



# When Not Every Adaptation to Climate Change Works: Evidence from Sub-Saharan Africa

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## Abstract

This paper presents a literature-based case analysis of climate change maladaptation in Sub-Saharan Africa (SSA), examining instances in which adaptation interventions have inadvertently increased vulnerability rather than reduced it. Drawing on a multi-theoretical framework integrating vulnerability theory, political ecology, and the maladaptation lens, the paper synthesizes published evidence from selected cases in Kenya, Ethiopia, Mozambique, Nigeria, and Senegal. The review identifies recurring drivers of maladaptation, including top-down planning, weak stakeholder inclusion, socio-cultural misalignment, ecological unsuitability, and short-term policy approaches. The analyzed cases include irrigation-induced conflict, exclusionary climate-smart agriculture, ecologically damaging afforestation, inequitable water harvesting, and displacement associated with coastal defense and resettlement programs. The paper demonstrates how adaptation interventions can reinforce inequalities, undermine local livelihoods, and generate new environmental risks when contextual realities are overlooked. The analysis underscores the need for context-sensitive, participatory, and equity-oriented adaptation planning in SSA. The paper concludes by advocating for transformative adaptation approaches that address structural vulnerabilities and promote sustainable, locally grounded climate resilience.

## Subject Areas

Environmental Sciences

## Keywords

Climate Change Adaptation, Maladaptation, Transformative Adaptation, Sub-Saharan Africa. Vulnerability

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## 1. Introduction

The cardinal question addressed in this paper is: Are there cases when adaptation to climate change does not work in Sub-Saharan Africa (SSA)? The answer to this critical question is in the affirmative. This paper aims to investigate why and how certain adaptation strategies in SSA fail to achieve their intended outcomes, a phenomenon currently referred to in the literature as maladaptation [1]-[5]. It highlights key drivers of maladaptation, including top-down planning, poor stakeholder engagement, socio-cultural disconnects, and short-termism. By unpacking empirical cases from Kenya, Ethiopia, Mozambique, and Nigeria, the paper aims to generate lessons that can inform future adaptation practice and policy in Africa and beyond. The first assignment undertaken in this paper is to provide a brief history of the debate, second, to identify the appropriate theoretical and conceptual underpinnings for analysis, and third, to offer some relevant examples from SSA where adaptation to climate change has not been effective. After that, the paper concludes and provides some recommendations.

## 2. Brief History of the Maladaptation Debate

The use of maladaptation as a concept in the space of climate change dates back to the late 1990s. For example, [6] referred to it indirectly through nine principles that characterize effective adaptation, including the importance of accounting for “potential adverse side effects of adaptive strategies... to avoid solutions that are worse than the problem” (p. 85). According to their interpretation, “maladaptation can result in negative effects that are as serious as the climate-induced effects being avoided” (p. 87). The term also appears in the IPCC’s Third Assessment Report, which defines maladaptation as “an adaptation that does not succeed in reducing vulnerability but increases it instead” ([7], p. 990). On the other hand, [8] and [9] also mention the term maladaptation in their work. More recently, [1], [10] and [11], while describing the responses to water stress engineering in the city of Melbourne (Australia), refer to “an action taken ostensibly to avoid or reduce vulnerability to climate change that impacts adversely on, or increases the vulnerability of other systems, sectors or social groups” (p. 211). Very recently, the IPCC Working Group II contribution to the Fifth Assessment Report (AR5-WGII) [12] contains numerous references to the concept, including a one-page section dedicated to “Addressing Maladaptation” [13]. From the above, there is every indication that there is a scholarship of maladaptation, and that the concept is making its way into the mainstream, but it does not yet imply clarity on what it means. The glossary of the AR5-WGII report proposed to define maladaptation

as: “Actions that may lead to increased risk of adverse climate-related outcomes, increased vulnerability to climate change, or diminished welfare, now or in the future” [12]. This definition is partly derived from that developed in November 2012 by sixteen experts during a three-day workshop on the maladaptation issue: “Maladaptation is a process that results in increased vulnerability to climate variability and change, directly or indirectly, and/or significantly undermines capacities or opportunities for present and future adaptation” ([3], p. 3).

