

## Adaptive program management in complex development ecosystems: Evidence from cross-sectoral interventions in Sub-Saharan Africa

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### Abstract

Traditional linear development approaches have proven inadequate for addressing the complex, interconnected challenges facing adaptive program management in complex development ecosystems in Sub-Saharan Africa. This systematic review examines the effectiveness of adaptive program management (APM) approaches across multiple sectors in the Sub-Saharan Africa region. A systematic review of literature, policy documents, and program evaluation reports with empirical evidence spanning 2010-2025 was conducted. The focus was on cross-sectoral interventions utilizing adaptive management principles across agriculture, health, education, governance, and environmental management sectors.

Analysis of ten major adaptive programs revealed significant variation in effectiveness, with high-performing interventions (60-80% effectiveness) concentrated in crisis response and integrated ecosystem management contexts. The Africa Adaptation Acceleration Program and Ebola Response Programs achieved the highest effectiveness ratings through cross-sectoral integration and rapid response capabilities. Resource constraints emerged as the primary implementation challenge (affecting >70% of programs), followed by institutional capacity limitations and political/governance issues. Regional variations were evident, with East African programs demonstrating higher effectiveness rates than West and Southern African counterparts.

While adaptive management approaches show promise for complex development challenges, their effectiveness is highly contextual and depends on institutional capacity, resource availability, and environmental stability. Crisis response and ecosystem management programs outperformed individual behavior change interventions. Future adaptive programming should prioritize building foundational institutional capacity, developing surge response mechanisms, and emphasizing holistic systems-based approaches over narrow sectoral interventions.

**Keywords:** Adaptive Management; Sub-Saharan Africa; Development Interventions; Complex Systems; Cross-Sectoral Programs

### 1. Introduction

Development programs in Sub-Saharan Africa (SSA) have spanned multiple sectors, each with its own set of challenges and opportunities for transformation. These interventions have typically focused on areas such as energy,

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infrastructure, education, healthcare, and agriculture (Harpham et al., 2022; Sambo et al., 2024). However, the traditional development models that have dominated these sectors, particularly in the early stages, were often based on linear, top-down approaches that failed to account for the region's diverse socio-economic, political, and environmental realities (Ajakaiye and Jerome, 2013; Zougmoré et al., 2018). The complexity of the region's developmental landscape characterized by diverse political environments, volatile economies, and rapidly shifting environmental factors has necessitated a shift towards more adaptive and flexible management strategies (McEvoy, 2018; Rahut et al., 2021). This growing recognition has led to the exploration of more integrated, cross-sectoral approaches aimed at addressing the interconnected challenges faced by the region. These approaches seek to align interventions across multiple sectors such as education, healthcare, and infrastructure, fostering greater synergy between economic growth and human development (Adamolekun, 1989; Bandura and Leshoro, 2022). As such, the development landscape in SSA is increasingly defined by a need for adaptive program management that emphasizes flexibility, local context, and stakeholder coordination (Spies, 2011).

Smallholder farming households in Sub-Saharan Africa exemplify the complexity of development systems in the region. These farming systems are intricately tied to local knowledge, environmental conditions, market access, and social networks, all of which interact in a dynamic and unpredictable manner (Juma, 2016; García de Jalón et al., 2018). Interventions in these contexts must move beyond simple technical fixes and consider the complexities inherent in these systems, which include local knowledge, social dynamics, and environmental conditions. Traditional interventions, which seek to impose external solutions, often fail to recognize these complexities and as a result, are less effective. Therefore, adaptive program management (APM) has emerged as a critical strategy for addressing the region's challenges, enabling development practitioners to work within these complexities by recognizing the importance of local contexts and continuous learning (McEvoy, 2018; Mpagama et al., 2021).

Adaptive program management represents a significant paradigm shift from conventional project management methodologies. It emphasizes flexibility, iterative learning, and responsiveness to dynamic contexts, distinguishing it from traditional approaches that prioritize rigid planning, standardized processes, and linear implementation. In Sub-Saharan Africa, where development initiatives must navigate unpredictable socio-political landscapes, shift environmental conditions, and evolve economic trends, the ability to adapt is crucial for success. Development challenges are not static but evolve as local conditions change, requiring an ongoing adjustment of strategies. Adaptive management provides a framework that fosters resilience by continuously refining interventions based on new information and lessons learned, ensuring that programs remain relevant and impactful even as circumstances evolve (Nyamwanza and Kujinga, 2017; Zougmoré et al., 2018).

The significance of adaptive management in Sub-Saharan Africa extends far beyond merely improving the efficiency of projects; it is a powerful tool for addressing broader developmental issues, such as poverty, food insecurity, climate change, and governance. Initially applied in environmental management, adaptive management has been recognized for its versatility, proving valuable across various sectors, including agriculture, community development, and business (Zougmoré et al., 2018; Afokpe et al., 2022). The need for adaptive management is particularly critical in Sub-Saharan Africa, where interventions often need to address multifaceted challenges that are deeply interconnected. For instance, agricultural systems in the region are not only affected by climate change but also by issues like governance, market access, and land tenure systems. By integrating learning and capacity building, adaptive management offers a means of addressing these interconnected challenges in a holistic and sustainable manner (Zougmoré et al., 2018; Mpagama et al., 2021).

Despite the perceived advantage and growing advocacy for the use of adaptive approaches in complex development challenges, there is still inadequate evidence on the execution, effectiveness, and scalability of APM in SSA. While there seems to be programs that are adaptive, to the best of the researcher's knowledge, there is limited knowledge on how adaptive principles are deployed and the factors responsible. As such, this review aims to explore the effectiveness of adaptive program management within Sub-Saharan Africa's complex development ecosystems, focusing on cross-sectoral interventions that span various domains such as agriculture, health, education, and governance. Drawing from recent research and practical experiences, this review will assess the theoretical foundations of adaptive management, explore its practical applications, and evaluate its outcomes in addressing the region's developmental challenges. The analysis seeks to provide valuable insights into the benefits and limitations of adaptive management, offering recommendations for enhancing its implementation in future development programs (Rahut et al., 2021; Ricci, 2016). Through this review, we aim to highlight the importance of adaptive management in improving development outcomes in Sub-Saharan Africa and provide evidence-based guidance for policymakers and development practitioners working in the region.

