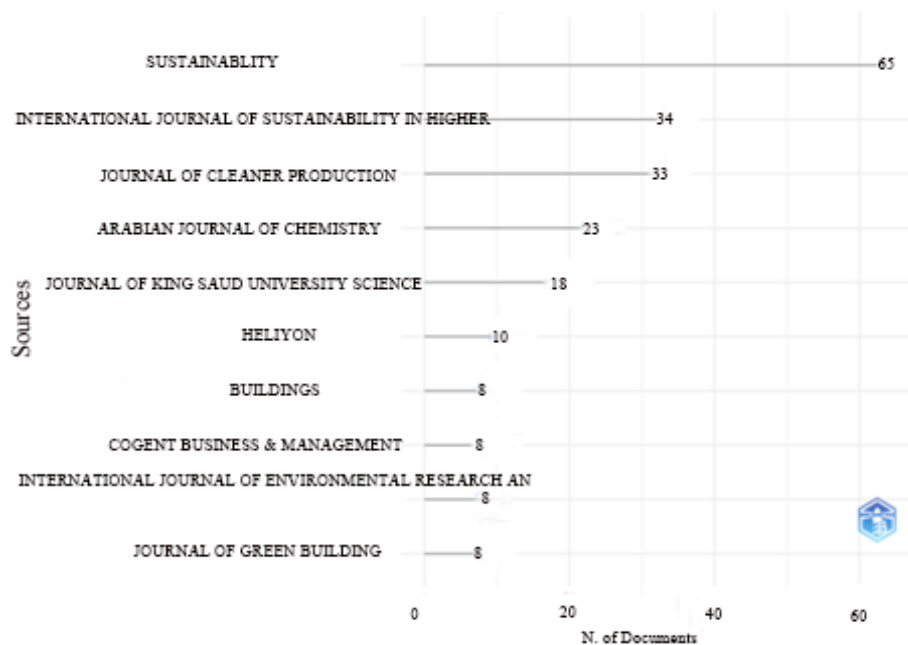


Figure 3. Most relevant sources

3.2 Global Distribution of Corresponding Authors

Globally, interest in the researched topic is high, with 92 countries contributing to the research. The main countries that have contributed to the research and publication of works on green policies and universities are China (709), the USA (532), and Italy (234). The global collaboration map and the publication distribution chart provide a complementary view of the involvement of countries in researching green policies and universities.

To understand global knowledge distribution and resource mobilization to address sustainability issues, Single Country Publications (SCP) and Multiple Country Publications (MCP) collaborations were studied in the field of green policies and universities. The most intense collaborations exist between the United States, Europe (particularly the United Kingdom), and China. China and the United States dominate international collaborations due to their robust research infrastructure, global academic leadership, and national focus on sustainability. Both countries attract significant funding, produce high volumes of research, and leverage advanced technological expertise, making them key players in the global landscape of green policies and sustainability. Home to many of the world's top universities and research institutions, these countries consistently rank highly in global academic rankings. Additionally, both nations host a substantial number of international students and visiting researchers, fostering long-term academic relationships that frequently lead to research collaborations. These exchange

programs help build the networks essential for sustained international cooperation.

Interestingly, there are also significant collaborations between East Asian countries (China, Japan, and South Korea) and countries in North America and Europe. Regions such as Africa and South America have a limited number of international collaborations, indicating lower integration into global research networks in this field.

China has an extremely high number of the SCP produced within the country. This may suggest a strong focus on domestic research and less openness to international collaborations. Italy, the United Kingdom, and India are also important players, but with a greater balance between SCP and MCP. This balance indicates significant involvement in international collaborations, thereby playing a key role in connecting different research networks and facilitating the diffusion of ideas, which enhances global collaboration. Countries such as Romania, Iran, and Japan have fewer publications and tend to be more involved in international collaborations.

However, both SCP and MCP are crucial for advancing research and developing and implementing green policies within universities. They contribute in a complementary manner to the growth of knowledge and the realization of necessary changes for a sustainable future. Figure 4 shows the countries of corresponding authors. Figure 5 shows the world collaboration map.

