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CLIMATE RESILIENCE AND SUSTAINABLE DEVELOPMENT IN AFRICA: AN INTEGRATED APPROACH TO HEALTH SYSTEMS

D. Chigudu[1*]

[1]University of South Africa, Email: chigud@unisa.ac.za

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Corresponding Author: D. Chigudu (chigud@unisa.ac.za)

ABSTRACT

Climate change exacerbates health and economic disparities in Africa, particularly for already vulnerable populations. This study conducts an integrative review and evidence synthesis, drawing on 74 peer-reviewed studies and institutional datasets from the World Bank, WHO Global Health Observatory, and UNECA, covering 48 sub-Saharan African countries over the period 2000–2023, to examine the intersection of climate change and health outcomes in tandem with economic development across the African continent. The original contribution of this study lies in its application of a systems-thinking lens to jointly model the climate–health–economy nexus, mapping bidirectional feedback mechanisms and identifying specific leverage points for integrated resilience-building aligned with SDG targets and AU Agenda 2063 milestones—an analytical synthesis that stand-alone sectoral reviews do not capture. Climate change has already produced measurable increases in temperature, extreme weather events, and environmental degradation with significant health impacts, disproportionately affecting the most vulnerable populations, including children, women, and low-income communities across the continent. Numerous leverage points emerging from the results provide opportunities to build resilience, including green financing, investments in renewable energy, and community-centred policies for adaptation, to advance economic growth and strengthen health systems that promote resilience by 2030, in line with the Sustainable Development Goals (SDGs).

KEYWORDS: Climate Change Adaptation; Health Equity; Economic Development; Resilience; Sub-Saharan Africa; Sustainable Development Goals; Systems Thinking; Climate Finance; Vulnerability; Integrated Policy Frameworks.

1. INTRODUCTION

Although Africa is a relatively minor contributor to greenhouse gas emissions, it finds itself at the forefront of the global climate crisis. Average temperatures across African eco-regions have increased since the early 1900s, and heat exposure, extreme weather events, and sea-level rise are increasing the vulnerability of African populations (IPCC, 2022; WHO-ROA, 2024). Climate change is already affecting the health and well-being of African communities and exacerbating pre-existing inequalities, according to the Intergovernmental Panel on Climate Change (IPCC). Africa's susceptibility stems from its majority rain-fed agricultural economies, inadequate infrastructure, and pre-existing low adaptive capacities, which undermine the continuity of health systems and economic development pathways (Calow et al., 2024). In Africa, climate change operates through multiple pathways simultaneously, including water stress, food insecurity, and an increased disease burden. Heightened vulnerability is experienced among women, children, minorities, low-income populations, and those with pre-existing health comorbidities (Calow et al., 2024). The reliance on climate-sensitive agriculture among rural populations in sub-Saharan Africa exceeds 60%, and inadequate adaptive capacity exposes communities to droughts and flooding, which lead to crop failures, food shortages, malnutrition, and health crises (Davies et al., 2024).

1.1. Problem Statement: Integration Gaps

Awareness of climate-related problems is increasing, but significant gaps persist in the adoption of holistic approaches to building resilience in Africa. Resilience interventions still tend to treat climate change, health outcomes, and economic development as disparate topics that do not require integrated thinking and action (Gibb et al., 2021). This disjointed approach overlooks how a single climate stressor can simultaneously impact food security, water availability, disease burden, and economic productivity. Health systems worldwide are challenged by climate change through both their own resilience needs and inequitable access to care (Davies et al., 2024). Extreme weather events, including flooding, hurricanes, and wildfires, destroy health facilities, disrupt supply chains, restrict patient access, and damage infrastructure and medical equipment—consequences that are especially severe in low-income countries. Current policy frameworks, therefore, fall short by failing to incorporate climate adaptation strategies, health system strengthening, and economic development planning as an integrated response.

1.2. Original Contribution

This study advances knowledge beyond existing reviews and policy reports in three distinct ways. First, it is among the first to apply a systems-thinking lens to jointly model the climate–health–economy nexus at a continental scale for sub-Saharan Africa, moving beyond the siloed sectoral analyses that dominate the existing literature. Second, rather than merely cataloguing climate impacts, the study maps bidirectional feedback mechanisms and identifies specific leverage points for integrated resilience-building aligned with SDG targets and AU Agenda 2063 milestones. Third, the integrated conceptual framework—the ACRIFA architecture—synthesises multi-domain evidence into an actionable policy framework, and its components are validated against empirical indicators in Table 2 (Framework–Evidence Mapping Matrix), providing analytical grounding that distinguishes this study from purely narrative or descriptive reviews.

1.3. Objectives

This research aims to bridge gaps between different policies and approaches through two main objectives:

1. Identify the links between climate change, health, and economic development in Africa. This involves examining how climate events shape health determinants, how health impacts create pathways for or against economic development, and determining the magnitude of economic costs resulting from climate-induced health burdens while identifying the most vulnerable geographical areas on the continent.

2. Determine how to create one cohesive approach to build climate resilience, adapt to climate change, strengthen health systems, and foster long-term economic sustainability. This involves evaluating current policies and strategies across multiple governmental sectors, developing an integrated approach, and aligning with AU Agenda 2063 and the Sustainable Development Goals.

