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Editorial Note

This issue of *AYIKA* brings together a rich and timely collection of scholarship that underscores a central truth: in Africa, environmental questions are deeply political, and political realities are increasingly shaped by environmental change. The contributions in this volume reflect the growing complexity of this relationship, engaging themes that span governance, technology, security, sustainability, and identity across diverse African contexts and beyond.

A defining feature of this issue is its strong engagement with the role of digitalisation in advancing sustainability. From the systematic review on how digitalisation enables decarbonisation, to analyses of agri-tech adoption in Nigeria and South Africa, the volume highlights the transformative potential of technology in addressing environmental challenges. These contributions move beyond optimism, carefully examining the mechanisms and constraints that shape technological uptake. They remind us that digital solutions are not neutral; their effectiveness depends on policy frameworks, institutional capacity, and socio-economic conditions.

Equally prominent is the question of governance, particularly in relation to service delivery and institutional performance. The examination of water service failures in Gauteng Province offers a sobering account of how governance lapses can translate into environmental and public health crises. Similarly, the discussions on public service reform and parliamentary oversight reveal the persistent challenges of accountability and administrative effectiveness across the continent. Together, these studies point to a critical insight: sustainable environmental outcomes are contingent on capable, transparent, and responsive institutions.

The issue also engages deeply with questions of political order, security, and regional cooperation. Analyses of Zimbabwe's political history, hybrid regimes in Central Africa, and border conflicts involving Nigeria reveal how political instability and governance structures shape environmental management and development trajectories. The exploration of indivisible security within the SADC region further highlights the interconnectedness of peace, cooperation, and sustainable development. These contributions reinforce the idea that environmental sustainability cannot be pursued in isolation from broader political and security dynamics.

Another important strand in this volume is the emphasis on economic strategies and livelihoods, particularly in rural contexts. Articles on organic agribusiness, marketing strategies aligned with climate action, and the challenges faced by women in agribusiness illuminate the everyday realities of sustainability. They foreground the experiences of local actors, especially women entrepreneurs, whose resilience and innovation are often overlooked. By examining the socio-economic factors shaping revenue growth and participation, these studies contribute to a more inclusive understanding of development.

The volume also makes a significant intellectual contribution by foregrounding indigenous knowledge systems and alternative epistemologies. The exploration of Ubuntu

as a framework for regional governance offers a human-centred perspective that challenges dominant policy paradigms. Similarly, the critique of epistemic violence in transboundary conservation highlights the marginalisation of local knowledge and agency. These interventions are particularly important in rethinking whose knowledge counts in environmental governance and how more equitable frameworks can be developed. Urban spaces and cultural expressions are not left out of this conversation. Contributions on city branding in Harare and the intersection of art, space, and identity in Durban demonstrate how environmental and political dynamics are experienced and expressed in urban contexts. These studies expand the scope of environmental politics by incorporating cultural and spatial dimensions, offering fresh insights into how cities in the Global South are responding to climate change.

Notably, this issue also extends its analytical reach beyond Africa, with a study on urban climate initiatives in Brazil and a comparative examination of socio-economic vulnerability in Sub-Saharan Africa and the Pacific Islands. These contributions enrich the volume by situating African experiences within a broader global context, encouraging cross-regional learning and dialogue.

Finally, the inclusion of research on language and education, such as the study on tense substitution errors among Tshivenda-speaking students, serves as a reminder of the interconnectedness of knowledge production, communication, and development. It highlights the importance of education in shaping the capacity to engage with complex environmental and political issues.

Taken together, the articles in this issue reflect a vibrant and interdisciplinary field of inquiry. They challenge simplistic narratives and instead offer nuanced analyses that recognise the interconnected nature of environment and politics in Africa. As the continent continues to navigate the pressures of climate change, population growth, and political transformation, the insights presented here are both timely and necessary. This volume invites scholars, policymakers, and practitioners to think more critically and act more collaboratively. It is our hope that the conversations sparked within these pages will contribute to more just, sustainable, and context-sensitive approaches to environmental governance in Africa and beyond.

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CLIMATE CHANGE AND SOCIO-ECONOMIC VULNERABILITY IN SUB-SAHARAN AFRICA AND PACIFIC ISLANDS

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ABSTRACT

Climate change has become one of the greatest threats to human security, destabilising economies and societies worldwide, with Sub-Saharan Africa (SSA) and the Pacific Island Countries (PICs) identified as among the most vulnerable regions due to their reliance on climate-sensitive sectors. migration, and food–agriculture systems interact as feedback loops under climate stress, leaving policymakers with limited evidence to design effective adaptation. The study, therefore comparatively assessed the socio-economic consequences of climate change in SSA and the PICs to derive context-specific adaptation imperatives. A qualitative, exploratory design was adopted, drawing on secondary data from 2020–2025, including peer-reviewed literature, global climate reports, and regional datasets, and analysing them through a systems-thinking lens. Findings revealed that in SSA, climate stress reduced crop and livestock yields, strained supply chains, and increased rural–urban migration, while in PICs, sea-level rise and cyclones triggered displacement, weakened fisheries, and overwhelmed health systems. Both regions faced overlooked mental health burdens that compounded socio-economic losses. The study recommended tailored adaptation portfolios: climate-smart agriculture and integrated health preparedness in SSA, and ecosystem restoration, relocation governance, and renewable-energy diversification in PICs, supported by climate-justice-aligned finance and transparent monitoring systems.

Keywords: *Climate change, socio-economic impacts, Sub-Saharan Africa, Pacific Island, adaptation strategies,*

INTRODUCTION

Climate change has become one of the most pressing threats to global security, reshaping economies and societies in

profound ways. Afzal (2024) asserts that its socio-economic consequences are particularly acute in vulnerable regions such as SSA and the PICs, where

exposure is high and adaptive capacity is limited. According to Amuwah, Filho and Amos (2021), these regions face disproportionate risks because their development pathways remain tightly bound to climate-sensitive sectors like agriculture, fisheries, and tourism, making them especially susceptible to losses that ripple across households, markets, and public systems. Furthermore, Kumar (2021) explains that climate shocks rarely operate in isolation; they cascade through interdependent infrastructures (roads, power grids, health services), exposing systemic fragilities that turn local hazards into national economic crises.

The study, therefore, focuses on the interconnected nature of climate change impacts. Raihan (2023) notes that scholarship has often treated migration, health, and food–agriculture separately, overlooking the feedback loops that bind them together into self-reinforcing cycles of vulnerability. Sahar (2024) concurs, stating that climate stress increasingly acts as a driver of human mobility, both slow-onset and sudden, with outcomes that reverberate through urban informality, labour markets, and social cohesion. Hales (2020) highlights that these dynamics include not only physical health effects such as heat illness and vector-borne diseases but also long-term psychological harms, which undermine resilience and productivity across generations.

