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Centers for Learning on Evaluation and Results
ANGLOPHONE AFRICA

RESEARCH REPORT

ADAPTIVELY MANAGING CLIMATE CHANGE:

THE CASE OF BUILDING FOOD SECURITY RESILIENCE IN TANZANIA, UGANDA AND ZAMBIA







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ACKNOWLEDGEMENTS

This work would not have been possible without the financial support of The Ministry of Foreign Affairs of the Netherlands under the CLEAR-AA Accelerated Regionalization (Acer) Project. We would like to acknowledge the valuable insights and assistance provided by senior government officials and climate change adaption experts working for non-governmental organizations and multilateral institutions from Tanzania, Uganda and Zambia. We also would like to extend our gratitude and thanks to our external reviewers who spend their valuable time reviewing the draft report. Finally, we are grateful to the CLEAR-AA team for their valuable inputs from conceptualization through to finalization of this report.

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LIST OF ACRONYMS

AM	Adaptive Management
CCA	Climate Change Adaptation
CCD	Climate Change Department
CLEAR-AA	Centre for Learning on Evaluation and Results, Anglophone Africa
CO_2	Carbon dioxide
COVID-19	Coronavirus Disease 2019 (Severe Acute Respiratory Syndrome Coronavirus 2)
CSOs	Civil Society Organisations
DMMU	Disaster Management Mitigation Unit
DNA	Designated National Authority
DoE	Division of Environment
EWS	Early Warning Systems
FAO	Food and Agricultural Organisation
FEWS NET	Famine Early Warning Systems Network
GEF	Global Environment Facility
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
ICPAC	IGAD Climate Prediction and Application Centre
IPCC	Intergovernmental Panel on Climate Change
LDC	Least Developed Countries
M&E	Monitoring and Evaluation
MICS	Multiple Indicator Cluster Surveys
MRV	Measuring, Reporting and Verification
NAPA	National Adaptation Programmes of Action
NCCFP	National Climate Change Focal Point
NCCP	National Climate Change Policy
NDC	Nationally Determined Contributions
NEWS	National Early Warning Systems
NGOs	Non-Governmental Organisations
R&D	Research and Development
SADC	Southern African Development Community
STAP	Scientific and Technical Advisory Panel for the Global Environment Facility
TMA	Tanzania Meteorological Agency
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
UNFCCC	United Nations Framework Convention on Climate Change
VPO	Vice President's Office
WFP	World Food Programme
ZMD	Zambia Meteorology Department

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EXECUTIVE SUMMARY

Introduction

The Centre for Learning on Evaluation and Results in Anglophone Africa (CLEAR-AA) is one of six regional centres in the CLEAR initiative working globally to strengthen capacity for monitoring and evaluation (M&E), to promote the use of evidence to improve programmes, and to enable policymakers and implementers to make sound and informed decisions. In 2020, the Centre conducted an investigation to determine how M&E data, information and evidence are being used by countries for adaptive management of climate change with specific emphasis on building resilience for food security in Tanzania, Uganda and Zambia.

Sub-Saharan Africa has been identified as one of the regions in the world most vulnerable to the impacts of climate change. This is because most African countries are dependent predominantly on climate-sensitive activities such as rain-fed agriculture, the terrain is arid or semi-arid, and the countries are subject to high levels of climate variability. The majority of the population of these countries resides in the rural areas and their livelihoods are dependent on crop production which is vulnerable to climate change. Current evidence shows that populations who are resource-poor, marginalised, and have a low adaptive capacity, are the most vulnerable to climate change. Building resilience for food security in the context of climate change depends on two processes – climate change adaptation actions and adaptive management of climate change.

Adaptation actions relate to the steps taken to live with the effects of climate change. Adaptation actions to build resilience must occur at national, sub-national, community and household levels. Adaptive management of climate change comprises a rigorous approach to implementing, monitoring, and evaluating adaptation actions in order to learn from previous interventions and to adjust the actions accordingly. Adaptive management seeks to produce and improve scientific knowledge and to develop management regimes that make provision for a range of possible future outcomes including potential unforeseen events. The inherent uncertainty surrounding climate change makes such preparation difficult as a wide array of potential scenarios and decision alternatives may exist thus necessitating the use of robust sources of information, evidence or data to inform sound decision making. Adaptive management of climate change bridges the gap between adaptive actions and building resilience. Failure to implement adaptive management of climate change exacerbates the risk of maladaptation. Successful implementation of adaptive climate change management processes requires the following: agreement by all stakeholders on objectives and required adaptation measures; formulation of models/scenarios of the climate change element being managed; consideration of a range of decision options to counter climate change uncertainty; monitoring and evaluation of the outcomes of adaptation actions; active learning during programme implementation to allow for course correction; and collaboration structures for stakeholder participation and learning.

Methods

To meet these objectives, a qualitative research approach supported by a collaborative research design was utilised during this study. The methodology allowed for a holistic approach with a specific emphasis on gaining an overview of how the three subject countries of this study adaptively manage climate change in the context of building food security resilience. The research design was collaborative and allowed the study subjects to function as co-researchers. Collaborative research design enabled the researchers to engage in a productive dialogue among those coordinating climate change adaptation actions, the implementers of climate change adaptation programmes, M&E practitioners, funders and decision makers. The collaborative research design enabled the opinions and experiences of the researchers, M&E practitioners, policymakers, funders and other stakeholders to be incorporated for the mutual interest and benefit of all stakeholders. Critical case sampling was used to draw respondents from key government departments or ministries, multilateral organisations, and non-governmental organisations across the three countries.

Findings

The findings indicate that there are several reasons for the impacts of climate change not having been adaptively managed across the three countries and these will be explained further in this report. It is the opinion of the researchers that the institutional arrangement for adaptive management of climate change in the context of building resilience for food security is more focused at the top (country level) than at the lower levels where adaptation actions and adaptation actually take place. The implication is that while the national systems may have the necessary policies, strategies, M&E systems and strategies, these have not been implemented at the local level, thereby making adaptive management of climate change practically unachievable. The key sources of local information and data for adaptive management of climate change at the local level are inadequately utilised.

Key findings

Climate change is coordinated at two levels in the three countries. The first is at the policy level where policies and strategies on climate change are formulated. In Uganda, climate change policy-level coordination falls under the Climate Change Department (CCD), which reports to the Ministry of Water and Environment. In Zambia, the vice president's office, the council of ministers and the Disaster Management and Mitigation Unit (DMMU) are responsible for the design of climate change policies and strategies. In Tanzania, the coordination of climate change and adaptation is the responsibility of the vice president's office, which sets the policy and is responsible for international engagement on climate change issues. The second level of coordination is the M&E of climate change initiatives. Uganda and Tanzania have climate change coordinating units with specific M&E mandates whilst in Zambia the climate change M&E mandate is mainstreamed into the national M&E system.

