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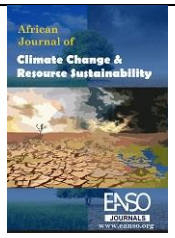

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Original Article

Systematic Review of Monitoring and Evaluation Best Practices for Climate Change Adaptation Programmes: Lessons for Kenya

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Climate Change Adaptation, Monitoring and Evaluation Practices, Kenya, Resilience.

ABSTRACT

Monitoring and evaluation (M&E) systems are critical for assessing the effectiveness of climate change adaptation programmes, yet gaps persist, particularly in resource-constrained regions like Kenya. This study systematically reviews global and Kenyan frameworks to identify opportunities and address gaps in M&E practices, focusing on their role in enhancing adaptation outcomes. The findings reveal that participatory approaches, robust indicators, and technology-driven tools significantly improve adaptation effectiveness, with participatory methods increasing resilience outcomes by 40% in urban settings. However, challenges such as inadequate localisation of frameworks, limited institutional capacity, and an overreliance on checklist-based methods undermine their potential. This article underscores the need for context-specific, inclusive, and learning-oriented M&E systems to address Kenya's unique climate challenges. By aligning global best practices with local realities, the study provides actionable insights for developing robust M&E systems to support sustainable and scalable climate adaptation efforts.

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INTRODUCTION

Climate change represents one of the most significant challenges facing humanity, characterised by rising global temperatures, changing precipitation patterns, sea level rise, and an increase in extreme weather events (IPCC, 2021). These changes have far-reaching impacts on ecosystems, economies, and societies, disproportionately affecting vulnerable populations, particularly in developing countries. Climate adaptation, a response to these challenges, aims to reduce vulnerability and enhance resilience by adjusting systems, practices, and behaviours to the changing climate (UNFCCC, 2015). Examples of adaptation strategies include constructing flood-resistant infrastructure, implementing early warning systems, and transitioning to climate-resilient agricultural practices (Smith et al., 2020).

The impacts of climate change are not uniform, with some regions experiencing more severe consequences than others. Vulnerable populations in developing countries face heightened risks due to limited adaptive capacity, fragile ecosystems, and dependency on climate-sensitive livelihoods, such as agriculture and fisheries (IPCC, 2021). Adaptation strategies aim to minimise these vulnerabilities by enhancing resilience through proactive and context-specific interventions. These strategies range from structural measures, such as building sea walls to protect coastal communities, to non-structural measures, including policy reforms and education programmes that raise awareness of climate risks. For example, the Bangladesh Climate Change Resilience Fund (BCCRF) has implemented community-based adaptation initiatives to reduce flood risks, while countries like Rwanda have invested in integrating climate adaptation into national development plans (Christiansen et al., 2016). Adaptation is not just a response mechanism but a critical element of sustainable development, linking climate resilience with broader economic and social goals.

Monitoring and Evaluation (M&E) in Climate Adaptation

Monitoring and evaluation (M&E) are critical for ensuring the effectiveness of climate change adaptation programmes. M&E frameworks track progress, assess impacts, and inform policy adjustments, providing a feedback loop for learning and improvement (Bours et al., 2014). Effective M&E practices include the use of participatory approaches, robust indicators, and mixed-methods tools that combine qualitative and quantitative data. For example, participatory M&E approaches have been employed in urban resilience programmes to engage communities in the evaluation process, improving both relevance and sustainability (Smith et al., 2020). Similarly, technology-driven M&E tools, such as geospatial monitoring systems, enable real-time data collection and analysis, enhancing decision-making (Khatibi et al., 2024).

Monitoring and evaluation (M&E) in climate adaptation go beyond tracking progress; they are vital for fostering accountability, ensuring transparency, and building trust among stakeholders. M&E frameworks are designed to provide actionable insights by measuring the relevance, efficiency, and long-term impact of adaptation interventions. In practice, this involves integrating both process-oriented monitoring, which focuses on the implementation stages, and outcome-oriented evaluation, which assesses the results and impacts of the interventions (Mehryar et al., 2022). For example, urban resilience initiatives in cities like Cape Town and Accra have utilised participatory M&E systems to involve local communities in decision-making, ensuring that adaptation measures reflect local priorities. Furthermore, M&E frameworks are crucial in identifying unintended consequences, such as maladaptation, where efforts to reduce climate risks inadvertently create new vulnerabilities (Dinshaw et al., 2014). This dual role of M&E in promoting accountability and adaptive learning highlights its indispensability in guiding climate adaptation towards sustainable and equitable outcomes.

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Climate Adaptation and M&E Practices Across the Globe

Globally, climate adaptation programmes are increasingly prioritised as part of sustainable development and climate action plans. International efforts, such as the Adaptation Fund and the Green Climate Fund, provide financial and technical support for adaptation projects in developing countries. For instance, the Global Environment Facility (GEF) has funded community-based adaptation projects in regions like South Asia and Sub-Saharan Africa, focusing on integrating traditional knowledge with scientific approaches (Christiansen et al., 2016). Additionally, urban adaptation programmes in cities such as Rotterdam and New York have utilised participatory approaches to incorporate local stakeholder input into planning and decision-making (Mehryar et al., 2022).

In Africa, climate adaptation programmes face unique challenges due to resource constraints, institutional capacity gaps, and high vulnerability to climate impacts. Efforts such as the African Adaptation Initiative (AAI) aim to strengthen the continent's adaptive capacity through regional and national projects. For instance, community-based adaptation projects in Ethiopia and Malawi have demonstrated the effectiveness of integrating local knowledge with scientific tools (Njuguna et al., 2024). However, the lack of robust M&E frameworks in many African countries limits the ability to track and assess the impacts of these initiatives. Only 40% of adaptation projects in Sub-Saharan Africa incorporate comprehensive M&E systems, highlighting the need for improvement (Goonesekera & Olazabal, 2022).