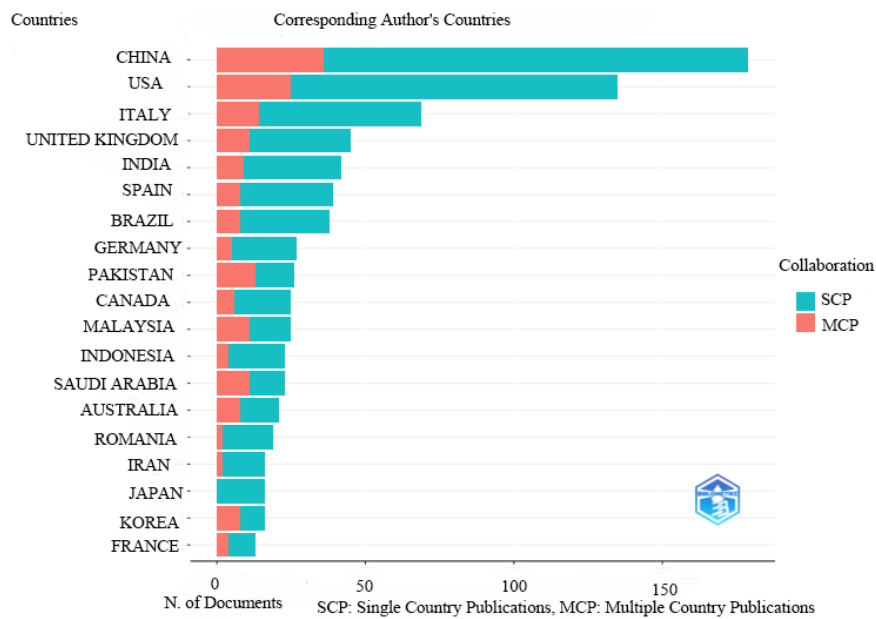


Figure 4. Countries of corresponding authors

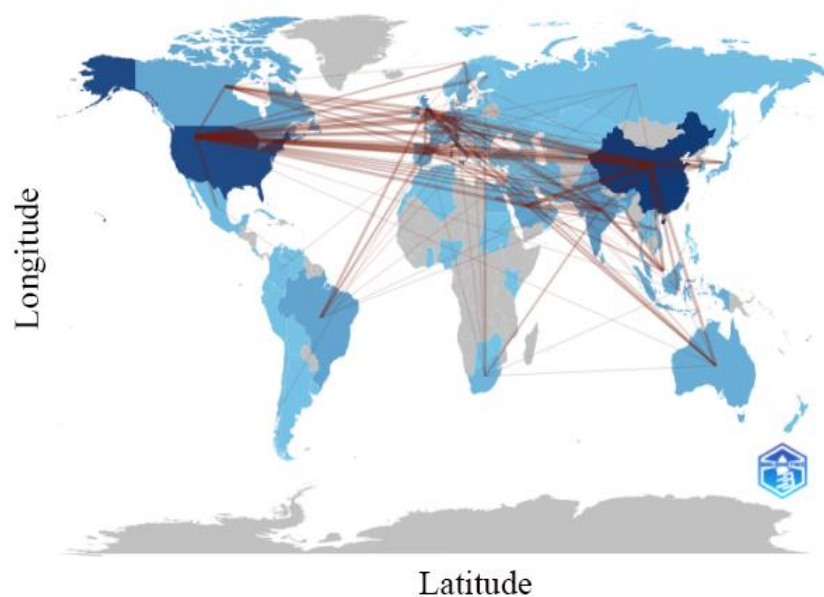


Figure 5. World collaboration map

3.3 Authors' Production and Most Relevant Affiliations

Figure 6 and Figure 7 provide a holistic view of research in the field of applying green policies in universities, both from the perspective of the authors and their institutional affiliations. The academic interest in this research field is expanding, as authors have focused their efforts and published the most in recent years. Wang Y and Zhang Y are the most prolific authors in this field with the most published articles, especially in the recent years (2022-2023). Wang Y has a high concentration of articles within a brief period, suggesting a significant contribution in terms of the number of publications and citations.