Despite the various national policy and coordination prescripts across the three countries, there is poor development of these policies and strategies at the lower levels of the state such as sector and sub-national level. The coordination and policy efforts evident at the national level are not vigorously pursued at sector and sub-national state levels. The key areas such as national climate change vulnerabilities, climate change impacts and adaptation priorities are clearly articulated at the national level, whilst the same vigour does not prevail at the sector, sub-national and community levels. The implication is that climate change vulnerabilities, impacts, assumptions, and anticipated outcomes are not clearly articulated, tracked, monitored and evaluated at the key adaptation levels. Despite the existence of national adaptation policies and strategies, systems to track key food security indicators across the four dimensions of availability, access, stability and utilisation are unavailable. The researchers argue that despite the progress in the development of national policies and strategies, the lack of systematic mainstreaming of climate change adaptation in the development planning process limits the adaptive management of climate change. The findings on institutional arrangement further show that across the three countries, the adaptive management of climate change strategies and policies is poorly implemented, as is the case with other development policies. Key impediments fuelling these challenges are poor coordination systems, fragmentation of climate change adaptation strategies, lack of financial and human resource investment in climate change initiatives, and limited state role in the implementation of adaptation actions. These key challenges are mirrored at sector and sub-national level hampering adaptive management of climate change processes at those particular levels of the state and thereby detrimentally affecting the information which is transmitted to the national level.

Across the three countries, there is a consensus that effective adaptive management of climate change is reliant on various accurate sources of information and evidence. Sources of information, such as early warning systems (the requisite measures to generate and disseminate timely and meaningful warning information that enables at-risk individuals, communities and

organizations to prepare and act appropriately and in sufficient time to reduce harm or loss), scientific research, monitoring and evaluations, and community contextual information and evidence (includes indigenous knowledge, socio-cultural, socio-economic, socio-political and ecological information), are needed for adaptive management of climate change. It is important to note that these sources of information are more clearly defined at the national level than at lower levels of the state, such as sub-national level (region, province or district), programme level, and community level.

Despite the existence of climate change coordinating units in the three countries, there is a lack of state-commissioned monitoring systems to track national adaptation outcomes and the units are largely dependent on project level information which is not an ideal situation. Where available, M&E systems are designed for accountability rather than for adaptive management of climate change. Additionally, the three countries have not conducted national evaluations on programmes which are focused on addressing the impact of climate change on food security. While the non-state sector has commissioned several programme evaluations, these are focused at programme level for interventions relating to specific climate change stressors or shocks but they do not reflect the general adaptation status. In terms of the sharing of data and evaluation findings, collaboration between the state and non-state sectors is limited as no platform currently exists for this purpose.

Across the three countries, Early Warning Systems (EWS) are available but they provide limited information to the various levels of decision makers. EWS mainly provide information at the national level and to a lesser extent at regional level. This deprives the decision makers of the opportunity for a localised response to localised climate change impacts. Information from the EWS is not packaged and communicated into actionable and comprehensible messages for those who would directly benefit from the information.

M&E systems have limited capacity to capture community contextual information and indigenous knowledge systems. This is problematic as these sources of information are key to informing adaptive management of climate change, especially the design of adaptation actions. The implication is that there is no baseline for household and community adaptive capacity and the contextual factors which influence adaptive capacities are unknown, resulting in uninformed assumptions being made on how communities are expected to respond to climate change and therefore adaptation actions are designed on the basis of inaccurate assumptions.

Ongoing awareness of scientific research and development is key as the research may result in improved products that enable farmers and communities to adapt. Research on drought- or flood-resistant crops, livestock, and climate change modelling are all key to informing adaptation actions taken at different levels. Climate change modelling presents decision makers with various scenario options for consideration that may be used when designing adaptation actions. Evidence has shown that scientific research and development is inadequate and that adaptive actions are designed without localised scientific information.

Evidence has shown that there is a dearth of new knowledge on the topic and that current practice is premised on existing established rigid strategies, policies and procedures for implementing adaptation actions. The researchers argue that countries, funders, donors and programme implementers do not need to choose between accountability and learning as, when viewed in tandem, these two aspects are complementary. During this study, it was found that instead of learning from each process, programme implementers concentrate on following set rules and procedures and detecting and correcting deviations from set procedures. This is incompatible with adaptive management of climate change, where M&E should create an enabling environment for learning so that programming can be corrected as trade-offs become evident, interventions fail to succeed in their intended impact, or key assumptions about the future are found to have been incorrect.

Conclusions and recommendations

Climate change is a serious problem requiring a carefully considered and informed approach to address its impacts. LDCs need support in formulating the requisite solutions to address this critical challenge. It is necessary for countries to go beyond simply developing national policies but rather to implement the policies whilst simultaneously focusing on improving the adaptive capacities of their citizens thereby reducing their vulnerabilities. The adaptive management of climate change systematises and reshapes the adaptation process to achieve sustainable outcomes.

The recommendations proposed are targeted at both national institutions and organisations involved in climate change adaptation. The success of the suggested recommendations is based on the state leading the adaptive management of climate change and creating an enabling environment for climate change adaptation. When implementing these recommendations, it is necessary to ensure sufficient flexibility and scope to enable country-specific adaptation. The recommendations are:

- Strengthen state leadership to promote collaboration and coordination of adaptive management of climate change. There is a need to strengthen the ability of the state to create an enabling environment by establishing collaborative spaces and platforms at all levels of adaptation for the various stakeholders involved in adaptive management of climate change.
- Mainstream climate change and M&E systems into the broad national development plans. Although a specific focus is required, climate change adaptation and M&E systems with clear mandates should be mainstreamed into broad development plans and should not be regarded as separate from the development planning programme implementation process because climate change, directly and indirectly, affects development outcomes. Mainstreaming will integrate climate change adaptation and its related M&E systems' needs into the available structures and systems thereby reducing administrative costs.
- Integrate indigenous knowledge systems and community contextual information into the adaptive management of climate change information matrix. All stakeholders involved in adaptive management of climate change/climate change adaptation should view indigenous knowledge systems as complementary to the modern knowledge systems and an integral element of the information matrix for adaptive management of climate change.
- Strengthen the available sources of information to address information gaps at all sector and adaptation levels. All levels of climate change adaptation should work collaboratively with all producers of information critical for adaptive management such as early warning systems and scientific research and development so that information needs are defined and understood. Efforts should also be made to review, revise and mainstream climate change into the national, sector and sub-national periodic surveys so that the key data obtained is incorporated into the national planning process. Challenges related to a lack of adaptive capacity and resilience baseline data can be addressed by mainstreaming climate change into the periodic national and sub-national surveys in the three countries.
- Strengthen collaborative learning platforms. Evidence has shown that there is little new knowledge on the topic and that current practice is premised on establishing rigid accountability-focused M&E strategies, policies and procedures for implementing adaptation actions thereby resulting in single-loop learning. The state should take responsibility for developing collaborative learning platforms which facilitate adaptive management iterative processes leading to the realisation of double- and triple-loop learning cycles.
- Strengthen country M&E systems. Across the three countries, the general state M&E systems are still in their developmental stages and require strengthening and priming for effective use in the adaptive management of climate change. Country M&E systems should be strengthened collaboratively with the state leading and the non-state sector providing the necessary support.

I. INTRODUCTION

1.1 Background to CLEAR-AA

The University of the Witwatersrand's Centre for Learning on Evaluation and Results – Anglophone Africa (CLEAR-AA) is one of six regional centres housed in academic institutions across the globe. Together with five other CLEAR centres based in Senegal, Mexico, India, China, and Brazil, these centres are part of the CLEAR global initiative based in Washington, DC. The CLEAR initiative is a collaborative global programme founded by academic, bilateral, and multilateral institutions to support evaluation capacity strengthening in developing countries. Conceived as an innovative approach to developing the monitoring and evaluation (M&E) capacities of governments and civil society organisations (CSOs), CLEAR focuses on south-south collaboration and is backed by prestigious academic institutions recognised for their excellence in the evaluation field.