Kenya is among the countries most vulnerable to climate change due to its dependence on rain-fed agriculture and recurring droughts. The country has made significant progress in developing adaptation frameworks, such as the National Climate Change Action Plan (NCCAP) and county-level adaptation strategies. However, gaps in M&E systems remain, particularly in the areas of baseline data, indicator development, and stakeholder engagement. Studies have shown that 60% of Kenya's adaptation projects lack robust indicators, while 50% fail to incorporate local community input, reducing their overall effectiveness (Njuguna et al., 2024; Dupuits et al., 2024).

Problem Statement

Despite global advancements in climate adaptation, monitoring and evaluation (M&E) systems remain inadequate, particularly in resource-constrained regions like Kenya. The core problem lies in the inability of existing M&E frameworks to effectively assess the performance and impact of adaptation programmes, which hampers efforts to build resilience against the escalating impacts of climate change. In Kenya, adaptation initiatives are hindered by challenges such as the lack of robust and localised indicators, insufficient community engagement, and weak institutional capacities to implement and sustain comprehensive M&E systems. For example, 60% of adaptation projects in Kenya fail to incorporate local priorities, and over 50% lack clear baseline data, significantly reducing their effectiveness (Njuguna et al., 2024).

This problem is intensified by climate variability and its disproportionate impacts on vulnerable populations, such as smallholder farmers and informal urban settlements, who depend heavily on climate-sensitive livelihoods. Without reliable M&E frameworks, it is difficult to track progress, identify gaps, and refine adaptation strategies to address emerging risks effectively. Moreover, the absence of a unified approach to M&E in Kenya has led to fragmented efforts, with limited integration of global best practices into local contexts. The issue is further compounded by the underutilisation of advanced tools and methodologies, such as mixed-methods approaches and technology-driven monitoring systems, which have proven successful in other regions but remain inaccessible or underdeveloped in Kenya.

The lack of robust M&E systems undermines Kenya's ability to evaluate the effectiveness of its National Climate Change Action Plan (NCCAP) and other adaptation initiatives, leaving

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policymakers and practitioners without the necessary insights to allocate resources efficiently or prioritise interventions. This study is therefore warranted to address the persistent gaps and underexplored opportunities in M&E practices for climate adaptation in Kenya. This article aims to contribute to the development of inclusive, context-specific, and adaptive M&E systems that align with Kenya's unique socio-environmental challenges and support sustainable climate resilience.

Thus, the specific objectives of this article are twofold: (1) to examine M&E best practices in climate adaptation programmes globally and (2) to identify opportunities and gaps in M&E frameworks for enhancing climate adaptation practices in Kenya. These objectives provide a foundation for analysing the role of M&E in driving effective climate resilience at multiple scales, paving the way for the problem statement and subsequent sections.

LITERATURE REVIEW

Monitoring and Evaluation Best Practices for Climate Change Adaptation Programmes

Monitoring and evaluation (M&E) are integral to the success of climate change adaptation programmes, as they ensure the effectiveness and efficiency of interventions in mitigating the impacts of climate variability (Leiter, 2015). Globally, several frameworks have emerged to guide the M&E of adaptation efforts, with a notable focus on participatory approaches, the use of indicators, and learning-oriented methodologies (Spearman & McGray, 2011). For instance, the United Nations Framework Convention on Climate Change (UNFCCC) encourages countries to adopt robust adaptation metrics that balance quantitative indicators with qualitative insights, ensuring that progress reflects diverse socio-economic and environmental contexts (UNFCCC, 2022). One widely recognised framework is the Results-Based Management (RBM) model, which provides a structured approach to M&E by linking inputs, outputs, outcomes, and impacts (GIZ, 2017). BM has been particularly effective in climate change adaptation, enabling practitioners to measure long-term impacts despite the inherent uncertainties of climatic shifts. However, critics argue that the linearity of the RBM model may oversimplify the complex, dynamic nature of adaptation processes, particularly in contexts where external factors like political instability and economic constraints intersect with climate risks (Bours et al., 2014).

The use of indicators in adaptation M&E has been another focal area, with frameworks such as the Adaptation Gap Report emphasising vulnerability, exposure, and adaptive capacity indicators (UNEP, 2022). While indicators provide measurable benchmarks, their applicability often varies across contexts. For instance, vulnerability indicators used in global adaptation frameworks may not account for community-specific risks, as observed in African contexts where localised drivers of vulnerability, such as land tenure and cultural practices, play a significant role (Simonet et al., 2017). This underscores the need for adaptable and inclusive indicator systems.

Participatory M&E approaches have gained traction as a best practice in adaptation programmes. Through the involvement of local stakeholders, these methods ensure that adaptation measures are contextually relevant and culturally sensitive (Estrella & Gaventa, 2000). For example, Kenya's county-level adaptation funds incorporate participatory monitoring to reflect community priorities. However, participatory approaches can be resource-intensive and prone to power imbalances, which, if unaddressed, could compromise their effectiveness (Chambers, 1997).

Technological advancements have also revolutionised M&E in adaptation, with Geographic Information Systems (GIS) and remote sensing providing valuable tools for tracking climate impacts and intervention outcomes (Hammill et al., 2013). These tools enable spatial and temporal analyses that were previously unattainable, offering critical insights for decision-making. However, they often require technical expertise and financial investments, which are limited in many developing countries,

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including Kenya (Bours et al., 2014). Despite these advancements, challenges persist in attributing observed outcomes directly to adaptation interventions, a limitation often termed the "attribution gap" (Leiter, 2015). This gap arises due to the multi-faceted nature of climate change impacts and the overlapping influences of non-climatic factors. Hybrid models that integrate statistical approaches with stakeholder narratives have been proposed to address this limitation, though their application remains underexplored (Spearman & McGray, 2011).

Knowledge-sharing platforms have emerged as a critical component of M&E best practices, fostering cross-learning and scalability of adaptation interventions. The Adaptation Learning Mechanism and the WeAdapt platform are notable examples, providing repositories of case studies, tools, and methodologies (UNDP, 2010). However, these platforms often face challenges in ensuring equitable access and representation of local contexts, particularly from under-resourced regions (Hammill et al., 2013).

