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Scientometric Analysis of Environmental Impact Assessment Research in the African Construction Industry

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Abstract

Purpose: This study is a scientometric survey of research in the Environmental Impact Assessment (EIA) in African construction industry, which maps the intellectual landscape, the thematic development, the interaction network, and the geography of the discipline.

Design/Methodology/Approach: A systematic search of the Scopus database using the keywords generated 367 peer-reviewed journal articles, which were analysed with VOSviewer based on the PRISMA methodological co-authorship, keyword co-occurrence, co-citation, and bibliographic coupling analysis.

Findings: The research identified five clusters and also identified China as the most prolific in research on this topic, with Nigeria as the most prolific African researcher. The prevailing analytical framework is Life Cycle Assessment. The geographical focus is narrow, as francophone and lusophone Africa are grossly misrepresented. The innovative digital environmental assessment tools are not widely featured in the academic agenda.

Practical Implications: The results provide researchers, practitioners, and policymakers with a systematic evidence base to understand existing EIA knowledge in the African construction industry, identify knowledge gaps, and develop targeted research and capacity-building interventions to enhance environmental governance on the continent.

Originality/Value: This scientometric investigation maps EIA research in the African construction industry, addresses a significant methodological gap in the literature, and provides a reproducible analytical basis for future academic research in the field.

Keywords: *Environmental Impact Assessment, African Construction Industry, Scientometric Analysis, Bibliometric Review, Life Cycle Assessment, Vosviewer, and Science Mapping.*

I. INTRODUCTION

The construction sector plays a pivotal yet disputed role in international environmental regulation. On the one hand, it boosts the economy, creates jobs, and provides the infrastructure societies rely on (Mahmood et al., 2025). On the other hand, it is among the most resource-intensive sectors globally, accounting for a substantial share of energy use, greenhouse gas emissions, waste production, and land-use change (Darko et al., 2025). These twin realities have ensured that environmental management of construction activity has remained a long-standing and growing area of academic interest, and that the Environmental Impact Assessment (EIA) has become the primary institutional tool for formally assessing, managing, and mitigating the environmental impacts of construction projects (Faisal & Ahmad, 2026). Sikdar (2021) defined EIA as the process of identifying, predicting, assessing, and reporting the probable environmental impacts of a proposed development before deciding whether it should proceed.

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EIA has been integrated into the regulatory framework of most countries since the 1970s and has since become a complex, multidisciplinary practice at the interface of environmental science, planning law and construction management (Morgan, 2022).
In the African context, EIA has taken on a certain strategic significance. Africa has the fastest rate of urbanisation, and the urban population is expected to double by 2050, driving a construction boom across housing, transport, energy, and industrial sectors on a scale never before seen (Martins et al., 2022). This building boom is taking place in an ecological landscape of unique importance: African ecosystems contain some of the greatest concentrations of biodiversity on Earth, and the continent's water, soil, and atmosphere are already strained by the compounding impacts of climate change and rapidly accelerating land-use transformation (Badji et al., 2022). The African construction industry has significant stakes in robust EIA. However, the institutional structures operating within EIA in Africa have been unequal, with vast differences in the quality of regulatory provisions, implementation capacities, monitoring effectiveness, and public participation across national settings (Okafor & Onwurliri, 2025). Relatively mature EIA systems have developed in countries such as South Africa, Ghana, Kenya, and Egypt, whereas others have nascent, sporadic, or poorly integrated EIA and construction project delivery systems (Sandham et al., 2022).

Although significant, systematic quantitative analysis of the academic literature on EIA in the African construction industry remains limited(Sandham et al., 2022). The available literature has increased significantly; the Scopus database lists 367 publications on this topic, yet it has expanded in a rather disorganised fashion, with research interests spanning national backgrounds, disciplinary orientations, and research traditions. This division challenges researchers, practitioners, and policymakers to determine the field's intellectual essence, historical development, drivers of knowledge production, and remaining critical gaps. Subjectivity and incomplete coverage are well-known limitations of traditional narrative reviews, which are most unfavourable to mapping the research domain of such complexity and scale (Olawumi & Chan, 2018). The methodology is both methodologically suitable and timely, as a scientometric methodology, i.e., using quantitative methods of analysis to bibliographic data, to uncover the structural patterns, intellectual development, and collaborative networks of a research area.

In recent years, scientometric analysis in construction research has become more sophisticated. It was shown to be useful in mapping the global landscape of sustainability research in its SciSpace form (Ghaleb et al., 2022), which has since been used to study social business research (Chaudhuri et al., 2023), construction robotics and human-robot teams (Onososen et al., 2022) , environmental health and safety in construction (Owusu-Boadi et al., 2025), and off-site construction (Olawumi & Chan, 2018) demonstrated that scientist analysis, involving text mining and citation analysis, is an efficient way to visualise data and identify structural patterns and track capabilities of frequently studied perspectives, which is exactly what is required to introduce order to the EIA-construction literature in the African context.. However, none of the studies have specifically implemented these techniques in the context of EIA research and the African construction industry, and this gap in the literature has significant and relevant implications
.
This paper fills that gap. Using a Scopus database of 367 bibliographic records, the paper provides a scientometric analysis of EIA studies in the African construction sector with the help of co-authorship analysis, keyword co-occurrence mapping, and citation network analysis with VOSviewer that demonstrates the intellectual organisation of the field, its thematic development, the patterns of collaboration, and the perspectives of the research in the future. The study identifies key gaps in research coverage, especially the under-representation of Francophone Africa, the limited inclusion of climate change adaptation in EIA frameworks, and the lack of systematic use of digital tools like BIM in EIA practice, which indicate directions for future scholarly and policy-focused research. The article contributes to the knowledge in three ways. First, it provides a scientometric mapping of EIA research in the African construction sector, offering a quantitative baseline for how this sector has emerged and where it is today. Second, it helps pinpoint the prevailing themes across research, authors, and journals that drive knowledge generation in the field, enabling researchers to navigate and build on the existing literature more efficiently. Third, surfacing collaborative networks and geographic concentrations of research activity indicates opportunities for partnerships and knowledge sharing, which can enhance the quality and contextual applicability of EIA practice across the continent. By doing so, this research addresses the challenge posed by scholars such as (Owusu-Boadi et al., 2025) to conduct more systematic, science-based mapping studies of areas of construction research where conventional reviews have failed to address intellectual gaps.

II. LITERATURE REVIEW

2.1 The Construction Industry and Its Environmental Impact.

The construction industry is in a paradoxical position in global development: it is both a major driver of economic growth and one of the world's greatest polluters (Edwards, 2021). In developed and developing countries, the industry accounts for a significant share of global energy use, carbon emissions, solid waste production, water use, and land conversion, affecting the entire project cycle from extraction through demolition and waste disposal (Liu et al., 2025). The environmental footprint of the industry is not just a question of operational inefficiency but a symptom of structural peculiarities such as the disunity of project delivery, the reliance on resource-consuming materials such as concrete, steel, and glass, and a historic shortage of incorporating environmentalism into design and procurement decision-making (Broome & Valentine, 1995). These attributes have rendered the construction industry a consistent target of environmental regulation efforts around the world, and have motivated the creation of a

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variety of evaluation frameworks, the most institutionally established and popular of which is Environmental Impact Assessment (Chen et al., 2023)

The construction business in Africa, especially, is at a crossroads. This is the fastest urbanisation in human history, and it is projected that by 2020 to 2050 the urban population in Africa will increase more than twofold, creating a titanic and ongoing demand for housing, transport infrastructure, energy installations, and industrial capacity (Martins et al., 2022). This growth in construction is taking place on an ecological landscape of unparalleled global importance; African biomes are home to a number of the world's biodiversity hotspots, and the fresh water, soil and atmosphere resources of the continent are already experiencing compounding pressure due to the rapid rate of land-use change, deforestation and climate-related stress (Tapale, 2024). Environmental management of construction activity in Africa thus extends far beyond individual projects, shaping national development paths, regional ecological sustainability, and global climate commitments (Grant et al., 2025). To strengthen environmental governance of the built environment in Africa, it is necessary to understand how EIA research has evolved to date, who the authors are, what it addresses, and where it falls short.