As a centre for public good, CLEAR-AA has contributed to the strengthening of country M&E systems and capacities across English-speaking African countries. In a continent facing challenges such as lack of an evaluation culture, the politicisation of evaluations, resistance to evaluation, lack of human and financial resources for evaluation, poor data, and mismatch between the timing of evaluations and decision-making cycles, the strengthening of M&E systems and capacities become critical as it enhances effectiveness, efficiency and accountability in the implementation of state and non-state-led development policies and programmes. CLEAR-AA supports the critical role of M&E systems in influencing positive socio-economic development outcomes which are key in low economically developed countries in Africa. The strengthening of M&E systems capacities across African countries strengthens the democracies of the countries by fostering transparency and accountability.

1.2 Introduction to climate change, adaptation, adaptive management and food security

Africa has been identified as one of the regions in the world most vulnerable to the impacts of climate change (Serdeczny *et al.*, 2017). This is because the majority of African countries are predominantly dependent upon climate-sensitive activities such as rain-fed agriculture, they consist of arid and semi-arid terrain, and are naturally prone to high levels of climate variability (Omari, 2018). The majority of the population also resides in rural areas and their livelihoods are dependent on crop production which is acutely vulnerable to climate change. In this study, climate change refers to the "change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer" (IPCC, 2020). Vulnerability to climate change varies from country to country and the differences in global climate change vulnerability are also attributable to non-climatic factors and other multidimensional inequalities (Tschakert, 2015). Current evidence shows that climate change affects the most vulnerable populations that are resource-poor and marginalised. These challenges are prevalent on the African continent, hence its high vulnerability to climate change. Among the vulnerable, the impacts of climate change also exacerbate the already recurrent food crises and water scarcity, with dire consequences for African economies, livelihoods and overall human welfare (Roudier *et al.*, 2011; Sarr, 2012).

1.3 Objectives

The overarching objective of this study was to explore how M&E data, information and evidence are being used by countries for adaptive management of climate change with specific reference to building resilience for food security in Tanzania, Uganda and Zambia. The following research questions were pursued:

- What information, data or evidence is needed to inform decision making to ensure food security in the context of climate change adaptation?
- To what extent is M&E data, information or evidence used for adaptive management of climate change with reference to building resilience for food security?
- What decisions and actions will support adaptive management of climate change by individuals, organisations and governments for greater food security resilience?
- What must be done to support adaptive management of climate change to ensure greater food security resilience?

1.4 Literature review

The review of the literature begins by examining the relationship between climate change and food security. Subsequent chapters examine the climate processes, challenges and opportunities with specific reference to the African context. Later sections of the review examine the literature on adaptive management of climate change and its impact on climate change adaptation.

1.4.1 Climate change and food security

This section examines the relationship between climate change and food security. Food security can be said to exist when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (FAO, 1996). Food security comprises four main components: food availability, food access, food utilisation, and food stability. Some scholars see food stability as a separate cross-cutting factor. For one to achieve a state of food security, all four components must be in place. Food availability is when all people have sufficient quantities of food available on a consistent basis. Food availability is determined by food production and food trade (Thomson, 2007). Precipitation and temperature variations impact on crop productivity by affecting plant growth and increased water demand due to evaporation and drought may result from altered rainfall patterns (Redden et al., 2014). In addition, climate change also threatens food production by altering the patterns and productivity of "livestock and fishery systems and also reconfigures food distribution, markets and access" (Vermeulen, Campbell and Ingram, 2012, p. 137).

Food security and nutrition are not only dependent upon a sufficient supply of food, but also on the ability of countries, communities, households and individuals to access and afford food of sufficient quality and quantity. In many regions in the world, particularly in Africa, the ability to afford and access food has historically been limited due to discriminatory practices based on ethnicity, gender, socio-economic status and religion. Many of these practices persist and hinder participation in markets, legal ownership of land and other assets, as well as infringing on other human rights crucial to accessing food (Bush, 2010). Additionally, climate change has devastating effects on agricultural production and food prices, especially in sub-Saharan Africa which is highly dependent on agriculture as a source of income (Schmidhuber and Tubiello, 2007).

Beyond the supply and demand for food, the **utilisation** of food is also critical to food security. According to the Food and Agriculture Organisation (FAO), food security also refers to the "utilization of food through adequate diet, clean water, sanitation, and health care to reach a state of nutritional well-being where all physiological needs are met" (Wheeler and Von Braun, 2013, p. 509). This involves having the ability to protect food against spoilage and pests, being able to cook safe and nutritious meals, and being healthy enough to absorb and retain the nutrients consumed. The latter is crucial because in the absence of clean water and functional sanitation systems, compounded by extreme climatic variability – both increased rainfall and prolonged drought – there will be increased exposure to pathogenic bacteria, parasites, mycotoxins, and a host of viruses resulting in infectious and diarrheal diseases with subsequent profound impacts on child nutrition and development (Myers et al., 2017). Climate change is anticipated to result in both negative and positive changes in dietary patterns as well as presenting new challenges for food safety, adversely affecting the nutritional status of citizens, and increasing the occurrence of food-related emergencies (Haris et al., 2013).

The fourth component of food security is equally crucial, "because to be food secure, a population, household or individual must have access to adequate food at all times" (Wheeler and Von Braun, 2013, p. 509). The **stability** of food supplies is expected to be adversely affected by climate change due to fluctuations in crop productivity brought about by soil erosion or landslides created by increases in the frequency and severity of extreme events including floods, hailstorms, cyclones and droughts. Scholars report that while climate change and short-term climate variability are not new phenomena in agriculture, the problem is that the areas subject to extreme climate variability are expected to expand, while the extent of short-term climate variability is also expected to increase across all regions. Furthermore, scientists believe that the rates and levels of global warming previously experienced will be exceeded. This will have more pronounced effects in Asia and Africa (Schmidhuber and Tubiello, 2007).

Evidence suggests that climate change poses threats to food security due to reduced availability of agricultural water. Agricultural water shortages of significantly increase the risk of African adults and children experiencing chronic hunger, malnutrition and ill health (Lloyd, Kovats and Chalabi, 2011; Serdeczny et al., 2017). Climate change, especially on the African continent, is responsible for increasing food insecurity for populations as unfavourable environmental conditions result in poor agricultural yields. It is pertinent to note that in sub-Saharan Africa, food insecurity is a multidimensional problem which is not only linked to climate change but also to poor healthcare, ongoing conflicts, poor policies, politics, leadership, trade and agricultural production, food systems, and the global food industry. In 2017, an estimated 22.4% of the sub-Saharan African population were categorised as undernourished and approximately 27.4% of the population was classified as severely food insecure (FAO, 2017). Adverse conditions due to climate change and conflict, often occurring concurrently, are key factors responsible for the worsening of food insecurity in the sub-Saharan region (Serdeczny et al., 2017). Stakeholders (state and non-state) are investing significantly in climate change adaptation by formulating national adaptation processes with the main objective of strengthening the adaptive capacity of individuals, organisations and national governments and by helping them to prepare for adverse impacts of climate change as well as making them aware of potential opportunities (STAP, 2017).

