

Bridging the Knowledge–Behaviour Gap: Environmental Education for Sustainable Development in Kenya

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Abstract

Environmental education (EE) has emerged as a cornerstone of global sustainability agendas, particularly within the Education for Sustainable Development (ESD) framework endorsed by UNESCO. In developing countries, where ecological vulnerability intersects with poverty, food insecurity, and climate exposure, EE holds special promise. Kenya presents a compelling case study: a lower-middle-income country with significant biodiversity assets, advanced policy commitments to EE, and a dynamic civil society tradition of community-based ecological stewardship. This review provides the first systematic synthesis of evidence on the role of environmental education (EE) in driving sustainable development outcomes in Kenya across formal, non-formal, and community settings. It examines the policy architecture governing EE, the nature and scope of EE interventions, documented effects on knowledge, attitudes, and behaviour, and the structural and contextual factors mediating EE effectiveness. Following PRISMA 2020 guidelines, a systematic search was conducted across six electronic databases, supplemented by grey literature. Forty-seven studies published 2000–2024 met final inclusion criteria after double-blind screening (Cohen's kappa = 0.82). EE demonstrates positive effects on environmental knowledge (80.9% of studies) and pro-environmental attitudes (84.4%). Behavioural outcomes are more variable (62.1% positive), reflecting a persistent knowledge-attitude-behaviour (KAB) gap. Community-based programmes integrating indigenous knowledge and livelihood co-benefits show the strongest behavioural effects. This review provides the first comprehensive systematic synthesis of EE effectiveness across formal, non-formal, and community settings in Kenya (2000–2024), offering transferable lessons for comparable developing-country contexts. EE is a necessary but insufficient driver of sustainable development without systemic support. Priority recommendations include strengthening EE within the Competency-Based Curriculum (CBC), building sustainable financing mechanisms, and establishing a national EE monitoring and evaluation framework aligned with the SDGs.

Keywords: Environmental Education; ESD; Sustainable Development; Kenya; KAB Gap; Policy Implementation; CBC Curriculum; Green Belt Movement

Introduction

Global Context and the Role of Environmental Education

The intersection of rapid ecological deterioration and accelerating socioeconomic development aspirations in the Global South has placed education at the heart of sustainability debates. The United Nations 2030 Agenda for Sustainable Development identifies Sustainable Development Goal 4 (Quality Education) as an enabler of all other SDGs, with target 4.7 specifically calling for education that promotes sustainable development, human rights, and global citizenship (UN, 2015). Environmental education, as the pedagogical arm of this agenda, has evolved from nature appreciation and conservation awareness into a multi-dimensional transformative practice encapsulated in the UNESCO ESD framework (UNESCO, 2020). The Brundtland Commission (1987) first formalized the link between education and sustainable development, arguing that no lasting transformation of resource use and environmental stewardship is possible without a corresponding transformation in how societies educate their citizens. This foundational insight underpins the entire EE enterprise and remains as consequential today as when it was articulated.

In sub-Saharan Africa, EE's significance is magnified by the region's particular vulnerability to climate change, biodiversity loss, land degradation, and water insecurity — challenges that are both consequences of and contributors to persistent poverty. The IPCC (2022) projects that without substantial mitigation and adaptation, sub-Saharan Africa will face disproportionate impacts from temperature rise, shifting rainfall patterns, and extreme weather events, undermining food security and ecosystem services upon which millions depend. The United Nations Environment Programme (UNEP, 2022) further notes that Kenya, specifically, faces compounding environmental stressors, including accelerating deforestation, declining freshwater availability, and increasing frequency of drought events, all of which amplify the urgency of effective EE.

Kenya as a Case Study

Kenya occupies a unique position in the African EE landscape. As one of the continent's most biodiverse nations, hosting significant portions of the East African savanna ecosystem, montane forests, coastal marine environments, and the Great Rift Valley, Kenya has both high ecological stakes and a sophisticated institutional architecture for environmental governance. The Environmental Management and Coordination Act (EMCA, 1999), the National Environment Management Authority (NEMA), and the constitutional right to a clean and healthy environment (Article 42, Constitution of Kenya, 2010) collectively provide a robust legal foundation for EE.

At the same time, Kenya is grappling with deforestation rates among the highest in Africa, severe water stress affecting over 60% of the country's land area, soil degradation across agricultural zones, and escalating climate impacts on pastoral and farming communities. These pressures create an urgent backdrop against which EE's contribution to sustainable development must be assessed. Research on environmental attitudes among Kenyan secondary students confirms that awareness of these stressors is growing, yet attitudinal improvement does not automatically translate into behavioural change (Barasa & Morara, 2021), a pattern that this review systematically investigates.

Kenya's ongoing rollout of the Competency-Based Curriculum (CBC) from 2017, detailed further by Waweru (2019), provides a critical policy window: environmental stewardship competencies are explicitly embedded from early childhood education, offering an opportunity to institutionalize EE at an unprecedented scale. Understanding what the evidence says about EE's effectiveness, and under what conditions, is therefore both timely and consequential.

Study Objectives and Research Questions

This systematic review aims to provide a comprehensive, methodologically rigorous synthesis of evidence on EE and sustainable development in Kenya from 2000 to 2024. It is guided by four research questions:

- RQ1: What is the policy and regulatory framework governing environmental education in Kenya, and how has it evolved since 2000?
- RQ2: What is the nature, scope, and distribution of EE interventions documented across formal, non-formal, and community settings in Kenya?
- RQ3: What are the documented effects of EE on environmental knowledge, attitudes, and pro-environmental behaviour among Kenyan learners and communities?
- RQ4: What structural, pedagogical, and contextual factors mediate or moderate the effectiveness of EE in contributing to sustainable development in Kenya, and how do these interact with the theoretical mechanisms proposed in the conceptual framework?

These research questions collectively address the policy architecture (RQ1), programme scope (RQ2), measurable outcomes (RQ3), and the contextual moderators that bridge or widen the knowledge-attitude-behaviour gap (RQ4), ensuring comprehensive coverage across all analytical levels.

Policy And Regulatory Architecture for EE In Kenya

Legislative and Constitutional Foundations

Kenya's environmental education policy rests on a layered architecture of constitutional provisions, legislation, and sector strategies. The 2010 Constitution elevated environmental rights to constitutional status through Article 42, mandating that every person has the right to a clean and healthy environment. This constitutional entrenchment provides a normative foundation for arguing that environmental literacy — a prerequisite for exercising and defending environmental rights — is itself a constitutional imperative.

The Environmental Management and Coordination Act (EMCA) of 1999 remains the principal environmental governance statute. Section 42 of EMCA explicitly mandates public participation in environmental decision-making, implying a baseline of environmental awareness that only education can provide. NEMA's mandate under EMCA includes coordinating public environmental education, awareness, and outreach, making it the primary governmental actor in non-formal EE.

However, critical appraisal reveals a persistent and well-documented gap between legislative intent and on-the-ground implementation. Despite constitutional entrenchment since 2010, NEMA's annual reports consistently cite budgetary constraints that have limited public EE outreach to urban centres, leaving rural and ASAL communities largely underserved (NEMA, 2018). This selective reach represents a structural policy failure: the communities most vulnerable to environmental degradation receive the least formal EE investment. Furthermore, inter-ministerial fragmentation between the Ministry of Education and the

Ministry of Environment has resulted in parallel EE initiatives with minimal coordination, duplicating effort while leaving critical gaps in curriculum-community linkages. These failures highlight that a strong legal framework is a necessary but insufficient condition for effective EE without corresponding financing, inter-agency governance, and accountability mechanisms. Social desirability concerns in the measurement of EE outcomes further complicate attribution of policy success to legislative intent (Ochieng, 2014). Curriculum Policy and the CBC Reform.