However, Abrams, Carden, Teta and Wågsæther (2021) argues that adaptation strategies continue to be undermined by inequality and marginalisation, narrowing household choices and weakening collective coping capacity. Uexkull (2021) adds that livelihood loss can fuel insecurity and even conflict, locking communities into what he terms

“vicious circles” of vulnerability. This variability underscores the necessity of comparative research, as Toulmin (2023) explains, SSA’s challenges stem largely from rain-fed agriculture and fragile governance, while PICs are defined by sea-level rise, cyclone intensity, and high per-capita infrastructure costs

The purpose of this study is to comparatively assess the socio-economic consequences of climate change in SSA and PICs, focusing on health, migration, and food–agriculture systems, and to derive context-specific adaptation imperatives. By bringing together evidence across sectors, the research not only advances scholarly understanding but also responds to the urgent demand for tailored strategies that address the realities of the world’s most climate-exposed regions.

BACKGROUND OF THE STUDY

Climate change is widely recognised as a global phenomenon that disrupts environmental, ecological, and socio-economic systems, with its impacts felt most severely in vulnerable regions (Raihan, 2023). According to Afzal (2024), developing countries remain at heightened risk because their economies rely heavily on climate-sensitive sectors such as agriculture and fisheries, leaving them exposed to even small shifts in rainfall, temperature, and storm intensity. Hidalgo, Nunn and Beazley (2021) explains that in PICs contexts, rising sea levels and recurrent flooding directly threaten local livelihoods that depend on fragile ecosystems, showing how environmental stress quickly translates into socio-economic instability. Similarly, Sahar (2024) asserts that climate change is an accelerating driver of human migration, forcing people to relocate due to both sudden disasters and

slow-onset changes, with wide-ranging implications for both displaced populations and host communities. In SSA, Abrams et al. (2021) demonstrates that droughts and floods intersect with entrenched poverty, unemployment, and service backlogs, particularly in rural and small-town contexts, creating overlapping vulnerabilities that deepen inequality and marginalisation. Taken together, these patterns reveal that climate change does not operate in isolation but magnifies existing structural weaknesses, reinforcing cycles of risk and underdevelopment in SSA and PICs.

PROBLEM STATEMENT

Despite evidence on the socio-economic consequences of climate change, existing research continues to treat agriculture, health, and migration as fragmented issues rather than interconnected processes that reinforce each other. Afzal (2024) states that the determinants of vulnerability are embedded within overlapping socio-economic and environmental pressures that remain poorly captured by isolated studies. According to Amuwah et al. (2021), SSA faces the compound challenge of high exposure and limited institutional capacity, yet empirical assessments rarely integrate how these weaknesses amplify climate shocks into enduring socio-economic losses. Similarly, Hales (2020) asserts that PICs confront unique risks such as sea-level rise, cyclone intensification, and climate-sensitive disease burdens, but comparative analyses that link these outcomes to broader migration and livelihood shifts are limited. Furthermore, Raihan (2023) explains that while climate change research has expanded globally, the evidence base still lacks systematic assessments that trace feedback loops

across sectors in vulnerable regions. However, Biggs, De Vos, Preiser, Clements, Maciejewski and Schlüter (2021) argues that only a systems-based approach can reveal how hazards cascade through infrastructure, health, and social systems, producing cycles of risk that undermine adaptation. Abrams et al. (2021) adds that marginalisation and inequality narrow household options, yet the socio-economic implications of these constraints in comparative regional contexts remain underexplored. This lack of integrated, cross-regional research leaves policymakers without the necessary evidence to design adaptation strategies that account for interconnected risks, differential exposures, and context-specific limits.

PURPOSE OF THE STUDY

The purpose of this study was to assess the socio-economic consequences of climate change in SSA and the PICs to derive context-specific adaptation imperatives. The findings will benefit a wide range of stakeholders. Policymakers will gain insights into the structural and sectoral vulnerabilities that require targeted interventions and funding priorities. International development agencies and donors will be able to use the results to align finance with climate-justice principles and ensure resources are directed towards the most exposed populations. Local governments and community organisations will benefit from evidence on how to integrate indigenous knowledge and strengthen resilience planning at the grassroots level. Health practitioners and education sectors will gain recognition of the importance of both physical and mental health impacts, which can inform integrated service delivery. Researchers and academics will

benefit from the study's interdisciplinary framework, which connects climate, health, and migration, thereby filling existing knowledge gaps and opening new pathways for inquiry. In this way, the study provides both conceptual advances and practical evidence to support more equitable and effective adaptation in highly vulnerable regions.

OBJECTIVE OF THE STUDY

The main objective comparatively assess the socio-economic consequences of climate change in SSA and the PICs to derive context-specific adaptation imperatives.

LITERATURE REVIEW

This literature review builds a comparative, systems-based account of how climate change translates into socio-economic consequences in SSA and the PICs. First, it establishes the conceptual scaffolding (vulnerability, resilience, and systems thinking) to compare regional risk architectures (exposure, sensitivity, adaptive capacity, and institutional/financial constraints). It then synthesises sectoral pathways from climate hazards to economic loss in food–agriculture and infrastructure, interpreting the included figures on agriculture–climate linkages, historical responsibility for damages, and disaster losses as a share of Gross Domestic Product (GDP). Next, it traces social outcomes (internal and cross-border migration, the growth of urban informality, and physical and mental health burdens) using the mortality and health-risk figures to position morbidity and mortality as both outcomes of, and drivers of, displacement. Lastly, it critically appraises adaptation strategies across agriculture, ecosystems, infrastructure, health systems, community-based approaches, and

energy/economy via the summary table, weighing effectiveness against hard ecological, technological, social, and fiscal limits to derive context-specific adaptation imperatives.

Comparative Systems Frame: Vulnerability & Resilience

Afzal (2024) conceptualises vulnerability as arising from the dynamic interaction of exposure, sensitivity, and adaptive capacity, while resilience refers to a system's ability to absorb shocks, reorganise, and maintain essential functions under climatic stress. Adopting a systems perspective, Biggs et al. (2021) argue that feedback loops, thresholds, and cross-scale linkages interweave ecological processes with institutional dynamics, rendering siloed, sector-specific analyses insufficient. Drawing on evidence from rural Fiji, Hidalgo et al. (2021) demonstrate that vulnerability and resilience are co-produced through the interplay of livelihoods, social networks, customary governance, and ecosystem services. Similarly, Amuwah et al. (2021) highlight that Sub-Saharan Africa (SSA) lies at the intersection of high climate hazard exposure and limited institutional and financial capacity, underscoring the urgency for comparative and context-sensitive assessments. Toulmin (2023) further contends that the region's sensitivity is structurally intensified by its reliance on rain-fed agriculture, compounded by governance fragilities and resource constraints.

Hales (2020) states that PICs, by contrast, confront sea-level rise, cyclone intensification, and climate-sensitive disease burdens, with archipelagic dispersion limiting surge capacity in health systems. Abrams et al. (2021) concurs that structural inequality and

marginalisation narrow household choice sets across both regions, depressing adaptive capacity even before hazards arrive. Abrams et al. (2021) further explains that deficits in water, sanitation, and hygiene embed climate sensitivity in rural and small-town settings, where service backlogs intersect with extreme events. Kumar (2021) asserts that because impacts cascade through interdependent networks, resilient critical infrastructure demands systemic risk assessment that anticipates cross-sector failures in energy, transport, and health. The Geneva Association (2023) argues that while risk-transfer and insurance can mobilise resilience capital, protection gaps persist where instruments are unaffordable or inaccessible, entrenching vulnerability for low-income populations.

