

Bibliometric Analysis of Green Buildings

Loso Judijanto

IPOSS Jakarta, Indonesia and losojudijantobumn@gmail.com

ABSTRACT

Green buildings have emerged as a critical strategy for addressing environmental challenges associated with rapid urbanization, energy consumption, and greenhouse gas emissions. Consequently, scholarly interest in green building research has increased substantially over the past two decades. This study aims to map the intellectual structure, research trends, influential contributors, and collaboration patterns within the field of green buildings through a bibliometric analysis. Data were collected from the Scopus database and analyzed using VOSviewer to examine publication networks, keyword co-occurrence, citation patterns, author collaborations, institutional relationships, and country-level partnerships. The findings reveal that green buildings, green building, sustainability, construction industry, and architectural design constitute the core themes of the literature. The overlay visualization indicates a shift in research focus from energy efficiency and building performance toward broader sustainability concerns, including green development, green economy, and sustainable construction. Citation analysis highlights the interdisciplinary nature of the field, with influential studies spanning sustainable materials, environmental management, urban green spaces, and green manufacturing. Co-authorship and institutional analyses identify several leading scholars and universities, particularly from China, which also emerges as the most influential country in international research collaboration. The country collaboration network further demonstrates strong global partnerships involving the United States, the United Kingdom, Australia, and other Asian and European countries.

Keywords: *Green Buildings, Sustainability, Sustainable Construction, Construction Industry, Architectural Design, Bibliometric Analysis*

1. INTRODUCTION

It has been seen that the construction industry makes a substantial contribution towards both economic growth and urbanization but on the other hand, it has also been established that this industry is a major source of environmental pollution. The construction of any structure requires a considerable amount of energy, water, and resources such as timber. The issue has been worsened because of rapid urbanization and industrialization as far as environmental impact due to construction processes is concerned. There are growing concerns about carbon emissions, wastage, and depletion of resources with traditional constructions methods as awareness about climate change increases across the world [1], [2].

Green buildings involve structures that are built in ways that minimize the environmental impacts and enhance their resource efficiency. Such structures emphasize efficient use of energy, sustainable use of materials, improved indoor environmental quality, water conservation, and minimization of greenhouse gases emissions. Some of the international rating systems which have greatly contributed to the widespread adoption of sustainable buildings include LEED, BREEAM, and Green Star. Green buildings have become increasingly supported by governments, industry players, and even universities because they are seen as effective means of promoting sustainable development [3], [4].

Recently, scientific studies on green building have been growing at an incredible rate not only in one field but in many fields ranging from engineering, architecture, environmental science, urban planning, and energy studies. Many scholars have focused their researches on issues like efficient energy technology, sustainability and green materials, occupant's health, renewable energy,

lifecycle assessment, and smart buildings. All these facts make it clear that green building studies have become a significant issue in academic circles all over the world. Nevertheless, the tremendous growth in scientific studies raises many questions for scientists regarding current trends in this area, key players in the field of study, cooperation between researchers, and so forth. Therefore, it is essential to adopt an effective approach in mapping green building research and development [5], [6].

The application of bibliometric analysis in assessing the development and structure of scientific studies has proven quite successful. Bibliometric analysis involves the use of quantitative methods in analyzing scholarly publication, citation analysis, keyword analysis, author analysis, and collaboration among institutions. By conducting bibliometric analysis, the researcher is able to determine the intellectual structure of the discipline, find the most prominent publications, and analyze research output from various countries and institutions. The topic of green buildings is one of the subjects that could benefit greatly from bibliometric analysis. Researchers are able to determine how research trends have changed over the years, the dominant themes within the literature, and which areas still need more research.

Although there are some review articles about green buildings, the majority of them mainly analyze the specific areas of the subject such as energy efficiency, sustainable materials or environmental performance of the buildings. There are very few analyses that evaluate the development of green building studies from the perspective of bibliometrics. The fast changing nature of sustainability studies implies that new themes or international collaboration relationships should be constantly recognized in order to keep up with the current developments in the field. In this respect, bibliometric analyses of green building studies would play a vital role in order to understand the publication trend, main players, important journals and evolving themes within the field [7].