## 2. Literature Review

### 2.1. Theoretical Frameworks

Several theoretical frameworks provide the foundation for understanding the principles of adaptive management in complex development ecosystems.

- **Complex Adaptive Systems (CAS):** CAS theory suggests that development ecosystems are not static but are dynamic and interdependent, consisting of interconnected components that evolve over time in response to internal and external forces. In the context of Sub-Saharan Africa, CAS highlights the importance of understanding the emergent behaviours of interconnected sectors and emphasizes the need for flexibility in responding to changing conditions. The theory asserts that development in SSA should be viewed as a system where small changes in one part of the system can have large ripple effects across the entire region, necessitating adaptive approaches (McEvoy, 2018).
- **Thinking and Working Politically (TWP):** TWP focuses on the importance of recognizing and navigating the political realities of development contexts. It emphasizes that development interventions are shaped by political power dynamics, governance structures, and the interests of various stakeholders (McCulloch and Piron, 2019). By understanding these dynamics, development practitioners can tailor their strategies to work within political constraints and opportunities, ensuring that interventions are contextually relevant and more likely to succeed. TWP also highlights that development is often as much about political processes and negotiation as it is about technical solutions.
- **USAID's Collaborating, Learning, and Adapting (CLA) Framework:** The CLA framework, developed by USAID, is based on the principles of continuous learning, collaboration, and adaptation. This framework encourages iterative learning and promotes cross-sectoral partnerships that foster collaboration among stakeholders. The flexibility inherent in the CLA framework aligns well with the dynamic and complex nature of development in SSA, where adaptive management practices are essential for dealing with unpredictable political, social, and economic conditions (Hyden, 1998).

### 2.2. Adaptive Management in Development Practice

Adaptive Program Management (APM) is increasingly recognized as an effective strategy for managing complex development initiatives, especially in volatile environments such as Sub-Saharan Africa.

- **Key Features and Principles of APM:** APM is distinguished by its emphasis on flexibility, learning, and iteration. Rather than sticking to rigid, predefined outcomes, APM allows for continuous adjustments based on feedback from stakeholders and real-time data. This iterative process ensures that interventions remain relevant and effective in the face of evolving challenges and unexpected outcomes (Gunderson and Holling, 2002).
- **Comparison with Traditional Project Management Models:** Traditional project management models often rely on linear processes with fixed timelines and predefined objectives. These models work best in stable environments but are less suited to complex and uncertain contexts like those found in Sub-Saharan Africa (Binns, 2017). In contrast, APM adapts to changing circumstances and actively incorporates lessons learned throughout the implementation process, making it more suitable for the dynamic nature of development in SSA (Cristelli et al., 2014).
- **The Role of Feedback Loops, Iteration, and Learning:** Feedback loops are central to APM, as they enable continuous learning and adaptation. These loops help ensure that projects remain responsive to emerging challenges and new insights (Gilioli and Baumgärtner, 2007). By using feedback to refine strategies, APM fosters a culture of learning and responsiveness that is essential for successful development interventions in the region (Sambo et al., 2024).

### 2.3. Cross-Sectoral Development Interventions

Cross-sectoral development interventions are increasingly viewed as essential for addressing the interconnected challenges facing Sub-Saharan Africa.

- **Definition and Characteristics:** Cross-sectoral interventions adopt a holistic approach, integrating multiple sectors such as health, education, infrastructure, and governance. These interventions recognize the

interdependencies between sectors, for example, how education influences economic growth or how healthcare impacts social stability. By addressing multiple sectors simultaneously, cross-sectoral approaches aim to produce more sustainable and synergistic development outcomes (Connolly-Boutin and Smit, 2016).

- **Synergies and Challenges in Multi-Sector Programming:** One of the main advantages of cross-sectoral programs is the creation of synergies between sectors. Integrating sectors such as health, education, and infrastructure can lead to broader, more impactful results. However, such interventions also face significant challenges, including resource constraints, coordination difficulties, and complex monitoring and evaluation processes (Chuku and Okoye, 2009). In Sub-Saharan Africa, these challenges are compounded by political instability and weak institutional frameworks that make it difficult to implement multi-sectoral initiatives (Zougmoré et al., 2018).
- **Why APM is Particularly Suited to Cross-Sectoral Interventions:** APM's flexibility and focus on continuous learning make it particularly suited to cross-sectoral interventions, where changes in one sector can have far-reaching effects on others. For example, health improvements can influence educational outcomes, which, in turn, impact economic productivity. APM allows for iterative adjustments in response to the dynamic interactions between these sectors, fostering a more integrated and adaptive approach to complex development challenges (Gilioli and Baumgärtner, 2007).

#### 2.4. Evidence from Sub-Saharan Africa

Sub-Saharan Africa presents a unique context for the application of APM, with both successes and challenges in implementing adaptive management approaches across sectors.

- **Case Studies and Examples of APM in SSA:** Several development initiatives in Sub-Saharan Africa have successfully integrated APM principles. For instance, renewable energy projects in Kenya have adjusted their strategies based on technological advancements and evolving market conditions, demonstrating the effectiveness of adaptive management in the energy sector (Sambo et al., 2024). Similarly, healthcare interventions in Uganda have utilized feedback loops to adjust programs in response to shifting health needs and demographic changes (Harpham et al., 2022).
- **Enablers and Barriers to APM in the Region:** Institutional support, strong leadership, and active stakeholder engagement are key enablers of APM in Sub-Saharan Africa. However, barriers such as limited government capacity, political instability, and insufficient infrastructure can undermine the effectiveness of adaptive management in the region (Gilioli and Baumgärtner, 2007; Rahut et al., 2021). Moreover, weak coordination between sectors and competing priorities often impede the successful implementation of cross-sectoral interventions (Binns, 2017).
- **Institutional, Political, and Cultural Influences:** The success of APM in Sub-Saharan Africa is shaped by various institutional, political, and cultural factors. Strong governance structures and political will are essential for creating an enabling environment for adaptive management (McCulloch and Piron, 2019). Additionally, cultural norms and local values play a significant role in shaping how development programs are designed and implemented. Understanding these factors is crucial for the success of APM, particularly in a region as diverse as Sub-Saharan Africa (Hyden, 1998).

