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Review article

Recurrent Urban Flooding in Nairobi City: A Systematic Review of Environmental Determinants, Public Health Impacts and Policy Gaps

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ABSTRACT

Nairobi has experienced recurrent and increasingly severe urban flooding over the past two decades. The April–May 2024 floods claimed between 267 and 294 lives and displaced approximately 380,000 people across Kenya, while the March 2026 flash floods — triggered by 112mm of rainfall within 24 hours — killed at least 66 people nationally and caused an estimated USD 300 million in infrastructure damage. These events reflect a systemic failure of intersecting environmental, structural, and governance determinants. This narrative systematic review (PRISMA 2020-adapted; final search: 31 March 2026) synthesizes evidence on the environmental determinants, public health burden, and governance gaps driving Nairobi's recurring floods. Searches across PubMed/MEDLINE, Scopus, Google Scholar, WHO IRIS, ReliefWeb, and national government portals identified 443 records, of which 68 sources met inclusion criteria across three evidence tiers. Five interconnected environmental determinants were identified: rapid unplanned urbanisation with significant green space loss; illegal encroachment on riparian reserves in violation of Kenya's 60-metre buffer zone mandate; ageing drainage infrastructure; intensifying bimodal rainfall amplified by climate change and El Niño; and upstream land degradation reducing catchment retention. Public health consequences include direct mortality, mass displacement, cholera and diarrhoeal disease outbreaks, vector-borne disease resurgence, and significant mental health burden, all disproportionately affecting informal settlement residents. Persistent governance gaps in land-use enforcement, flood risk assessment, inter-agency coordination, and community inclusion perpetuate this vulnerability. Lastly, 19 evidence-grounded recommendations are proposed across environmental, public health, and governance domains. Recurrent urban flooding in Nairobi is a preventable public health emergency amenable to structural intervention, with findings applicable to urban flood risk management across sub-Saharan African cities facing comparable intersections of rapid urbanisation, governance failure, and climate-change exposure.

KEYWORDS

Disaster; urban flooding; Nairobi; public health; climate change; diarrhoeal disease; riparian encroachment; urban planning; waterborne disease; Kenya.



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1. Introduction

Nairobi, sub-Saharan Africa's fourth-largest city with a population exceeding five million (African Climate Insights, 2025; Daily Nation, 2026d), has long occupied an uneasy relationship with water. The city was originally established in 1899 on a swampy plain alongside the Nairobi River- a site colonial engineers described as bleak and sippy. Railway engineer Richard Owen Preston described it as 'a bleak, swampy stretch of sippy landscape, windswept, devoid of human habitation of any sort.' Despite more than a century of development, the fundamental hydrological vulnerability of this terrain has never been adequately addressed (Daily Nation, 2026a).

Flooding in Nairobi has intensified in both frequency and severity over the past three decades. Major events were recorded in 1961, 1997-1998 (El Niño-enhanced), 2006, 2010, 2012, 2015, 2018, and have occurred annually since 2022 (Daily Nation, 2026a; Avery, 2024). The April-May 2024 long-rains season alone resulted in an estimated 267 deaths nationally and the displacement of approximately 380,000 people, with 41 of Kenya's 47 counties (87%) affected (Assessment Capacities Project [ACAPS], 2024; United Nations Children's Fund [UNICEF], 2024). The March 2026 event, the worst since 2024, recorded approximately 112mm of rainfall within 24 hours (Civil Society in Development [CISU], 2026), exceeding the average March monthly total and causing the Nairobi River to burst its banks. The floods swept away vehicles, disrupted arterial roads, including Uhuru Highway and Mombasa Road, forced flight diversions at Jomo Kenyatta International Airport, and reportedly killed at least 66 people nationally, with 33 fatalities confirmed in Nairobi alone (Reuters, 2026). Infrastructure damage was preliminarily estimated at USD 300 million in an early rapid assessment (Civil Society in Development [CISU], 2026); this figure awaits confirmation by official post-disaster assessments.

What makes these floods particularly alarming is not their scale alone but their predictability. Every major rainy season exposes the same systemic vulnerabilities: encroached riparian corridors, overwhelmed drainage systems, inadequate early-warning translation, and a population of urban poor bearing disproportionate risk. A 2021 study by the African Population and Health Research Centre (APHRC) found that residents of informal settlements are approximately 50% more likely to experience flood damage than those in formal neighborhoods (African Population and Health Research Centre [APHRC], 2021). Despite repeated disasters and repeated pledges of reform, structural solutions have not materialized at the required scale.

Globally, urban flooding is recognized as the most frequent natural disaster in sub-Saharan Africa, with 654 floods recorded between 1980 and 2013 (Zevenbergen et al., 2020). Africa is urbanizing faster than any other continent, with its urban population expected to triple to 1.3 billion by 2050 (United Nations Human Settlements Programme [UN-Habitat], 2020). However, this growth is not matched by adequate housing, infrastructure, or governance, with over 60% of urban dwellers in sub-Saharan Africa living in informal settlements that are disproportionately vulnerable to extreme weather events (United Nations Human Settlements Programme [UN-Habitat], 2020). Nairobi represents one of the most acute manifestations of this continent-wide challenge.

This review provides a comprehensive synthesis of the environmental determinants, public health consequences, and governance failures underpinning Nairobi's recurrent flooding crisis, to inform evidence-based policy, practice, and research.

2. Methods

2.1. Review Design

This review follows a narrative systematic approach, synthesizing quantitative and qualitative evidence from heterogeneous source types. The review adheres to the PRISMA 2020 framework adapted for narrative synthesis (Tricco et al., 2018), including explicit documentation of the search strategy, a three-tier source quality classification, a two-stage screening process, and thematic data extraction. A PRISMA-adapted flow diagram (Figure 1) presents records identified, screened, ex-

cluded, and included at each stage. Sources are classified into three evidence tiers reflecting differential evidentiary weight, as described in Section 2.3.

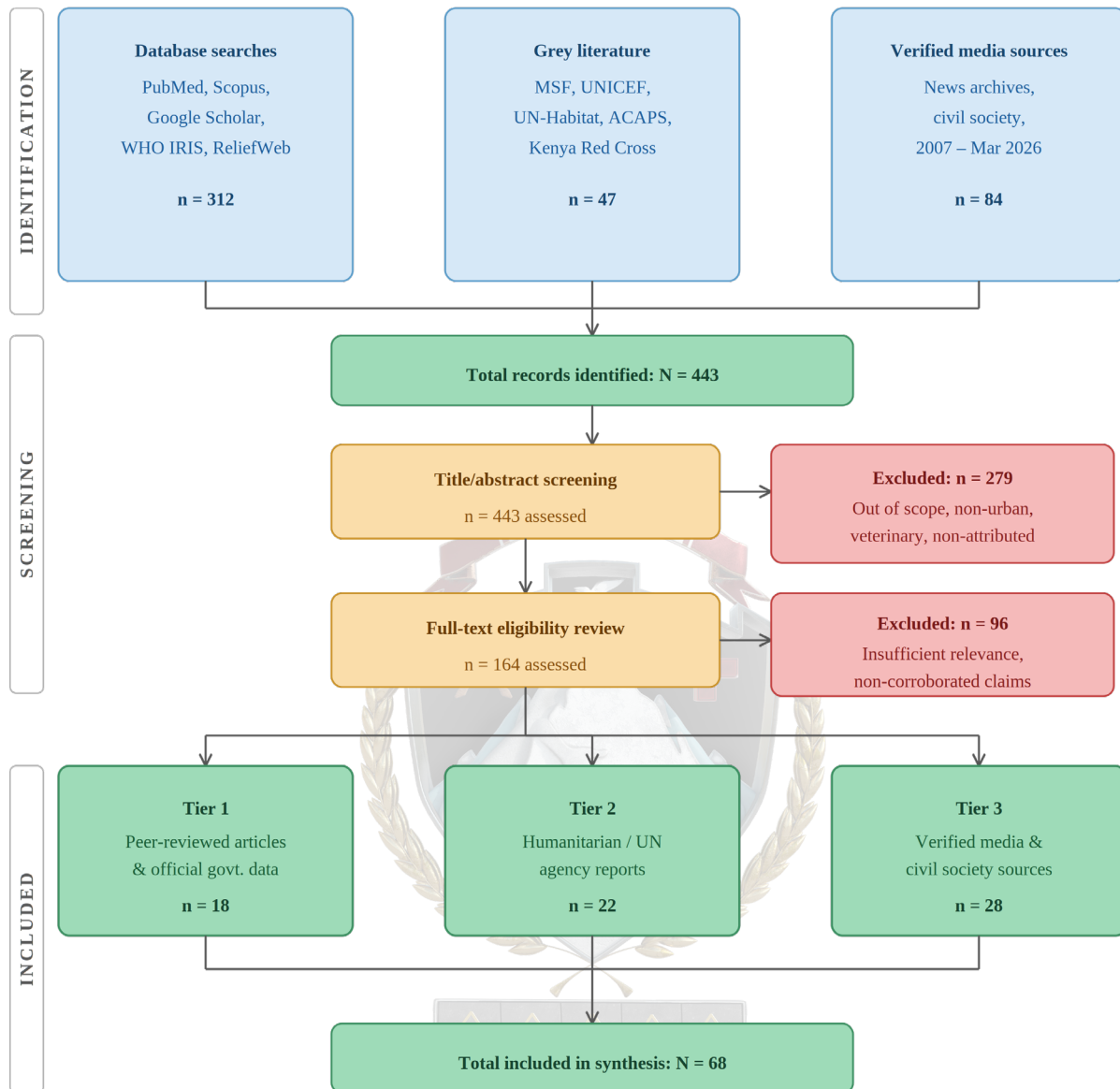


Figure 1: PRISMA 2020 flow diagram of study selection process. Adapted from Tricco et al. (2018). Tier 3 sources subject to additional corroboration requirements. Evidentiary weight: Tier 1 > Tier 2 > Tier 3.

Figure 1. PRISMA 2020 Flow diagram of study selection process.

Note: Adapted from PRISMA 2020 (Tricco et al., 2018). Tier 3 sources are subject to additional corroboration requirements (Section 2.4). Evidentiary weight: Tier 1 > Tier 2 > Tier 3.

2.2. Search Strategy and Sources

A comprehensive literature search was conducted across the following databases and platforms: PubMed/MEDLINE, Google Scholar, Scopus, WHO IRIS, ReliefWeb (OCHA), the Humanitarian Data Exchange, and government portals of the Kenya Ministry of Health, Ministry of Water and Sanitation, and Nairobi City County. Grey literature from Médecins Sans Frontières (MSF), Kenya

Red Cross, UN-Habitat, UNICEF, UNDP, ACAPS, Pamoja Trust, and E Co. Ltd Group was also reviewed. Additional sources included peer-reviewed journals: the Asia-Pacific Journal of Convergent Research Interchange, Physics and Chemistry of the Earth, BMC Public Health, PLoS Neglected Tropical Diseases, ScienceDirect, African Journal of Empirical Research, and African Journal on Land Policy and Geospatial Sciences.

The final search was conducted on 31 March 2026. Complete Boolean search strings used per database are provided below.

PubMed/MEDLINE:

("urban flood*" OR "flash flood*" OR "pluvial flood*") AND (Nairobi OR Kenya OR "East Africa") AND ("public health" OR "waterborne disease" OR "diarrhoeal disease" OR "diarrheal disease" OR cholera OR typhoid OR displacement OR mortality OR "vector-borne" OR malaria OR "mental health" OR "informal settlement*")

Scopus:

TITLE-ABS-KEY (("urban flood*" OR "flash flood*" OR "flood risk") AND ("Nairobi" OR "Kenya" OR "East Africa") AND ("public health" OR "governance" OR "drainage" OR "riparian" OR "climate change" OR "disaster risk" OR "waterborne" OR "cholera" OR "displacement"))

Google Scholar:

"urban flooding" "Nairobi" public health OR "waterborne disease" OR cholera OR displacement OR governance OR "riparian encroachment" OR "informal settlement" OR "climate change" OR "flood risk"

WHO IRIS:

flood* AND (Kenya OR Nairobi OR "East Africa") AND (health OR cholera OR displacement OR "disease outbreak")

ReliefWeb / Humanitarian Data Exchange (HDX):

"Kenya floods" OR "Nairobi floods" (filtered to 2007-2026; document types: situation reports, field assessments, rapid needs assessments)

Government portals (Kenya MoH, Ministry of Water and Sanitation, Nairobi City County Government):

flood* AND (health OR infrastructure OR drainage OR response) [site-specific keyword search and manual browsing of publications and reports sections, 2010-2026]

Grey literature (MSF, UNICEF, UN-Habitat, ACAPS, Kenya Red Cross, UNDP, Pamoja Trust):

"Kenya floods" OR "Nairobi floods" OR "East Africa floods" [direct organizational repository searches and manual review of situation reports, briefing notes, and field assessments published 2007-2026]

These strings were supplemented by hand-searching reference lists of all included Tier 1 sources, and by citation tracking of key papers. The sole author conducted all searches. Deduplication was performed manually across platforms prior to screening.

