AFRICA HABITAT REVIEW 21(3) 2026

ISSN: 2524-1354 (Online), ISSN: 2519-7851 (Print)
Africa Habitat Review Journal
Volume 21 Issue 3 (September - October 2026)
http://uonjournals.uonbi.ac.ke/ojs/index.php/ahr

Riparian Zone Planning and Governance Challenges in Nairobi River Basin, Kenya:

A Systematic Literature Review

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Received on 25th June, 2026; Received in revised form 3rd August, 2026; Accepted on 1st September, 2026.

Abstract

Riparian zone degradation in urban areas is a critical global planning challenge, with rivers increasingly encroached upon, polluted, and channelized. Despite existing legal frameworks, limited research systematically synthesizes planning-oriented evidence on why riparian encroachment persists in Nairobi City County. This study aimed to identify the major planning and governance challenges affecting riparian management in Nairobi through a systematic literature review guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). The review synthesised 41 peer-reviewed articles, academic theses, and official reports. Four planning-oriented themes emerged: institutional fragmentation, progressive physical encroachment, weak policy implementation, and integrated planning interventions. The review found that Kenya's legal frameworks on riparian protection differ in specification and are inconsistently enforced. It concludes that riparian degradation in Nairobi is systemic, resulting from fragmented governance, conflicting laws, and weak enforcement. The review provides an integrated planning and governance framework to guide sustainable riparian management in Nairobi and other rapidly urbanising cities.

Keywords: Riparian zone, riparian governance, urban planning, systematic literature review, Nairobi River Basin, land use planning

INTRODUCTION

Riparian zone degradation is now one of the major global planning challenges. Globally, rivers in urban areas are continually encroached upon, polluted, and channelised, leading to biodiversity loss, increased flood risk, and the displacement of poor communities (Tickner et al., 2020). The Worldwide Fund for Nature (2018) estimates that over 80% of riparian zones in urban areas worldwide have been significantly altered by human activities. In addition to rapid urbanisation, weak enforcement of environmental regulations and conflicting land-use policies have exacerbated these problems, particularly in developing countries where institutional capacity is often limited (Richardson & Soloviev, 2021).

In Africa, the situation persists because of rapid urbanisation, weak governance, and historical planning legacies. Studies across the continent reveal widespread encroachment of riparian areas by informal settlements, industrial activities, and agricultural practices, resulting in the disappearance of natural buffers (Kiwango, 2021). In Addis Ababa, Asfaw and Worku (2021) found that informal settlements account for 78% of the high-risk flood areas along the Kebena River. Similarly, Magudu (2024), in a study of Durban, found that land restoration initiatives were consistently hindered by recurring encroachment. Olokeogun and Kumar (2022), studying Ibadan, identified rapid urban settlement as the greatest cause of riparian vulnerability. Across Sub-Saharan Africa, weak enforcement and fragmented governance have allowed riparian degradation to persist (Mumuni et al., 2025).

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Kenya is experiencing a severe riparian zone crisis, with Nairobi being the most affected. The city is traversed by four major rivers—Nairobi, Ngong, Mathare, and Kirichwa—which pass through a mixture of informal settlements, industrial areas, and affluent neighbourhoods (Odongo et al., 2025). Riparian reserves are officially recognised under the Environmental Management and Coordination Regulations (NEMA, 2009), which prescribe buffer widths of 30–60 metres. However, enforcement remains highly inconsistent. Residents of informal settlements are frequently evicted, whereas some private developments continue to occupy riparian reserves (Mwangi et al., 2024). The floods of 2024–2026 intensified calls for evictions while exposing the planning dilemma of balancing environmental protection with social justice (Dick & Olando, 2026).

This article uses a systematic literature review to synthesise existing knowledge, identify planning-oriented themes emerging from the literature, and propose evidence-based recommendations for addressing the riparian crisis in urban areas.

Problem Statement

Riparian zones are universally recognised as critical ecological buffers that protect water quality, mitigate flooding, preserve biodiversity, and sustain livelihoods. International frameworks such as the Ramsar Convention and the United Nations Sustainable Development Goals, particularly SDG 6 (Clean Water and Sanitation) and SDG 11 (Sustainable Cities and Communities), emphasise the protection of freshwater ecosystems. Urban planning literature consistently advocates preserving river corridors as green infrastructure essential for climate resilience and public health.

Despite this global consensus, urban rivers continue to experience severe degradation through progressive encroachment, pollution, and channelisation. In many cities across the Global South, rivers have become sites of contestation where informal settlements, industries, and waste disposal systems compete for limited space. Flood events are increasing in frequency and severity, disproportionately affecting vulnerable populations residing within riparian zones.

While extensive research exists on specific aspects of riparian degradation, including water quality, ecological health, and legal frameworks, there remains a conspicuous absence of systematically synthesised planning-oriented evidence. The institutional factors driving enforcement failure, the effectiveness of past interventions, and the transferable lessons from different urban contexts remain fragmented across individual studies. Although previous studies have examined the ecological, legal, and environmental dimensions of riparian management, limited attention has been given to interpreting these challenges through integrated planning theories. This review addresses that gap by systematically synthesising global, regional, and local evidence to identify recurring planning challenges and evidence-based interventions. By examining Nairobi as a representative case, the review contributes to a broader understanding of riparian zone governance challenges applicable to rapidly urbanising cities worldwide.

Study Objectives

i. To systematically review and synthesise the existing literature on riparian zones and land-use dynamics.
ii. To identify and synthesise the key thematic issues emerging from the reviewed literature.
iii. To propose evidence-based planning interventions and policy recommendations for the sustainable management of urban riparian zones in Nairobi.

THEORY

Literature Review and Theoretical Background

The reviewed literature demonstrates that riparian zone degradation is a multidimensional planning challenge influenced by institutional, environmental, and socio-economic factors. No single planning theory adequately explains the complexity of riparian governance; therefore, this review adopts complementary planning theories to provide a broader framework for interpreting the literature and analysing the planning challenges identified through the systematic review. Collaborative Planning Theory, the Rational Planning Model, and Environmental Justice Theory were selected because they collectively address institutional coordination, planning processes, and equity in environmental governance.