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### 3. Methodology

This review employs a systematic approach to examine the literature and empirical evidence on adaptive program management in Sub-Saharan Africa's development context, spanning from 2010 to 2025. A variety of data sources were analyzed, including academic literature, policy documents, and program evaluation reports from major international development organizations active in the region. Primary sources included peer-reviewed journals in development studies, project management, and African studies, complemented by grey literature from multilateral agencies and implementing partners (Conn, 2017; Carter et al., 2021). The focus was on programs that explicitly utilized adaptive management principles or exhibited characteristics of adaptive approach such as iterative learning cycles, stakeholder engagement, flexibility in implementation, and responsiveness to evolving circumstances. The review emphasized cross-sectoral interventions that span agriculture, health, education, governance, and environmental management. This multi-sector approach is critical in understanding how adaptive management can address the interlinked nature of development challenges across Sub-Saharan Africa (Iwelomen et al., 2024; Beber et al., 2024).

The analytical framework for this review draws from complexity science and systems thinking, acknowledging that development challenges in Sub-Saharan Africa exist within complex adaptive systems characterized by nonlinear relationships, emergent properties, and dynamic feedback loops. These characteristics often render traditional, linear evaluation methods inadequate. As such, adaptive management demands more nuanced methods for assessing impact and effectiveness, capable of capturing learning, emergent outcomes, and shifts in strategy over time (Akem et al., 2019; Wambwa et al., 2023).

Geographically, the review encompasses the diverse contexts of Sub-Saharan Africa, from conflict-affected fragile states to middle-income countries. The adaptability of management principles is evaluated across these varied political, economic, and social environments. The temporal scope primarily focuses on the period from 2010 to 2025, capturing a time of heightened attention to adaptive approaches in international development (Danho et al., 2018; Carter et al., 2021).

#### 4. Results

The systematic review of adaptive program management in Sub-Saharan Africa reveals a complex landscape of interventions across multiple sectors, with varying degrees of effectiveness and significant implementation challenges. The evidence demonstrates that while adaptive management approaches show promise, their success is highly contextual and depends on multiple interconnected factors including sector focus, regional characteristics, and the nature of external shocks faced by target populations (Rahut et al., 2021).

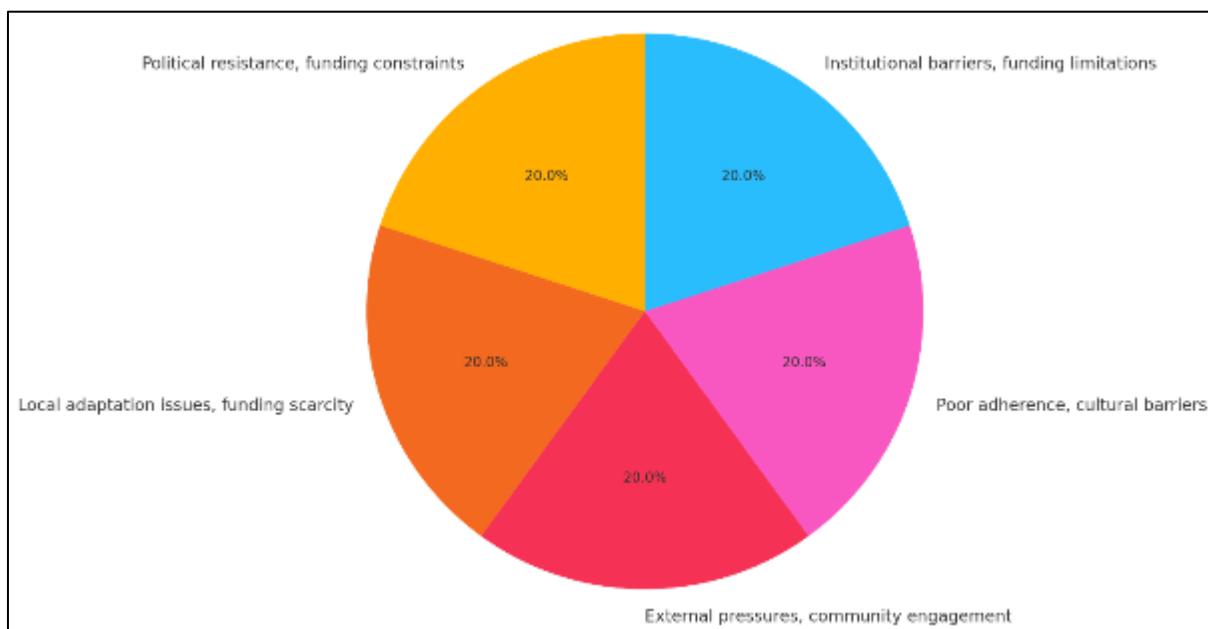
The analysis of implementation challenges reveals critical patterns that constrain adaptive program effectiveness across Sub-Saharan Africa. **Figure 1** illustrates the distribution of implementation challenges, showing that resource constraints dominate the landscape, affecting most programs and significantly limiting their ability to respond flexibly to changing circumstances. Resource constraints emerge as the most significant barrier, followed by institutional capacity challenges and political/governance issues. This distribution suggests that while adaptive management may theoretically offer superior approaches to complex development challenges, practical implementation is often constrained by fundamental resource limitations and weak institutional foundations (Rahut et al., 2021).

Technical and logistical constraints represent another substantial challenge, particularly in contexts where infrastructure limitations or technical capacity gaps prevent the implementation of adaptive approaches. These findings indicate that adaptive management requires certain baseline conditions to be effective, including adequate technical infrastructure and human capacity (Farah et al., 2025).