2.2.1. Screening and Selection Process

Screening was conducted in two stages. In Stage 1 (title and abstract screening), all retrieved records were assessed against the inclusion criteria; records that were clearly outside the geographic scope, focused solely on agricultural impacts, or from non-attributable sources were excluded. In Stage 2 (full-text review), remaining records were read in full and assessed for relevance to at least

one of the four thematic domains. A total of 68 sources met all inclusion criteria and are included in the synthesis, disaggregated by source type in Figure 1 and summarized in Table 2.

2.2.2. Inclusion and Exclusion Criteria

Eligibility criteria were defined a priori to ensure that the evidence base was geographically relevant, temporally current, and thematically aligned with the four domains of this review. Given the heterogeneous nature of the source types included, spanning peer-reviewed literature, grey literature, government and humanitarian agency reports, and verified media documentation, criteria were framed to be applicable across all tiers rather than restricted to peer-reviewed studies alone. Geographic scope was Centreed on Nairobi, and the broader Kenyan urban context, with comparative evidence from East Africa and sub-Saharan Africa admitted where directly relevant. The temporal window of 2007–March 2026 was selected to capture the period of documented intensification of Nairobi’s flooding crisis while encompassing the March 2026 events that precipitated this review—exclusions targeted sources that would not contribute meaningfully to the urban public health focus of the synthesis. The full inclusion and exclusion criteria are summarized in Table 1.

Table 1. Inclusion and Exclusion Criteria for Source Selection.

Criteria	Description
Inclusion – Geography	Studies conducted in Nairobi, Kenya, or directly comparable East African urban settings; broader sub-Saharan African urban flood evidence where directly relevant
Inclusion – Time frame	Publications, reports, and verified media from 2007 to March 2026
Inclusion – Language	English-language publications and reports
Inclusion – Content	Peer-reviewed studies, government/humanitarian/NGO reports, and verified news documentation addressing urban flood determinants, health impacts, or policy responses in Kenya
Exclusion	Purely rural flood studies without urban or peri-urban relevance; studies focused solely on agricultural impacts without population health components; non-verified or non-attributable sources; veterinary diarrhoeal studies

2.3. Source Classification by Evidence Tier

Sources are classified into three tiers reflecting evidentiary weight (see Section 2.4). Tier 1 (highest weight): peer-reviewed journal articles and official government data reports with full methodological documentation (e.g., Juma et al., 2023; Kiama et al., 2023; Nairobi City County Government, 2025). Tier 2 (moderate weight): situation reports and field assessments from established humanitarian agencies with documented data collection standards (e.g., ACAPS, 2024; UNICEF, 2024; MSF, 2024; UN-Habitat, 2025). Tier 3 (contextual/corroborative): national and international news outlets with established editorial standards, where content is attributed to named sources and corroborated by at least one independent source, and civil society analysis (e.g., Daily Nation, 2026; Reuters, 2026; Olando & Dick/Pamoja Trust, 2024). Tier 3 sources are included because, for events in 2025–2026 that are too recent for peer-reviewed publication, attributed media documentation is a legitimate primary source for contemporary disaster evidence, consistent with rapid evidence synthesis practice. Wikipedia was used only as a secondary, supplementary source for confirmed factual data corroborated by official sources and is flagged as such at each citation.

2.4. Source Quality Assessment

Quality criteria were applied to each source tier before synthesis. For Tier 1 sources: study design and methodological appropriateness; sample characteristics; whether conclusions were grounded in the data presented; and declaration of conflicts of interest. For Tier 2 sources: organizational man-

date and independence; transparency of data collection methodology; geographic and temporal specificity; and recency. For Tier 3 sources: (a) identifiable, attributed author or institutional source; (b) content grounded in primary data, direct observation, or named expert testimony; and (c) corroboration of quantitative claims by at least one additional independent source. Sources that did not meet these criteria were excluded. Quantitative headline figures are cross-referenced against at least two independent sources where possible; discrepancies between official and non-governmental estimates are explicitly noted in the text.

2.5. Data Extraction and Thematic Synthesis

Data extraction was performed by the sole author using a pre-designed extraction template applied systematically to all included sources. The template comprised the following fields: (i) source identifier; (ii) source type (Tier 1: peer-reviewed articles and official government data; Tier 2: humanitarian and UN agency reports; Tier 3: verified media and civil society sources); (iii) year of publication or report; (iv) geographic scope (Nairobi-specific, Kenya national, or regional); (v) thematic domain (environmental determinants; meteorological and climate drivers; public health impacts; policy and governance gaps); (vi) key quantitative finding, where available; and (vii) key qualitative finding.

A separate coding log was maintained alongside the extraction template. Each extracted finding was assigned to one or more of the four thematic domains prior to synthesis, providing a transparent audit trail linking included sources to the thematic categories reported in the results. The extraction log is available from the author on request.

Thematic synthesis was conducted narratively following the approach described by Dixon-Woods et al. (2005) for narrative synthesis of heterogeneous sources. Evidence was integrated across the four thematic domains with in-text citations provided for all factual claims. Where quantitative data were available from included sources, these were extracted and presented in summary tables within the relevant sections. Specifically, flood-event mortality, displacement, and rainfall-intensity figures are compiled in the Major Historical Flood Events table (Section 3.3); key demographic and urbanization statistics, including population estimates, informal settlement coverage, and green-space loss, are presented in the Key Demographic Statistics summary (Section 3.2). Spatial data on riparian encroachment, including counts of affected structures and displaced persons, are presented in the Kasarani Sub-County Case Study (Section 4.2). These quantitative data points are drawn from peer-reviewed literature, official government reports, humanitarian agency assessments, and verified media sources, consistent with the tiered sourcing framework described in Section 2.3.

Table 2. Summary of Key Included Sources (35 of 68 total included sources)

Source / Author	Year	Tier	Geographic Scope	Thematic Domain	Key Finding
Juma et al., <i>Physics & Chemistry of the Earth</i>	2023	1	Nairobi (Kibera)	Environmental determinants	Flood inundation and hazard levels in Kibera: near-total vulnerability above modest rainfall thresholds
Kiama et al., <i>PLoS NTD</i>	2023	1	Kenya national	Public health	Nairobi and Mombasa are identified as high-priority cholera hotspots in the national elimination plan.
Ngome & Yeom, <i>Asia-Pacific J. Convergent Research</i>	2024	1	Nairobi and Mombasa	Environmental; governance	Multi-factor flood risk from urbanization, riparian encroachment, and governance failure
Oluchiri, <i>African J. Empirical Research</i>	2025	1	Nairobi, Kisumu, Mombasa	Environmental; governance	Urbanization, drainage failure, and weak enforcement are compounding flood drivers.

Land Use Policy / African J. Land Policy	2025	1	Nairobi City County	Environmental; governance	Land-use change contributes to downstream flooding; inadequate FRAs have been documented.
PubMed Central — Infectious disease in flood disasters	2024	1	Global/regional	Public health	Systematic evidence on post-flood infectious disease outbreaks: attribution challenges
PubMed Central — Socio-ecological impacts in Nairobi	2024	1	Nairobi informal settlements	Public health; equity	Compound social and ecological vulnerability in informal settlements
BMC Research Notes — Disease outbreaks, Kenya 2007-2022	2024	1	Kenya national	Public health	Surveillance weaknesses: structural undercounting in facility-based reporting
Zevenbergen et al., iJDRM	2020	1	Global review	Environmental; governance	State-of-the-art urban flood risk management; proximate/structural/governance framework
Wisner et al., iJDRM	2022	1	Global South	Governance	Urban governance and DRR: legal/administrative/political failure typology
Tariq & van de Giesen, iJDRM	2021	1	Pakistan / comparative	Environmental; governance	Pre-climate-change infrastructure systematically underperforms in rapidly urbanizing cities.
Garschagen et al., iJDRM	2021	1	Global	Public health; equity	Multidimensional loss and damage extend beyond physical damage to mental health and livelihoods.
ACAPS, Kenya Floods Briefing Note	2024	2	Kenya national	Public health; displacement	Displacement, cholera, and sanitation collapse across 41 counties
UNICEF, East Africa Floods Press Release	2024	2	Kenya / East Africa	Displacement; public health	Nearly 1 million affected; cholera fourth wave triggered; GBV risk elevated.
MSF USA & MSF Eastern Africa	2024	2	Nairobi (Eastlands)	Public health; mental health	~1,000 displaced in 9 sites; acute mental trauma documented; waterborne and vector disease risk
Olando & Dick / Pamoja Trust / Misereor	2024	2	Nairobi (Kasarani)	Equity; governance	Official undercount by ~6x in Kasarani; community exclusion from planning; evictions without alternatives
CFK Africa	2024	2	Nairobi (Kibera, Viwandani)	Public health; displacement	Water source contamination, flooded roads restricting access to health facilities, and stress on the healthcare system.
UN-Habitat Strategic Plan (2026). -2029	2025	2	Global / Kenya	Governance; equity	Community-based approaches needed; housing, land, and property rights essential for resilience
UNDP Kenya Floods Recovery Needs Assessment	2025	2	Kenya national	Governance; recovery	Comprehensive multi-sector recovery needs; governance coordination required
CISU, Flash Floods Alert Note	2026	2	Nairobi / Kenya	Environmental determinants	March 2026: 112mm in 24 hours; infrastructure damage estimated at USD 300 million (early rapid assessment, not independently verified)
Avery / The East African	2024	3	Nairobi	Environmental; governance	Riparian encroachment and drainage failure as structural drivers; political resistance to enforcement documented

Daily Nation (2026a). — Ainsworth to Sakaja	2026	3	Nairobi	Historical context	Historical analysis of Nairobi's flood vulnerability from the colonial era to the present
Daily Nation (2026b). — After the floods	2026	3	Nairobi / Kenya	Public health	Post-flood disease risk: cholera, typhoid, malaria, dengue; expert public health warnings
The Standard 2024	2024	3	Nairobi	Governance	Nairobi Expressway drainage failure documented; FRA absence; urban planning gap identified. KSh 8 billion committed by (Kenya Urban Roads Authority)
The Standard 2026	2026	3	Nairobi	Governance	KURA for drainage; acknowledgment of existing infrastructure inadequacy
The Star 2026a	2026	3	Nairobi	Environmental determinants	Brig. Muracia: Riparian encroachment directly linked to flood deaths; river engineering program announced
Inside Climate News	2026	3	East Africa / Kenya	Climate change	Climate change doubled the likelihood of extreme rainfall; the climate whiplash phenomenon has been documented.
African Climate Insights	2025	3	East Africa / Nairobi	Context; equity	Informal settlement residents 50% more flood-prone (citing APHRC 2021); Mathare drainage improvements are noted.
Kenyans.co.ke, 48-hour action plan	2026	3	Nairobi	Governance	Governor Sakaja convened an emergency coordination meeting; the absence of a pre-existing governance protocol was illustrated.
Reuters 2026	2026	3	Kenya national	Direct mortality	Death toll from Kenyan floods rises to 62 (confirmed by police)
Down to Earth 2026	2026	3	Nairobi	Environmental determinants	Director of Water Storage confirms rapid urbanization reducing natural drainage capacity; funding constraints noted
Olando & Dick / Development+Cooperation	2024	3	Nairobi, Kisumu	Equity; governance	Community-led spatial analysis; evictions perpetuate root causes of vulnerability
Borgen Project 2025	2025	3	Kenya / Nairobi	Public health	WHO supplied ~1,100 cholera treatment kits to Nairobi County across the 2022-2024 outbreak period?
Eastleigh Voice 2026	2026	3	Nairobi	Public health; infrastructure	Pipeline ruptures during the March 2026 floods; emergency repairs are required before a safe water supply is restored
People's Daily Digital 2026	2026	3	Nairobi	Governance; early warning	National Disaster Operation Centre (NDOC) identified 37 flood-prone areas; a formal alert was issued 10 days pre-event

Note: Table 2 presents 35 of 68 included sources. Tier 1 = peer-reviewed / official government; Tier 2 = humanitarian/UN agency; Tier 3 = verified media/civil society. Full extraction log available from the corresponding author on request.