Though there have been many studies conducted on green buildings in recent times, the existing literature is still scattered across various fields and areas of study, which makes it hard to get an overall perspective on the evolution of this particular area. It becomes hard for scholars to find out the influential literature, major themes, co-citation networks, and upcoming areas of research in the case of green buildings. In addition, very few bibliometric analyses have assessed the evolution of green building research on an international level. Due to this, there is a lack of information related to the trends, citation patterns, and intellectual structure of the field. The purpose of this research is to perform a bibliometric analysis on the area of green buildings to find out the pattern of publications, key authors, journals, and research themes in the area.

2. METHODS

The current research adopts the methodology of bibliometric analysis to assess the emergence of studies on green buildings. Bibliometric analysis is a technique employed for evaluating scientific publications in order to detect patterns in scientific literature in terms of publication growth, citation network, collaborative research, and the themes developed in it. In this context, this research will focus on journal articles, conference articles, and reviews associated with the topic of green buildings in internationally indexed literature. The relevant articles can be identified through the use of specific keywords, including “green building,” “sustainable building,” “green construction,” and others. This process will be confined to publications available in English.

Analysis of the bibliographic data set is done using VOSviewer to illustrate and analyze the interrelations among the authors, institutions, countries, keywords, and citations. Some bibliometric

metrics that have been used in this study include number of publications, citations, author collaborations, co-citations, and keyword co-occurrences. The publication trends are considered to measure the increasing trend in the literature of green buildings, while the citation metrics help in finding out the most impactful studies, authors, and journals on green buildings. Also, the collaboration network between researchers and institutions is considered to find out the global structure of scientific collaboration concerning green building literature. In order to increase the accuracy and validity of the research outcomes, the acquired data are subject to screening and cleaning prior to their further analysis. Duplicates, missing information, and irrelevant documents are not included into the dataset. The obtained outcomes of bibliometric analysis are described and interpreted in a descriptive manner in order to describe the intellectual and thematic structure of green buildings research.

3. RESULT AND DISCUSSION

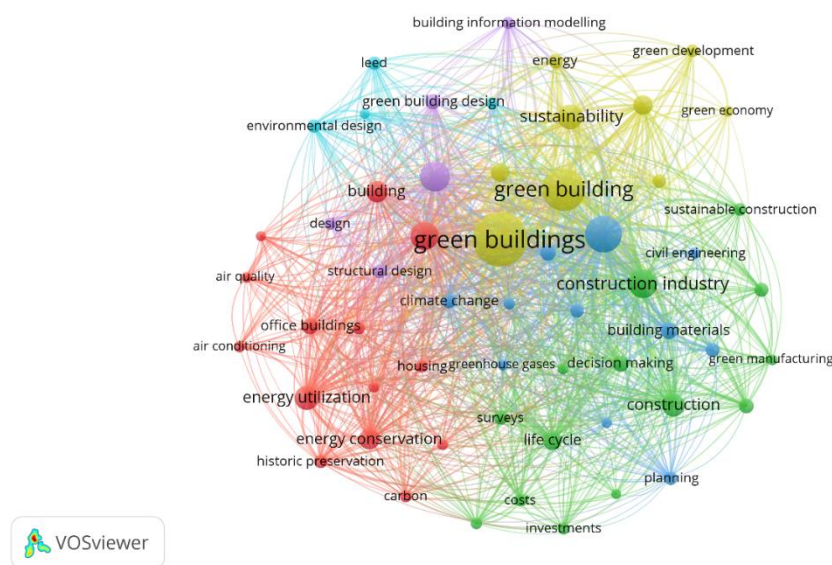


Figure 1. Network Visualization

Source: Data Analysis Result, 2026

As illustrated in the network of keyword co-occurrences, the term “green buildings” acts as the dominant and most impactful concept in the body of knowledge, since it has the largest node and many links to other keywords. Other closely linked keywords including green building, building, construction industry, and sustainability are also at the center of the network, implying that this area is deeply rooted in sustainable construction. The strong linkages between these keywords imply that the study of green buildings has become a multidisciplinary research area. The red cluster centers mainly on energy performance and environment quality within buildings. Concepts including energy usage, energy saving, air conditioning, air quality, office buildings, and carbon are strongly associated with each other, suggesting that much research has been done regarding energy saving and improvement of indoor environmental quality. This shows the roots of green building research since energy efficiency and carbon reduction were among the first and the most important topics studied under the green building area. Climate change also emphasizes the increasing importance of buildings as contributors to global warming.