Raihan (2023) states that the contemporary evidence base frames three lines of inquiry: social impacts (migration and health), economic impacts (agriculture and infrastructure), and the performance and limits of adaptation, which together enable rigorous cross-regional comparison. Sahar (2024) explains that climate now acts as a salient driver of mobility via both slow-onset and rapid-onset pathways, a pressure especially acute for drought-prone SSA and low-lying PICs.

Uexkull (2021) argues that hazard shocks can trigger “vicious circles” in which livelihood loss elevates insecurity and conflict risk, further undermining adaptation capacity. Tietjen (2023) states that these dynamics often channel rural-to-urban flows into informal settlements where service deficits heighten exposure to floods and heat.

Barabanova (2023) concurs that aligning financial mechanisms with sustainable development is pivotal to stabilise adaptation investment pathways and address climate-justice obligations embedded in differential responsibility and risk. Taken together, Afzal (2024) contends that only a comparative frame (explicitly relating exposure, sensitivity, adaptive capacity, and institutional-financial constraints) can anchor a rigorous assessment of socio-economic consequences in SSA and PICs and thereby prepare the ground for context-specific adaptation imperatives.

Economic Impacts: Food–Agriculture & Infrastructure

Barabanova (2023) asserts that climate change imposes severe yet uneven macroeconomic losses, with low-income regions facing the steepest projected output declines, placing agriculture and infrastructure at the centre of risk.

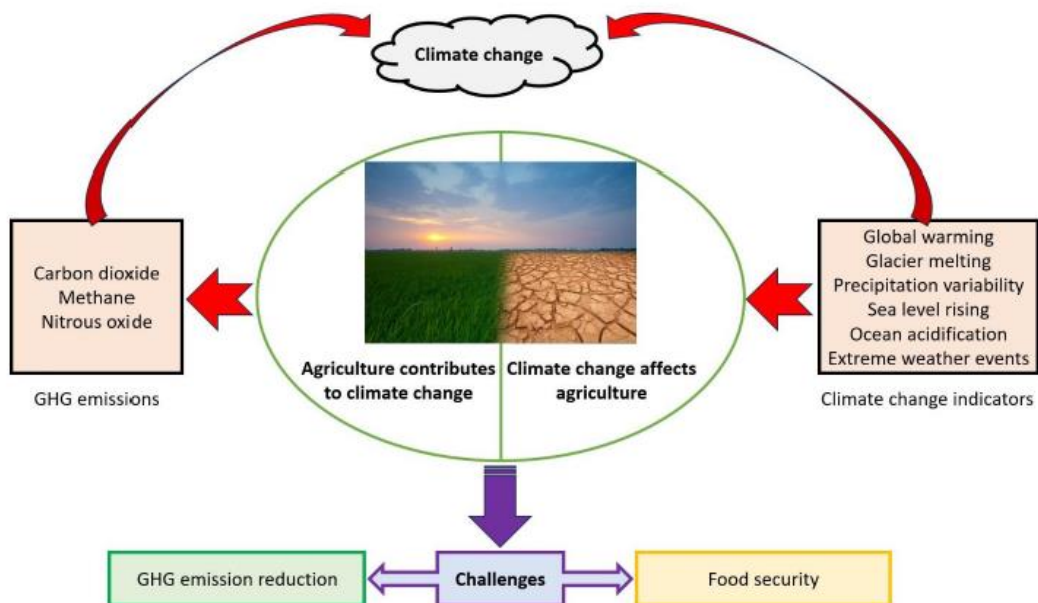


Figure 1: The Linkage Between Agriculture and Climate Change (source: Chari & Ngcamu, 2022)

The figure depicts a two-way feedback loop between agriculture and climate change. Agriculture emits key greenhouse gases (CO₂, CH₄, N₂O), which intensify climate indicators (warming, shifting rainfall, sea-level rise, ocean acidification, and extreme events) that, in turn, stress crops and livestock and disrupt post-harvest systems. These shocks create “challenges” that cascade into food insecurity and broader socio-economic losses; in SSA this is driven mainly by heat/drought and supply-chain fragility, while in PICs it is amplified by ocean change and coastal exposure. The “GHG emission reduction” box signals a leverage point to dampen the loop, while the study uses this causal chain to compare regions and derive context-specific adaptation imperatives for food–agriculture systems.

Chari and Ngcamu (2022) explains, via figure 1, that crop pathways run through water scarcity and extreme heat that depress yields, with limited high-altitude exceptions where warmer temperatures

extend growing seasons. Chari and Ngcamu (2022) further state that livestock losses arise from heat stress, reduced forage, and expanded pest and disease ranges that undermine productivity and reproduction. Olumba, Olumba and Alimba (2021) argue that post-production chains are climate-sensitive because heat spoilage and transport interruptions erode value before goods reach markets. Furthermore, Dube, Sibanda and Chiwara (2021) explain that inundation damages roads, raises storage costs, and shortens shelf life, compounding volatility across processing and logistics. Dube et al. (2021) also assert that labour productivity falls as heat stress trims working hours and climate-sensitive disease burdens rise, inflating enterprise costs.

According to Kumar (2021), infrastructure failures (warped roads, power outages, and flooded communication networks) translate climatic shocks into food-system instability and broader economic losses.

Alhassan (2021) concurs, as reflected in Figure 2, that responsibility for accumulated climate damages is concentrated: the United States alone

accounts for roughly \$1.9 trillion, with China and Russia following, an empirical basis for climate-justice arguments about who should finance adaptation.

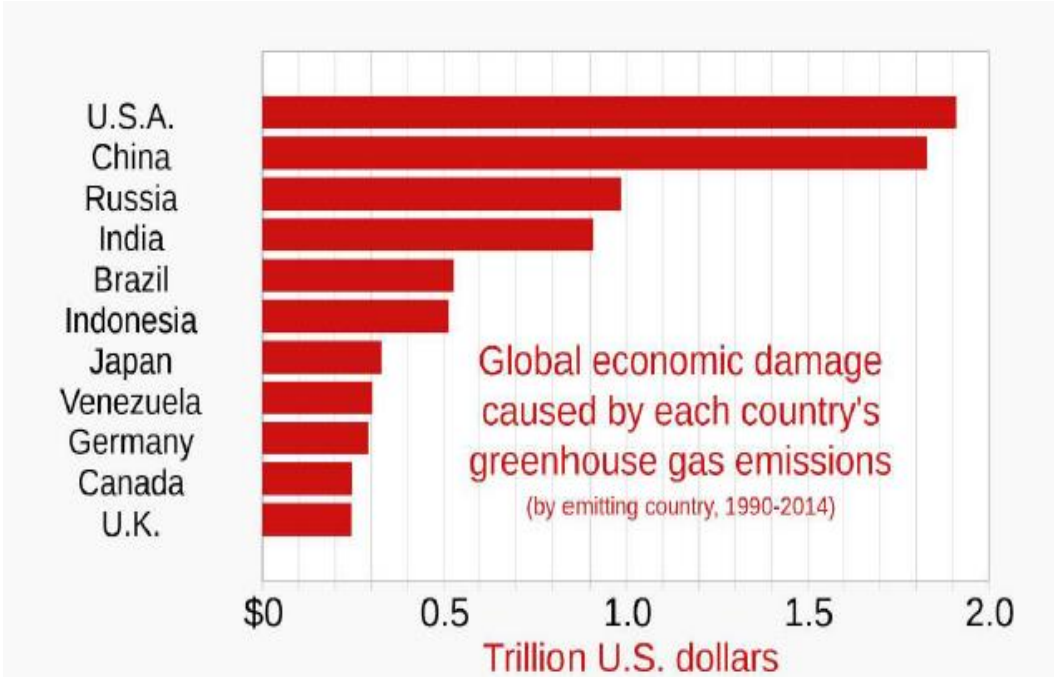


Figure 2: Global economic damage caused by GHGs emissions (source: Alhassan, 2021).