The maladaptation debate gained traction as development and adaptation projects, especially in the Global South, came under scrutiny for failing to account for local contexts, perpetuating inequalities, or locking communities into unsustainable practices [1]. For instance, large-scale irrigation, seawalls, or reliance on air conditioning have at times provided short-term relief but intensified long-term environmental or social vulnerabilities. [1] were instrumental in advancing the maladaptation debate by proposing five key characteristics of maladaptive actions: they increase greenhouse gas emissions, disproportionately burden the most vulnerable, reduce incentives to adapt, have high opportunity costs, or set paths that limit future options. As aptly stated by [14], our main focus should be to achieve sustainable adaptation that embraces: 1) reducing risk using existing methods to ensure prosperity, 2) strengthening adaptive efforts by increasing the capacity of marginalized communities, and 3) addressing the causes of community vulnerability. The maladaptation lens was further refined in the 2010s, especially in Sub-Saharan Africa and other climate-vulnerable regions, where adaptation funding and practices were scrutinized for failing to deliver equitable outcomes [5] [15]. Scholars highlighted how power relations, institutional dynamics, and socio-political contexts can transform well-intended adaptations into maladaptive outcomes. Today, maladaptation is increasingly mainstreamed in climate risk assessments, adaptation planning, and policy evaluations, including the IPCC *Sixth Assessment Report* [16], which stresses that avoiding maladaptation requires inclusive, long-term, and flexible decision-making processes.

### 3. Review Methods

This paper used a narrative literature review to examine cases of climate change maladaptation in Sub-Saharan Africa (SSA). Relevant literature was identified through searches of major academic databases, including Google Scholar, Scopus, and Web of Science, and by consulting reports from the Intergovernmental Panel on Climate Change (IPCC) and other international organizations. The search focused on peer-reviewed journal articles, policy reports, and book chapters published primarily between 2000 and 2025. Key search terms included: “climate change maladaptation”, “failed adaptation”, “adaptation failure”, “transformative adaptation”, “vulnerability”, “political ecology”, “Sub-Saharan Africa”, “climate-smart agriculture”, “resettlement”, “irrigation”, “afforestation”, “water harvesting”, and “coastal adaptation”.

The inclusion criteria comprised studies that: i) examined climate change adaptation interventions in SSA; ii) documented unintended negative social, ecolog-

ical, or economic outcomes associated with adaptation actions; and iii) provided empirical evidence or detailed conceptual analysis relevant to maladaptation. Studies were excluded if they focused solely on mitigation, lacked clear evidence of maladaptive outcomes, or were outside the SSA context. Studies that addressed equity, governance, and vulnerability were also prioritized.

The case studies presented in this paper—drawn from Kenya, Ethiopia, Mozambique, Nigeria, and Senegal—were selected purposively to represent diverse forms of maladaptation across ecological, socio-political, and livelihood contexts in SSA. These cases collectively capture a broad spectrum of maladaptive outcomes, including resource conflict, exclusion, ecological degradation, displacement, and inequitable access to adaptation benefits. They are not intended to be exhaustive but rather illustrative examples that demonstrate recurring patterns and drivers of maladaptation within climate adaptation practice in the region.

#### **4. Theoretical Conceptualization of Climate Change Maladaptation**

In this section, we operationalize climate change maladaptation to refer to any deliberate or unintended action, policy, or strategy implemented to address the impacts of climate change that, in practice, increases vulnerability to climate risks, transfers risks to other systems or groups, or undermines long-term adaptation capacity, resilience, or sustainability. To understand theories of climate change maladaptation, we build on a multi-theoretical framework integrating Vulnerability Theory, Political Ecology, and the Maladaptation Lens. Together, these theories provide a robust foundation for analyzing why certain climate adaptation strategies fail or lead to unintended consequences in SSA. The vulnerability theory posits that the impacts of climate change are mediated not only by the biophysical hazards but also by the social, economic, and political conditions that shape people's ability to respond [17]. This theory speaks to this study by explaining how adaptation strategies may fail when they overlook the differentiated vulnerabilities of communities. For example, interventions that assume homogeneity may inadvertently increase risks for marginalized groups (e.g., women, pastoralists, or ethnic minorities).