Collaborative Planning Theory

Collaborative Planning Theory emerged in

the 1990s through the work of Patsy Healey (1997, 2006), in response to dissatisfaction with traditional expert-based planning models that inadequately considered diverse stakeholder interests (Healey, 1997).

The theory recognises planning as a value-based and socially constructed process in which diverse interests are incorporated through stakeholder participation and shared responsibility (Healey, 2006). In this study, the theory guides the analysis of how stakeholder engagement and institutional coordination influence riparian planning outcomes. It provides a framework for evaluating whether planning processes meaningfully involve affected communities or remain technocratic exercises that exclude local voices.

The strengths of Collaborative Planning Theory include its emphasis on inclusive decision-making, recognition of diverse values, and promotion of implementation through stakeholder ownership. However, the theory may be time-consuming to apply, can be dominated by powerful interests, and assumes a willingness to collaborate that may not exist in contexts characterised by deep social and economic inequalities.

Rational Planning Model

The Rational Planning Model became the dominant paradigm in urban planning during the 1950s, drawing on systems analysis and decision science to conceptualise planning as a scientific and systematic process (Faludi, 1973; Meyerson & Banfield, 1955).

The model defines planning as the systematic process of identifying goals and designing the most appropriate means of achieving them (Faludi, 1973). It assumes that planners can objectively identify problems, develop alternative solutions, evaluate possible outcomes, and select optimal strategies based on comprehensive analysis (Meyerson & Banfield, 1955). Faludi (1973) describes this as a technical conception of rationality in which expert knowledge guides planning decisions.

In this review, the model guides the analysis of how planning institutions define riparian problems, formulate solutions, and implement enforcement mechanisms. It also assists in evaluating the gap between policy formulation and implementation. Its strengths include providing a structured analytical approach, promoting evidence-based decision-making, and enabling systematic evaluation of planning alternatives. However, the model assumes comprehensive knowledge is attainable, overlooks power relations, and tends to privilege technical expertise over local knowledge.

Environmental Justice Theory

Environmental Justice Theory emerged during the 1980s in the United States from civil rights activism and scholarship documenting the disproportionate environmental burdens experienced by marginalised communities (Bullard, 1990; Schlosberg, 2007).

The theory asserts that all people have the right to equal environmental protection and meaningful participation in environmental decision-making (Bullard, 1990). It incorporates three interrelated dimensions: distributive justice, which concerns the equitable distribution of environmental benefits and burdens; procedural justice, which focuses on inclusive decision-making; and recognitional justice, which acknowledges diverse needs, identities, and knowledge systems (Schlosberg, 2007; Ntiwane & Coetzee, 2018).

In this study, Environmental Justice Theory guides the analysis of spatial inequalities in planning enforcement by examining why some communities experience displacement while others receive exemptions, and how planning processes either include or exclude affected populations. Its strengths lie in its emphasis on equity and justice, provision of normative criteria for evaluating planning outcomes, and integration of distributive, procedural, and recognitional dimensions. However, the theory is primarily evaluative rather than explanatory, and its practical implementation depends on political commitment and institutional capacity.

Theoretical synthesis

Collectively, Collaborative Planning Theory, the Rational Planning Model, and Environmental Justice Theory provide complementary perspectives for understanding institutional coordination, planning decision-making, and equity in riparian governance. Together, these theories informed the interpretation of the four thematic findings emerging from the systematic literature review, namely institutional

fragmentation, physical encroachment, policy implementation, and integrated planning interventions. They also provide the analytical lens through which the planning challenges and evidence-based interventions are discussed in this study.

Conceptual Framework

The conceptual framework illustrates the logical relationship between the existing body of knowledge, the theoretical perspectives adopted in this study, the systematic review process, and the expected study outcomes. It demonstrates how gaps identified in the literature informed the selection of the theoretical framework, which subsequently guided the systematic literature review and the interpretation of the thematic findings. The framework further shows how the synthesised findings informed the proposed planning interventions and policy recommendations for the sustainable management of riparian zones. **Figure 1** presents the conceptual framework adopted in this study.

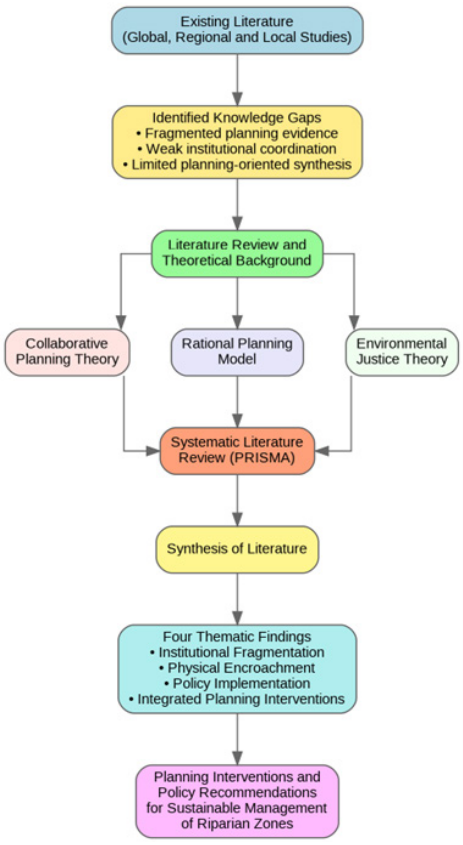


FIGURE 1
Conceptual framework linking literature, theory, review process and outcomes
Source: Author compilation from reviewed literature and analysis, 2026

The process begins with the existing global, regional, and local literature on riparian zone planning, from which key knowledge gaps are identified. These gaps justify the adoption of three complementary planning theories—Collaborative Planning Theory, the Rational Planning Model, and Environmental Justice Theory—which provide the analytical lens for interpreting the reviewed literature. Guided by the PRISMA systematic literature review methodology, the literature is synthesised into four thematic findings: institutional fragmentation, physical encroachment, policy implementation, and integrated planning interventions. These thematic findings form the basis for the planning interventions and policy recommendations proposed to enhance the sustainable management of riparian zones, particularly within the Nairobi River Basin.