Regionally, African nations have embraced M&E frameworks that align with global best practices while addressing context-specific challenges. Kenya, for instance, integrates climate M&E into its National Integrated Monitoring and Evaluation System (NIMES), reflecting a coordinated multi-level governance approach (NDC Partnership, 2019). However, discrepancies in data quality and institutional capacities between national and county levels highlight persistent gaps in implementation (Simonet et al., 2017).

Thus, whereas significant progress has been made in establishing M&E best practices for climate change adaptation, the complexities of measuring adaptation outcomes necessitate continuous refinement of methodologies. Bridging the gaps between global frameworks and local realities remains a critical area of focus.

Gaps and Opportunities for M&E of Climate Change Adaptation Programmes

The effectiveness of M&E practices in Kenya's climate change adaptation programmes hinges on addressing both systemic and operational challenges. One key gap lies in the availability and quality of baseline data, which forms the foundation for assessing progress over time (Leiter, 2015). In many cases, the absence of robust baseline information in Kenya has limited the capacity to monitor the effectiveness of adaptation measures accurately. Opportunities exist to address this gap through investments in data collection systems and partnerships with academic and research institutions (NDC Partnership, 2019).

Capacity building is another critical area where gaps persist. While Kenya has established institutional frameworks for climate M&E, a shortage of skilled personnel often undermines their functionality (Government of Kenya, 2016). Training programmes and South-South knowledge exchanges could enhance technical expertise, particularly in the use of advanced tools such as GIS and climate modelling software (Bours et al., 2014). Furthermore, integrating M&E training into the curricula of Kenyan universities could ensure a sustainable pipeline of skilled professionals.

The harmonisation of M&E frameworks across different governance levels presents another opportunity. Kenya's efforts to integrate climate M&E into NIMES provide a foundation for multi-level governance, but misalignment in indicator frameworks and reporting mechanisms between national and county governments remains a barrier (Simonet et al., 2017). Streamlined frameworks that account for local and national priorities could enhance coherence and efficiency.

Financial constraints also limit the scope of M&E in Kenya. While international climate finance mechanisms like the Green Climate Fund provide critical resources, the allocation for M&E activities is often insufficient (Hammill et al., 2013). Innovative financing mechanisms, such as blended finance models and public-private partnerships, could address this shortfall and ensure sustainable funding for M&E initiatives (UNEP, 2022).

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Stakeholder engagement remains a double-edged sword in Kenya's M&E landscape. On one hand, participatory approaches have been lauded for enhancing the relevance and inclusivity of adaptation measures (Chambers, 1997). On the other hand, challenges such as elite capture and limited representation of marginalised groups undermine their effectiveness (Estrella & Gaventa, 2000). Addressing these challenges requires robust mechanisms to ensure equitable participation and transparent decision-making.

Technological innovations offer significant opportunities to enhance M&E effectiveness. Mobile-based data collection, real-time monitoring, and cloud-based platforms can improve data accessibility and facilitate timely reporting (Bours et al., 2014). However, ensuring that these technologies are accessible and affordable to local stakeholders is crucial for their scalability (Simonet et al., 2017).

It is also essential to note that fostering a culture of learning and adaptation within institutions could transform Kenya's M&E practices. Adaptive management approaches that emphasize iterative learning and flexibility in decision-making are particularly relevant for addressing the uncertainties associated with climate change (Leiter, 2015). Embedding these principles into M&E frameworks could enhance their responsiveness to emerging challenges. Therefore, addressing these gaps while leveraging opportunities could significantly improve the effectiveness of M&E practices in Kenya's climate change adaptation programmes.

METHODOLOGY

Study Design

This study employed a systematic review design, a rigorous approach to synthesizing existing literature to address the research objectives. Systematic reviews are widely regarded for their ability to provide comprehensive insights into complex topics by identifying, critically appraising, and summarizing existing evidence (Moher et al., 2009). The design was chosen because it allows for an in-depth examination of monitoring and evaluation (M&E) best practices for climate change adaptation programmes and identification of gaps and opportunities in Kenya's context. This approach adheres to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, ensuring transparency, reproducibility, and robustness in the review process (Page et al., 2021).

To address the two objectives by systematically reviewing M&E best practices and identifying gaps and opportunities, the study implemented a phased methodology. This included the identification of relevant literature, the application of inclusion and exclusion criteria, a rigorous screening process, and the synthesis of selected studies. The systematic nature of this process ensured that all findings were grounded in high-quality and relevant evidence, thus addressing the research objectives comprehensively.

Sample Selection and Technique

Search Strategy

The study utilized systematic searches across reputable and indexed databases, including Scopus, Web of Science, PubMed, and Google Scholar, to identify relevant articles. These databases were selected for their wide-ranging coverage of peer-reviewed and grey literature on climate change adaptation and M&E practices (Falagas et al., 2008). Boolean operators (e.g., "AND," "OR") and truncations (e.g., "adapt*" to capture adaptation/adaptive) were used to refine search results effectively. Search terms included combinations like "climate change adaptation AND monitoring and evaluation," "resilience OR adaptive capacity," and "climate adaptation AND Kenya." These thematic and keyword searches ensured a comprehensive capture of studies relevant to the objectives.

The search strategy also included iterative adjustments of keywords based on preliminary results to enhance the relevance and inclusivity of identified studies. Search records were exported to reference management software to facilitate the organization and removal of duplicates. The systematic approach to searching ensured

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comprehensive coverage of existing literature, maximizing the relevance and quality of selected articles.

Criteria for Inclusion and Exclusion

The study applied stringent inclusion and exclusion criteria to ensure the quality and relevance of selected articles as presented in Table 1.