3. Results

3.1. Nairobi: Geographic, Demographic and Historical Context

3.1.1. Physical and Hydrological Setting

Nairobi sits at approximately 1,660 meters above sea level on the East African Plateau, established at the confluence of several river systems draining toward the Indian Ocean. The principal urban rivers are the Nairobi, Ngong, Mathare, Gitathuru, and Karura, all tributaries of the larger Athi-Galana-Sabaki river system. The city's topography creates natural runoff-concentration points, with steep upstream gradients that accelerate river flow during heavy rainfall events. Kenya experiences a bimodal rainfall pattern: the 'long rains' from March to May and the 'short rains' from October to December (Daily Nation, 2026c). Both seasons have historically been associated with flooding in the capital, though the long-rain season has produced the most catastrophic recent events.

The timing and intensity of Kenya's rainy seasons are modulated by global-scale climatic phenomena, including El Niño Southern Oscillations (ENSO), the Indian Ocean Dipole (IOD), and modifications in monsoon wind patterns that alter sea surface temperatures and atmospheric moisture levels (Wikipedia, 2026). El Niño events in particular have been associated with significantly enhanced rainfall across East Africa, including the 1997-1998 floods and the 2023-2024 flooding driven by one of the strongest El Niño events in recent decades (UNICEF, 2024).

3.1.2. Urbanization and Demographic Pressures

Nairobi's population has grown exponentially from approximately 8,000 in 1901 to 118,579 by 1948, 343,500 in 1962, and has surpassed five million by 2025 (African Climate Insights, 2025; Daily Nation, 2026d). This growth, among the fastest of any city in sub-Saharan Africa, has been largely unplanned, with formal urban development processes chronically lagging behind demographic realities. The result is a city where an estimated 60% of residents live in informal settlements that collectively occupy only about 5% of the city's residential land (UN-Habitat, 2020). Compounding this spatial inequity, nearly 10% of Nairobi's total green spaces have been lost to urbanization in the last five years alone — green infrastructure that previously moderated runoff and reduced flood peaks (African Climate Insights, 2025; Garschagen et al., 2021). Looking ahead, by 2050 half of Kenya's population is projected to live in urban areas, placing immense forward pressure on already-strained urban systems (Inside Climate News, 2026).

Informal settlements, including Mathare, Kibera, Mukuru, Viwandani, and Eastlands, are densely populated, poorly served by formal infrastructure, and frequently located on low-lying terrain adjacent to river corridors — precisely the areas of highest flood exposure. The health and welfare consequences of this geography are severe: a 2021 study by the African Population and Health Research Centre found that residents of informal settlements are 50% more likely to experience flood damage than those in formal neighborhoods (CISU, 2026). As Prof. Samuel Owuor of the University of Nairobi observes, "Floods do not just destroy homes. They disrupt lives, spread disease, and deepen poverty. The impact is long-lasting" (CISU, 2026). The disproportionate concentration of the urban poor in flood-prone areas is not an accident of geography but a consequence of land markets, governance failures, and the systematic exclusion of low-income communities from formal housing (Down to Earth, 2026).

3.1.3. Major Historical Flood Events in Nairobi

Nairobi has a well-documented history of recurrent flooding that predates the current era of rapid urbanization. Understanding this historical record is essential for contextualizing the environmental determinants and governance failures examined in subsequent sections, as it demonstrates that flooding in the city is neither recent nor aberrant but a persistent structural condition that has

intensified in frequency, scale, and human cost over time. Each major flood event has exposed the same underlying vulnerabilities: encroached riparian corridors, overwhelmed drainage infrastructure, and informal settlements occupying flood-prone terrain, yet structural interventions have consistently failed to materialize between events. Table 3 summarises the major flood events recorded in Nairobi from 1961 to March 2026, identifying the scale and key impacts of each event, as well as the primary driving factors documented in the literature and in official post-event assessments.

Table 3. Major Historical Flood Events in Nairobi (1961–2026)

Year	Scale and Key Impact	Primary Driving Factor
1961	Severe flooding reported; high caseloads	Extreme rainfall, undeveloped drainage
1997-1998	Widespread displacement; significant deaths	El Niño-enhanced rainfall
2006	Recurrent flooding; national caseloads	River overflow, drainage failure
2010	Mathare and Kibera are severely affected	Informal settlement expansion into riparian zones
2012	Infrastructure damage; deaths	Mathare River flooding; riparian encroachment
2015 / 2018	Repeated displacement cycles	Worsening riparian encroachment; inadequate drainage
April-May 2024	267 deaths nationally; ~380,000 affected; 87% of counties	El Niño-enhanced long rains; sustained multi-week rainfall
March 2026	66+ deaths; 50,000+ displaced in Nairobi; 10,000+ households affected nationally	112mm rainfall in 24hrs; river overflow; ageing drainage failure

As Table 3 illustrates, the driving factors behind each event are not random: they reflect the progressive accumulation of unaddressed structural vulnerabilities from the drainage failures and undeveloped infrastructure that characterized the 1961 event, through escalating riparian encroachment documented from 2010 onward, to the compound failure of aging infrastructure, governance fragmentation, and climate-amplified rainfall intensity that defined the catastrophic 2024 and 2026 floods. The consistency of these drivers across six decades underscores that Nairobi's flood problem is systemic rather than episodic. The five environmental determinants that explain this pattern are examined in Section 4

3.2. Environmental Determinants of Recurrent Flooding

The recurrence and increasing severity of flooding in Nairobi are not primarily due to rainfall alone. It reflects a confluence of structural, environmental, and governance-related factors that have accumulated over decades of inadequately managed urban growth. Research consistently identifies multiple mutually reinforcing determinants rather than any single causal factor (Juma et al., 2023; Kenya IDSR, 2024; Jha et al., 2012). These are examined in turn below.

3.2.1. Conceptual Framework: The Flood–Vulnerability–Health Nexus

The three thematic areas addressed in this review- environmental determinants, public health impacts, and governance failures- are not parallel or independent phenomena. They form an integrated causal system in which governance failures amplify environmental vulnerabilities, and environmental vulnerabilities translate into public health consequences whose severity is itself de-

terminated by governance capacity. This review adopts the Flood–Vulnerability–Health Nexus as its organizing conceptual framework, which posits the following logical chain:

Environmental drivers (rainfall, topography, and upstream land use) create the physical hazard potential. Structural vulnerabilities, including informal settlement expansion into flood-prone zones, loss of permeable surfaces, encroachment on riparian buffers, and degraded drainage capacity, convert hazard potential into actual flood events of greater frequency and severity than the physical drivers alone would produce. Governance failures: fragmented institutional mandates, unenforced regulations, absence of flood risk assessments, and exclusion of affected communities from planning, both permit structural vulnerabilities to persist and impair the emergency response and recovery capacity that would otherwise limit health consequences. Public health impacts: mortality, displacement, waterborne and vector-borne disease, and mental health burden are the downstream outputs of this system, concentrated in populations whose social and economic marginalization maximizes their exposure and minimizes their adaptive capacity.

This framework implies that effective flood risk reduction cannot be achieved by addressing any single component in isolation. An engineering intervention that improves drainage capacity but leaves riparian encroachment unaddressed will be overwhelmed. A riparian clearance program that removes informal settlers without providing alternative housing will relocate rather than reduce vulnerability. A governance reform that creates better institutional mandates but excludes community participation will fail to reach the populations at greatest risk. Table 4 summarises the causal pathways through which each of the five environmental determinants identified in this review interacts with specific governance failures to produce documented public health consequences.

Table 4. Causal Pathway Summary: Environmental Determinants, Governance Failures, and Public Health Consequences.

Environmental Determinant	Mechanism of Flood Generation	Governance Failure Amplifying Risk	Documented Public Health Consequence
Rapid unplanned urbanization	Impermeable-surface expansion accelerates runoff; a loss of ~10% green space over five years increases peak flow volumes.	Absence of mandatory flood risk assessments for new developments; planning approvals issued without drainage impact review	Mass displacement, mortality and injury, disruption of health services and water supply
Riparian encroachment	Eliminates 60m riparian buffer; constricts river channels; removes natural floodplain storage capacity	Unenforced Water Act provisions; corruption enabling encroachment; evictions without housing alternatives, perpetuating re-encroachment	Drowning and electrocution mortality, structural collapse, and repeated displacement of informal settlement residents
Aging and inadequate drainage infrastructure	Undersized, blocked, and silted channels are unable to convey modern stormwater volumes; sewage-stormwater co-contamination	Fragmented inter-agency maintenance responsibility; chronic under-investment; infrastructure approvals issued without drainage integration	Cholera and diarrhoeal disease outbreaks; contaminated drinking water; post-flood sanitation collapse; skin and wound infections
Climate change and intensifying rainfall	More intense, shorter-duration rainfall events exceed drainage design thresholds; climate whiplash reduces soil infiltration capacity.	Early warnings were not translated into community-level preparedness; infrastructure was designed for historical, not projected, climate parameters.	Escalating mortality in successive flood events; malaria and vector-borne disease resurgence; mental health burden from repeated displacement

Upstream land degradation and catchment loss	Deforestation and wetland loss reduce catchment retention; increased sediment loads alter flood hydrographs and accelerate downstream peak flows.	In the absence of inter-jurisdictional watershed governance, there is no mechanism to link Nairobi flood risk management to upstream land-use decisions.	Amplified flood severity in downstream Nairobi communities; increased turbidity of contaminated floodwater raises waterborne disease risk
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Sources: Ngome & Yeom (2024); Avery (2024); Borgen Project (2025); UNICEF (2024); MSF (2024); Orlando & Dick (2024); Down to Earth (2026); The Standard (2024); Inside Climate News (2026).

3.2.2. Rapid and Unplanned Urbanization

Nairobi has experienced substantial population growth and spatial expansion without commensurate infrastructure planning, resulting in the encroachment of settlements and built infrastructure into flood-prone zones, including riparian reserves, wetlands, and low-lying floodplains (Kenya IDSR, 2024; Juma et al., 2023). These natural landscapes have historically served as hydrological buffers, storing floodwaters, attenuating peak flows, recharging aquifers, and reducing downstream flood severity. Their degradation or conversion to impermeable built environments significantly increases flood risk across urban catchments (Kenyans.co.ke, 2026).

Kenya's Water Storage and Flood Control Director, Eng. Martin Ngaa confirmed that flooding has become a recurring challenge in Nairobi, mainly due to heavy rains that often cause flash floods, compounded by rapid urbanization that has reduced the city's natural drainage capacity (Garschagen et al., 2021). Studies estimate that nearly 10% of Nairobi's total green spaces have been lost to urbanization in just five years (Garschagen et al., 2021), fundamentally altering the city's watershed hydrology. As green space is replaced by buildings, roads, and paved surfaces, storm rainfall is converted into surface runoff almost instantaneously rather than being absorbed gradually, dramatically increasing peak flow volumes in urban rivers (Wikipedia, 2026).

A particularly concerning dimension is the expansion of informal settlements along river corridors. Communities in Kibera, Mathare, Mukuru, Viwandani, and numerous other settlements have grown directly onto land that was previously a natural floodplain or riparian buffer. Research by Juma et al. (2023) on flood inundation and hazard levels in Kibera found overlapping conditions of rapid urbanization and climate change threatening the city's capacity to manage climate risks, with the informal settlement's physical configuration creating a near-total vulnerability to any significant rainfall event. In these areas, inundation is not a risk but an inevitability when rainfall exceeds modest thresholds (Juma et al., 2023).

3.2.3. Encroachment on Riparian Reserves and Floodplains

Among the most persistent structural drivers of flooding in Nairobi is the illegal occupation and development of riparian land, the areas bordering rivers and water bodies that serve critical hydrological functions. Kenya's Water Act designates a 60-metre riparian buffer zone from any river or lake within which construction is prohibited. In practice, this regulation has been systematically violated by both formal developers with political connections and informal settlers with no viable housing alternatives (Jha et al., 2012; Inside Climate News, 2026).

A multi-agency assessment following the March 2026 floods identified encroachment on riparian reserves as a principal proximate cause of flood severity (Kiama et al., 2023). The true scale of this encroachment is illustrated by a spatial analysis conducted by Pamoja Trust in the informal settlements of Chieko, Budalangi, and Gituamba in Nairobi's Kasarani Sub-County, which identified approximately 700 residential buildings and an estimated 1,417 people living within the legally prohibited 60-metre buffer zone, alongside four schools and nine religious institutions. In stark contrast, the official satellite-based government assessment following the 2024 floods identified only approxi-

mately 118 affected buildings across the entire Kasarani area — a nearly sixfold undercount. Pamoja Trust submitted this finding as an Advisory Opinion to the Nairobi Rivers Commission, illustrating both the extent of riparian encroachment and the degree to which official flood-risk mapping fails to capture ground realities (Down to Earth, 2026). Brigadier Joseph Muracia of the Nairobi Rivers Regeneration Programme corroborated these findings, stating that deaths and displacement were directly linked to permanent structures within restricted river corridors, obstruction of waterways and stormwater drains by solid waste, and improper waste disposal, all contributing to what he described as “the increasing risks posed by extreme weather and the urgent need to safeguard human life” (Kiama et al., 2023).