RESEARCH METHODS

Study Design

This study employs a systematic literature review

to examine how riparian zones are governed, managed, and planned in Nairobi, Kenya. The review synthesises existing peer-reviewed research, academic theses, and empirical studies to identify key themes, areas of agreement and disagreement, and gaps in the literature. The focus is on planning-oriented questions, including how riparian buffer zones are defined and enforced, how institutional arrangements function, and what planning interventions have been proposed or implemented.

Study Area

Nairobi, the capital city of Kenya, is the focus of this study. The city has a population of about 4.4 million people (Kenya, 2019) and is among the fastest-growing urban centres in East Africa (UN-Habitat, 2014). It is traversed by four major rivers—the Nairobi, Ngong, Mathare, and Kirichwa—which flow through diverse land uses, including informal settlements such as Kibera, Mathare, and Korogocho, industrial areas, affluent residential neighbourhoods, and the central business district (Odongo et al., 2025).

Data Collection

The researcher had direct hands-on experience within the study area as the team leader for the GIS Mapping of Structures on Nairobi Rivers and their Riparian Reserves Project, commissioned by the National Construction Authority (NCA) in 2019. The project involved three GIS experts, eight research assistants, and forty-three field assistants who mapped nine rivers covering approximately 204 kilometres using GPS and the Kobo Collect mobile application.

Data collected included the number and type of structures within river channels, the 6 m, 10 m, and 30 m riparian reserves, and the 2 m high-water mark, together with photographic records of solid waste, liquid waste, quarrying activities, and urban agriculture. Geospatial data from Google Earth Pro, cadastral maps, survey plans, and topographical maps were also analysed to determine riparian wayleaves and property boundaries. Although these field experiences informed the identification of the research problem, the present study is based exclusively on a systematic review of published literature.

Secondary data were obtained from peer-reviewed journal articles, academic theses, government reports, and legal instruments, including EMCA (1999), the Water Act (2002), the Physical Planning Act (Cap. 286), and the Survey Act (Cap. 299). A systematic literature review was adopted because it provides a rigorous, transparent, and replicable approach for identifying, evaluating, and synthesising empirical evidence.

Literature Search

The review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure transparency and reproducibility (Moher et al., 2009). Given that riparian studies comprise qualitative case studies, quantitative analyses, geospatial assessments, and legal reviews, a qualitative synthesis approach was adopted.

The search strategy was guided by the SPIDER framework (Sample, Phenomenon of Interest, Design, Evaluation, and Research Type) (Cooke, Smith, & Booth, 2012). **Table 1** summarises the SPIDER framework used to guide the literature search and study selection process.

Search terms were developed iteratively from key concepts in riparian planning literature and included riparian reserve, riparian buffer, urban river, encroachment, eviction, exclusion, Nairobi, and Kenya. Searches were undertaken in Sage Journals, ResearchGate, and Google Scholar. Initial search strings were refined as additional keywords emerged from retrieved studies. Searches were limited to titles, abstracts, and keywords to improve relevance.

Table 2 presents the final search queries applied across the selected academic databases in March 2026.

The included studies were analysed through thematic analysis involving iterative reading, open coding, comparison of recurring concepts, and synthesis into broader planning-oriented themes. Similar findings were grouped and refined until four dominant themes emerged.

Study Material Selection

Study selection followed a multi-stage PRISMA process (Moher et al., 2009), with inclusion criteria guided by the SPIDER framework (**Table 1**). Each study was assessed for methodological clarity, relevance to the research objectives, credibility

TABLE 1
Spider framework guiding systematic literature search and study selection

Component	Description
Sample	Urban residents, informal settlement dwellers, rriparian zoneowners, planners, and government officials in Nairobi and comparable African cities
Phenomenon of Interest	Riparian reserve encroachment, evictions, selective enforcement, elite capture, flood vulnerability, and land governance
Design	Qualitative case studies, quantitative surveys, geospatial analysis, policy analysis, mixed methods, systematic reviews
Evaluation	Policy and laws, Flood risk, physical encroachment, Riparian width
Research Type	Peer reviewed journal articles, academic theses, official reports (published 2000–2026)

Source: Adapted from Cooke, Smith and Booth framework (2012).

TABLE 2
Final search queries applied across selected academic literature databases

Date	Database	Search Query
March 2026	Sage Journals	(("riparian reserve" OR "riparian buffer" OR "river corridor" OR "floodplain") AND ("urban planning" OR "land use planning") AND ("encroachment" OR "eviction" OR "exclusion") AND ("Nairobi" OR "Kenya" OR "East Africa"))
March 2026	ResearchGate	(("riparian zone" OR "riparian land") AND ("informal settlement" OR "urban poor") AND ("governance" OR "enforcement") AND ("Nairobi" OR "Kenya"))
March 2026	Google Scholar	("riparian reserve" OR "urban river") AND ("exclusion" OR "displacement") AND "Nairobi."

Source: Author compilation based on systematic literature search strategy , 2026

of evidence, and consistency of reported findings before inclusion in the qualitative synthesis.

The first screening retained studies addressing riparian reserves, urban rivers, or river encroachment, while purely hydrological or water-quality studies without planning dimensions were excluded. Full-text articles were then assessed against the inclusion criteria, and reference lists were manually searched (snowballing) to identify additional relevant studies.

Secondary Data Collection
The review relied exclusively on documentary sources comprising peer-reviewed journal articles, academic theses, and official reports. Data extracted from each study included the author(s), year, geographical focus, methodology, key findings, and identified research gaps.