In sub-Saharan Africa, governments, multilateral organisations and other non-state sector organisations are actively implementing climate change adaptation programmes with several of these focusing on strengthening food security and augmenting household livelihoods. Climate change adaptation (CCA) is the planning and implementation of actions to reduce risks posed by climate variability and climate change and to exploit potentially beneficial opportunities (Marmorek et al., 2019). In short, it is a process of adjusting to actual or expected climate change and its effects (Reser and Swim, 2011). Climate change adaptation aims to reduce harm to human systems/livelihoods, improve the ability of communities to plan and manage, and to ensure that economic activities are not negatively affected by climate change (Huq, Reid and Murray, 2006). Adaption requires a change in the prevailing human economic, social and livelihood approaches (adaptation

actions). It is important to understand that that climate change is long-term and uncertain and cannot simply be mitigated by development programmes. Adaptation actions should, therefore, focus on long-term actions that build adaptive capacity of communities and households. Regardless of the uncertainty surrounding climate change modelling and predictions, adaptations are necessary to eliminate and reduce the impacts of climate change. Definition and measurement of adaptation-induced change is inherently complex as the real impact of adaptation interventions may not become apparent for decades (Baird et al., 2014). As alluded to earlier, climate change impacts, severity and timing are uncertain and occur in environments marked by dynamic socio-economic, political and ecological processes, emphasising the need to consider these factors when adapting to climate change.

Arguably, climate change is the primary determinant of global food security, particularly in low-income countries that depend on climate-sensitive activities such as agriculture and aquaculture which are susceptible to drought, temperature fluctuations, and flooding. Such climate change impacts increase the vulnerability of these countries to hunger and malnutrition (Vermeulen, Campbell and Ingram, 2012). The effects of climate change could potentially threaten the goal of ending world hunger by reducing food production among agriculture-dependent countries in sub-Saharan Africa. Climate change affects food security on all four dimensions including the availability of, access to, utilisation of, and stability of safe and nutritious food (FAO, 2006). Climate change influences agro-ecological conditions thereby threatening crop productivity, livestock and fisheries and, consequently, food availability. Higher levels of carbon dioxide affect the nutritional value of crops. Access to food is compromised by increased trading costs and higher food prices resulting in food becoming unaffordable for poor people. In addition, poor crop yields reduce income from farming. Utilisation of food is impaired by the loss of access to drinking water with resulting damage to health. Lastly, the increasing variability of weather conditions and the volatility of food production and supply pose risks to the stability of food systems (Wheeler and Von Braun, 2013). It is argued that climate change and its related extreme weather events are a threat multiplier i.e. at micro level other socio-economic aspects not directly related to climate change are impacted. This, in turn, reduces the resources allocated for food and increases the incidence of food-insecure households, undernourishment, child stunting, child wasting, and child mortality. Evidence also shows that countries with high levels of food insecurity are affected worst by climate change and have the lowest adaptive capacity.

1.4.2 Climate change adaptation challenges in Africa

Despite a variety of climate change adaptation actions and programmes in sub-Saharan Africa, literature shows that most African countries face persistent adaption-related challenges. These challenges negatively influence how communities, households and individuals develop resilience to climate change. The first challenge faced by climate change adaptation interventions in sub-Saharan Africa is that of their limited scale and scope and that their impacts lack continuity and sustainability (Hassan and Tularam, 2018). This contributes directly to the ineffectiveness of measures aimed at building resilience to a persistent long-term food insecurity problem. Climate change is marked by uncertainty and is a long-term situation affecting various aspects of human livelihood, occasioning the need for interventions that are broad in scope and scale so that all affected livelihood components are addressed. Literature has shown that an approach that is limited in scope and scale to address the impacts of climate change is unsustainable as households will reallocate resources (as a coping mechanism) from one area to another. An example is the reallocation of educational resources to address climate change-induced food insecurity – this affects other areas of livelihoods such as educational outcomes of children leading to long-term impacts (Atteridge and Remling, 2018). In such situations, the implication is that adaptation actions become a process of redistributing the vulnerabilities to other areas of livelihoods.

The second challenge is that the climate change adaptation actions of sub-Saharan African countries are hampered by a lack of policies, inadequate state capacities, and the absence of practices to assess and manage climate change risks and vulnerabilities (Chanza, 2018). This has led to countries failing to create an

enabling environment underpinned by political and socio-economic policies to support the formulation and implementation of efficient solutions to a problem with complex multi-sectoral effects (Stringer et al., 2017). This is exacerbated by the prevailing limited knowledge of appropriate adaptation policies and measures – a situation which impedes countries from strengthening their institutional capacities to support climate risk management.

The third challenge is related to the availability of resources. Low economically developed countries, such as those in sub-Saharan Africa, face a perennial lack of resources with resulting limited financing options for climate change adaptation to sustain scaled-up adaptation measures (Serdeczny et al., 2017). Funding options have largely been short term (with humanitarian interventions for food security) and do not address the long-term adaptation problem. The lack of resources results in communities, households, and individuals having to bear the responsibility of adapting and building long-term resilience. This has a detrimental effect on their food security and livelihoods in general – an increasing trend in sub-Saharan Africa (FAO, 2020).

The fourth challenge is that despite climate change being a common challenge in sub-Saharan Africa, there is an absence of networks and coordinated efforts to address climate change (Saito, 2013). Even within countries, this coordination is lacking. This represents a lost opportunity for mutual learning resulting in various different approaches to adaptation being implemented from country to country. Coordination fosters a holistic and systematic approach to addressing the impacts of climate change, thereby affording countries, communities and households with the best opportunity to build sustainable resilience to climate change challenges.

1.4.3. Climate change adaptation and resilience

Resilience refers to the capacity of a system, individual, household or community to continue to maintain food security despite disturbances, by recovery to its original condition or by some degree of transformation which changes components in a system or the relationships between components in a system (Tendall *et al.*, 2015). The Intergovernmental Panel on Climate Change's (IPCC) definition of resilience is widely used in the context of climate change and is the "ability of a system and its components to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner" (IPCC, 2012, p. 56). From these definitions, one can deduce that resilience comprises three attributes. The first is an absorptive capacity, which includes all the various risk management strategies by which individuals and/or households moderate or cope with the impacts of shocks on their livelihoods and basic needs. The second attribute is an adaptive capacity that reflects the capacity to learn, combine experience and knowledge, adjust responses in a pro-active way to changing external drivers and internal processes, and to continue operating (Berkes, 2003). The third attribute of resilience is a transformative capacity, i.e. the capacity to create an enabling environment through investment in good governance, infrastructure, formal and informal social protection mechanisms, basic service delivery, and policies/regulations that constitute the necessary conditions for systemic change (STAP, 2017).

It is pertinent to distinguish the relationship between climate change adaptation and resilience. CCA (adaptation actions) refer to those crucial actions or plans that a country, community, household, or individual will employ against a current or anticipated impact of climate change whilst resilience refers to the ability to recover (bounce back to the original state before the exposure to shock) from the effects of climate change. In simpler terms, adaptation actions are where communities, households and individuals make changes (adapt) to fit with the new circumstances caused by climate change whilst resilience is how communities, households and individuals cope with the new circumstances. The relationship between these two aspects is that the more a community, household or individual can adapt, the more resilient they are. Adaptation actions enable food security resilience, hence the more one is able to adapt the more resilient one will be.