The engineering consequence of riparian encroachment is well-established in hydrology. As Sean Avery, a Chartered Consultant in Hydrology and Visiting Research Fellow at King’s College London, explains, “Modern-day urban flood mitigation measures include the provision of flood storage basins. Unfortunately, this is impossible in Nairobi, where developments are built right up to the edge of watercourses. Constrained channels thereby cause upstream flooding as there is nowhere else for the water to go” (Jha et al., 2012). In response, the multi-agency Nairobi Rivers Regeneration Programme has initiated demarcation of riparian areas and river engineering works, including widening rivers to 30–35 metres to handle increased water volumes and restoring floodplains to absorb excess water (Kiama et al., 2023). Historically, however, attempts to reverse riparian encroachments have faltered due to legal challenges and political resistance. The programme’s longer-term success similarly depends on sustained political will, adequate funding, and critically, the resolution of the housing alternatives crisis, which currently makes riparian clearance a displacement exercise rather than a genuine risk-reduction measure.

3.2.4. Aging and Inadequate Drainage Infrastructure

Much of Nairobi’s stormwater drainage infrastructure was designed and constructed decades ago for a city a fraction of its current size and under pre-climate-change climatic conditions. As the city’s drainage infrastructure director confirmed, the Ministry is engaged in efforts to expand automated weather stations, improve hydrological modeling, and develop GIS-based flood forecasting systems.’ However, these are future improvements against a baseline of existing systems that are fundamentally inadequate (Garschagen et al., 2021). Key infrastructure deficiencies include severely undersized channels that cannot accommodate modern stormwater flow volumes; blocked and silted drains due to inadequate maintenance and solid waste mismanagement; and pervasive discharge of sewage effluent into stormwater drains, a practice documented even in high-income areas of the city (Jha et al., 2012).

Several major infrastructure developments within Nairobi have been implemented without comprehensive Flood Risk Assessments (FRAs), exacerbating rather than mitigating the drainage burden. The Nairobi Expressway, completed in 2022, is the most prominent example. Rather than incorporating an integrated stormwater management system as international best practice requires, additional drainage pipes were later introduced to collect their runoff and discharge it into the existing Uhuru Highway drainage network. The result was that the additional runoff from this vast infrastructure exceeded the design capacity of the existing drainage system, directly explaining the large volumes of flooding witnessed around the Uhuru/Haile Selassie roundabout during subsequent rain events (Kenya.co.ke, 2026). This pattern of infrastructure development without drainage integration is not limited to the expressway; it characterizes much of Nairobi’s recent construction boom.

The governance dimension of drainage failure is also significant. The physical planning process in Nairobi is hindered by corruption and fragmented institutional mandates (Inside Climate News, 2026). Multiple agencies, the Nairobi City County, KURA, Kenya National Highways Authority (KeNHA), and the Nairobi Rivers Commission, share overlapping responsibilities over drainage and riparian management, creating a diffusion of accountability in which enforcement responsibilities are contested, and clearance orders are routinely blocked in courts (Médecins Sans Frontières [MSF], 2024; Daily Nation, 2026d).

3.2.5. Climate Change and Intensifying Rainfall Extremes

Climate change functions as a critical amplifier of Nairobi's flood risk, compressing more rainfall into shorter, more intense bursts and delivering it onto a landscape that has simultaneously lost much of its natural absorption capacity. A 2024 World Weather Attribution (WWA) study found that climate change had made devastating rains in the East Africa region at least twice as likely as in a pre-industrial climate (WWA, 2024). Scientists at the Intergovernmental Panel on Climate Change (IPCC) have confirmed a discernible trend toward the intensification of extreme rainfall events across East Africa, with the region's bimodal seasons becoming less predictable and more intermittent (IPCC, 2021).

The March 2026 event recorded approximately 112mm of rainfall within 24 hours, exceeding the average monthly March rainfall total and overwhelming drainage systems not designed for such intensity (Civil Society in Development [CISU], 2026). Climate scientists note that temperatures above 25 degrees Celsius significantly increase atmospheric moisture that drives intense convective rainfall events, a condition increasingly observed across Nairobi's warming urban heat island (Nairobi City County Government [NCCG], 2025).

A critical and paradoxical climate effect further compounds flood severity: the 'climate whiplash' phenomenon, in which extended drought periods, such as the five consecutive failed rainy seasons between late 2020 and early 2023, the worst drought in 40 years, are followed by catastrophically intense rains (WWA, 2024; ACAPS, 2024). Prolonged drought compacts and desiccates soil, dramatically reducing its infiltration capacity. When extreme rain arrives, water runs off the hardened surface rather than being absorbed, producing flash-flood conditions even from rainfall volumes that historically would have been manageable. Nairobi's soil infiltration profiles have also been permanently altered by extensive groundwater over-abstraction: Nairobi's persistent water supply shortages have led to a proliferation of boreholes whose over-abstraction has resulted in a dramatic decline in underground water table levels, leading to aquifer compression and ground-level subsidence that creates low spots where stormwater collects and floods (Jha et al., 2012).

Looking forward, climate projections for East Africa consistently indicate further intensification of extreme rainfall events over the next 50 years, directly threatening metropolitan areas including Nairobi, Nakuru, Mombasa, Kisumu, and Eldoret (Wikipedia, 2026). The implications for flood risk and public health are profound and constitute an accelerating threat unless structural vulnerabilities are reduced simultaneously.

3.2.6. Upstream Land Degradation and Catchment Loss

Upstream land degradation in the catchment areas that feed Nairobi's rivers represents an often-overlooked yet significant flood amplifier. Larger floods are scouring out natural watercourses throughout Kenya due to land-use pressures; riparian vegetation cover is disappearing; and floodplains are being converted to agricultural or residential land, reducing their capacity to regenerate natural vegetation that attenuates floods by reducing the force of runoff and erosion (Jha et al., 2012).

Deforestation in the Aberdare and Mount Kenya catchments, which supply the principal rivers flowing through Nairobi, has increased sediment loads, altered flood hydrographs, and reduced the natural storage that historically buffered downstream communities from peak flows. The destruction of upstream wetlands further eliminates what were once important natural flood-storage systems. These upstream losses create flood conditions in Nairobi even during moderate-intensity rainfall events that would previously have been adequately buffered by intact catchment ecosystems (Ngome & Yeom, 2024).

3.3. Public Health Impacts of Recurrent Flooding

Flooding generates a complex, multi-phase cascade of public health consequences that extend far beyond the acute emergency phase. Where evidence is directly documented in Nairobi through primary or secondary sources, it is presented as such; where outcomes are supported by Kenya national data or are inferred from regional evidence, this is stated explicitly. Evidence from Nairobi's flood events consistently demonstrates impacts across at least six distinct pathways: direct mortality and injury; mass displacement and associated vulnerabilities; waterborne and enteric disease outbreaks; vector-borne disease resurgence; respiratory and chronic disease disruption; and mental health burden (Olando & Dick, 2026; Oluchiri, 2025a; Juma et al., 2023). The burden falls disproportionately on the urban poor, women, children, the elderly, and individuals with pre-existing health conditions who are both more exposed and less able to recover.

3.3.1. Direct Mortality and Injury

The most immediate public health consequence of flooding is acute mortality. In the March 2026 events, at least 66 people died across Kenya, with 33 fatalities documented in Nairobi specifically (BMC Research Notes, 2024; Daily Nation, 2026c). Causes of death were primarily drowning and electrocution from exposed or submerged power lines, a pattern consistent across all major recent Nairobi flood events and documented as the predominant mechanism of flood mortality in the city (Oluchiri, 2025b; Pamoja Trust, 2024). The demographic pattern of the March 2026 deaths is instructive: among 62 confirmed fatalities, 46 were men, 8 were women, and 8 were children (Daily Nation, 2026c). Men's higher fatality rates likely reflect greater occupational and mobility exposure, attempting to commute through floodwaters, recovering stranded vehicles, or maintaining commercial activities in flood-affected areas. Children's vulnerability reflects both physiological susceptibility and residence in flood-prone informal settlements.

The 2024 floods were considerably more lethal. At the Kenya national level, official government data recorded a death toll of 169, with 185,000 people displaced from their homes (ACAPS, 2024). Other reports placed the toll at 294 deaths with 162 people missing and 101,132 displaced (Wikipedia, 2026). Nairobi-specific disaggregated mortality figures for 2024 were not available in the sources reviewed. These discrepancies in official data likely reflect the undercount of deaths in informal settlements where community members are not formally registered and where bodies may not be recovered during flood emergencies.



3.3.2. Mass Displacement and Shelter Vulnerability

Mass displacement is a consistently severe secondary impact of Nairobi's floods. Documented directly in Nairobi, the March 2026 floods displaced approximately 50,000 residents, with an estimated 10,000 households affected across Kenya; by March 8, 4,845 people were displaced, and 10,000 households were affected nationally (Daily Nation, 2026c). According to Kenya national data in 2024, an estimated 380,000 people were affected, with approximately 293,661 people and 54,837 households displaced, 151 schools closed, and widespread damage to health facilities, water sources, and major roads (UNICEF, 2024). By July 2024, more than 400,000 people in Nairobi had been affected by flooding, with around 40,000 households in informal settlements forced to relocate (CISU, 2026).

Displaced persons face compounded health risks. Loss of shelter exposes individuals to hypothermia (particularly children), respiratory infections from cold and damp conditions, and violence, including gender-based violence, which UNICEF notes is 'most likely to exacerbate as the support systems have been affected' (UNICEF, 2024). Crowded displacement camps and makeshift shelters in schools and government buildings lack proper sanitation infrastructure, creating conditions for accelerated infectious disease transmission. MSF's assessment in Nairobi's Eastlands following the 2024 floods documented approximately 1,000 displaced individuals temporarily housed in nine locations, with field teams encountering cases of acute mental trauma (Olando & Dick, 2026). MSF's

Head of Mission in Kenya, Hajir Elyas, reported that ‘the immediate needs include shelter, access to safe water and sanitation, access to health care, mental health needs, access to medicines for people with chronic diseases, and access to food’ (People’s Daily Digital, 2026).

The displacement crisis is systematically underestimated. Because the government does not formally recognize many informal settlement communities and residents lack formal property rights, their numbers rarely appear fully in official estimates (Down to Earth, 2026; Eastleigh Voice, 2026). Communities displaced by floods but lacking legal tenure are effectively ineligible for government relocation support, leaving them to return to the same flood-prone areas after each event (UN-Habitat, 2025).

3.3.3. Waterborne Disease Risk: Mechanisms and High-Risk Groups

Waterborne and enteric pathogens account for the majority of the post-flood disease burden in Nairobi. Floodwater in the city is typically a complex mixture of sewage effluent (Perić & Cvetković, 2019), animal waste, industrial chemical runoff — particularly from the petrochemical and automotive industries concentrated in flood-affected areas, and contaminated soil, carrying key pathogenic agents including *Vibrio cholerae* (cholera), *Salmonella typhi* (typhoid), *Shigella* spp. (dysentery), and multiple serotypes of diarrhoeagenic *Escherichia coli*. Flooding contaminates drinking water sources through multiple simultaneous mechanisms: sewage overflow as combined sewer systems are overwhelmed; industrial chemical runoff from the dense concentration of petrochemical businesses, mechanics workshops, and light industry in flood-prone areas such as Grogan; direct mixing of floodwaters with pit latrines and open defecation sites; and rupture of water distribution pipelines. These pathogens enter the body through ingestion of contaminated water or food exposed to floodwaters, skin abrasions and wounds from wading through floodwaters, and contact with contaminated surfaces during clean-up activities. Critically, disruption of water treatment and distribution infrastructure means that even households with piped connections may receive contaminated supplies for days or weeks following flooding. Risk is highest for children under five, the elderly, and immunocompromised individuals — including those living with HIV/AIDS, who constitute a significant proportion of Nairobi’s informal settlement population. As CFK Africa’s response team observed in Kibera and Viwandani in 2024, floodwaters contaminated water sources by mixing with pit latrines and sewer lines, producing gastrointestinal diseases associated with faecal-oral transmission, while long-term exposure to contaminated floodwater also caused bacterial and fungal skin infections (CFK Africa, 2024). Brown Ashira, public health consultant and Secretary-General of the Kenya Environmental Health and Public Health Practitioners’ Union, similarly confirms that heavy rainfall and flooding reliably produce communicable disease outbreaks through contamination of water sources, increased disease vector breeding, community displacement, and disruption of sanitation systems (Tariq & van de Giesen, 2021).