2.2 Environmental Impact Assessment: Conceptual Principles and Global Development.

Before 1970, Environmental Impact Assessment became a policy tool when the United States National Environmental Policy Act required federal agencies to conduct environmental impact assessments of significant proposed actions before carrying them out (Lindstrom & West, 2022). Through this regulatory source, EIA spread quickly across national jurisdictions, and by the 1990s, it was incorporated into the environmental regulatory systems of most countries (Sánchez & Duarte, 2022). Fundamentally, EIA is a procedural, analytical exercise in which the probable environmental impacts of a given development are determined, anticipated, assessed, and reported to decision-makers so regulatory approval procedures and project design can be guided toward more responsible outcomes (Rathoure, 2021). Its disciplinary roots are interdisciplinary, drawing on ecology, hydrology, atmospheric science, social science, planning law, and engineering to produce assessments that are technically rigorous and institutionally actionable.

The conceptual development of EIA has drifted significantly from its procedural conceptualisation. The initial experience of EIA was mainly related to the determination of adverse effects and the prescription of mitigation steps- a reactive, project-oriented approach that critics claimed to be ill-suited to the wider planning process and not responsive enough to cumulative and transboundary effects (Nita et al., 2022). The latter practice introduced Strategic Environmental Assessment, which applies EIA principles to policies, plans, and programs rather than individual projects, enabling more proactive, systems-level environmental governance. Life Cycle Assessment, an evaluation of the environmental impact of products and processes throughout their full lifecycle, i.e., from raw material extraction to end-of-life disposal, has increasingly become part of EIA practice, and it allows accounting for the environmental burdens related to construction activity in a more comprehensive way than project-specific assessments can do (Ibrahim et al., 2024). These methodological innovations have strengthened the analytical rigour of environmental assessment in construction, but have also raised knowledge requirements among practitioners, posing an enduring challenge in developing country contexts where professional capacity and institutional infrastructure are limited.

2.3 Environmental Impact Assessment in Africa: Regulations and Implementation Issues.

Formal EIA systems have been adopted unevenly in Africa because of the interaction of colonial legal legacies, donor-led governance reforms, national political priorities, and the availability of institutional and professional capacity (Saklani, 2023). South Africa, with its National Environmental Management Act of 1998 and its Environmental Impact Assessment rules, is one of the most advanced EIA systems on the continent, featuring fairly well-defined procedural requirements, a hierarchical assessment framework, and community involvement and environmental management programs (Mathabatha, 2019). Ghana also established an extensive EIA system through its Environmental Protection Agency Act of 1994, which required environmental permits for new ventures and Environmental Management Plans as a prerequisite for certification. Kenya, Tanzania, Mozambique and Egypt have established their own frameworks with differing levels of procedural rigour, but the issue of implementation with relation to monitoring, enforcement and post approval compliance is well documented across these national settings (Lema, 2025).

Despite these institutional transformations, the quality of EIA systems in Africa remains well below what the continent's ecological interests require. (Gunningham, 2009) recognised a lack of harmonised regulatory requirements between jurisdictions as a core obstacle to uniform environmental governance, and observed that conflicting legislative requirements can make it challenging for developers working in multiple national settings to use consistent methods. The stability of the implementation of EIA has in numerous cases been compromised by political instability and changes in administrative priorities since regulatory frameworks that appear sufficient on paper can be implemented poorly in practice, where political will is lacking or institutional capacity is inadequate (Nandmehar & Marah, 2025). Environmental agencies are often understaffed because many technical evaluations of large-scale infrastructure are complex and difficult to review, and because qualified practitioners are concentrated in capital cities rather than in the regions where construction activity is most prevalent. Provisions for public participation, though officially incorporated into the majority of African EIA frameworks, fail to ensure meaningful participation due to limited access to information, language barriers, and time constraints under which consultation processes are organized (Strauss, 2022). These

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institutional issues suggest that EIA in African construction is often a compliance exercise rather than a substantive tool of environmental regulation, a trend that the academic literature on the topic has recorded limited scientometric analysis of.

2.4 Life Cycle Assessment and its overlap with Environmental Impact Assessment in Construction.

(Fnais et al., 2022) opined that Life Cycle Assessment (LCA) has also become one of the most important approaches in the environmental evaluation of construction activity, which offers a systematic means to quantify the environmental burdens of a building or infrastructural project across all its entire lifetime, including the extraction and processing of raw materials, the construction phase, operation and maintenance, and eventually the demolition and processing of waste. The combination of LCA with EIA practice is a substantive step toward enhancing environmental governance capacity, allowing decision-makers to see the overall environmental picture of the proposed developments rather than focusing on site-specific effects during construction (Nandmehar & Marah, 2025).

LCA has received increasing scholarly interest in the African construction research literature, but its use has been limited to a few countries, mostly South Africa, where institutional capacity, data availability, and professional awareness are relatively well developed. Crafford et al. (2021) found that the greatest advantage of LCA adoption in the South African construction industry is its support for policy and legislative development, followed by environmental performance, marketing benefits, and strategic planning. These results highlight LCA's potential as a technical evaluation tool and governance instrument, and they can inform regulations and project-specific decisions (Scherz et al., 2022). The fact that LCA has become the most prevalent framework in the EIA-construction literature found in the scientometric analysis of the present study can be seen as evidence of this increasing scholarly agreement concerning its methodological dominance, at the same time pointing to the necessity of more geographically diverse studies that can extend the LCA-informed EIA practice beyond the few African countries currently represented in the literature.

2.5 Research gaps and the necessity for Scientometric mapping.

As indicated in the review above, several gaps in the current literature are interrelated and make this study a justifiable endeavour. To begin with, although EIA has been extensively addressed in African construction, limited research has adopted a scientometric approach to comprehensively chart the global and continental landscape of this research field (Owusu-Boadi et al., 2025). The intellectual networks, thematic clusters, geographic concentrations, and temporal development of the field remain unmapped, leaving researchers and policymakers without systematic evidence on where knowledge has concentrated and where it remains sparse. Second, the current literature is extremely skewed towards English-speaking African countries, especially South Africa, Nigeria, Ghana, and Kenya, and the francophone and lusophone African world is grossly underrepresented, even though the construction industries of these countries are rapidly growing, and the environmental impact of these industries is substantial (Owusu-Boadi et al., 2025; Sandanayake, 2022; Wells, 2026) . Third, little scholarly focus on the application of emerging digital technologies, such as Building Information Modeling, geographic information systems, and remote sensing, to the EIA practice of the construction projects in Africa has been studied, and it is a frontier research area the field has not approached systematically (Hanna, 2022). Fourth, project-level EIA studies have addressed the cumulative and transboundary effects of construction on the environment, especially in ecologically connected African landscapes, only marginally, highlighting the need for more strategic, landscape-level assessment frameworks (Akintoye, 2025; Okafor & Onwurliri, 2025). These gaps constitute the intellectual space this scientometric analysis seeks to illuminate, providing a structured, data-driven foundation for identifying and pursuing future research priorities.