Figure 2 ranks countries by the cumulative global economic damage attributable to their GHG emissions (1990–2014), with the United States (~\$1.9 trillion) leading, followed by China and Russia. The distribution shows that a small set of high-emitting economies accounts for a disproportionate share of climate-related losses, whereas regions central to this study (SSA and the PICs) contribute little to emissions yet experience outsized socio-economic consequences. In the context of the research objective, the

figure anchors the comparative assessment in climate-justice economics, providing empirical justification for context-specific adaptation finance and loss-and-damage support targeted to vulnerable, low-emitting states.

Against this responsibility map, figure 3 shows that while the global direct-loss average in 2020 was ~0.2% of GDP, small islands bear far higher ratios because tourism and fisheries dominate their economies and coastal-protection costs outstrip public budgets.

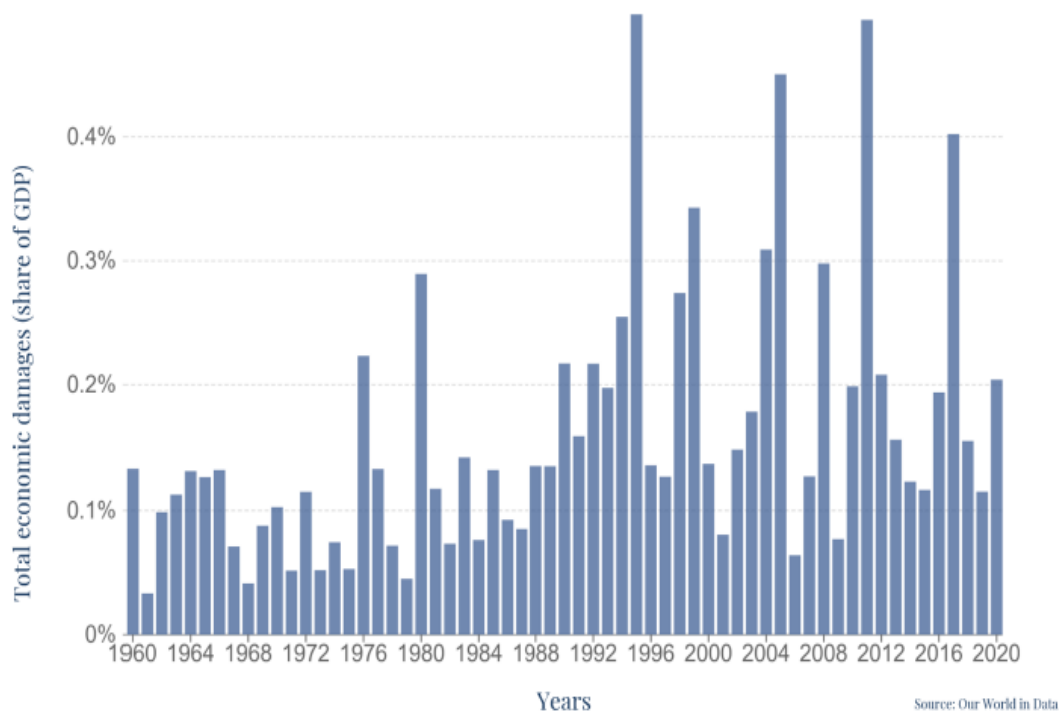


Figure 3: Global economic losses due to climate-related disasters as % of GDP (*Source: Press, 2022*)

Figure 3 plots annual global direct economic losses from climate-related disasters as a share of world GDP (1960–2020), revealing a volatile but upward-leaning burden with clusters of high-loss years since the 1990s. As a baseline benchmark, it shows that climate shocks are already macro-significant at the global level. Critically for this study, percentage-of-GDP losses are typically

far higher for small, open economies (notably PICs) than this world average, while SSAn economies face recurrent drought and flood shocks that compress fiscal space. The figure therefore contextualises the comparative objective, indicating why region-specific adaptation imperatives are necessary to stabilise food–agriculture systems and protect economic performance.

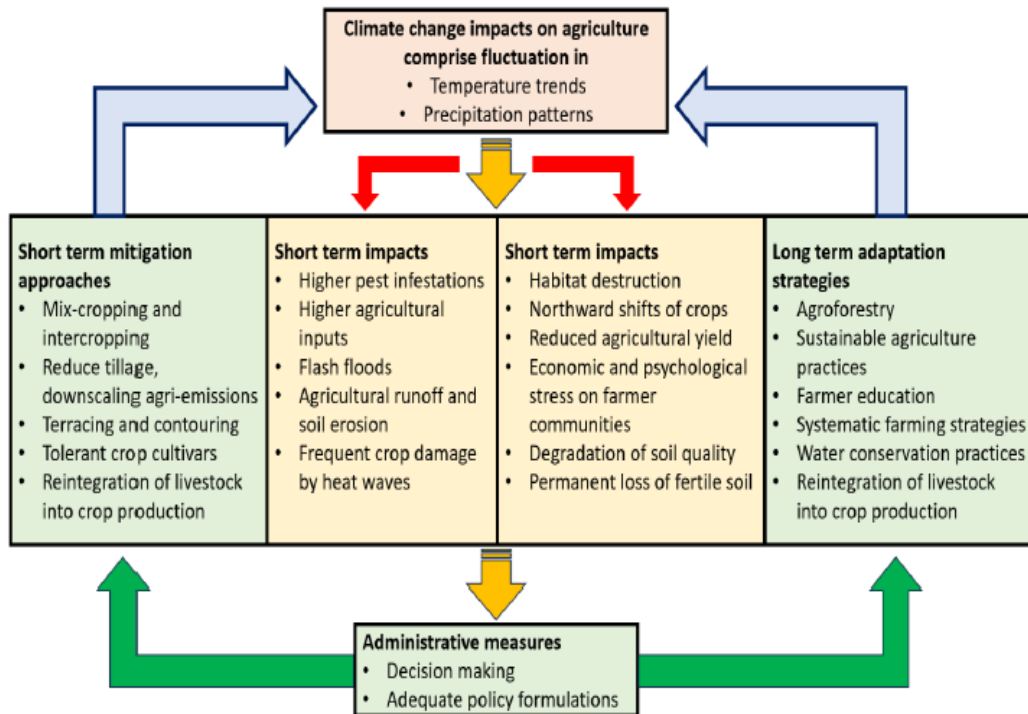


Figure 4: Impacts of climate change on crop productivity and food security (source: Dube et al., 2021)

Figure 4 schematises the causal chain from climate variability (temperature and precipitation shifts) to agricultural outcomes and, ultimately, food security. The figure links proximate stressors (heightened pest pressure, flash floods, runoff/erosion, heat-wave damage, habitat loss, crop-zone shifts, soil degradation, and reduced yields) to two tiers of response: (i) short-term mitigation (mixed/inter-cropping, reduced tillage, terracing, heat/drought-tolerant cultivars, and crop–livestock reintegration) and (ii) long-term adaptation (agroforestry, sustainable practices, farmer education, systematic farming strategies, and water-conservation measures). The base “administrative measures” block foregrounds governance (decision-making and policy formulation) as the enabling infrastructure for these options. Interpreted within this study’s

comparative lens, the pathways map directly onto SSA’s heat- and drought-driven yield volatility and the PICs’ constrained arable land and salinisation risks, thereby clarifying the food-system levers that inform region-specific adaptation imperatives.