1.4.4 Adaptive management of climate change

Adaptive management (AM) originated in the early 1970s as an approach to manage climate change. It draws from different disciplines such as engineering, industrial psychology, and economics (O'Donnell, 2016). AM is generally defined as "an intentional approach to making decisions and adjustments in response to new information and changes in context" (USAID, 2018). AM does not postpone actions until enough is known about the phenomenon, but rather it is designed to support action in the face of limited evidence (O'Donnell, 2016). During the development of programmes, it is crucial to focus on climate change adaptation as this is key to making sound decisions in times of uncertainty. Adaptive management seeks to achieve the following: (a) enhance scientific knowledge and thereby reduce climate change uncertainties; (2) create policies that can help organisations and stakeholders respond to possibly even take advantage of anticipated events; (3) recognise the uncertainties associated with forecasting future outcomes; (4) encourage consideration of a range of possible future outcomes. Climate change adaptation measures advocate for climate change programmes/projects that have a flexible design, are open to iterative processes, and allow learning. AM also emphasises the necessity for programme implementers to make timely responses in the context of new information.

In this study AM is defined as a rigorous approach to implementing, monitoring, and evaluation of adaptation actions, and, if necessary, learning to adjust those actions (Marmorek et al., 2019). Adaptive management of climate change requires that decision makers take action in the face of uncertainty and seeks to improve scientific knowledge and develop response regimes that consider a range of possible future outcomes and even to take advantage of unanticipated events (Lankford et al., 2007). The definition of AM emphasises the linking of decision making, learning, policy and implementation. For effective AM in climate change adaptation, various components and actions need to be adhered to. The following elements and actions are key to effective AM:

- From the outset of the programme there is a need to agree on the objectives and the progress and outcomes required by all stakeholders.
- Monitoring and evaluation (M&E) is essential as it supports the understanding and prioritisation of actions to assist in decision making, learning, and adjusting of climate change adaptation actions. Effective AM requires an intentional M&E design targeted at real-time collective learning and accountability that enables continuous course correction to improve programme effectiveness and impact.
- M&E should make it easier for users and decision makers, communities and state entities to learn during the process what is working and what is not. However, it is important to note that AM goes beyond simple tracking of adaptation actions as this will lead to maladaptation1.
- AM includes exploring alternative ways to meet adaptation outcomes and therefore makes use of climate change models and predictions of the outcomes of alternatives based on the current state of knowledge. This will enable those implementing adaptation actions to change course if necessary.
- Coordination between various stakeholders who are key to achieving the intended outcomes.
- AM embraces uncertainty and views adaptation as a long-term iterative process.

1 Defined as 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 (Barnett and O'Neill, 2010).

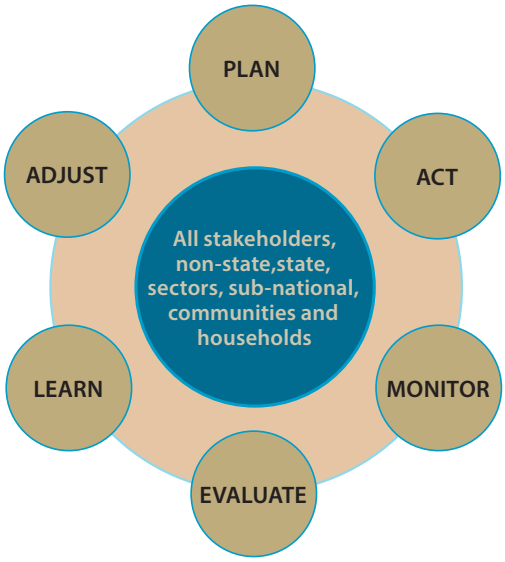

Figure 1: Adaptive management of climate change process

Several studies have shown that AM is implemented infrequently despite its recognised efficacy in addressing the impacts of climate change (Agrawal, 2008; Dodman and Satterthwaite, 2008; Yates *et al.*, 2010; England *et al.*, 2018; Richardson *et al.*, 2020). There are several challenges associated with AM that stakeholders implementing climate change adaptation interventions must take cognisance of. M&E plays an important role in AM and a number of these challenges are M&E-related.

First, AM requires a different approach to M&E. In CCA, causality (attribution and contribution) is difficult to determine and is uncertain mainly because change occurs in ways that are often complex, difficult to pinpoint, and intangible. These 'hard-to-measure' elements are difficult to quantify using traditional M&E practices (Marmorek *et al.*, 2019). There is need for M&E systems that are able to capture dynamic and shifting baselines, uncertainty, and non-events, allowing decision makers to make iterative adjustments to their adaptation actions. In the sub-Saharan context, this is a challenge that is exacerbated by the prevailing poorly developed M&E systems (Holvoet and Dewachter, 2013).

Second, due to the many ecological and socio-economic factors influencing CCA, the reality is that many state departments, donors or other contributors concurrently implement similar adaptation interventions seeking to build the same resilience for the same household or community (STAP, 2017). This poses methodological challenges surrounding attribution in such complex change scenarios and it is often difficult, and sometimes impossible, for performance monitoring and evaluation to directly attribute results to a particular intervention. Contrary to traditional M&E design, AM performance monitoring and evaluation should lean more towards assigning contribution.

Third, in sub-Saharan Africa, there is a challenge of poor connection of adaptive management of climate change across levels. Local level adaptation articulates poorly with the regional or national level adaptation (Ifejika Speranza, 2010). This prevents states, donors, communities and other organisations from implementing a consolidated response to adaptively manage climate change. To be effective, CCA interventions must address issues across all levels. Effective and efficient adaptation policies and programmes often require coordination and collaboration across local to national (and sometimes international) organisations and institutions (England *et al.,* 2018).

Fourth, the lack of baseline, predictable comparability, replicability, and scalability of CCA create practical methodological challenges for M&E (STAP 2017). CCA is typically a much more complex, long-term, uncertain,

and unpredictable undertaking which is difficult to track using single method designs (Krause, Schwab and Birkmann, 2015). In such cases, mixed methods, systems approach, innovation, and learning approaches are favoured over single-method M&E designs (Bours, McGinn and Pringle, 2014; Fisher *et al.*, 2015; Williams, 2016)

Fifth, identifying meaningful indicators and establishing baselines and targets is a challenge as affective adaptation impacts are unpredictable and are only realised in the long term (Marmorek *et al.*, 2019). This is compounded by the lack of widely agreed indicators to determine the effectiveness of CCA interventions. In addition to lack of agreed indicators, sub-Saharan African countries also lack M&E systems, expertise, capacity and resources to implement AM M&E systems (Baird *et al.*, 2014). This poses the risk of maladaptation which is harmful to communities and households.

Sixth, despite the recognition that learning underpins AM (Lal *et al.,* 2012), most traditional M&E frameworks do not incorporate learning mechanisms. Even if they did, successful learning requires more than simply having a plan. It also requires the cultural safety to experiment, take risks, fail (and learn from failure), and an understanding of these factors by donors and/or governments (Leiter, 2015). This is also exacerbated by the pressure to account for resources and therefore implementers perceive that there is no room for failure.

Seventh, considering the long timeframes, the pervasive impacts and resulting risks and the 'deep' uncertainties attached to many of those risks pose a challenge for M&E (Ogden and Innes, 2009; Lempert and McKay, 2011). These uncertainties include not only future climate change but also socio-economic changes and potential changes in norms and values within and across generations, hence traditional M&E systems cannot capture these complexities. Each situation requires different modes of M&E practice, including a learning orientation that can be accurately characterised as that of monitoring, evaluation and learning. To support strategic learning at the systems levels required for CCA, double- and triple-loop practices are seen as particularly important (Tschakert and Dietrich, 2010; Vogel, Colvin and Scharfetter, 2015) even though single-loop learning has, to date, been the predominant focus of M&E.

