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Review

Sustainable Affordable Housing: State-of-the-Art and Future Perspectives

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Abstract: Nowadays, there are many studies with a significant focus on affordable housing. The relevance of this theme, which is usually the central object of public housing policies, requires an updated review of the problems and challenges to be overcome, especially in terms of sustainability, in favor of an improvement in the quality of products delivered to beneficiaries. This research concentrates on applying the sustainability concept to affordable housing, emphasizing technical, social, and governance aspects. A novel classification framework is introduced, encompassing these aspects in the context of sustainability integrated with affordable housing. A systematic literature review is conducted and more than 100 articles are examined based on bibliometric and bibliographic analyses to highlight the main dimensions and topics involved in the housing public policy sphere. The study has been elaborated based on collecting relevant materials, building a descriptive analysis of the literature examined, highlighting the classification structure that categorizes the studies examined, and evaluating the material identified based on the classification structure. The outcomes aim to spotlight the diverse dimensions of sustainable affordable housing and associated research themes. Furthermore, the research outlines deficiencies in current approaches and outlines a future research agenda for implementing sustainability in affordable housing. It establishes a strong connection between technical, social, and governance aspects of affordable housing and sustainability, considering anticipated approaches, techniques, and challenges.

Keywords: affordable housing; energy efficiency; sustainability analysis; affordable housing; environmental impacts; sustainable decision-making process; performance; stakeholders

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1. Introduction

As outlined in the 2022 report from the United Nations Human Settlements Programme (UN-HABITAT), one out of every eight individuals on the planet currently resides in slums or inadequate housing. This alarming statistic signifies that over 1 billion people presently inhabit slums within the urban areas of developing countries. Unfortunately, projections indicate that the ambitious objective of eliminating poverty in all its manifestations is to ensure that no one is left behind, as articulated in the Sustainable Development Goals, which may not be realized until 2030. The persistence of slum living conditions poses a significant challenge to achieving these global goals [1]. The year 2008 marked a pivotal moment in urban development, as the global population shifted toward urban living, surpassing rural dwellers. Presently, over half of the world's population resides in urban areas, within progressively more crowded cities. Projections suggest that by 2030, the inhabitants of these areas will reach 5 billion. With the swift expansion of urban populations worldwide, cities face numerous challenges [2].

One of the current challenges is the expansion of the urban housing supply, particularly affordable (or, more specifically, low-cost) housing, alongside the necessity to operate and maintain all existing urban infrastructure globally. In this scenario, with these perspectives, the topic of affordable housing has been widely debated worldwide, along with its potential as a solution to the housing deficit [3,4]. Its concept, dynamic over time and regionally variable, can be described as affordable housing available for lease or acquisition by any family with an income equal to or lower than the local average (according to official public assessment), irrespective of its economic and financial capacity. It is important to note that this concept excludes any analysis regarding the family's commitment to other needs, such as food, transportation, clothing, and healthcare, among others, in order to bear the potential expenses related to the property that may span long time intervals. In some contexts, affordable housing may refer only to subsidized or public housing, while in other cases, it may encompass market-priced or "affordable" housing for different income levels, ranging from households with no income to those with moderate incomes, generally with interest costs associated with acquisition in installments over extended periods. Present in several countries around the globe, affordable housing involves various stakeholders, with social, economic, and environmental impacts. The development of enterprises focused on affordable housing is increasingly viewed as a way to address the needs of low- and middle-income populations in countries, serving as a form of public policy [5]. The concept emerged as a solution that must consider the sustainability of cities in all domains and throughout all phases of project implementation [6].

There is an effort to achieve the goals outlined by the Sustainable Development Goals (SDGs), representing a global call to action to eradicate poverty, safeguard the environment and climate, and realize the 2030 Agenda, as defined at the United Nations General Assembly in New York in September 2015. Due to the comprehensive nature of the sustainability concept, it becomes necessary to narrow the focus of research to one of its numerous areas. This study specifically concentrates on the application of the sustainability concept to affordable housing. This includes the development of sustainable affordable housing worldwide, the technical, social, and governance aspects associated with affordable housing, and the stakeholders involved in affordable housing programs, examining their relevance to the expansion of the concept of sustainability applied to this theme.

The construction industry has consistently demonstrated itself as a significant consumer of natural resources and energy in various forms, as well as a generator of waste. In the current context, with an increased focus on sustainability across all sectors of society, the construction business should be no exception. The application of the sustainability concept to construction aims to optimize the reduction in environmental impacts, minimize the consumption of natural inputs and energy, and enhance the economic viability of products throughout the entire useful lifespan of the building [7–11]. Sustainable solutions in the construction sector can encompass various factors, with repercussions throughout their useful life. These impacts extend beyond economic considerations and also encompass aspects of quality, building performance, and their socio-environmental applications [12].

The recent literature on the sustainability of buildings underscores the significance of pursuing energy efficiency, particularly through technical evaluations. Notably, emphasis is placed on assessments that target thermal and lighting performance [13–18]. Numerous studies concentrate on experimenting with alternative and/or sustainable materials and construction techniques [19–27], often advocating for comparisons between different solutions that favor socio-economic and environmental implementations. Additionally, the noteworthy topic of clean energy use, particularly with an emphasis on solar energy, deserves highlighting [28–30]. Furthermore, publications delve into the literature on highly specific topics, such as the carbon market [31], technology transfer [4], building envelope [24], and even energy retrofits [32]. In the pursuit of sustainable development in construction, the recurrent themes in published articles are related to public housing policies [3,33–77] and infrastructure [78–82]. These topics encompass the planning, conception, modification, rehabilitation, requalification, expansion, and even demobilization of urban

centers when necessary, in fortuitous and force majeure cases like accidents, disasters of significant proportions, wars, and epidemics such as the coronavirus, which recently had a devastating global impact. Another frequently discussed subject is the real estate market [83–97], emphasizing the influence of economic themes on the construction sector for all stakeholders, with a focus on users [98–106]. It is noteworthy that, as highlighted by various researchers, the practical application is still considerably distant from theoretical analyses centered on these subjects [44]. However, comprehending the logic of housing policies requires knowledge that considers technical and social constraints, as well as governance. Understanding how these aspects are interconnected is also of paramount importance.

The novelty of this study is to present a classification framework that encompasses technological, social, and institutional aspects, blending the theme of sustainability with affordable housing. There is a limited body of literature specifically focused on sustainable affordable housing: some studies concentrate on barriers or critical success factors, while others explore correlations with stakeholders, emphasizing economic and social factors such as production costs, household economics, and user satisfaction. Certain studies examine the impact of these dwellings (and their clusters) on the urban environment where they are situated. However, many studies primarily outline opportunities and challenges without proposing a classification structure for sustainable affordable housing research.

This is indeed the primary contribution of the mentioned article: the proposal of a framework, based on the literature, which identifies the close relationship between technical, social, and governance-related aspects of affordable housing and sustainability. This framework connects these aspects with the approaches, techniques, and challenges that are anticipated. The article introduces a systematic flowchart of the analysis conducted, which is based on bibliometric and bibliographic analyses of smart city infrastructure research. The VosViewer software (version 1.6.20) was utilized to generate keyword clusters and identify the most influential key patterns in each scenario. The article presents a framework highlighting the main research topics on sustainable affordable housing in the last five years. The review has developed a classification structure covering technical, social, and governance aspects associated with sustainable affordable housing, thus providing a comprehensive overview of the research focus. To achieve this, the literature review in this work aims to address the following critical research questions:

a. What are the different dimensions that sustainable affordable housing research focuses on?
b. What are the research themes associated with these dimensions?
c. What are the main limitations of current approaches and what would be a promising research agenda for the future in sustainability applied to affordable housing?

2. Materials and Methods

Given the large amount of academic research that addresses the technological, social, and governmental issues linked to this paper's research questions, it was decided that a systematic literature review (SLR) would be conducted. This tool is suitable for performing bibliometric and bibliographic analyses, where the first addresses quantitative aspects of the research, while the second explores it qualitatively. Bibliometric analysis aims to evaluate the production and dissemination rates of scientific knowledge through citation analysis and keyword grouping. Bibliographic analysis, in turn, seeks to identify, compile, and discuss the latest in the international literature, promoting a solid theoretical foundation on a given topic. According to [102,103], the combined use of both techniques allows the development of a holistic understanding of the current literature. Figure 1 illustrates the methodological framework used to develop this study. The main stages are summarized in the following sequence:

Step 1: Selection of the bibliographic database to be used and collection of relevant materials based on predefined criteria;
Step 2: Descriptive analysis of the examined literature;
Step 3: Presentation of a classification structure categorizing the examined studies;

Step 4: Assessment of material identified in Step 1, based on the classification framework developed in Step 3.