On the other hand, the political ecology theory examines the relationships between political, economic, and social factors with environmental issues and changes [18]. It emphasizes power relations, resource access, and institutional dynamics. In this study, the theory reveals how adaptation decisions are shaped by unequal power relations, governance structures, and political interests. It explains how elites may capture the benefits of adaptation or how external interventions may undermine local institutions and knowledge systems. The maladaptation lens, introduced by [1], focuses specifically on identifying and understanding adaptation actions that inadvertently increase vulnerability, reinforce existing inequalities, or cause environmental harm. This lens directly informs the assessment of failed adaptation efforts in the paper. It helps to classify and evaluate adaptation

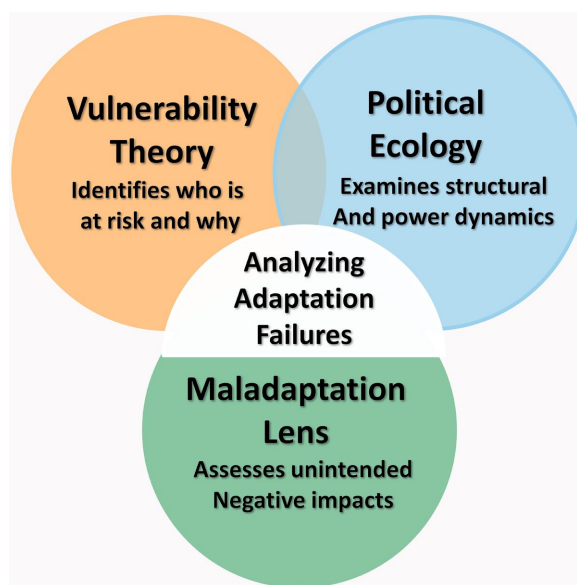
outcomes not just by intentions but by actual social and ecological effects. **Table 1** summarizes how these three theories are integrated in the present study and which cardinal questions they address.

**Table 1.** Interaction of the three theories in this study.

Theoretical lens	Role in the study	Questions it helps to answer
Vulnerability theory	Identifies who is at risk and why	How do adaptation projects affect different social groups?
Political ecology	Examines structural and power dynamics	Who benefits and who loses from adaptation decisions?
Maladaptation lens	Assesses unintended negative impacts	What forms of harm result from poorly designed adaptation?

Source: Processed from various literature sources, 2025.

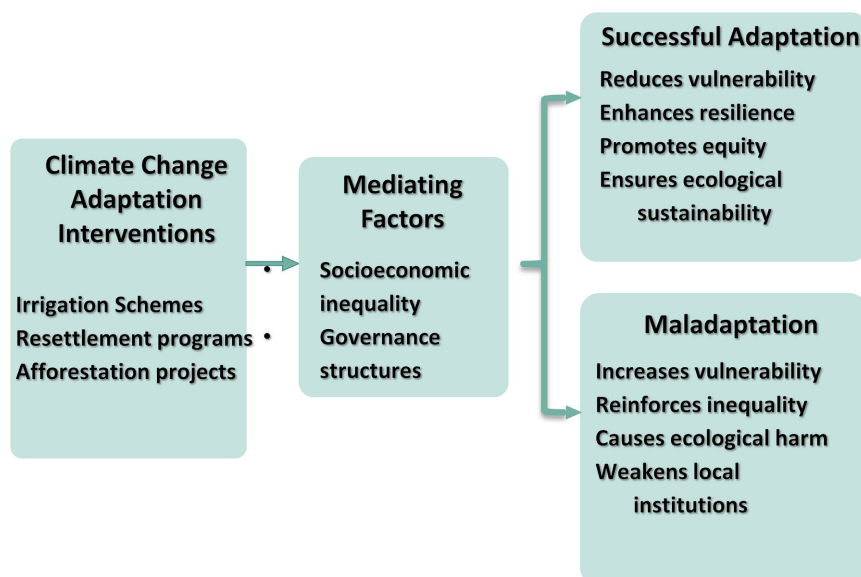
The integration of vulnerability theory, political ecology, and maladaptation analysis provides a critical and comprehensive lens for understanding why not every adaptation effort works (**Figure 1**). It enables the study to go beyond technical assessments and probe the social, political, and institutional underpinnings of adaptation failures in SSA.