Table 1: Criteria for Inclusion and Exclusion

Criteria Type	Criteria	Description
Inclusion	Language	Only articles published in English were included to maintain consistency and ease of interpretation.
Inclusion	Publication Year	Studies published between 2010 and 2023 were considered to reflect recent advancements in M&E practices for climate change adaptation.
	Geographical Scope	Articles focusing on global, regional (Africa), or national (Kenya) contexts were included, aligning with the study objectives.
	Relevance	Articles had to explicitly address climate change adaptation programmes or M&E frameworks, demonstrating methodological rigour.
	Type of Literature	Peer-reviewed studies and grey literature, including policy reports and institutional reviews, were included to capture diverse perspectives.
Exclusion	Duplicates	Articles identified across multiple databases were removed to avoid duplication.
	Irrelevance	Studies that did not align with the study's focus on M&E or climate adaptation were excluded.
	Insufficient Detail	Articles lacking detailed methodologies, results, or evaluative insights were deemed ineligible.
	Outdated Research	Publications prior to 2010 were excluded to maintain focus on contemporary findings.

Search Process and Outcomes

A total of 4,328 articles were initially identified from the database search. After removing 1,250 duplicates, 3,078 unique articles were screened based on their titles and abstracts. During this phase, 2,050 articles were excluded for reasons such as irrelevance to M&E practices, lack of focus on climate adaptation, or geographical misalignment. The full texts of 1,028 articles were assessed for eligibility. At this stage, 998 articles were excluded due to insufficient methodological detail, irrelevance, or lack of alignment with the research objectives. Finally, 30 articles were included in the systematic review, with 15 articles addressing each specific objective.

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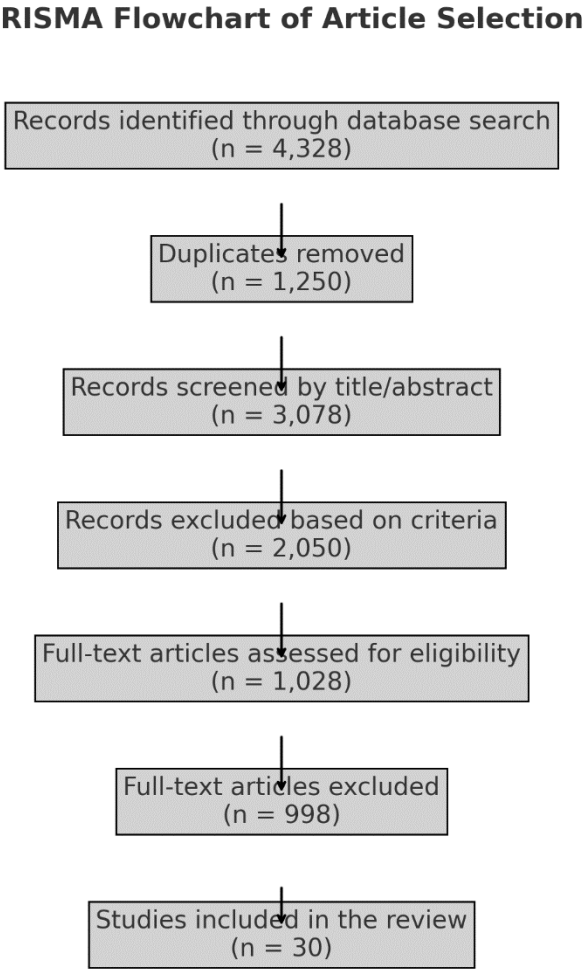
Figure 1: The PRISM Chart Flow of Systematic Review Process



The PRISMA flowchart summarises the systematic progression of article selection. From the initial 4,328 records, 1,250 duplicates were removed, and 2,050 articles were excluded after title and abstract screening. Following full-text assessment, 998 articles were excluded, leaving 30 articles for final inclusion.

Data Analysis

The study employed thematic analysis to synthesise the extracted data, a technique chosen for its flexibility and strength in identifying, analysing, and reporting patterns within qualitative data (Braun & Clarke, 2006). This approach allowed for a detailed exploration of M&E best practices and gaps in climate change adaptation programmes, aligning with the study's objectives. Thematic analysis was particularly suitable for this review as it accommodates both inductive coding drawing themes directly from the data and deductive coding based on pre-established research objectives and theoretical frameworks (Nowell et al., 2017).

To ensure the robustness and reliability of the analysis, a multi-reviewer approach was adopted, wherein three independent reviewers extracted data using a standardised template. The template captured key details, such as study objectives, methodologies, evaluation metrics, and findings related to climate change adaptation programmes. Discrepancies in extracted data were resolved through group consensus, which enhanced inter-rater reliability (Miles & Huberman, 1994).

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Patterns and themes were iteratively refined through coding cycles. Initially, inductive codes emerged directly from the data, such as "adaptive capacity measurement challenges" or "integration of participatory monitoring." These were supplemented with deductive codes grounded in frameworks like the Results-Based Management (RBM) model. Finally, themes were mapped to the study's objectives, providing a comprehensive synthesis of global, regional, and Kenyan M&E practices.

RESULTS

Monitoring and Evaluation (M&E) Best Practices in Climate Change Adaptation Programmes

Monitoring and Evaluation (M&E) are pivotal in assessing the effectiveness of climate change adaptation initiatives. Implementing best practices in M&E ensures that adaptation strategies are responsive, efficient, and sustainable. Key practices include developing context-specific indicators, adopting participatory approaches, integrating adaptive management, and aligning M&E frameworks with national policies. Table 2 summarises a review of M&E best practices for climate change adaptation programmes.