III. METHODOLOGY

This study employed a scientometric methodology to systematically analyse the intellectual organisation, thematic development, and collaborative networks of Environmental Impact Assessment (EIA) research in the African construction industry. (Olawumi & Chan, 2018), has used similar approach to construct a comprehensive and objective mapping of the research area, the study used a science-mapping approach, combining quantitative bibliometric techniques and visual network analysis.

The Scopus database was chosen as the primary data source because of its proven reliability and its larger number of construction-related publications than other bibliographic databases (Akinlolu et al., 2022; Aliu & Aigbavboa, 2023; Olawumi & Chan, 2018). The usage of Scopus has been embraced effectively in similar scientometric research in the field of construction management research such as green building (Wang et al., 2024), environmental health and safety (Owusu-Boadi et al., 2024), and sustainable development (Olawumi & Chan, 2018), offering a valid and reliable precedent of its use in the current study. Data extraction involved a systematic search using keywords and the Boolean operators AND and OR to combine terms related to environmental impact assessment and construction in Africa in the title, abstract, and keywords. The dataset has been published in Mendeley Data (Abiola-Ogedengbe, 2026).

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We applied no publication-year restrictions to capture the field's full history, and after applying inclusion and exclusion criteria, we obtained a final dataset of 367 bibliographic records. To ensure analytical consistency, the dataset was restricted to peer-reviewed journal articles published in English in the engineering and environmental science subject areas, excluding conference papers, book chapters, editorials, and non-English articles.

The bibliographic information obtained was exported from Scopus in comma-separated values (CSV) format and imported into VOSviewer (version 1.6.18) for scientometric analysis and network visualisation. The choice of VOSviewer was driven by its proven ability to visualise networks by distance, its common use in similar research, and its ability to handle large amounts of bibliographic data (Owusu-Boadi et al., 2025). Four main analytical methods were used: Co-authorship analysis to map the collaboration relations between authors, institutions, and countries, keyword co-occurrence analysis to determine the prevailing research themes and thematic groups, co-citation analysis to determine the intellectual basis and knowledge base of the field, and, lastly, bibliographic coupling analysis to determine clusters of publications that share common reference structures. A publication trend analysis also examined the temporal development of EIA research contributions in the African construction context. Together, these methods provided a multidimensional view of the field's structure, patterns of influence, and thematic boundaries that traditional narrative review methods do not capture.

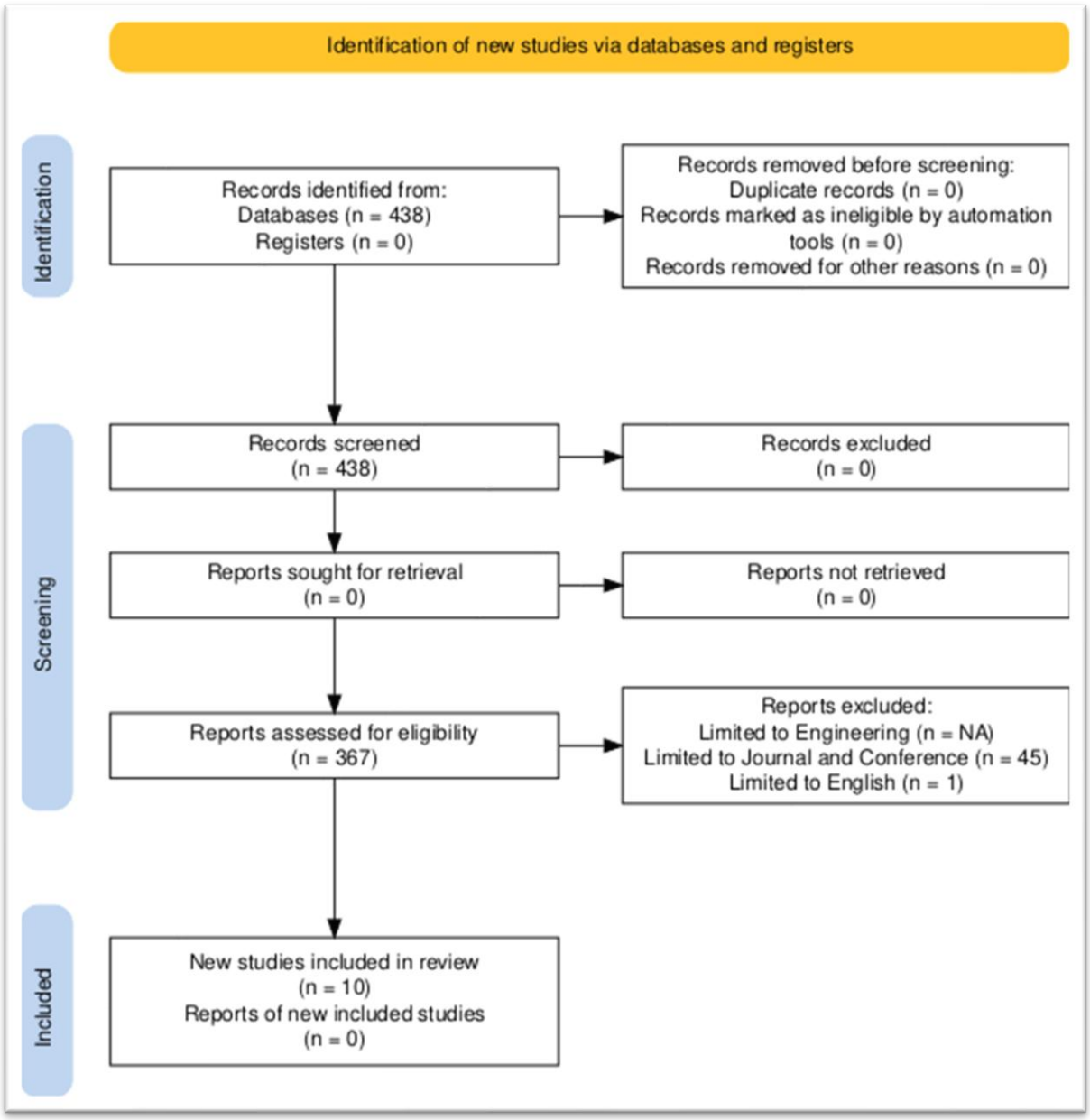


Fig 1: PRISMA 2020 Methodology
Source: Haddaway et al. (2022)

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3.1 Country and Institutional Analysis

Fig. 2 presents the geographical distribution of research output on Environmental Impact Assessment (EIA) in the construction industry, highlighting major gaps in global knowledge production. China is the most productive country, with 70 articles (19.07%), followed by the United States with 43 articles (11.72%) and the United Kingdom with 32 articles (8.72%). This dominance reflects strong research capacity, access to funding, and a focus on sustainability and environmental management in these countries.

Spain and Australia (26 articles each, 7.09 percent), India (23 articles, 6.27 percent), and Hong Kong (21 articles, 5.72 percent) follow closely with other significant contributors, and suggest a wide but skewed spread of research activity with a global presence. Other European nations, such as Italy, the Netherlands, Sweden, Denmark, Portugal, and Finland, also contribute steadily, supporting the region's high level of involvement in sustainability research.

Conversely, there is a low representation of Africans. Nigeria has the most publications of 8 (2.18%), followed by Egypt, which has 6 (not in the top 20 but mentioned in the dataset). This minimal contribution highlights a significant research gap, especially as environmental challenges and construction activities in Africa rise.

In conclusion, the figure shows that EIA research is highly motivated by developed and emerging economies outside Africa, indicating that more research should be invested, more capacity built, and more context-based research conducted in the African construction industry.

