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Systematic Literature Review of Environmental Impact Assessments

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Abstract

This article provides a systematic literature review (SLR) of Environmental Impact Assessments (EIA) in Public Administration (PA), analysing scholarly articles published between 1971 and 2023 through bibliometric and qualitative methods. Using VOSviewer for quantitative insights and qualitative analysis, the study comprehensively examines the evolution and thematic trends of EIA research. It identifies critical themes like public participation, regulatory frameworks, and environmental integration that shape EIA practices. Analysing 287 journal articles, the review shows that public participation is a dominant theme, reflecting a shift toward inclusive, participatory governance. This transition includes climate change considerations in EIA processes and the use of advanced technologies like remote sensing and AI to improve accuracy and efficiency. EIA research has evolved from strict regulatory compliance to broader, tech-enhanced, participatory approaches. This SLR tracks EIA studies' historical progression and diversification, revealing emerging trends and gaps while laying a foundation for future research. It offers valuable insights into environmental assessment and public policy, contributing significantly to environmental management discourse.

Keywords:
systematic literature review; environmental impact assessment;
research cluster; future research; public administration

Introduction

Environmental Impact Assessment (EIA) is recognised as a crucial tool in environmental management, enabling public administration (PA) scholars to predict and assess the environmental impacts of government policies, plans, and projects (Munn, 1979). Environmental Impact Assessment (EIA) holds significant importance within PA due to its crucial role in shaping policy-making, governance, and regulatory frameworks (Akerboom & Craig, 2022). EIA functions as a fundamental tool in ensuring transparency, accountability, and evidence-based decision-making in environmental governance (Veronez & Montaño, 2024). The rising popularity of EIA among PA scholars is reflected in the growing volume of EIA-related publications, emphasising its capacity to facilitate sustainable, evidence-based decision-making (Morrison-Saunders et al., 2024). The trend of EIA studies underscores the increasingly recognised strategic role of EIA in promoting environmentally conscious policy and development (see Figure 1).

Moreover, the surge in EIA studies is largely driven by the growing environmental degradation and the complex interactions between human activities and ecological systems. Rapid urbanisation, industrial expansion, and climate change require a forward-looking framework like EIA to assess

and mitigate potential impacts on sustainability (C. J. Johnson & Ray, 2021; Rathi, 2023; Yang, 2022). Without EIA, large government or private projects risk causing unforeseen and harmful environmental impacts, such as water pollution, air quality deterioration, biodiversity loss, and permanent ecosystem damage, all of which can exacerbate the ongoing global environmental crisis (e.g Enríquez-de-Salamanca, 2021; Sikdar, 2021; Vandana et al., 2020).

Previous studies have explored EIA literature development through systematic literature reviews (SLR) and bibliometric analyses, including Zhuang et al. (2011), Li and Zhao (2015), Nita (2019), and Zyoud and Zyoud (2021). While offering valuable insights into EIA themes and their evolution, these studies had limitations. Zhuang et al. (2011) analysed the Web of Science (WoS) database from 1973 to 2009 but did not identify specific EIA themes or use manual review-based methods like VOSviewer. Li and Zhao (2015) reviewed the WoS database from 1993 to 2012, focusing on general trends instead of specific themes. Nita (2019) examined articles from 1980 to 2018 in the *Environmental Impact Assessment Review* journal without mapping emerging EIA themes. Zyoud and Zyoud (2021) focused exclusively on EIA literature in Arab countries until 2021 but did not specify the database sources, literature types, or academic disciplines.

The limitations of existing studies highlight significant research gaps, particularly in capturing recent developments in EIA literature from 2020 to 2023. Notably, between 2020 and 2023, 140 EIA-related articles emerged in the social sciences, constituting 16.75% of the total publications (see Figure 1). This surge underscores that prior research has not adequately addressed the latest trends and developments in this evolving field, particularly within PA and social sciences. To address this shortfall, the present study aims to extend and enrich previous EIA SLR by conducting a bibliometric analysis of EIA articles from 1971 to 2023, with a specific focus on PA. Bibliometric analysis serves as a quantitative tool for assessing the impact and connectivity of past research on a given topic

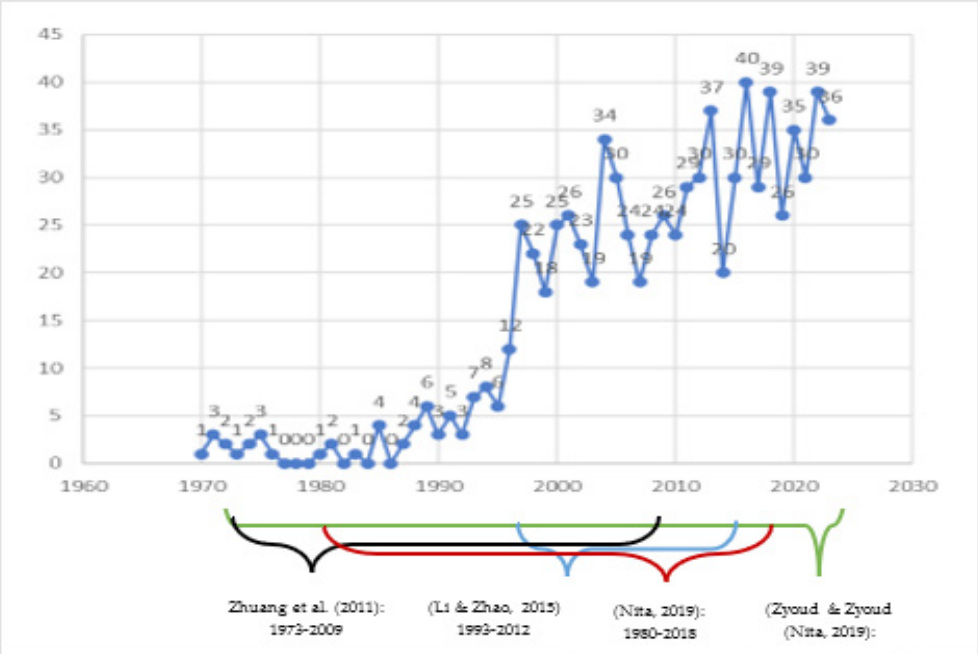

Figure 1. Total Number of EIA Publications in the PA discipline in the Scopus database
Source: Scopus Database, 1970-2023

(Ospina et al., 2018). Synthesising existing research accelerates knowledge development within academic disciplines (Chandra & Walker, 2019). While bibliometric methods are widely used, their application to PA, especially concerning EIA research themes, remains underexplored (Marques, 2021).

This study introduces several advancements over previous research. First, it employs VOSviewer software to quantitatively analyse the development of research themes in EIA literature. Although VOSviewer has been used in various bibliometric studies, its application to EIA topics within PA remains scarce. Second, the study integrates VOSviewer-based bibliometric analysis with qualitative methods, offering a logical interpretation of EIA content. This combination addresses the limitations of VOSviewer, which often overlooks specific article contents (Marques, 2021). Finally, this study covers EIA literature from 1971 to 2023, providing a more comprehensive analytical foundation than previous studies and revealing the evolution of EIA within the PA discipline. By extending the timeframe of literature database coverage, this study aims to deliver more robust and reliable findings, thereby bridging gaps in EIA meta-analyses and addressing several key research questions:

1. Which countries, levels of government, and sectors are most frequently studied in EIA publications within the PA discipline?
2. How are EIA publications categorised in the PA discipline?
3. What are the most frequently found antecedents and impacts in EIA articles?
4. What future research questions on EIA provide new directions for PA scholars?