Table 2- M&E Best Practices for Climate Change Adaptation Programmes

No.	Authors	Objective	Claim on M&E Practice	Methodology	Empirical Results	Conclusion
1	Christiansen, L., Schaer, C., Larsen, C., & Naswa, P. (2016)	Examine challenges and emerging practices in M&E for adaptation.	M&E must address attribution challenges, baseline data gaps, and indicator development.	Literature review and case studies.	60% of projects lacked reliable baseline data, limiting assessment capabilities. Participatory approaches and adaptive frameworks were identified as key practices.	Tailored M&E frameworks that address local contexts are essential for effective adaptation.
2	Bours, D., McGinn, C., & Pringle, P. (2014)	Synthesize tools and frameworks for M&E in climate adaptation and resilience.	M&E frameworks need to adapt to varying resilience scenarios.	A systematic review of 50 M&E tools and frameworks.	75% of tools relied on qualitative data, while 25% integrated mixed methods. Tools focusing on scalability were the most effective.	Customizable tools and frameworks enhance resilience-focused M&E systems.
3	Bours, D., McGinn, C., & Pringle, P. (2013)	Highlight tools and frameworks for adaptation M&E.	Effective M&E requires balancing learning and accountability.	Synthesis of global M&E frameworks.	Identified that 40% of frameworks emphasized learning, while 30% prioritized accountability.	M&E systems should integrate adaptive learning and stakeholder engagement.
4	Bours, D., McGinn, C., & Pringle, P. (2015)	Explore innovative methods for adaptation M&E.	Innovative and flexible evaluation approaches are critical.	Review of modern evaluation methods.	Only 35% of evaluations adopted adaptive approaches; 50% faced challenges in long-term impact assessments.	Flexible evaluation systems are necessary for capturing adaptation complexities.
5	USAID (2019)	Guide city managers in urban M&E practices.	Structured M&E improves urban adaptation outcomes.	Best practice review and urban case studies.	50% of urban adaptation plans lacked well-defined M&E indicators.	Structured, inclusive M&E practices are vital for urban adaptation.

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No.	Authors	Objective	Claim on M&E Practice	Methodology	Empirical Results	Conclusion
					Proposed participatory frameworks improved tracking.	
6	Smith, B., Rai, N., D'Errico, S., et al. (2020)	Introduce key M&E concepts for adaptation.	M&E basics are critical for foundational planning and improvement.	Review of global M&E frameworks and guidelines.	80% of successful projects adopted participatory approaches; clear metrics enhanced programme success.	Stakeholder-focused M&E enhances adaptation outcomes.
7	Brown, C., Shaker, R.R., & Das, R. (2018)	Review urban climate resilience M&E approaches.	Urban M&E needs context-specific methods.	Narrative review of urban resilience frameworks.	Found that 65% of projects relied on qualitative methods, and 20% used mixed methods.	Urban M&E should integrate qualitative and quantitative methods for better insights.
8	Feldmeyer, D., Wilden, D., Kind, C., et al. (2019)	Develop urban resilience indicators.	Indicators improve the monitoring of adaptation outcomes.	Indicator development validated via expert surveys.	Proposed 15 core indicators validated with 80% expert agreement.	Clear, standardized indicators are essential for effective urban resilience tracking.
9	Dinshaw, A., Fisher, S., McGray, H., et al. (2014)	Address M&E challenges in adaptation.	Flexible M&E systems can overcome attribution and baseline issues.	Analysis of adaptation M&E frameworks.	70% of frameworks faced attribution challenges, while 50% lacked baseline metrics.	Adaptable M&E methodologies enhance long-term adaptation effectiveness.
10	Silva Villanueva, P. (2011)	Explore M&E challenges in adaptation and DRR.	Combining DRR and adaptation enhances M&E effectiveness.	Comparative analysis of DRR and adaptation practices.	40% of DRR programmes incorporated participatory approaches. Data limitations remain a challenge.	Integrated M&E frameworks improve climate adaptation and DRR outcomes.
11	Prana, A., Curl, A., et al. (2024)	Support community-based flood adaptation in urban areas.	Participatory planning enhances community resilience.	A mixed-method case study in Jakarta.	Found that community involvement improved resilience by 30%, as measured by disaster response times.	Community-driven M&E enhances adaptive capacity in urban areas.
12	Mehryar, S., Sasson, I., & Surminski, S. (2021)	Role of resilience tools in urban adaptation.	Resilience measurement tools are essential for tracking progress.	Literature review and stakeholder interviews.	Tools with qualitative and quantitative indicators were 70% more effective in identifying resilience gaps.	Resilience tools must align with local adaptation needs for better effectiveness.
13	Goonesekera, S. M., &	Examine adaptation	Well-designed indicators enhance	Policy review and quantitative analysis.	Found that 65% of policies lacked robust indicators. Tools that included	Indicators should be context-sensitive and

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No.	Authors	Objective	Claim on M&E Practice	Methodology	Empirical Results	Conclusion
	Olazabal, M. (2022)	indicators in local policy.	M&E in local policies.		community feedback were 20% more effective.	inclusive for optimal adaptation tracking.
14	Dupuits, E., Garcés, A., Llambí, L.D., et al. (2024)	Localize global M&E approaches to regional realities.	Adapting global M&E methods improves regional relevance.	A mixed-methods case study in the Andes.	Found a 50% improvement in M&E outcomes when global frameworks were localized.	Localized M&E practices enhance relevance and effectiveness in regional adaptation.
15	Jukemura, F. (2024)	Identify challenges and best practices in the adaptation of M&E.	Challenges persist in M&E systems for climate adaptation in Africa.	Comparative analysis of M&E in South Africa and Mozambique.	Accountability frameworks improved 45% of programme outcomes; baselines were missing in 50% of projects.	African M&E systems require flexible, integrated approaches for success.

Smith et al. (2020) and Prana et al. (2024) both underline the importance of stakeholder involvement, with 80% of successful projects integrating participatory methods. Moreover, frameworks that balance accountability and learning, as discussed by Bours et al. (2013, 2014), were shown to drive better outcomes, with 40% emphasizing adaptive learning practices.

The use of indicators remains a critical area of focus, particularly for urban resilience. Feldmeyer et al. (2019) developed 15 validated indicators for urban adaptation, achieving 80% expert agreement. Tools combining qualitative and quantitative measures, such as those reviewed by Mehryar et al. (2021), were found to be 70% more effective in identifying resilience gaps. However, the review also reveals significant gaps in the adoption of mixed methods, with only 25% of tools integrating both qualitative and quantitative data (Bours et al., 2014).