1.4. Hypotheses

Two main hypotheses guide this study:

H1: A combination of climate-related health crises creates and exacerbates economic inequalities through several interrelated mechanisms, including increased healthcare costs, reduced worker productivity, undermined agricultural production, and diverted government

spending from development-oriented programmes into disaster response. Such economic impacts disproportionately affect the most vulnerable populations and reinforce poverty cycles (WHO, 2024b).

H2: Multi-sector interventions significantly improve adaptive capacity more than single-sector interventions by providing a broader understanding of how climate, health, and economic systems interact (Muhumuza et al., 2024). Integrated approaches incorporating climate-resilient healthcare infrastructure and community-based adaptation will improve service delivery, efficiency, readiness, acceptability, and affordability across multiple sectors.

2. CONCEPTUAL FRAMEWORK

Utilising a systems-thinking method, this research illustrates how climate change impacts are interconnected and how these factors influence health outcomes and economic growth across Africa. The systems-thinking approach enables identification of intervention points within the system where resilience-building strategies can be developed to mitigate the impact of climate change, as well as the direct and indirect pathways through which climate change affects development trajectories, and the feedback mechanisms that may contribute to greater vulnerabilities or enhance adaptive capacity (Figure 1).

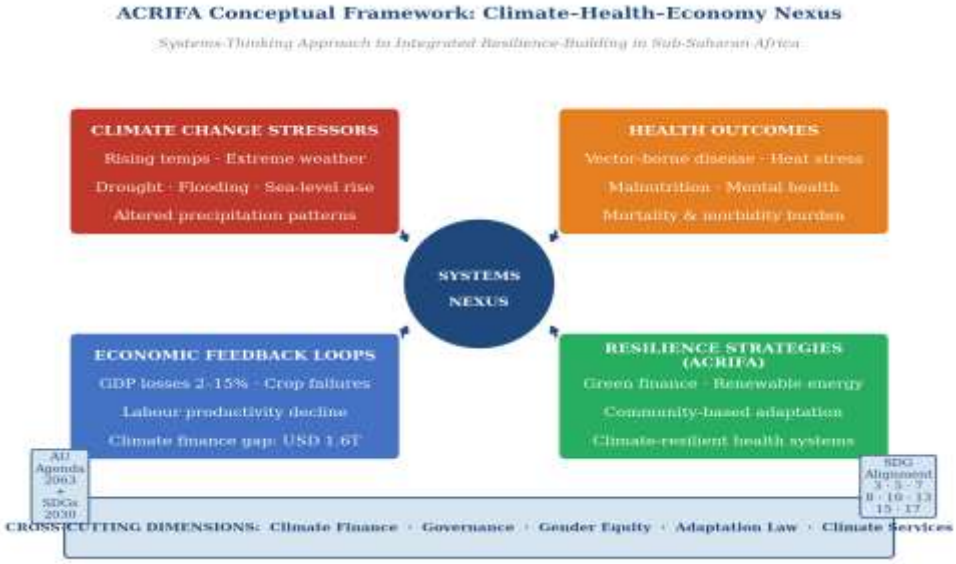

Figure 1: Conceptual Framework.

2.1. Terminology Definitions

The following working definitions apply consistently throughout this manuscript, anchored to the IPCC Sixth Assessment Report (IPCC, 2022) and the WHO-AFRO Framework (WHO, 2024b):

Resilience: The capacity of social, economic, and ecological systems to cope with a hazardous event, trend, or disturbance, responding or reorganising in ways that maintain their essential function and structure while maintaining the capacity for adaptation, learning, and transformation (IPCC, 2022).

Adaptive Capacity: The ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to the consequences of climate change (IPCC, 2022).

Vulnerability: The propensity or predisposition to be adversely affected by climate change. Vulnerability encompasses a variety of concepts and elements, including sensitivity or susceptibility to harm and lack of capacity to cope and adapt (IPCC, 2022).

2.2. Component Integration

The conceptual framework consists of four interconnected components:

1. Climate Change Stressors: Primary stressors include increased temperatures, altered precipitation patterns, and extreme weather events. Secondary stressors include water scarcity, land degradation, and ecosystem changes. Africa has the highest level of climate stress among regions, owing to both geographic factors and its limited adaptive capacity (WHO-ROA, 2024).

2. Climate Change Health Outcomes: Direct impacts include heat-related illnesses and injuries from extreme weather events. Indirect impacts include increased risk of vector-borne diseases, malnutrition, and mental health burdens. Vulnerabilities are not equally distributed; women, children, rural communities, and older people are disproportionately affected (CARE International, 2016).

3. Economic Feedback Loops: Climate shocks create substantial economic impacts through multiple channels, and resulting economic pressures further limit health system capacity and adaptive capacity, exacerbating vulnerability cycles (UNECA, 2016). These include increased healthcare spending, diminished productivity, crop losses, and reduced investment in development.

4. Resilience Strategies (ACRIFA): The framework distinguishes multilevel intervention points for vulnerability reduction, including climate-resilient health systems, economic livelihood diversification, cross-sectoral partnerships, community-based adaptation, and transformative governance arrangements.

3.3. Cross-Cutting Dimensions

The framework incorporates five cross-cutting dimensions identified in the IPCC AR6: climate finance, governance, cross-sectoral solutions, adaptation law, and climate services (WHO-ROA, 2024). These dimensions recognise that building resilience requires integrated rather than siloed interventions.