This study makes three key contributions. First, it provides context for EIA research by PA scholars over the past 52 years, highlighting underexplored areas like countries, government levels, and sectors. Second, it sheds new light on various research streams, which represent distinct research areas and themes. It is crucial for future scholars seeking to expand EIA knowledge (Apriliyanti & Alon, 2017; Chandra & Walker, 2019; Putu et al., 2022). This study synthesises 287 EIA articles in PA from 1971-2023, offering theoretical insights into EIA and an evidence-based review of major research clusters. Third, identifying key antecedents and impacts in EIA articles enhances understanding of factors influencing EIA effectiveness. Fourth, this study proposes future EIA research directions for PA scholars.

The article is organised as follows: methods, results, discussion, conclusions, limitations, and future research.

History of the Concept, Typology, and Theory of EIA

The development of EIA began with the U.S. National Environmental Policy Act (NEPA) in 1970 (Hundloe, 2021). Morgan (1998) first introduced EIA as a scientific method for assessing potential impacts of policies or projects on the environment, covering social and biophysical aspects. This assessment is conducted to inform decision-making on specific issues (Morgan, 1998). EIA has since evolved into a recognised decision-making tool, adopted by over 191 UN member states (Kamijo, 2022; Morgan, 2012).

Over time, various forms of EIA emerged, including Social Impact Assessment (SIA), which gained prominence in the late 1970s. Vanclay (2020) positioned SIA as both a regulatory and social management process. Wolf (1983) and Vanclay (2002, 2003) established guidelines for applying SIA broadly.

In the 1990s, Health Impact Assessment (HIA) was introduced to address public health concerns in EIA processes. Birley (1995) emphasised integrating human health risks, which was then further developed by Kemm et al. (2004) and Winkler et al. (2020). Since then, subsequent work by Birley (2013) has guided global HIA practices.

Table 1.
EIA Typology

EIA Type	Definition	Reference	Substance
SIA	The process of assessing or estimating the social consequences that may arise from a particular policy action or project development of an EIA	Wolf (1983) Vanclay (2002, 2003)	Ensure social impact towards individuals and society.
HIA	The process of assessing human health risks as part of the EIA regulatory process.	M. Birley (1995) M. Birley (2013)	Ascertain the impact on individual and community health.
SEA	Expanding EIA assessments to decision making at higher levels, namely policies, programs and plans.	Wood and Djeddour (1989) Fischer (2010) Sadler (1996) Therivel (2012)	Ensure environmental impacts are considered at policy, program and strategic plan levels.

Source: Author's construction, 2024

Strategic Environmental Assessment (SEA) arose to address broader decision-making beyond project scales. Wood and Djeddour (1989) first introduced the concept, with further contributions from Fischer (2010) and Sadler (1996b). While SEA's benefits are recognised, debates persist about its objectives, particularly regarding sustainability and balanced decision-making (Fundingsland Tetlow & Hanusch, 2012; Thissen, 2001). This debate is closely related to the theoretical insights about EIA that underpin SEA (see Table 2).

Theoretical Developments in EIA Studies

The evolution of theories in EIA has provided a crucial foundation for empirical research, demonstrating how EIA has developed into both a technical tool and a socio-political instrument. In the early stages (1970-1980), rationalist theories emphasising neutrality and technical precision dominated, as reflected in research clusters focusing on EIA effectiveness, including regulatory enforcement and process simplification. In this context, regulations became the basis for EIA implementation (Sadler, 1996a; Wood, 2014). The early application of EIA was closely associated with environmental regulations, such as the National Environmental Policy Act (NEPA) of 1969 in the United States (Emerson et al., 2022). However, critiques of this approach, which was deemed overly technical and lacking alternative solutions, align with empirical findings highlighting challenges in balancing efficiency and quality in EIA practice (e.g Alberts et al., 2022; Loomis et al., 2021; Van Gool, 2022).

In the following decade (1990s-2000s), a significant shift occurred with the emergence of collaborative and deliberative models, reflected in research clusters related to public participation (Menini et al., 2022; Yang et al., 2023). This research cluster emphasised the critical role of communities in shaping the EIA process, consistent with deliberative democracy theory, which stresses the importance of stakeholder involvement in decision-making to enhance procedural legitimacy (Glucker et al., 2013; Hartley & Wood, 2005). This shift was driven by international environmental movements and global declarations, such as the 1992 Earth Summit (Sánchez & Croal, 2012), which highlighted the importance of transparency and accountability in large-scale environmental projects.

Despite the collaborative effort to enhance participation, the emergence of power analysis theory in the early 2000s critiqued this model for failing to recognise power imbalances among participants. These imbalances, particularly between governments, large corporations, and local communities, often rendered the

Table 2.
EIA Theories

Theoretical Underpinning	Focus	Locus	Impact on EIA Concept	Reference
Rationalist Theory (1970-1980)	Efficiency, regulation enforcement	EIA viewed as a technical process conducted by neutral experts	Overly technical and lacks consideration of alternatives in decision-making	Alberts et al. (2022), Loomis et al. (2021), Van Gool (2022)
Collaborative and Deliberative Theory (1990s-2000s)	Stakeholder involvement/ participation	Emphasises balanced stakeholder participation	Advocates for more inclusive and transparent decision-making to ensure legitimacy of the EIA process	de Avila Batista and Júnior (2023), Menini et al. (2022), Yang et al. (2023)
Power Analysis Theory (2000s)	Influence of power dynamics among stakeholder (government, business, community, academics) in participation	Critiques the collaborative model for ignoring power dynamics	Highlights the barriers to equitable participation and calls for recognising power imbalances in EIA processes	Johnson (2020), Yigzaw (2020)
Marxist Critical Theory (2000s)	EIA as a formal tool for capitalist interests	Economic inequality	EIA serves as a tool for facilitating capitalist exploitation	Bond et al. (2020), Harrison and Contreras (2023), Kumayza (2021) van Staden and Retief (2022)
Green Governmentality Theory (2000s)	Interaction between power and scientific knowledge, knows as power knowledge, aiming to commercialization of nature	Nature as a resource governed through cost-benefit frameworks	EIA frameworks tend to favour large corporations, privatising natural resources and undermining smaller operators or communities	Castillo and Silva, (2020),Hart (2011), Spiegel (2017)
Risk Society Theory (2010s)	Society's scepticism toward technocratic solutions due to environmental risks and uncertainties	EIA fails to address increasing societal distrust of scientific expertise	Technocratic decision-making models are increasingly irrelevant due to rising public scepticism and complexity of modern risks	Huang and Mabon (2022), Kumayza and Hariyadi (2022), Weston (2004)

Source: Author's construction, 2024

engagement of marginalised groups ineffective (e.g Bednarek-Szczepańska, 2022; Mwanyoka et al., 2019; Yigzaw, 2020). This transition is reflected in research clusters focusing on biodiversity and ecological impacts, which discuss the need to account for social injustices in environmental management, particularly for marginalised communities.