Inclusion and Exclusion Criteria
Studies were included if they demonstrated methodological rigour, addressed riparian planning or governance, were published in English, and were available in full text. Peer-reviewed journal articles, academic theses, and recognised institutional reports were considered, while studies focusing exclusively on rural riparian zones, water quality, aquatic ecology, conference abstracts, editorials, news articles, and policy briefs without original research were excluded.

Summary of Included Studies
A total of 1,420 records were identified through database searches. After removing 410 duplicates, 1,010 records were screened by title and abstract, resulting in 128 full-text articles assessed for eligibility. Following full-text review and snowballing, 41 studies met all inclusion criteria and were included in the qualitative synthesis.

Ethical Considerations
This systematic literature review relied exclusively on publicly available scholarly publications, academic theses, government reports, and official policy documents. The supporting GIS fieldwork informed the research context but did not contribute data to the review. No personal or confidential information was collected; therefore, no additional ethical approval was required for the present study.

RESULTS

Overview of Included Studies

This review included 41 studies comprising peer-reviewed journal articles, academic theses, and official policy documents published between 2001 and 2026. Most studies were published after 2020, reflecting increased attention to Nairobi's riparian corridors.

The studies covered Nairobi (n = 22), other Kenyan urban areas including Kisii (n = 6), other African cities (n = 8), and global comparative contexts (n = 6). Methodologies included qualitative case studies (n = 14), quantitative surveys and policy analyses (n = 12), mixed-methods approaches (n = 8), geospatial and remote-sensing analyses (n = 5), and systematic reviews (n = 3).

Detailed Thematic Analysis

Qualitative synthesis of the 41 studies identified four planning-oriented themes representing the major challenges in Nairobi's riparian zone governance. The themes emerged through iterative reading, coding, and cross-referencing of the reviewed literature.

Figure 2 illustrates the geographic distribution of studies included in the qualitative synthesis.

Geographic Distribution

Most studies (27; 65.9%) were global, covering countries such as China, the USA, Brazil, and Australia. Seven studies (17.1%) focused on Nairobi, six (14.6%) on other African countries, including Ethiopia, South Africa, and Nigeria, while one study examined Kisii, Kenya.

This finding addresses Objective 2 by identifying the geographical focus of the reviewed literature.

Temporal Distribution

Figure 3 illustrates the annual distribution of studies included in the review.

Only one study was published before 2010. Between 2011 and 2020, 15 studies were published, while 2021–2023 recorded the highest output with 16 studies (39%). A further nine studies (22%) were published during 2024–2025.

This finding addresses Objective 2 by identifying publication trends in the reviewed literature.

Methodological Distribution

Figure 4 illustrates the methodological approaches

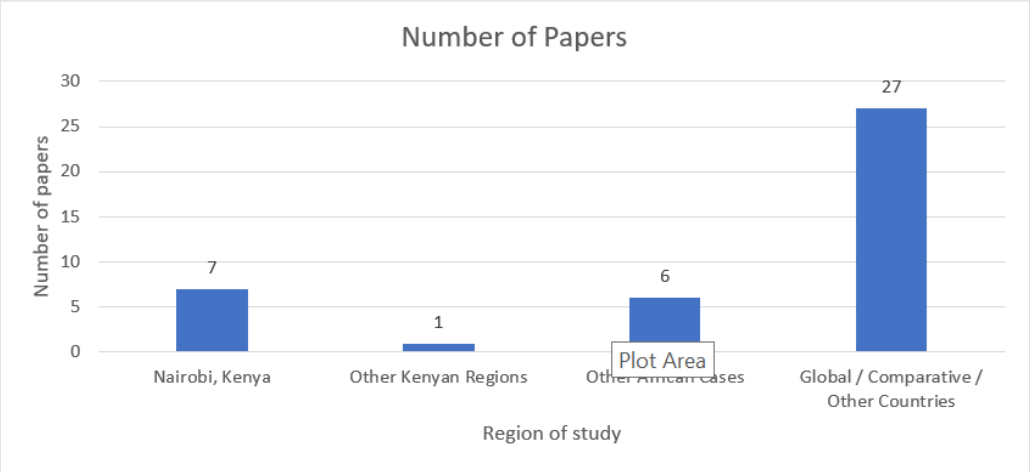


FIGURE 2
Geographic distribution of reviewed riparian planning studies across regions
Source: Author's compilation from reviewed literature and analysis, 2026

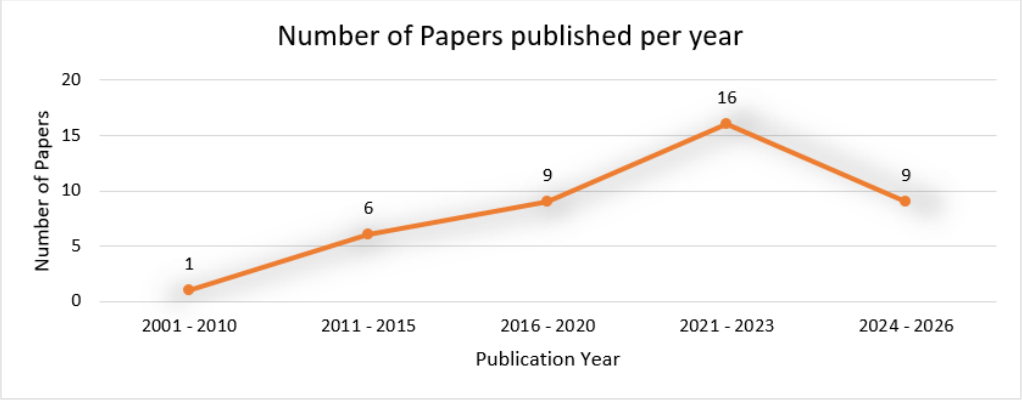


FIGURE 3
Annual publication trends of reviewed riparian planning studies worldwide
Source: Author's compilation from reviewed literature and analysis, 2026