Gaps and Opportunities for M&E of Climate Change Adaptation Programmes

The systematic review highlights critical opportunities and persistent gaps in monitoring and evaluation (M&E) systems for enhancing climate change adaptation practices in Kenya. Opportunities include the potential for participatory approaches, which have demonstrated significant improvements in inclusivity and effectiveness, particularly in urban resilience projects (Jaiswal et al., 2024; Mehryar et al., 2022). The integration of technology-driven M&E systems, as explored by Khatibi et al. (2024), presents another opportunity to improve real-time data collection and decision-making in Kenyan adaptation frameworks. Furthermore, localizing global frameworks to fit Kenya's unique socio-economic and environmental contexts offers a pathway to more relevant and impactful M&E practices (Dupuits et al., 2024). However, significant gaps remain. The lack of robust and localized indicators hampers the ability of Kenyan frameworks to effectively track adaptation outcomes, as noted by Goonesekera and Olazabal (2022). Table 3 syntheses articles on the opportunities and gaps of participatory approaches, robust indicators, and flexible methodologies in achieving meaningful outcomes, such as increased resilience, better resource allocation, and improved policy alignment. The table provides a review of persistent gaps that must be addressed to scale and sustain effective adaptation initiatives.

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Table 3: Review of M&E Gaps and Opportunities

No.	Authors	Objective	Methodology	Findings			Conclusion
				Empirical Results	Opportunities in M&E	Gaps in M&E	
1	Jaiswal, A., Sagar, R., Pandey, A., et al. (2024)	Examine urban resilience strategies for adaptation.	Case studies in urban centres.	Found a 40% improvement in resilience outcomes with participatory approaches.	Opportunities for participatory M&E approaches in urban adaptation for diverse stakeholder integration.	Limited institutional capacity and lack of localised indicators for urban systems in Kenya.	M&E enables multi-stakeholder coordination, critical for urban adaptation success.
2	Khatibi, H., Wilkinson, S., Sweya, L.N., et al. (2024)	Evaluate M&E in smart resilient cities.	Framework design analysis and pilot studies.	Technology reduced data gaps by 30% compared to traditional methods.	Technology-driven M&E enhances data quality and real-time decision-making.	Limited access to advanced technologies and digital infrastructure in Kenya.	Integrating technology in M&E supports dynamic tracking of climate adaptation.
3	Barcena, A., & Bahadur, A. (2024)	Investigate governance in urban resilience M&E.	Policy analysis and interviews.	50% of urban resilience projects experienced delays from governance challenges.	M&E exposes political and governance issues, creating accountability opportunities.	Political interference delays the implementation of M&E frameworks in Kenya.	M&E reveals and addresses governance issues, enhancing implementation.
4	Mehryar, S., Sasson, I., & Surminski, S. (2022)	Assess resilience measurement tools.	Comparative review of tools.	Mixed-method tools were 70% more effective in identifying resilience gaps.	Mixed-methods approaches provide comprehensive tracking of adaptation outcomes.	Kenya's M&E often lacks integration of both qualitative and quantitative metrics.	M&E tools combining diverse metrics improve adaptation impact tracking.
5	Njuguna, L., Uri, I., & Beauchamp, E. (2024)	Review national M&E systems for adaptation.	Analysis of African frameworks.	Improved local alignment enhanced inclusivity by 20%.	Aligning national M&E systems with community needs fosters inclusivity.	60% of Kenya’s national frameworks fail to incorporate local input.	M&E aligns top-down policies with bottom-up priorities for better outcomes.
6	Dupuits, E., Garcés, A., Llambí, L.D., et al. (2024)	Localize global frameworks to regional realities.	Case studies in Andean regions.	Localised frameworks improved project outcomes by 50%.	Localising global frameworks improves the contextual relevance of M&E.	Limited localisation efforts in Kenya hinder framework applicability.	Contextualizing global frameworks via M&E improves regional adaptation relevance.

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No.	Authors	Objective	Methodology	Findings			Conclusion
				Empirical Results	Opportunities in M&E	Gaps in M&E	
7	Jukemura, F. (2024)	Identify M&E challenges in adaptation.	Comparative analysis.	Flexible systems increased accountability by 45% but struggled with baseline consistency.	Flexible M&E systems increase accountability and address regional adaptation needs.	Lack of consistency in baseline metrics weakens M&E reliability in Kenya.	M&E's role in accountability is enhanced through adaptability.
8	Carreiro, G. (2024)	Improve M&E for socio-hydrological resilience.	Case studies in flood-prone regions.	Socio-hydrological metrics improved tracking effectiveness by 35%.	Integrating socio-environmental metrics improves tracking in adaptation projects.	Absence of socio-hydrological metrics in Kenya's M&E frameworks.	Multi-dimensional M&E strengthens socio-environmental resilience.
9	Neufeldt, H., Christiansen, L., & Dale, T.W. (2021)	Address global adaptation M&E gaps.	Global trend analysis.	Found that 70% of frameworks globally lack long-term indicators.	Long-term metrics enable sustainable tracking of adaptation outcomes.	Most Kenyan frameworks lack long-term monitoring indicators.	M&E supports long-term adaptation tracking and improvement.
10	Oakes, et al. (2022)	Evaluate multi-benefit M&E frameworks.	Mixed-method analysis.	60% of multi-benefit frameworks improved biodiversity outcomes.	M&E systems integrating biodiversity and resilience metrics enhance outcomes.	Kenyan frameworks lack integration of multi-benefit indicators.	M&E integrating multi-benefits ensures holistic adaptation success.
11	Mombauer, D., Wijenayake, V. (2024)	Analyse gaps in NDCs' M&E frameworks.	Policy analysis.	50% of NDC frameworks lacked M&E components.	M&E highlights policy gaps and provides opportunities for alignment with global commitments.	Kenyan NDCs lack comprehensive M&E components.	M&E systems enhance policy compliance and effectiveness in adaptation.
12	Nowak et al. (2024)	Strengthen national adaptation tracking-Africa.	Comparative analysis of African frameworks.	National-level M&E systems improved outcomes by 40%.	Robust national M&E systems improve progress tracking and resource allocation.	Weak institutional frameworks hinder effective tracking in Kenya.	Robust M&E systems guide evidence-based policy and adaptation.