3.4. Feedback Mechanisms

A critical aspect of this framework is its recognition of bidirectional relationships. While climate change impacts health, poor health outcomes reduce an individual's or a community's adaptive capacity to it. Similarly, economic shocks can compromise the functioning of the health system, while improved health can enhance economic productivity and climate resilience. These feedback loops highlight the importance of synchronous, cross-sectoral interventions (CARE International, 2016).

3. LITERATURE REVIEW

4.1. Climate–Health Nexus

In Africa, climate-related threats have significant health consequences. Over 25% of Africa's 5 million annual deaths attributable to non-optimal temperatures can be linked to excessive heat exposure (WHO, 2024c). Northern Africa has experienced record temperatures exceeding 50°C, substantially increasing heat-related illness and death among at-risk groups, including children, the elderly, and outdoor workers (WHO, 2024c; IPCC, 2022). Climate change also exacerbates the dynamics of vector-borne diseases. In tropical Africa, changing temperatures and precipitation patterns are altering the geographic range of malaria, schistosomiasis, and leishmaniasis. A strong correlation exists between rising temperatures and increased malaria incidence in the East African highlands, with a reported sixfold increase in Kenyan malaria cases following the 1997 El Niño event (McMichael et al., 2003). Climate models project temperature increases of 1.4–1.6°C across equatorial and semi-arid regions of Africa, with implications for disease transmission profiles (Ogu, 2021).

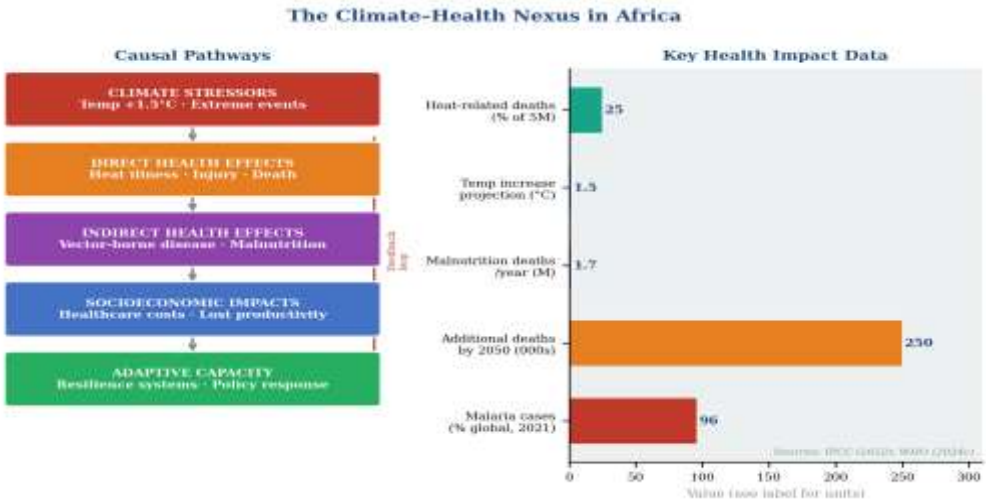

Figure 2: The Climate–Health Nexus in Africa.

The third significant health impact is malnutrition. The Sahel has been affected by

prolonged droughts, which have contributed to food insecurity, weakened immunity, and increased hospitalisation rates (WHO, 2024c; IPCC, 2022). In Burkina Faso, children exposed to average temperatures exceeding 35°C show significantly lower height-for-age scores, compromising nutritional security during critical developmental windows (WHO, 2024a). The IPCC (2022) projects an additional 250,000 deaths annually by 2050 attributable to climate change, with over 50% of these projected to occur in Africa.

4.2. Economic Implications

The impact of climate change on economic development in Africa is severe and multifaceted. Climate change threatens crop yields, livestock health, and overall food security, with cascading effects on rural livelihoods. Evidence suggests that a 2.5°C temperature increase in Burkina Faso could produce a 46% reduction in agricultural revenues, rising to 93% at higher temperature increments (UNECA, 2016). At the macroeconomic level, quantitative modelling across four African countries (Kenya, Mali, Nigeria, and Senegal) for the period 2020–2050 indicates projected GDP declines of 4–9%, with the agricultural sector accounting for approximately 68% of the total GDP impact (ReSAKSS, 2024). Western and Eastern Africa may experience GDP declines of up to 15% by 2050, with Ethiopia projected to face the most severe losses—14.7% in total GDP and 20.5% in agricultural GDP (ReSAKSS, 2024). Infrastructure damage represents another substantial burden; flood-related destruction across Africa from 2005 to 2020 exceeded USD 4.4 billion (BII, 2023). Africa will require approximately USD 1.6 trillion from 2022 to 2030 to implement national climate goals, but received only USD 18.3 billion in climate financing between 2016 and 2019—representing 1% of total global climate financing (ADB, 2022).

4.3. Resilience Frameworks

Successful integrated resilience strategies are emerging across the continent. Renewable energy projects, including the Africa Renewable Energy Initiative (AREI) and the SDG7 Initiative for Africa, aim to secure 10 GW of renewable capacity by 2025, supporting rural electrification, agricultural irrigation, and stable healthcare infrastructure (AFREC, 2022). Early warning systems represent a second successful approach: the CLIM-WARN project has developed comprehensive warning systems in Burkina Faso, Ghana, and Kenya, while Mozambique has deployed artificial intelligence-based flood detection systems (Ngila et al., 2024). Climate-resilient agriculture initiatives, including the Comprehensive Africa Agriculture Development Programme (CAADP) and the African Forest Landscape Restoration Initiative (AFR100), provide a third framework. These case studies collectively underscore the importance of integrated, multidimensional approaches, while also highlighting implementation challenges, including capacity limitations at the local government level and insufficient cross-institutional coordination (UNECA, 2016).