**Figure 1.** Theoretical framework integrating three critical theories that speak to the study (Source: Author's conceptualization based on various literature sources, 2025).

## 5. Conceptual Framework

From the proposed theoretical framework (**Figure 1**), we can now conceptualize a framework illustrating how climate change adaptation interventions, when shaped by specific mediating factors, may result in either successful adaptation or maladaptation (**Figure 2**).



**Figure 2.** Conceptual framework showing the input, mediating, and output parameters in climate adaptation and maladaptation (Source: Author's conceptualization based on various literature sources, 2025).

This framework draws on the theoretical perspectives of vulnerability, political ecology, and maladaptation (Table 1) to explain the causal logic behind adaptation failure. The core components of the framework include:

#### A. Climate change adaptation interventions

These are planned or spontaneous responses to climate risks, including:

- Irrigation schemes
- Resettlement programs
- Afforestation projects
- Climate-smart agriculture

The above interventions are triggered by governments, NGOs, or communities to reduce vulnerability and increase resilience.

#### B. Mediating factors (Contextual conditions)

These determine the outcome of adaptation efforts. Key mediators include:

- Socioeconomic Inequality (e.g., class, gender, land tenure)
- Governance Structures (e.g., participation, transparency, decentralization)
- Cultural and Institutional Fit (e.g., respect for indigenous practices)
- Ecological Suitability (e.g., appropriateness to local ecosystems)
- Power Relations (e.g., elite capture, marginalization)

These factors influence how adaptation is designed, implemented, and received.

#### C. Outcomes of adaptation

Based on how the above mediating factors interact with the interventions, outcomes diverge:

- **Successful Adaptation**
  - Reduces vulnerability
  - Enhances resilience

- Promotes equity
- Ensures ecological sustainability
- **Maladaptation**
  - Increases vulnerability
  - Reinforces inequality
  - Causes ecological harm
  - Weakens local institutions

**Figure 2** shows the following:

- Input: Climate Change Adaptation Interventions
- Mediated by: Contextual/Mediating Factors
- Output: Two divergent pathways: *Successful Adaptation* or *Maladaptation*

In the ensuing subsections, we provide examples of maladaptation to climate change in SSA. At the outset, we appreciate that climate change maladaptation in SSA refers to adaptation interventions or strategies, whether by governments, communities, or development partners, that inadvertently increase vulnerability to climate change rather than reduce it. In this region, maladaptation arises primarily from limited adaptive capacity, weak institutions, poor policy coherence, and socio-economic inequalities that shape how climate responses are designed, implemented, and experienced. Many adaptation efforts in SSA are externally funded, technically driven, and often fail to incorporate local ecological knowledge, social contexts, and long-term sustainability considerations. For example, donor-promoted climate-smart agriculture (CSA) practices such as conservation tillage or high-input monoculture may impose additional labor or financial burdens on smallholder farmers, reduce agrobiodiversity, or lead to dependence on external inputs, thereby compromising resilience. Similarly, large-scale irrigation schemes meant to enhance water security can marginalize pastoralists and downstream users, creating new conflicts or exacerbating existing vulnerabilities. Maladaptation in the region is further shaped by intersecting vulnerabilities, such as gender, ethnicity, poverty, and land tenure insecurity, that determine differential access to resources and benefits from adaptation initiatives. Additionally, short-term political incentives, inadequate risk assessments, and a focus on technocratic fixes often overlook systemic and structural causes of vulnerability.