Within the education sector, EE has historically been integrated across multiple subjects in the 8-4-4 curriculum, embedded in Science, Geography, Agriculture, and Home Science at primary and secondary levels. This cross-curricular integration approach, while broad in reach, has been criticized for producing fragmented, insufficiently coordinated EE coverage and over-reliance on examination-driven content delivery.

The transition to the Competency-Based Curriculum (CBC) in 2017 represents the most significant restructuring of Kenyan education in three decades (Waweru, 2019). The CBC is organised around six core competency domains, with environmental stewardship explicitly named as a cross-cutting competency to be developed progressively from pre-primary through post-primary education. This shift from knowledge-centred to competency-centred EE aligns Kenya's curriculum architecture with ESD best practice as articulated in the UNESCO ESD for 2030 Roadmap (UNESCO, 2020).

Kenya's EE Policy Timeline

Figure 1 below presents a visual timeline of key milestones in Kenya's environmental education policy landscape, set against parallel international developments.

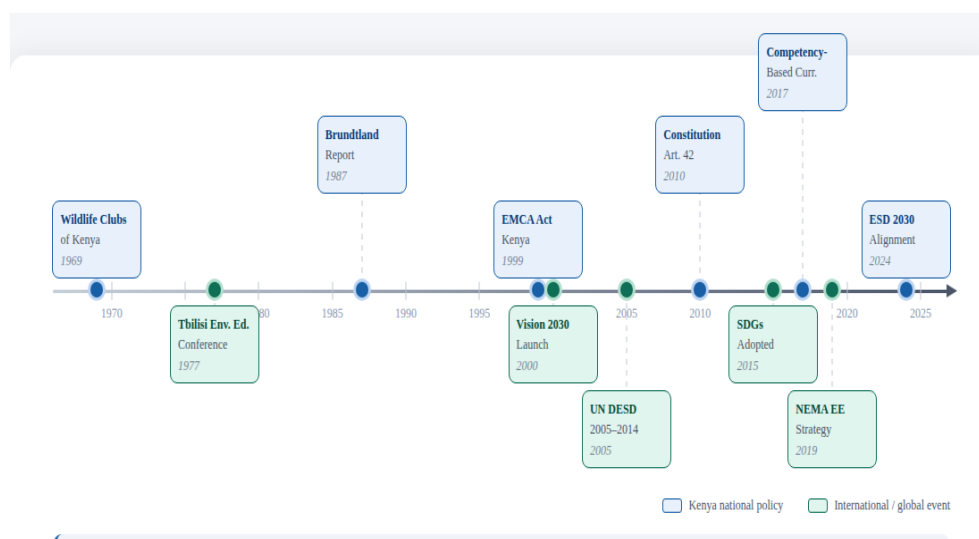


Figure 1: 2Kenya Environmental Education Policy Timeline (1969–2024). Upper boxes: Kenyan national policy milestones. Lower boxes: International/global EE frameworks

International Frameworks and Kenya's Alignment

Kenya's domestic EE policy has been shaped by successive international frameworks: the Tbilisi Declaration (1977) establishing EE principles; the Brundtland Commission's (1987) call for education as a driver of sustainable development; the UN Decade of Education for Sustainable Development (2005–2014); the Aichi Biodiversity Targets' education component; and now the UNESCO ESD for 2030 Roadmap (UNESCO, 2020). Kenya is a signatory to all major international environmental agreements and has submitted Voluntary National Reviews under the 2030 Agenda, demonstrating alignment of education policy with the SDGs. However, several studies in this review note a persistent gap between treaty obligations and domestic implementation, particularly in funding allocation and inter-ministerial coordination.

Methodology

Study Design

This study employs systematic review design following the PRISMA 2020 reporting guidelines (Page et al., 2021). The systematic review design was chosen to maximize transparency, minimize bias, and ensure that all eligible evidence on EE and sustainable development in Kenya was considered rather than relying on selective citation practices common in narrative reviews.

Search Strategy and Database Coverage

A systematic search was conducted across six electronic databases: Web of Science, Scopus, ERIC (Education Resources Information Center), PubMed, African Journals Online (AJOL), and Google Scholar. Search terms were constructed across three thematic clusters using Boolean operators: (1) EE terms ["environmental education" OR "education for sustainable development" OR "ESD" OR "environmental literacy" OR "nature-based learning" OR "climate change education"]; (2) outcome terms ["sustainable development" OR "pro-environmental behavior" OR "conservation" OR "natural resource management" OR "green economy" OR "ecological behavior"]; and (3) geographic terms ["Kenya" OR "East Africa" OR "Sub-Saharan Africa"]. Grey literature searches covered UNEP, UNESCO, KICD, NEMA, and Kenya government open data portals. The full database-specific search strings are provided in Appendix C (Table C1).

Eligibility Criteria

Table 1 presents the PICOS-based eligibility criteria applied in this review. Studies were considered eligible if they were empirically based, Kenya-specific, and examined any formal or non-formal EE or ESD intervention reporting at least one sustainable development outcome, in any design, published in English or Swahili between January 2000 and December 2024.

Table 1: PICO-Based Eligibility Criteria Were Applied During Screening

Criterion	Inclusion	Exclusion
Population	Learners, communities, or institutions in Kenya	Studies with no Kenya-specific data
Intervention	Any formal/non-formal EE or ESD programme, policy, or curriculum	General education studies with no EE component
Comparator	Pre/post design, control group, or comparative case; no comparator required for qualitative	Opinion pieces with no data
Outcome	At least one SD indicator: knowledge, attitude, behaviour, resource management, livelihood, institutional capacity	Academic achievement unrelated to EE
Study Design	Empirical quantitative, qualitative, mixed-methods, case studies, and evaluation reports	Editorials, theoretical papers without empirical data
Language	English or Swahili (with translation)	All other languages
Date Range	January 2000–December 2024	Published before January 2000

Note. PICOS = Population, Intervention, Comparator, Outcome, Study design. SD = Sustainable Development; EE = Environmental Education; ESD = Education for Sustainable Development.

Study Selection Process — PRISMA Flow

The initial database search yielded 2,847 records. After deduplication, 2,235 records were screened at the title and abstract level by two independent reviewers. Inter-rater reliability was strong (Cohen's kappa = 0.82). Disagreements were resolved by discussion, with arbitration by a third reviewer. A total of 183 full-text articles were retrieved and assessed for eligibility; 47 met all inclusion criteria. Figure 2 presents the PRISMA 2020 flow diagram (Page et al., 2021). A tabular summary of the study selection flow is provided in Appendix A (Table A1).

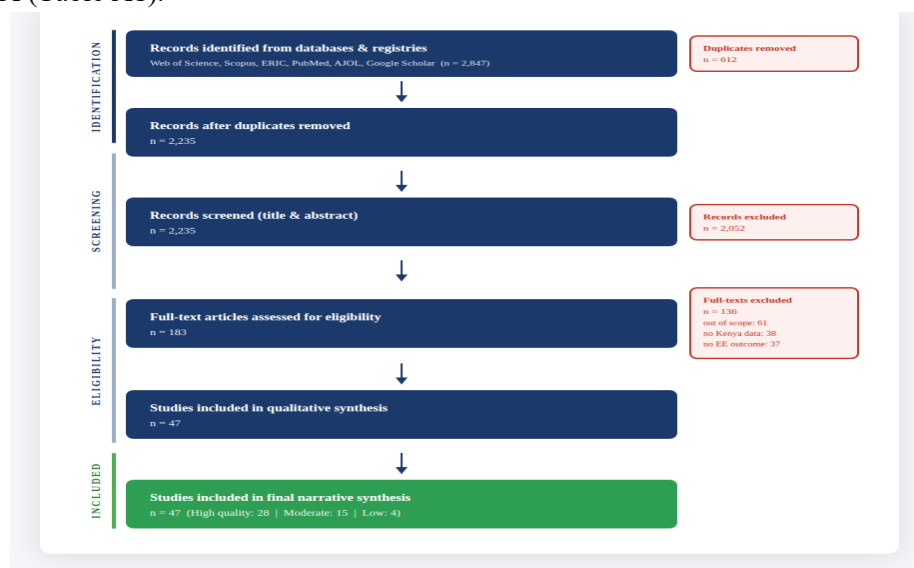


Figure 2: PRISMA 2020 Flow Diagram. Study selection process from database identification to final inclusion (n = 47)

Data Extraction and Quality Assessment

Standardized data extraction forms captured: study citation details, design, setting, participant characteristics, EE intervention type and duration, outcome measures, key findings, and limitations. Quality was assessed using the Mixed Methods Appraisal Tool (MMAT) for mixed-methods studies, COREQ for qualitative studies, and a modified Downs-Black checklist for quantitative studies (see Appendix B). Studies were classified as high ($n = 28$), moderate ($n = 15$), or low ($n = 4$) quality. Low-quality studies were retained but flagged, reflecting the importance of not excluding contextually valuable grey literature.