As for the authors' affiliations, a global distribution can be noticed, with important research centers in Europe (Italy), Asia (China and South Korea), and North and South America. Tsinghua University is the undisputed leader in this sector with 29 publications, suggesting it is an important research center for green policies. King Saud University and Universidad Nacional Autónoma de México also have significant contributions with 23 and 22 publications, respectively, highlighting a global involvement in this topic. The University of Oradea in Romania appears on the list with 13 publications, indicating an active presence in this field at the local and regional levels.

Moreover, the figures also suggest a trend toward international and interdisciplinary collaboration among top universities, leading to increased academic production in this field.

It is important to note that prolific authors are often affiliated with top institutions, and these institutions, in turn, dominate research in this area. This interdependence between the authors' output and institutional affiliations underscores the importance of prestigious universities in advancing research on green policies in universities.

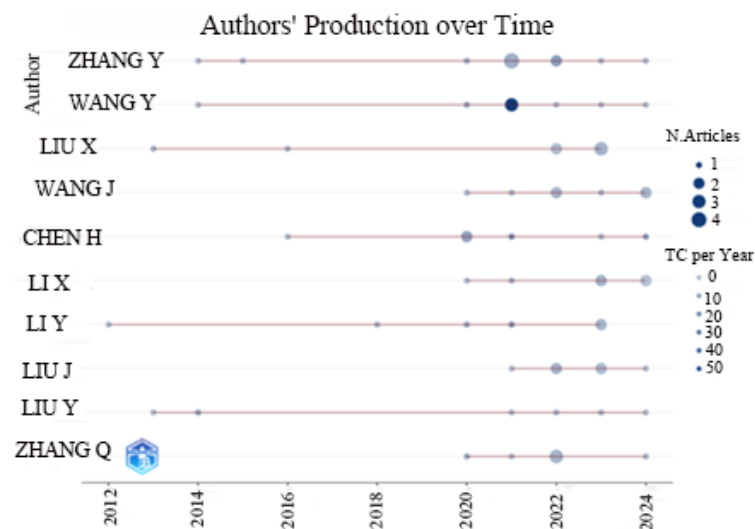


Figure 6. Authors' production

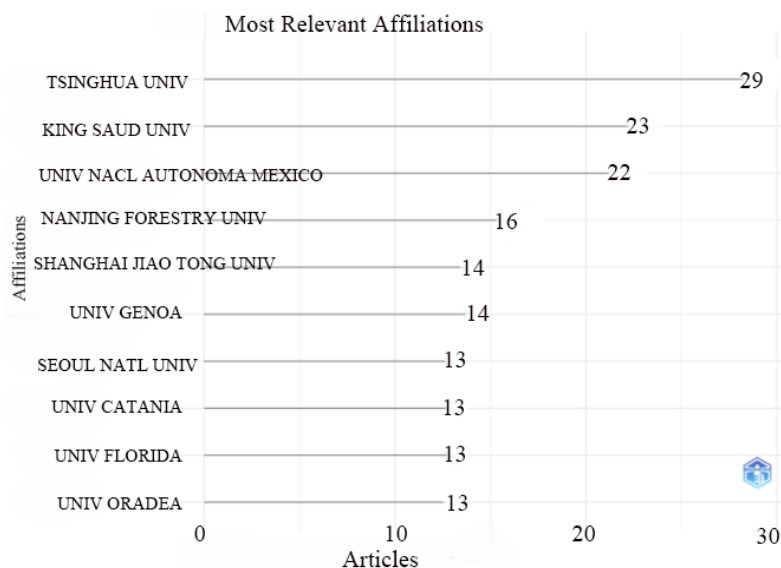


Figure 7. Most relevant affiliations

3.4 Word Cloud and Clusters

The analysis of the most relevant keywords as well as the clustering based on document coupling indicates that the literature on green policies in universities primarily focuses on the concepts of green, university, and sustainability, with significant attention given to the performance and management of these policies.