As globalisation and economic growth in developing countries advanced, social inequalities deepened. In this context, Marxist critical theory gained prominence in EIA in the 2000s, viewing EIA as a capitalist instrument designed to serve elite interests (Weston, 2010). Critics argued that EIA was often used to protect the interests of large businesses, particularly in developing countries, at the expense of local communities and ecosystems (e.g Harrison & Contreras, 2023; Kumayza, 2021; van Staden & Retief, 2022). This perspective is reflected in research clusters that examine the tension between environmental sustainability and economic development (Dias et al., 2022; Guilhon et al., 2022; Wentzel et al., 2023). In the same decade, green governmentality theory emerged, criticising how EIA frameworks often viewed nature as a commodity governed by cost-benefit analysis. This perspective

reflected the influence of large corporations in the EIA process, which benefited from the privatisation of natural resources while putting small operators and local communities in disadvantaged positions (e.g Castillo & Silva, 2020; Hart, 2011; Spiegel, 2017). This paradigm shift emphasised the need for EIA to not only assess environmental impacts but also consider social and economic justice dimensions.

In the 2010s, the risk society theory gained momentum, particularly in response to the complexities of scientific and social uncertainties related to environmental impacts. This theory criticised the declining relevance of rational and technocratic decision-making models in modern societies, which have become increasingly sceptical of scientific claims and expert authority (e.g Huang & Mabon, 2022; Kumayza & Hariyadi, 2022; Weston, 2004). The growing risks posed by climate crises and other global environmental issues underscored the need for more adaptive and participatory approaches in EIA. While technological advancements such as risk modelling and visualisation have modernised EIA practices, environmental risks prevail (Dryzek et al., 2020; Larsen, 2017).

Methods

Research Strategy and Review Criteria

This SLR aims to analyse and synthesise empirical findings to understand developments in EIA-related knowledge (Snyder, 2019). Using a systematic, transparent, and reproducible approach based on five research questions, it follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines for identification, screening, eligibility, inclusion/exclusion, qualitative analysis, and interpretation of findings (Page et al., 2021). The PRISMA approach was used to examine the evolution of EIA within policy and PA. PRISMA is recognised as an effective technique for studying topic evolution and is particularly suitable for analysing the development of EIA in social sciences, especially policy and PA (Moher, Liberati, Tetzlaff, Altman, Antes, et al., 2009) (see Figures 1 and 2).

Analysis Tools and Methods

This study used quantitative and qualitative methods to review 287 EIA articles in PA systematically. Quantitatively, it analyses the growth frequency of EIA articles from 1971 to 2023 and employs VOSviewer software for visualising emerging research themes. VOSviewer is known for mapping literature data, highlighting most-cited articles, and visualising citation networks, widely used in bibliometric analysis for thematic mapping and cluster analysis (Kokol et al., 2018; Shah et al., 2020). It is the most widely used compared to other bibliometric tools (Pan et al., 2018).

Qualitatively, this study analysed the content of each article via Microsoft Excel and assessed the title, knowledge base, authors, objectives, methods, units of analysis, locations, samples, findings, limitations, and future research directions. Journal articles were the primary unit of analysis due to their crucial role in disseminating scientific knowledge, evaluating academic reputation, and recognising intellectual contributions (Chandra & Walker, 2019; Putu et al., 2022).

Data Collection and Research Process

Literature Search

Our research began with a literature search in the Scopus database, chosen for its extensive coverage across various academic fields. The search, conducted in February 2024, targeted EIA studies in social sciences from 1971 to 2023. The year 1971 was selected as the starting point, aligning with Andrews' (1971) seminal work, the earliest EIA entry in Scopus. Keywords such as "environmental impact assessment" and "EIA" were used to filter articles by title, abstract, or keywords, resulting in 3,642 relevant studies. Scopus was favoured

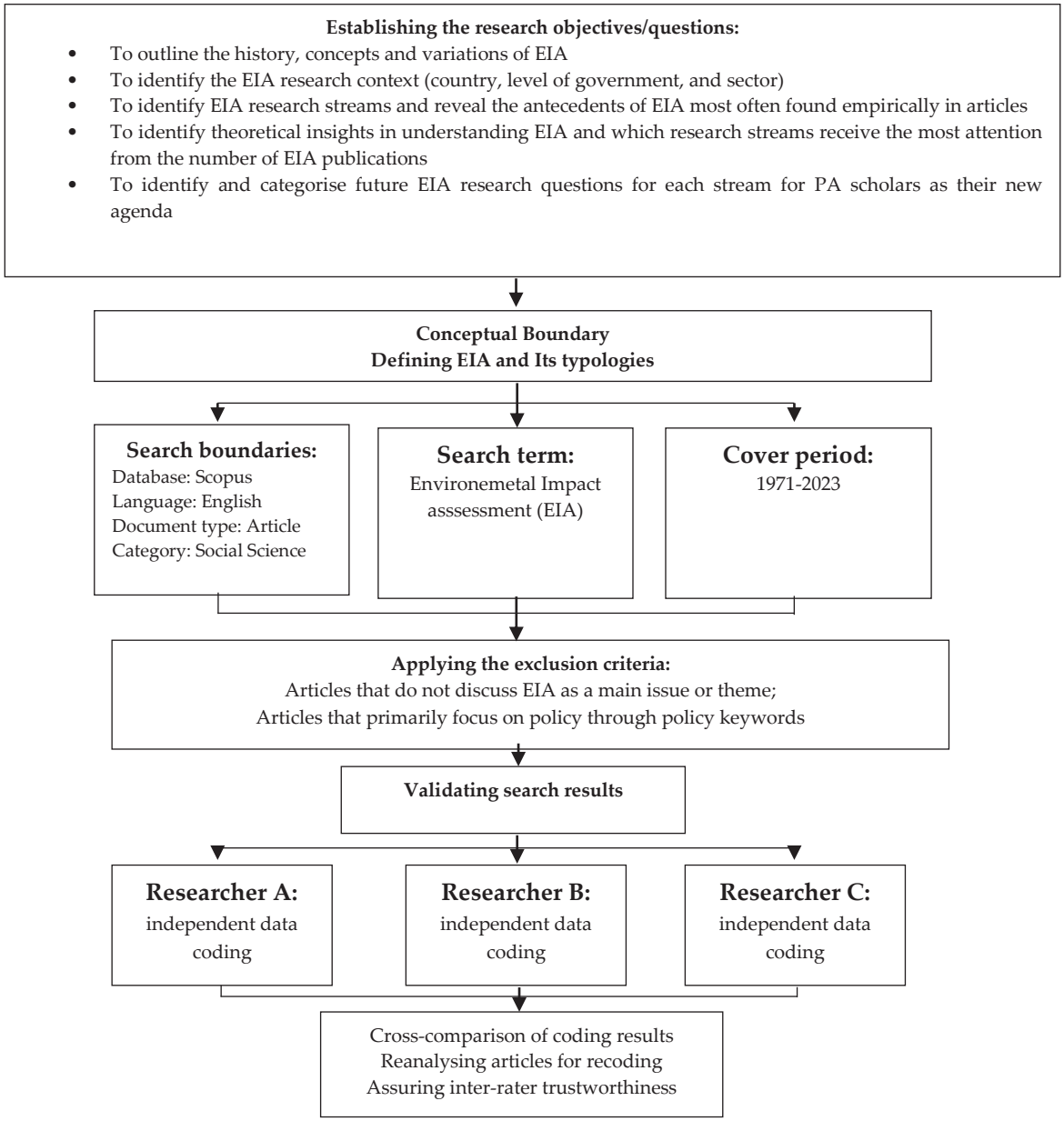

Figure 2. Summary of the SLR process

Source: Modified from Nolan & Garavan (2016) dan Pradana, et al. (Putu et al., 2022)

over other databases like Web of Science for its superior bibliographic coverage (Harzing & Alakangas, 2016; J. Zhu & Liu, 2020). The PRISMA process, outlined in Figure 2, guided the study's methodology.