4. METHODOLOGY

This study employs an integrative review design with descriptive quantitative synthesis, drawing on peer-reviewed literature and institutional datasets to examine the interconnections between climate change, health outcomes, and African economic development. This design was selected as the most appropriate for the research objectives, as it accommodates diverse methodologies and study types within a structured analytical framework. The study is not characterised as a systematic review, as it incorporates policy analysis and grey institutional literature alongside empirical studies; however, it adopts a rigorous and transparent approach to study identification, selection, and synthesis, guided by the PRISMA 2020 reporting standards. No primary data collection or original econometric modelling was conducted; all quantitative evidence is drawn from the published sources detailed in Table 1.

4.1. Study Selection and PRISMA Process

The literature search and selection followed PRISMA 2020 guidelines. Figure 3 presents the PRISMA flow diagram detailing the identification, screening, eligibility assessment, and inclusion of studies.

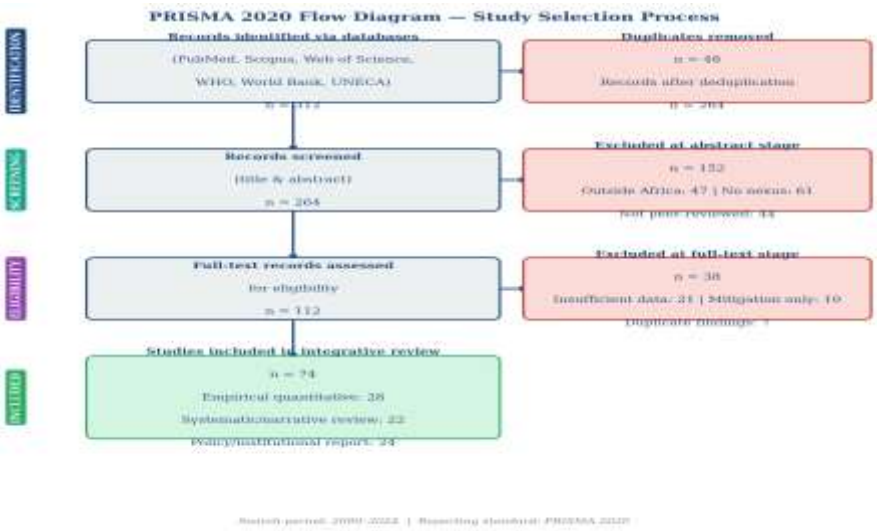

Figure 3: Prisma 2020 Flow Diagram.

4.1.1. Inclusion Criteria

- Peer-reviewed empirical or review studies, or institutional reports from recognised bodies (WHO, World Bank, ADB, UNECA, AU), published between 2000 and 2024.
- Studies or reports focused on sub-Saharan African countries or African sub-regions.
- Studies examining at least one of the three nexus dimensions: climate change, health outcomes, or economic development.
- English-language publications.

4.1.2. Exclusion Criteria

- Grey literature lacking peer review or institutional endorsement.
- Studies focused exclusively on regions outside Africa.
- Studies focused exclusively on climate mitigation without health or adaptation components.

• Studies Predating Systematic Climate Data Series (Pre-2000), Unless Providing Essential Historical Baseline Data.

4.2. Data Sources

Table 1 details the databases and institutional sources used, specifying the indicators extracted, country and time coverage, and unit of analysis for each source.

Table 1: Data Sources Summary.

Database / Source	Indicators Extracted	Country Coverage	Time Span	Unit of Analysis
World Bank Open Data	GDP growth (%), poverty headcount ratio, agricultural value added (% GDP), and infrastructure investment	48 sub-Saharan African countries	2000–2023	Country-year
WHO Global Health Observatory	DALYs lost, malaria incidence, child stunting rates, healthcare access index, health expenditure (% GDP)	54 African countries	2000–2023	Country-year
UN Economic Commission for Africa (UNECA)	Climate vulnerability index, disaster loss estimates (USD), labour productivity indicators	54 African countries	2005–2023	Country-year
IPCC AR6 Working Group II	Projected temperature change (°C), agricultural yield change (%), health impact projections	African sub-regions	2020–2100 projections	Regional -scenario

African Development Bank (ADB)	Climate finance flows (USD), NDC investment requirements, GDP loss estimates	Regional + country	2016–2023	Country / regional
Peer-reviewed literature (n=74)	Thematic evidence on climate–health–economy nexus; resilience intervention outcomes	Sub-Saharan Africa focus	2000–2024	Study-level synthesis
CARE International / AU / UNFCCC reports	Policy frameworks, community adaptation outcomes, and green bond issuances	Continental/regional	2010–2024	Programme/ policy

4.3. Analytical Approach

A two-component analytical framework was employed:

1. Thematic Synthesis: Conducted following Thomas and Harden guidelines. The synthesis involved: (i) line-by-line coding of findings from included studies; (ii) grouping of codes into descriptive themes; and (iii) development of analytic themes that identify cross-study patterns in climate–health–economy relationships. This approach is well-suited to integrating findings across diverse methodologies and disciplines (EquiNet, 2023).