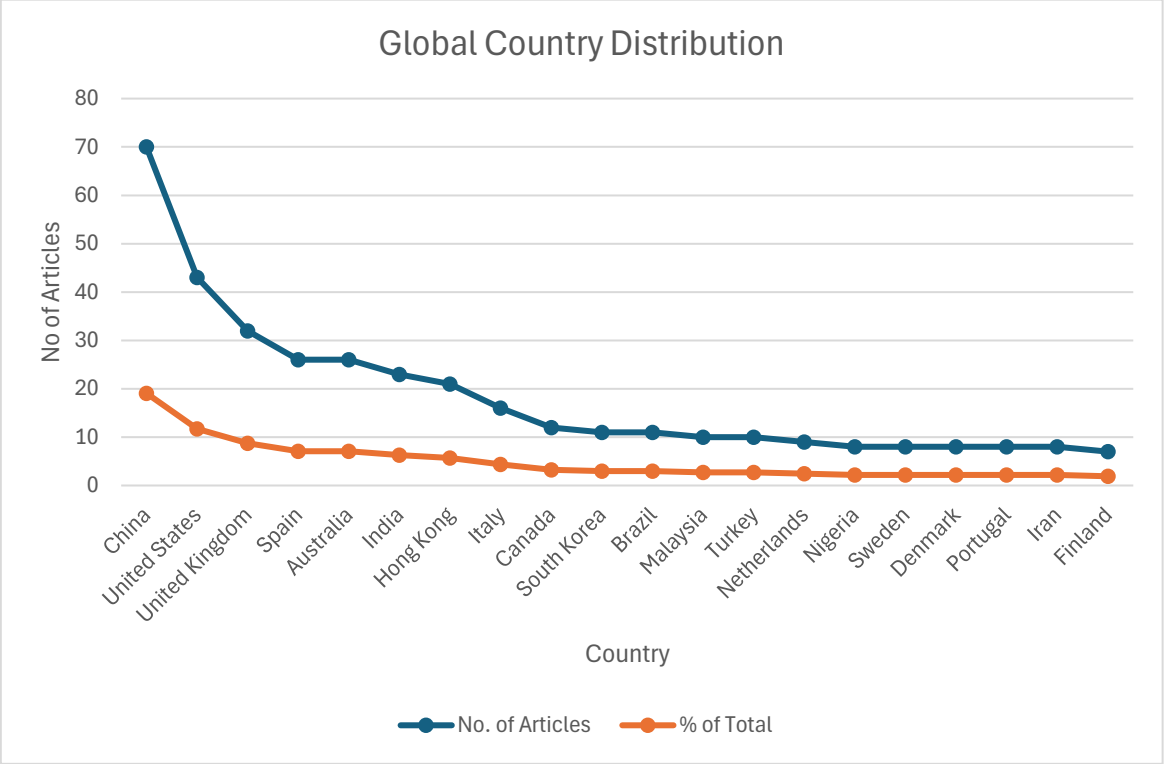


Fig 2: Global Country Distribution
Source: Author's Compilation

3.2 Publication Trend Analysis (1988-2026)

Table 1 presents the number of publications on Environmental Impact Assessment (EIA) in the African construction industry between 1988 and 2026. Between 1988 and 2000, research output was very low and sporadic, averaging 1-3 articles per year, in an emerging field with little attention. There is a slow rise between 2001 and 2008, which shows the increasing awareness on environmental concerns in construction.

A significant increase begins in 2009, and by 2012, publications grow 18-fold, indicating a shift to more active research. Between 2013 and 2019, output remained at relatively high levels, indicating the field's maturation. The largest increase in the number of articles is anticipated between 2020 and 2025, when the number is projected to reach 44, likely due to greater emphasis on sustainability and environmental regulations. The lower number in 2026 likely reflects incomplete data rather than a decrease in research.

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Table 1: Publication Trend Data

Year	No. of Articles
1988	1
1991	1
1996	3
1997	1
1999	1
2001	2
2004	2
2005	1
2006	3
2007	4
2008	2
2009	7
2010	13
2011	14
2012	18
2013	8
2014	12
2015	15
2016	18
2017	19
2018	19
2019	18
2020	21
2021	30
2022	26
2023	26
2024	31
2025	44
2026	7

Author's Compilation, 2026

3.3 Source Journal Analysis

Table 2 presents the initial source journals that have contributed to research on Environmental Impact Assessment (EIA) in the African construction industry, based on both productivity and citation impact. Sustainability (Switzerland) has the most publications (27, 7.37%), which demonstrates its popularity as a primary source of EIA-related research. However, for citation impact, Waste Management has the highest total citations (2,389), followed by Journal of Cleaner Production (1,376) and Building and Environment (1,125), suggesting that although these publications are less numerous, they have significant scholarly impact.

Other prominent journals include Environmental Impact Assessment Review and Resources, Conservation, and Recycling, which have balanced outputs and citations. Mid-ranked journals have moderately high contribution, and lower-ranked sources have low contribution and impact. Overall, the distribution indicates that publications are concentrated in high-impact, sustainability-oriented journals, reflecting the interdisciplinary and environment-oriented character of EIA studies in the construction industry in Africa.

Table 2: Source Journal Data

Rank	Source Journal	Count	% of Total	Total Citations
1	Sustainability (Switzerland)	27	7.37%	484
2	Environmental Impact Assessment Review	20	5.45%	715
3	Waste Management	20	5.45%	2,389
4	Resources, Conservation and Recycling	15	4.09%	1,046
5	Building and Environment	14	3.81%	1,125
6	Science of the Total Environment	14	3.81%	733
7	Journal of Cleaner Production	14	3.81%	1,376
8	Journal of Building Engineering	10	2.72%	71
9	Environmental Monitoring and Assessment	10	2.72%	153

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10	IOP Conference Series: Earth and Environmental Science	9	2.45%	55
11	Buildings	9	2.45%	63
12	Int. Journal of Environmental Research and Public Health	8	2.18%	252
13	Journal of Environmental Management	8	2.18%	862
14	Waste Management and Research	5	1.36%	151
15	Construction Management and Economics	5	1.36%	111
16	International Journal of Life Cycle Assessment	5	1.36%	330
17	Journal of Industrial Ecology	4	1.09%	363
18	WIT Transactions on Ecology and the Environment	4	1.09%	5
19	Environment, Development and Sustainability	4	1.09%	55
20	Marine Pollution Bulletin	4	1.09%	77

Authors' Compilation, (2026)

3.4 Most Cited Articles

Table 3 shows the twelve most-cited documents. Marinković et al. (2010) leads with 726 citations for a comparative lifecycle assessment of natural and recycled aggregate concrete. Bajpai et al. (2020) follows with 500 citations and records the highest annual citation rate in the corpus at 71.4. Qin et al. (2013) ranks third with 491.

The composition of this group is informative. Ten of the twelve apply lifecycle methods to a specific material, technology or waste stream; only Ameen et al. (2015), a critical review of environmental assessment tools, addresses assessment methodology directly. The field's most influential work is therefore applied and quantitative rather than procedural or institutional.

Table 3: Most Cited Articles

First author	Year	Source	Citations	Cites/yr
Marinković, S.	2010	Waste Management	726	42.7
Bajpai, R.	2020	Journal of Cleaner Production	500	71.4
Qin, H.-P.	2013	Journal of Environmental Management	491	35.1
Li, X.	2010	Building and Environment	270	15.9
Hossain, M.U.	2017	Resources, Conservation and Recycling	234	23.4
Ameen, R.F.M.	2015	Environmental Impact Assessment Review	226	18.8
Butera, S.	2015	Waste Management	215	17.9
Quale, J.	2012	Journal of Industrial Ecology	206	13.7
Li, Z.	2014	Resources, Conservation and Recycling	194	14.9
Hossain, M.U.	2018	Journal of Cleaner Production	183	20.3
Tait, M.W.	2016	Int. Journal of Life Cycle Assessment	180	16.4
Zhang, X.	2015	Building and Environment	177	14.8

Author, Compilation, (2026)

3.4 Most Productive Author

This reveals the most-cited authors who have contributed to the study of Environmental Impact Assessment (EIA) in the construction industry. The prevalence of highly referenced studies indicates the focus on life cycle assessment (LCA), sustainable materials, and environmental performance assessment.