It can be observed that green is the most frequent concept, indicating its centrality in academic discussions. Other important words are performance and impact, highlighting the interest in measuring and evaluating the effects of these policies. Terms such as sustainability and management suggest that discussions are also oriented towards the implementation and management of these policies in universities. Thus, the central concerns of academic literature regarding the transformation of universities into green institutions are reflected.

Clustering shows a diversity of themes and connections among planned behaviors, higher education, and sustainability, underscoring the multidimensional nature of this research field. The most central and impactful clusters are related to higher education, universities, and green policies. These form the core of academic discussions, emphasizing the close connection between education and sustainability.

Another important cluster explores planned behaviors and attitudes towards green policies, suggesting a significant interest in how these policies are perceived and implemented at both individual and institutional levels. In Figure 8, there are clusters addressing performance, management, and sustainability, highlighting practical aspects of implementing these policies.

These clusters indicate thematic diversity in the literature, with a focus on both theoretical and educational aspects as well as practical issues related to the implementation and impact of green policies in universities. Figure 9 shows the clusters by document coupling.



Figure 8. Word cloud

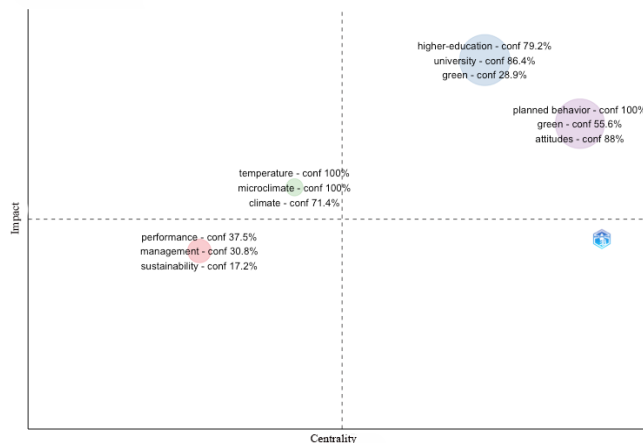


Figure 9. Clusters by document coupling

3.5 Thematic Evolution

Figure 10 traces the evolution of key themes in research related to green policies and universities over four distinct periods: 1994-2015, 2016-2020, 2021-2022, and 2023-2024. The research themes have evolved from broad and general concepts in the 1990s and 2000s to much more specific and applied topics in recent periods. This reflects a maturation of the field and a shift from conceptualization to the implementation and optimization of green policies.

During the 1994-2015 period, research focused on general themes related to climate change, sustainable development, and strategies for integrating these concepts into various systems. The themes are broader and reflect an initial stage of exploring the fundamental concepts.

Starting in 2016, there is a transition toward more specific themes, such as green synthesis, which involves sustainable methods for developing new materials or processes. The theme of performance suggests an increased interest in evaluating the effectiveness of green policies and practices.

Research from the 2021-2022 period appears to focus on practical aspects, such as stress management in urban environments and identifying specific solutions for cities (the themes of cities and management). Green continues to be a central term but is associated with more applied contexts.

In the recent period, there has been an observed interest in specific technologies and processes, such as nanoparticles and wastewater (wastewater management). Themes related to design and reduction indicate a heightened focus on how green policies can be implemented in infrastructure design and reducing ecological impact.

The term green remains consistent across all periods, highlighting that green policies and practices have remained a key area of interest in research.