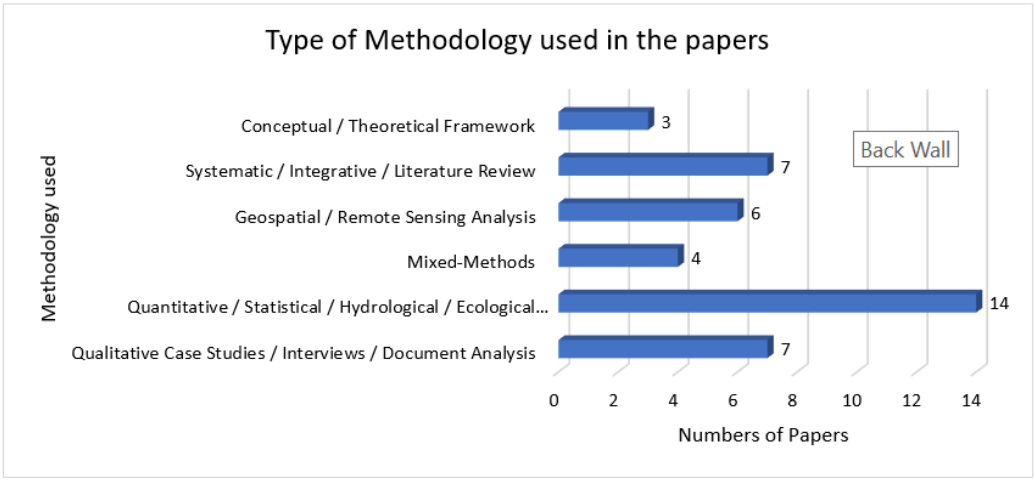


FIGURE 4
Methodological approaches adopted in reviewed riparian planning studies globally
Source: Author's compilation from reviewed literature and analysis, 2026

adopted in the reviewed studies.

Most studies (27; 65.9%) were global, covering countries such as China, the USA, Brazil, and Australia. Seven studies (17.1%) focused on Nairobi, six (14.6%) on other African countries, including Ethiopia, South Africa, and Nigeria, while one study examined Kisii, Kenya.

This finding addresses Objective 2 by identifying the geographical focus of the reviewed literature.

Primary Riparian Issues

Figure 5 illustrates the distribution of studies by primary riparian issue.

Water quality and ecological health were the most studied issues, accounting for 11 studies (26.8%). Physical encroachment and land use change followed with 8 studies (19.5%), while institutional governance and policy appeared in 6 studies (14.6%). Climate vulnerability and ecosystem restoration each accounted for 5 studies (12.2%). Urban planning appeared in 3 studies (7.3%), while green gentrification was the least studied issue, with one study (2.4%).

This finding addresses Objective 2 by identifying the major riparian issues reported in the literature.

Data Sources

Figure 6 illustrates the main data sources used in the reviewed studies.

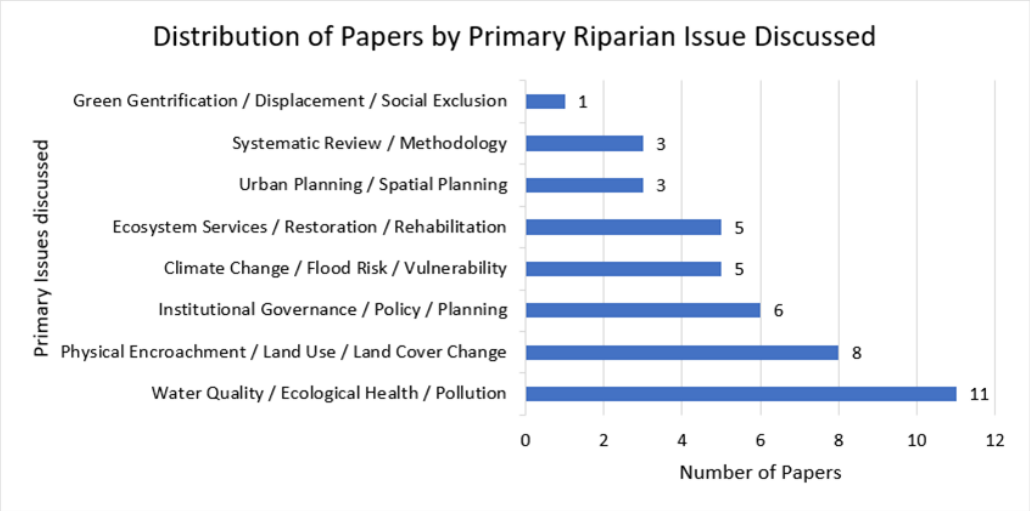


FIGURE 5
Distribution of reviewed studies by primary riparian issues discussed
Source: Author's compilation from reviewed literature and analysis, 2026

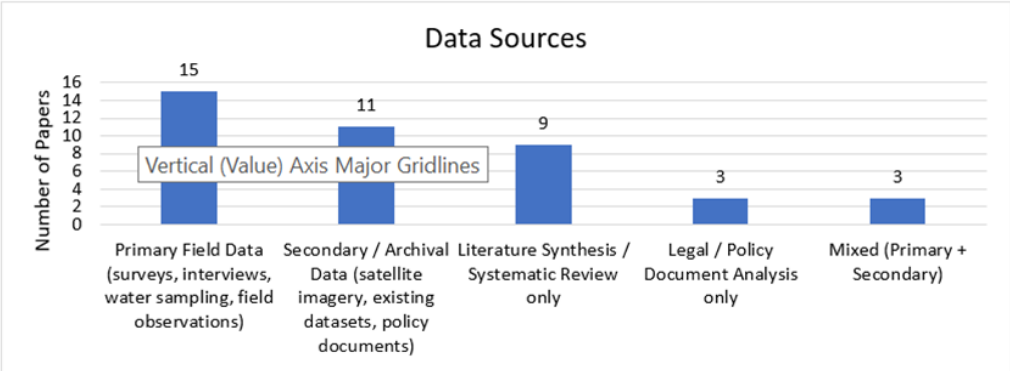


FIGURE 6
Data sources used in reviewed riparian planning research studies
Source: Author's compilation from reviewed literature and analysis, 2026

Primary field data were the most frequently used source, appearing in 15 studies (36.6%). Secondary and archival data accounted for 11 studies (26.8%), while literature reviews were used in 9 studies (22.0%). Legal document analysis and mixed-methods approaches each appeared in 3 studies (7.3%).