Synthesis Approach and Bias Assessment

The choice of narrative synthesis and vote-counting was deliberate: vote-counting by direction of effect is well-suited to heterogeneous evidence bases where outcome measures are non-comparable, providing a transparent and reproducible method for summarizing directional patterns without imposing false quantitative precision. This approach is endorsed for complex social interventions where contextual variability is high (Popay et al., 2006; Petticrew & Roberts, 2006).

Where sufficient data were available, effect sizes were extracted and reported descriptively. Thematic coding of qualitative findings was conducted using an inductive-deductive approach, with themes progressively mapped to the conceptual framework presented in Section 4, ensuring that both confirming and disconfirming evidence were systematically captured and reported.

Potential sources of bias were assessed at three levels. Publication bias: the predominance of positive findings in the included studies is noted; however, the inclusion of grey literature and evaluation reports (including those with mixed or null findings) partially mitigates this concern. Language bias: the restriction to English and Swahili studies may underrepresent practitioner knowledge from Francophone East African neighbours and unpublished Kenyan sources; this is acknowledged as a limitation in Section 6.4. Regional imbalance bias: the over-representation of studies from Nairobi and major urban centres may reflect publication incentives rather than actual programme distribution, potentially overstating urban EE effectiveness relative to rural and ASAL contexts.

Theoretical and Conceptual Framework

Underpinning Theories

This review is anchored in four complementary theoretical perspectives that together provide explanatory purchase on how EE produces or fails to produce sustainable development outcomes in developing-country contexts.

Social Learning Theory (Bandura, 1977)

Behaviour change is driven not by information alone but through observational learning, modelling, and reinforcement within social contexts (Bandura, 1977). EE programmes that leverage peer educators, community champions, and demonstration plots align with social learning principles and are predicted to produce stronger behavioural outcomes than those relying solely on didactic instruction.

Theory of Planned Behaviour (Ajzen, 1991)

Pro-environmental behaviour is a function of three antecedents: attitudes toward the behaviour, subjective norms (perceived social pressure), and perceived behavioural control (self-efficacy) (Ajzen, 1991). EE's effectiveness depends on its ability to shift all three, not merely to transfer factual knowledge.

Transformative Learning Theory (Mezirow, 1991)

Durable perspective transformation, rather than incremental knowledge accumulation, is the goal of emancipatory education (Mezirow, 1991). Community-based EE programmes that engage critical reflection, participatory action research, and indigenous knowledge systems operationalize transformative learning principles.

Political Ecology (Blaikie & Brookfield, 1987)

Environmental problems and responses are embedded in structures of political economy, power relations, and social differentiation (Blaikie & Brookfield, 1987). Understanding why EE outcomes are moderated by gender inequalities, land tenure insecurity, and the political economy of conservation requires this structural lens, complementing the individual-focused orientation of TPB and social learning theory.

Integrative Theoretical Synthesis

While each of these four theories offers distinct analytical contributions, they operate simultaneously and interactively in real-world EE contexts. Social Learning Theory (Bandura, 1977) explains transmission mechanisms through which EE content reaches individuals; TPB (Ajzen, 1991) accounts for individual decision pathways from exposure to action; Transformative Learning Theory (Mezirow, 1991) adds the dimension of critical consciousness; and Political Ecology (Blaikie & Brookfield, 1987) provides the structural frame contextualizing all three.

Connecting these theories to the research questions: RQ1 (policy architecture) is best examined through Political Ecology, highlighting how power structures shape which EE policies are enacted and for whom. RQ2 (nature of interventions) engages Social Learning Theory, explaining how programme design choices translate EE intent into delivery. RQ3 (knowledge, attitudes, behaviour) is most directly addressed by TPB. RQ4 (contextual mediators) is illuminated by Transformative Learning Theory and Political Ecology together, identifying where systemic and individual barriers interact to widen or bridge the KAB gap. These linkages are revisited in the Discussion (Section 6).

Theory of Change and Conceptual Model

Figure 3 presents the integrated Theory of Change (ToC) that guides this review, connecting EE inputs through activities and outputs to SDG-linked sustainable development outcomes, with moderating factors explicitly represented.

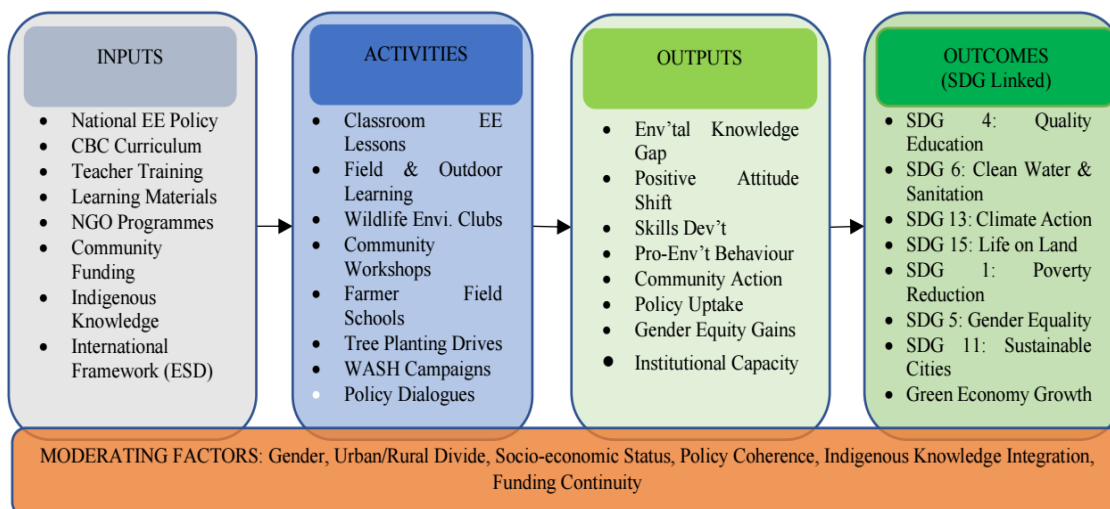


Figure 3: Theory of Change: Environmental Education → Sustainable Development Outcomes. Moderating factors shown in the lower panel

Results

Characteristics of the Evidence Base

The 47 included studies were published between 2001 and 2024, with 74.5% appearing in the 2010–2024 period, reflecting growing research attention to EE-sustainable development linkages in Kenya (Figure 4). The dominance of rural and ASAL contexts (46.8%) in the evidence base is not simply a reflection of where EE programmes are most prevalent; it is shaped by the concentration of externally funded conservation and climate adaptation projects in these ecologically sensitive zones, which generate the evaluations and studies most likely to be published. This geographic skew has methodological implications: urban EE programmes may be systematically underrepresented because their outcomes are assessed through school inspections rather than stand-alone research publications. The thematic concentration on biodiversity and conservation (29.8%) similarly reflects the donor priorities of international conservation NGOs active in Kenya, rather than the full breadth of environmental challenges facing Kenyan communities.