Dube et al. (2021) demonstrate in Figure 4 that rising temperatures reduce staple yields and erratic rainfall elevates drought and flood risk, while coral bleaching and ocean acidification shrink fish stocks, together swelling food insecurity. Therefore, Alhassan (2021) states that agriculture remains a principal exposure channel in SSA, where productivity is tightly coupled to heat and water regimes, magnifying output shocks into income and price instability. Chari and Ngcamu (2022), and Dube et al. (2021) concur that SSA’s risks extend beyond farms: supply-chain fragility, storage losses, and heat-related labour

constraints transmit field-level stress into urban markets and fiscal space.

By contrast, Hales-aligned evidence embedded in Figure 4 emphasizes PICs’ dependence on ocean-based food systems, where fisheries decline intersects with tourism exposure and the capital intensity of coastal protection highlighted by Figure 3. However, Raihan (2023) notes that many studies still treat sectors in isolation, and there remains limited integration of socio-economic linkages, which complicates precise, region-tailored adaptation economics and costed policy design. The figures cohere with the textual evidence: hazards propagate through crops, livestock, post-harvest chains, labour, and infrastructure into GDP-scale losses, while responsibility for damages is historically concentrated, an analytical foundation for comparing SSA’s heat-

and-drought-centred risks with PICs’ ocean-change and tourism dependencies.

Social Impacts: Migration, Informality & Health

Raihan (2023) notes that climate stress reorganises social life through both slow-onset processes (drought, salinisation, sea-level rise) and sudden disasters that precipitate displacement across internal and cross-border scales, making mobility a core social impact of climate change. In SSA, recurrent agricultural shocks propel rural-to-urban flows into peripheral settlements where tenure is insecure and services are thin, entrenching exposure to floods and heat (Tietjen, 2023). By contrast, PICs experience place-loss from cyclone damage and land submergence that pushes planned and unplanned relocation across dispersed islands (Hales, 2020).

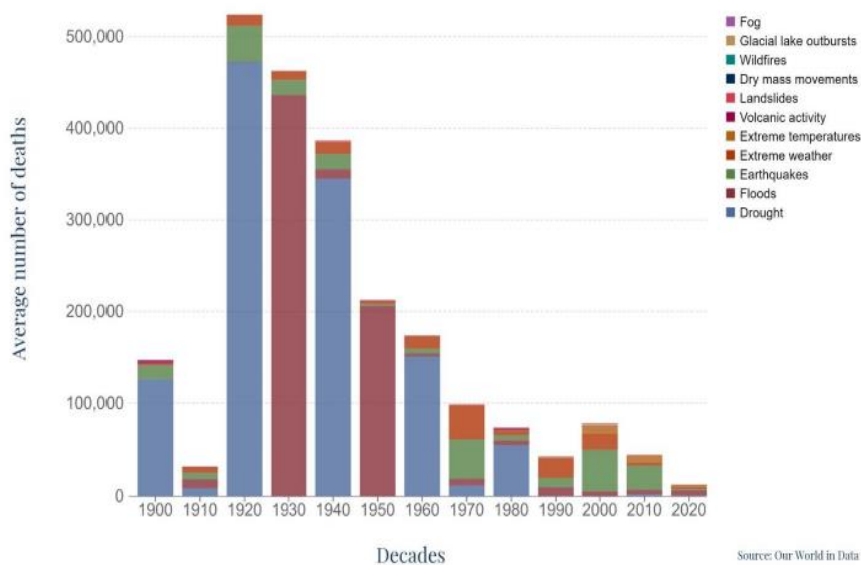


Figure 5: Deaths caused by climate-related disasters worldwide (by decade) (*Source: Alhassan, 2021*)

Figure 5 displays the average number of deaths per decade from climate-related disasters worldwide (1900–2020), disaggregated by hazard type (e.g.,

droughts, floods, extreme weather; with other listed hazards shown in the legend). Mortality peaks in the 1920s–1930s, then declines markedly from the 1970s

onward, indicating gains from early warning, public health, and disaster-risk reduction. Nonetheless, residual fatality spikes persist, evidencing continuing vulnerability to high-impact events. In the context of this study, the pattern positions mortality and serious injury as both outcomes of extreme events and catalysts of secondary displacement, straining health systems and social safety nets, as households move after bereavement, asset loss, or service collapse (Alhassan, 2021). This baseline underscores why SSA and PICs (despite low emissions) require context-specific risk reduction, surveillance, and lifesaving services to limit death, prevent post-disaster migration, and protect socioeconomic stability.

Although global disaster mortality shares have declined with early warning and

stronger infrastructure, the figure’s spikes underscore that single catastrophic events still cause large, sudden population movements, with small islands remaining acutely exposed. Urban informality grows where migrants concentrate in settlements lacking piped water, drainage, and waste services, which amplifies Water, Sanitation, and Hygiene (WASH)-related health risks and compounds climate sensitivity (Abrams et al., 2021). Furthermore, Abrams et al. (2021) explain that marginalisation narrows household choices, weakening adaptive capacity and deepening the social gradient of climate risk. In SSA, these vulnerabilities intersect with governance and income constraints; in PICs, archipelagic remoteness and thin health workforces limit surge response and continuity of care (Hales, 2020).