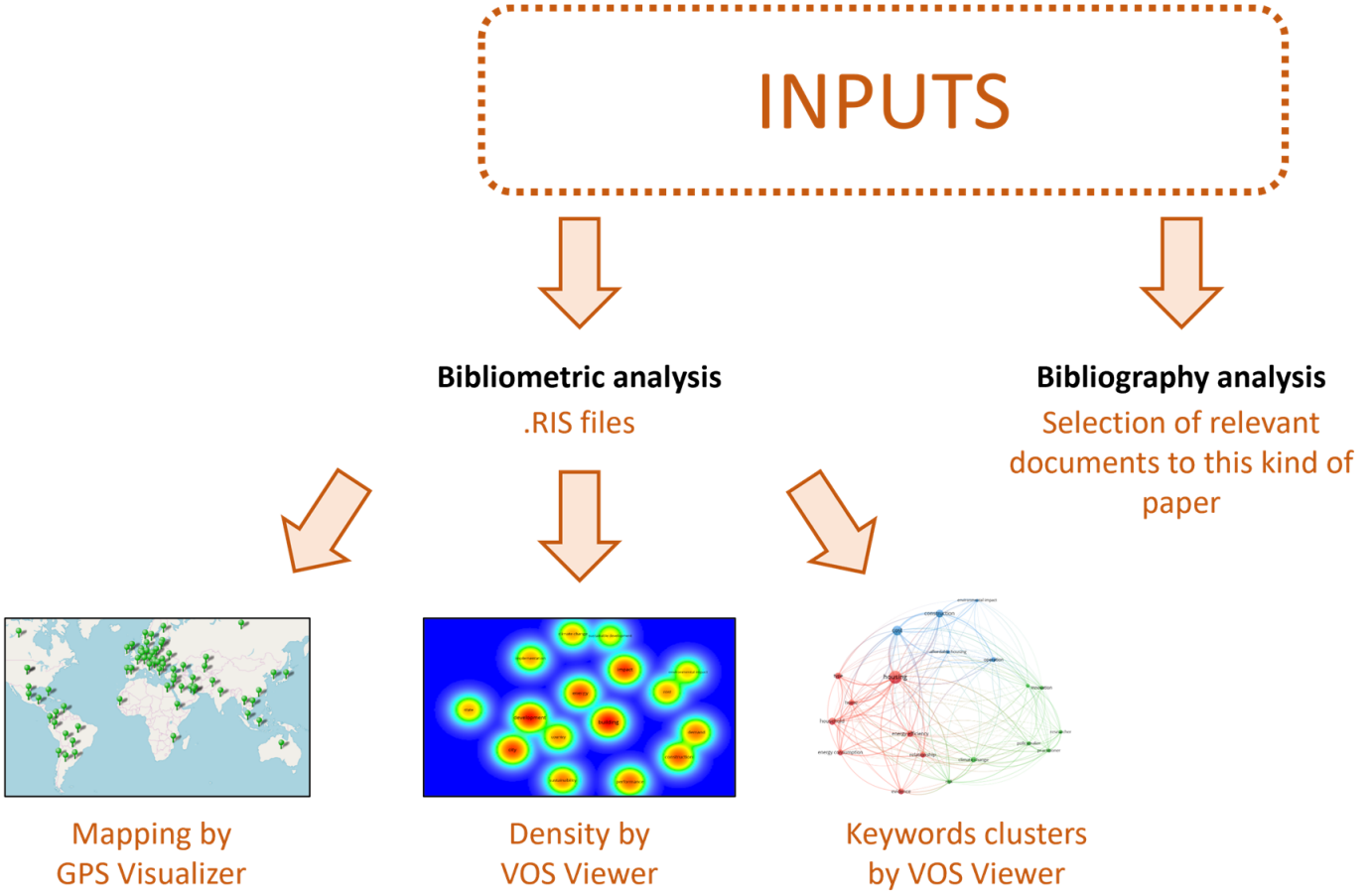

Figure 1. Bibliometric and bibliographic analyses were adopted in this review article.

This research used the Scopus database by consulting a set of keywords directly related to the topic, such as: "affordable housing", "sustainability", "energy efficiency", and "environmental impact". This ensured a filtering process of publications that provided raw material aligned with the scope of the issues raised in Section 1 of this article.

Initially, a time spam was not established, resulting in a large number of publications. Given the more than 7000 manuscripts returned by the database (Figure 2), an advanced filter was applied, restricting the search to materials published only in the five years preceding the search date (2019 to July 2023).

The refinement process identified 3155 manuscripts published between 2019 and 2023 (1st semester). Figure 3 illustrates the evolution of publications on the topic from 1999 onward, indicating that the period covered by this research is one of the most prolific for the subject. This can be easily verified by observing the greater slope of the dashed curve, indicating an exponential increase in research on the topic over the years. The column referring to the year 2023 is marked in a different color since the data obtained only consider the first half of the year. However, considering the trend curve, it appears that the number of publications at the end of the year most likely exceeded the previous year's number.

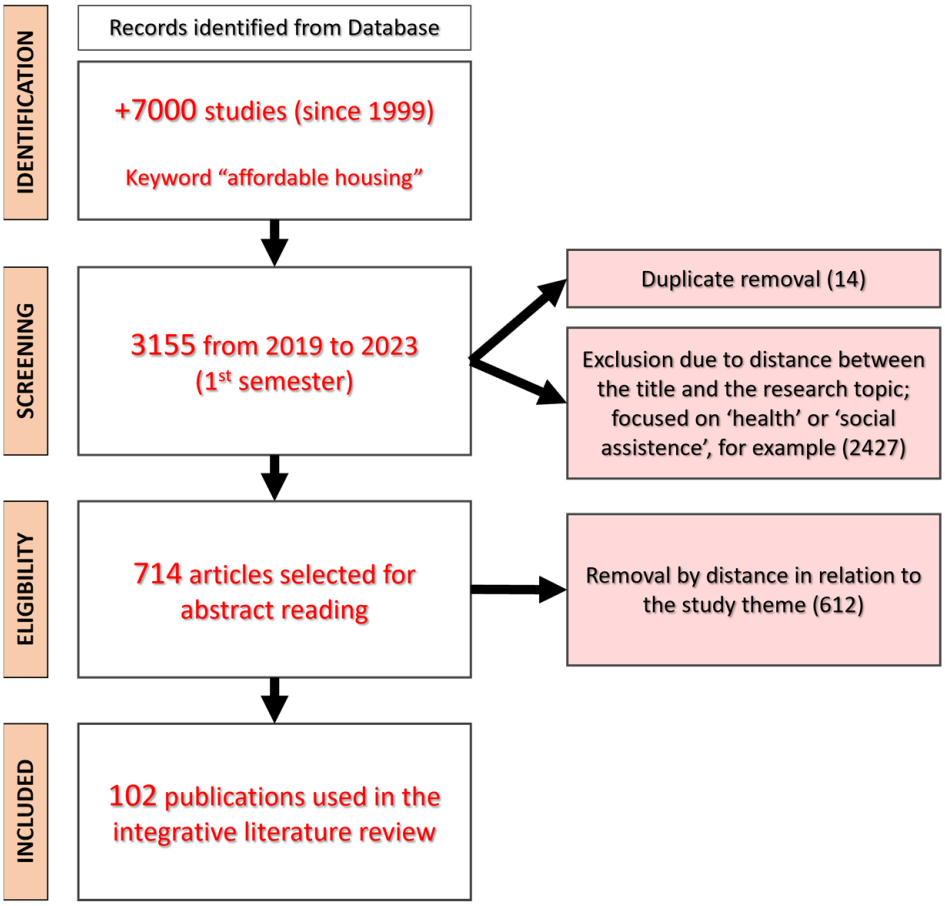

Figure 2. Data collection flow used in the literature review.