2. Descriptive Quantitative Synthesis: Secondary quantitative data drawn from the World Bank Open Data, WHO Global Health Observatory, UNECA, and ADB were used to support comparative analysis across countries and time periods, including correlation of Disability-Adjusted Life Years (DALYs) lost with climate vulnerability indices, and descriptive comparison of GDP loss projections across African sub-regions. All quantitative data are derived from the published sources listed in Table 1; no primary data collection or original statistical modelling was conducted as part of this study.

4.4. Framework Validation

To analytically ground the ACRIFA conceptual framework beyond illustration, each framework component was assessed against empirical indicators drawn from the data sources in Table 1. The results are presented in Table 2 (Framework–Evidence Mapping Matrix) in Section 6, enabling readers to evaluate the evidential basis for each framework component.

4.5. Ethical Considerations

The study is based exclusively on secondary data from publicly available peer-reviewed sources, institutional reports, and global datasets. No primary data involving human participants were collected, and no ethical approval or informed consent was required. All secondary data sources are cited in accordance with appropriate academic standards.

5. FINDINGS

5.1. Framework–Evidence Mapping

Table 2 presents the Framework–Evidence Mapping Matrix, which validates each component of the ACRIFA conceptual framework against empirical indicators and evidence drawn from the included literature and datasets. This matrix demonstrates that the framework components are not merely illustrative but are grounded in observable, measurable indicators from the data sources specified in Table 1.

Table 2: Framework–Evidence Mapping Matrix.

Framework Component	Key Indicators Used	Empirical Evidence Base (selected)	SDG Alignment
1. Climate Change Stressors	Temperature anomaly (°C); extreme event frequency; rainfall variability index	Africa avg. temp +1.5°C since 1900 (IPCC, 2022; WHO-ROA, 2024); 70% of natural disasters occurred 2017–2021 (WHO, 2024c)	SDG 13 (Climate Action); SDG 15 (Life on Land)
2. Health Outcomes	Malaria incidence per 1,000; DALYs lost; child stunting prevalence; heat-related mortality	Africa: 96% of global malaria cases (2021); 250,000 additional deaths projected by 2050 from climate causes (IPCC, 2022); 1.7M deaths/year from malnutrition	SDG 3 (Good Health); SDG 2 (Zero Hunger)
3. Economic Feedback Loops	GDP loss (%); agricultural revenue change; labour productivity decline; climate finance gap (USD)	GDP losses of 2–15% across African countries (ADB, 2022; ReSAKSS, 2024); Africa needs USD 1.6T by 2030 but received USD 18.3B (2016–2019)	SDG 8 (Decent Work); SDG 10 (Reduced Inequalities); SDG 17 (Partnerships)

4. Resilience Strategies (ACRIFA)	Renewable energy capacity (GW); green bond issuances (USD); community adaptation programme coverage	Green bond issuances +125% to USD 1.4B in Africa (2023) (ADB, 2022); AREI targets 300 GW by 2030 (AU, 2022)	SDG 7 (Clean Energy); SDG 9 (Infrastructure); SDG 11 (Sustainable Cities)
5. Cross-Cutting Dimensions (Governance, Finance, Gender)	NDC health integration score; gender-disaggregated vulnerability index; multi-sector coordination index	Only a minority of African NDCs integrate health and economic outcomes jointly; women are disproportionately affected (CARE International, 2016; IPCC, 2022)	SDG 5 (Gender Equality); SDG 16 (Strong Institutions); SDG 17

5.2. Challenges

5.2.1. Health: Increased Disease Burden from Extreme Weather

Africa is facing an escalating health crisis directly linked to climate change. Vector-borne diseases, notably yellow fever, account for 28% of climate-related health emergencies on the continent. Natural disasters have increased dramatically since 2010, with 70% occurring between 2017 and 2021, and floods accounting for 33% of these events.