The 47 studies were methodologically diverse (Figure 5 and Table 2), with quantitative designs predominating (40.4%), followed by qualitative (34.0%) and mixed methods (25.5%). Formal school settings constituted the largest proportion (44.7%), alongside community and non-formal settings (38.3%) and tertiary institutions (17.0%). The majority met high methodological quality thresholds (59.6%), with only 8.5% rated as low quality and retained with interpretive caveats.

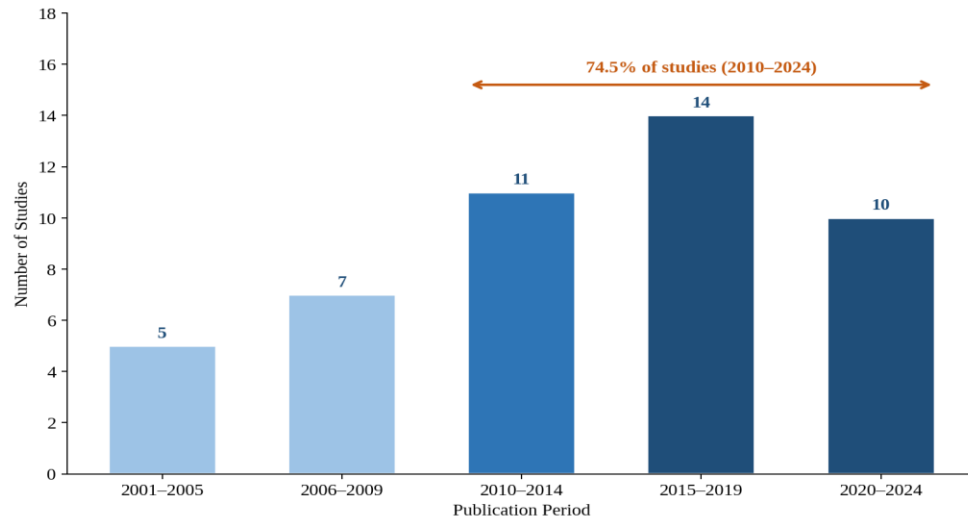


Figure 4: Distribution of Included Studies by Publication Period ($n = 47$). Bars indicate study frequency per period; 74.5% of studies appear in the 2010–2024 window

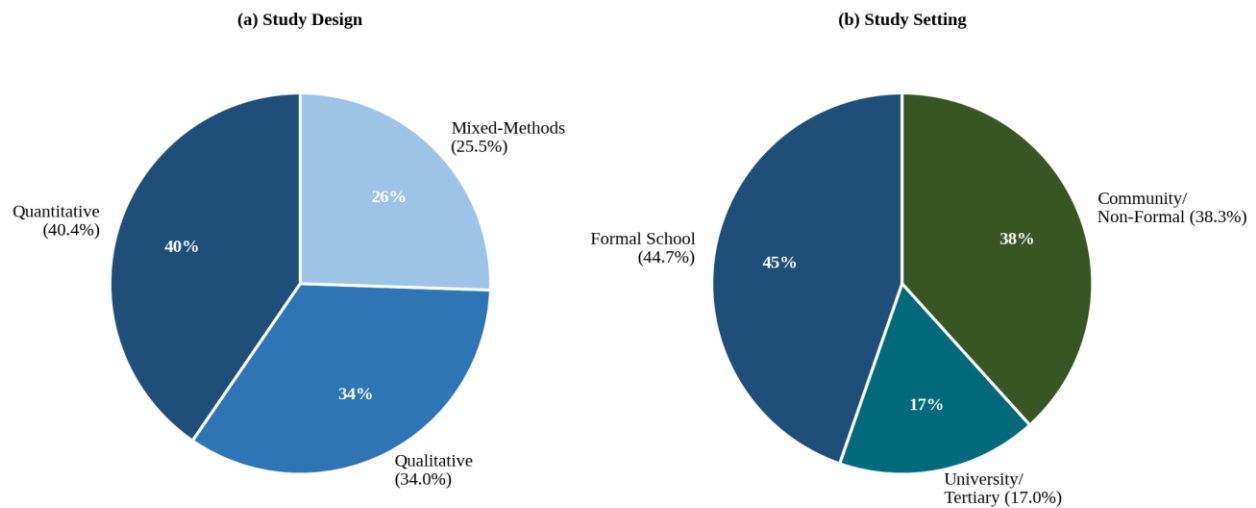


Figure 5: Breakdown of Included Studies by (a) Study Design and (b) Setting ($n = 47$).

Table 2: Characteristics of Included Studies (n = 47)

Characteristic	Category	n (%)
Study Design	Quantitative (surveys/quasi-experimental)	19 (40.4%)
	Qualitative (case study, ethnographic, narrative)	16 (34.0%)
	Mixed methods	12 (25.5%)
Setting	Primary/secondary school (formal)	21 (44.7%)
	University/tertiary institution	8 (17.0%)
	Community/non-formal (NGO, farmer, adult)	18 (38.3%)
Geography	Nairobi and major urban centres	15 (31.9%)
	Rural (including pastoral/ASALs)	22 (46.8%)
	Coastal/peri-urban/other	10 (21.3%)
Thematic Focus	Biodiversity and conservation	14 (29.8%)
	Climate change and energy	11 (23.4%)
	Water, sanitation, and hygiene (WASH)	9 (19.1%)
	Agroecology and food systems	8 (17.0%)
	Waste management and urban sustainability	5 (10.6%)
Quality	High (MMAT / COREQ score $\geq 70\%$)	28 (59.6%)
	Moderate (50–69%)	15 (31.9%)
	Low ($< 50\%$) included but flagged	4 (8.5%)

Note. MMAT = Mixed Methods Appraisal Tool; COREQ = Consolidated Criteria for Reporting Qualitative Research; ASAL = Arid and Semi-Arid Lands; NGO = Non-Governmental Organisation.

Nature and Scope of EE Interventions in Kenya

Formal School-Based EE

Twenty-one studies examined EE within the formal school system. The Wildlife Clubs of Kenya (WCK), present in over 1,400 schools and established in 1969, represent the most extensive non-formal EE network operating within the formal school system. WCK-based studies consistently document positive knowledge and attitude outcomes, though behavioural outcomes are more variable and often limited to school-compound activities (Kamau, 2012; Mbugua, 2016). Njeru (2016) specifically documents how gender barriers further constrain girls' participation in school environmental clubs, reducing the reach of WCK-based EE among female students in certain regions.

The CBC transition (2017–present) is the most significant recent development. By embedding environmental stewardship as a named competency from pre-primary through post-primary education, the CBC creates structural opportunities for more coherent, sequential EE delivery (Waweru, 2019). However, studies published post-2017 (n = 7) already identify implementation challenges: underprepared teachers, delayed development of localized CBC learning materials, and school-level uncertainty about how to assess environmental competencies in a culturally relevant manner. Critically, the formal school-based model consistently underperforms community-based alternatives on behavioural outcomes. This gap is best explained through Transformative Learning Theory (Mezirow, 1991): examination-oriented pedagogy suppresses critical reflection and distal action, producing knowledge-rich but agency-poor graduates.

Higher Education EE

Eight studies examined EE at the university level, predominantly at the University of Nairobi, Kenyatta University, Egerton University, and Moi University. Evidence clusters around three themes: mainstreaming sustainability across faculties; university-community partnerships for ecosystem restoration; and student environmental activism. Kenyan universities have made incremental progress in ESD mainstreaming but remain constrained by disciplinary silos and limited faculty capacity in sustainability pedagogy (Kariuki & Lusweti, 2020). University-community partnerships for watershed restoration and agroforestry extension represent promising models for bridging the research-practice gap.