1.5 Conceptual framework

In the researchers' conceptualisation of AM, M&E and other sources of evidence as regarded as critical to ensure the success of food security climate change adaptation initiatives, plans and actions. Adaptive management of climate change should enable the tracking of the performance of activities undertaken during the development of an adaptation plan, tracking the degree of acceptable risk, the level and timing of climate change impact, and the ability to correct the course if necessary (Berrang-Ford, Ford and Paterson, 2011). Traditional M&E approaches being used by climate change adaptation implementers adopt a simplistic approach with an assumed linear cause and effect relationship where a known type of intervention will result in a known outcome and this pattern can be repeated over and over again (STAP, 2017). Climate change adaptation is typically a much more complex, long-term, uncertain, and unpredictable undertaking and is not compatible with a linear cause and effect relationship approach. M&E systems for AM should have the capacity to identify when new adaptation actions should be undertaken and be able to determine whether planned outputs and outcomes from adaptation actions have been achieved (Bours, McGinn and Pringle, 2014; STAP, 2017).

M&E should provide a platform for learning what is working and under which circumstances. This is important in the African context as some agricultural production groups, such as the rural poor, are more susceptible to climate change risk and have limited socio-economic capital to cushion them against maladaptation which would risk their food security and their livelihoods (Davis and Vincent, 2017). It is pertinent to note that M&E for adaptive management of climate change differs significantly from routine M&E, dealing as it does with the uncertainty surrounding the timing of climate change, the long time period associated with the onset of climate change impacts and associated adaptation outcomes, and the uncertainty associated with the magnitude and nature of climate change (Valencia, 2017). These challenges emphasise the importance of ensuring that food security is not adversely affected by maladaptation resulting from poor uninformed

decision making. A properly designed M&E system, complemented by other sound sources of evidence, enables decision makers to make evidence-informed decisions and appropriate adjustments to food security adaptation planning through learning.

Given the adverse impacts of climate change on food security, it is clearly imperative for national and local governments, organisations and individual decision makers to have access to monitoring and evaluation (M&E) systems and other sources of evidence that enable them to determine climate change vulnerability, to assess the risks likely to occur, and to determine the risk thresholds and adaptive capacities of individuals and communities. This will, in turn, enable decision makers to formulate policies and decide on actions for food security-focused climate change adaptation processes. Besides the longterm tracking of adaptation actions, it is also necessary for M&E systems to track or be complemented by other systems which track/measure the resilience of communities – the goal for implementing adaptation actions. Measuring resilience implies the need to embrace complex adaptive systems and their components in a dynamic way and this complicates the choice of indicators (Resilience Alliance, 2010). This is further challenged by the fact that resilience can only really be assessed *a posteriori*, i.e. after the system has successfully coped, adapted or collapsed or, in cases where adaptation actions are short term, where the implementers have exited (Redman, 2005; Dodman, Ayers and Huq, 2009).

To build food security resilience for climate change through adaptive management of climate change, the researchers posit that there are specific actions that must be taken before resilience outcomes are achieved. These are:

1. Collaborations in adaptive management of climate change. By definition, AM emphasises collaboration between various stakeholders in decision making to formulate policies, identify outcomes, design interventions, implement interventions, monitor, evaluate, learn and make iterative actions as a collaborative. Decision makers such as state departments, donors, funders, implementers and the communities involved should all collaborate in designing policies and adaptation actions. This collaboration should happen at all levels i.e. international, national, sector, sub-national[2] and local level[3] (community level). Adaptive strategies and actions developed at the national level might not be compatible in the local context, particularly when climate impacts and adaptation responses are local. A national effort in designing policies and adaptation options is, therefore, required. Collaboration also means that if one stakeholder exits, there is enough institutional capacity to carry on adaptive actions without re-initiating the process. Collaboration also addresses the lack of resources. The state will drive the agenda, which will guarantee the continuation of long-term interventions.

2. Consolidating different sources of information and data. AM is an iterative process and draws on different sources of data such as early warning systems, scientific research, population surveys, monitoring and evaluations, community culture, socio-economic and ecological information. These should be readily available at all levels where decisions on adaptations are made. In resource-constrained countries, such information is not readily available resulting in decisions being made without adequate information.

2 Refers to the lower level of the state (e.g. state, province, region, district or municipality)
3 In this study this specifically refers to the level of government with a direct link to the citizens (provides immediate services)

3. There is a need to purposefully learn and reflect and lessons learned should be integrated into decision making. In AM, there is an ongoing need to continuously refine approaches by decision makers at all levels (rapid learning and learning). The refining of approaches does not only apply at implementation level but also policy level, in programme design, and even applies to the intended outcomes. This is because climate change is uncertain, long-term, and envisaged models and predictions might need to be reviewed, indicating the need for an iterative process to reduce maladaptation.

4. Efficient monitoring and evaluation of short-, medium- and long-term trends is key to adaptive management of climate change. This is because resilience to climate change can only really be assessed *a posteriori*, i.e. after the system has successfully coped, adapt or collapsed. Most development interventions only monitor and evaluate short- and medium-term outcomes because of the short duration of the interventions. Short- and medium-term trends will show if the adaptation actions are on course to achieve the desired outcomes whilst long-term trends will show if the actions have built resilience.

As stated in the objectives, the goal of this study is to examine how the three countries are managing climate change adaptation. Specific focus is on examining the systems supporting the M&E of adaptive management of climate. This will provide an overview at country level and identify factors which can potentially improve the adaptive management of climate in order to build food security resilience.

2. METHODOLOGY

This study adopted a qualitative research approach. The objective was to explore the adaptive management of climate change practices in Tanzania, Uganda and Zambia. The methodology allowed for a holistic approach with a specific emphasis on gaining an overview of how the three countries are adaptively managing climate change in the context of building food security resilience. The research design was collaborative and allowed the study subjects to be co-researchers. Collaborative research design allowed the researchers to engage in a dialogue with coordinators of climate change adaptation actions and implementers of climate change adaptation programmes, M&E practitioners, funders, and decision makers. The expectation was that a collaborative research design would enable the opinions and experiences of researchers, M&E practitioners, policymakers, funders and other stakeholders to contribute to an inquiry of mutual interest and/or benefit (Pushkor, 2008). The researchers took cognisance of the fact that adaptive management of climate change and the building of food security resilience is multi-disciplinary, and is reliant on input from M&E practitioners, climate change scientists, and other stakeholders in the development space, hence the need for diverse voices and perspectives to enable comprehensive and holistic research. Besides the mere participation of the stakeholders as co-researchers in this study, the collaborative research design, in this case, involved a joint process of knowledge production that led to new insights on building resilience for food security in the context of climate change on the part of both researchers, funders, policymakers, and M&E practitioners. However, due to travel restrictions and other constraints imposed to control the Covid-19 pandemic, some of the planned collaborative activities did not occur. These are discussed in the next section.

2.1 Procedures

At the design phase of this study, researchers established consensus on the research objectives and research questions with identified key stakeholders in Tanzania, Uganda and Zambia. After a consensus was reached, the research proposal was submitted for ethical clearance which was subsequently granted. The initial approach to data collection was to convene an in-person participatory workshop per country with specific targeted participants. However, this was not possible because of the Covid-19 pandemic which limited movement and prevented group meetings. To circumvent the challenge posed by the pandemic, the researchers identified the key in-country persons and a decision was made to modify the research design. The changes made to the research design substituted participatory workshops with key informant interviews. The modified design commenced with key informant interviews with purposively selected individuals using a critical-case sampling approach. The key informant interviews were followed by an analysis of the interviews and drafting of the study findings. The draft findings were shared with the key informants for validation purposes. After validation, the researchers finalised the report which was then shared with the various stakeholders in the three countries for their comments.