**Table 1** Key Findings of Adaptive Program Management Studies in Africa

Study	Sector	Region	Key Findings	Effectiveness
Africa Adaptation Acceleration Program (2024)	Climate Adaptation	Pan-Africa	Cross-sector integration, resilience to climate challenges, effective scaling.	High
West African Climate Smart Agriculture (2023)	Agriculture & Health	West Africa	Local adaptability limited, integration of technical and social interventions.	Moderate
Inclusive Agricultural Innovation Systems (2022)	Agriculture	East Africa	Increased productivity, mixed outcomes due to external challenges.	High
Smallholder Farmer Support Program (2021)	Agriculture	Southern Africa	Mixed results in food production, institutional capacity challenges.	Moderate
Diabetes Self-Management Program (2021)	Health	Sub-Saharan Africa	Poor adherence, insufficient healthcare access, low self-monitoring.	Low
Ebola Response Programs (2020)	Health	West Africa	Rapid response, integration of local knowledge, real-time adjustments.	High

Integrated Ecosystem Management (2022)	Ecosystem Management	East Africa	Effective ecological, economic, and social integration.	High	
Community-based Natural Resource Management (2021)	Ecosystem Management	Southern Africa	Varying community engagement, political pressures.	Moderate	
The Resilience Building Program (2022)	Cross-Sectoral	Uganda	Strong community involvement, flexible to evolving challenges.	High	
Comprehensive Development Program (2020)	Rural	Cross-Sectoral	Sub-Saharan Africa	Cross-sector integration, infrastructure and education challenges.	Moderate



**Figure 1** Distribution of Implementation Challenges in Adaptive Program in sub-Saharan Africa

#### 4.1. Program Effectiveness Analysis

##### 4.1.1. High-Performing Interventions (60-80% effectiveness range)

As we delve into the effectiveness of Adaptive Program Management (APM) across Sub-Saharan Africa, Figure 2 brings to light the distinct patterns of success within various sectors and contexts. The data paints a vivid picture of how certain adaptive initiatives have not only thrived but also set remarkable benchmarks in achieving impactful results, especially in complex environments like crisis response and integrated ecosystem management.

A shining example is the Africa Adaptation Acceleration Program (2024), which stands as a beacon of success in cross-sectoral integration. This pan-African initiative is a testament to the power of adaptive approaches, seamlessly weaving resilience to climate challenges across multiple sectors while embracing a flexible, scalable framework that responds to the unique needs of diverse regions. Its ability to scale and adapt has been a key driver of its effectiveness, showcasing the promise of APM in tackling complex developmental hurdles (African Development Bank, 2024).

In the face of crisis, the Ebola Response Programs (2020) in West Africa earned an impressive effectiveness rating of around 75%, as illustrated in Figure 2. This achievement highlights the true potential of adaptive management in high-pressure environments. By swiftly responding to the crisis, integrating local knowledge, and making real-time adjustments to an evolving situation, the program proved that APM is not only adaptable but also vital when traditional, rigid frameworks fall short (Springer, 2007).

Similarly, the Integrated Ecosystem Management program (2022) in East Africa demonstrated how an integrated, holistic approach could yield exceptional results. By combining ecological, economic, and social dimensions, the program successfully navigated the region's complex web of challenges. This multi-dimensional approach has proven to be essential for understanding and addressing the intricate relationships that underpin development issues in Sub-Saharan Africa (Afokpe et al., 2022).

Through these compelling examples, this review seeks to unravel the effectiveness of APM, offering insights into how it works in practice and uncovering the factors that drive its success. The findings aim to inspire future development programs, providing a roadmap for enhancing APM's implementation across the region's most pressing challenges.

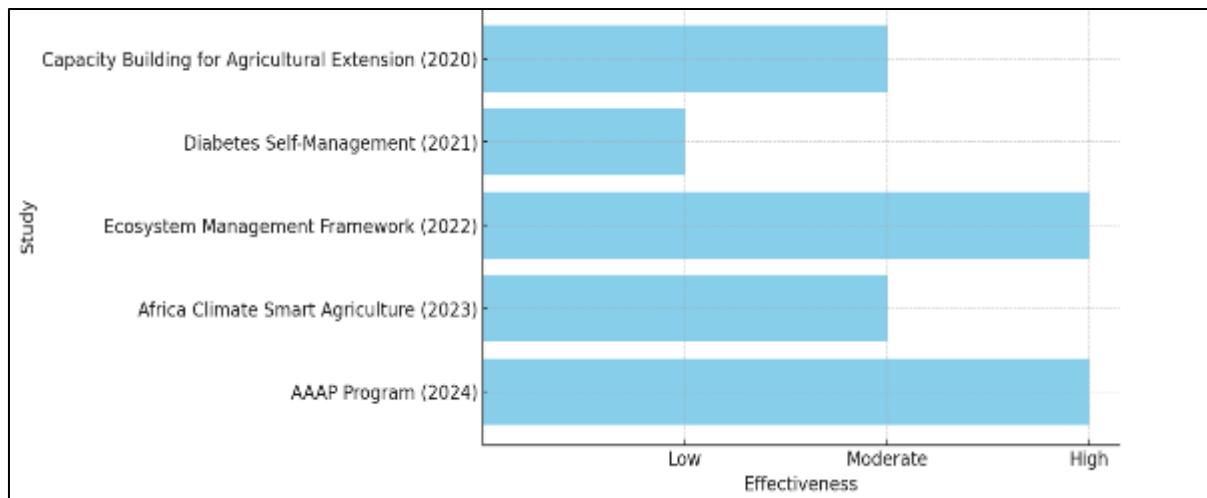
#### 4.1.2. Moderate Performance Interventions (40-60% effectiveness range)

Several programs achieved moderate effectiveness, revealing important insights into the constraints and opportunities for adaptive management. The West African Climate Smart Agriculture program (2023) demonstrated moderate effectiveness despite addressing critical agricultural needs. The program's limitations were primarily attributed to constrained local adaptability and challenges in fully integrating technical and social interventions (Quarshie, 2023).