Thus, maladaptation in Sub-Saharan Africa is not merely a failure of individual projects but a symptom of deeper governance and development challenges. Addressing it requires inclusive, context-sensitive, and long-term approaches that center equity, flexibility, and local participation in climate adaptation planning and implementation. It is with this in mind that voices for transformative adaptation to climate change impacts are gaining traction, given the shifting pathway towards more equitable and climate-resilient development [19]-[21]. Transformative adaptation promises “transformation of broader aspects of development through adaptation activity” ([22], p. 6). This means that, alongside the goal of reducing climate risk, there is also a goal of simultaneously addressing issues of social justice and the root causes of risk [23] [24]. Capacity building efforts under

the United Nations Framework Convention on Climate Change (UNFCCC), however, often focus on incremental adaptation, with limited attention to power and justice [25]. We argue that the growing focus on transformative adaptation requires attention to new types of capacity building that rely on knowledge creation at the grassroots level as the first phase, and on the empowerment of community actors to meaningfully inform and implement adaptation responses as the second phase [26].

The cases analyzed in this paper were assessed using a common set of analytical criteria derived from vulnerability theory, political ecology, and the maladaptation framework. Specifically, the analysis evaluated whether adaptation interventions: i) increase vulnerability to climate risks; ii) reinforce social inequalities or exclusion; iii) generate ecological degradation or unsustainable resource use; iv) disrupt local livelihoods, institutions, or indigenous knowledge systems; v) prioritize short-term technocratic solutions over long-term resilience; and vi) exhibit governance deficits such as weak participation or elite capture. Applying these criteria consistently across cases enabled a more systematic comparison of maladaptive outcomes and helped identify recurring structural drivers of adaptation failure in Sub-Saharan Africa.

## 6. Evidence of Climate Change Maladaptation in SSA

### 6.1. Irrigation-Induced Conflict in Turkana, Kenya

Large-scale irrigation schemes in northern Kenya, such as the Turkwel Irrigation Scheme and parts of the LAPSET Corridor agricultural initiatives, serve as compelling examples of climate change maladaptation, given their unintended negative social, environmental, and economic consequences despite being framed as adaptive responses [27]. The maladaptive outcomes include:

**a) Water resource overexploitation:** These projects often extract water from already stressed rivers like the Turkwel and Kerio, reducing downstream flow and exacerbating water scarcity for pastoralist communities and ecosystems reliant on seasonal flows.

**b) Disruption of pastoralist livelihoods:** Large-scale irrigation frequently involves converting communal grazing lands into farmland, undermining the mobility-based pastoral systems, which are better suited to the region's climate variability. This displacement erodes traditional coping mechanisms and increases conflict over shrinking resources.

**c) Exacerbation of inequalities:** Benefits from these schemes often accrue to external investors or local elites, while marginalizing Indigenous communities, particularly women and poorer households who lack land titles or access to irrigated plots.

**d) Environmental degradation:** Intensive irrigation in arid zones accelerates land degradation, salinization, and biodiversity loss, thereby undermining long-term agricultural viability and ecosystem resilience.

While designed to enhance food security and climate resilience, these irrigation

schemes often undermine traditional adaptive capacities and increase vulnerability, making them prime cases of maladaptation. Any sustainable alternatives should prioritize inclusive, ecosystem-based approaches that respect local livelihoods and water limits.

## 6.2. Afforestation with Invasive Species in Ethiopia

Afforestation with invasive species in Ethiopia, particularly the widespread planting of *Eucalyptus* and *Prosopis juliflora*, is a widely cited example of climate change maladaptation, where interventions intended to mitigate or adapt to climate impacts have resulted in increased vulnerability and ecological harm [28]. The maladaptive dimensions include:

**a) Water Resource Depletion:** Species like *Eucalyptus globulus* have high water demands and deplete groundwater and soil moisture, worsening water scarcity in already dry regions [29] [30].

**b) Biodiversity Loss and Land Degradation:** Monoculture plantations reduce native biodiversity, displace indigenous vegetation, and degrade soil quality, undermining the ecological integrity of landscapes [31].