Cholera represents the most acute and well-documented post-flood enteric disease risk in Nairobi. Nairobi and Mombasa have been consistently identified as high-priority cholera hotspots in Kenya’s national cholera elimination planning, driven by the combination of large urban populations in informal settlements and inadequate water and sanitation infrastructure (Reuters, 2026). Kenya recorded nearly 9,000 cholera cases and 145 deaths in 2023 alone (WHO, 2024). Between January and March 2024 the country recorded 289 cases; since the onset of flooding in March 2024, 48 cholera cases were documented in Tana River County alone, with cases rising as floodwaters contaminated water sources across multiple counties (ACAPS, 2024). By May 2024, the floods had triggered a fourth wave of an ongoing cholera outbreak (UNICEF, 2024). WHO Kenya-supplied cholera kits in Nairobi County alone treated an estimated 1,100 mild and severe cases across the 2022–2024 outbreak period (Borgen Project, 2025). Following the March 2026 floods, the chief executive of Amref, Dr. Githinji Gitahi, warned that Kenya must brace for outbreaks of cholera, typhoid, and acute diarrhoeal diseases, given that floodwaters had contaminated drinking sources across the country and an active cholera outbreak was already under way before the rains arrived (Oluchiri, 2025a).

It is important to note that cholera case counts reported in association with flooding events may not represent flood-attributable cases alone. Given that Kenya, and Nairobi specifically, experienced an active and ongoing cholera outbreak throughout the 2022–2024 period, the figures cited above reflect the compound burden of pre-existing endemic transmission accelerated by flood-related contamination, rather than a discrete flood-caused cholera incidence. Direct causal attribution of specific case counts to individual flood events is not possible from the available data; the appropriate interpretation is that flooding substantially amplifies an already-elevated baseline risk (Reuters, 2026; ACAPS, 2024).

The destruction of sanitation infrastructure during flooding severely and durably compounds the disease burden. In 2024, over 20,000 pit latrines and toilets in Kenyan schools were either sunken or severely damaged by floodwaters, posing direct disease-transmission risks to more than two million children even after floodwaters receded (ACAPS, 2024). The principal of Ruiru Girls' Secondary School reported that over 20 ablution block toilets collapsed due to heavy rains, leaving more than 1,031 learners without sanitation facilities (The East African, 2024). Nairobi City Water and Sewerage Company reported multiple pipeline ruptures during the March 2026 floods, requiring emergency repairs before a safe water supply could be restored to affected areas (The Standard, 2024).

3.3.4. Vector-Borne Disease Resurgence

A predictable surge invariably follows the flooding season in vector-borne diseases, primarily malaria. Stagnant flood residue and standing water in displaced settlements, damaged infrastructure, and abandoned containers provide ideal breeding sites for *Anopheles* mosquitoes. Consistent with evidence from Kenya national public health authorities, Dr. William Olaka, Director of Public Health in Kakamega County, confirms the mechanism: 'When floods displace people, they mostly seek shelter in areas where mosquitoes are likely to breed in large numbers. Rain creates more breeding sites through stagnant water. People are then exposed to mosquito bites, putting them at risk of malaria (Oluchiri, 2025a). No Nairobi-specific post-flood malaria incidence data were available in the sources reviewed; the causal mechanism is inferred from the established relationship between flood-generated stagnant water and mosquito breeding in Nairobi's informal settlements, consistent with the national pattern. Malaria incidence typically rises within two to six weeks of major flooding events in Nairobi and western Kenya.

Beyond malaria, MSF has highlighted that 'In the aftermath, an increase in breeding sites for mosquitoes may lead to malaria outbreaks' and has confirmed preparedness to 'increase disease surveillance and collaborate with hospitals to respond to potential outbreaks' (People's Daily Digital, 2026). At the Kenya national level, the March 2026 floods prompted the Kenya Ministry of Health to announce an active flu outbreak associated with the long rainy season, and public health authorities issued warnings of elevated dengue fever risk due to expanded mosquito breeding habitats, adding to a vector-borne disease burden compounded by post-flood population displacement (Oluchiri, 2025a; Tariq & van de Giesen, 2021).

3.3.5. Respiratory Disease, Chronic Condition Disruption, and Skin Infections

Cold, damp post-flood conditions create conditions for increased respiratory tract infections- including pneumonia, bronchitis, and asthma exacerbations particularly among children, the elderly, and individuals with pre-existing respiratory conditions. Following the 2024 floods in Nairobi's Mathare neighborhood, MSF teams distributed warm clothing to approximately 500 children presenting with hypothermia symptoms (Olando & Dick, 2026). Prolonged contact with contaminated floodwater also causes bacterial and fungal skin infections; CFK Africa staff in Kibera encountered individuals whose 'feet had turned white due to long hours of being immersed in water' (CFK Africa, 2024).

Flooding disrupts access to health facilities and medication supply chains, creating dangerous interruptions in treatment for chronic conditions including HIV/AIDS, tuberculosis, diabetes, hypertension, and epilepsy. As Médecins Sans Frontières documents, flood-related health risks include ‘complications from interrupted medication regimens for chronic diseases’ (Olando & Dick, 2026). In a city where HIV prevalence is high in informal settlement populations and where antiretroviral therapy adherence depends on consistent drug supply and facility access, flood-induced supply chain disruptions can have serious clinical consequences.

3.3.6. *Mental Health Burden*

The mental health consequences of recurrent flooding in Nairobi represent a significant but systematically undercounted public health burden. Communities experiencing repeated flooding and displacement - losing their homes, possessions, and livelihoods in successive flood seasons with no prospect of permanent solutions- carry accumulating trauma that standard health surveillance does not capture. Médecins Sans Frontières field teams in 2024 found ‘a few who were in acute mental trauma,’ including a mother who had lost a child to the floods (Olando & Dick, 2026). Consistent with evidence from Nairobi and Kisumu informal settlements, Pamoja Trust, working with informal settlement communities in Kisumu and Nairobi, has documented that participatory loss assessments capture not only material losses but also ‘non-material impacts such as anxiety and trauma resulting from repeated flooding and displacement’ (Down to Earth, 2026).

Experts note that while Médecins Sans Frontières addresses urgent medical needs, ‘broader recovery will require sustained efforts from multiple sectors, including the government, to rebuild and support affected communities,’ with explicit recognition that ‘the impact of these floods is profound, with long-term implications for livelihoods, infrastructure, and mental health’ (People’s Daily Digital, 2026). The psychological burden falls disproportionately on communities with the least access to formal mental health services, precisely the informal settlement populations most repeatedly flooded.

3.3.7. *Health System Impacts*

Flooding directly damages health facilities, disrupts pharmaceutical supply chains, and simultaneously generates massive spikes in emergency demand. Following the 2024 floods, schools, health facilities, water sources, and major roads were damaged across 41 counties (ACAPS, 2024). CFK Africa documented that ‘flooded roads have significantly restricted travel, making it difficult for patients to access our facilities and further straining the already limited access to healthcare in Kibera’ (CFK Africa, 2024). The health system’s adaptive capacity is further compromised by the 2024 nationwide doctors’ strike (which began March 14, 2024), coinciding with the onset of catastrophic flooding, leaving the healthcare system simultaneously understaffed and overwhelmed with flood-related emergencies (ACAPS, 2024).

Kenya’s disease surveillance infrastructure - the Kenya Health Information System (KHIS2/DHIS2) operating through the Integrated Disease Surveillance and Response (IDSR) strategy, theoretically provides the framework for rapid flood-associated disease detection. However, timely, publicly accessible data at the city-ward or sub-county level remains limited (The Standard, 2026). Passive surveillance through health facility reporting is the primary mechanism. However, displaced populations who cannot reach health facilities and residents of informal settlements who may avoid formal care due to cost, distance, or lack of documentation are systematically undercounted in disease surveillance data.

3.4. *Policy and Governance Gaps*

A central finding of this review is that Nairobi’s recurrent flood disasters are fundamentally governance failures rather than natural inevitabilities. Kenya possesses the legal frameworks, technical

institutions, scientific knowledge, and international development partnerships to reduce flood risk substantially. The persistent gap lies in enforcement capacity, political will, inter-agency coordination, and the structural exclusion of the urban poor from planning and decision-making processes (MSF, 2024; Down to Earth, 2026). The National Coordinator of People's Health Movement Kenya, Dan Owala, stated directly: 'The loss of life and property is not just due to heavy rains. It exposes long-standing flaws in urban planning, drainage, and emergency preparedness (MSF, 2024).

For analytical precision, and consistent with the disaster governance literature (The Star, 2026b; Daily Nation, 2026d), the governance failures documented in this review are organized into three distinct categories. Legal failures occur where a clear statutory mandate exists, but enforcement mechanisms are absent or ineffective - the law is on the books but not in practice. Administrative failures occur where institutional capacity, coordination structures, or resource allocation are the binding constraint, such that the intent to act may exist, but the institutional machinery to deliver it does not. Political failures occur where political interests, corruption, or electoral incentives explain why legally mandated or technically feasible actions have not been taken — the machinery exists but is captured or diverted by competing interests. These categories are not mutually exclusive; several governance failures in Nairobi exhibit multiple failure modes simultaneously, as noted below. The original sub-sections 6.1 through 6.5 are retained within the narrative but are now grouped under these analytical categories to make the diagnostic logic explicit.

3.4.1. Legal Failures: Statutory Mandates Without Enforcement

Legal failures are characterized by a gap between what the law requires and what is enforced in practice. In Nairobi's flood governance context, this gap is pervasive and extends across multiple statutory instruments.

Kenya's Water Act, Physical Planning Act, and Environmental Management and Coordination Act collectively provide clear legal mandates for the protection of riparian buffer zones, floodplain management, and development restrictions in flood-prone areas. In practice, these mandates have been systematically violated for decades. It is documented that the lack of enforcement of building regulations, including riparian reserve protection, is compounded by the multiplicity of actors involved, which creates confusion about institutional roles in flood disaster response. The legal prohibition on construction within the 60-meter riparian buffer zone is widely known but routinely ignored by both private developers and informal settlers, with the gap between legal prescription and enforcement reality now visible at the citywide scale (Jha et al., 2012; Inside Climate News, 2026).

A second legal failure is the absence of a binding domestic statutory requirement for Flood Risk Assessments (FRAs) prior to infrastructure approval, despite Kenya being a signatory to the Sendai Framework for Disaster Risk Reduction 2015–2030, which explicitly requires pre-development risk assessments. Several major infrastructure developments in Nairobi have been approved and constructed without comprehensive FRAs, with the Nairobi Expressway being the most prominent example. The Standard's analysis of Nairobi's flood risk management confirmed that 'several major infrastructure developments within Nairobi have been implemented without comprehensive FRAs' (Kenyans.co.ke, 2026). Without a legally enforceable domestic FRA mandate, infrastructure continues to be designed to historical rainfall parameters that climate change is already rendering obsolete.

A third legal failure is embedded in Kenya's land tenure and planning legislation, which does not formally recognize informal settlements as legitimate residential areas. This legislative gap denies informal settlement residents legal standing in flood response and recovery processes. Because the government does not formally recognize informal settlement communities and residents lack formal property rights, their numbers rarely appear fully in official estimates (Down to Earth, 2026; Eastleigh Voice, 2026). Communities displaced by floods but lacking legal tenure are effectively ineligible for government relocation support, leaving them to return to the same flood-prone areas after each event (Nkengasong & Smith, 2024). The resulting undercount of affected populations, documented at a factor of six or more in Kasarani, means that official responses are structurally inadequate from the outset (Down to Earth, 2026).

3.4.2. Administrative Failures: Fragmented Mandates and Absent Coordination Structures

Administrative failures are those in which the institutional architecture for flood risk management is structurally inadequate, regardless of whether political will to act exists. In Nairobi, three distinct administrative failures compound one another.

The first is the fragmentation of institutional mandates over flood-relevant functions across multiple agencies with overlapping and sometimes conflicting responsibilities. The Nairobi City County, the Nairobi Rivers Commission, the National Land Commission, National Environment Management Authority (NEMA), KURA, KeNHA, and Kenya Rural Roads Authority (KeRRA) all simultaneously hold responsibilities over drainage management, riparian enforcement, or road infrastructure — functions that are inseparable in flood risk terms. The March 2026 floods illustrated this acutely: Nairobi Governor Johnson Sakaja was required to convene an emergency meeting involving principal secretaries from multiple national ministries and representatives from six separate agencies to coordinate the response to a single city-level flood event (The Star, 2026c; Tricco et al., 2018). The necessity of improvising this coordination meeting after the disaster, rather than activating a pre-existing operational structure, is itself an administrative failure. As Dan Owala of People's Health Movement Kenya observed, authorities continue to be caught off guard, scrambling to respond to crises that better planning could have prevented' (MSF, 2024).