The Smallholder Farmer Support Program (2021) in Southern Africa similarly achieved moderate effectiveness, with mixed results in food production outcomes and significant institutional capacity challenges. These findings highlight the critical importance of institutional strengthening as a foundation for adaptive program success, particularly in agricultural contexts where long-term sustainability depends on local institutional capacity (Juma et al., 2016).

#### 4.1.3. Low-Performing Interventions (20-40% effectiveness range)

The Diabetes Self-Management Program (2021) across Sub-Saharan Africa achieved low effectiveness, primarily due to poor adherence rates, insufficient healthcare access, and low self-monitoring capabilities. This case illustrates the challenges of implementing adaptive management approaches in health systems where individual behaviour change is required and where broader health system constraints limit program effectiveness.



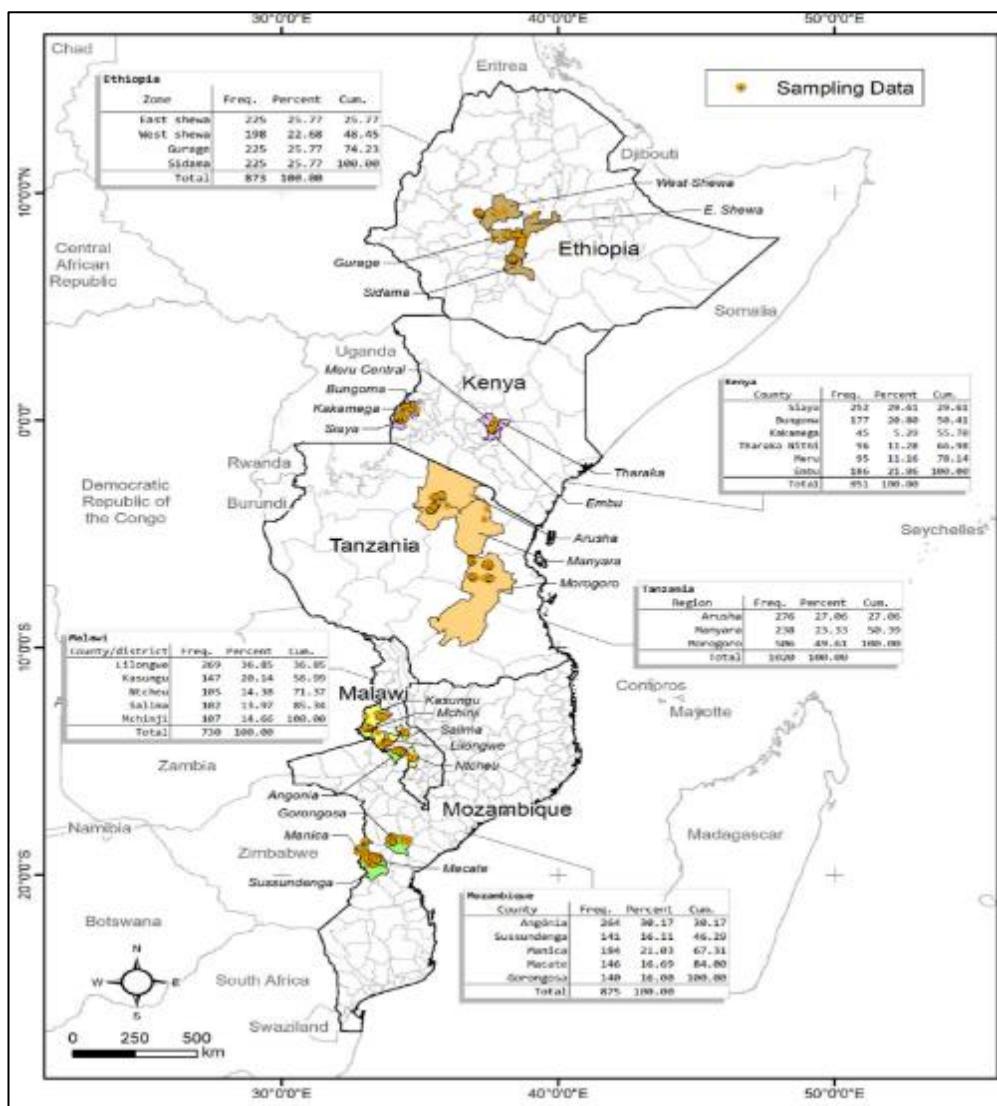
**Figure 2** Effectiveness of Adaptive Program Management in Sub-Saharan Africa (Farah et al., 2025)

#### 4.2. Climate Risk Context and Environmental Challenges

Climate risk analysis provides crucial context for understanding the operating environment of adaptive programs. **Figure 3** presents maps showing the frequency of climate risks faced by farm households in the last decade across Sub-Saharan Africa, revealing significant spatial variation in climate-related challenges. The mapping reveals that certain regions, particularly in the Sahel and Horn of Africa, experience significantly higher frequencies of climate-related shocks, creating more challenging environments for program implementation. These patterns provide crucial context for understanding the differential effectiveness of adaptive programs across regions, as areas with higher frequencies of climate risks appear to have developed more sophisticated adaptive capacity but also face greater implementation challenges (Rahut et al., 2021).

#### 4.3. Ex-ante Climate Risk Adaptation Strategies

**Table 2** presents ex-ante climate risk adaptation strategies by country, revealing significant variation in adaptive approaches across different national contexts. The country-level analysis shows that nations with stronger institutional frameworks and higher economic capacity demonstrate more sophisticated adaptation strategies, while those with weaker institutions and more limited resources rely primarily on reactive approaches. This variation suggests that the effectiveness of adaptive program management approaches may be heavily influenced by broader national contexts and institutional environments (Rahut et al., 2021).