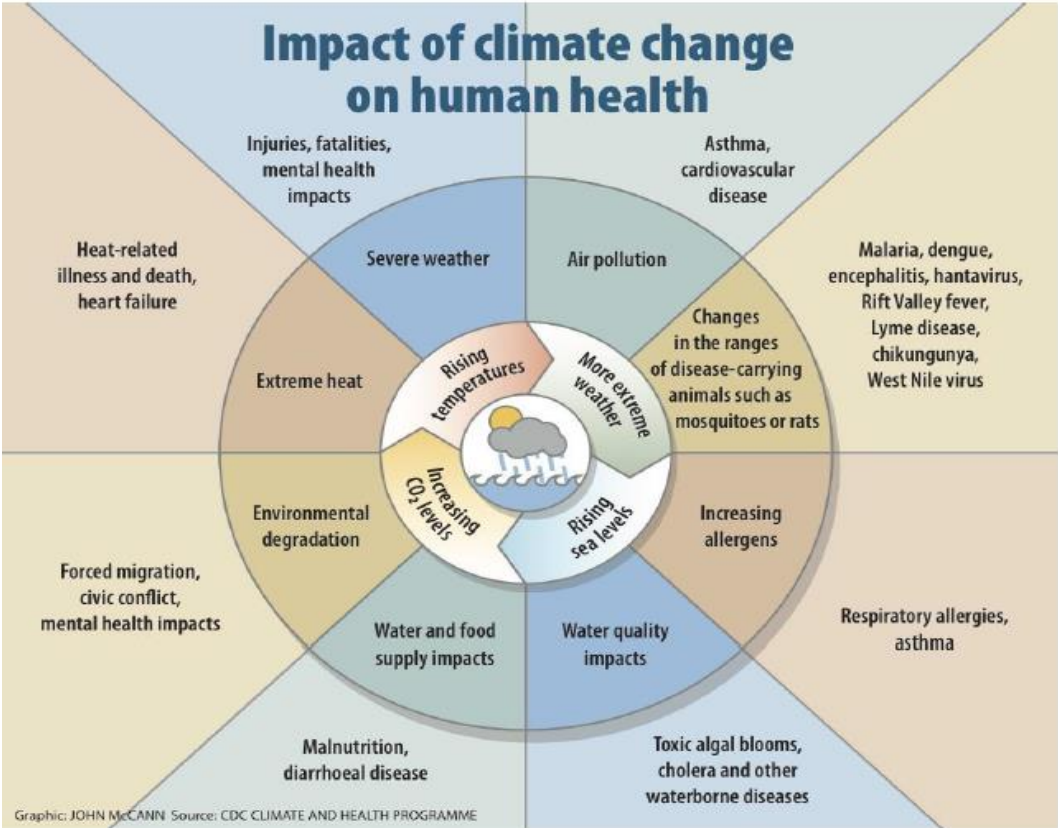


Figure 3: Physical and mental health risks linked to climate change (Simon Hales, 2020)

Figure 6 maps the causal pathways by which climate change affects physical and mental health: rising temperatures, more extreme weather, sea-level rise, and degraded air/water quality drive heat illness, cardiorespiratory disease, vector- and water-borne infections, allergies/asthma, malnutrition, and psychological harms (trauma, anxiety, chronic stress). These outcomes also feed back into mobility, with injury, asset loss, and degraded living conditions precipitating forced migration and protracted displacement. Read against this study’s comparative frame, the diagram clarifies regional risk profiles: SSA faces intense heat, malaria/dengue, diarrhoeal disease, and undernutrition burdens that depress labour productivity and household income, while PICs experience storm-related trauma, water insecurity, and vector expansion exacerbated by sea-level rise and settlement disruption. The figure thus locates health at the centre of the socio-economic consequences under assessment, illuminating why risk reduction, disease surveillance/WASH, and integrated psychosocial services are prerequisite enablers of effective, context-specific adaptation in both regions.

Figure 6 catalogues heat stress, respiratory and vector-borne disease (e.g., malaria, dengue), water-borne illness, and an often-neglected mental-health burden (trauma, anxiety, and chronic stress) following repeated shocks and uncertain recovery trajectories (Hales, 2020). Sahar (2024) argues that these health burdens and mobility

Adaptation: Effectiveness, Limits & Imperatives

Table 1: Summary of adaptation strategies, their strengths, and their limitations

Adaptation Area	Strategy	Effectiveness	Limitations
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patterns reinforce each other: disasters and deteriorating living conditions elevate movement, while displacement itself heightens exposure to overcrowding, disease, and psychosocial strain. Uexkull (2021) adds that livelihood loss can trigger vicious circles of insecurity and violence, further undermining community coping capacity. Cross-sector feedback translates health shocks into economic impacts. Dube et al. (2021) shows that heat and illness reduce labour time and productivity, shrinking household income and constraining education and skills acquisition for youth.

According to Amuwah et al. (2021), weak social safety nets and fragmented governance in many SSA contexts limit buffering against these losses, whereas PICs face systemic fragility from small population bases and high per-capita infrastructure costs that strain public health budgets. Biggs et al. (2021) highlight that a systems lens is essential to track these loops from disaster to health to migration and back, because sector-by-sector views miss emergent risks. Taken together, the literature and Figures 5 and 6 indicate that effective adaptation requires risk-reduction measures that cut disaster mortality, surveillance and early-warning systems for heat and infectious disease, and psychosocial services embedded in primary care to address lasting mental-health harms, preconditions for stabilising labour productivity, incomes, and human-capital trajectories in SSA and PICs.

Agriculture	Crop diversification, climate resilient seeds, irrigation improvements.	Increases resilience to drought and floods, stabilizes yields	Cannot fully offset losses from high temperatures, requires resources and farmer training
Ecosystems	Mangrove restoration, coral reef protection, afforestation	Provides coastal protection, enhances biodiversity, low coast natural buffer	Ecological limits exist (e.g., coral bleaching is irreversible once threshold sare crossed)
Infrastructure	Sea walls, coastal defenses, elevated housing	Protects urban centers and critical infrastructure from flooding	Very costly, especially for small island developing states; may only delay impacts rather than solve them
Health systems	Disease surveillance, vaccination programs, public awareness campaigns	Reduces spread of vector-borne and infectious diseases; strengthens preparedness	Mental health support is rarely included; health systems in small island developing states lack resources and staff
Community Based Approaches	Relocation from exposed areas; use of traditional knowledge	Saves lives from sea-level rise and cyclones; respects local practices when integrated	Disrupts culture and livelihoods; relocation may cause long-term social stress
Energy and Economy	Investment in renewable energy (solar, wind), diversification away from tourism	Reduces dependence on fossil fuels; creates new jobs; supports Paris Agreement goals	High upfront costs; require technical expertise and international funding

(Source: constructed by researchers)

Table 1 synthesises six adaptation domains (agriculture, ecosystems, infrastructure, health systems, community-based approaches, and energy/economy) and shows that performance is context-dependent rather than uniformly effective (Raihan, 2023). In agriculture, climate-smart practices (crop diversification, climate-resilient

seed use, and irrigation upgrades) stabilise yields under drought and flood, yet cannot fully offset heat losses and require capital and farmer training (Amuwah et al., 2021). Ecosystem-based measures (mangrove restoration, coral protection, afforestation) provide low-cost coastal buffers and biodiversity co-benefits, but face ecological limits once

thresholds (e.g., coral bleaching) are crossed (Hidalgo et al., 2021). Infrastructure options (sea walls, coastal defences, elevated housing) protect urban centres and critical assets, although they are very costly for small island developing states and can merely postpone impacts (Kumar, 2021). These cost pressures are visible in figure 3, where climate-disaster losses as a share of GDP are much higher for small islands, frequently exceeding public budgets and underscoring affordability constraints in the PICs context (Press, 2022).

Health-system strategies (disease surveillance, vaccination, and public awareness) consistently reduce transmission risks, yet mental-health support is seldom integrated and many PIC health services have limited surge capacity (Hales, 2020). Community approaches (planned relocation and use of traditional/indigenous knowledge) save lives from sea-level rise and cyclones but can fracture livelihoods and social fabric, producing long-term stress (Tietjen, 2023). Renewable-energy diversification reduces fossil-fuel dependence and creates jobs but requires high upfront investment and external finance/technical expertise, a recurring barrier for SSA and PICs (Biggs et al., 2021).