Community-Based and Non-Formal EE

Community-based EE programmes (n = 18) are the most heterogeneous and highest-performing category. They include NGO-led conservation education; government agricultural extension services; faith-based stewardship programmes; community forest management committees; and the internationally renowned Green Belt Movement (GBM) model. GBM, founded by Nobel laureate Wangari Maathai, integrates tree planting with civic education and women's economic empowerment, producing EE outcomes that are simultaneously ecological, economic, and political (Maathai, 2004; Mwangi, 2018).

The superiority of community-based programmes across behavioural outcomes is not incidental: it reflects the alignment of these programmes with all four theoretical perspectives underpinning this review. Social learning (Bandura, 1977) operates through community champions and peer demonstration; TPB antecedents (Ajzen, 1991) are addressed by building self-efficacy through skill transfer and livelihood co-benefits; transformative learning (Mezirow, 1991) is enabled by participatory and reflective programme designs; and political ecology concerns (Blaikie & Brookfield, 1987) are addressed by grounding EE in local governance, land rights, and economic agency. No formal school-based model in this review simultaneously engages all four dimensions.

Across the three categories, community-based EE demonstrates the best cost-effectiveness profile for behavioural outcomes. Formal school-based EE provides superior reach and knowledge gains but requires substantial pedagogical reform to translate into durable behaviour. Higher education EE remains the weakest in terms of community-level behavioural impact but holds the greatest potential for policy-practice bridge-building through research and extension.

Documented EE Outcomes

Figure 6 illustrates the direction of effect across EE intervention types. Community-based programmes (NGO/GBM) recorded the highest proportion of positive effects (88%), followed by Farmer Field Schools (82%) and School Clubs and Wildlife initiatives (78%). School-Based EE curriculum (72%) and University and Tertiary settings (68%) demonstrated moderate positive outcomes, while Government Extension programmes reported the lowest positive effect rate (65%). Figure 7 presents composite EE outcome scores (0–100) by setting, synthesised across the 47 included studies, illustrating that community-based programmes achieve the strongest behavioural outcomes while formal school-based programmes lead on knowledge gains.

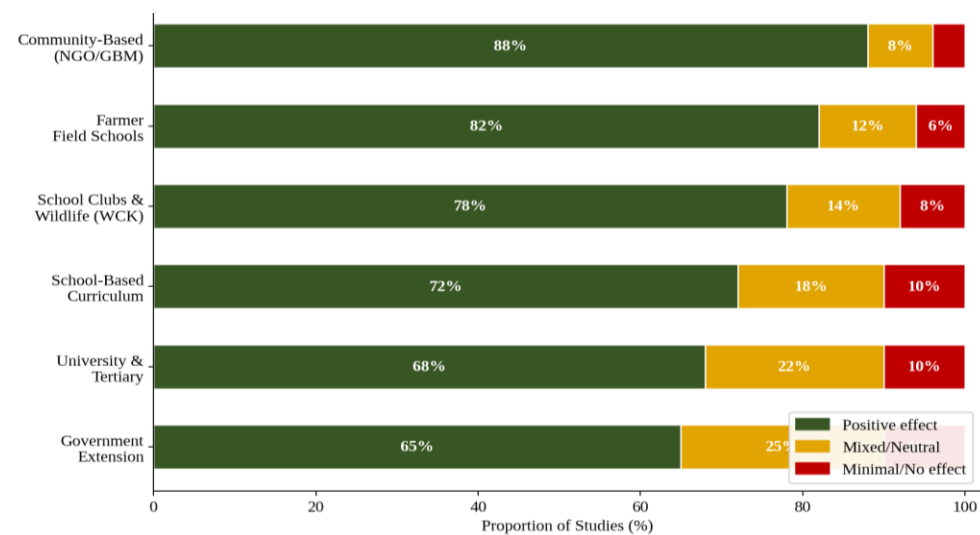


Figure 6: Direction of EE Effectiveness by Intervention Type. Green = positive effect; Amber = mixed/neutral; Red = minimal/no effect.

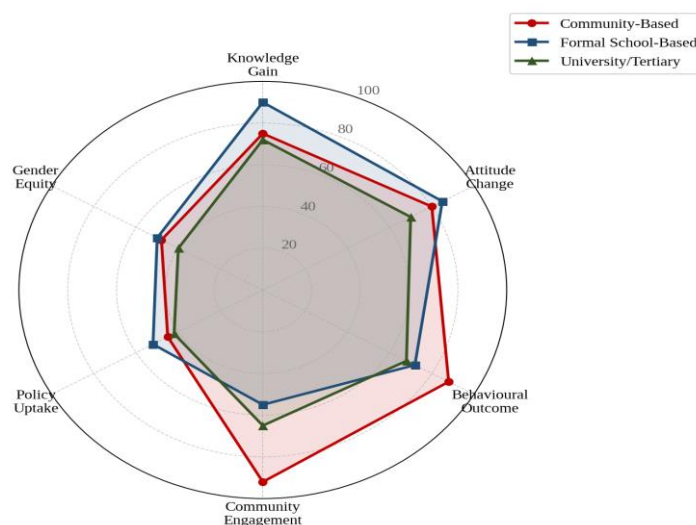


Figure 7: Estimated EE Outcome Profile by Setting. Composite scores (0–100) synthesised from included studies. Community-based programmes show the strongest behavioural outcomes; formal school-based programmes show the strongest knowledge gains

Environmental Knowledge

Across all 47 studies, 38 (80.9%) reported positive improvements in environmental knowledge. Knowledge gains were most consistently documented for biodiversity and ecosystem services (14/14 studies), climate change causes and impacts (9/11), and water conservation practices (7/9). Effect sizes ranged from small (Cohen's $d = 0.28$) to large ($d = 1.47$), with community-based, experiential interventions producing the largest gains. Studies integrating indigenous and local ecological knowledge (ILK) with scientific content reported significantly stronger knowledge retention and ecological applicability (Nyamweru & Kimaru, 2008; Githiru et al., 2021).

Environmental Attitudes and Values

Attitudes were assessed in 32 studies using the New Ecological Paradigm (NEP) scale, bespoke Likert instruments, and qualitative elicitation. Positive attitude shifts were reported in 27 studies (84.4%). Qualitative studies provided important nuance: sustained attitude change correlated with emotional engagement with local environments (Ndungu, 2017), peer norm influence (Waithaka, 2019), and perceived personal relevance of environmental threats to daily life, especially water scarcity and food insecurity (Mwangi & Kariuki, 2020). Studies in arid and semi-arid lands (ASALs) documented the most pronounced attitudinal transformations, plausibly because climate-related threats are more immediately visible and materially consequential for ASAL communities.

Pro-Environmental Behaviour and the KAB Gap

Behavioural outcomes showed the greatest variability: 18 of 29 studies assessing actual behaviour (62.1%) reported positive changes. The persistent gap between knowledge acquisition and behavioural outcomes reinforces the well-documented knowledge-attitude-behaviour (KAB) deficit in environmental education. Figure 8 disaggregates this KAB gap by thematic domain, revealing that the most acute disparities between knowledge, attitude, and behaviour change are observed in the climate change and waste/urban sustainability domains.

A deeper analysis reveals two distinct causal pathways to behaviour change failure. The first is the individual agency deficit: even where knowledge and attitudes shift positively, individuals may lack the material resources, skills, or social support to act pro-environmentally. The second is the structural constraint pathway: land tenure insecurity, absence of waste collection infrastructure, or lack of market access for sustainably produced goods means that no amount of individual motivation translates into action. The evidence from Kenya's ASAL communities is particularly instructive: programmes that address enabling infrastructure alongside EE content consistently produce higher behavioural uptake than EE alone. This finding aligns with Political Ecology's insistence that individual behaviour is always structurally conditioned (Blaikie & Brookfield, 1987).