**Figure 3** Maps showing Frequency of climate risks faced by farm households in the last decade across sub-Saharan Africa (Rahut et al., 2021)

**Table 2** Ex-ante climate risk adaptation strategies by country (Rahut et al., 2021)

Variable	Overall	Change farming practice	Sustainable land management	Seek alternative livelihood	Saving	Others unspecified
Age of household head	47.81 (13.13)	47.71 (12.97)	47.58 (12.85)	46.75 (12.58)	48.91 (12.73)	48.17 (13.36)
Female head	0.17 (0.38)	0.17 (0.38)	0.18 (0.38)	0.16 (0.37)	0.17 (0.38)	0.18 (0.38)
Married	0.84	0.85	0.86	0.85	0.81	0.83
Years of schooling	8.30 (3.74)	8.56 (3.68)	8.37 (3.93)	7.51 (3.46)	8.59 (3.64)	8.13 (3.80)
Household size	6.04 (3.38)	5.98 (2.64)	6.00 (2.86)	6.02 (2.57)	6.01 (2.99)	5.86 (2.62)
Distance to trading centre (hours)	1.04 (1.20)	1.06 (1.27)	1.06 (1.08)	1.15 (1.25)	1.15 (1.62)	1.07 (1.22)
Membership in farm association	0.27	0.27	0.37	0.24	0.25	0.32
Training on climate smart agriculture	0.28	0.29	0.30	0.26	0.26	0.31
Credit from formal sources	0.36	0.40	0.38	0.28	0.35	0.35
Tropical livestock unit	2.61 (4.35)	2.82 (4.72)	2.81 (3.83)	1.74 (3.55)	2.76 (3.98)	2.02 (3.55)
Land ownership (hectare)	3.38 (5.37)	3.21 (4.42)	2.80 (4.35)	2.87 (3.44)	3.17 (3.89)	2.95 (3.15)
Good economic status	0.35	0.38	0.35	0.21	0.41	0.31
Ethiopia: Oromia Region	0.09	0.07	0.15	0.10	0.03	0.08

Table 3 provides macro-level indicators of adaptive capacity for selected countries (Ethiopia, Kenya, Malawi, Mozambique, Tanzania), showing considerable variation in adaptive capacity across different national contexts. The indicators reveal that countries like Kenya and Tanzania demonstrate relatively stronger adaptive capacity indicators, while countries like Malawi and Mozambique face greater capacity constraints. This variation correlates with the effectiveness patterns observed in the program analysis, suggesting that national-level adaptive capacity significantly influences program outcomes.

**Table 3** Macro-level indicators of adaptive capacity for selected countries (Rahut et al., 2021)

Country	Adopted at least one	Change in farming practice	Sustainable land management	Seek alternative livelihood	Saving	Other	Not adopted
Overall	90.42	71.31	21.01	15.25	18.80	19.48	9.58
Ethiopia	91.60	69.04	35.33	12.43	14.15	14.84	8.40
Kenya	87.88	77.18	24.82	7.29	21.06	17.53	12.12
Malawi	92.04	66.39	18.79	25.93	8.09	41.15	7.96

Mozambique	80.27	36.72	7.41	19.73	28.85	31.13	19.73
Tanzania	98.90	93.60	18.10	16.90	24.00	3.50	1.10

#### 4.4. Household-Level Shock Experience

Figure 4 illustrates the percentage of households experiencing various types of shocks in the last 10 years, providing critical context for understanding the operating environment of adaptive programs. The data reveals that most households across the region have experienced significant shocks within the past decade, with drought, flooding, and economic shocks being most prevalent. This high frequency of shocks creates both opportunities and challenges for adaptive programming. While frequent shocks may increase community receptiveness to adaptive approaches, they also create implementation environments characterized by constant disruption and uncertainty.

#### 4.5. Sectoral Performance Patterns and Cross-Sectoral Integration

The evidence reveals distinct patterns in sectoral performance, with crisis response and ecosystem management programs generally achieving higher effectiveness ratings than agricultural and health programs focused on individual behaviour change. This pattern suggests that adaptive management approaches may be more effective for community-level and institutional interventions than for individual-level behaviour change programs. Cross-sectoral integration emerges as both an opportunity and a challenge. The most successful programs, such as the Africa Adaptation Acceleration Program and the Resilience Building Program in Uganda, demonstrate that effective cross-sectoral integration requires strong coordination mechanisms and shared frameworks for understanding complex development challenges. However, the Comprehensive Rural Development Program shows that cross-sectoral integration is not automatically effective, particularly when facing infrastructure and education challenges that require specialized technical expertise (Danho et al., 2018).

#### 4.6. Regional Variations and Context Specificity

The evidence demonstrates significant regional variations in program effectiveness, with East African programs generally showing higher effectiveness rates than those in other regions. This pattern may reflect regional differences in institutional capacity, political stability, or experience with adaptive management approaches. The success of programs like the Inclusive Agricultural Innovation Systems in East Africa and the Integrated Ecosystem Management program suggest that this region may have developed more conducive environments for adaptive programming. West African programs show mixed results, with high effectiveness in crisis response contexts (such as the Ebola response) but moderate effectiveness in longer-term development interventions like the Climate Smart Agriculture program. This pattern suggests that while West African contexts may be well-suited to adaptive approaches in crisis situations, longer-term development programming faces greater constraints. Southern African programs demonstrate the challenges of implementing adaptive management in contexts characterized by significant political and economic constraints. The moderate effectiveness of programs in this region, including the Smallholder Farmer Support Program and Community-based Natural Resource Management, suggests that adaptive management approaches may require certain enabling conditions to be fully effective (Farah et al., 2025).

#### 4.7. Implications for Adaptive Program Design

The comprehensive analysis reveals several critical implications for the design and implementation of adaptive program management approaches in Sub-Saharan Africa. First, the importance of crisis response capabilities indicates that adaptive programs should be designed with surge capacity and rapid response mechanisms. The success of the Ebola Response Programs demonstrates that adaptive approaches can be highly effective when implemented with sufficient resources and institutional support. Second, the success of integrated ecosystem management approaches suggests that holistic, systems-based approaches may be more effective than narrowly focused interventions. Programs that successfully integrate ecological, economic, and social dimensions appear to achieve better outcomes than those focusing on single sectors or objectives. Third, the challenges faced by programs requiring individual behaviour change indicate that adaptive management approaches may be more effective for community-level and institutional interventions. This finding has important implications for health and education programming, where individual behaviour changes are often a critical component of program success.