Amuwah et al. (2021) notes that these advantages and limits translate differently by region: SSA gains most from climate-smart agriculture paired with risk-aware infrastructure and public-health preparedness, whereas PICs must foreground coastal buffers, selective hard defences, and relocation planning in tandem with health capacity and energy diversification (Amuwah et al., 2021). Evidence on health burdens in figure 6 strengthens the case for

embedding surveillance and psychosocial care within adaptation portfolios, since heat stress, vector/water-borne disease, and trauma undermine labour productivity and household recovery prospects (Hales, 2020). Moreover, the hard limits were identified (ecological, economic, technological, and social) marking thresholds that cannot be removed by incremental measures, implying the need to anticipate transformational options where recovery is infeasible (Hidalgo et al., 2021).

Crucially, figure 2 anchors a financing logic: a small set of high-emitting economies accounts for a disproportionate share of cumulative climate damages (e.g., the U.S. $\approx$ \$1.9 trillion, with China and Russia following), supporting climate-justice claims for adaptation and loss-and-damage support to low-emitting, highly exposed regions (Alhassan, 2021). Within SSA, literature therefore prioritises feasible, equity-enhancing mixes (field-level measures plus basic infrastructure resilience and disease control) where financing and training gaps are binding (Dube et al., 2021). Within PICs, scholarship emphasises ecosystem restoration coupled with selective hard-defence investments, relocation governance, and health-system reinforcement, acknowledging budget constraints documented by GDP-loss metrics (Press, 2022).

Across both regions, the literature stresses that adaptation remains uneven and often short-term unless mental health, affordability, and ecological thresholds are addressed, which is why action gap hinges on dedicated international funding, multi-year horizons, and routine monitoring of yields, fish stocks, disease surveillance

coverage, and service capacity (Raihan, 2023).

In conclusion, climate hazards propagate through crops, livestock, post-harvest chains, labour, and critical infrastructure into GDP-scale losses, while mortality, illness, and psychosocial harm amplify displacement and depress productivity, income, and human-capital formation. The figures and table collectively show that responsibility for cumulative damages is concentrated in a few high-emitting economies, that small islands face disproportionately high losses relative to GDP, and that health impacts (heat, infectious disease, and mental health) are central to socio-economic trajectories. Adaptation portfolios work best when matched to context: SSA benefits from climate-smart agriculture, basic resilient infrastructure, and integrated public-health preparedness; PICs require ecosystem restoration coupled with selective hard defences, relocation governance, and strengthened health capacity and diversified energy. Yet hard limits, affordability gaps, and uneven access persist, underscoring the need for climate-justice-aligned finance, multi-year horizons, and routine monitoring (yields, fish stocks, surveillance coverage, service capacity) to close the assessment-action gap.

METHOD

This study employed a systematic literature review to examine the socio-economic impacts of climate change in vulnerable regions, such as SSA and the PICs. This approach was chosen to provide a comprehensive understanding of the topic by gathering and analysing existing research. The goal of the review was to explore how climatic variability affects various sectors, including agriculture, infrastructure, public health,

and migration, as well as to identify major adaptation and mitigation strategies. This approach helped to collect and combine findings from multiple studies, providing a solid summary of the current research.

To find relevant information, several academic databases were used, including Google Scholar and the UKZN Library. The search queries combined keywords related to the study, such as "climate change," "socio-economic impacts," "vulnerable regions," "SSA," and "PICs." Terms for specific sectors like "agriculture," "health," and "migration" were also included to broaden the scope of the search.

The initial search provided many publications. Publications were reviewed by their titles, abstracts, and full texts to ensure they were directly relevant to the study's objectives. This process was crucial for focusing the research. A detailed analysis of the selected papers was then performed, identifying key themes, methodologies, and findings. This helped to identify the main arguments and connections between different studies, allowing for a clear picture of how climate change affects various sectors to be presented.

At least 25 references in APA style were compiled, ensuring that 60% were journal articles published between 2020 and 2025, and 40% were books, statutory publications, or government documents less than five years old. References from sources like Wikipedia and dictionaries were not used, and any without a publication date were excluded.

During the search, many high-quality articles were found that were directly relevant to the topic. However, a significant number of these had to be removed from the final list because they

were published before the 2020 cut-off date. This careful selection process was necessary to build a current and relevant body of work for the literature review.

FINDINGS AND DISCUSSION

The secondary evidence makes clear that climate change restructures economies and societies through interlocking pathways that differ in intensity and tractability between SSA and the PICs. Vulnerability in both regions is produced at the intersection of high biophysical exposure and constrained adaptive capacity, but the mechanisms are not identical: SSA's dependence on rain-fed agriculture and governance fragility amplifies climate shocks into persistent losses, whereas PICs face the compound pressure of sea-level rise, cyclone intensification, and small health and fiscal systems stretched by geographic dispersion (Afzal, 2024; Amuwah et al., 2021; Hales, 2020; Toulmin, 2023). A systems lens is therefore not optional; feedbacks run from damaged crops and infrastructure to household income, public revenue, and service provision, and then loop back through weakened resilience to the next event (Biggs et al., 2021). Crucially, the distribution of responsibility for cumulative damages is highly skewed (major emitters account for outsized economic harm) strengthening the normative and practical case for channeling adaptation finance to low-emitting yet highly impacted regions such as SSA and PICs (Alhassan, 2021; Barabanova, 2023).

The economic channel is led by food–agriculture and reinforced by critical infrastructure. The agriculture–climate linkage diagram shows a two-way loop: agriculture contributes to emissions while climate stress depresses yields and livestock productivity, pushing food

insecurity and income volatility (Chari & Ngcamu, 2022). Under heat and water stress, staple crop yields fall; livestock face heat stress, forage decline, and wider pest and disease ranges; and the post-harvest chain loses value as spoilage increases and transport is disrupted (Chari & Ngcamu, 2022; Olumba et al., 2021). Urban and rural logistics are brittle: inundation damages roads and storage, power instability halts cold chains and processing, and communications failures impede market coordination, converting hazard exposure into macroeconomic loss (Dube et al., 2021; Kumar, 2021). These sectoral hits register at the national scale. Global data show climate-disaster losses already material to GDP, with small, open economies (typical of the Pacific) bearing far higher loss ratios than the world average, while SSA's fiscal space shrinks under recurrent droughts and floods (Press, 2022). The contrast is stark: SSA's risk profile is dominated by heat/drought and inland flooding interacting with supply-chain fragility; PICs' profile is ocean-facing, with fisheries decline and coastal tourism exposure compounded by the capital intensity of shoreline protection (Dube et al., 2021; Press, 2022). Against this backdrop, the concentration of historical damage among a few high-emitting economies provides a coherent financing logic for adaptation and loss-and-damage support that matches exposure with responsibility (Alhassan, 2021).