Eligibility or Inclusion Criteria

We established inclusion criteria in line with the PRISMA guidelines (Moher, Liberati, Tetzlaff, Altman, Altman, et al., 2009; Page et al., 2021). Articles must (1) focus on EIA within social sciences journals; (2) explicitly mention "environmental impact assessment" or "EIA" in the title or abstract; (3) use empirical or theoretical methods to explore the evolution and implementation of EIA; (4) be published between January 1971 and December 2023; (5) be written in English; and (6) appear in internationally recognised journals. This process yielded 2,360 articles.

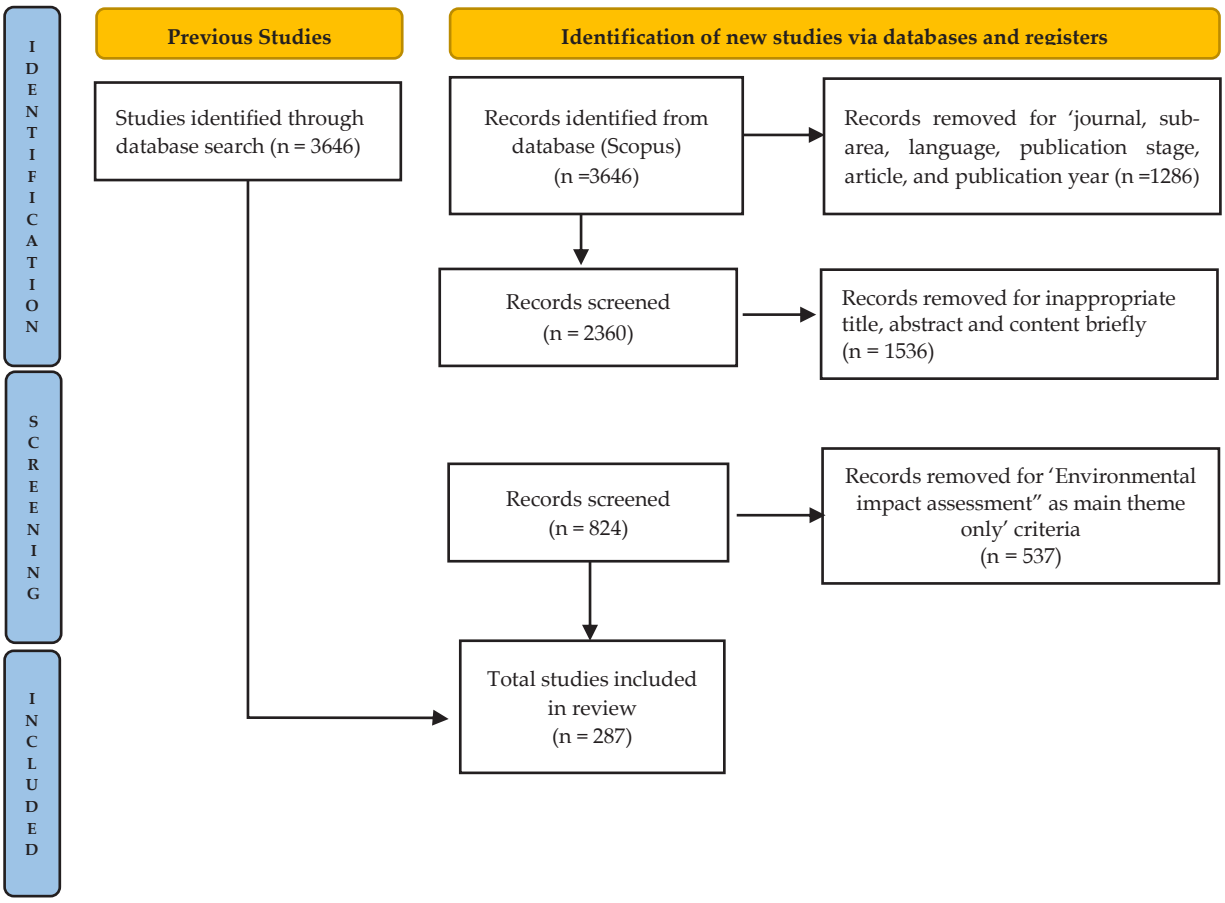

Figure 3. PRISMA Flow Chart

Source: Filtering and selection process using the PRISMA flow stream (Page et al., 2021)

Exclusion Criteria and Study Selection

This study applied exclusion criteria for article filtering as informed by previous SLRs, such as Johannes et al. (Johannes et al., 2023) and Pradana et al. (Putu et al., 2022). In the first phase, titles, abstracts, and keywords were screened, leading to the exclusion of 1,536 articles. In the second phase, 537 more articles were removed after a detailed review of their relevance to EIA in PA, leaving 287 articles for qualitative analysis. These articles were then qualitatively analysed independently using Excel by three researchers, with themes agreed upon in advance. In the final phase, coding discrepancies and methodologies were discussed, consulting prior SLR studies (Alon et al., 2020; Apriliyanti & Alon, 2017; Putu et al., 2022). The PRISMA flow diagram is presented in Figure 3.

Results

Countries, Research Methods, Government Level, and Sector

This section discusses the context in which EIA studies have been conducted, covering countries, research methods, government levels, and sectors where EIA operates. For countries, a qualitative analysis of 287 EIA articles shows a significant increase in studies from Asian countries as emerging research settings, with China leading (13/14.1%), followed by Pakistan (9/9.8%) and India (8/8.7%). Southeast Asia is relatively less studied (Aung, 2017; Chanchitpricha & Fischer, 2022; Kurniawan et al., 2020). Our findings also indicate that Anglo-Saxon countries such as the United Kingdom (12/13.0%), Canada (8/8.7%), and Australia (7/7.6%) are the second most dominant in the context of EIA research. In third place, continental European countries like

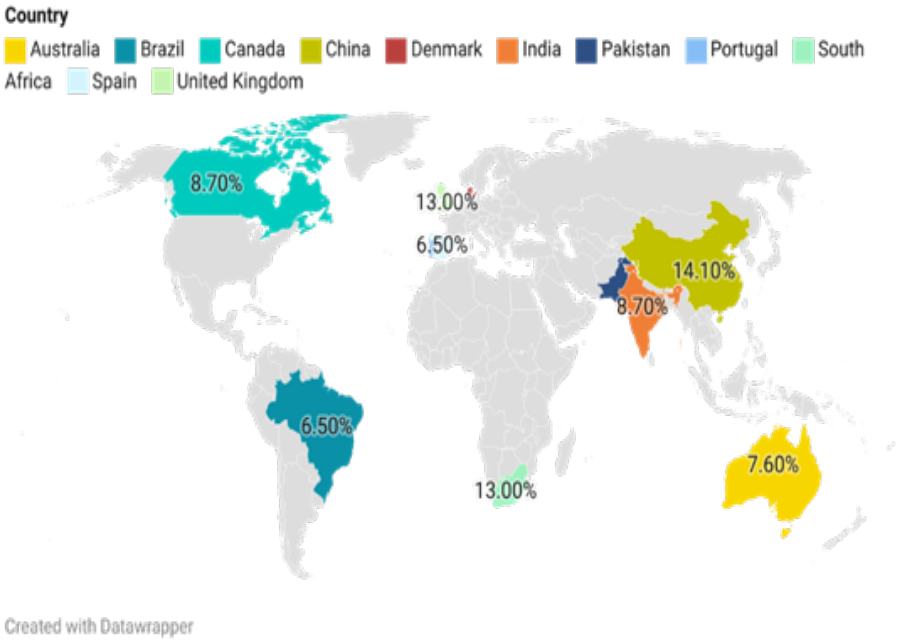

Figure 4. Spread of EIA research
Source: Primary data, 2024

Denmark (6/6.5%), Spain (6/6.5%), and Portugal (5/5.4%) are at the forefront. Additionally, we observed growth in African countries like South Africa (12/13.0%) (Lambrecht et al., 2023; Wentzel et al., 2023) and South American countries like Brazil (6/6.5%) (Dias et al., 2022; Ferrante et al., 2021).