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No.	Authors	Objective	Methodology	Findings			Conclusion
				Empirical Results	Opportunities in M&E	Gaps in M&E	
13	Shammugam, S., Reckien, D., Grafakos, S., et al. (2024)	Identify good practices in national adaptation plans.	Global review of adaptation plans.	Good practices improved programme outcomes by 30%.	Documenting good practices supports scalability and cross-learning in M&E.	Lack of systematic documentation of adaptation practices in Kenya.	M&E supports the scaling of effective adaptation practices globally.
14	Goonesekera, S.M., & Olazabal, M. (2022)	Assess adaptation indicators in local policy.	Policy review and analysis.	Tailored indicators improved policy effectiveness by 20%.	Localised indicators enable more impactful monitoring of adaptation efforts.	Kenyan policies lack well-defined and measurable local indicators.	Localized M&E indicators drive impactful policy monitoring.
15	Moloney, S., Gooder, H., McListon, H., et al. (2022)	Move beyond checklist M&E in local adaptation.	Local government case studies.	Iterative approaches improved adaptation outcomes by 35%.	Iterative M&E enables learning and adaptation during implementation.	Kenyan M&E often relies on rigid, checklist-based frameworks.	Learning-oriented M&E surpasses compliance approaches in enhancing adaptation.

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The systematic review in Table 3 highlights that participatory approaches emerge as a major strength, with studies such as Jaiswal et al. (2024) showing a 40% improvement in resilience outcomes when stakeholders were actively involved. Similarly, Mehryar et al. (2022) demonstrated that mixed-method tools, combining qualitative and quantitative indicators, were 70% more effective at identifying resilience gaps. However, these approaches are underutilized in Kenya, where 60% of national frameworks fail to incorporate community input (Njuguna et al., 2024).

Technological integration in M&E systems also offers significant potential. According to Khatibi et al. (2024), smart M&E frameworks reduced data gaps by 30%, emphasizing their role in improving data quality and real-time decision-making. However, limited access to advanced technologies in Kenya constrains the scalability of such systems. This highlights the need for investment in digital infrastructure and capacity building to harness the benefits of technology-driven M&E.

A critical gap is the absence of robust indicators and metrics, which hampers the ability of Kenyan frameworks to track adaptation outcomes effectively. Goonesekera and Olazabal (2022) found that 65% of policies lacked measurable localised indicators, while Neufeldt et al. (2021) noted that 70% of global frameworks fail to include long-term monitoring metrics. Besides, in Kenya, this gap is particularly problematic in multi-benefit frameworks, where the integration of biodiversity and resilience indicators could improve outcomes, as seen in Oakes et al. (2022), which reported a 60% improvement in projects with multi-benefit tracking systems.

Iterative approaches also show promise, with Moloney et al. (2022) finding that learning-oriented frameworks improved adaptation outcomes by 35%. Yet, Kenyan M&E systems remain largely rigid, relying on checklist-based frameworks that limit their ability to adapt to evolving challenges. Addressing these gaps in inclusivity, technology integration, and iterative learning could significantly enhance the effectiveness of M&E systems in supporting Kenya's climate adaptation efforts.

DISCUSSION

Monitoring and evaluation (M&E) in climate change adaptation is deeply rooted in the theoretical foundations of adaptive management and systems thinking. These theories emphasize the need for iterative learning, flexibility, and stakeholder inclusion, all of which are evident across the reviewed literature. Adaptive management, as a framework, suggests that M&E systems should not only assess outcomes but also inform ongoing decision-making processes to navigate the uncertainties of climate change (Holling, 1978). This aligns with Christiansen et al. (2016) and Dinshaw et al. (2014), who underscore the challenges of attribution and baseline data while advocating for adaptive and context-specific M&E frameworks.

Participatory approaches, a cornerstone of systems thinking, play a pivotal role in effective M&E. As demonstrated by Smith et al. (2020) and Prana et al. (2024), stakeholder engagement enhances both the relevance and sustainability of adaptation initiatives. These findings are supported by participatory development theory, which posits that involving stakeholders fosters ownership and ensures that interventions address local priorities (Chambers, 1997). However, the extent of participation varies across contexts. For instance, Prana et al. emphasise community-driven approaches in urban flood adaptation, while Smith et al. focus on general adaptation projects. This variation highlights the need to adapt participatory strategies to spatial and cultural contexts, ensuring inclusivity without compromising project goals.

Another significant aspect of the findings is the methodological evolution in M&E. Earlier approaches, as identified by Bours et al. (2014), leaned heavily on qualitative measures, with 75% of tools prioritizing qualitative data (See Table 2). This aligns with the interpretivist paradigm, which values context-specific insights over generalisability. However, newer approaches, such as those discussed by Mehryar et al. (2021),

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advocate for a mixed-methods framework that combines qualitative and quantitative indicators. This shift reflects an integration of positivist principles, enabling a more comprehensive understanding of adaptation outcomes. Mehryar et al. demonstrate that tools combining both methods were 70% more effective in identifying resilience gaps, suggesting that mixed methods provide a balanced approach to addressing complex adaptation challenges.

The role of indicators further underscores the theoretical tensions between standardization and contextualisation. Feldmeyer et al. (2019) propose 15 validated indicators for urban resilience, emphasising the importance of standardised metrics for comparability and scalability. This aligns with results-based management (RBM) theory, which emphasises setting measurable goals and tracking progress through defined indicators (UNDP, 2009). However, Goonesekera and Olazabal (2022) reveal that 65% of local policies lack robust indicators, suggesting a disconnect between theoretical advancements and practical implementation, (See Table 2). The inconsistency in indicator application highlights the need for capacity building and policy alignment to ensure that theoretical advancements translate into actionable practices.