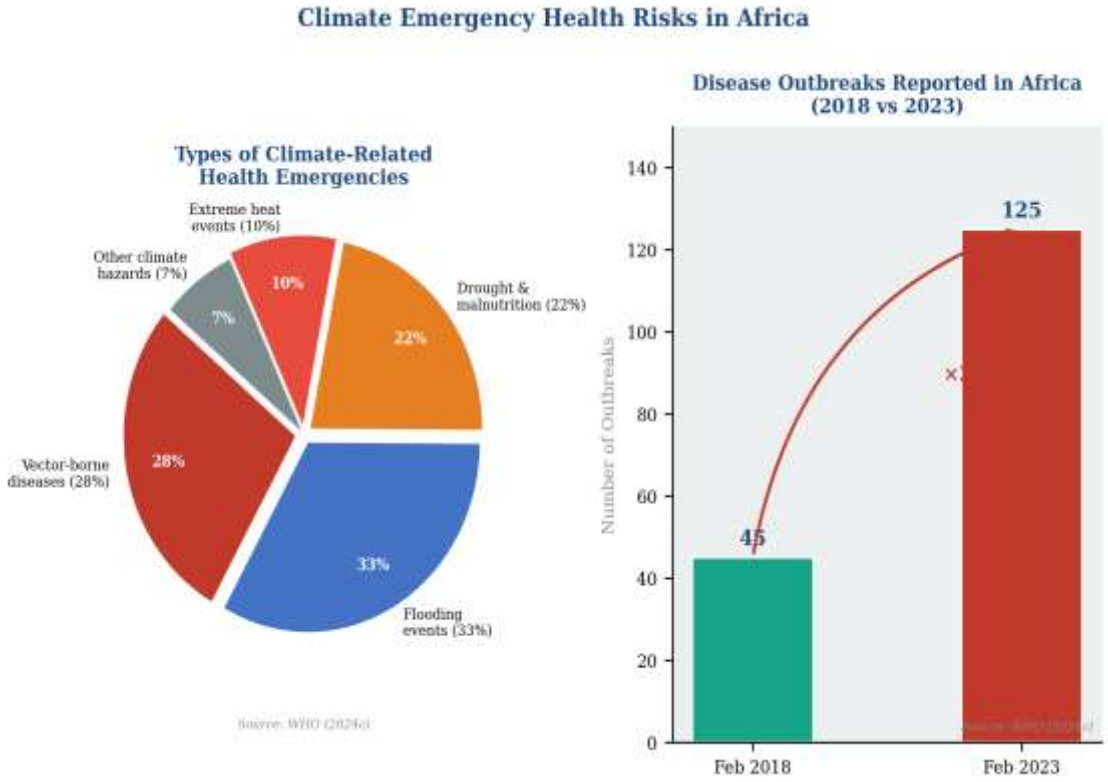

Figure 4: Climate Emergency Health Risks in Africa — Replace with Original Figure.

Climate change affects health through direct and indirect pathways. Direct effects include injuries, illnesses, and deaths from extreme weather events and heat stress. Indirect effects are more widespread: malnutrition causes an estimated 1.7 million deaths annually in Africa and is the leading cause of climate-related mortality globally. The number of disease outbreaks has increased dramatically; African countries reported 125 outbreaks in February 2023, 2.8 times the number in February 2018. Africa accounted for 96% of global malaria cases and 98% of malaria deaths in 2021, and new malaria cases increased by 17% between 2017 and 2021 as warming temperatures extended mosquito ranges to higher elevations (WHO, 2024c). The impacts of extreme heat events on mental health are increasingly recognised as a significant and underestimated burden (IPCC, 2022; WHO, 2024c).

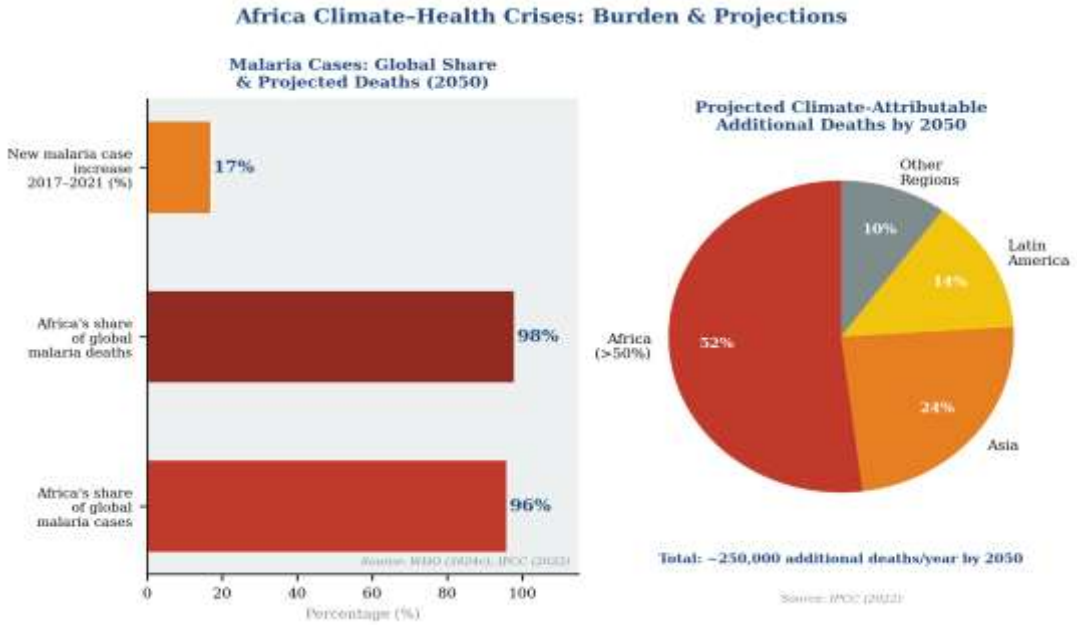

Figure 5: Africa Climate–Health Crises — Replace with Original Figure.

5.2.2. Economic: GDP Losses In Climate-Vulnerable Nations

The economic burden of climate change on African nations is severe. On average, African countries lose 2–5% of their GDP annually due to climate impacts, with many diverting up to 9% of their budgets to respond to climate extremes (ADB, 2022). Some estimates indicate losses of 5–15% of GDP per capita growth (ADB, 2022). Regional variation is significant: Western and Eastern African countries may experience a 15% decline in GDP by 2050, and The Gambia, Mauritania, Burkina Faso, Niger, and Mali may each face per capita GDP losses exceeding 15% (ADB, 2022). Infrastructure destruction from floods between 2005 and 2020 exceeded USD 4.4 billion across Africa (BII, 2023). The ADB estimates total climate-related loss and damage at USD 289.2–440.5 billion. The climate finance gap remains critical: Africa requires approximately USD 1.6 trillion for NDC implementation through 2030, but received only USD 18.3 billion in climate financing between 2016 and 2019.