The second administrative failure is the absence of a legal requirement for Flood Risk Assessments as a gate-keeping condition within the planning approval process. While the preceding sub-section identifies this as a legal gap, it also has an equally important administrative dimension: planning agencies lack embedded technical review procedures to screen infrastructure proposals for flood impacts before approval. The result is that several major developments, including the Nairobi Expressway, were approved and constructed without comprehensive FRAs, with entirely foreseeable drainage consequences (Kenyans.co.ke, 2026; Ngome & Yeom, 2024). Effective Flood Risk Management begins with Flood Risk Assessments that inform infrastructure design and land-use planning before development occurs (Kenyans.co.ke, 2026); the administrative systems to operationalize this principle do not yet exist.

The third administrative failure is the forecast-to-action translation gap in the early warning system. Kenya has developed progressively more capable climate monitoring infrastructure. The Kenya Meteorological Department issued a forecast on February 25, 2026, ten days before the catastrophic March 6 event, warning of heavy rainfall across multiple regions (Daily Nation, 2026c). On March 19, 2026, the National Disaster Operations Centre (NDOC) identified 37 flood-prone areas across Nairobi and issued a formal flood-risk alert (UNICEF, 2024). Despite these warnings, preparedness actions were insufficient to prevent significant additional loss of life and infrastructure damage. Kenya's Emergency Alert and Response System (EARS), developed with CDC support, represents a significant technical investment (UN-Habitat, 2020). However, the critical administrative gap lies in translating national-level meteorological forecasts into concrete community-level preparedness actions, particularly for residents of informal settlements who cannot easily relocate, cannot afford to reinforce their structures, and have no formal authority to act on city-level alerts without explicit community-level coordination mechanisms. No standing operational protocol links forecast receipt to the activation of community-level preparedness. This is an administrative gap, not merely a technical one.

3.4.3. Political Failures: Corruption, Electoral Incentives, and Structural Exclusion

Political failures are the most resistant to technical solutions because they are produced not by a lack of knowledge or capacity but by the deliberate or structurally incentivized actions of political actors. In Nairobi's flood governance, four distinct political failures are identifiable, each perpetuating the legal and administrative gaps described above.

The first is corruption in the physical planning process. While the legal prohibition on riparian encroachment applies equally to all actors, its enforcement is selective. Corruption allows political-

ly connected developers to construct within prohibited riparian zones with impunity. At the same time, informal settlers, who settle in the same areas due to the absolute absence of viable, affordable housing alternatives, face the risk of uncompensated eviction. This differential enforcement produces a system in which the law's protection is available to the politically connected and its penalties fall disproportionately on the politically marginal (Jha et al., 2012; Inside Climate News, 2026). Clearance orders are routinely challenged and blocked in courts by developers with legal resources, while enforcement against informal settlers proceeds without equivalent procedural protections (MSF, 2024; Daily Nation, 2026d).

The second political failure is the absence of meaningful housing alternatives for informal settlement communities living in riparian and flood-prone areas. Forced evictions along Nairobi's River corridors may be legally justified under Kenya's Water Act. However, as Olando and Dick (2024) argue, they 'perpetuate the root causes of vulnerability, including historical social inequalities and politically institutionalized exclusion' without providing genuine risk reduction. The government's March 2024 announcement that flood victims would receive KES 10,000 (USD 70) to find alternative accommodation exemplifies the inadequacy of displacement-without-solutions approaches (ACA-PS, 2024). UN-Habitat explicitly recognizes that secure access to adequate housing and land is 'essential to protect urban populations from the effects of climate change' (UN-Habitat, 2025). Evictions without meaningful alternative housing provision merely relocate poverty rather than eliminating the structural conditions that produce flood vulnerability. The chronic absence of housing alternatives is not a resource impossibility; it reflects the sustained political marginalization of the urban poor in public expenditure decisions.

The third political failure is the pattern of reactive, post-disaster investment that substitutes for sustained preventive governance. Following the March 2026 floods, Transport Cabinet Secretary David Chirchir announced that KURA had set aside KSh 8 billion to address Nairobi's drainage and flooding problems (UN-Habitat, 2025). This response, while significant in scale, follows a well-established cycle in which every major flood event generates emergency commitments that are not preceded by equivalent pre-disaster investment. Governor Sakaja similarly ordered an emergency 48-hour action plan and instructed agencies to prepare comprehensive infrastructure reports (The Star, 2026c), work that, had it been conducted routinely, would have prevented the disaster. Civil society organizations were explicit: 'Seasonal flooding is not new in Nairobi or other African cities, yet authorities continue to be caught off guard' (MSF, 2024). The political economy of flood governance rewards visible emergency responses over invisible preventive maintenance, producing a structural incentive for reactive rather than proactive governance.

The fourth political failure is the systematic exclusion of flood-affected communities from the planning, governance, and resilience-building processes that determine their flood exposure. Informal settlement residents, the primary victims of Nairobi's flooding, are often not formally recognized as legal city residents, lack formal land rights and property titles, and are therefore excluded from official flood impact assessments, recovery planning, and development processes (Down to Earth, 2026). This is not merely a consequence of the legal tenure gap described in Section 6.1: it reflects a sustained political choice to exclude the urban poor from planning entitlements. The gap between the accuracy of community-led flood-impact data and that of official satellite assessments, documented as a factor of six or more in Kasarani, illustrates the practical cost of this exclusion (Down to Earth, 2026). Community organizations have already demonstrated the feasibility of more inclusive approaches: Pamoja Trust is described as 'a pioneer in community-led planning', having applied participatory spatial analysis to produce flood impact data of far greater accuracy than official assessments (Down to Earth, 2026). UN-Habitat's Strategic Plan 2026-2029 acknowledges the need for 'settlement- and community-based approaches to enable context-specific preparedness and response, while safeguarding housing, land and property rights' (UN-Habitat, 2025). However, incorporating community-led data and planning approaches into formal government processes remains an unresolved structural challenge, reflecting the political resistance of established planning agencies to sharing data authority and decision-making power with informal settlement communities.

4. Discussion

This review confirms that Nairobi's recurring flood disasters are neither primarily natural nor inevitable. As the Daily Nation's historical analysis documents, 'Nairobi did not become a flood victim with the ongoing rains. It was born one', but the city's vulnerability has been profoundly worsened by decades of policy failures (APHRC, 2021). Rain is the occasion; structural failure is the cause. The city was founded on a hydrologically challenging site and grew at a pace that systematically outstripped its physical, institutional, and governance infrastructure. Each major flood event has been followed by official expressions of urgency and pledges of reform that have rarely translated into the structural changes required to break the cycle.

To understand why this cycle persists, it is analytically necessary to distinguish between three different tiers of causation, each operating at a different level of the system and requiring a different category of intervention. This tripartite framework aligns with the Pressure and Release model of disaster vulnerability developed by Wisner et al. (2004), which distinguishes between root causes, dynamic pressures, and unsafe conditions as progressively proximate contributors to disaster outcomes, and connects to the broader IJDRM literature on urban disaster governance (Juma et al., 2023; Daily Nation, 2026d).

Proximate causes are the immediate physical triggers of individual flood events: intense, short-duration rainfall, drainage-channel overflow, and river-bank breach. These are the causes most visible in post-disaster reporting and the focus of emergency response. In the March 2026 event, the proximate cause was 112mm of rainfall in 24 hours, overwhelming already-degraded drainage infrastructure (Avery, 2024). In the 2024 floods, the proximate cause was sustained El Niño-enhanced long rains saturating soils and filling rivers (ACAPS, 2024). Addressing proximate causes means improving early warning systems, clearing drainage channels before the rainy season, and rapidly deploying emergency response capacity. These are necessary but not sufficient measures.

Underlying structural drivers are the accumulated physical and demographic conditions that make the city systemically flood-vulnerable, converting moderate rainfall into catastrophic flood events. These include: illegal riparian encroachment, eliminating the 60-meter buffer zone required under Kenya's Water Act; loss of permeable green space through unplanned urbanization; aging stormwater drainage infrastructure designed for a city a fraction of its current size; and upstream catchment degradation, reducing natural retention capacity. These structural drivers have accumulated over decades and will not be reversed by any single season's response. They represent what Wisner et al. (2004) term 'unsafe conditions', the physical and social landscape that translates hazard into harm.

Governance amplifiers are the institutional and political failures that prevent structural drivers from being addressed and that impair the capacity to respond effectively when floods occur. They include: fragmented mandates across the Nairobi City County, KURA, KeNHA, the Nairobi Rivers Commission, and NEMA, creating diffused accountability; unenforced riparian buffer regulations enabling continued encroachment; the systematic absence of Flood Risk Assessments from major infrastructure approvals; and the exclusion of informal settlement communities from planning and recovery processes. These are not merely administrative inefficiencies but the root causes, in the sense used by Wisner et al. (2004), of the political and economic structures that generate and sustain vulnerability. Addressing governance amplifiers requires institutional reform, legal accountability, and political will operating across electoral cycles.

This three-tier distinction has direct implications for the recommendations presented in Section 8, which are structured accordingly: short-term actions address proximate causes; medium-term actions address underlying structural drivers; and long-term actions address governance amplifiers. This alignment between the analytical and action frameworks is itself a core argument of this review: effective flood risk reduction requires interventions at all three tiers simultaneously, not merely the most visible proximate tier.

4.1. The Systemic Nature of Nairobi's Flood Vulnerability

The five environmental determinants identified in this review are mutually reinforcing, creating a compounding flood-risk system. As the Flood–Vulnerability–Health Nexus framework presented in Section 4.1 and summarized in Table 4 makes explicit, these determinants do not operate in isolation but interact with specific governance failures to produce and amplify public health consequences. Unplanned urbanization converts permeable surfaces to impermeable ones while simultaneously expanding the population in flood-exposed locations. Riparian encroachment eliminates natural flood storage while creating settlements that amplify human risk when rivers overflow. Inadequate drainage fails to compensate for the loss of natural attenuation capacity. Climate change intensifies all these dynamics by delivering more extreme rainfall events to a landscape that has simultaneously lost its natural resilience. Upstream catchment degradation accelerates runoff before it even reaches the city. At each step, governance failures: unenforced regulations, fragmented mandates, absent flood risk assessments, and community exclusion, function not merely as co-existing weaknesses but as active amplifiers that prevent each environmental vulnerability from being corrected before it generates the next cascade of public health harm. Together, these factors do not add to, but multiply, flood risk in ways that isolated technical interventions cannot adequately address, and it is this interactive, systemic character of Nairobi's flood crisis that justifies the integrated analytical approach adopted throughout this review.

4.2. Public Health as the Primary Framework for Flood Response

This review argues that treating Nairobi's flooding as primarily an infrastructure or engineering problem fails to capture the full scale and nature of the crisis. The public health burden, encompassing acute mortality and injury, mass displacement and associated vulnerabilities, post-flood enteric and vector-borne disease outbreaks, mental health trauma, chronic disease disruption, and long-term nutritional and livelihood insecurity, constitutes a public health emergency that demands the systematic, proactive involvement of public health institutions in flood risk governance (Olando & Dick, 2026; Oluchiri, 2025a; Juma et al., 2023).

The diarrhoeal disease risk in post-flood Nairobi is particularly acute and particularly illustrative of this argument. The city's combined sewer and stormwater drainage system consistently fails during heavy rains, simultaneously contaminating drinking water sources and flood evacuation routes. Nairobi's pre-existing cholera endemicity, with the informal settlements of Nairobi and Mombasa identified as high-priority hotspots in Kenya's national cholera elimination program (Reuters, 2026), creates a dangerous epidemiological baseline that flooding reliably and predictably exacerbates. This predictability means that post-flood disease outbreaks are not unforeseeable emergencies but expected public health consequences that can and should be prepared for systematically before each rainy season.

4.3. Equity, Land Rights, and the Urban Poor

Flood mortality and morbidity in Nairobi are not randomly distributed. They concentrate in informal settlements along riparian corridors not because the urban poor are unaware of the risk, but because Kenya's land markets, governance failures, and historical social inequalities have systematically excluded low-income migrants from safe, affordable, formal housing (Down to Earth, 2026; Nkengasong & Smith, 2024). As a result, the effective zoning of poverty into flood risk zones is not a market failure but a governance product, one that requires governance solutions.

The equity dimension of flood governance is acute in the context of riparian clearance programs. Forced evictions of residents of informal settlements from river corridors may reduce immediate flood exposure for cleared communities. However, without adequate alternative housing, they displace residents to other informal settlements, where comparable risks may exist. Misereor's research has documented that evictions perpetuate the root causes of vulnerability, including historical social

inequalities and politically institutionalized exclusion, when conducted without adequate participation and alternatives (cited in Olando & Dick, 2026). The government's March 2024 announcement that flood victims in Nairobi would receive KES 10,000 (USD 70) to find alternative accommodation exemplifies the inadequacy of displacement-without-solutions approaches (ACAPS, 2024).