This finding addresses Objective 2 by identifying the main data sources used in the reviewed literature.

Summary of Key Observations

Table 3 summarises the key observations from the reviewed studies.

This summary addresses Objective 2 by highlighting the principal characteristics of the reviewed literature.

Thematic Literature

Theme 1: Institutional Fragmentation and Uncoordinated Governance

Most authors agree that institutional fragmentation is the biggest obstacle to effective riparian planning. Mugo et al. (2025) found that multiple government agencies working without coordination are the leading cause of unplanned developments along the river. Similarly, Mwangi et al. (2024) and Odongo et al. (2025) documented how overlapping mandates among Nairobi City County, NEMA, and the Water Resources Authority create enforcement vacuums in which no single agency takes responsibility. Muketha (2014, 2020) argued that this fragmentation results from historical institutional design.

TABLE 3
Summary of key observations from reviewed riparian planning studies

Metric	Finding
Total articles analysed	41
Most studied location	Global/Comparative (65.9%), followed by Nairobi (17.1%)
Peak publication period	2021–2023 (39.0%)
Dominant publication type	Peer-reviewed journal articles (82.9%)
Most common methodology	Quantitative/statistical (34.1%)
Most common primary issue	Water quality/ecological health (26.8%)
Most common data source	Primary field data (36.6%)
Least studied issue	Green gentrification/displacement (2.4%)

Source: Author's synthesis based on reviewed literature and thematic analysis, 2026

However, authors differ on whether the problem lies in institutional structure or implementation capacity. Gorazd et al. (2022) argued that governance fragmentation can still function with effective coordination, while Asfaw and Worku (2021) considered limited political will to be the main problem rather than institutional structure. Larsen et al. (2023) maintained that both institutional design and implementation capacity are important.

Despite these differences, all studies recognise that no single organisation has clear responsibility for riparian zones. A major limitation is that most studies identify the problem but provide little evidence on the most effective institutional reform model.

Theme 2: Progressive Physical Encroachment and Land Use Conversion

Nearly all 41 studies report consistent evidence that riparian zones are gradually being lost to urban development. Omollo and Ogendi (2023) found that built-up land in Kisii increased from 21% to 29% between 2005 and 2021, while vegetation declined from 53% to 41%. Similar findings were reported by Aineah (2022), Odongo et al. (2025), Le et al. (2022), and Czortek et al. (2020), all of whom identified urban expansion as the main driver of riparian degradation.

Authors disagree on the primary cause of encroachment. Mumuni et al. (2025) attributed it to population pressure and lack of affordable land, whereas Olokeogun and Kumar (2022) emphasised weak enforcement. Jamtsho et al. (2025) identified impervious surfaces as the primary cause of riverbank degradation, while Howland (2024) highlighted that treating all encroachment as illegal overlooks the livelihood needs of poor communities.

A major drawback is that most geospatial studies compare only a few time points, with no continuous, real-time monitoring of encroachment.

Theme 3: Weak Policy Implementation and Enforcement Gaps

Authors agree that Kenya and other African countries have adequate legal frameworks for riparian protection, but implementation remains weak. Mugo et al. (2025) reported that 71% of respondents cited poor law enforcement as a major cause of encroachment, while 40% cited ignorance of existing laws. Muketha (2014, 2020) argued that the problem is not a lack of laws but a lack of political will. Asfaw and Worku (2021) reported similar findings in Addis Ababa.

However, disagreement remains over why enforcement continues to fail. Gorazd et al. (2022) emphasised public awareness and community participation, while Olokeogun and Kumar (2020, 2022) attributed weak enforcement mainly to corruption. Ivanov (2022) demonstrated that enforcement is feasible where funding and political support exist. Richardson and Soloviev (2021) argued that riparian zones receive lower policy priority than roads, housing, and industry.

Most studies identify enforcement challenges but provide little evidence on which enforcement approaches produce the highest compliance.

Theme 4: Integrated Planning Interventions and Restoration Outcomes

The literature on planning interventions and restoration outcomes presents mixed views. Yu and Dong (2023) argued that integrated planning can balance environmental protection with social needs, while Denning and Schulte (2024) reported that well-designed riparian buffers improve water quality, flood control, and habitat connectivity.

Other studies reported negative social impacts. Huq and Azaz (2024) found that restoration projects displaced fishing communities, while Reis and De Oliveira (2021) associated restoration with green gentrification. Muketha (2020) raised similar concerns for Nairobi if communities are excluded from planning.

Sobowale (2019) observed that public participation often remains a formality, with community views rarely reflected in final plans. Aineah (2022) and Odongo et al. (2025) suggested that the Nairobi River Corridor Special Planning Area could provide a remedy if participation is meaningful and affordable housing alternatives are available. Walsh et al. (2005) emphasised addressing the root causes of degradation rather than relying only on restoration measures.

A major limitation is that most studies assess restoration over only 5–10 years, providing limited evidence on long-term ecological and social outcomes. **Table 5** summarises the major areas of agreement and disagreement identified in the reviewed literature across the four thematic areas examined in this study.

Thematic Findings from Nairobi Riparian Zone Context

Theme 1: Institutional Fragmentation and Uncoordinated Governance

A study conducted in 2019 (NCA, 2019) across nine rivers in Nairobi revealed that no single institution has clear accountability for riparian zones. Survey plans showed conflicting riparian reserves of 3 metres, 6 metres, 12 feet, and 30 metres, while many parcels had no riparian reserve indicated. Of the 423 parcels examined, only 26 had a properly indicated 30-metre reserve. This inconsistency reflects the fragmented legal framework, where different laws prescribe different widths and reference points.