With 726 citations, Marinkovic et al. (2010) are the most significant in their category, and the need to compare natural and recycled aggregate concrete, a key area of focus in sustainable construction, is highlighted. Likewise, with 500 and 491 citations, respectively, Bajpai et al. (2020) and Qin et al. (2013) showed the growing relevance of geopolymer materials and low-impact urban development strategies in addressing environmental issues.

One peculiarity shared by the most frequently referenced articles is that publications in high-impact journals (Journal of Cleaner Production, Waste Management, and Building and Environment) are relatively concentrated, suggesting that EIA studies are closely related to discussions of sustainability and resource efficiency. Moreover, several studies (e.g., (Butera et al., 2015; Hossain et al., 2017)) have focused on construction and demolition waste management, supporting the view that it is a key sustainability concern. The fact that several studies have used LCA (e.g., (Bilec et al., 2010; Li et al., 2014) further indicates that LCA remains the most widely used methodological approach in EIA research. Overall, the table shows that the field is somewhat dominated by efforts to mitigate environmental impacts through material innovation, waste minimisation, lifecycle considerations, and growing interest in new sustainable technologies and policy platforms.

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Table 4: Most Productive Authors

Author	Docs	Citations	Cites/doc	Rank
Hossain, Md. Uzzal	4	550	137.5	1
Poon, Chi Sun	3	367	122.3	2
Ng, S. Thomas	3	308	102.7	3
Li, Xiaodong	3	288	96.0	4
Huang, Beijia	3	230	76.7	5
Li, Heng	3	72	24.0	6
Hoxha, Endrit	3	65	21.7	7
Faith-Ell, Charlotta	3	44	14.7	8=
Balfors, Berit	3	44	14.7	8=
Zhou, Zhiwu	3	41	13.7	10=
Yepes, Víctor	3	41	13.7	10=
Alcalá, Julián	3	41	13.7	10=

Authors' Compilation (2026)

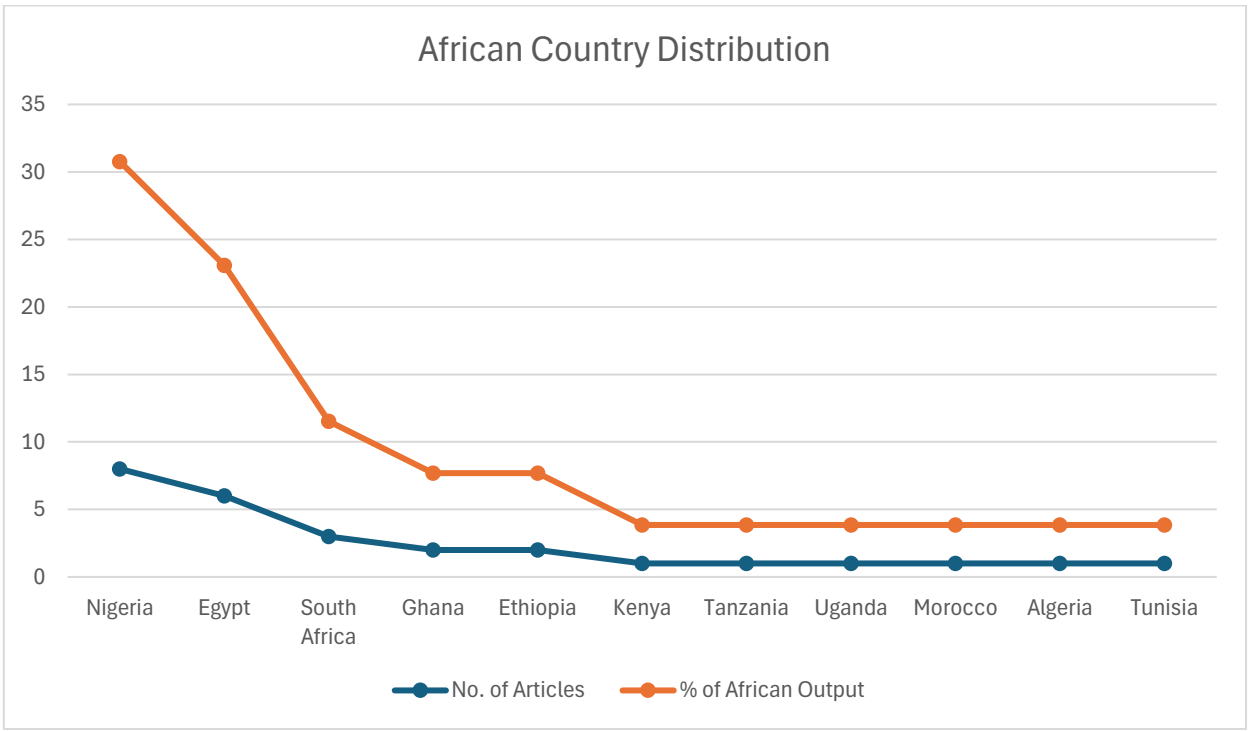
3.6 African Country Distribution

Fig. 3 shows the distribution of African countries and their contributions to Environmental Impact Assessment (EIA) studies in the construction industry. Eleven African countries are represented, indicating a growing but still limited research presence on the continent.

Nigeria has the most publications, with 8 articles (30.77% of African publications), and Egypt has 6 articles (23.08%). These two nations account for over 50 percent of global research output, underscoring the concentration of academic activity in a small number of the most prominent countries. South Africa ranks third with 3 publications (11.54%), indicating relatively strong research potential in the built environment.

Ghana and Ethiopia, with 2 articles each (7.69%), represent a second level of new contributors. The rest of the nations, Kenya, Tanzania, Uganda, Morocco, Algeria, and Tunisia, only made one publication (3.85%), which demonstrates a diffuse and low-volume research environment in a large part of Africa.

Overall, the distribution shows a major imbalance in research output, with a few countries heavily represented while many others remain underrepresented. This trend highlights why research capacity should be invested in, regional cooperation should be enhanced, and more context-agent studies should be conducted to develop EIA.



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Fig 3: African Country Distribution
Authors' Compilation (2026)

3.7 Keyword Analysis

Table 5 presents the frequency distribution of keywords, which presents the prevailing research themes and conceptual framework of Environmental Impact Assessment (EIA) studies in the construction industry. As indicated, the most salient keyword is life cycle assessment (61 occurrences), which supports its use as the main methodological tool to the assessment of environmental performance. This is reinforced by associated terms like LCA and life cycle assessment (LCA) (21 instances each), indicating a unified reliance on lifecycle-based evaluation methods.

Keywords such as environmental impact assessment (46) and sustainability (30) are also ranked highly, confirming that the area is largely rooted in sustainability-based assessment practices. Similar terms such as environmental impact (27) and environmental impacts (13) suggest that approaches to quantifying and analysing impact are important.

Industry-wise, terms such as construction industry (18) and construction (14) indicate the industry-specific use of these concepts. Moreover, new sustainability trends are reflected in keywords such as circular economy (15), recycling (11), and waste management (10), indicating growing interest in resource efficiency and material reuse.

Specificity to a material is presented in these two terms: concrete (13) and construction and demolition waste (13), highlighting real-world places of environmental interest. Nevertheless, comparatively smaller counts of hits of terms like carbon footprint (6) indicate that the analysis with emissions in mind is still in an underdeveloped state.