These findings are compelling, as EIA practices originated in the United States in 1969 and were adopted by the European Union in 1985. However, research has shifted to Asia, particularly China, reflecting global economic trends and the growing need to manage environmental impacts in emerging economies (Glasson & Therivel, 2012). This transition is driven by experts seeking to understand EIA challenges stemming from social, cultural, economic, political, and bureaucratic factors in non-Western nations (Aung et al., 2020; Kamijo, 2022). China's rapid economic growth has caused environmental issues like air, water, and soil pollution, raising public and government awareness of environmental protection (Mol & Carter, 2006). Consequently, the Chinese government now prioritises EIA studies to identify and mitigate the environmental effects of the country's development projects (D. Zhu & Ru, 2008).

Since 1979, China has enforced the Environmental Protection Law, requiring EIA studies for large development projects (Y. Wang et al., 2003). Stricter regulations in 2003 further mandated public involvement in the EIA process, reflecting China's commitment to transparency and public participation (D. Zhu & Ru, 2008). Methodologically, EIA research primarily employs qualitative methods (248/86.41%) (Kruopiene et al., 2009), with quantitative (30/10.45%) and mixed methods (9/3.14%) used less often. Qualitative approaches like in-depth interviews, observation, and document analysis are dominant due to the complexity of EIA, involving many stakeholders with diverse perspectives (Morgan, 2012). Qualitative methods help researchers capture this complexity and the local context-specific factors affecting environmental impacts (Loomis & Dziedzic, 2018).

Our analysis revealed that most EIA studies are conducted at the central government

level (181/85.78%), with fewer focusing on cross-country comparisons (22/10.43%) and local governments (8/3.79%) (see Figure 4). Central governments are pivotal in establishing EIA policies and regulations, leading to many studies evaluating these frameworks and their implementation (Sinclair & Diduck, 2000). In contrast, studies at the local level are limited due to data constraints and challenges stemming from issues in resource, capacity, or information access (Gulakov & Vanclay, 2018). Cross-country comparative research is also less frequent due to social, cultural, economic, and political variations, as well as differing legal systems and EIA regulations (Loomis & Dziedzic, 2018).

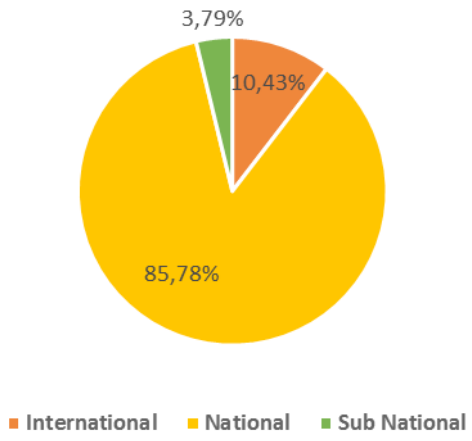

Figure 5. EIA Studies by the Level of Institution (1973-2023)

Source: Scopus database, 1973-2023

In terms of locations, the analysis of 243 EIA studies reveals the following coverage: Antarctica (3 articles, 1.23%), rivers (26 articles, 10.70%), coasts (19 articles, 7.82%), water bodies (24 articles, 9.88%), forests (30 articles, 12.35%), villages (59 articles, 24.28%), and cities (82 articles, 33.74%). The three dominant locations—cities, villages, and forests—are highly susceptible to environmental impacts. Cities are often focal points due to large-scale infrastructure, industrial, transport, and housing projects causing air pollution, noise, and habitat degradation (Gangolells et al., 2011; Ilhan & Yobas, 2019). Rural areas receive attention for their rural infrastructure, agriculture, and livestock projects that impact local environments and communities (Bednarek-Szczepańska, 2022; Lwesya Sibale & Fischer, 2023). Forests are studied for their vulnerability to development activities like land clearing for plantations, logging, and mining (Dias et al., 2022; Wentzel et al., 2023).

Moreover, EIA studies cover diverse sectors like livestock, waste, dams, industry, tourism, agriculture, infrastructure, power generation, renewable energy, mining, and transportation. Among these sectors, transportation, mining, and renewable energy are the most prevalent, notable for their significant environmental impacts. Transportation infrastructure can fragment habitats, degrade land, and increase emissions (Soria-Lara et al., 2020). Mining leads to water pollution, land degradation, and biodiversity loss (Bernauer et al., 2023). Although renewable energy aims to minimise environmental impacts, projects like wind and solar plants can affect local habitats (Azechi & Nishikizawa, 2014; Schumacher, 2017). In any case, EIA plays a crucial role by identifying, reducing, and managing environmental impacts.

EIA Research Clusters in PA Context

EIA research in PA has developed to cover critical topics. A VOSviewer analysis of keyword co-occurrence identified four main clusters. The first cluster examines EIA implementation effectiveness, which is divided into three sub-clusters: EIA legislation enforcement, approval procedures and alternative considerations, and project justification with streamlined EIA. Initially, legislation enforcement dominated, emphasising the importance of robust policies and regulations for effective EIA (Sadler, 1996a; Wood, 2014). The focus shifted to approval procedures and alternative considerations, stressing the need for transparent processes

Table 3.
EIA Study Fields

Sector	Total (%)	Area	Total (%)
Livestock	13 (10,74%)	Antarctica	3 (1,23%)
Waste	14 (11,57%)	River	26 (10,70%)
Dams	15 (12,40%)	Coast	19 (7,82%)
Industry	17 (14,05%)	Water Body	24 (9,88%)
Tourism	18 (14,88%)	Forest	30 (12,35%)
Agriculture	20 (16,53%)	Village	59 (24,28%)
Infrastructure	21 (17,36%)	City	82 (33,74%)
Power Generation	22 (18,18%)		
Renewable Energy	27 (22,31%)		
Mining	34 (28,10%)		
Transportation	42 (34,71%)		
Total	243	N	243

Source: Primary data, 2024

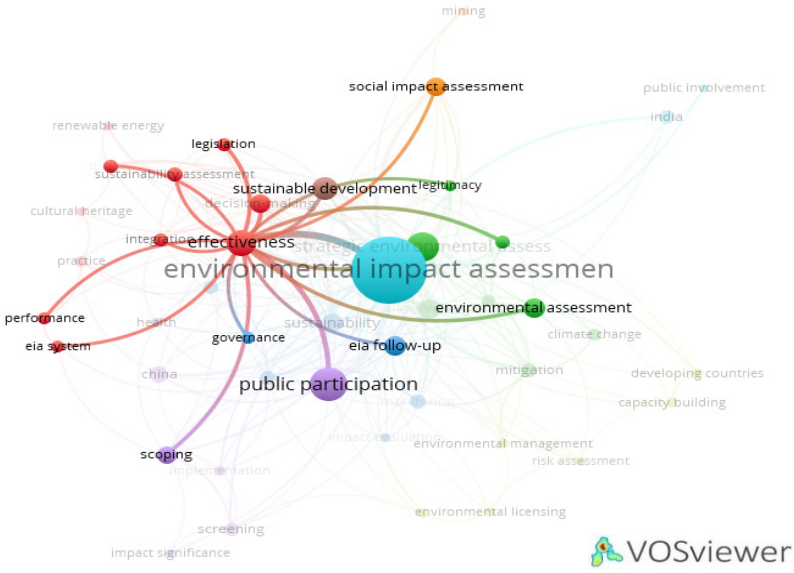

Figure 6. Effectiveness Cluster
Source: Scopus database, 1973-2023

and viable alternatives (Steinemann, 2001; Weston, 2000). Recent research emphasises project justification and streamlining, seeking environmental and economic justifications for projects while exploring efficient EIA processes (Borioni et al., 2017; Lyhne et al., 2017).