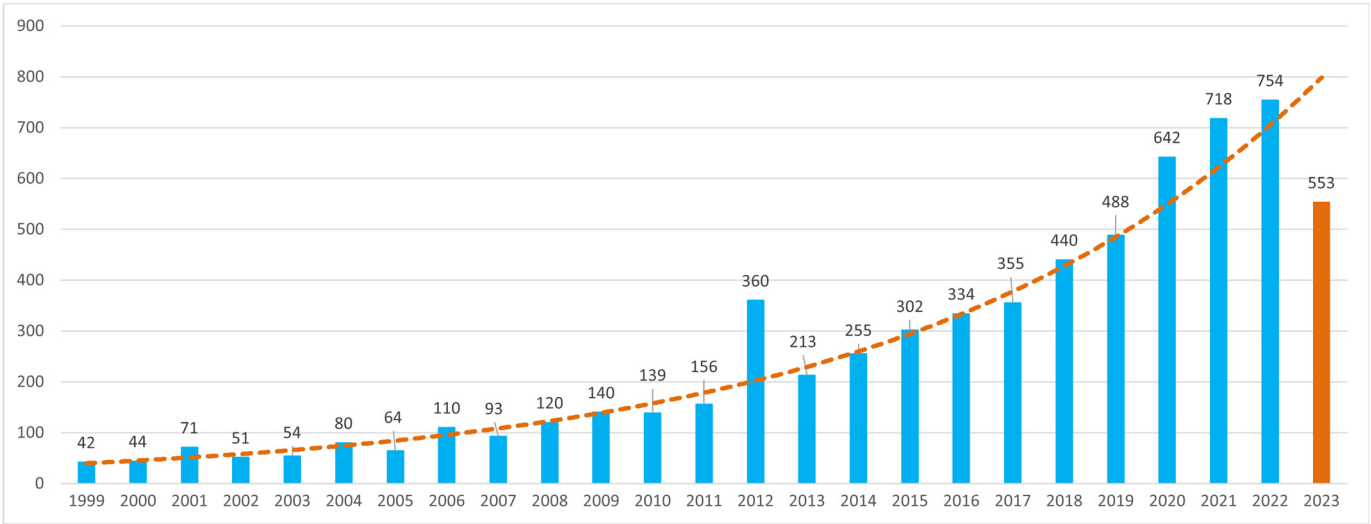

Figure 3. Evolution of publications with the theme of "affordable housing "since 1999.

Considering that even after applying the first filter the number of results remained high, a new survey had to be applied. Thus, a second analysis was carried out, applying the expression "affordable housing" as the focal point, observing the following pairs of keywords: (a) "affordable housing" and "environmental impact"; (b) "affordable housing" and "energy efficiency", and (c) "affordable housing" and "sustainability". It is important to highlight the use of the Boolean operator "AND" in all keyword combinations. The

second survey led to 416, 344, and 1835 results, respectively, distributed according to Table 1.

Table 1. Publications from January 2019 to July 2023 with the themes in pairs.

Year	"Affordable Housing" and "Environmental Impact"	"Affordable Housing" and "Energy Efficiency"	"Affordable Housing" and "Sustainability"
2019	57	58	276
2020	70	45	351
2021	119	88	424
2022	99	95	454
2023	71	58	330
Total	416	344	1835

To analyze the themes that showed the greatest correlation between research on "affordable housing" in more depth, a new search was conducted, this time considering three terms together. Table 2 shows the results of this new stage.

Table 2. Publications from January 2019 to July 2023 with the themes in trios.

Terms Used in the Search	2019	2020	2021	2022	2023	Total
"affordable housing" and "energy efficiency" and "environmental impact"	22	21	47	35	26	151
"affordable housing" and "sustainability" and "environmental impact"	52	64	114	92	63	385
"affordable housing" "sustainability" and "energy efficiency"	53	43	82	84	51	313

This article leverages bibliometric and bibliographic analysis to reveal the strong connection between affordable housing and sustainability. The analysis of the bibliometric results from the three search groups paves the way for defining the focus of further research. This analysis employed the VOSViewer software (version 1.6.20), a tool that facilitates bibliometric analysis and integrates with various databases. The search results were exported in the (.ris) format, a common file type for bibliographic data, and then uploaded into a bibliometric software tool for further analysis. Following the definition of clusters using the initial VOSViewer visualizations, three subsequent searches were formulated, leveraging the knowledge gained from these cluster views.

A summary of the results of each stage of the performed bibliographic search is presented in Table 3. All searches were conducted considering the keywords in the "title" and "abstract" fields of the databases. In addition, time (last five years) and language (English) filters were used.

Table 3. Summary of the literature search results.

Stage	Keywords	Publications
1	"affordable housing"	3155
2	"affordable housing" and "environmental impact"	416
3	"affordable housing" and "energy efficiency"	344
4	"affordable housing" and "sustainability"	1835
5	"affordable housing", "energy efficiency" and "environmental impact"	151
6	"affordable housing", "sustainability" and "environmental impact"	385
7	"affordable housing", "sustainability" and "energy efficiency"	313
8	"affordable housing", "sustainability", "energy efficiency" and "environmental impact"	109

3. Results and Discussions

3.1. Descriptive Analysis of Materials

Based on the publication rate between 2019 and 2023, it can be realized that the evolution curve of publications with the theme "affordable housing" highlights a constant increase in the number of articles published on affordable housing, which could justify the increasing attention that the subject has received recently. Particularly, themes that have not been accompanied by an equivalent level of investment in infrastructure and housing programs for all social classes. This situation occurs worldwide and can be verified by the fact that the articles included in this review originate from several countries. The distribution of the analyzed articles in their most diverse origins is presented in Figure 3. It is also important to note that only articles in English were considered in this review, which can directly influence its results. Although the United States and the United Kingdom are the largest source of information on the subject, China and India have increased their production in recent years.

GPS Visualizer software was used to create a map of the affiliations of the documents found. The first step herein is to develop a toolbox in BibExcel software, version 2016-02-20, based on transforming the file (.csv) with citation information retrieved from the Elsevier database in location information (latitude, longitude, name, and description). Then, the developed toolbox could be inserted into the GPS Visualizer software to perform the required reading, decoding, and georeferencing on a map (using the Google Maps platform by generating Google API key code), pointing out the countries in which the documents originated. Thus, the countries of origin of the documents analyzed are presented in Figure 4, for ease of visualization.

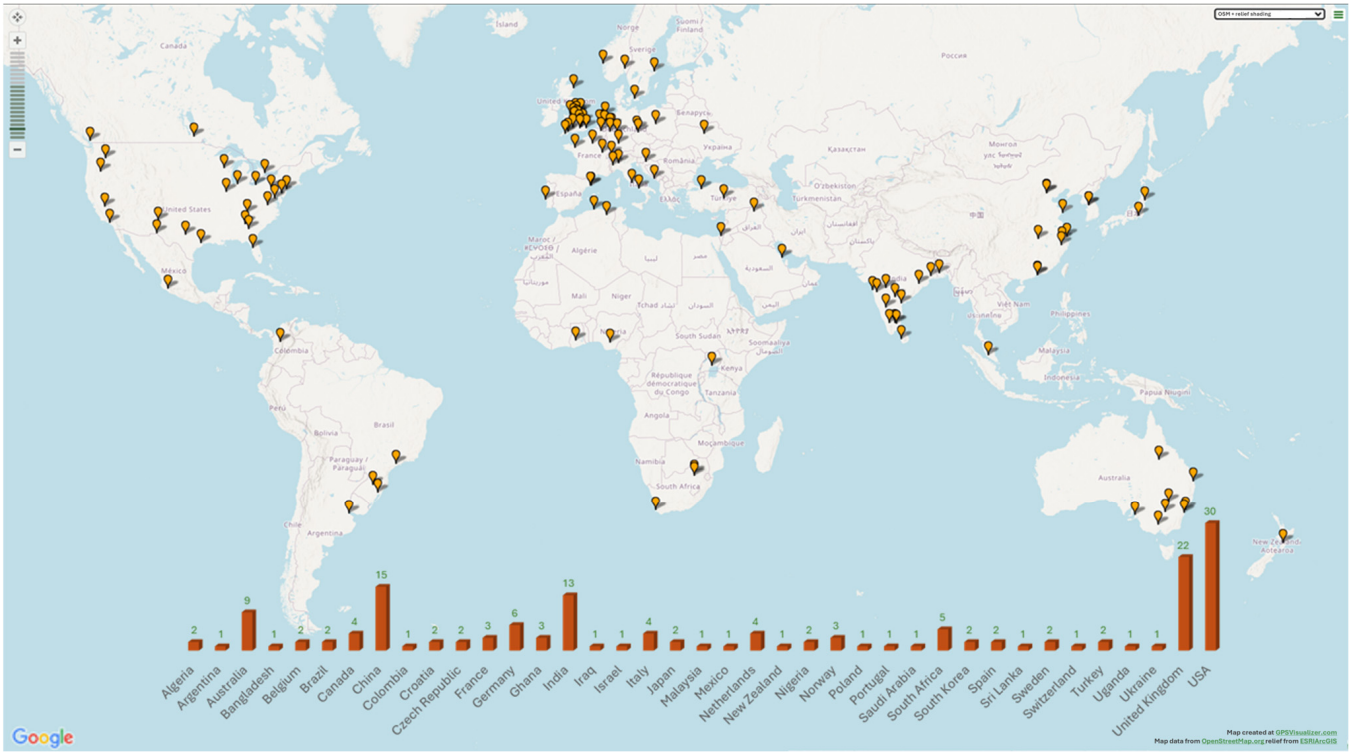

Figure 4. Origin of publications.