4.4. *Climate Change as Accelerant and Complicating Factor*

Climate change does not create Nairobi's flood problem, but it accelerates and intensifies it in ways that are already measurable and will worsen. The 2024 World Weather Attribution finding that climate change has made devastating rains in the region at least twice as likely as before (WWA, 2024) means that the same infrastructure now faces double the probability of being overwhelmed. Climate projections consistently indicate further intensification of extreme rainfall over East Africa's cities over the next 50 years (Wikipedia, 2026), meaning that a city with today's flood vulnerabilities will face substantially greater flood risk by 2050.

The climate whiplash phenomenon - alternating drought and extreme flood- adds a dimension of unpredictability that complicates flood risk governance. As experts note, it is 'very clear that Nairobi is not prepared for these events' because 'it is difficult to move from one extreme of a response to the other one' (WWA, 2024). Drought-adapted infrastructure and governance frameworks do not translate easily into flood-response capabilities, and vice versa. Designing for climate resilience across the full range of climate extremes, rather than optimizing for average conditions, is the appropriate planning paradigm but remains far from standard practice in Nairobi.

Promising adaptation models exist. Rwanda's capital, Kigali, has spent a decade converting degraded swamps into functioning wetlands designed to absorb both water and carbon (WWA, 2024). Cities such as Philadelphia and Copenhagen have restored wetlands and reinforced drainage systems as part of the 'Sponge City' movement. The construction of new drainage channels in Nairobi's Mathare has demonstrably reduced flood damage in targeted areas (CISU, 2026). These precedents demonstrate the technical feasibility of the required interventions; the constraints are political and financial, not technical.

4.5. *The Role of Data and Surveillance in Flood-Health Response*

A cross-cutting finding of this review is the critical importance and current inadequacy of health surveillance data for informing flood-associated disease response. The Kenya Health Information System (KHIS2/DHIS2) provides the infrastructure for surveillance data collection, and the IDSR strategy provides the framework for outbreak detection (The Star, 2026a). However, the existing system has several structural weaknesses in the flood response context: data are typically aggregated at the sub-county level rather than ward or settlement level, limiting geographic precision for targeted response; reporting is primarily facility-based, systematically excluding displaced populations who cannot reach health facilities; and timely, publicly accessible data for real-time decision-making at the county level remains limited.

Community health promoter (CHP) networks represent an underutilized resource for improving post-flood disease surveillance. CHPs operating in informal settlements are positioned to detect and report early signs of disease outbreaks before they escalate. Linking CHP observations to digital reporting platforms connected to the KHIS2 system with pre-defined trigger thresholds for cholera, diarrhoeal disease clustering, and malaria spikes that automatically activate a defined response cascade would represent a significant improvement in early outbreak detection and response capability. This recommendation draws on models tested in East African countries that have integrated community-level surveillance with national digital health platforms (The Star, 2026a).

4.6. Geographic Scope of Evidence: Nairobi-Specific, National, and Regional Findings

A deliberate analytical distinction is maintained throughout this review between evidence that is Nairobi city-specific, evidence that is Kenya-wide in scope, and evidence drawn from the broader East African or sub-Saharan African regional context. Readers should note the following geographic attributions as they interpret the findings presented across Sections 4, 5, and 6.

Nairobi city-specific evidence includes: the March 2026 flood mortality figures (33 fatalities within Nairobi; 66 nationally); displacement of approximately 50,000 Nairobi residents in March 2026; the 112mm 24-hour rainfall intensity triggering that event; riparian encroachment findings from the Kasarani spatial analysis (Down to Earth, 2026); Nairobi Expressway drainage failures (Kenyans.co.ke, 2026); the Mathare and Kibera inundation studies (Vatican News, 2026; Juma et al., 2023); cholera hotspot designation of Nairobi's informal settlements (Reuters, 2026); and MSF field assessments in Eastlands and Mathare (Olando & Dick, 2026).

Kenya national-level evidence includes: the April–May 2024 flood death toll of 267 and national displacement of approximately 380,000 people across 87% of counties (ACAPS, 2024); Kenya's national cholera burden of nearly 9,000 cases in 2023 (World Health Organization [WHO], 2024); the national cholera elimination programme designating Nairobi and Mombasa as priority hotspots (Reuters, 2026); national early warning system advisories issued by the Kenya Meteorological Department (Daily Nation, 2026; UNICEF, 2024); and the KSh 8 billion KURA drainage commitment (UN-Habitat, 2025). Where national statistics are used in this review, they are explicitly framed as a national context for Nairobi-specific analysis rather than as city-level findings.

Regional and global comparative evidence, including climate attribution findings for East Africa (WWA, 2024), sub-Saharan Africa urbanization projections (CFK Africa, 2024), and global urban flood burden statistics (Centres for Disease Control and Prevention & Global Implementation Solutions Worldwide, 2020), is used solely to contextualize Nairobi's experience within broader structural trends and is not presented as direct evidence of conditions within Nairobi city. Readers should treat Nairobi-specific claims and national or regional contextual framing as analytically distinct throughout this review.

4.7. Limitations

This review has several limitations that should be considered when interpreting its findings. Five are identified here as particularly material to the strength and scope of conclusions that can be drawn.

Source heterogeneity. The synthesis integrates evidence from peer-reviewed literature, grey literature, government and humanitarian agency reports, and credentialed media sources. These source types differ substantially in methodological rigor, data definitions, measurement approaches, and reporting completeness. Peer-reviewed sources underwent formal expert review; grey literature and media sources did not. As a consequence, some claims rest on a stronger evidentiary foundation than others. The tiered sourcing framework described in Section 2.3, which assigns higher evidentiary weight to Tier 1 peer-reviewed and official sources, mitigates but does not fully resolve the risks of inconsistent methodological quality across the evidence base. Readers should exercise particular caution in drawing strong causal inferences from findings supported solely by Tier 3 sources.

Publication bias. The available literature on urban flooding in Nairobi is likely biased toward severe, politically salient, or unusually lethal events that attract media, policy, and research attention. Smaller floods, chronic low-level inundation affecting informal settlements outside the major rainy seasons, and cumulative incremental impacts on health and livelihoods are probably underrepresented in the available evidence base. This means that the public health burden and the frequency of flood exposure documented in this review may be conservative estimates of the full chronic burden borne by vulnerable communities. There is also a risk that the documented evidence over-represents Nairobi's most studied informal settlements, notably Kibera, Mathare, and Mukuru, relative to less-studied flood-prone areas across the city.

Use of non-peer-reviewed material. The inclusion of non-peer-reviewed sources was a deliberate methodological decision, justified by the recency and policy relevance of the events under review, and by the recognized limitations of peer-reviewed literature in capturing rapidly evolving humanitarian and environmental crises (see Section 2.3). However, this approach carries acknowledged limitations. Non-peer-reviewed sources have not undergone independent expert scrutiny of their data collection methods, analytical assumptions, or conclusions. The strength of causal inference that can be drawn from findings supported primarily by such sources is therefore constrained. Throughout this review, non-peer-reviewed sources are used primarily to document facts and events rather than to establish causal mechanisms; causal analysis relies, wherever possible, on peer-reviewed evidence.

Single-author extraction. A single author performed data extraction and thematic coding without independent second-reviewer screening. This approach is consistent with the resources available for this review but does not fully exclude reviewer bias in source selection, inclusion decisions, and thematic assignment. The use of a pre-designed extraction template and a separate coding log (described in Section 2.5) provides some procedural safeguards against arbitrary decisions, and the extraction log is available from the author to ensure transparency. Future systematic reviews on this topic would benefit from dual-reviewer screening to strengthen the reproducibility of inclusion and coding decisions.

Rapidly evolving evidence base. Several sources included in this review document events as recent as March 2026. At the time of submission, a fuller peer-reviewed analysis of those events, including the March 2026 Nairobi floods, was not yet available in the published literature. Findings relating to the most recent events, therefore, rest more heavily on grey literature, humanitarian rapid assessments, and credentialed media reporting than they would for more established flood events. As peer-reviewed analyses of the 2024 and 2026 flood events enter the published record, the evidence base underpinning several of this review's findings will strengthen. This review should be read as reflecting the state of evidence available as of March 2026.

5. Recommendations

Based on the evidence synthesized in this review, and drawing on the specific lessons of the 2024 and 2026 Nairobi floods, the following evidence-grounded recommendations are presented. To maximize actionability, the recommendations are organized into a three-tier temporal framework aligned with the causal analysis presented in Section 7.1. Short-term recommendations (0–12 months) target proximate causes and can be initiated immediately using existing institutional authority and available resources. Medium-term recommendations (1–5 years) address the underlying structural drivers that have accumulated over decades of inadequate urban management and require coordinated planning, budget allocation, and legislative alignment. Long-term recommendations (5–15 years) address governance amplifiers: the institutional and political failures that perpetuate structural vulnerability, and require sustained commitment across multiple electoral cycles. Research priorities are presented as a cross-cutting domain that supports evidence generation across all three tiers. Within each tier, recommendations are organized by domain: environmental and structural; public health; and governance. Each recommendation is grounded in documented evidence of a gap or need from the cited literature.

5.1. Short-Term Recommendations (0–12 Months): Addressing Proximate Causes

Short-term recommendations are those that can be initiated immediately within existing institutional authority and resource envelopes. They address the proximate causes of flood-related harm: the immediate physical and organizational conditions that determine whether a flood event produces serious public health consequences. Actions in this tier should be operational before the onset of the 2027 long-rains season.

Environmental and Structural

1. Pre-season drainage clearance: commission systematic pre-season clearing of all identified blocked and silted stormwater channels, culverts, and drainage outlets across Nairobi's flood-prone sub-counties (Mathare, Kibera, Kasarani, Eastleigh) before the onset of each rainy season (March and October), using the KSh 8 billion committed by KURA in March 2026 as the initial funding vehicle. Evidence base: drainage blockage identified as a proximate cause of flooding in March 2026 (UN-Habitat, 2025; Jha et al., 2012).
2. Emergency water supply engineering upgrades: undertake emergency upgrades to protect water supply infrastructure in flood-prone areas, including elevation of pump stations, waterproofing of distribution infrastructure, and pre-positioned pipe repair teams with 24-hour emergency response protocols following flooding events. Evidence base: multiple pipeline ruptures during the March 2026 floods (The Standard, 2024).

Public Health

3. Pre-position health emergency supplies: pre-position water treatment supplies, oral rehydration salts (ORS), cholera treatment kits, antimalarial treatments, and WASH emergency supplies in all flood-risk sub-counties before each rainy season onset, with pre-activated response protocols that do not require post-disaster coordination from scratch. Evidence base: WHO supplied 1,100 cholera kits to Nairobi County during the 2022–2024 outbreak; pre-positioning would reduce response time (Borgen Project, 2025).
4. Establish integrated post-flood disease surveillance protocols: implement pre-defined trigger thresholds for cholera, diarrhoeal disease cluster detection, and malaria spikes that automatically activate a response cascade linking community health promoters, health facility reporting through DHIS2, county epidemiologists, and national rapid response teams. Risk basis: cholera - documented in Nairobi; diarrhoeal disease - documented; malaria - anticipated based on established evidence. Evidence base: near-annual post-flood disease outbreaks (Olando & Dick, 2026; Oluchiri, 2025a; Okaka & Odhiambo, 2019).
5. Incorporate mental health support: include trauma-informed counseling, psychological first aid training for community health promoters, and group psychosocial support for displacement-affected communities as a mandatory component of every flood response plan. Risk basis: acute mental trauma — documented in Nairobi (MSF, 2024; Basic Needs Kenya, 2024); chronic cumulative burden — plausible given repeated displacement cycles, warrants systematic monitoring (Olando & Dick, 2026). Evidence base: MSF field teams documented cases of acute mental trauma among flood-displaced residents in Nairobi's informal settlements, including psychologist-attended counseling interventions during the 2024 flood response (MSF, 2024), while community-level documentation records anxiety and trauma as non-material impacts of repeated displacement cycles among riparian zone communities (Basic Needs Kenya, 2024; Olando & Dick, 2026).

Governance

6. Activate community-level early warning response: translate meteorological forecasts into community-level preparedness actions through designated Flood Preparedness Coordinators in each flood-prone sub-county, with defined authority to activate pre-positioned emergency resources upon receipt of Kenya Meteorological Department forecasts, without requiring case-by-case national authorization. Evidence base: warnings issued but inadequately translated into preparedness in both 2024 and 2026 (Daily Nation, 2026c; UNICEF, 2024).