On the whole, the keyword distribution shows that the field under consideration is occupied by lifecycle assessment methods, with interest in the circular economy and research on carbon issues still emerging.

Table 5: Keywords Analysis

Keyword	Occ.	% of corpus	TLS	Cluster
Life cycle assessment	113	30.8%	97	1
Environmental impact assessment	53	14.4%	34	2
Environmental impact	40	10.9%	46	1
Sustainability	30	8.2%	36	1
Construction industry	18	4.9%	21	2
Construction and demolition waste	18	4.9%	20	3
Circular economy	15	4.1%	21	1
Construction	14	3.8%	14	2
Concrete	13	3.5%	13	1
Sustainable construction	13	3.5%	16	1
Environment	11	3.0%	8	2
Environmental assessment	11	3.0%	10	1
Recycling	11	3.0%	13	3
Waste management	10	2.7%	11	3
Sustainable development	8	2.2%	8	2
China	6	1.6%	5	2
Carbon footprint	6	1.6%	5	1

Authors' Compilation (2026)

3.8 Index Keywords (Scopus -Assigned)

The index keywords allocated by Scopus and listed in Table 6 provide a standardised, general overview of the prevailing research themes in Environmental Impact Assessment (EIA) in the construction sector. Unlike author keywords, these index terms indicate database-level classification and thus offer a broader view of the field's intellectual organisation.

The most common keyword, the construction industry (369), provides the disciplinary basis for the research corpus. This is followed by environmental impact assessment (244) and environmental impact (190), showing that EIA remains the main methodological and analytical framework for studies in this field. The high similarity of the terms (e.g., environmental impact assessments, 119) also supports the methodological consistency of the studies.

Keywords such as sustainable development (126), life cycle (121), life cycle assessment (91), and life cycle analysis (82) are also featured, suggesting a strong focus on lifecycle thinking in measuring environmental performance. Moreover, the terms recycling

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(115), waste management (112), and industrial waste (46) indicate significant research interest in resource efficiency and waste minimisation in construction activities.

The concepts of decision support and governance appear in decision-making (80) and risk assessment (45), suggesting the incorporation of EIA into planning and management processes. Emerging international issues, such as global warming (49) and environmental monitoring (68), also point to a shift toward climate-related, data-driven methods.

Overall, the index keyword distribution indicates a mature, sustainability-oriented research area supported by lifecycle approaches, with growing risk, policy, and environmental surveillance aspects.

Table 6: Index Keyword (Scorpus Assigned)

Rank	Index Keyword	Frequency
1	Construction industry	369
2	Environmental impact assessment	244
3	Environmental impact	190
4	Sustainable development	126
5	Life cycle	121
6	Environmental impact assessments	119
7	Recycling	115
8	Waste management	112
9	Life cycle assessment	91
10	Life cycle analysis	82
11	Decision making	80
12	China	73
13	Environmental monitoring	68
14	Building industry	66
15	Environmental management	66
16	Sustainability	50
17	Global warming	49
18	Industrial waste	46
19	Risk assessment	45
20	Environment	44

Author's Compilation, (2026)

3.9 Discussion of Keyword Co-occurrence Network

The VOSviewer co-occurrence network included 20 nodes (keywords) connected by edges representing co-occurrence relationships across the full dataset of 367 Scopus documents. The network was divided into five thematic clusters, each with a different colour; node size corresponded to keyword frequency, and edge thickness corresponded to the strength of co-occurrence between any two keywords.

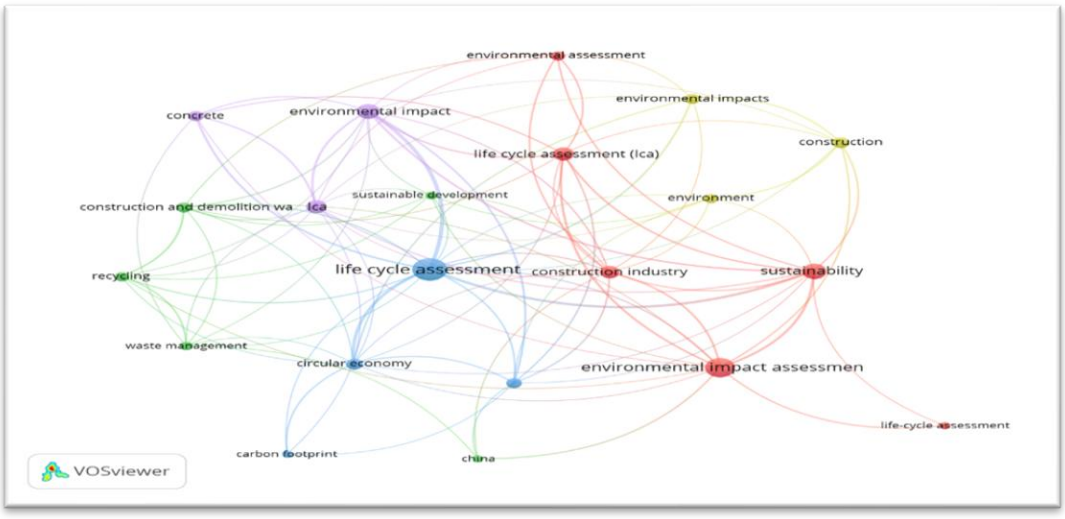


Fig 4: Keyword Co-occurrence Network

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Cluster 1 (red cluster): Environmental impact assessment and sustainability.
It is the network's central and largest cluster, with six high-profile nodes: environmental impact assessment, life cycle assessment (LCA), sustainability, and the construction industry. The environmental impact assessment node has the most nodes in the network, indicating the highest frequency of occurrence, and its centrality confirms its role as the literature's main intellectual core. Sustainability also appears as a large node with many edges linking it to keywords across clusters, indicating a high degree of cross-thematic bridging. Other members are environmental assessment and life-cycle assessment (the hyphenated form), because authors use different terms to index closely related ideas.

Cluster 2 (blue cluster): Sustainable development and Waste Management.
The blue cluster focuses on China, Construction and demolition, recycling, Sustainable development, and waste management. This cluster links to sustainability through a second node: the circular economy. The strong link between the blue cluster and the red and purple clusters indicates that the LCA methodology is an integrative paradigm that connects environmental assessment practice with materials-focused research.

Cluster 3 (Purple cluster): Materials and Circular Construction.
This cluster brings together Waste Management, sustainable development, China, Construction and demolition, and recycling. These clusters point to a sub-stream of literature dedicated to quantifying environmental impact at the material level, especially in the use of cement and concrete. Sustainable development provides a conceptual point of convergence between material analysis and broader sustainability objectives. Circular economy and carbon footprint: this cluster encapsulates the waste-economy aspect of EIA research in African construction environments.

Cluster 4 (green cluster): Waste and circular construction.
Loaded with sustainable construction, environmental, and circular-economy aspects, this cluster encapsulates the waste-economy aspect of EIA research in African construction environments. The circular economy is a peripheral node; this is likely due to the number of China-related publications in this thematic sub-stream (the largest globally, per the co-authorship analysis).

Cluster 5 (olive/yellow cluster): environmental conditions and context of construction.
A smaller group of environmental impacts, concrete, and LCA is a grouping of keywords used to reflect the contextual framing of environmental conditions in the built environment, rather than particular methodologies.

3.10 Overlay Visualisations of the Research Network
The VOSviewer visualisation shows the co-occurring network of keywords in EIA research in the African construction industry, with nodes coloured by the mean publication year of the related documents, ranging from dark blue (2018) to teal and green, up to bright yellow-green (2022). The node size is the frequency of the keyword, and the thickness of the link is the strength of co-occurrence.