A bibliometric analysis was involved in the descriptive analysis of this work, uploading all citation information of the articles considered (title, author, abstract, and keywords) in the VOS Viewer software (version 1.6.20) and creating keyword groups. The binary counting option was used to remove duplicate documents in clusters. The VOS Viewer software (version 1.6.20) identified how many relevant words appeared in the title and summary fields of all submitted documents, taking into consideration restraining the results to

a minimum number of occurrences and eliminating general terms that are not related to the question such as "Article", "facility", "Time", "Place", "Work", "thing", and "health". A total of 7000 documents were retrieved. At this level of the analysis, the number of words was considered relevant, though the number of occurrences was considerably reduced, being temporally reduced to 3155 (from 2019 to 2023). Eventually, the list of keywords was released and each cluster generated was examined and used to further refine this search. It should be noted that this step was not applied using the results found in the first search (only with the term "affordable housing"), due to its breadth and the amount of documents returned.

In the second survey, terms such as "affordable housing" and "environmental impact" were applied and 416 documents were retrieved. Using the (.ris) documents in the VOS Viewer (version 1.6.20), more than 4000 keywords were identified in the "title" and "summary" fields. However, upon restraining the results to a minimum of 250 occurrences and excluding generic terms, only 39 keywords reached the limit; 17 of them were considered more relevant and then, after checking the preliminary results, the results of the cluster analysis were generated, as shown in Figure 5.

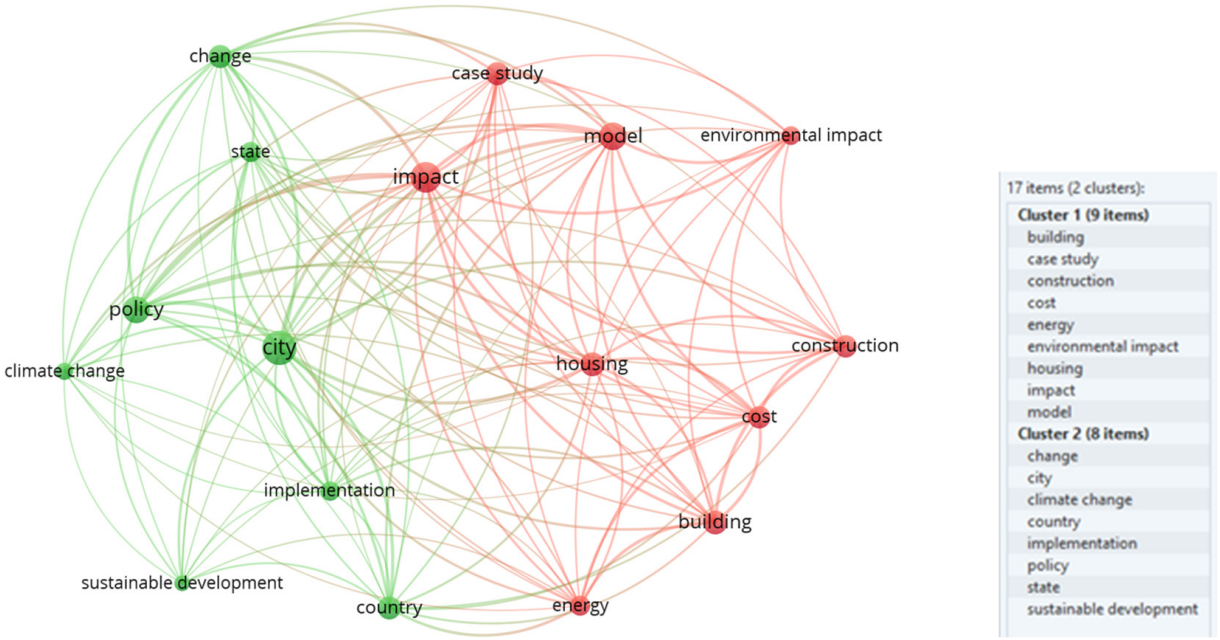

Figure 5. Connection visualization (network visualization).

Cluster 1, in green, highlights important aspects of the dimension of the concept of" city "with" policy". In turn, cluster 2, in red, highlights the strength of the theme "housing", with the "impact" generated (of all natures). Together, clusters 1 and 2 highlight how public policies related to housing influence urban development and the impacts generated. These keywords can be used to refine searches for affordable housing. It can also be inferred that although a holistic view is necessary to understand the subject completely, each aspect must also be considered in its particular way through the individual evaluation of each "bridge" in this network.

The third search retrieved 344 documents using the terms "affordable housing" and "energy efficiency", which led to more than 4000 keywords identified in the "title" and "summary" fields. However, restraining the results to a minimum of 250 occurrences and excluding generic terms, only 32 keywords reached the limit; 14 of them were considered more relevant and then, after checking the preliminary results, the results of the cluster analysis were generated, as shown in Figure 6. In this search, it can be realized that terms like "construction" and "policy" could reinforce the importance of public policies in the construction market and, obviously, in the housing issue.

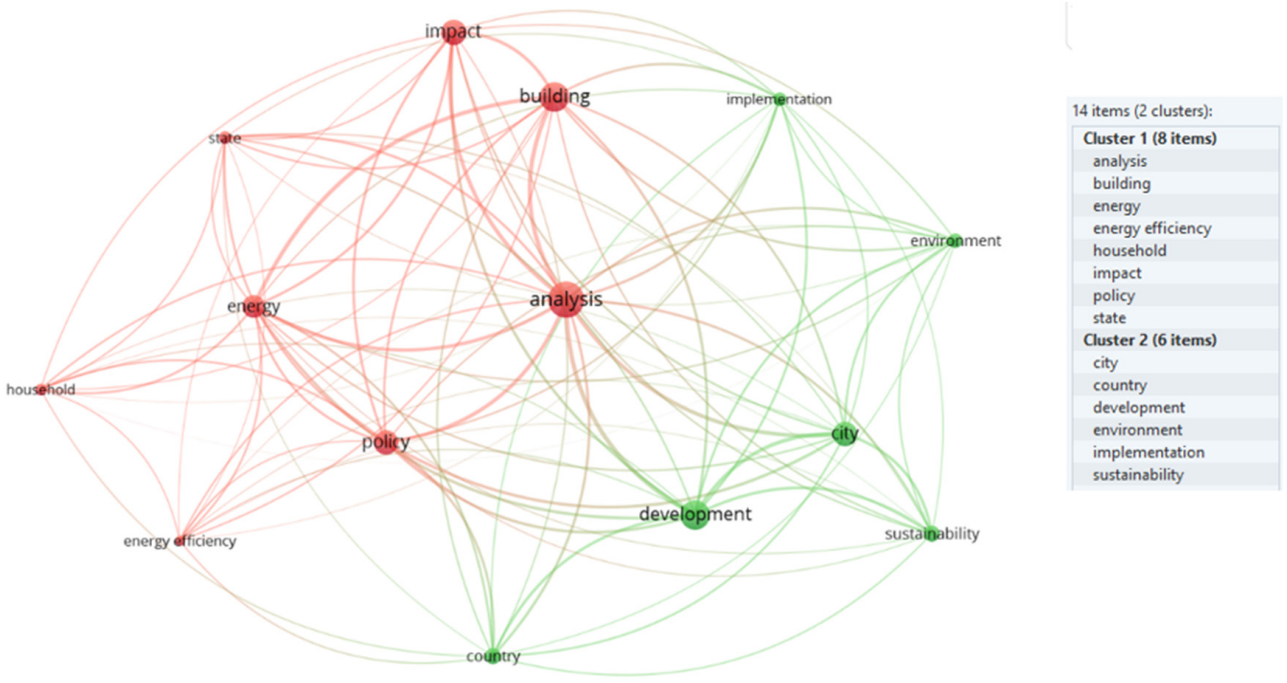

Figure 6. Visualization of the links between the words of the third search (network visualization).