The NCA (2019) also identified weak enforcement as a major driver of encroachment. Despite laws requiring a 6–30 metre buffer, enforcement has remained weak, allowing informal settlements and industries to occupy riparian zones, particularly along the Ngong River in Mukuru, where over 600,000 residents live close to the river channel. Residents also reported uncertainty over which institution was responsible for riparian matters.

This finding addresses Objective 2 by identifying institutional fragmentation in Nairobi's riparian zone.

Theme 2: Progressive Physical Encroachment and Land Use Conversion

The NCA (2019) identified 4,354 structures within the 10-metre riparian reserve and 5,308 structures within the 2-metre high-water mark. The Ngong River recorded the highest number of structures (1,840), followed by the Mathare (1,778), Nairobi (1,395), and Kirichwa (408) rivers. While 40% (80.79 km) of the river length is built up, 60% (101.55 km) remains open and could still be protected.

The worst encroachment occurred along the Ngong River through Mukuru settlements. Similar conditions were observed along the Mathare River, where solid waste has narrowed the river channel, and along the Nairobi River, where Gikomba Market operates directly on the riverbank and waste is discharged into the river.

This finding addresses Objective 2 by identifying progressive physical encroachment and land use conversion.

Theme 3: Weak Policy Implementation and Enforcement Gaps

Studies have documented that enforcement of riparian regulations is inconsistent across Nairobi. While Dagoretti Riruta remains free of structures within the riparian reserve, Riverside Drive, Grogan, South B, and the Industrial Area contain developments close to or within the river channel.

According to NCA (2019), solid waste was

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TABLE 5
Summary of Agreement and Disagreement in Literature

Theme	Points of Agreement	Points of Disagreement	Weaknesses / Gaps
Theme 1: Institutional Fragmentation	Multiple agencies with overlapping mandates create enforcement vacuums (Mugo et al., 2025; Asfaw & Worku, 2021; Gorazd et al., 2022; Lin et al., 2024).	Some argue that fragmentation can work with effective coordination (Gorazd et al., 2022). Others say it is inherently flawed (Larsen et al., 2023; Muketha, 2020)—a third viewpoint on the lack of political will (Asfaw & Worku, 2021).	No empirical testing of which reform model works best. No cross-country comparisons.
Theme 2: Physical Encroachment	Built-up land increases while vegetation declines in riparian zones globally (Omollo & Ogendi, 2023; Le et al., 2022; Czortek et al., 2020; Jamtsho et al., 2025).	Some attribute the decline to population pressure (Mumuni et al., 2025; Olokeogun & Kumar, 2022). Others blame impervious cover (Jamtsho et al., 2025) or weak enforcement (Mugo et al., 2025).	Only 3-4 time points were studied. No real-time monitoring. No tracking of evicted residents.
Theme 3: Policy Implementation Gaps	Legal frameworks exist, but enforcement is consistently weak across all continents (Mugo et al., 2025; Asfaw & Worku, 2021; Ivanov, 2022; Richardson & Soloviev, 2021).	Some point to corruption and capacity (Asfaw & Worku, 2021; Mugo et al., 2025). Others blame elite capture (Olokeogun & Kumar, 2022) or lack of public awareness (Gorazd et al., 2022). Ivanov (2022) shows that enforcement can work with dedicated funding.	No comparison of enforcement strategies (fines vs monitoring vs incentives). No cost-benefit analysis.
Theme 4: Planning Interventions	Restoration is possible, and participation is essential (Yu & Dong, 2023; Denning & Schulte, 2024; Sobowale, 2019; Walsh et al., 2005).	Optimists say planning balances protection and social needs (Yu & Dong, 2023). Critics argue that restoration leads to green gentrification and displacement (Huq & Azaz, 2024; Reis & De Oliveira, 2021; Muketha, 2020).	Most studies evaluate only 5-10 years post-restoration. No long-term tracking of displaced households. Nairobi River SPA has not yet been evaluated.

Source: Author's synthesis based on reviewed literature and thematic analysis, 2026

recorded in 31% of Ngong River sections, 25% of Nairobi River sections, and 7% of Mathare River sections. Common waste included plastics, metals, glass, rubber, synthetic textiles, and construction debris. Raw sewage from informal settlements, planned estates, and industries also drains directly into the rivers, with residents reporting frequent outbreaks of cholera, typhoid, and dysentery during the rainy season.

This finding addresses Objective 2 by identifying policy implementation and enforcement gaps.

Theme 4: Integrated Planning Interventions and Restoration

The Nairobi River Corridor Special Planning Area (SPA), gazetted in 2025 under the Physical and Land Use Planning Act (2019), is the first comprehensive legal framework for integrated riparian management. The SPA covers a 60-metre buffer from Naivasha Road to Ruai, including the Ngong and Mathare rivers, and aims to protect riparian zones, reduce pollution and flooding, promote affordable housing, and enhance urban resilience.

Spatial analysis showed that 40% of Nairobi's river length is built up, while 60% remains undeveloped (Muketha, 2014 & 2025). The SPA requires public participation and draws on the Mukuru SPA

experience. However, public scepticism and fears of eviction indicate the need for transparent communication and meaningful community participation.

This finding addresses Objective 2 by identifying integrated planning interventions and restoration initiatives

DISCUSSION

The review identified four interconnected themes that collectively explain persistent riparian degradation. Institutional fragmentation in Nairobi is evidenced by survey plans showing conflicting riparian wayleaves: some parcels have 3-metre reserves, others 6 metres, 12 feet, or 30 metres, while many parcels have no reserve indicated. This agrees with Mugo et al. (2025), Mwangi et al. (2024), and Odongo et al. (2025), who documented overlapping mandates creating enforcement vacuums, and aligns with Kiwango (2021) across Sub-Saharan Africa. From the perspective of Collaborative Planning Theory, effective governance requires coordinated stakeholder engagement and institutional integration, the absence of which produces the fragmentation documented in Nairobi. However, the findings challenge Gorazd et al. (2022), suggesting that coordination alone is insufficient where conflicting legal definitions persist and institutional redesign is required.