The cluster “green” stresses the approach to constructing and managing green buildings. The use of keywords like construction, construction industry, building materials, sustainable construction, green manufacturing, life cycle, and cost points to increasing attention towards sustainable building throughout the whole process of their existence – from the material choice and

construction process itself, to their operation and end of life. The inclusion of decision making and investments suggests increasing interest in the financial side of implementing sustainable buildings. The yellow cluster revolves around the themes of sustainability and development. Sustainability, green economy, green development, and energy are some of the keywords that show how green building studies are not just focused on the efficiency of buildings but have taken an even wider scope towards achieving socio-economic sustainability. There is a clear link between all these terms and the core of green buildings, which implies that the focus is on using green buildings as a tool for sustainable urban development and environmental policies.

The blue and purple clusters represent emerging themes related to digitalization, design innovation, and advanced building technologies. Keywords such as building information modelling (BIM), green building design, environmental design, LEED, and civil engineering indicate a shift toward integrating digital technologies and innovative design approaches into sustainable construction practices. The presence of BIM and certification systems such as LEED suggests that contemporary research increasingly focuses on data-driven planning, performance monitoring, and standardized sustainability assessment frameworks.

3.1 Overlay Visualization

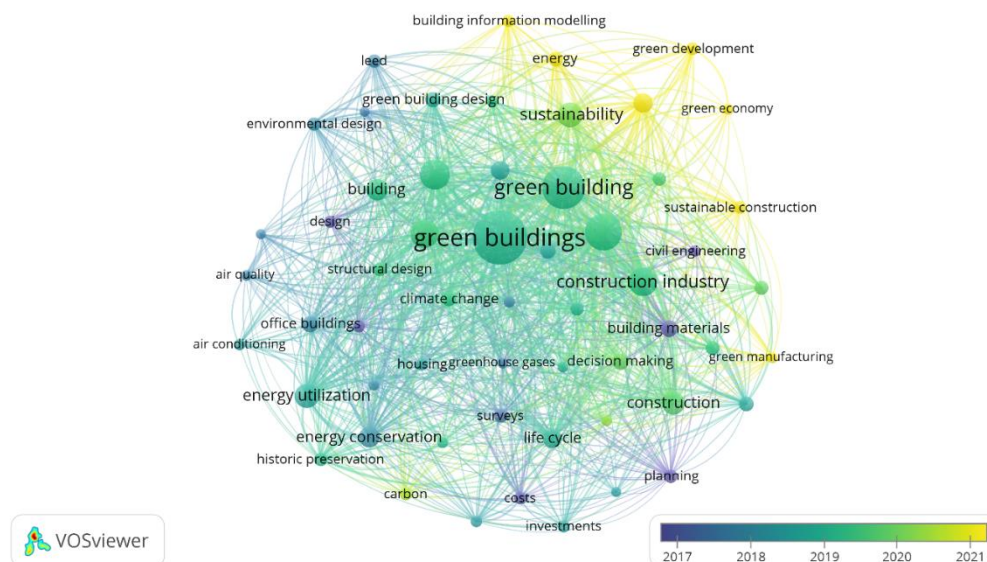


Figure 2. Overlay Visualization

Source: Data Analysis Result, 2026

The overlay network visualization depicts the development of the topic of green building studies over time between 2017 and 2021. The keywords shown in blue and purple show the topics discussed earlier. The topics in green and yellow colors signify relatively new developments within the subject. The major keywords "green buildings," "green building," and "construction industry" are shown in green color, indicating that these keywords have been persistently relevant through the entire timeline and form the basis of the whole field of study. Earlier studies, represented by blue-colored keywords, focused primarily on technical and operational aspects of buildings, including air quality, air conditioning, office buildings, energy conservation, costs, investments, and planning. These topics indicate that initial research efforts concentrated on improving building performance, reducing energy consumption, and evaluating the economic feasibility of sustainable building practices. The presence of terms such as building design, structural design, and environmental design further suggests that early green building research was largely concerned with architectural and engineering solutions for enhancing building efficiency and occupant comfort.