2.2 Sampling

The study used critical case sampling because of limitations of resources, the restrictions due to the Covid19 pandemic, and the number of stakeholders involved in CCA across the three countries. The approach focused on instances that were considered most likely to produce important information. Critical case sampling was regarded as appropriate because the small number of key individuals working in climate change adaptation are able to provide informed opinions and explain the state of adaptive management of climate change within their respective countries. Although statistical generalisations are not possible, logical generalisations across the country can be carefully applied to the findings.

The researchers, in collaboration with the in-country key stakeholders, identified organisations with a national reach which are involved in adaptation actions and are key to building food security resilience.

These organisations include funders/donors, programme implementers, and policymakers from either state or non-state sectors. The main organisations identified were multilateral, international non-governmental organisations and also included were members of staff from the climate change coordination units in state institutions. The key people from these organisations were identified to take part in interviews. The key informant interviews (KII) were held between June and July 2020 via online platforms. It is important to note that across the three countries there is a dominance of international institutions who either support sector implementation of adaptation actions or implement these actions independent of the state. The data from the critical samples was augmented by a desktop review of literature, policies, strategies and evaluation reports. The table below shows the distribution of key informants from the three countries.

Table 1: Types of respondents

Country	Number of state KII	Number of multilateral and other NGO KII	Total
Tanzania	2	3	**5**
Uganda	3	3	**6**
Zambia	3	3	**6**
Total	**8**	**9**	**17**

To foster the collaborative approach adopted for this study, the findings were shared with the interviewees to validate and contribute any additional information.

2.3 Study area

Three countries, Zambia, Tanzania and Uganda, were purposively selected as case studies. These three countries share common traits, including that the majority of the population live in rural areas and depend on agriculture for their livelihood, the countries have high climate change-induced food security vulnerability, and are poor performers on the Global Hunger Index. In addition to these traits, CLEAR-AA has been working in these countries to strengthen their M&E systems and consequently this work will not exist independently of other systems but will serve to contribute to country M&E system capacity strengthening.

2.4 Data analysis

Data from key informant interviews was analysed using an interpretive approach and a further participatory analysis (through validation of findings) was done with the assistance of a group of stakeholders for data interpretation and meaning-making processes. The process was done by means of a webinar during which the analysed data was discussed and validated (to be revised after the webinar). This thorough approach increases the likelihood that the findings and recommendations will be put to practical use and accurately reflect of what is happening in each of the countries.

3. CLIMATE CHANGE ADAPTATION IN TANZANIA, UGANDA AND ZAMBIA

3.1 National adaptation programmes of action, climate change vulnerability and priorities

Climate change has been a priority of the global development agenda and there have been significant efforts to help the least economically developed countries to adapt to climate change and mitigate climate change impacts by reducing the accumulation of greenhouse gases in the atmosphere responsible for global warming. As a global systematic approach to climate change adaptation, least developed countries (LDCs) such as Tanzania, Uganda and Zambia were asked to develop the National Adaptation Programmes of Action (NAPAs) – a document that identifies urgent and immediate activities useful for coping with climate change. All three countries in this study developed their NAPAs in 2007. The NAPAs were then presented to the international donor community for support through the United Nations Framework Convention on Climate Change (UNFCCC). The development of NAPAs in the three countries was consultative and involved a range of stakeholders from government, academia, and non-governmental organisations. The NAPAs identified areas of vulnerability by means of vulnerability assessments, climate change impacts, and priority areas for climate adaptation.

The three countries are also signatories to the 2015 Paris Agreement (an agreement according to which all signatory nations espouse the common cause of combating climate change and agree to seek solutions to mitigate the effects of climate change while also undertaking to provide enhanced support to assist developing countries to do so). Under the terms of the Paris Agreement, countries are expected to submit their Nationally Determined Contributions (NDCs). The NDCs comprise the undertakings of each country to reduce national carbon emissions and adapt to the impacts of climate change. Currently, the three countries are at various levels of developing their NDCs. In addition to the NAPAs, the three countries also have developed national climate change policies/strategies and are also signatory to the Sendai Framework. It is pertinent to note that the NAPAs, climate change policies, and strategies across these three countries highlight the countries' vulnerabilities, the prevailing climate change impacts, and the key priorities identified to address the climate change impacts. The following table highlights the three countries' climate change vulnerabilities and projected impacts – these were extracted from the NAPAs and country strategies/policies.

Table 2: Climate change vulnerabilities and projected climate change impacts

Climate change vulnerability/ hazards	Projected climate change impact
TANZANIA	
Increasing temperatures	• Shifts in disease vector habitats/incidence of malaria; respiratory problems • Shifts in the suitable areas for cash crops; reduced maize output; • Increased evaporative losses; damage to road infrastructure; cooling costs; and • Biodiversity loss as niches are obliterated; changing ecological dynamics.
Increased occurrence of droughts	• Increased risk of waterborne disease; food shortage; water conflict; famine; • Crop failure; reduction in grazing lands and livestock loss; • Water shortages for human and livestock consumption; and • Additional pressure on natural resource use (forests and fisheries).
Increased rainfall and shift in seasonality	• Increased risk of waterborne disease; flood/landslide risk; • Elevated erosion, land degradation and crop loss; change in crop yields/disease; • Flood damage to infrastructure, transport, communications and settlements; and • The shift in habitats and growing seasons.
Sea level rise	• Inundation of low-lying coastal areas; possible elevated salinization of coastal aquifers; • Coastal flooding and modification to port facilities.

Climate change vulnerability/ hazards	Projected climate change impact
UGANDA	
Increased rainfall	• Heavier and more violent storms in the wettest districts; • Heavy rainfall leads to flash floods, and floods result in the outbreak of waterborne diseases such as diarrhoea and cholera; • Waterlogged fields or washing away of crops affecting agricultural production; • Erratic onset and cessation of rainfall seasons affecting the crop growing season; • Destruction of infrastructure, destruction of biodiversity, direct loss of lives; • Soil erosion and land degradation; and • Epidemics of pests and diseases.
Drought (frequent and prolonged)	• Prolonged dry spells resulting in outbreaks of respiratory diseases. • Reduction in agricultural production seriously impacting the livelihoods of rural communities; • Increases in food prices leading to an unstable macro-economy and resulting in inflation which discourages foreign investment; • Severe water shortage/scarcity leading to loss of animals, low production of milk, food insecurity; • Famine, malnutrition, pasture insufficiency, lack and disappearance of pastures, water stress, drop in water levels in bodies of water; • Low production and productivity of crops and animals; and • Health hazards and poverty.
High temperatures	• The emergence of new pests; • Impact on coffee growing; • Wildfires and burning leading to the destruction of natural vegetation and detrimental impacts on biodiversity; • Proliferation of mosquitoes and increasing prevalence of malaria; and • Reduction in labour and agricultural productivity.
ZAMBIA	
Drought	• Key crop varieties such as maize not maturing due to the shortening of the growing season; and • Increased food insecurity and famine.
Flooding	• Increased risk of flooding in areas which traditionally are not prone to flooding. • Destruction of crops and infrastructure causing hunger, siltation and sedimentation of rivers and streams, soil erosion resulting in the formation of gullies on roads and agricultural lands; • Reducing arable land; • Proliferation of epidemics such as malaria and the destruction of livestock; and • Displacing people and destroying grasses, reeds and some plants.
Extreme temperatures	• Increase in climate-sensitive diseases, heat stress caused by the rising temperatures, malaria, diarrhoea, cholera, and respiratory infections; and • Increase in water-borne diseases
Prolonged dry spells	• Poor pastoral conditions; • Damage to crops and subsequent reduction in food production, especially staple foods.