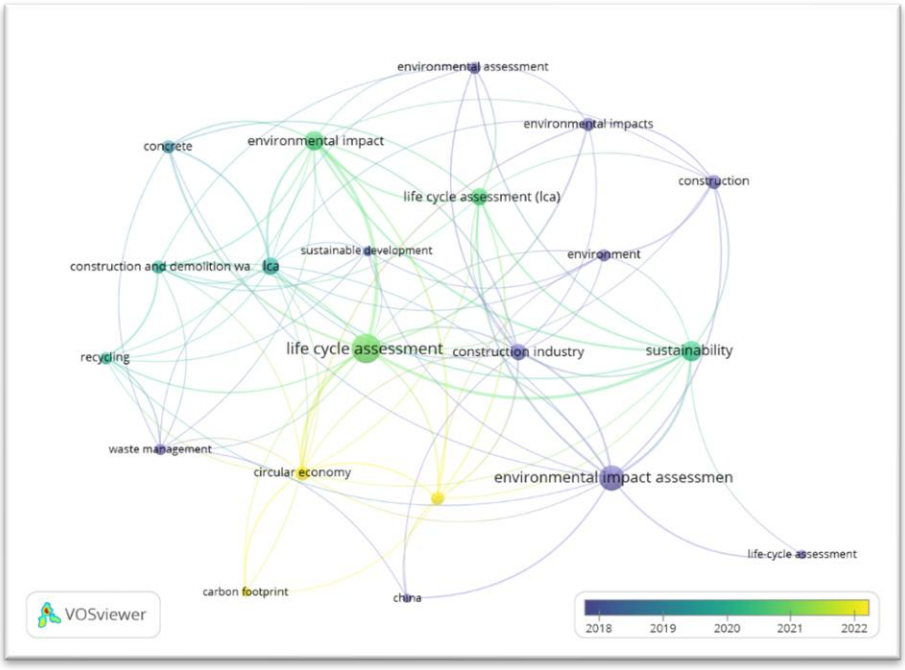


Fig 5: Overlay Visualisations of the Research Network

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The network has a prominent core-periphery set-up. The central positions lie in environmental impact assessment, the construction industry, and life cycle assessment, which validate their status as the keystones of the research field. The dark blue colouring of environmental impact assessment and the construction industry indicates that the terms have a more basic, earlier literature, whereas the green colouring of life cycle assessment reflects its continued and increasing contemporary relevance, in line with its prevailing burst power of 16.363, as determined in the burst analysis.

The most notable finding is that the two concepts, the circular economy and carbon footprint, have become bright yellow-green frontier nodes, indicating that the latest scholarly work focused on 2021-2022. These results confirm that the domain is shifting towards a wider EIA discussion of carbon-oriented and circular economy-based assessment systems. Interestingly, the lack of Africa-specific contextual keywords in the network's frontier cluster supports the literature review's observation of geographic distance.

3.11 Density Visualisation Map

The density visualisation map helps to visualise the intensity and concentration of research topics in the studies of Environmental Impact Assessment (EIA) in the construction industry as described in Fig 6.

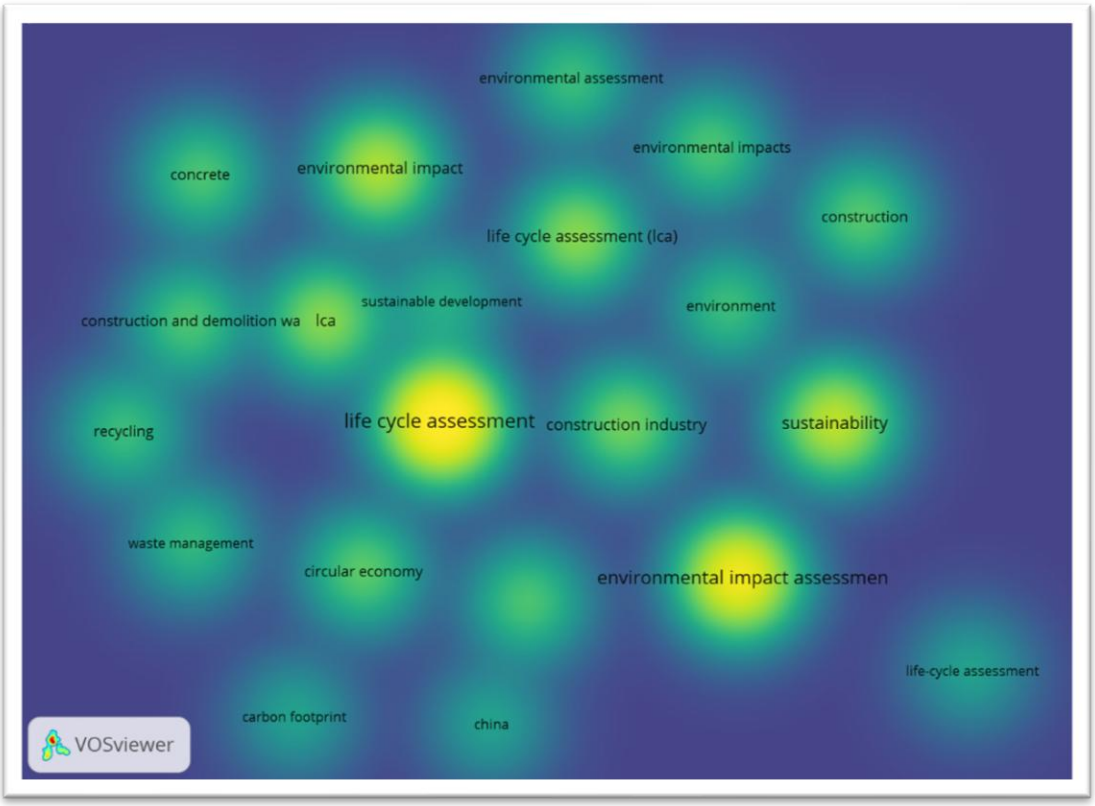


Fig 6: Density Visualisation Map

The bright yellow spots signify the most common and strongly related keywords. The most prominent theme is life cycle assessment (LCA), underscoring its leading role as a major methodological approach for assessing environmental performance in construction projects. Its strong presence indicates that many studies use life-cycle thinking to evaluate effects such as energy consumption, emissions, and material sustainability.

Likewise, the density of environmental impact assessment and sustainability is high, supporting them as key concepts in the field. The close proximity of these keywords indicates that sustainability principles are increasingly incorporated into EIA practice. The medium-density categories, such as circular economy, waste management, and recycling, indicate new research interests in resource efficiency and the sustainable use of materials, but they are not yet as dominant as LCA-related methods.

Conversely, keywords like carbon footprint and geographically specific ones like China appear in sparsely populated areas, suggesting unexplored or area-specific research topics. Overall, the map shows a methodologically developed field that still calls for more context-specific research, especially in the African construction sector.

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3.12 EIA Research in the African Construction (Burst Strength Analysis)

Burst strength reflects the degree to which a keyword frequency within a defined time window exceeds the expected background rate. A burst strength of a higher value indicates a more concentrated or stronger surge in scholarly attention. Strength above 5.0 is considered significant in research scientometrics (Olawumi & Chan, 2018). The silhouette score measures the internal cohesion and external separation of the burst cluster, as described in Table 7.