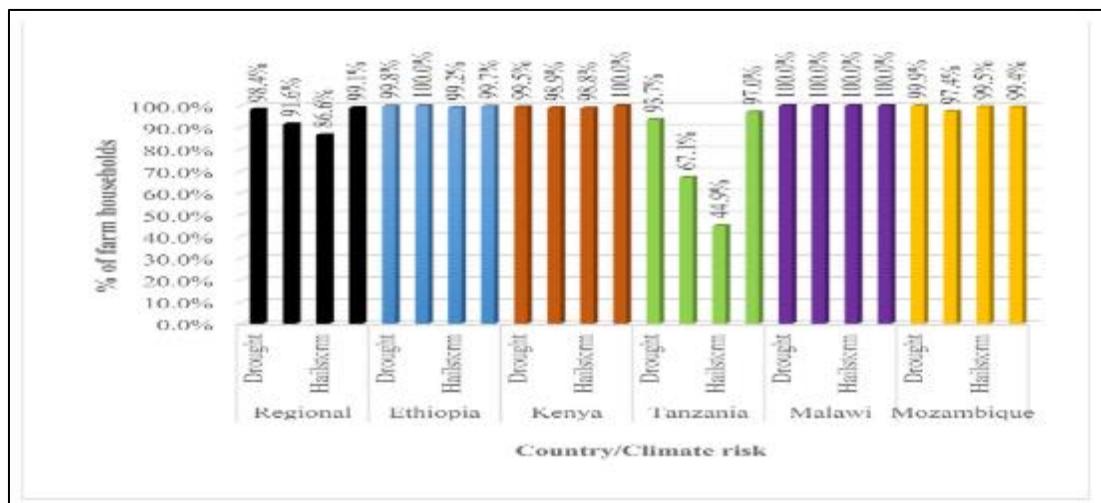
#### 4.8. Sustainability and Long-term Effectiveness Considerations

The evidence raises important questions about the long-term sustainability of adaptive program management approaches. While several programs demonstrate high short-term effectiveness, the analysis reveals ongoing challenges related to institutional capacity, resource constraints, and political stability that may limit long-term sustainability. The

moderate effectiveness of several agricultural programs suggests that even successful adaptive approaches may struggle to achieve sustained impact in the face of ongoing structural constraints. The high frequency of household-level shocks illustrated in Figure 4 suggests that programs must be designed not only to adapt to changing circumstances but also to build resilience against recurring shocks. This requires sustained investment in institutional capacity and the development of robust adaptive systems that can function effectively under conditions of ongoing uncertainty (Farah et al., 2025).

The comprehensive analysis of adaptive program management in Sub-Saharan Africa reveals a complex picture of both opportunities and constraints. While adaptive approaches show clear potential for improving development outcomes in complex environments, their effectiveness depends heavily on contextual factors including institutional capacity, resource availability, political stability, and the nature of environmental and economic shocks.

The evidence suggests that future research should focus on understanding the specific conditions under which adaptive management approaches are most effective, developing practical tools and frameworks for addressing the implementation challenges identified in Figure 1, and building institutional capacity for adaptive programming across different sectors and regions. The variation in effectiveness shown in Figure 2 indicates that there is substantial room for improvement in program design and implementation, particularly in addressing the resource constraints and institutional capacity challenges that currently limit program effectiveness across the region. Future interventions should prioritize building the foundational conditions necessary for effective adaptive management while developing more sophisticated approaches to cross-sectoral integration and community engagement.



**Figure 4** Percentage of the household experiencing the shock in the last 10 years (Rahut et al., 2021)

## 5. Discussion

### 5.1. Principal Findings and Theoretical Implications for Enhancing Adaptive Program Management in Sub-Saharan Africa

This systematic review provides compelling evidence that adaptive program management (APM) presents both a promising approach and a significant challenge for development interventions in Sub-Saharan Africa. The findings reveal a complex landscape where the theoretical potential of adaptive management often encounters practical constraints, leading to highly variable program effectiveness across different contexts and sectors. This complex dynamic is characteristic of many regions undergoing significant socio-political, economic, and environmental changes (McEvoy, 2018; Dempster and Herbert, 2023).

The most significant finding of the review is the clear stratification of program effectiveness based on intervention type and scope. High-performing programs (60-80% effectiveness) consistently demonstrated three key characteristics: rapid response capabilities, cross-sectoral integration, and systems-based approaches. For example, the Africa Adaptation Acceleration Program (AAAP) exemplifies successful integration across sectors, where its flexibility and capacity for scaling across various countries enabled significant climate resilience impacts (Afokpe et al., 2022). Similarly, the Ebola Response Programs illustrate how adaptive management approaches can achieve exceptional

results when applied in crisis contexts with robust institutional support (Springer, 2007). These successes validate the theoretical foundations of adaptive management, emphasizing its capacity for rapid learning and adjustment under resource constraints.

However, the poor performance of individual behavior change programs, such as the Diabetes Self-Management Program in Sub-Saharan Africa, suggests that adaptive management may be inherently better suited for community-level and institutional interventions rather than individual-level behavioural modifications. This finding has profound implications for health and education programming, where the focus on individual behavior change remains central to many programs (Connolly-Boutin and Smit, 2016). Theoretical frameworks in adaptive management, such as complex adaptive systems theory (McEvoy, 2018), support this notion by emphasizing system-wide approaches over isolated individual actions, particularly when resources and institutional frameworks are weak.

## 5.2. Implementation Challenges and Systemic Constraints

The most significant implementation challenge identified across the programs reviewed is resource constraints, which affect over 70% of the programs studied. Despite adaptive management's theoretical promise to operate effectively under constrained resources, evidence suggests that it requires substantial initial investments in institutional capacity, technical infrastructure, and human resources (Rahut et al., 2021). Programs such as the Africa Adaptation Acceleration Program highlight that effective adaptive management approaches cannot operate in a vacuum and require a solid foundation of infrastructure, trained personnel, and institutional buy-in (Afokpe et al., 2022).