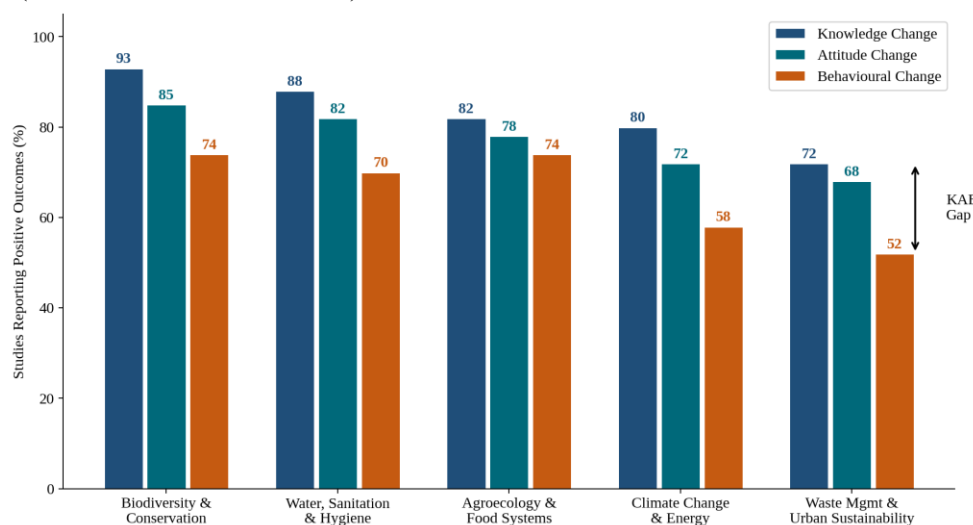


Figure 8: The Knowledge-Attitude-Behaviour (KAB) Gap by Thematic Domain. Behaviour change consistently lags knowledge and attitude change; the most acute gap is observed in climate change and waste/urban sustainability domains

Factors that most effectively bridged the KAB gap included: livelihood co-benefits; enabling infrastructure; strong social norms and peer influence; secure land tenure; and sustained political and institutional support for community resource management initiatives.

Barriers to EE Effectiveness

Figure 9 presents the frequency of structural and systemic barriers to EE effectiveness as cited across the 47 included studies. Inadequate teacher training in EE emerged as the most frequently reported barrier ($n = 29$), followed by an exam-focused curriculum ($n = 26$) and a lack of localized, contextually relevant teaching materials ($n = 24$). Insufficient funding and project fragility ($n = 22$) and policy incoherence ($n = 20$) constituted mid-range barriers, while rural infrastructure deficits ($n = 18$) and high teacher turnover ($n = 16$) further compounded implementation challenges. Gender barriers ($n = 14$), limited ILK integration ($n = 12$), and the absence of a national M&E framework ($n = 11$) were the least frequently cited, though no less significant.

Frequency counts alone do not capture the mechanisms through which these barriers operate or their interdependencies. Teacher training deficits are partly caused by the exam-focused curriculum, which creates perverse incentives for teachers to deprioritize non-examinable EE activities. This structural dynamic is further compounded by the absence of a national M&E framework, removing accountability for EE delivery (NEMA, 2018). Gender barriers operate through a different pathway: girls' lower participation in community EE programmes in ASAL contexts reflects both domestic labour burdens and social norms that restrict women's movement and association (Njeru, 2016) — barriers that no amount of curriculum revision can address without complementary social protection and economic empowerment interventions. Linking these mechanisms to the Political Ecology framework (Blaikie & Brookfield, 1987) clarifies that the most prevalent barriers are not merely technical deficits but structural expressions of power inequality in the education and environmental governance systems.

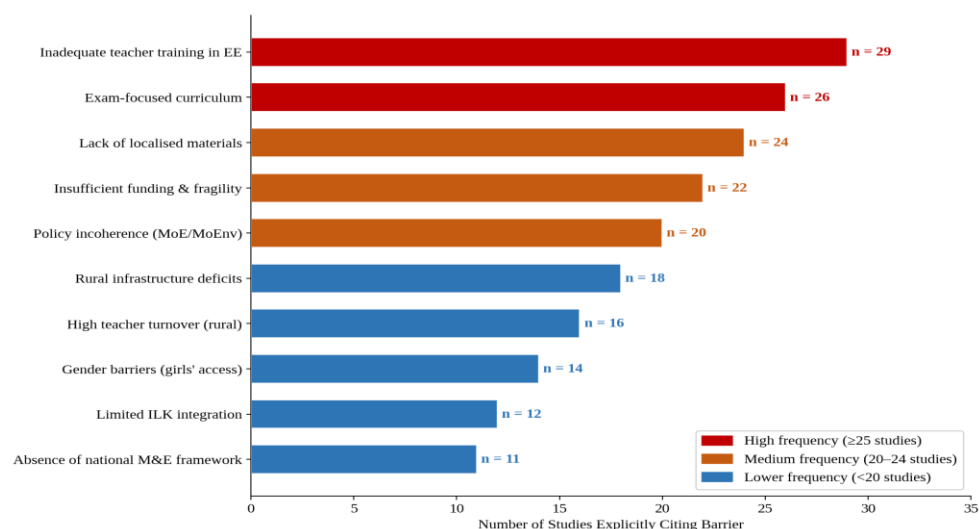


Figure 9: Frequency of Barriers to EE Effectiveness Cited in Included Studies ($n = 47$). Bars show the number of studies explicitly citing each barrier

Discussion

Synthesis of Key Findings

The weight of evidence from 47 studies confirms that environmental education in Kenya demonstrably improves environmental knowledge and attitudes across formal, non-formal, and community settings. The evidence base for behavioural change is more modest but positive, particularly where EE is delivered through participatory, contextually grounded, and livelihood-linked approaches. These findings are broadly consistent with international systematic reviews of EE effectiveness (Ardo et al., 2020; Monroe et al., 2019) while adding important Kenya-specific nuance regarding indigenous knowledge integration, gender dynamics, and the political economy of community conservation.

The persistent KAB gap is the most theoretically significant finding of this review. From a Social Learning Theory perspective (Bandura, 1977), this gap reflects insufficient penetration of peer modelling into formal school EE. From a TPB standpoint (Ajzen, 1991), the gap signals that EE rarely addresses perceived behavioural control with the same rigour as knowledge and attitude formation. From a Transformative Learning perspective (Mezirow, 1991), the gap indicates that most EE programmes fail to produce the critical consciousness that drives durable pro-environmental behaviour. Political Ecology (Blaikie & Brookfield, 1987) adds the structural frame: even where individual agency is mobilized, material constraints and governance failures systematically undermine behavioural translation. From a policy perspective, this finding implies that EE budget allocations that prioritize curriculum content development over community livelihood integration and infrastructure provision are likely to produce knowledge-rich but behaviorally limited outcomes.

The evidence base also contains significant contradictions. Several studies in ASALs report strong positive behavioural outcomes for community forest management, while others from the same geographic contexts document minimal or transient change, with programme gains rapidly reversed following project exit. This inconsistency points to the fragility of behaviour change in the absence of sustained institutional support. Furthermore, some studies report positive attitude shifts without corresponding behavioural change, while others document behavioural adoption without measurable attitude change, suggesting that the assumed linearity of the KAB model may be empirically questionable in certain contexts. These contradictions do not undermine the overall positive assessment of EE effectiveness but caution against overgeneralization and highlight the need for longitudinal, theory-driven evaluation designs.

Kenya's Experience in Comparative Perspective

Kenya's EE landscape exhibits both features common to developing countries (resource constraints, policy-implementation gaps, teacher capacity deficits) and distinctive strengths that may offer transferable lessons. The Green Belt Movement model — integrating ecological restoration, civic education, and women's economic empowerment — demonstrates that EE can function as a vehicle for multi-dimensional sustainable development when strategically connected to livelihood, equity, and governance goals (Maathai, 2004; Mwangi, 2018). This system-level perspective contrasts with narrower EE models that treat environmental literacy as an end in itself.