The fourth search, which used the terms "affordable housing" and "sustainability", retrieved 1835 documents. It led to more than 14,000 keywords identified in the "title" and "summary" fields. However, upon restraining the results to a minimum of 70 occurrences and excluding generic terms, only 33 keywords reached the limit; 18 of them were considered more relevant and then, after checking the preliminary results, the results of the cluster analysis were generated, as shown in Figure 7.

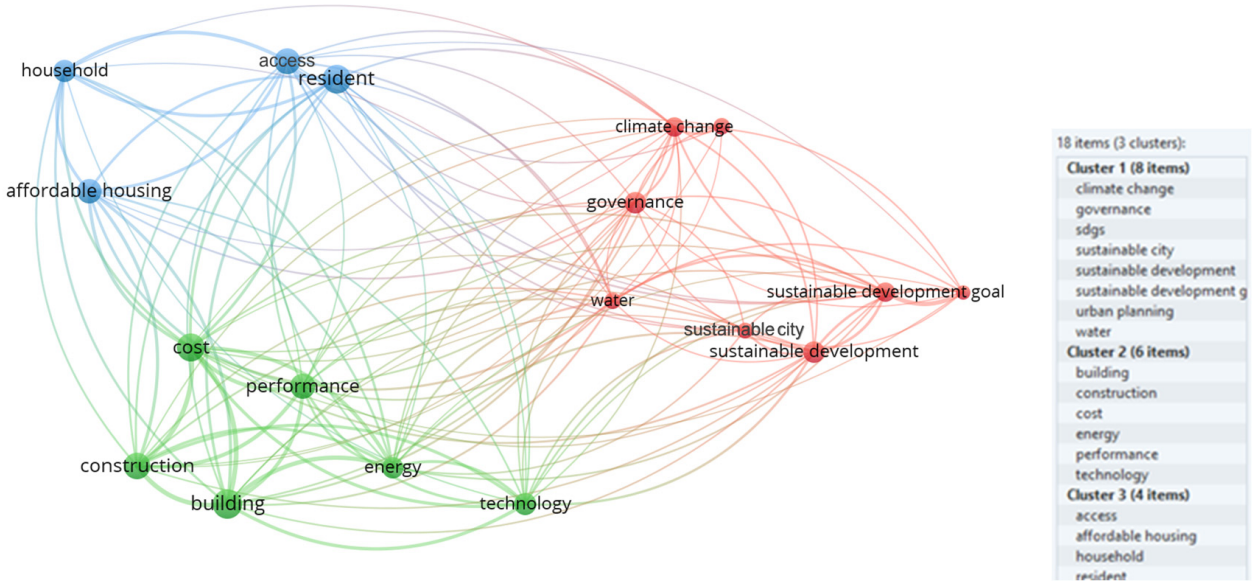

Figure 7. Visualization of the links between the words of the fourth search (network visualization).

The cluster map created shows three different clusters: in blue, fundamental concepts in sustainable housing, such as "resident" and "domestic"; in red, themes related to sustainability, such as "climate change" and "governance"; and, finally, in green, a range of words that, once interpreted, are a mixture between the two previous clusters, given by "performance", "construction", and "energy". Since this work focused on "sustainability"

within the theme of "affordable housing", this fourth research was important to indicate the relevance of the research.

Terms "energy" and "cost" are highlighted in other secondary terms, justifying their use in the literature as factors related to affordable housing. This comes back to the fact these terms refer to financially affordable buildings intended for less affluent individuals or families.

The fifth research aimed to identify the highest correlations between the keywords "affordable housing", "energy efficiency", and" environmental impact"; 1835 retrieved documents, with 10 relevant words divided into three clusters, as highlighted in Figure 7, and 4939 terms initially found. The action was restricted to 15 occurrences, returning 19 terms that were then filtered. The main reflection of the selected three keywords is given precisely by the term "development", as illustrated in Figure 8, with greater emphasis indicating that the keywords and, consequently, research of this nature, are part of the evolution of nations and their populations.

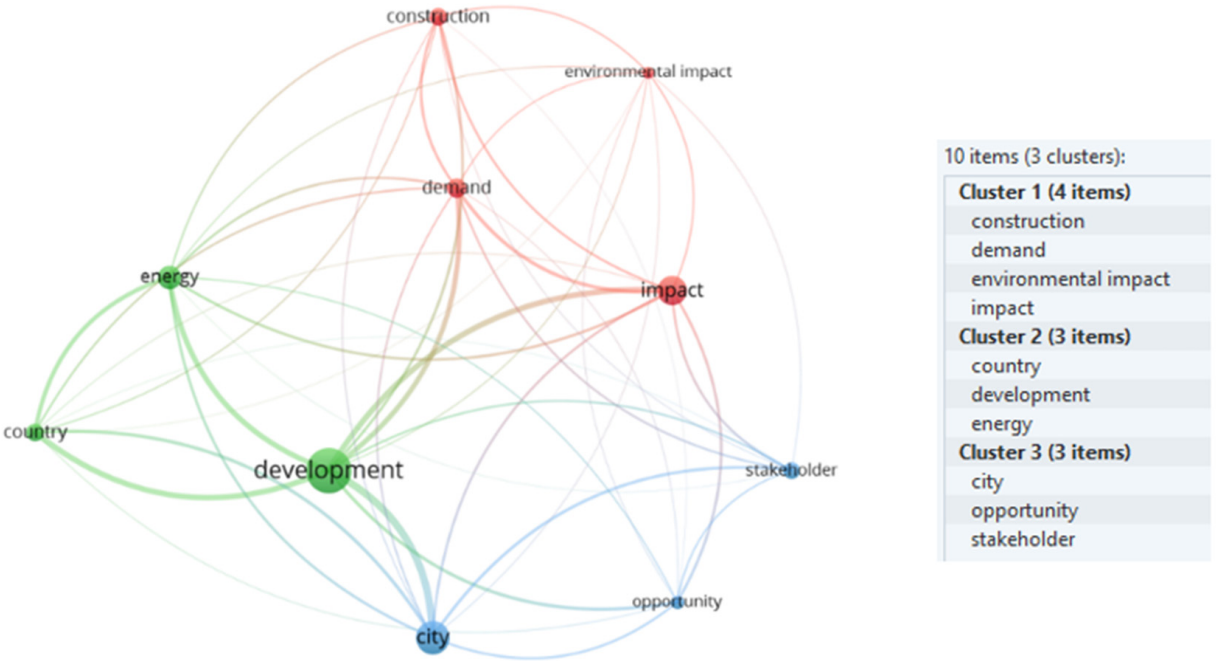

Figure 8. Visualization of the links between the words of the fifth search (network visualization).

The sixth search considered the most environmental footprint related to the term affordable housing. Three keywords are included: "affordable housing", "sustainability", and "environmental impact". A total of 385 documents were verified with 14 relevant words divided into two clusters, as shown in the grouping map in Figure 9. Almost 10,000 terms were initially found; hence, the action was restricted to 14 occurrences, returning 31 terms that were then filtered. The main reflection of the selected keywords is given precisely by the term "city", with greater emphasis, indicating that the keywords and, consequently, research of this nature bring a specific reflection to cities and their populations that will directly feel the environmental impacts produced.

Three keywords were included in the seventh search; "affordable housing", "sustainability", and "energy efficiency". A total of 264 relevant expressions were identified in a complete (binary) scan; marking 20 items divided into three clusters, as presented in Figure 10.