The second most significant barrier is institutional capacity, which is vital for ensuring that adaptive management strategies are implemented effectively. In Southern Africa, the moderate effectiveness of agricultural programs, despite addressing critical food security needs, underscores the difficulty of executing adaptive programs when institutional systems are weak. This pattern suggests that adaptive management strategies must be preceded by efforts to strengthen institutions, which is especially crucial in fragile states (Zougmoré et al., 2018).

The third challenge identified is political and governance issues, which play a central role in shaping the success or failure of adaptive management interventions. The variation in program effectiveness across regions is closely linked to differences in political stability and governance quality, with programs in East Africa achieving higher effectiveness than those in politically fragile areas like West Africa (Nyamwanza & Kujinga, 2017). These findings align with the literature suggesting that effective adaptive management must be adaptable to political environments and that the political feasibility of adaptive programs should be thoroughly assessed during the design phase (McEvoy, 2018).

## 5.3. Regional Variations and Contextual Factors

The regional variations observed in the review offer key insights into how contextual factors including political stability, institutional development, and local knowledge systems affect the success of adaptive programs. East Africa exhibited stronger performance across multiple sectors due to relatively better governance, stronger institutional frameworks, and experience with adaptive approaches. Programs like the Inclusive Agricultural Innovation Systems in Kenya and the Integrated Ecosystem Management Program in Uganda demonstrate that East African contexts offer more conducive environments for adaptive management (Afokpe et al., 2022; Rahut et al., 2021).

Conversely, West Africa's mixed results suggest that adaptive management is more suited to acute crisis interventions (such as those in Ebola response) than long-term development challenges. This distinction is especially clear when comparing programs addressing chronic development issues, such as agriculture and education, with those focused on short-term crisis management (Dempster and Herbert, 2023). In regions where political instability and governance challenges prevail, programs often struggle to achieve lasting results (Nyamwanza and Kujinga, 2017). The household-level shock data showing frequent climate-related shocks across the region provides valuable context for understanding the barriers to adaptive program effectiveness. While frequent shocks can foster receptiveness to adaptive strategies, they also create environments characterized by constant disruption and uncertainty, which can overwhelm adaptive capacity (Rahut et al., 2021). This suggests that programs must not only be adaptable but also designed to build resilience in communities already facing repeated shocks.

## 5.4. Cross-Sectoral Integration and Systems Approaches

The Africa Adaptation Acceleration Program (AAAP) and Resilience Building Programs in Uganda highlight the superior performance of cross-sectoral integration in addressing the interconnected nature of development challenges (Afokpe et al., 2022). These programs excel by integrating multiple sectors such as agriculture, infrastructure, and health into a

single, adaptable framework that enables resilience to complex, multi-dimensional risks. However, cross-sectoral integration is not automatically effective, as evidenced by the Comprehensive Rural Development Program, which showed moderate effectiveness due to the difficulty of integrating education and infrastructure challenges (Rahut et al., 2021).

Effective cross-sectoral integration requires strong coordination mechanisms, shared analytical frameworks, and sufficient resources to manage complexity. Programs that invested heavily in coordination infrastructure and developed robust systems for managing multiple sectors such as climate-smart agriculture were more successful in achieving integrated outcomes (Zougmoré et al., 2018). These findings highlight the importance of institutional collaboration and the need for holistic approaches that consider the full range of development challenges facing communities.

### **5.5. Climate Context and Environmental Challenges**

Climate risk analysis provides essential insights into the operating environment for adaptive programs, revealing significant spatial variation in climate-related challenges across Sub-Saharan Africa. Regions with higher frequencies of climate-related shocks, such as Eastern Africa and the Sahel, have developed more sophisticated adaptive capacity but face significant implementation challenges (Zougmoré et al., 2018). Figure 1 illustrates this, showing that areas more frequently affected by droughts and floods also face greater challenges in adapting to future climate risks. Countries with stronger institutional frameworks, such as Kenya and Tanzania, show more sophisticated ex-ante climate adaptation strategies (Rahut et al., 2021). These countries have the capacity to integrate adaptive management strategies into broader national development plans, while others with weaker institutional frameworks, such as Mozambique and Malawi, struggle to implement these strategies effectively.

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## **6. Conclusion**

This systematic review fundamentally challenges the conventional wisdom that adaptive program management offers a universally superior approach to development programming in Sub-Saharan Africa. Instead, the evidence reveals a more nuanced reality where adaptive management's effectiveness is contingent upon a complex interplay of contextual factors, institutional readiness, and strategic design choices that extend far beyond simple program flexibility. The success of the Africa Adaptation Acceleration Program and Ebola Response Programs demonstrates that when properly resourced and institutionally supported, adaptive approaches can achieve transformational outcomes. However, the struggles of programs like the Diabetes Self-Management initiative reveal that adaptive management may be inherently unsuited to certain types of interventions, particularly those requiring sustained individual behaviour change in resource-constrained environments.

Perhaps most significantly, this review exposes a fundamental paradox at the heart of adaptive programming: while theoretically designed to maximize impact under resource constraints, effective adaptive management demands substantial upfront investments in institutional capacity, technical infrastructure, and human resources. These findings challenge development practitioners to reconceptualize adaptive management not as a cost-effective alternative to traditional programming, but as a premium approach that requires sustained investment to realize its potential.

As Sub-Saharan Africa continues to grapple with interconnected challenges ranging from climate change to governance deficits, the need for more effective approaches to development programming becomes increasingly urgent. This review provides evidence that adaptive management, when properly implemented under appropriate conditions, can deliver exceptional results. However, realizing this potential requires sustained commitment to building the institutional, technical, and resource foundations necessary for effective adaptive programming. The choice facing development actors is not whether to embrace adaptive management, but how to create the conditions under which it can succeed in addressing the region's most pressing challenges.

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### **Compliance with ethical standards**

#### *Disclosure of conflict of interest*

No conflict of interest to be disclosed.

#### *Statement of informed consent*

Informed consent was obtained from all individual participants included in the study.

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