5.2. Medium-Term Recommendations (1–5 Years): Addressing Underlying Structural Drivers

Medium-term recommendations address the accumulated structural vulnerabilities that convert moderate rainfall into catastrophic flood events. They require planning, budget allocation, legisla-

tive alignment, and multi-stakeholder coordination. Actions in this tier should be initiated within the current electoral cycle and operationalized within five years.

Environmental and Structural

7. Commission a comprehensive stormwater drainage masterplan: develop a masterplan for Nairobi based on current hydrological modeling, incorporating projected climate change scenarios to 2050. The KSh 8 billion committed by KURA in March 2026 should be disbursed against this masterplan rather than on an ad-hoc reactive basis, with independent technical oversight and public disclosure of spending (UN-Habitat, 2025).
8. Enforce riparian buffer zone regulations: enforce the 60-meter riparian buffer required under Kenya's Water Act through clearly defined institutional mandates assigned to a single lead agency, independent monitoring supported by satellite and drone surveillance, transparent public reporting, and meaningful penalties for violation applicable equally to formal developers and informal settlers. Evidence base: systematic violations documented across 2024 and 2026 events (Kiama et al., 2023; Jha et al., 2012).
9. Implement the Nairobi Rivers Regeneration Program at full scale: execute with adequate financing, legal enforceability, community participation, including formal consent processes, and realistic alternative housing provision for displaced riparian residents. River channel widening to 30–35 meters where hydrologically indicated, and floodplain restoration to increase natural absorption capacity, are priorities (Kiama et al., 2023).

Public Health

10. Invest in ward-level disease surveillance infrastructure: supplement facility-based DHIS2 reporting with active community-based surveillance at ward and informal settlement level to enable targeted, evidence-based responses to post-flood disease risks. Evidence base: documented undercounting of cases in informal settlements (The Star, 2026a; Eastleigh Voice, 2026).

Governance

11. Establish a permanent, legally mandated Nairobi Urban Flood Risk and Resilience Committee: mandate a standing inter-agency committee with defined statutory authority, a dedicated budget line, transparent public reporting requirements, and a mandate to operate year-round rather than only following disasters. Membership should include representation from public health alongside infrastructure, planning, and emergency management expertise. Evidence base: inter-agency coordination failures documented in the 2026 response (The Star, 2026c).
12. Scale community flood mapping tools: scale and validate Pamoja Trust's participatory community flood mapping and loss documentation tools across all of Nairobi's flood-prone informal settlements, and create a formal mechanism for community-generated data to feed directly into official flood impact assessments, recovery planning, and DHIS2 surveillance systems (Down to Earth, 2026).
13. Commission FRA compliance audit: conduct a comprehensive, independently audited review of all major infrastructure projects approved in Nairobi since 2010 for compliance with Flood Risk Assessment requirements, with findings made public, and retrospective FRAs commissioned for any non-compliant project.

5.3. Long-Term Recommendations (5–15 Years): Addressing Governance Amplifiers

Long-term recommendations address the institutional and political governance amplifiers that perpetuate structural vulnerability. They require sustained political commitment over multiple electoral cycles, cross-cutting legislative reform, and structural changes in how the urban poor are recognized and included in planning. These actions will not produce results within a single budget cycle but are essential to breaking the recurring cycle of flood disasters.

Environmental and Structural

14. Mandate Flood Risk Assessments as a statutory requirement: enact a binding domestic legal requirement for FRAs as a prerequisite for all new infrastructure development, urban expansion, and rezoning decisions across all Kenyan urban Centres. FRAs should be conducted by independent experts, reviewed by a multi-agency panel, and the results made publicly accessible. Evidence base: multiple major developments approved without FRAs, including the Nairobi Expressway (Kenyans.co.ke, 2026).
15. Invest in Sponge City nature-based solutions: restore degraded wetlands, create urban forests and permeable pavement zones, and convert suitable publicly owned land to water retention functions, drawing on models from Kigali, Copenhagen, and Philadelphia (WWA, 2024; CISU, 2026). Evaluate effectiveness through the research recommendation in Section 8.4.

Governance

16. Harmonize flood-relevant legislation: harmonize Kenya's Water Act, Physical Planning Act, Environmental Management and Coordination Act, and Public Health Act to eliminate conflicting mandates, assign clear lead agency responsibility for riparian enforcement, and integrate public health impact assessment requirements into land-use planning processes. Evidence base: multiple overlapping and conflicting mandates documented (Daily Nation, 2026d; Inside Climate News, 2026).
17. Develop an evidence-based alternative housing policy for riparian residents: design and fund a rights-respecting resettlement framework for Nairobi's riparian corridor communities, including structured community engagement, transparent compensation, provision of adequately serviced alternative sites with formal tenure, and monitoring of compliance with non-refoulement principles. Evidence base: the inadequacy of the KES 10,000 relocation support offered to displaced riparian residents (ACAPS, 2024; Olando & Dick, 2026), combined with the documented pattern whereby evicted residents return to flood-prone riparian sites in the absence of viable alternatives (Okaka & Odhiambo, 2019; O'Donovan-Iland, 2024; Mutura, 2025), demonstrates that displacement-without-solutions approaches fail both on humanitarian and flood-risk grounds.

5.4. Research Priorities (Cross-Cutting)

Research priorities span all three temporal tiers and are essential for generating the evidence base needed to evaluate intervention effectiveness and to inform adaptive management over the long term.

18. Conduct systematic, ward-level baseline surveys of flood-associated disease incidence, including acute diarrhoeal disease, cholera, typhoid, and malaria, across Nairobi's flood-prone informal settlements, covering both rainy seasons, to establish evidence baselines for intervention impact evaluation. Priority sub-counties: Mathare, Kibera, Kasarani, Eastleigh, and areas along the Mathare and Nairobi River corridors.
19. Commission longitudinal, prospective research on the mental health impacts of repeated flooding and displacement in Nairobi's informal settlement communities, including validated psychological burden measurement, identification of protective factors, and evaluation of community-led psychosocial support interventions.
20. Evaluate the hydrological and public health effectiveness of Sponge City interventions in Nairobi's specific context, beginning with controlled studies of the drainage channel improvements already implemented in Mathare and proposed wetland restoration projects (CISU, 2026).

6. Conclusions

Nairobi's recurrent flooding is one of the most thoroughly documented, systematically analyzed, and persistently neglected preventable public health crises in sub-Saharan Africa. The evidence reviewed in this paper establishes that every element of the problem: the encroached river corridors, the overwhelmed drainage systems, the informal settlements built on floodplains, the inadequate health surveillance, the fragmented governance, and the systematic exclusion of the urban poor from planning and recovery processes, has been identified, studied, and reported in the literature and in official post-event assessments following every major flood since at least 2006. What has been consistently absent is the political will and institutional capacity to translate this accumulated knowledge into structural change at the required pace and scale.

The March 2026 floods, with their toll of at least 66 deaths nationally — rising from 62 confirmed by police on 13 March (Reuters, 2026) to 66 by 15 March as recovery operations continued, 50,000 displaced residents, a city paralyzed by 112mm of rainfall in a single day, and an active cholera outbreak facing the prospect of flood-driven amplification, are not an anomaly. They are, in the absence of fundamental structural reform, a preview of what each rainy season will deliver with increasing frequency and severity as climate change continues to intensify. A 2024 World Weather Attribution study found that climate change has already doubled the likelihood of such events (WWA, 2024). Nairobi's growing population and the progressive loss of its natural drainage capacity mean that the consequences of each event will be correspondingly greater.

The public health case for urgent action is unanswerable. Kenya recorded nearly 9,000 cholera cases in 2023 alone (WHO, 2024). Post-flood diarrhoeal disease, malaria, typhoid, and respiratory infections kill and disable residents of informal settlements whose resilience is already compromised by poverty, insecure tenure, and limited access to healthcare. Mental health burden accumulates with each successive flood season. Children, the most physiologically vulnerable, are exposed to contaminated floodwaters in their homes, on their way to school, and in displacement camps that lack functional WASH facilities. These consequences are not the random costs of natural disaster; they are the predictable products of a flood governance system that has consistently prioritized reactive response over structural prevention.

This review identifies five interconnected environmental determinants of Nairobi's floods, six distinct public health consequence pathways, and five systematic governance gaps. It proposes 19 specific, evidence-grounded recommendations across environmental interventions, public health infrastructure, governance reform, and research. None of these recommendations is novel; comparable recommendations appear in virtually every post-flood assessment conducted in Nairobi over the past decade. What makes this moment different, and creates a genuine window of opportunity, is the unprecedented public visibility of the March 2026 disaster, the KSh 8 billion infrastructure commitment from KURA, the activation of the Nairobi Rivers Regeneration Programme, the NDOC flood mapping, and the calls from civil society for structural rather than cosmetic reform (UN-Habitat, 2025; Kiama et al., 2023; Wisner et al., 2004).

The science, legal frameworks, technical capacity, and institutional architecture needed to substantially reduce Nairobi's flood risk exist. What Nairobi's communities, particularly the 50,000 people displaced in March 2026 and the hundreds of thousands more who will face the next rainy season without adequate protection, require is the sustained political commitment to act before the rains return.

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Data Availability Statement: No new primary data were generated or analyzed in this study. The full data extraction log covering all 68 included sources is available from the corresponding author upon reasonable request.

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Appendix A

List of Acronyms and Abbreviations

The following table provides the full meaning of all acronyms and abbreviations used in this systematic review, listed alphabetically.

Acronym / Abbreviation	Full Meaning
ACAPS	Assessment Capacities Project
AIDS	Acquired Immunodeficiency Syndrome
BMC	BioMed Central (open-access publishing group)
CDC	Centres for Disease Control and Prevention (United States)
CFK	Carolina for Kibera (CFK Africa -- non-governmental organization)
CHP	Community Health Promoter
CHPs	Community Health Promoters (plural)
CISU	Civil Society in Development (Danish NGO -- <i>Civilsamfund i Ud-vikling</i>)
DHIS2	District Health Information Software 2
DTE	Down to Earth (science and environment news platform)
EARS	Emergency Alert and Response System
El Nino	El Niño-Southern Oscillation (ENSO warm event)
ENSO	El Niño-Southern Oscillation (global climate pattern)
FRA	Flood Risk Assessment
FRAs	Flood Risk Assessments (plural)
FRM	Flood Risk Management
GIS	Geographic Information System
HIV	Human Immunodeficiency Virus
IDSR	Integrated Disease Surveillance and Response
IOD	Indian Ocean Dipole (climate variability pattern)
IPCC	Intergovernmental Panel on Climate Change
IRIS	Institutional Repository for Information Sharing (WHO document repository)
KES	Kenyan Shilling (currency code)
KeNHA	Kenya National Highways Authority

KeRRA	Kenya Rural Roads Authority
KHIS2	Kenya Health Information System 2
KMD	Kenya Meteorological Department
KSh	Kenyan Shilling (alternate abbreviation)
KURA	Kenya Urban Roads Authority
MEDLINE	Medical Literature Analysis and Retrieval System Online (bibliographic database)
MSF	Médecins Sans Frontières (Doctors Without Borders)
NCCG	Nairobi City County Government
NDOC	National Disaster Operations Centre (Kenya)
NEMA	National Environment Management Authority (Kenya)
NGO	Non-Governmental Organisation
NTD	Neglected Tropical Disease
OCHA	United Nations Office for the Coordination of Humanitarian Affairs
ORS	Oral Rehydration Salts
PLoS	Public Library of Science (open-access scientific publisher)
PMC	PubMed Central (free full-text archive of biomedical literature)
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
PubMed	Public MEDLINE (bibliographic database of biomedical literature, NLM/NIH)
RANA	Resilience Action Network Africa
Scopus	Elsevier's abstract and citation database of peer-reviewed literature
UN	United Nations
UNDP	United Nations Development Programme
UNICEF	United Nations International Children's Emergency Fund
USA	United States of America
USD	United States Dollar
WASH	Water, Sanitation, and Hygiene
WHO	World Health Organization

Note on Usage

Several acronyms in this review refer to Kenyan institutional bodies (e.g., KURA, KeNHA, KeRRA, NCCG, NDOC, KMD, NEMA) and are used consistently throughout to avoid repetition of lengthy institutional names. DHIS2 and KHIS2 are related but distinct systems: DHIS2 is the international open-source platform developed by the University of Oslo, while KHIS2 is Kenya's national adaptation of DHIS2 for the Kenya Health Information System. Database and publisher acronyms (PubMed, MEDLINE, Scopus, PMC, PLoS, BMC) refer to bibliographic and open-access platforms used in the systematic literature search. Currency conversions: KES/KSh are equivalent abbreviations for the Kenyan Shilling; USD is used for US Dollar equivalents, as provided in the source documents.

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