Later research, highlighted through yellow keywords, clearly demonstrates the movement toward sustainability and development concepts. Keywords like "green development," "green economy," "energy," "sustainability," and "sustainable construction" have been prominent research topics in recent years. This implies that research on green buildings has gone beyond the realm of buildings themselves to focus on sustainability at a much wider level – for instance, sustainable urbanism, low-carbon economy growth, and environmental governance. These trends clearly suggest that research will increasingly focus on the role of green buildings in terms of climate change, circular economy, and sustainability policies.

3.2 Citation Analysis

Table 1. The Most Impactful Literatures

Citations	Authors and year	Title
2411	[8]	Conversion of biomass to selected chemical products
2404	[9]	Management of singlet and triplet excitons for efficient white organic light-emitting devices
2373	[10]	Zr-based metal-organic frameworks: Design, synthesis, structure, and applications
2172	[11]	Sustainable Bio-Composites from renewable resources: Opportunities and challenges in the green materials world
2123	[12]	Exploring pathways linking greenspace to health: Theoretical and methodological guidance
1445	[13]	The greening of the concrete industry
1444	[14]	Environmental management and manufacturing performance: The role of collaboration in the supply chain
1410	[15]	The Tol2kit: A multisite gateway-based construction Kit for Tol2 transposon transgenesis constructs
1313	[16]	Challenges and strategies for urban green-space planning in cities undergoing densification: A review
1272	[17]	Natural fibers, biopolymers, and biocomposites

Source: Scopus, 2026

From Table 1 below, the most significant literature in terms of influence in the database does not include green buildings alone but is spread across various sustainability topics including biomaterials conversion, green materials, organic electronics, metal-organic frameworks, greenspaces and human health, concrete greening, environmental management along the supply chain, urban green-spaces development, and biocomposites. The top cited articles by [8], [18], and [10] reveal that the knowledge base of this domain is closely associated with concepts such as green chemistry, material science, and sustainable technology. On the other hand, research work conducted by [12], [13], [16], reveals the connection between construction materials, urban planning, and environment.

3.3 Density Visualization

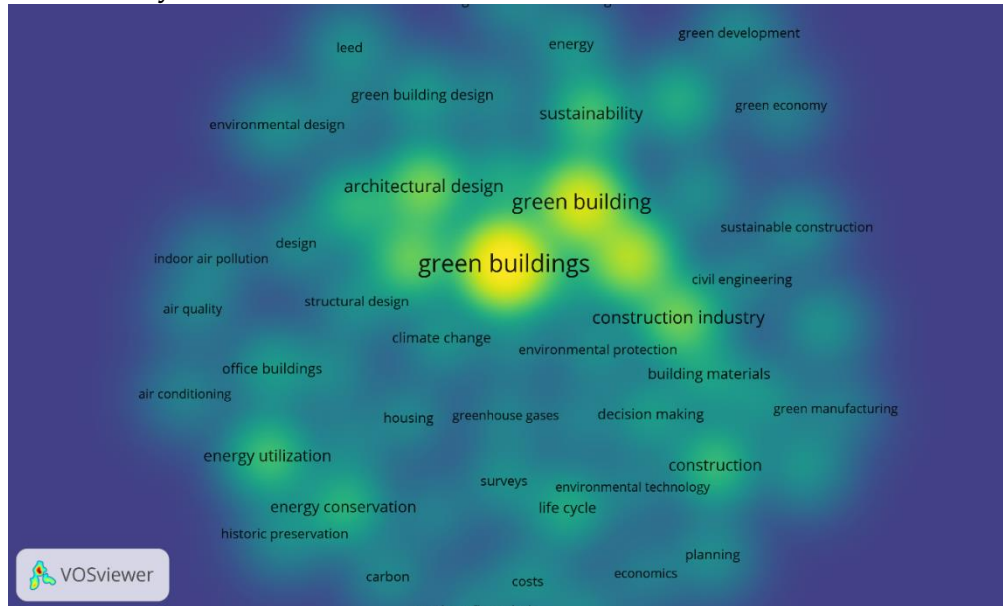


Figure 3. Density Visualization

Source: Data Analysis Result, 2026

In the density visualization, one can see the clustering of research issues within the literature on green buildings. The yellow spots that appear bright are those keywords that occur very frequently and are well related to each other. The keyword "green buildings" is the most dominant theme in the current literature because of its central appearance. Other highly dense keywords, such as "green building," "architectural design," "construction industry," and "sustainability," are present in the middle portion of the visualization, meaning that these issues are considered the core body of knowledge in this discipline. The occurrence of these keywords shows that the research on green buildings is highly associated with sustainable architecture and construction. Apart from the major hotspots, there are some areas with medium density that have significant research trends. The words like "energy consumption," "energy conservation," "construction," "building materials," "life cycle," and "environmental protection" can be seen in green colors, showing that research is conducted in those areas significantly, but in lesser concentration than the hotspots. On the other hand, areas like "planning," "economics," "carbon," "green manufacturing," and "historic preservation" have low research density and hence can be seen near the edges.