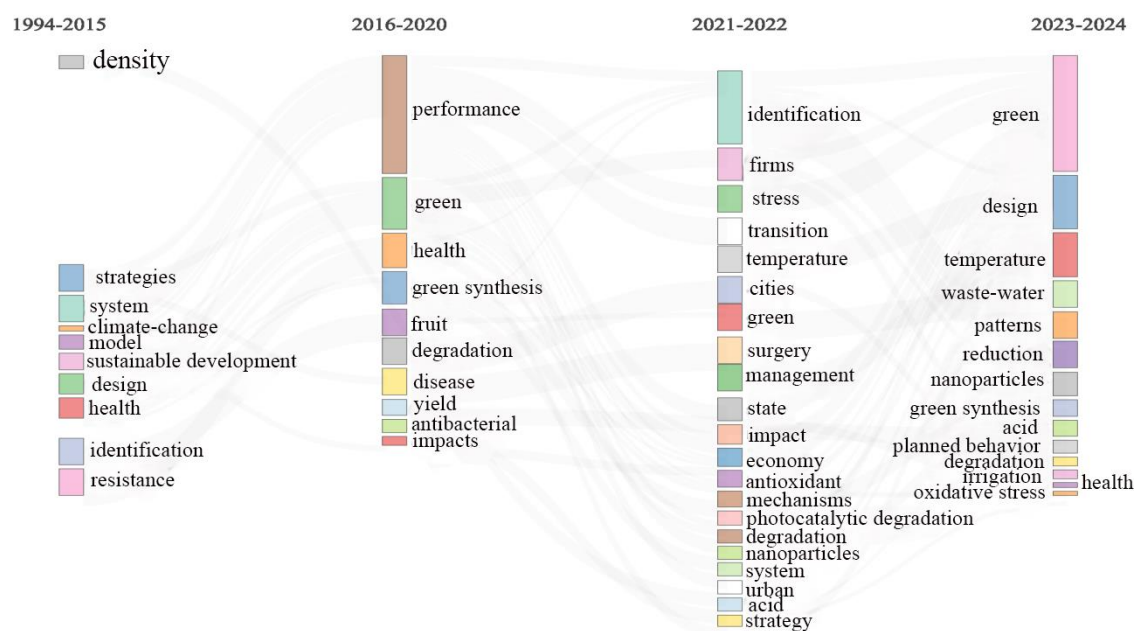


Figure 10. Thematic evolution

3.6 Most Global and Local Cited References

The most globally cited document is the study by Hart (1997), with 799 citations. This highlights the major impact of this article in the studied field. However, it does not appear in the local graph, suggesting that its impact is more recognized on the international stage than at the local level. This could reflect a difference in priorities or resource availability in local regions, where other works are preferred.

Other globally impactful documents include articles from journals such as the *Chemical Society Reviews* and the *Ecological Economics*. Additionally, the top global documents come from a variety of fields ranging from economics to chemical and environmental research, suggesting a multidisciplinary approach to green policies.

The most locally cited documents come from journals such as the *Journal of Cleaner Production*, with articles authored by Lozano (2010), gathering a remarkable number of citations (up to 37 local citations). This finding stipulates that local research is firmly influenced by international articles and concentrates on sustainability in production and ecological behavior.

Furthermore, articles from the *Journal of Cleaner Production*, such as the one by Lozano (2010), appear in both

global (503 citations) and local (27 citations) graphs. This suggests that this work has strong relevance and recognition, being consistently used in both local and global research. Lozano (2010) also has an impact in both graphs, indicating continuity and thematic relevance on both international and local levels.

There is a correlation between the globally and locally cited documents, with essential works contributing to the implementation of green practices from both business and educational perspectives. Scientific production is strongly influenced by universities and authors with consistent contributions to green policy research, and the most cited documents reflect key themes of sustainability and ecology both globally and locally. Figure 11 and Figure 12 show the most locally and globally cited documents, respectively.