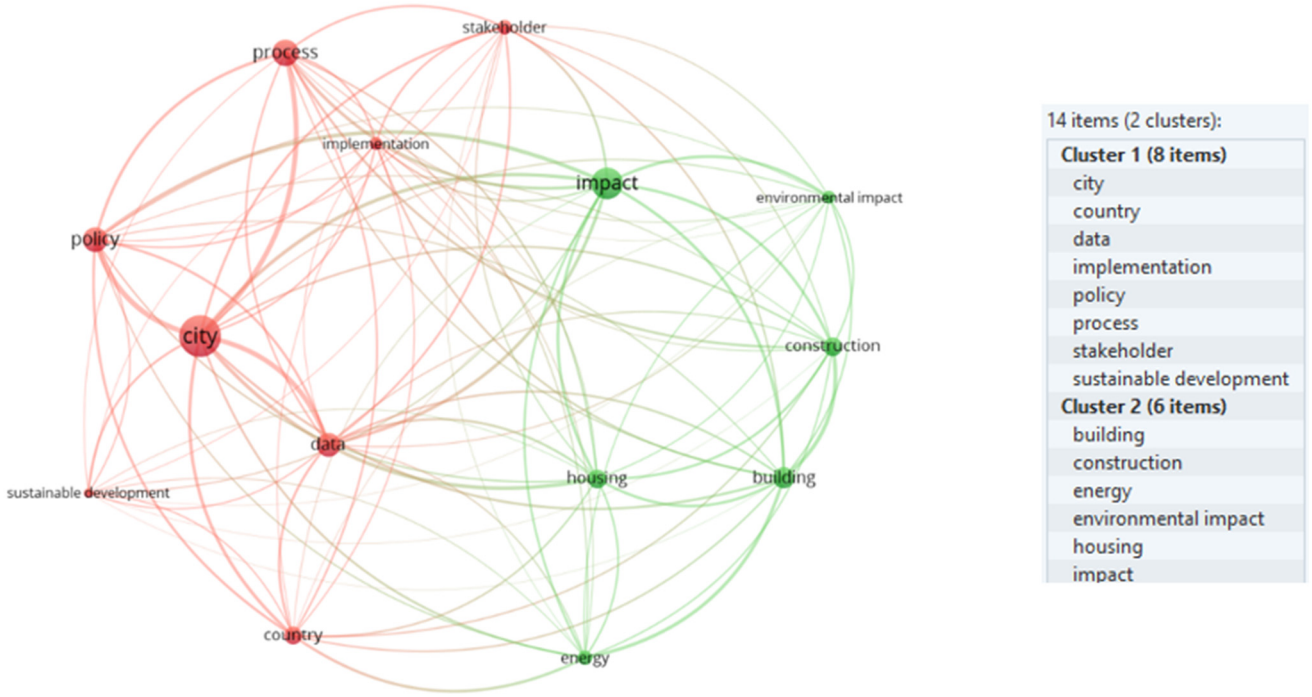

Figure 9. Visualization of the links between the words of the sixth search (network visualization).

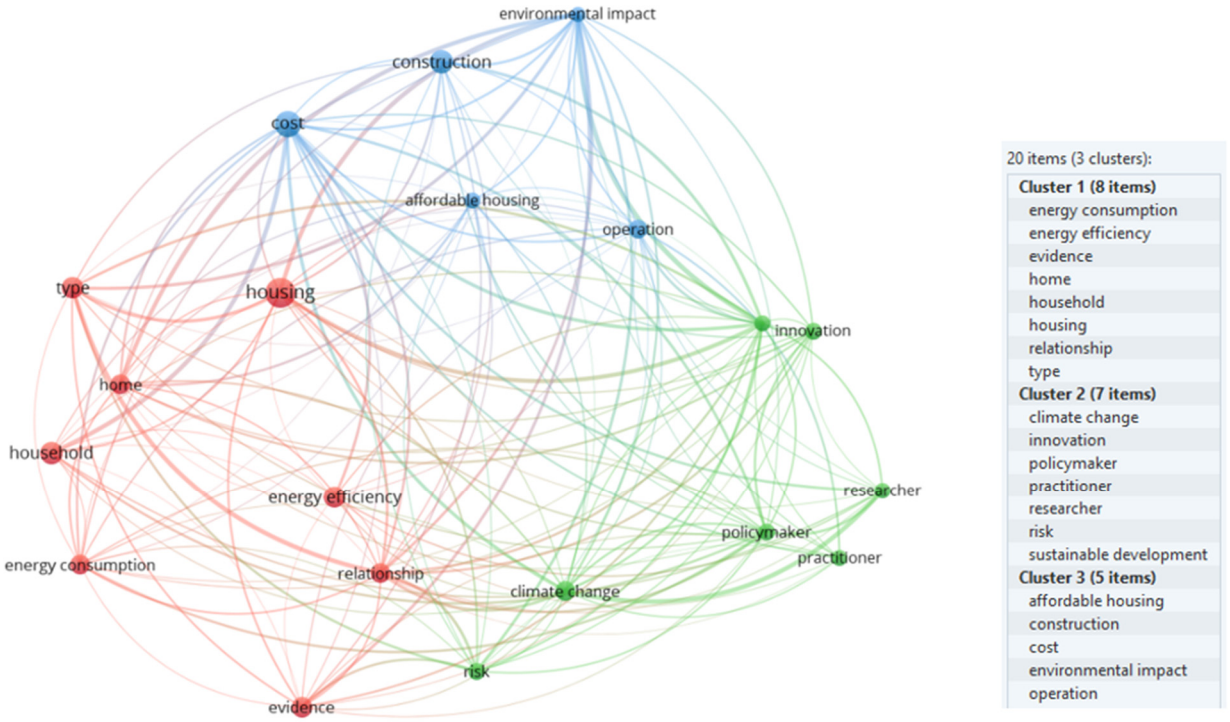

Figure 10. Visualization of links between seven search terms (network visualization).

Four keywords were included in the last research for this study; "affordable housing", "sustainability", "energy efficiency", and "environmental impact"; a total of 109 articles were retrieved. The importance is given to the centralization of all research; in Figure 11, the cluster in green (i.e., "development" and "energy") presents terms related to the aspects of governance and environment and the red one (i.e., "building" and "impact") reaches the technical issues of the theme more focused on environmental and civil engineering.

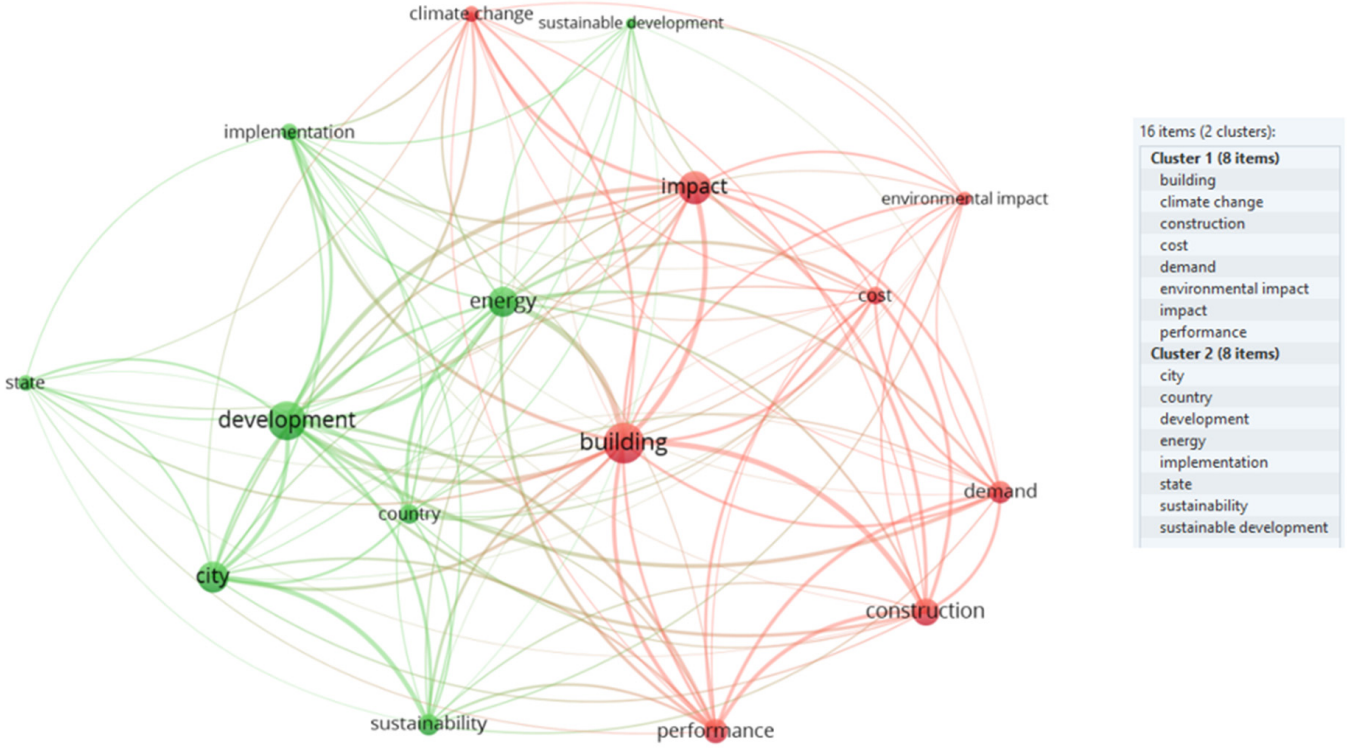

Figure 11. Visualization of links in the eighth search (network visualization).