3.4 Co-Authorship Visualization

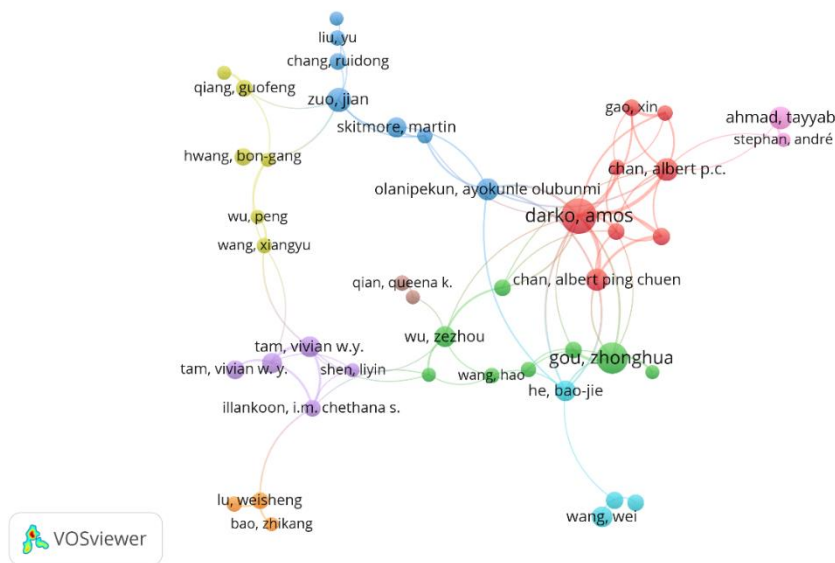


Figure 4. Author Visualization

Source: Data Analysis Result, 2026

The collaboration network analysis shows that there is fragmentation in terms of collaboration networks within green building research, which includes several author clusters. Among those who could have the highest influence on collaboration, Darko, Amos, Gou, Zhonghua, and Chan, Albert P.C. seem to be the most dominant authors, since they have been found to hold pivotal positions within the network. Their key positions, as well as their large size, suggest that they produce many publications within the domain and that they are highly influential collaborators. There also seem to be some regional groups, specifically the Chinese, including Liu, Yu, Chang, Ruidong, Qiang, Guofeng, and Wu, Peng, in green building research.

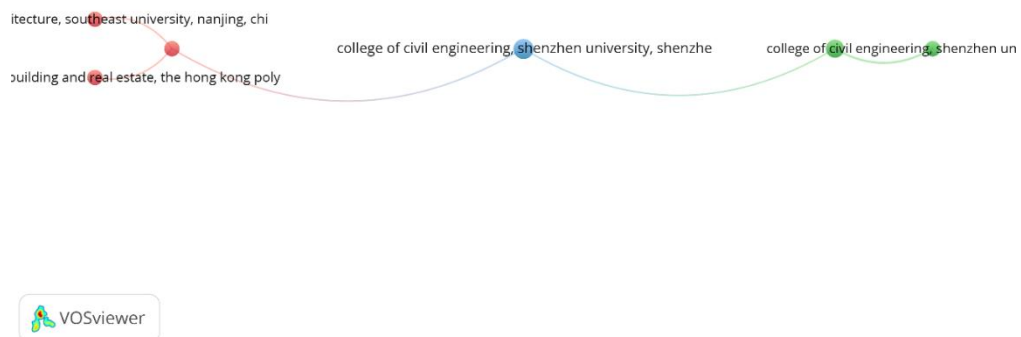


Figure 5. Institution Visualization

Source: Data Analysis Result, 2026

themes such as green economy, green development, sustainable construction, and environmental protection. The collaboration maps also show that China, the United States, the United Kingdom, Australia, and several Asian and European countries play important roles in advancing this research area.

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