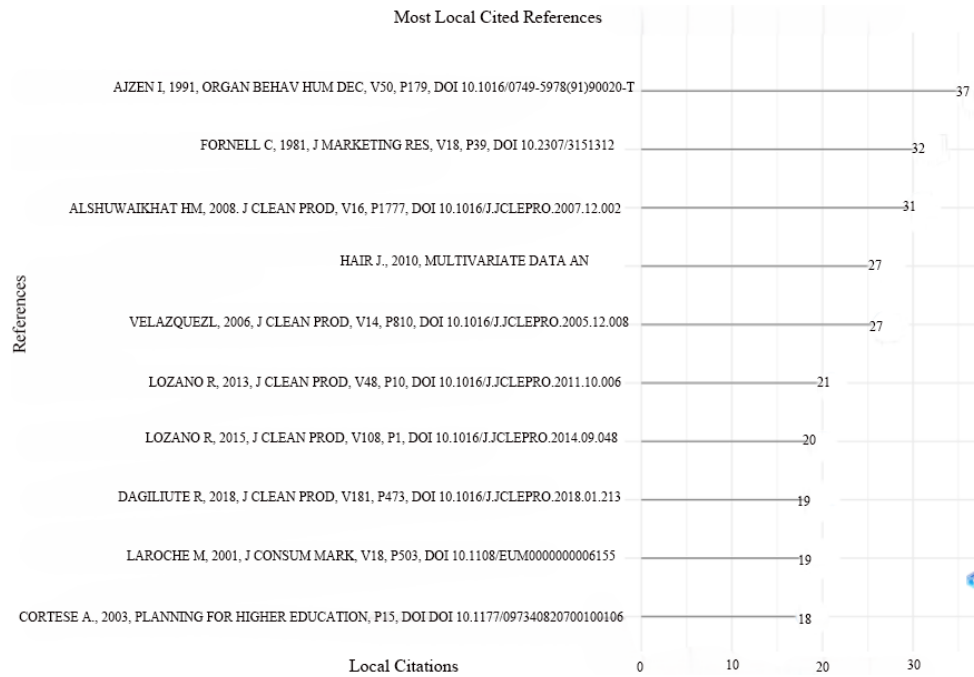


Figure 11. Most locally cited references

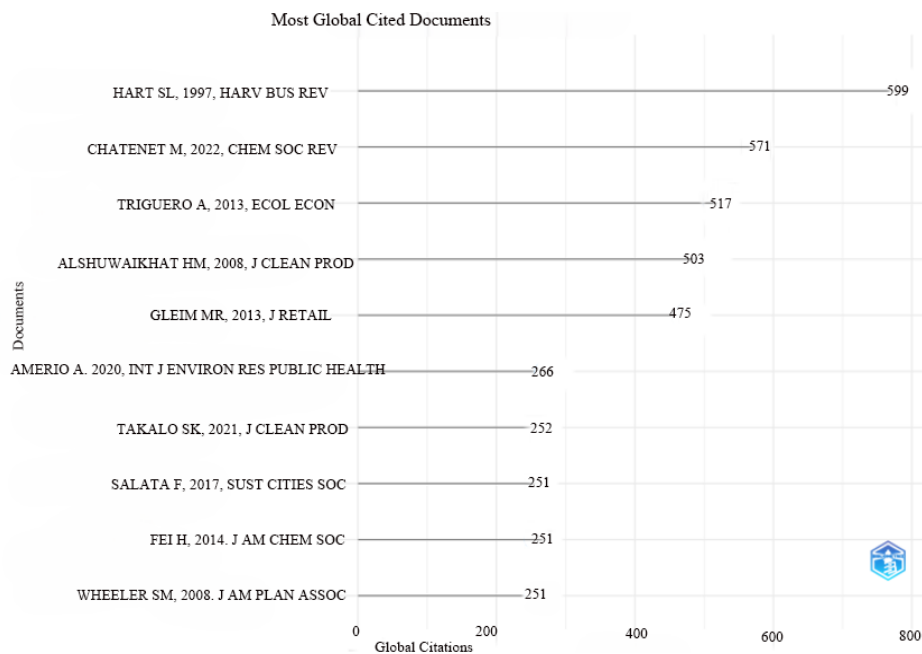


Figure 12. Most globally cited documents

4. Discussion

As shown in the previous section of this study, the interest of the academic field in applying green policies has

been growing since all these measures contribute to achieving the ambitious goals established by the Green Deal (Nimerenco & Leoveanu, 2024; Romania's Sustainable Development Strategy 2030, 2018; The European Green Deal, 2019). Recent works reveal that there is a need to reconsider these ambitious goals and adopt a realistic roadmap (Bruch et al., 2024).