Table 7: Keyword Burst Strength and Silhouette Scores

Rank	Keyword / Research theme	Burst strength	Burst period	Duration (yrs)	Silhouette score
LCA & Carbon					
1	Life cycle assessment	**16.363**	2023-2026	4	**0.842**
2	Global warming	**6.502**	2013-2019	7	**0.747**
3	Life cycle assessment (LCA)	**6.331**	2015-2020	6	**0.838**
4	Greenhouse gas emissions	**5.547**	2021-2025	5	**0.986**
5	Carbon footprint	**4.823**	2022-2026	5	**0.961**
6	Carbon	**6.453**	2022-2026	5	**0.943**
Waste & Materials					
7	Leaching	**10.555**	2012-2018	7	**1.000**
8	Solid waste	**9.316**	2015-2020	6	**0.963**
9	Recycling	**8.687**	2019-2022	4	**0.755**
10	Compressive strength	**6.133**	2020-2024	5	**0.918**
11	Concrete	**5.679**	2010-2016	7	**0.579**
12	Fly ash	**5.520**	2017-2023	7	**0.905**
13	Industrial waste	**4.802**	2013-2019	7	**0.837**
Sustainability					
14	Circular economy	**11.829**	2022-2025	4	**0.972**
15	Environmental monitoring	**6.728**	2012-2018	7	**0.744**
16	Environmental management	**6.469**	2004-2009	6	**-0.083**
17	Sustainable construction	**5.422**	2019-2025	7	**0.899**
18	Cost analysis	**4.829**	2021-2026	6	**0.877**
19	Climate change	**4.988**	2019-2025	7	**0.862**
Digital & Assessment					
20	Decision making	**6.851**	2016-2021	6	**0.788**
21	Risk assessment	**5.744**	2015-2018	4	**0.731**
22	Artificial life (AI/ML)	**5.117**	2025-2026	2	**0.991**
Geography & Urbanisation					
23	United States	**6.098**	2009-2015	7	**1.000**
24	Eurasia	**5.997**	2004-2010	7	**1.000**
25	Urbanization	**5.931**	2013-2018	6	**0.898**
26	Hong Kong	**5.396**	2013-2018	6	**1.000**
27	Mining	**5.181**	2018-2022	5	**0.960**
28	Brazil	**5.118**	2016-2019	4	**0.967**

Author's Compilation (2026)

Table 7 shows that scores near 1.0 indicate keyword frequency is sharply concentrated within the burst period and differs sharply from non-burst years, reflecting a hallmark of a genuine, well-defined research surge. Scores below 0.5 suggest a more diffuse and ambiguous burst pattern. The negative silhouette for "Environmental Management" (-0.083) indicates that the keyword's activity was not yet temporarily concentrated; it was distributed relatively evenly across years and does not represent a true emerging surge. When the burst duration is longer (6-7years), it indicates sustained scholarly momentum, while shorter durations (2-4 years) reflect more acute, concentrated surges.

The strongest (burst strength = 16.363, silhouette = 0.842, 2023-2026) and most recent burst keyword in the entire dataset is life cycle assessment, validating its status as the dominant and rapidly expanding analytical tool in EIA research in the African construction industry. Its highest burst strength and high silhouette score indicate a real, well-defined, and rapidly advancing research frontier.

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The second strongest burst and the most closely clustered keyword in the sustainability theme, circular economy (burst strength = 11.829, silhouette = 0.972, 2022-2025), suggests that the introduction of the principles of the circular economy into the practice of EIA is the most clearly outlined emergent research direction in the current literature.

Leaching (burst strength = 10.555, silhouette = 1.000, 2012–2018) and solid waste (burst strength = 9.316, silhouette = 0.963, 2015-2020) represent robust historical spikes in the environmental assessment of materials, especially in the analysis of construction and demolition waste, and these are the historical heart of the waste and materials research cluster.
Greenhouse gas emissions (burst strength = 5.547, silhouette = 0.986, 2021-2025) and carbon footprint (burst strength = 4.823, silhouette = 0.961, 2022-2026) show high silhouette scores and high burst activity, confirming that carbon accounting shows a highly concentrated surge.

Artificial life / AI -ML methods (burst strength = 5.117, silhouette = 0.991, 2025-2026) is the newest burst keyword and has the highest silhouette score in all data. Despite its limited duration of two years, a near-perfect score in the silhouette category suggests that AI and machine learning applications in EIA are making an impressive entry into the literature, with an incredible specificity of themes, a field worthy of future comprehensive research.

The only keyword with a negative silhouette score is environmental management (silhouette = -0.083), which supports the assumption that, although it has the highest overall frequency, its scholarly activity has spread widely over time and is not necessarily concentrated in a burst window. It is a seminal, ongoing theme and not a new research wave.

IV. DISCUSSION OF FINDINGS

This scientometric analysis shows that the research area has grown in both size and geographic scope, but remains structurally concentrated and thematically disproportionate (Zhang, 2022). The fact that China preponderates in the world research output on EIA in the African construction industry is an interesting observation, which also reflects the overall trends of Chinese involvement in the scholarly approach to African infrastructure development, a relationship which is symptomatic of China's growing investment in construction on the continent through initiatives like the Belt and Road Initiative (Van Staden et al., 2023). This finding is aligned with Olawumi and Chan (2018) and Xiaoyang and Sun (2016), who found China as one of the most prolific countries in sustainability research and indicate that the intellectual agenda of African construction EIA is being influenced, in part, by researchers based outside of the continent whose institutional priorities and research questions may not aptly capture African contextual realities.

Nigeria is also the top African contributor to this body of research, reflecting its status as the largest economy and the most vibrant construction market in sub-Saharan Africa (Oyewunmi & Ehanmo, 2021). Nevertheless, the density of African research production in Nigeria, South Africa, and Ghana, though yielding valuable country-level information, leaves large sections of the continent, especially francophone and lusophone Africa, underrepresented in the academic literature (Megaptche & Serge, 2017; Tewodrost, 2024). This geographic imbalance resembles findings from similar scientometric surveys in other construction areas, where Africa and Latin America are repeatedly reported as underrepresented relative to their role in development (Owusu-Boadi et al., 2025).
The prevalence of Life Cycle Assessment as the most popular form of analysis in the literature indicates the discipline's methodological maturation and its growing interest in whole-lifecycle environmental thinking in building. Nevertheless, the lack of incorporation of emerging digital assessment tools, such as BIM-based environmental simulation and GIS-based spatial impact analysis, into the EIA research agenda remains a clear frontier the field has yet to explore (Tosi et al., 2025). Equally, the fact that Strategic Environmental Assessment is, in comparison, not a topic of the other dominant research themes indicates that the literature has focused on project-level assessment rather than on the larger planning and policy tools that are arguably more significant to the fast-growing construction industry of Africa (Kabir & Morgan, 2021).

V. CONCLUSION

This paper provided a scientometric review of EIA research within the African construction sector based on a Scopus collection of 367 bibliographic records visualised in VOSviewer. The intellectual framework, thematic clusters, network patterns, geographic patterns, and temporal patterns of the field were mapped, yielding results that help explain how knowledge of environmental impact assessment has evolved in the African construction context and identify critical gaps.

The review concluded that China is the largest producer of research on this topic, Nigeria is the largest African producer, and that Life Cycle Assessment is the predominant analytical framework in the literature. The results also indicate that the research area's geographical focus is very narrow, that francophone and lusophone Africa is highly underrepresented, and that nascent digital tools for evaluating the environment have yet to be incorporated into the scholarly agenda. These observations point to a research area that has already made significant advances but remains too narrow, geographically limited, and technologically limited to fully address the environmental governance issues the fast-growing construction industry in Africa faces.

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The paper contributes to the body of knowledge by providing a scientometric mapping of EIA research in the African construction sector. It also lays the groundwork for the discipline's intellectual framework and cooperation patterns, and pinpoints specific research gaps that indicate clear priorities for further academic research. Future studies should expand this work to other databases, such as Web of Science, and include non-English-language sources to reflect research in francophone and lusophone African settings, and to examine how digital environmental assessment technologies are integrated into EIA practice across African construction markets.

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