While attempts to streamline EIA aim to enhance efficiency, this often conflicts with the need to maintain assessment quality. Some systems have added requirements that could complicate the process, raising a debate about balancing efficiency and rigour in environmental evaluation. Fischer et al. (2023) emphasise this trade-off, highlighting the challenges of simplifying the EIA process without compromising quality.

The second cluster in the EIA literature centres on public participation, explicitly examining the role of communities and the social aspects involved in EIA. Early research emphasised the importance of community involvement and effective participation strategies (Glucker et al., 2013; Hartley & Wood, 2005). Gradually, the focus shifted to environmental justice and the social impacts of projects, underscoring the need for equitable

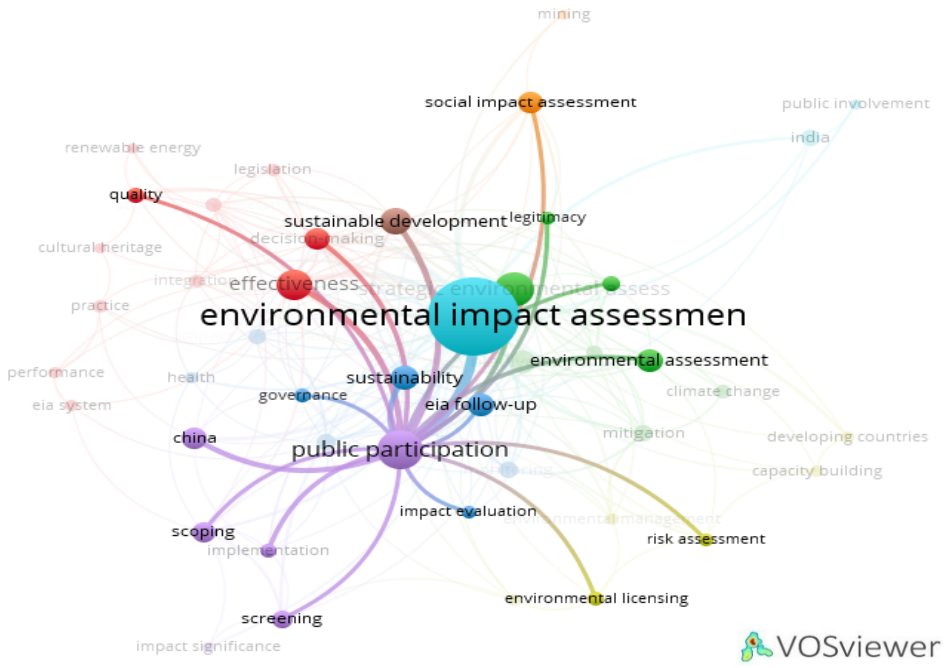

Figure 7. Public Participation Cluster

Source: Scopus database, 1973-2023

impact distribution and assessment of social consequences (King, 2000; J. Wang et al., 2023a). More recent studies have investigated stakeholders' ability to participate and challenge EIA decisions in court, advocating improved access to the EIA process and legal recourse (Barandiaran & Rubiano-Galvis, 2019; Dilay et al., 2020). Although this cluster has evolved, debates persist around expanding public involvement to ensure environmental justice and EIA legitimacy (Ye et al., 2023). The challenge lies in balancing development needs with community participation.

The third cluster in the EIA bibliometric analysis focuses on assessing the impact of activities on biodiversity and ecology. Research topics include project effects on biodiversity (Wentzel et al., 2023), ecological connectivity (Patterson et al., 2022), the mitigation hierarchy (Cares et al., 2023), ecosystem impact analysis (Guilhon et al., 2022), and biodiversity monitoring (Dias et al., 2022). In the early stages, studies emphasised evaluating development impacts on biodiversity (Gontier et al., 2006; Wentzel et al., 2023). Later, research shifted to ecological connectivity and the mitigation hierarchy, highlighting the need for habitat connectivity and responsible mitigation (Cares et al., 2023; Patterson et al., 2022). A recent focus on ecosystem impact analysis and biodiversity monitoring underscores the need for comprehensive assessments and sustainable monitoring programs, ensuring environmental sustainability despite development pressures (Dias et al., 2022; Guilhon et al., 2022; Wentzel et al., 2023).

The fourth cluster in the EIA corpus delves into methods and sustainability in EIA practice, focusing on field surveys, monitoring, sustainability assessment, and risk analysis. Initially, research centred on traditional field survey methods and environmental monitoring techniques (Ahammed & Nixon, 2006; Ramjeawon & Beedassy, 2004). Technological advances have shifted focus towards the use of uncrewed aerial vehicles (UAVs) and remote sensing to enhance the effectiveness and efficiency of monitoring the environmental impacts of development projects