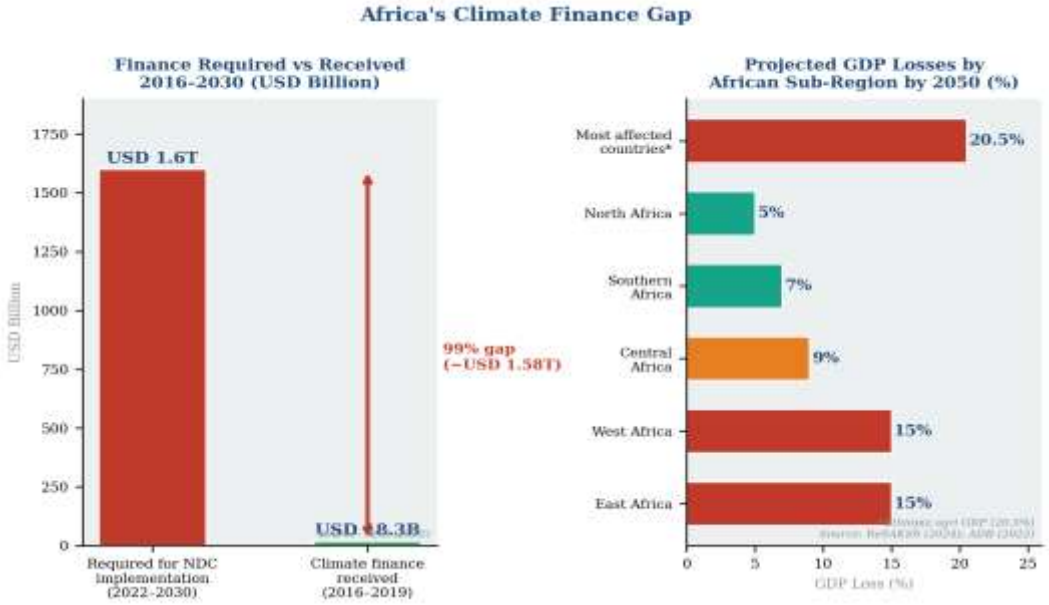

Figure 6: Africa's Climate Finance Gap — Replace with Original Figure.

5.3. Opportunities

5.3.1. Community-Based Adaptation

Community-Based Adaptation (CBA) represents one of the most promising pathways for building resilience. CARE International describes CBA as an invaluable part of Africa's vision for developing resilience, emphasising collaborative community approaches to identifying and implementing adaptation strategies. Agroforestry—integrating tree growing with crop production and livestock—is an exemplary nature-based solution that boosts crop productivity, reduces greenhouse gas emissions, and restores ecosystems while providing shade, shelter, fertiliser, fuel, food, and fodder (Taillandier et al., 2023). In Niger's Dakoro district, 20 pastoralist and agropastoralist communities implemented Community Adaptation Action Plans that incorporated improved seed varieties, tree planting, income generation, and goat rearing, resulting in improved nutrition, diversified income, reduced debt, reduced migration, and enhanced community adaptive capacity (CARE International, 2016). This example illustrates the framework's conceptualisation of climate–health–economy interactions: enhanced economic security and nutrition create positive feedback loops that strengthen community-level adaptive capacity.

5.3.2. Sdg-Driven Financing Mechanisms

Innovative financing mechanisms offer transformative potential for mobilising resources aligned with Africa's climate and development priorities. Green bond issuances increased substantially in Africa in 2023, reflecting growing investor appetite for climate-aligned instruments (ADB, 2022). The Adaptation Benefits Mechanism (ABM), tested under the UNFCCC's Non-Market Approaches platform, supports climate adaptation by certifying adaptation benefits and providing independently verified results. The European Investment Bank and Green Climate Fund's Green Debt Resilience Platform, alongside sustainability-based bonds, climate debt swaps, and blended finance options, offer pathways to close Africa's climate finance gap while encouraging SDG-aligned investment.

6. DISCUSSION

6.1. Advancing Knowledge Beyond Existing Reviews

This study's integrative review and systems-thinking approach generate insights that stand-alone sectoral or narrative reviews do not capture. While IPCC WGII reports and WHO-AFRO frameworks provide essential sectoral guidance, they do not jointly model the bidirectional feedback between climate stressors, health outcomes, and economic development at the African continental scale. By mapping these feedback loops and validating them against empirical indicators (Table 2), this study produces an integrated evidence base that directly informs multi-sectoral policy design—a contribution distinct from the outputs of existing sectoral analyses or descriptive reviews.

6.2. Policy Integration: Aligning Ndcs with Health and Economic Agendas

Africa's climate commitments within the Paris Agreement must be directly connected to national health and economic agendas if the continent is to achieve resilience by 2030. While some countries, including Rwanda and Nigeria, incorporate climate adaptation outcomes into green growth strategies, most Nationally Determined Contributions (NDCs) remain sectorally focused on mitigation rather than combining efforts for integrated resilience. Nigeria's reliance on oil revenue, for instance, contradicts its climate-mitigation aims, illustrating a missed opportunity for cross-sectoral governance (ADB, 2022). The financial gap is equally striking: Africa requires USD 3 trillion to achieve NDC targets, yet between 2016 and 2019, only USD 18.3 billion in climate finance was allocated. Scaling up sustainable financing through instruments such as green bonds and the Adaptation Benefits Mechanism can help close this gap and promote cross-sector synergies.