The density analysis for the last research is the most comprehensive in terms of the selected keywords that highlight the radial dispersion between the terms and their arrangements depending on the main keyword "building", as seen in Figure 12.

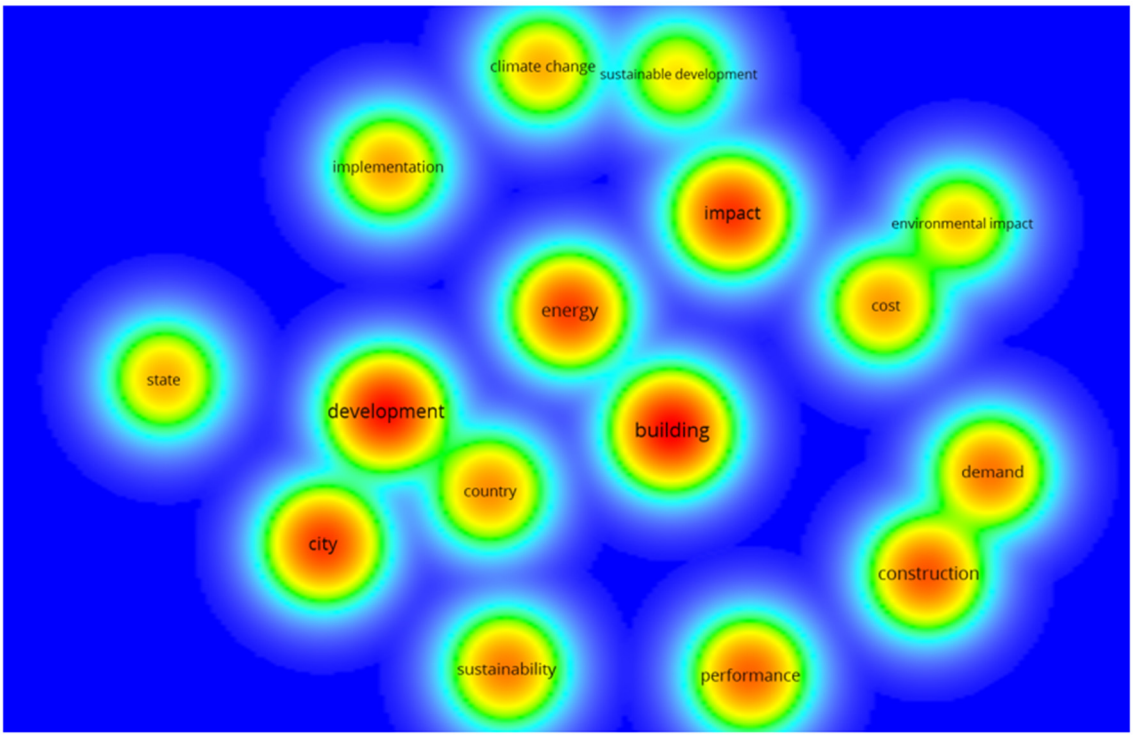

Figure 12. Density visualization of words from the last search (density visualization).

3.2. Analysis of the Collected Documents

This part of the study uses the conducted bibliometric analysis. The carried out evaluations, using the VOSViewer software (version 1.6.20) and taking into consideration all the clusters presented in surveys (from 1 to 7), illustrate that the most relevant terms are as follows; environmental impact, building, city, development, cost, policy, inhabitant, process, stakeholders, demand, energy efficiency, energy, HIS, performance, and sustainability, as presented in Figure 13.

Figure 13. Word cloud or tag cloud.

3.3. Dimensions and Themes of Research in Affordable Housing

These research dimensions of this work are broken down into several themes that define the areas of research examined in affordable housing. An initial scan was carried out to delete duplicates and eliminate articles that depart from the core of this technical research of engineering and architecture such as those belonging to the areas of health and social assistance. A total of 102 publications relevant to its scope were finalized and categorized according to their main theme upon retrieval of the 12 topics: public housing policy, sustainable development, low-cost materials and techniques, sustainable affordable housing, thermal performance, public infrastructure policy, carbon market, sustainability in projects, energy retrofit, solar energy, real estate market, and family economy. These topics were framed in five terms that most appear in the results presented by the VOSViewer (version 1.6.20) (identified from the bibliometric analysis); namely environmental impact, building, city, development, and cost, as presented in Figure 14.

The articles related to each of the classification areas or dimensions were chosen and expanded in Supplementary Materials; Tables S1–S5. These tables also briefly present the objectives, methodology, and results of each of the selected documents, based on their associated cluster. However, the discussion of the results can be stated in three main questions after reviewing the literature as follows:

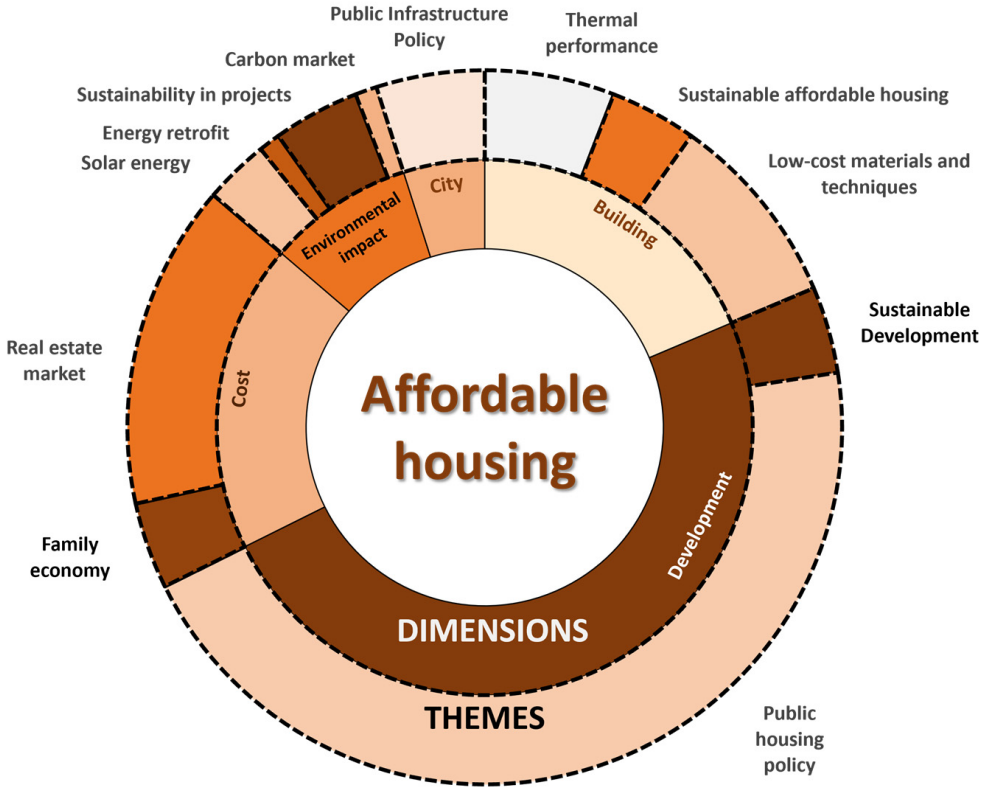

Figure 14. Proposed classification framework for affordable housing.

a. What are the different dimensions that sustainable affordable housing research focuses on?