The social channel converts hazard and economic stress into mobility, informality, and health burdens that reinforce the next round of losses. Climate pressures now drive both slow-onset movements (salinisation, aridity, sea-level rise) and sudden disaster displacement, reconfiguring population

distribution within and across borders (Raihan, 2023; Sahar, 2024). In SSA, agricultural shocks funnel people to urban peripheries where tenure is insecure and services are thin, raising exposure to floods, heat, and disease; in PICs, place-loss from cyclones and submergence triggers planned and unplanned relocation across islands (Tietjen, 2023; Hales, 2020). Mortality patterns have improved over the century with risk-reduction and public health, yet catastrophic spikes persist and act as both outcome and driver of displacement when bereavement, asset loss, and service collapse strip communities of the means to remain in place (Alhassan, 2021). Health sits at the centre of these loops: heat illness, respiratory and vector-borne disease, water-borne infection, undernutrition, and psychological harm accumulate after repeated shocks, depressing labour time and productivity and constraining educational progression for youth, thereby weakening future adaptive capacity (Hales, 2020; Dube et al., 2021). Where safety nets are shallow and governance is fragmented (as in many SSA settings) households fall faster and recover more slowly; in PICs, remoteness and small health workforces limit surge capacity and continuity of care (Amuwah et al., 2021; Hales, 2020). In the most stressed contexts, livelihood loss and insecurity ignite cycles of violence that further degrade social resilience, tightening the trap (Uexkull, 2021).

Deriving credible, context-specific adaptation imperatives, therefore requires testing options against both their effectiveness and their limits. The strategy matrix indicates that climate-smart agriculture (diversification, resilient seed, and irrigation) can

stabilise yields, but it cannot erase heat penalties and demands capital and farmer training, which are often scarce in SSA (Amuwah et al., 2021; Raihan, 2023). Ecosystem restoration (mangroves, coral, afforestation) offers cost-effective buffers and biodiversity co-benefits for PICs, yet ecological thresholds (such as irreversible coral bleaching) place a ceiling on protective value (Hidalgo et al., 2021). Hard infrastructure (sea walls, elevating housing) shields dense assets but is extremely expensive for small islands and can postpone rather than solve inundation risk, aligning with GDP-loss evidence on fiscal strain (Kumar, 2021; Press, 2022). Health strategies (surveillance, vaccination, risk communication) are consistently beneficial, but mental-health services remain under-integrated despite their central role in restoring productivity and social function aftershocks (Hales, 2020). Community-level measures (planned relocation and the use of indigenous knowledge) save lives yet may fracture livelihoods and identity when not paired with economic transition support (Tietjen, 2023). Energy diversification reduces fuel import dependence and broadens the economic base but requires external finance and technical expertise that many local institutions cannot mobilise quickly (Biggs et al., 2021).

Taken together, the comparative logic is strong. For SSA, the most financeable and equity-enhancing mix couples field-level agricultural measures with basic resilient infrastructure and integrated public-health preparedness, explicitly funding extension services, cold-chain reliability, early-warning systems, and primary-care platforms that include psychosocial support (Dube et al., 2021; Amuwah et al., 2021; Hales, 2020). For

PICs, priority stacks toward ecosystem restoration, selective hard defences at critical nodes, relocation governance that protects livelihoods and culture, strengthened health surge capacity, and renewable-energy deployment to ease fiscal pressure from fuel imports, each calibrated to small budgets and high per-capita costs (Kumar, 2021; Press, 2022; Biggs et al., 2021). Because historical responsibility is concentrated, these portfolios should be underwritten by international mechanisms aligned with climate-justice principles and structured on multi-year horizons with clear indicators (yields and fish-stock trends, surveillance coverage, service capacity) to close the gap between assessment and action (Alhassan, 2021; Barabanova, 2023; Raihan, 2023).

RECOMMENDATIONS

Grounded in the comparative evidence, the study recommends context-specific adaptation portfolios underwritten by multi-year, climate-justice-aligned finance and tracked with transparent indicators. For SSA, priorities are to scale climate-smart agriculture (diversified cropping, climate-resilient seed systems, water-saving irrigation) through adequately resourced extension; harden agri-food supply chains via storage and cold chains, rural roads, and reliable power; embed heat-health early warnings, vector control, WASH, and psychosocial care in primary health systems; and reduce urban risk through drainage, flood-safe settlement upgrading, and tenure regularisation coupled to social protection. For the PICs, portfolios should foreground nature-based coastal buffers (mangroves/coral) with selective hard defences at critical sites, strengthen water security (rainwater harvesting, leakage reduction, saline-intrusion

management), establish robust planned relocation frameworks that protect livelihoods and culture with advance investments in receiving areas, expand health surge capacity (including mental health), and accelerate renewable-energy deployment and grid resilience to cut fuel-import exposure and diversify beyond tourism. Across both regions, implementation should be co-designed with communities and indigenous knowledge, use affordable risk-transfer as a complement to public investment, and rely on interoperable data systems that link climate, health, migration, and agriculture; monitoring should minimally track crop yields/post-harvest losses, fish stocks, disease-surveillance coverage, disaster losses as a share of GDP, and service capacity to close the assessment-action gap.

FUTURE RESEARCH

Future inquiry should move beyond single-sector views to portfolio-level, cross-sector designs that trace how climate variability jointly shapes livelihoods, public health (including mental health), and mobility in SSA and the PICs. Priority tasks include quantifying direct and indirect economic costs of extreme events (e.g., cyclones, droughts) on local economies (especially in tourism-, fisheries-, and forestry-dependent settings) while linking these shocks to household income, labour productivity, and food security. The climate-migration nexus requires comparative studies that examine both drivers of relocation (sea-level rise, water scarcity, heat stress) and receiving-community impacts on services, jobs, social cohesion, and cultural life, alongside evaluations of local, national, and international policy responses. Health research should pair epidemiological metrics with validated

mental-health measures and test how psychosocial support can be embedded in adaptation packages. Methodologically, the field needs longitudinal and quasi-experimental designs, interoperable subnational data systems that integrate climate, health, migration, and economic accounts, and context-specific case clusters that respect regional heterogeneity rather than broad generalisations. Lastly, studies should include distributional analyses (gender, youth, disability, indigeneity) and finance/implementation evaluations (including loss-and-damage and risk-transfer instruments) to identify cost-effective, equitable, and scalable adaptation portfolios.

CONCLUSION

This study shows that climate change is already reshaping economies and societies in SSA and the PICs through feedback loops that link food–agriculture, infrastructure, health, and migration. Hazards reduce productivity, fracture supply chains, and erode revenues, which in turn fuel displacement, lower labour capacity, and strain health and municipal services.

Adaptation is underway but remains constrained by ecological and fiscal thresholds as well as weak institutions and fragmented coordination. Effective resilience requires recognising health in its full scope, including neglected mental health burdens, as central to sustaining livelihoods and social cohesion. The study therefore recommends context-specific, community-led adaptation portfolios, climate-smart agriculture, resilient supply chains, integrated health and psychosocial services, and risk reduction in urban areas for SSA; and coastal ecosystem restoration, selective hard defences, water security, relocation governance, and renewable-energy diversification for PICs, financed under climate-justice principles and monitored through clear indicators to ensure adaptation translates into equitable, durable socio-economic resilience.

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