**c) Spread of Invasive Species:** *Prosopis juliflora*, introduced in Afar and Somali regions to combat desertification, has aggressively invaded rangelands and farmlands, reducing pasture availability and threatening food security [32] [33].

**d) Livelihood Disruption:** Invasion by *Prosopis* has significantly reduced access to grazing areas and water points for pastoralist communities, thereby increasing socio-economic vulnerability [34].

Although afforestation was intended to combat land degradation and sequester carbon, the use of inappropriate species has degraded ecosystems, undermined pastoralist livelihoods, and exacerbated vulnerability to climate variability—key markers of maladaptation.

## 6.3. Planned Resettlement in Zambezi Valley, Mozambique

The planned resettlement in the Zambezi valley in Mozambique, particularly following recurrent flooding events such as those in 2000, 2007, and 2013, is widely regarded as a testament to maladaptation to climate change, in which measures intended to reduce vulnerability to climate impacts have, paradoxically, increased long-term risks and social insecurity [35]. The maladaptive dimensions include:

**a) Inappropriate site selection:** Resettlement sites were often located in remote, ecologically fragile, or agriculturally unproductive areas with poor soil quality and limited access to water, markets, or services, undermining the livelihoods of displaced communities [36] [37].

**b) Livelihood disruption:** Many resettled populations, originally reliant on floodplain farming and fishing, lost access to fertile land and riverine ecosystems. The new sites did not support equivalent income-generating activities, leading to deepened poverty [38].

**c) Erosion of social capital:** Forced relocations often fragmented kinship net-

works and traditional governance structures, weakening community resilience and adaptive capacity [39].

**d) Increased vulnerability:** In some cases, new settlements were ironically more exposed to drought or poor infrastructure, while failing to offer sufficient support systems, making people more vulnerable than before [35].

While intended as a protective adaptation to climate-induced flooding, planned resettlement in the Zambezi Valley has often led to new socio-economic vulnerabilities, environmental stresses, and dependency, clear indicators of maladaptation. It illustrates the critical need for participatory, locally grounded, and livelihood-sensitive relocation planning in climate adaptation strategies.

#### 6.4. Exclusion in Climate-Smart Agriculture in Nigeria

The exclusion of smallholder farmers, women, and indigenous communities from climate-smart agriculture (CSA) initiatives in Nigeria, particularly the marginalization of these groups, provides a clear example of climate change maladaptation, in which adaptation measures inadvertently exacerbate social inequalities and vulnerability rather than reducing them [40]. The maladaptive dimensions include:

**a) Elite capture and unequal access:** CSA projects in Nigeria, often supported by international donors and government agencies, have tended to favor large-scale, well-connected farmers who can meet program requirements (e.g., access to credit, land titles, or inputs). This excludes resource-poor smallholders—the majority of Nigeria’s rural population—thus reinforcing existing inequalities [41] [42].

**b) Gender exclusion:** Many CSA interventions overlook the specific constraints faced by women—such as limited land ownership, decision-making power, or extension access—thereby marginalizing female farmers who are crucial to local food systems [43].

**c) Disruption of traditional knowledge systems:** By promoting top-down technological fixes (e.g., hybrid seeds, precision farming, or carbon credit schemes), CSA projects often sideline traditional agroecological practices and local adaptation strategies that have been effective in managing climate risks [44].

**d) Reduced adaptive capacity:** The lack of meaningful participation and ownership among marginalized groups reduces the sustainability of CSA initiatives. Without social inclusion, farmers are less likely to adopt, adapt, or benefit from the interventions, limiting long-term resilience and even increasing dependence or land tenure insecurity [45].

While CSA in Nigeria aims to improve resilience, productivity, and emissions reduction, its exclusionary implementation has often worsened vulnerability, deepened inequality, and weakened local adaptive capacity, which are signs of maladaptation. Effective CSA must be inclusive, participatory, and sensitive to the context to prevent doing more harm than good.