There are five main focal points to evaluate affordable housing research dimensions: environmental impact, building, city, development, and cost. However, publications in this field focus on one or two of these dimensions only, without taking into account all of the dimensions. This means that most of the documents are technical and are generally focused on the development aspect. For instance, the number of articles well below the development dimension reflects the environmental aspect that appears in the background. Hence, a major consideration could be given to the tripod in vogue today; E (environmental), S (social), and G (corporate governance). Regarding environmental considerations, publications that consider the building dimension are being integrated with new technologies to measure the performance of the buildings, emphasizing the thermal and lighting comfort of buildings [13–18]. Moreover, few publications are focusing on sustainable affordable housing (SAH), analyzing the building typology and critical success factors [9,42,104,105] without proposing clear solutions for the development of a feasible product for all stakeholders and disregarding the environmental factor. At this level of the analysis, SAH is given by the place to be used by any citizen of a given region, regardless of their financial–economic state, endowed with stability and security, and with facilitated access to essential public services. Furthermore, it neglected the compromising ability of the future generation to meet their residential demands in compliance with sustainable objectives (i.e., economic, environmental, and social) [9].

Publications that consider the development dimension sorted out that the popular housing factor is the principal concern of the public managers of large urban centers, confirming the change in the profile of the population and the disorganized growth between rural and urban regions [38–40,43]. Such an issue could culminate in several problems that could influence other areas objects of public policies such as health, transport, security, and leisure [44,45,71,74,75]. In terms of publications that consider the cost dimension, it can be noted that some adversities seem insurmountable in the current market profile that

greatly influences public housing policies. On environmental impacts, this study highlights that clean energy and green technology have been assessed in the literature to improve building performance toward sustainable construction [4]. Moreover, energy retrofit has been discussed in the literature to increase energy efficiency in buildings and examine the impact of a given government's current housing policy and its alternative housing strategies with national carbon and biodiversity targets [32]. However, one can perceive a gap in examining the contradictory carbon credit market in the literature [31]. Publications that consider the city dimension present several areas of study that are dedicated to evaluating the integration of affordable and low-cost housing with the built environment; urbanization, transport, accessibility, and urban rehabilitation and requalification [80,82]. Similarly, one can perceive a gap in assessing the impact of low-cost development on the built environment in terms of neighborhood and environment [78,79,81].

b. What are the research themes associated with these dimensions?

Upon analyzing the literature, it can be realized that a large number of publications are focusing on construction projects that try to implement improvements in the standards of low-income housing, especially those located in slum settlements. These settlements are the core of the discussion in many articles and their replacement by standards with higher performance is the engine of public policies at the housing level [33,39–41,54,55,65,68,71]. Another topic of great relevance is the real estate market, with its financial impact among the stakeholders. While there are customers with low purchasing power begging for products with a minimum of quality and performance at a reasonable price [83,88,93,95,98,100,101], there are some developers and builders that aim to maximize profits and minimize costs often renouncing the quality of the product delivered [84,85,87,90,97,99]. Such an issue is still a recurring point that has been noticed in studies dealing with social rent. Another topic of relevance herein is the location of housing implantation, in terms of region, neighborhood, and even available land. Buildings are the next most highly active topic in research, including construction techniques and materials in terms of ensuring sustainable construction, improvement methods in energy consumption, and enhancing the building performance over the operation period of buildings. However, there are other themes with lesser promotion and equal relevance that have been reported in the literature for each dimension, as presented in Table 4.

Table 4. Classification by themes and dimensions.

Dimensions		Detailed Topic (Themes)	
Construction	19	Thermal performance	6
		Sustainable affordable housing (SAH)	4
		Low-cost construction materials and techniques	9
Development	50	Sustainable development	4
		Public housing policy	46
Cost	19	Family economy	4
		Real estate market	15
Environmental Impact	9	Solar energy	3
		Power Retrofit	1
		Sustainability in projects	4
		Carbon market	1
City	5	Public infrastructure policy	5
			102

c. What are the main limitations of current approaches and what would be a promising research agenda for the future of sustainability applied to affordable housing?

A holistic view involving all dimensions of affordable housing is a major key to a deeper understanding of sustainability assessment in public housing. This review indicates that a potential blind spot continues to exist in the low-cost housing public policy and real estate market landscape. This gap can prevent the solution of housing problems in large centers. At this level of the analysis, the focus could be elevated to raise the profit of the suppliers by developing products with optimal performance throughout their lifespan, sustainability, and low cost [88]. For example, some publications in the literature discussed how public policies fail to fulfill their philosophical and sustainable goals, often replicating retrograde processes of a traditional capitalist policy without well-defined strategies. Moreover, local urban development is needed to accompany the implementation of affordable housing toward enhancing the living conditions in such communities [39]. The main shortcomings identified in the current literature are as follows:

- A more comprehensive understanding of the impacts of socio-technological practices on the future roadmap of environmentally sound affordable housing development;
- Most studies focus on the technical implementation of the product, without taking into consideration a broader view of the whole life cycle of these assets;
- Few publications examined the impact of public housing policies on economic growth and infrastructure policies in regions. Hence, it can be realized that there is an urgent need for studies that evaluate the achievement of these aspects through quantitative analysis;
- Affordable housing should be conceptualized as an emerging theme of socio-technological development;
- Future studies can focus on all stages of the useful lifespan of affordable housing, from cradle to grave. Hence, empirical research should be conducted to investigate the required issues to elaborate a product that is optimal in all its longevity and demobilization;
- It can be noted that applying sustainable characters and products to the building could increase its initial cost and only generate benefits over time. Such an assumption necessitates conducting robust impact assessment studies of applications of sustainable solutions in construction projects, which have a direct impact on the economic, social, and environmental pillars;
- Expanding the search for socio-environmental synergy to evaluate the connections between population, government, and the environment, taking into consideration the governance responsible for public policies and the existing theories of social transformation, and studying their development as an evolutionary process of institutional change with regional implications.

4. Conclusions

Using content analysis, more than 100 journal articles were examined in this article to highlight the main dimensions and topics involved in the housing public policy sphere. Three main research questions have been addressed in this review, namely, a. what are the different dimensions that sustainable affordable housing research focuses on?; b. what are the research themes associated with these dimensions?, and c. what are the main limitations of current approaches and what would be a promising research agenda for the future in sustainability applied to affordable housing?

Through the proposal of a classification table and the performance of comprehensive bibliometric analyses and bibliographic analyses of articles published in the last five years, different research trends were revealed. The bibliometric analysis presented five main clusters of keywords around which the research of affordable housing revolved: “development”, “construction”, “cost”, “environmental impact”, and “city”. On the other hand, the bibliographic analysis reflected important aspects regarding the theme, includ-

ing sustainability, the family economy, the real estate market, and public housing and infrastructure policies.

The knowledge disseminated in this study serves to suggest a path for future research, aligning proposals for affordable housing with a set of dimensions and research themes. A limitation associated with the categorization structure proposed in this work is a subject bias due to the interpretative nature of the structure. In addition, there is a lack of focus on interconnected and holistic approaches to the presented structure; aspects of affordable housing are not related to social and environmental factors or technical solutions with a view to the economy but which can greatly impact, even indirectly, these two areas of interest—such as social dimensioning and environmental damage. The use of a single database for searching the manuscripts considered in this research is also a limitation of this article.

Based on the recommendations derived from the structure developed, the study here predicts that future research will focus on issues such as the life cycle of affordable housing and the feasibility of sustainable solutions throughout the useful life of the building, to help form a deeper understanding of the socio-environmental aspects of these buildings. Finally, the following topics could also be considered relevant for future research. Life cycle analysis, from cradle to grave, of affordable housing; impact analysis of adopting different sustainable solutions for affordable homes through case studies and computational simulations; and expanded understanding of the synergy between social and environmental aspects when approaching affordable housing solutions.

Supplementary Materials: The following supporting information can be downloaded at https://www.mdpi.com/article/10.3390/su16104187/s1, Table S1: Publications with emphasis on the term 'environmental impact'; Table S2: Publications with an emphasis on the term "construction"; Table S3: Publications with an emphasis on the term "city"; Table S4: Publications with emphasis on the term "development"; Table S5: Publications with emphasis on the term "cost".

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