Generally speaking, serious efforts have been made to fulfill these objectives, particularly within the energy sector (Toró, 2023). However, it appears that these efforts may not be sufficient. So far, it can be stated that the transition in the energy sector in the European Union obviously is unequal (Drăcea et al., 2020), even if an increased trend of investments in renewable energy sources in the sector can be perceived in the last decade. The green policies can create for certain a series of positive effects on the economy to achieve a sustainable future. In addition, the education level of the population can positively influence its implementation at the EU level (Drăcea et al., 2024). Several countries have been trying to build a sustainability leadership, but it is critical to notice that new perspectives can be developed by not using mainstream approaches (Bendell & Little, 2015). It is very important to notice that EU member states made serious efforts to fulfill environmental policies, but there is still a long road to obtain the desideratum of neutrality (Drăcea et al., 2024). To unlock innovation and build a sustainable future, collaboration over competition needs to be fostered. Otherwise, the challenges can be overwhelming, and it could not lead to achieving the final goals from an environmental perspective. In this manner, innovation could constitute a barrier instead of serving as a source of inspiration (CISL, 2015).

After analyzing authors' productivity over time, Zhang Yu and Dr. Yan Wang stand out as the most prolific, with the highest number of published works. Zhang Yu, affiliated with the Academy of Global Food Economics and Policy and the College of Economics and Management at China Agricultural University, has made notable findings to the academic field by conducting research on critical issues in global food economics and agricultural policies. Meanwhile, Dr. Yan Wang, a leading UK researcher in remanufacturing, has published over 50 papers and holds 10 patents. She plays an important role in defining remanufacturing standards and is actively engaged in the academic field, serving as a reviewer and editorial board member for several high-profile journals.

5. Conclusions

It can be concluded that the field of applying green policies in universities is of growing interest, characterized by an active and collaborative scientific community. The impact of the published works is significant, and the subject continues to be relevant and intensively studied. In conclusion, the data highlights a dynamic and rapidly expanding research field with a well-connected research community and a strong academic impact. There is a strong correlation between the growth in scientific production and the development of top journals in the field of sustainability, indicating an increasing academic interest and a need to create dedicated platforms on this topic.

Research in the field of green policies and universities has evolved significantly, adapting to contemporary challenges and integrating modern technologies and methodologies to address sustainability more effectively and concretely. This analysis indicates a concentration of academic efforts around key authors and institutions that dominate research on green policies in universities. Wang Y and Zhang Y stand out as important authors, and Tsinghua University is an academic leader in this field. The growth of academic output in recent years suggests that this topic is of great interest and has been expanding.

The global-local connection is evident through the partial overlap of documents, particularly in research published in sustainability-focused journals like the *Journal of Cleaner Production*. These works have a consistent impact at both levels, indicating that the research is essential for the development and implementation of green policies in general. At the same time, there are differences, with highly cited global works not having the same impact locally, possibly due to factors such as accessibility, region-specific relevance, or local research priorities. Thus, there is a strong correlation between some works recognized at both levels, while other works are more relevant in the global context than locally.

This study has some limitations. For example, its reliance on the Web of Science database may not include all relevant studies or documents from other databases like Scopus or Google Scholar. The research's focus on specific keywords could limit the scope of the results, excluding potentially relevant articles that do not exactly match the selected terms. The context in which the analysis was carried out, including regional relevance and the relatively nascent status of the research topic, reflects some of the limitations regarding the applicability of global research to local contexts. Furthermore, some topics may be underdeveloped in certain regions.

This research can be extended by addressing interdisciplinary gaps and exploring the socio-economic impact of green policies in higher education institutions through a more holistic approach. In addition, the scope of analysis could be expanded beyond citation data to include other aspects like temporal, regional and contextual specificities.

Data Availability

The data used to support the research findings are available from the corresponding author upon request.

Conflicts of Interest

The authors declare no conflict of interest.

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