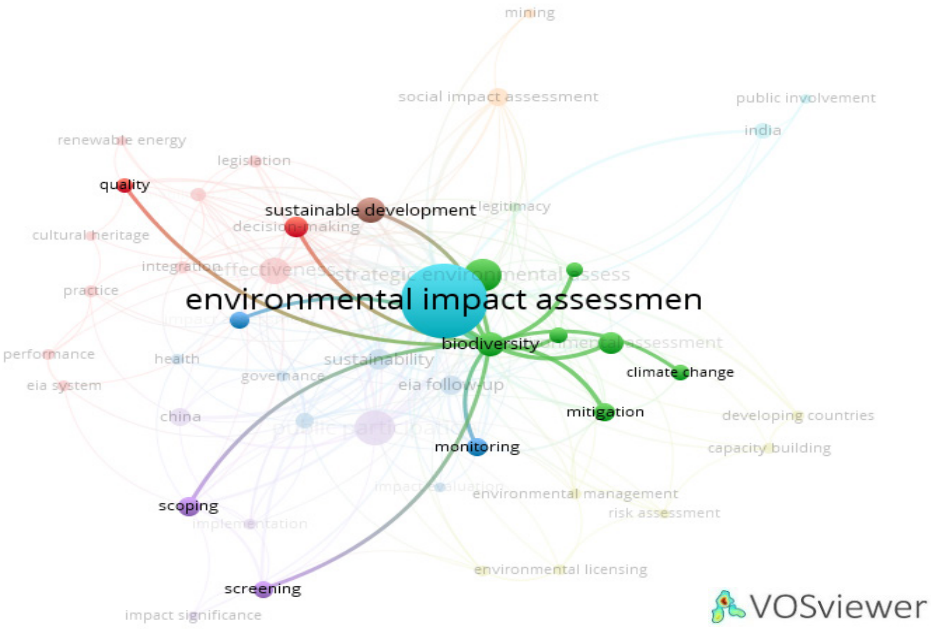

Figure 8. Biodiversity and Ecology Impact Cluster

Source: Scopus database, 1973-2023

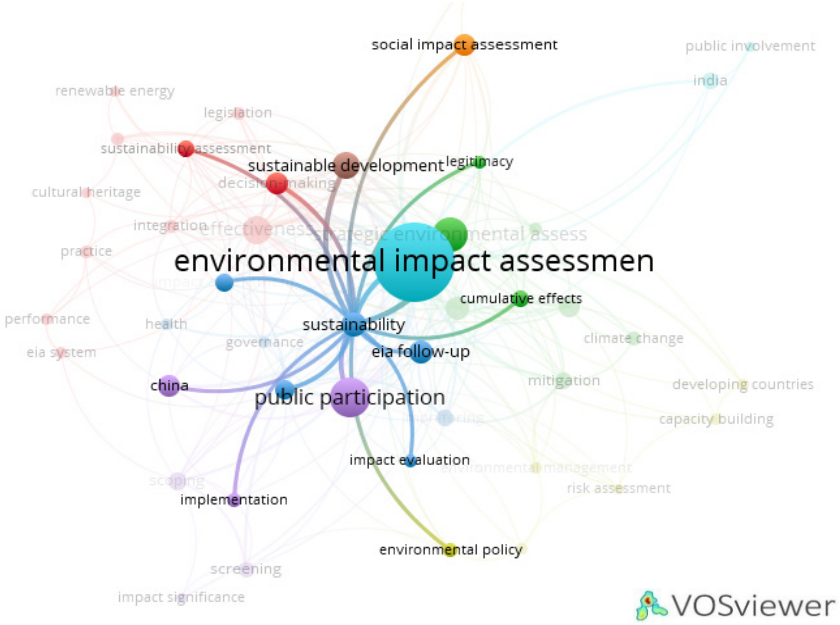

Figure 9. Sustainability Cluster

Source: Scopus database, 1973-2023

(Costagliola-Ray et al., 2022; Wentzel et al., 2023). Recent years have seen an increased emphasis on integrating sustainability principles into EIA processes and conducting comprehensive risk analyses to manage potential environmental risks (Yuan et al., 2023; Zeleňáková et al., 2020). However, the adoption of advanced visualisation technologies in EIA presents challenges such as limited visual literacy among local communities and logistical issues like slow Internet and visual projection constraints, highlighting the need for more inclusive and accessible communication

of EIA results to diverse audiences (de Oliveira et al., 2023).

Antecedents and impacts of EIA in PA

A systematic analysis of EIA research in PA was conducted on 287 reputable journal articles, resulting in 240 articles categorised into specific themes, as shown in Table 3. Public participation emerged as the dominant antecedent in EIA studies, represented in 75 articles (31.25%), followed by regulation and policy with 55 articles (22.91%), environmental integration with 40 articles (16.66%), and practitioners' capacity and competency with 35 articles (14.58%), and the monitoring or evaluation of effectiveness with another with 35 articles (14.58%). The study also highlighted the most prevalent antecedents: the level of public participation in the EIA process with 40 articles (16.66%), the existence of EIA regulations and policies with 30 articles (12.5%), and the quality of EIA reports with 25 articles (10.41%). Glucker et al. (2013) analysed that community involvement enhances transparency, accountability, and legitimacy, while EIA regulations and policies provide a framework for implementation and ensure consideration of environmental impacts, as described by Loomis and Dziedzic (2018). High-quality EIA reports, highlighted by Annandale (2001), are crucial for accurate decision-making and effective impact mitigation.

Meanwhile, the less frequently discussed antecedents in EIA research include the decentralisation of environmental governance, training for EIA consultants, climate change considerations, and key performance indicators for evaluating EIA effectiveness; each featured in ten articles (4.16%). It highlights regional differences in priorities and the need for further development in these areas. On the impact side, 140 articles identified four primary types of EIA impact: environmental quality, decision-making, public participation and stakeholder engagement, and environmental policy and governance. Improved environmental quality, noted in 40 articles (28.57%), is the most common result of impact mitigation in development projects (McManamay et al., 2020). EIA also supports more informed decision-making by providing comprehensive environmental data (de Oliveira et al., 2023; de Oliveira & Partidário, 2020) and enhances transparency, accountability, and legitimacy through public participation and stakeholder engagement (T. Johnson, 2020). These impacts reflect EIA's core objectives: environmental protection, informed decision-making, and improved stakeholder involvement.

Future Research Questions Suggested in the Current EIA Literature

Based on qualitative analysis, this study identifies several future research questions representing each EIA research area in PA, as shown in Table 4.

Discussion

The current SLR of EIA in PA discipline reveals a clear evolution in both conceptual and practical dimensions. The four primary research clusters—implementation effectiveness, public participation, ecological impacts, and sustainability—correspond with major theoretical frameworks that have shaped the development of EIA. By linking these clusters to rationalist theory, deliberative democracy, power analysis, and risk society theory, this study offers a more profound understanding of how EIA has evolved as both a regulatory tool and a socio-political mechanism.

Implementation Effectiveness and Rationalist Theory

The earliest stage of EIA research aligns with rationalist theory, which emphasises regulatory enforcement, technical precision, and efficiency in decision-making. Studies focusing on implementation effectiveness largely examine the role of legislation, procedural requirements, and administrative

Table 3.
Antecedents and impact EIA in PA context

Regulation and Policy Antecedents		Public Participation and Stakeholder Engagement Antecedents		Capacity and Competency Antecedents		Environmental Integration Antecedents		Monitoring and Effectiveness Evaluation Antecedents		EIA Impacts	
	30 (12,5%)		40 (16,66%)		25 (10,41%)		15 (6,25%)	Post-EIA monitoring and follow-up (Morrison-Saunders et al., 2022)	10 (4,16%)		40 (28,57%)
Existence of EIA regulations and policies		Public participation level in the EIA process		Quality of EIA reports		Biodiversity considerations in EIA				Environmental Quality	
	10 (4,16%)		15 (6,25%)	Training and guidelines for EIA consultants	10 (4,16%)	Ecological connectivity integration in EIA	15 (6,25%)	Procedural, substantive, and transactional effectiveness evaluation of EIA	15 (6,25%)	Decision-Making	30 (21,42%)
Decentralisation of environmental governance		Stakeholders in the EIA process									
	15 (6,25%)		20 (8,33%)				10 (4,16%)	Key performance indicators for evaluating EIA effectiveness (Nel et al., 2023)		Public Participation and Stakeholder Engagement	30 (21,42%)
Legislative reform of EIA		Communication and consultation with the public				Climate change considerations in EIA					
										Environmental Policy and Governance	25 (17,85%)
										Efficiency and Resource Savings	15 (10,71%)
Total (N)	55 (22,91%)	Total (N)	75 (31,25%)	Total (N)	35 (14,58)	Total (N)	40 (16,66%)	Total (N)	35 (14,58%)	Total (N)	140 (100%)

Source: Obtained from Primary Data, 2024

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Table 4.
Suggested Research Questions