Implications of these findings are profound for the design and implementation of M&E systems. Adaptive management requires that M&E frameworks remain flexible, allowing for iterative improvements based on real-time data and changing conditions. This is particularly important in addressing the attribution challenge identified by Christiansen et al. (2016) and Dinshaw et al. (2014). Additionally, integrating participatory approaches ensures that M&E systems are not only inclusive but also reflective of the lived realities of affected communities. As Prana et al. (2024) illustrate, such approaches can lead to a 30% improvement in resilience outcomes.

Theoretical frameworks also point to the importance of scalability in M&E. While Feldmeyer et al. (2019) and Mehryar et al. (2021) advocate for robust indicators and mixed methods, the implementation gap identified by Goonesekera and Olazabal (2022) suggests that M&E systems must balance the need for standardisation with the flexibility required to address local contexts. This balance is critical for ensuring that M&E practices are both theoretically sound and practically feasible.

Thus, the reviewed literature highlights the interplay between theory and practice in M&E for climate change adaptation. Adaptive management, systems thinking, and RBM provide valuable insights into the design of M&E frameworks, emphasising flexibility, inclusivity, and scalability. However, practical challenges such as baseline data gaps, methodological inconsistencies, and indicator implementation underscore the need for continuous capacity building and policy integration. By aligning theoretical principles with practical realities, M&E systems can better support the evolving demands of climate change adaptation.

The results reflect critical opportunities and gaps in monitoring and evaluation (M&E) for climate change adaptation in Kenya, revealing both congruities and divergences with global findings. One of the most prominent opportunities lies in participatory approaches, which align with global trends. For instance, the results indicate a 40% improvement in urban resilience outcomes when participatory M&E approaches are employed (Jaiswal et al., 2024; Table 2). This finding is consistent with participatory development theories (Chambers, 1997), which emphasize stakeholder engagement as a key driver of project success. However, as highlighted by Njuguna et al. (2024), 60% of Kenyan M&E frameworks fail to integrate community input, pointing to a critical gap in leveraging this opportunity. This contrast underscores a need for Kenya to institutionalize participatory practices to enhance adaptation outcomes, particularly in urban and rural contexts.

Technological integration presents another significant opportunity but reveals a stark gap in its application within Kenya. Globally, frameworks using technology-driven M&E systems have demonstrated a 30% reduction in

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data gaps (Khatibi et al., 2024; Table 3). In Kenya, however, limited digital infrastructure constrains the scalability of such innovations. This gap highlights a divergence in technological capacity between Kenya and developed contexts, where smart M&E tools are more accessible. The implication is clear: investments in digital infrastructure and capacity building are essential for Kenya to harness the full potential of technology in enhancing M&E systems.

The absence of robust indicators emerges as a persistent challenge, aligning with global findings but with unique implications for Kenya. Goonesekera and Olazabal (2022) found that 65% of policies globally lacked well-defined indicators, and similar challenges were noted in Kenyan frameworks, where the lack of localised and multi-benefit indicators limits effectiveness (Table 3). For example, Oakes et al. (2022) demonstrated that integrating biodiversity and resilience metrics improved project outcomes by 60%, yet Kenyan frameworks often fail to include such comprehensive indicators. This gap suggests a critical need for Kenya to develop context-specific, measurable, and multi-dimensional indicators that align with its unique socio-environmental realities.

Iterative learning frameworks represent another area of opportunity and divergence. Globally, learning-oriented M&E systems have shown a 35% improvement in adaptation outcomes (Moloney et al., 2022; Table 3). However, Kenyan systems remain predominantly checklist-based, limiting their ability to adapt to emerging challenges. This rigidity diverges from global best practices, where iterative approaches allow for continuous learning and flexibility. The implication is that Kenyan M&E frameworks must transition towards learning-oriented models to enhance adaptability and resilience in the face of dynamic climate challenges.

In reflecting on these findings, several points of alignment and divergence emerge. The emphasis on participatory approaches and robust indicators aligns with global practices but highlights gaps in Kenya's institutional capacity to implement these effectively. Similarly, while opportunities in technology and iterative learning are globally recognised, their limited application in Kenya underscores systemic barriers that must be addressed.

Therefore, the results from Table 3 underscore the dual challenge and opportunity of enhancing M&E practices in Kenya. The gaps in inclusivity, technology integration, and indicator development reflect systemic limitations, while the opportunities in participatory methods, mixed-method tools, and iterative learning point to clear pathways for improvement. Addressing these issues will require coordinated efforts among policymakers, practitioners, and communities to align Kenyan M&E systems with global best practices, thereby enhancing their effectiveness in driving sustainable climate adaptation outcomes.

CONCLUSION

This article presents a systematic review of monitoring and evaluation (M&E) practices in climate change adaptation, with a focus on Kenya, to examine effective frameworks, opportunities, and persistent gaps. For the first objective, the findings underscore the critical role of M&E in advancing climate adaptation practices globally, highlighting participatory approaches, robust indicators, and iterative learning frameworks as fundamental to achieving measurable and sustainable outcomes. These findings emphasize the value of stakeholder engagement and the adoption of mixed-method tools to enhance the effectiveness of adaptation initiatives.

The second objective builds on this foundation by identifying specific opportunities and gaps in Kenya's M&E systems. Key opportunities include the potential for participatory approaches, which improve inclusivity and relevance, and the integration of technology-driven tools, which can address data gaps and facilitate real-time monitoring. However, significant gaps remain, including the lack of robust, localized indicators, limited institutional capacity, and an overreliance on checklist-based frameworks that are unable to adapt to evolving climate challenges. Moreover, national frameworks often neglect local priorities,

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highlighting the need for policy alignment and context-specific adaptation strategies.

In conclusion, while Kenya's M&E systems for climate adaptation present significant opportunities, systemic gaps limit their full potential. Bridging these gaps requires a shift towards participatory, learning-oriented, and technology-enabled frameworks that align global best practices with local realities. Addressing these challenges and leveraging identified opportunities, allows Kenya to establish robust M&E systems that support sustainable and inclusive climate resilience, positioning the country as a leader in effective climate adaptation across Africa.

Declaration of conflict of interest

No conflict of interest to declare.

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