6.3. Limitations: Data Heterogeneity and Regional Variability

Africa's diverse data ecosystem and national disparities constrain the generalisability of conclusions. Climate regimes, development trajectories, economies, and health systems vary considerably across the continent, and a uniform analytical framework risks oversimplification. Health data frequently omit climate-related outcome dimensions, such as mental health impacts from heatwaves, while economic assessments rarely capture indirect costs, such as labour-market exit. These constraints mean that findings should be interpreted as capturing regional and sub-regional patterns rather than uniform continental averages. Importantly, these data limitations are not merely caveats—they are substantive findings in their own right. The heterogeneity and gaps identified in this review reveal that the absence of harmonised,

longitudinal, country-level data on climate, health, and economic indicators is itself a critical barrier to integrated resilience-building in Africa. This finding directly motivates two of the study's core policy recommendations: (i) investment in national climate and health monitoring systems with standardised indicators, and (ii) establishment of continental data repositories that enable comparative, cross-country analysis.

6.4. Future Research Directions

Longitudinal research is needed to evaluate the long-term effectiveness of climate–health–economic interventions. Future research priorities include: establishing the lifecycle of resilience initiatives; examining the scalability of localised solutions across Africa's agroecological zones; analysing equity implications of green financial mechanisms for marginalised groups; evaluating trade-offs between rapid infrastructure development and ecosystem sustainability; and systematically mapping best practices for integrating traditional knowledge with technological innovation. A particularly important gap is the absence of consistent, country-level panel datasets linking climate vulnerability indices, health outcome indicators, and economic performance metrics across African nations over time. The development of such datasets, through investment in national statistical systems and coordinated continental data infrastructure, represents the most critical enabling condition for advancing this field.

7. POLICY IMPLICATIONS

This study underscores the importance of policies that treat climate change, health, and economic development as interconnected challenges. The following recommendations are grounded in the evidence synthesis presented in Sections 4–6.

7.1. Cross-Sectoral Governance Frameworks

The current fragmentation of climate, health, and economic policies requires stronger, integrated governance systems. Each country should establish climate–health–economy coordination units within planning ministries, mandated to ensure policy coherence and mainstream climate considerations across governmental sectors. Governments must also formalise multi-stakeholder engagement processes—bringing public institutions, the private sector, civil society, and affected communities to the decision-making table—ensuring that climate policies reflect the needs of vulnerable populations. Health and economic considerations should be substantive components of National Adaptation Plans and NDCs, not incidental additions.

7.2. Scaling Up Climate-Resilient Healthcare Infrastructure

Africa's health systems require urgent climate-proofing. Investment priorities include: constructing cyclone-resistant medical facilities in coastal and island regions; deploying solar-powered medical equipment systems resilient to extreme weather disruptions; supporting water harvesting and storage systems for health facilities; establishing early warning systems for climate-sensitive diseases; and implementing nutritional support programmes at health facilities in food-insecure areas. Workforce development programmes should train health workers on climate–health linkages, and performance-based financing strategies should incentivise the adoption of sustainable practices, as demonstrated by the Green Performance-Based Financing initiative in Burundi.

7.3. Leveraging Digital Tools for Real-Time Data Monitoring

Timely and accurate data are essential for effective climate adaptation. Governments should prioritise: expanding real-time climate data tools such as the Automatic Weather Station Data Tool; developing integrated monitoring platforms that simultaneously track climate, health, and economic indicators; supporting AI-based early warning systems for floods and other extreme events; establishing open data portals, democratising access to climate information; and strengthening national statistical capacity. These digital solutions require both technical infrastructure investment and human capacity building, with regional and international partnerships facilitating knowledge transfer.

8. CONCLUSIONS

This integrative review highlights the critical importance of implementing integrated resilience approaches across Africa to achieve 2030 SDG targets and navigate the interconnected challenges of climate change, health outcomes, and economic development. Climate change already has significant and measurable health and economic impacts across Africa, threatening to exacerbate adverse effects on vulnerable populations through cascading, cross-sectoral mechanisms. The evidence presented in this study—synthesised across 74 studies and institutional datasets covering 48 sub-Saharan African countries over 2000–2023, and validated through the Framework–Evidence Mapping Matrix (Table 2)—demonstrates that siloed, sector-specific

responses are insufficient to address these interrelated challenges.

An integrated approach that addresses climate resilience, health system strengthening, and sustainable economic development simultaneously can significantly reduce systemic vulnerability, optimise resource use, and enable transformational adaptation. African nations must strengthen adaptation to the SDGs in their NDCs, particularly in health systems (SDG 3), education (SDG 4), gender equality (SDG 5), infrastructure (SDG 9), reduced inequalities (SDG 10), and sustainable cities (SDG 11). Achieving the SDGs by 2030 requires unprecedented cooperation among governments, communities, the private sector, and international partners to mobilise resources, transfer technology, and build capacity for integrated responses. The window for action is narrowing, but with coordinated efforts and strategic investments, Africa can forge a resilient and sustainable development pathway that leaves no one behind.

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