Research topic	Future Research Question and its Author
Effectiveness of EIA governance, implementation and process improvement	• How can best practice principles be developed to ensure high-quality EIA practices across international, national, and regional protected areas? (Malepe et al., 2022) • What strategies can monitor EIA effectiveness and enhance design-based feedback in different industries? (Zhao et al., 2023) • How do EIA decentralisation regulations vary among regional governments, and how can they be evaluated? (Khan et al., 2022) • How can climate change considerations be better integrated into EIA laws, guidelines, and practices to ensure climate-resilient dam infrastructure? (Loza & Fidélis, 2022)
Public participation and social aspects in EIA	• What communication issues arise during the collection of citizen opinions for EIA using text mining, and what are the alternatives? (Jae-hyuck et al., 2022) • How can comprehensive public participation throughout the project lifecycle—from planning and EIA to monitoring and evaluation—be increased to support fair and sustainable decision-making? (Ye et al., 2023) • How can inclusive and representative public participation of directly affected groups be ensured in EIA across different country contexts? (Lwesya Sibale & Fischer, 2023) • How can the stakeholder analysis framework be practically implemented to improve public participation in EIA? (Kantamaturapoj et al., 2023) • What strategies can ensure equal participation and validate local, traditional, and indigenous knowledge in the EIA process? (Huang & Mabon, 2022) • How can we analyse the impact of social mobilisation on EIA processes and results while understanding the factors contributing to protests and conflicts related to EIA? (Irarrazaval et al., 2023)
Assessment of impacts on biodiversity and ecology in EIA	• How can the mitigation hierarchy be effectively applied in EIA to reduce biodiversity impacts? (Cares et al., 2023) • How can EIA be used to assess the fair distribution of benefits and impacts from infrastructure projects across different community groups? (J. Wang et al., 2023b)
Sustainability survey, monitoring and assessment methodology in the context of EIA	• How can the quality of viewshed analysis in visual impact assessment (VIA) reports be enhanced as part of environmental impact assessments (EIA)? (Cilliers et al., 2023) • How can a risk assessment model be developed to identify high-risk scenarios in EIA-related accidents on construction projects, and how can mitigation strategies be tailored to each scenario? (Yuan et al., 2023) • How can visual communication in EIA be improved to enhance understanding and increase public acceptance of projects? (de Oliveira et al., 2023)

Source: Obtained from primary data, 2024

mechanisms that ensure EIA compliance (Sadler, 1996a; Wood, 2014). This framework sees EIA as a neutral scientific process designed to improve decision-making by integrating environmental considerations. However, critiques of this approach argue that excessive reliance on regulatory compliance often neglects alternative perspectives, innovation in mitigation strategies, and broader socio-economic implications (e.g Alberts et al., 2022; Loomis et al., 2021; Van Gool, 2022).

Public Participation and Deliberative Democracy

The shift from a purely regulatory perspective to a participatory model aligns with the deliberative democracy theory. Public participation emerged as a dominant research theme in the 1990s and 2000s, reflecting the increasing recognition that stakeholder engagement enhances transparency, legitimacy, and decision-making quality (Glucker et al., 2013; Hartley & Wood, 2005). Studies in this cluster highlight mechanisms for improving participatory processes, the role of public consultation, and the impact of local knowledge in EIA decision-making (Menini et al., 2022; Yang et al., 2023). However, while participatory approaches have strengthened EIA's democratic legitimacy, they remain susceptible to elite capture, tokenistic engagement, and procedural inefficiencies,

requiring more robust frameworks to ensure meaningful public involvement (Nyanchama, 2021; Olorundami, 2022)

Ecological Impacts and Power Analysis Theory

The research cluster on ecological and biodiversity impacts is closely linked to power analysis theory, which critiques how power dynamics shape environmental decision-making. Studies show that large corporations and state actors often dominate EIA processes, sidelining marginalised communities and downplaying ecological concerns in favour of economic interests (e.g Bednarek-Szczepańska, 2022; Mwanyoka et al., 2019; Yigzaw, 2020). Power analysis theory helps explain persistent inequities in EIA implementation, particularly in developing countries where environmental governance structures are weak. Research suggests that addressing these disparities requires integrating social justice principles into EIA frameworks, ensuring equitable distribution of environmental costs and benefits (e.g Harrison & Contreras, 2023; Kumayza, 2021; van Staden & Retief, 2022).

Sustainability and the Risk Society Theory

The sustainability cluster aligns with the risk society theory, which critiques the inadequacies of technocratic decision-making in addressing contemporary environmental uncertainties. As climate change, biodiversity loss, and large-scale industrial activities create unprecedented risks, EIA must transition from a reactive, compliance-based approach to a proactive, adaptive framework that integrates long-term sustainability considerations (e.g Huang & Mabon, 2022; Kumayza & Hariyadi, 2022; Weston, 2004). Recent advancements in EIA research emphasise the use of advanced technologies, such as AI-driven modelling, GIS mapping, and predictive analytics, to improve risk assessment and enhance the sustainability of development projects (de Oliveira et al., 2023). However, challenges remain in ensuring that technological innovations complement, rather than replace, participatory and justice-oriented approaches to environmental governance (Larsen, 2017)

Future Directions for EIA Research

Building on these theoretical linkages, future research should further explore governance effectiveness in EIA implementation, particularly in contexts where regulatory frameworks are inconsistently enforced. Investigating how participatory mechanisms can be strengthened to prevent elite capture and ensure more inclusive decision-making remains a pressing concern. Additionally, research on ecological impacts should integrate interdisciplinary approaches, combining power analysis with environmental justice frameworks to develop more equitable mitigation strategies. Finally, given the growing uncertainties of climate change, future EIA studies should focus on adaptive management approaches that incorporate resilience planning, scenario modelling, and real-time environmental monitoring to enhance sustainability outcomes.

By bridging empirical findings with these theoretical perspectives, this study deepens the academic discourse on EIA, highlighting its evolution from a regulatory mechanism to a multifaceted governance tool. This discussion underscores the need for continuous theoretical refinement and empirical validation to ensure that EIA remains an effective instrument for balancing development with environmental stewardship.

Conclusion

This study provides significant conceptual contributions to the field of EIA by systematically reviewing 287 articles published between 1971 and 2023, offering insights into its evolution as both a technical tool and a socio-political instrument. The research highlights

four primary clusters—implementation effectiveness, public participation, ecological impacts, and sustainability—reflecting the progression of EIA from a regulatory mechanism to a more inclusive, adaptive, and interdisciplinary framework. These findings illuminate the critical role of governance, public participation, and advanced technological tools in shaping contemporary EIA practices. By linking these clusters to key theoretical models, such as the rationalist theory, deliberative democracy, power analysis, and the risk society theory, this study enriches the conceptual understanding of EIA and underscores its relevance in addressing global challenges like climate change, biodiversity loss, and environmental justice.

The research contributes to the academic discourse by emphasising the importance of integrating equity, transparency, and sustainability into EIA frameworks. It highlights governance effectiveness as a pivotal factor for strengthening EIA implementation, particularly in regions with inconsistent regulatory enforcement. Moreover, it sets a forward-looking research agenda by identifying underexplored themes, such as mitigation hierarchies, regional adaptations, and social mobilisation, to ensure EIA remains responsive to emerging environmental and societal complexities. Through its conceptual synthesis and practical implications, this study advances the understanding of EIA as a cornerstone for sustainable development, providing a foundation for future research and policy innovations aimed at enhancing environmental governance.

While this study offers valuable insights into EIA within PA, certain limitations must be acknowledged. The reliance on the Scopus database may have excluded relevant publications not indexed there, and there is a potential bias toward English-language literature, possibly overlooking important contributions from non-English-speaking regions, particularly in Asia. Future research should address these gaps by incorporating non-English sources and expanding the analysis to include more diverse databases. Additionally, deeper exploration of key research clusters, especially the role of governance in EIA effectiveness, is needed to strengthen theoretical frameworks. Empirical studies are also necessary to validate the identified antecedents and impacts, ensuring that future EIA research remains relevant and inclusive, particularly by integrating regional nuances and local knowledge into global EIA frameworks.

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