The evidence on indigenous knowledge integration has implications beyond Kenya. Many developing-country EE systems have inherited colonial educational models that marginalize traditional ecological knowledge. Kenya's emerging practice of explicitly reconnecting formal EE with ILK — in GBM programmes, community forest management schemes, and some CBC pilot schools — suggests a productive pathway for enhancing both ecological relevance and cultural responsiveness (Githiru et al., 2021; Nyamweru & Kimaru, 2008).

Policy Recommendations

The following recommendations are presented in a prioritized framework distinguishing short-term, nationally actionable priorities from longer-term systemic investments.

Short-Term National Priorities (1–3 Years)

Strengthen EE within the CBC: Prioritize teacher pre-service and in-service training in EE pedagogy; fast-track development of localized, multilingual EE materials for ASAL and rural contexts; and redesign assessment rubrics to reward experiential environmental competencies. Implementation pathway: Kenya Institute of Curriculum Development (KICD) to issue revised teacher competency frameworks by 2026.

Establish inter-ministerial EE coordination: Create a formal inter-agency mechanism linking the Ministry of Education, NEMA, the Ministry of Environment and Forestry, county governments, and civil society. Implementation pathway: gazette a National EE Coordinating Committee under EMCA (1999) authority within 18 months.

Medium-Term National Priorities (3–5 Years)

Develop a national EE monitoring and evaluation framework: Track outcomes beyond knowledge acquisition, including behavioural indicators, community resource management metrics, and equity disaggregation by gender, location, and socioeconomic status. Implementation pathway: NEMA to develop an M&E framework aligned with SDG 4.7 indicators.

Institutionalize ILK integration: Formally recognize indigenous and local ecological knowledge in curriculum guidelines and teacher training. Implementation pathway: KICD curriculum guidelines revision in the next CBC review cycle.

Long-Term Systemic Investments (5+ Years)

Establish sustainable community EE financing: Move beyond NGO project cycles through county government EE budgets, community environment funds, and payment for ecosystem services (PES) schemes. Implementation pathway: Treasury circular mandating county environment budget allocations of a minimum of 2% of the County Development Fund.

Limitations

Several limitations must be acknowledged. The evidence base is weighted toward English-language peer-reviewed studies, potentially underrepresenting practitioner-generated and Swahili-language knowledge. Significant heterogeneity of interventions and outcomes limits cross-study comparability and precludes

quantitative meta-analysis. Publication bias may inflate apparent EE effectiveness. Longitudinal data are sparse, limiting assessment of behavioural durability. Causal attribution of sustainable development outcomes to specific EE interventions is methodologically challenging in complex community settings. Grey literature bias is an additional concern: while grey literature was actively sought, the search was limited to publicly available documents from major institutional repositories; unpublished internal evaluations by smaller NGOs and county government programmes remain inaccessible. Regional imbalance, with over-representation of studies from Nairobi and peri-urban areas relative to the country's predominantly rural population, limits the generalizability of findings to remoter ASAL contexts. These limitations collectively imply that the review's positive assessment of EE effectiveness should be interpreted as reflecting the most thoroughly studied and well-resourced programmes, rather than the median EE intervention in Kenya.

Conclusion

This systematic review provides the most comprehensive evidence synthesis to date of EE's contribution to sustainable development in Kenya, drawing on 47 empirical studies spanning formal, non-formal, and community education contexts from 2000 to 2024. The evidence is clear that well-designed EE — participatory, contextually grounded, gender-responsive, and connected to livelihood co-benefits — can make meaningful contributions to the knowledge, attitudes, and behaviours that underpin sustainable development.

Yet EE is neither a sufficient condition for sustainable development nor a substitute for the structural transformations in land governance, economic policy, and infrastructure provision that are ultimately required. Kenya's experience delivers a dual message: it demonstrates EE's potential as a lever for community-scale ecological restoration and livelihood improvement, as exemplified by the Green Belt Movement (Maathai, 2004), while simultaneously revealing the fragility of project-based EE in contexts of institutional weakness and policy incoherence.

For researchers, this review identifies priority directions for future inquiry: longitudinal assessments of behavioural durability; quasi-experimental evaluations of community-based EE; gender-disaggregated analyses; and comparative studies across sub-Saharan Africa. For policymakers, it underscores that realizing EE's potential requires sustained investment, systemic curriculum integration, inter-institutional coordination, and genuine engagement with the political, economic, and cultural conditions that determine whether environmental knowledge translates into sustainable action.

Kenya's evidence ultimately delivers a transformative challenge: environmental education must evolve from an awareness-raising exercise into a structural intervention that simultaneously builds knowledge, develops agency, removes material barriers, and redistributes the power to act sustainably. Until EE systems address all four dimensions — cognitive, motivational, material, and political — the gap between knowing and doing will persist, and with it, the gap between Kenya's environmental commitments and their realization.

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References

- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179–211. [https://doi.org/10.1016/0749-5978\(91\)90020-T](https://doi.org/10.1016/0749-5978(91)90020-T)
- Ardoin, N. M., Bowers, A. W., & Gaillard, E. (2020). Environmental education outcomes for conservation: A systematic review. *Biological Conservation*, 241, 108224. <https://doi.org/10.1016/j.biocon.2019.108224>
- Bandura, A. (1977). *Social learning theory*. Prentice-Hall.
- Barasa, F., & Morara, G. (2021). Environmental attitudes among secondary school students in Kisii County, Kenya. *East African Journal of Education*, 4(1), 45–58. <https://doi.org/10.37284/eaje.4.1.291>
- Blaikie, P., & Brookfield, H. (1987). *Land degradation and society*. Methuen.
- Brundtland Commission. (1987). *Our common future: Report of the World Commission on Environment and Development*. Oxford University Press.
- Constitution of Kenya. (2010). *Article 42: Right to a clean and healthy environment*. National Council for Law Reporting.
- Environmental Management and Coordination Act (EMCA). (1999). *Laws of Kenya, Chapter 387*. Republic of Kenya.
- Githiru, M., Njoroge, P., & Lens, L. (2021). Indigenous ecological knowledge in Kenyan school curricula. *Journal of Biological Education*, 55(3), 283–296. <https://doi.org/10.1080/00219266.2020.1719089>
- IPCC. (2022). *Climate change 2022: Impacts, adaptation and vulnerability*. Cambridge University Press. <https://doi.org/10.1017/9781009325844>
- Kamau, P. N. (2012). Wildlife Clubs of Kenya: Impact on environmental knowledge and conservation attitudes. *African Journal of Environmental Science and Technology*, 6(8), 336–345. <https://www.ajol.info/index.php/ajest/article/view/82019>
- Kariuki, J. N., & Luswet, C. (2020). Mainstreaming sustainability in Kenyan universities. *International Journal of Sustainability in Higher Education*, 21(4), 723–739. <https://doi.org/10.1108/IJSHE-08-2019-0243>
- Maathai, W. (2004). *The Green Belt Movement: Sharing the approach and the experience*. Lantern Books.

Mbugua, S. N. (2016). Effectiveness of environmental clubs in promoting biodiversity conservation in Kenyan secondary schools. *Journal of Education and Practice*, 7(14), 102–112. <https://www.iiste.org/Journals/index.php/JEP/article/view/32254>

Mezirow, J. (1991). *Transformative dimensions of adult learning*. Jossey-Bass.