#### 6.5. Coastal Defense and Displacement in Dakar, Senegal

The implementation of coastal defense infrastructure and displacement policies

in Dakar, Senegal, particularly in vulnerable neighborhoods such as Guet Ndar and Yoff, illustrates a notable case of climate change maladaptation, in which responses to coastal erosion and sea-level rise have deepened socioeconomic vulnerabilities and created new risks [46]-[48]. The particular maladaptive characteristics include:

**a) Technocratic and Top-down Planning:** Coastal protection efforts, such as sea walls, groynes, and embankments, were designed with minimal community involvement. These hard-engineering approaches often ignored local ecological dynamics and social contexts, resulting in erosion being redirected to neighboring communities and increasing risks elsewhere [47] [48].

**b) Forced Displacement of Coastal Communities:** In areas like Saint-Louis (near Dakar) and the Lébou fishing communities, planned relocations were undertaken to move residents away from high-risk zones. However, resettlement sites often lacked adequate infrastructure, economic opportunities, and cultural continuity, leading to loss of livelihoods, social fragmentation, and increased poverty [48] [49].

**c) Undermining of Traditional Livelihoods:** Coastal defenses have disrupted fish landing zones and altered sediment flows, severely affecting artisanal fisheries, a primary livelihood source for many urban poor in coastal Senegal. This has undermined long-term resilience and heightened food insecurity [50].

**d) Ecological Consequences:** Rigid infrastructure has interfered with natural coastal processes, such as beach replenishment and wetland dynamics, leading to ecosystem degradation, which in turn reduces the buffering capacity of coastlines [47].

While intended to reduce climate risks from coastal erosion and sea-level rise, Dakar's hard-infrastructure defenses and relocation efforts have, in many cases, increased socio-economic vulnerability, ecological fragility, and spatial inequality, which are key indicators of maladaptation. Future responses must adopt nature-based solutions, participatory planning, and social justice relocation policies to ensure adaptive success.

## 6.6. Water Harvesting and Equity in Tigray, Ethiopia

Water harvesting interventions in Tigray, Ethiopia, particularly the widespread construction of household ponds, micro-dams, and check dams as part of climate change adaptation and land restoration efforts, have turned out to be the best examples of climate change maladaptation, where well-intended solutions unintentionally increased vulnerability, inequity, and environmental degradation [15]. The salient features of maladaptation include:

**a) Inequitable Access and Benefit Distribution:** Water harvesting infrastructure, though intended for widespread benefit, was disproportionately accessed by wealthier households with more land, labor, and financial capacity to construct and maintain the ponds. Poor and landless farmers were often excluded or burdened with communal labor obligations without receiving direct benefits [51] [52].

**b) Environmental Side Effects:** Many poorly designed or unlined ponds led to water seepage, soil salinization, and even land degradation. In some cases, over-harvesting surface runoff also disrupted downstream ecosystems and water availability, undermining broader landscape resilience [53] [54].

**c) Health Risks and Maintenance Burden:** Stagnant water in ponds created breeding grounds for mosquitoes and waterborne diseases. Additionally, the burden of maintaining silted or drying-up structures often fell on communities without adequate technical or financial support [55].

**d) Disruption of Traditional Water-Sharing Norms:** The focus on individual or household-based infrastructure undermined customary communal water management systems, weakening social cohesion and creating conflict over water access during drought periods [56].

Although designed to improve water security and climate resilience, water harvesting practices in Tigray have, in many cases, increased inequality, degraded ecosystems, and overburdened marginalized households, thus exemplifying maladaptation. Sustainable and equitable adaptation requires inclusive planning, appropriate technologies, and recognition of social dynamics.