Progressive physical encroachment is confirmed by fieldwork identifying 4,354 structures within the 10-metre reserve and 5,308 within the active floodplain, with the Ngong River recording the highest encroachment (1,840 structures). This agrees with Omollo and Ogendi (2023), who found that built-up land increased from 21% to 29% in riparian zones. From the perspective of the Rational Planning Model, persistent encroachment reveals a gap between policy design and implementation. However, the findings differ from Mumuni et al. (2025), who attributed encroachment mainly to population pressure. Instead, NCA (2019) indicates that inconsistent enforcement better explains spatial patterns, extending Olokeogun and Kumar's (2022) observation on elite capture.

Weak policy implementation is illustrated by inconsistent enforcement: Dagoretti Riruta's riparian reserve remains conserved, whereas Riverside Drive and the Industrial Area contain structures on river channels. This agrees with Mugo et al. (2025), who found that 71% of respondents cited poor enforcement as a major cause of encroachment, and with Asfaw and Worku (2021). From the perspective of Environmental Justice Theory, environmental burdens fall disproportionately on vulnerable communities while privileged groups benefit from selective enforcement. However, the findings extend Ivanov (2022) by showing that enforcement is not only constrained by funding but is also shaped by political economy.

Integrated planning interventions through the Nairobi River Corridor SPA (2025) align with Yu and Dong (2023). However, fieldwork revealed public scepticism and fear of eviction, reflecting concerns reported by Huq and Azaz (2024) in Bangladesh and Reis and De Oliveira (2021) in Brazil. Consistent with Collaborative Planning Theory, meaningful participation is essential for effective planning outcomes. The participation gap identified in Nairobi suggests that planning remains largely technocratic, supporting Sobowale's (2019) observation that public participation is often formal rather than influential.

This review contributes to planning knowledge by demonstrating that Nairobi's riparian degradation results from the interaction of institutional fragmentation, conflicting legal frameworks, and spatially uneven enforcement. The finding that 60% of the river corridor remains undeveloped presents an important opportunity for strategic planning and long-term conservation.

Limitations

This review is limited by its reliance on published English-language literature and the variation in methodologies across the reviewed studies. Although PRISMA and predefined inclusion criteria were applied to ensure comprehensive coverage, relevant unpublished studies and grey literature may not have been included. Consequently, the findings should be interpreted within the scope of the reviewed evidence.

Synthesis

Overall, the findings demonstrate that effective riparian management requires more than regulatory enforcement. Sustainable outcomes

depend on integrated planning, institutional collaboration, and equitable governance, reinforcing the complementary contribution of Collaborative Planning Theory, the Rational Planning Model, and Environmental Justice Theory in explaining riparian planning challenges within the Nairobi River Basin.

CONCLUSION

This systematic review of 41 studies, together with the NCA (2019) study of Nairobi's nine rivers, found that riparian degradation is systemic rather than accidental. Institutional fragmentation, conflicting laws, and weak enforcement have allowed 4,354 structures to be built within the 10-metre riparian reserve and 5,308 within the active floodplain. The Ngong River is the most degraded, followed by the Mathare and Nairobi rivers.

However, 60% of Nairobi's river length remains in open areas that can still be protected. The Nairobi River Corridor Special Planning Area (SPA), gazetted in 2025, provides a promising framework for integrated riparian management, but its success depends on genuine community participation, political will, and adequate resettlement funding. Without timely intervention, the remaining open river corridors are likely to face continued encroachment.

By integrating evidence from previous studies with findings from the Nairobi River Basin, this review contributes to planning knowledge by providing a coherent framework for improving riparian governance and supporting sustainable urban development in Nairobi and other rapidly urbanising cities.

RECOMMENDATIONS

The recommendations presented below are informed by the study findings and are intended to strengthen the sustainable management of Nairobi's riparian corridors. They address policy and planning reforms, institutional coordination, community participation, environmental restoration, and future research priorities to support resilient, integrated, and evidence-based riparian governance.

Policy and Planning Recommendations

i. Parliament should harmonise the conflicting riparian laws and adopt a single policy framework with a variable riparian reserve based on floodplain characteristics rather than fixed distances.
ii. The Nairobi Rivers Commission should be strengthened through a clear legal mandate, adequate funding, and responsibility for coordinating all riparian management functions currently undertaken by multiple institutions.
iii. A single coordinating body should maintain a centralised GIS registry, coordinate enforcement, and institutionalise real-time monitoring using GPS, remote sensing, and tools such as Kobo Collect.
iv. The remaining 60% of Nairobi's open river corridors should be demarcated immediately using concrete pillars and GPS before further encroachment occurs.
v. A humane resettlement programme should be implemented for the 5,308 households within the floodplain, with priority given to integration into the Affordable Housing Programme.
vi. Community-led conservation committees should be established to organise clean-up activities, plant native vegetation, monitor encroachment, and strengthen public participation.
vii. Stricter penalties should be enforced for illegal dumping of solid waste and discharge of untreated sewage into rivers.
viii. The "polluter pays" principle should be strengthened so that developments increasing impervious surfaces contribute to downstream flood resilience and environmental restoration.
ix. Adaptive riparian buffer zones should replace fixed-width buffers, with widths determined by river size, slope, flood history, and environmental sensitivity.
x. Participatory mapping should be institutionalised by training local communities to document encroachment and support routine monitoring.

Recommendations for Future Research

i. Conduct longitudinal studies to assess the long-term social and economic outcomes of households relocated from riparian zones.
ii. Undertake comparative studies across African cities to identify effective institutional models

for riparian governance.

iii. *Develop GIS-based predictive models to evaluate how upstream land-use and zoning changes influence downstream flood risk.*

iv. *Evaluate the effectiveness of the Nairobi River Corridor SPA five to ten years after implementation, with particular attention to governance, community participation, environmental restoration, and climate resilience.*

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