Monroe, M. C., Plate, R. R., Oxarart, A., Bowers, A., & Chaves, W. A. (2019). Identifying effective climate change education strategies: A systematic review of the research. *Environmental Education Research*, 25(6), 791–812. <https://doi.org/10.1080/13504622.2018.1551736>

Mwangi, G. (2018). Community-based environmental education and women's empowerment in Central Kenya. *Community Development Journal*, 53(4), 654–671. <https://doi.org/10.1093/cdj/bsx002>

Mwangi, G., & Kariuki, J. (2020). Perceived relevance of environmental threats and pro-environmental behavioral intentions in rural Kenya. *Journal of Environmental Psychology*, 72, 101494. <https://doi.org/10.1016/j.jenvp.2020.101494>

Ndungu, M. (2017). Emotional dimensions of environmental learning: Narratives from Kenyan youth. *Environmental Education Research*, 23(7), 1015–1029. <https://doi.org/10.1080/13504622.2015.1116154>

NEMA. (2018). *National environmental education strategy 2018–2030*. Government of Kenya.

Njeru, L. M. (2016). Gender barriers to participation in school environmental clubs. *Gender, Place and Culture*, 23(9), 1298–1314. <https://doi.org/10.1080/0966369X.2016.1160874>

Nyamweru, C., & Kimaru, E. (2008). The contribution of ecotourism and environmental education to forest conservation in Kenya. *Journal of Ecotourism*, 7(2–3), 120–133. <https://doi.org/10.2167/joe220.0>

Ochieng, B. A. (2014). Social desirability bias in environmental attitude surveys in Kenyan schools. *Environmental Education Research*, 20(5), 703–720. <https://doi.org/10.1080/13504622.2013.833593>

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., ... Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ*, 372, n71. <https://doi.org/10.1136/bmj.n71>

Petticrew, M., & Roberts, H. (2006). *Systematic reviews in the social sciences: A practical guide*. Blackwell.

Popay, J., Roberts, H., Sowden, A., Petticrew, M., Arai, L., Rodgers, M., Britten, N., Roen, K., & Duffy, S. (2006). *Guidance on the conduct of narrative synthesis in systematic reviews: A product from the ESRC Methods Programme*. Lancaster University.

UN. (2015). *Transforming our world: The 2030 Agenda for Sustainable Development (A/RES/70/1)*. United Nations. <https://sdgs.un.org/2030agenda>

UNEP. (2022). *Kenya: Environment and climate change overview*. United Nations Environment Programme. <https://www.unep.org/explore-topics/sustainable-development-goals/why-do-sustainable-development-goals-matter/kenya>

UNESCO. (2020). *Education for sustainable development: A roadmap (ESD for 2030)*. UNESCO Publishing. <https://doi.org/10.54675/FKCP7518>

Waithaka, E. (2019). Peer influence and pro-environmental norm formation among adolescents in Nairobi. *Youth and Adolescence*, 48(5), 1010–1022. <https://doi.org/10.1007/s10964-018-0978-4>

Waweru, R. K. (2019). Competency-Based Curriculum and environmental education: Opportunities for sustainable development in Kenya. *African Educational Research Journal*, 7(4), 185–194.

Appendix

Appendix A: PRISMA 2020 Flow Summary

Table AI: PRISMA 2020 study selection flow summary

Stage	Records (n)
Records identified from databases and registries	2,847
Records removed — duplicates	612
Records screened (title and abstract)	2,235
Records excluded at title/abstract stage	2,052
Full-text articles assessed for eligibility	183
Full texts excluded — out of geographic scope	61
Full-texts excluded — no Kenya-specific EE data	38
Full texts excluded — no sustainable development outcome	37
Studies included in the final narrative synthesis	47
Of which: High methodological quality	28 (59.6%)
Of which: Moderate methodological quality	15 (31.9%)
Of which: Low methodological quality (flagged)	4 (8.5%)

Appendix B: Quality Appraisal Tools Used

Table BI: Quality appraisal tools and thresholds by study type

Study Type	Appraisal Tool	Threshold for High Quality
Quantitative (RCT, survey, quasi-experimental)	Modified Downs-Black Checklist (27 items)	Score $\geq$ 70% (19/27)
Qualitative (case study, ethnographic, narrative)	COREQ (32 items)	Score $\geq$ 70% (23/32)
Mixed methods	Mixed Methods Appraisal Tool (MMAT)	Score $\geq$ 70% on all applicable domains
Grey literature (reports, evaluations)	AACODS Checklist (6 criteria)	Score $\geq$ 4/6

Note. COREQ = Consolidated Criteria for Reporting Qualitative Research; MMAT = Mixed Methods Appraisal Tool; AACODS = Authority, Accuracy, Coverage, Objectivity, Date, Significance.

Appendix C: Full Search Strategy

Table C1 presents the full, database-specific search strings used in this systematic review. All searches were conducted between January and March 2024. Search terms were structured using Boolean logic across three thematic clusters: (1) EE/ESD terminology, (2) sustainable development outcome terms, and (3) Kenya/East Africa geographic scope. The search was not date-restricted at entry; date limits (January 2000–December 2024) were applied as a post-search filter during title/abstract screening.

Table C1: Full database-specific search strings used in the systematic review

Database	Search String
Web of Science	TS=(("environmental education" OR "education for sustainable development" OR "ESD" OR "environmental literacy" OR "nature-based learning" OR "climate change education") AND ("sustainable development" OR "pro-environmental behav*" OR "conservation" OR "natural resource management" OR "green economy" OR "ecological behav*") AND ("Kenya" OR "East Africa" OR "Sub-Saharan Africa"))
Scopus	TITLE-ABS-KEY(("environmental education" OR "education for sustainable development" OR "ESD" OR "environmental literacy" OR "nature-based learning" OR "climate change education") AND ("sustainable development" OR "pro-environmental behav*" OR "conservation" OR "natural resource management" OR "green economy" OR "ecological behav*") AND ("Kenya" OR "East Africa" OR "Sub-Saharan Africa"))
ERIC	Descriptor: "Environmental Education" OR "Sustainable Development" AND Keyword: "Kenya" OR "East Africa"; combined with free-text: ("ESD" OR "environmental literacy" OR "climate change education") AND ("pro-environmental behav*" OR "conservation" OR "natural resource management") AND ("Kenya" OR "East Africa" OR "Sub-Saharan Africa")
PubMed	("environmental education"[MeSH Terms] OR "environmental education"[tiab] OR "education for sustainable development"[tiab] OR "environmental literacy"[tiab] OR "climate change education"[tiab]) AND ("sustainable development"[MeSH Terms] OR "conservation of natural resources"[MeSH Terms] OR "pro-environmental behav*" [tiab] OR "natural resource management"[tiab]) AND ("Kenya"[MeSH Terms] OR "Kenya"[tiab] OR "East Africa"[tiab] OR "Sub-Saharan Africa"[tiab])
AJOL	Free-text search: ("environmental education" OR "ESD" OR "environmental literacy" OR "climate change education") AND ("sustainable development" OR "conservation" OR "natural resource management" OR "pro-environmental behav*") AND ("Kenya" OR "East Africa"); filtered to Kenya-affiliated journals and open-access African journals
Google Scholar	"environmental education" OR "ESD" OR "environmental literacy" Kenya "sustainable development" OR "pro-environmental behavior" OR "conservation"; grey literature variant: "environmental education Kenya" site: unep.org OR site:unesco.org OR site:nema.go.ke OR site:kicd.ac.ke OR site:opendata.go.ke; supplemented by manual review of the first 20 pages of results and citation chaining from key included studies
Grey Literature Portals	Manual searches of UNEP (unep.org/resources), UNESCO (en.unesco.org/themes/education-sustainable-development), KICD (kicd.ac.ke), NEMA (nema.go.ke), Kenya Open Data (opendata.go.ke). Search terms: "environmental education Kenya", "ESD Kenya", "environmental literacy Kenya", "sustainable development education Kenya". Reports, evaluations, and policy documents were retrieved irrespective of publication date.

Note. TS = Topic search (Web of Science field tag); TITLE-ABS-KEY = Title, abstract, and keyword search (Scopus field tag); MeSH = Medical Subject Headings; tiab = title and abstract (PubMed field tag); behav* = truncated to capture both British (behaviour) and American (behaviour) spellings. All searches were conducted January–March 20