Taken together, the reviewed cases reveal several recurring drivers of maladaptation across Sub-Saharan Africa, despite differences in ecological settings and intervention types. The most consistent mechanisms include top-down planning approaches, inadequate participation by affected communities, insufficient consideration of local socio-cultural and livelihood systems, and unequal distribution of adaptation benefits. Across nearly all cases, adaptation interventions disproportionately disadvantaged already vulnerable groups, such as pastoralists, women, smallholder farmers, artisanal fishers, and poorer households, thereby reinforcing existing social inequalities. Similarly, technocratic and externally driven adaptation models frequently overlooked long-term ecological sustainability, leading to environmental degradation, resource depletion, or the disruption of customary institutions and indigenous knowledge systems. At the same time, some maladaptive mechanisms were more specific to particular intervention types. Large-scale irrigation and water-harvesting projects were particularly associated with water inequities, downstream resource conflicts, and hydrological disruption, while afforestation initiatives primarily led to biodiversity loss and invasive species problems. Resettlement and coastal defense interventions were more strongly linked to displacement, social fragmentation, and livelihood disruption, whereas climate-smart agriculture initiatives highlighted issues of elite capture, exclusion from resource access, and the marginalization of local knowledge. Collectively, these patterns suggest that maladaptation in SSA is driven not only by technical shortcomings but also by broader governance, equity, and development challenges that shape how adaptation interventions are designed and implemented.

## 7. Limitations of the Study

This paper is based entirely on published secondary literature and selected illustra-

tive case studies, and therefore has several limitations. First, the analysis depends on the availability, quality, and interpretation of existing studies, which may vary across countries and sectors within Sub-Saharan Africa. Second, the cases are purposively selected to illustrate different forms of maladaptation and are not intended to represent the full range or frequency of maladaptive outcomes across the region. Consequently, the paper does not establish how widespread or prevalent each form of maladaptation is in Sub-Saharan Africa. Third, because the study relies on literature-based case analysis rather than primary empirical research, it cannot directly assess local perceptions, long-term outcomes, or the evolving dynamics of adaptation interventions on the ground. Despite these limitations, the selected cases provide valuable insights into recurring mechanisms and structural drivers of maladaptation, informing future research, policy, and adaptation practice.

## 8. Conclusions

This paper has demonstrated that not all climate change adaptation efforts in Sub-Saharan Africa yield positive outcomes. Through a critical examination of empirical cases from Kenya, Ethiopia, Mozambique, Nigeria, and Senegal, the study has shown how well-intended adaptation initiatives can inadvertently reinforce existing vulnerabilities, deepen social inequalities, and cause environmental harm—hallmarks of maladaptation. By employing an integrated theoretical lens combining vulnerability theory, political ecology, and the maladaptation framework, the study has unpacked how contextual factors such as power asymmetries, institutional weaknesses, socio-cultural disconnects, and ecological unsuitability mediate adaptation outcomes.

The findings underscore that maladaptation in SSA consistently emerges where adaptation interventions combine ecological unsustainability, social exclusion, weak participation, and short-term technocratic planning. Adaptation interventions that ignore local realities, exclude marginalized voices, or pursue short-term fixes are likely to produce unintended negative consequences. Conversely, sustainable adaptation requires inclusive, participatory, and justice-centered approaches that are rooted in local knowledge, responsive to differential vulnerabilities, and adaptive over time [57].

Moving forward, policy and practice must shift from purely technocratic or donor-driven models toward transformative adaptation frameworks that address structural inequalities and embed climate resilience within broader development agendas. Strengthening institutional capacity, enhancing social learning, and promoting co-production of knowledge with communities are essential for avoiding maladaptation. Ultimately, adaptation must not only reduce climate risks but also contribute to more equitable, inclusive, and sustainable futures across Sub-Saharan Africa.

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### Author Contributions

C.A.S. conceptualized, prepared the original draft; and reviewed and edited the final draft; T.E.M. and C.W.R. reviewed and edited the draft. All authors have read and agreed to the submitted version of the manuscript.

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### Data Availability

This study is based entirely on analysis and synthesis of published literature and secondary sources. No primary datasets were generated or analyzed during the current study. All sources used are cited in the reference list.

### Consent for Publication

This is original work that has not been submitted anywhere for publication

### Ethics Approval and Consent to Participate

Not applicable.

### Conflicts of Interest

The authors declare no competing interests.

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