Source: *Tanzania NAPA 20017; Zambia NAPA 2007; Uganda NAPA 2007, Zambia climate change policy 2017; Uganda National Climate Change Policy (NCCP) 2015* and *Tanzania National Climate Change Strategy 2012.*

3.1.1 Tanzania

In developing its NAPA, Tanzania conducted assessments of climate change vulnerabilities. These assessments identified a variety of vulnerabilities in the agricultural sector. They included decreased production of different crop types which was exacerbated by climatic variability and unpredictability of seasonality, erosion of the natural resource base, and environmental degradation. With regard to maize, it was found that as a result of increased temperatures, reduced rainfall, and a change in rainfall patterns, the average yield would decrease by 33% countrywide. Furthermore, it was predicted that the yield of maize would decrease by up to 84% in the central regions, 22% in north-eastern highlands, 17% in the Lake Victoria region, and by 10 to 15% in the southern highland. Regarding coffee, it was found that a temperature increase of 2 to 4 ºC, coffee production would decrease by 18% in bimodal rainfall areas and 16% in unimodal rainfall areas.

It is further expected that climate change would shrink the rangelands which are important for livestockkeeping communities in Tanzania. This shrinkage is expected to be even further aggravated by the fact that about 60% of the total rangeland is infested by tsetse fly, making it unsuitable for livestock pastures and human settlements. Also, this shrinkage of the rangelands is anticipated to exacerbate conflicts between livestock keepers and farmers in many areas because the number of cattle in most areas surpasses the optimal carrying capacity. This has resulted in most livestock keepers moving their herds towards southern Tanzania in search of pastures.

The recurrent droughts in Tanzania are leading to critical food shortages with consequent food insecurity and hunger. Therefore, considering the effects of the drought and the findings of the climate change vulnerabilities assessment, for each sector, depending on its vulnerability, various coping strategies were identified and potential adaptation strategies were proposed for each sector. It is clear that significant efforts would be required to achieve food security at national and household levels and to enable rural communities to generate income from farming activities.

The vulnerabilities of the agriculture sector in Tanzania include unpredictable rainfall and uncertainty in cropping patterns; shifting in agro-ecological zones; prolonged dry spells beyond normal patterns; increased weed competition with crops for moisture, nutrients and light; ecological changes for pests and diseases; and, due to increased temperatures, a 33% decline in maize yields (staple diet) which is the national food crop due with the highest decline being reported for Dodoma and Tabora. The existing adaptation activities identified in the NAPA include the use of small-scale irrigation systems; research and development (R&D) on drought-tolerant seed varieties; agriculture extension activities; diversification of agriculture, including growing different types of crops on different land units; and water harvesting. The NAPA also identified potential adaptation activities to address the vulnerabilities of the agriculture sector. These included alternative farming systems; promoting indigenous knowledge; changing planting dates in some agro-ecological zones; increasing irrigation to boost maize production in selected areas; and drip irrigation for specific regions. Other proposed adaptation measures included reducing reliance on maize as a staple food by growing short-season and drought-tolerant crops such as sorghum and millet; shifting crop farming to more appropriate agro-ecological zones; changing crop rotation practices; integrated crop and pest management; making better use of climate and weather data, weather forecasts and other management tools; creating awareness on the negative effects of climate change; sustainable water management to boost food crop production; and strengthening the early warning system.

3.1.2 Uganda

The Uganda NAPA was developed collaboratively by several organisations including the Government of Uganda, the Global Environment Facility (GEF) and the United Nations Environment Programme (UNEP) in 2007. According to NAPA and NCCP, more than 80% of Uganda's population is rural and depends heavily on rain-fed agriculture which is vulnerable to the impacts of the adverse effects of climate change. According to the NAPA and the climate change strategy, climate change is expected to increase the frequency and intensity of extreme weather events such as droughts, floods, landslides and heatwaves in Uganda.

The effects of climate change on agricultural production in Uganda are diverse and complex. An example is that an increase in temperature escalates soil chemical reactions leading to an increase in the decomposition of organic matter and therefore the release of greenhouse gases into the atmosphere. This process also results in a loss of soil fertility which negatively affects yield. Another example provided was that increased concentrations of CO^2 improve rice, wheat, and soybean production while corn, sorghum, sugarcane, and millet yields are affected negatively. It was found that temperature increases lead to an extension of the growing period for crops in high-latitudes and raised CO^2 levels result in an increase in yield in colder conditions; this is linked to increased prevalence and emergence of pests and vectors resulting into an escalation of diseases. Therefore, it was concluded that the effects of climate change are difficult to predict.

In various areas of the country the rising temperatures have resulted in an abundance of mosquitoes, thereby increasing the prevalence of malaria with consequent negative effects on labourers and a reduction in agricultural productivity. Furthermore, crops such as cassava which previously did not thrive in the cold mountainous zones of those could now be grown in these areas. With regard to pest and disease epidemics, the rise in temperature in the cold mountain areas has enabled vectors and pests to increase their ecological range to areas where they would otherwise have been limited by low temperatures. The consequence is that there is greater infestation during the following production season. Also, altered wind patterns were found to have changed the spread of wind-borne pests, vectors and crop pathogens, and livestock and human diseases thereby limiting production.

Rural communities in Uganda are implementing a variety of strategies to cope with climate change and its effects. The climate change policy states that these existing practices should be incorporated into planned interventions. The coping strategies relating to agriculture and food security include:

- Food preservation, which involves the use of different techniques such as sun drying, use of herbal plants and ashes to store food, and the use of honey and smoking to preserve meat.
- Underutilised and non-conventional foodstuffs are consumed by households in times of food scarcity. Many are grown traditionally or occur in the wild and these include wild yams (modo, endagu), mulondo, matungulu, honey and wild fruits and also crops traditionally used for brewing beer, such as banana and sorghum varieties, cassava and jackfruit;
- Water harvesting by collecting water from various sources such as ground, rooftops and stem runoffs during droughts and times of water scarcity. Farmers use stem runoff for drip irrigation of crops such as vanilla, bananas and vegetables;
- Soil conservation to prevent soil erosion, landslides and soil degradation involves the construction of infiltration ditches around homes, planting grass cover, terrace farming, digging trenches to divert runoff, mulching and tree planting;
- Changes in husbandry practices to cope with feed and water scarcity and high temperatures during droughts by manipulating grazing and watering practices.

The Ugandan government identified a need to improve meteorological services to provide timely weather and climate information early warning systems. Further improvements could be made if stress-resistant species were developed and promoted. The key intervention strategy for the agriculture sector was to promote community best practices of collaborative natural resource management.

3.1.3 Zambia

According to the Zambian NAPA, the vulnerable sectors in Zambia include agriculture and food security, wildlife, forestry, water, energy, and human health. These sectors have been adversely affected by climate change thereby significantly impeding the economic, social, and environmental goals of the national sustainable development of the country. Vulnerability assessments found that with regard to crop production key crop varieties such as maize would not mature due to the shortening of the growing season and, as this is staple crop, this would seriously undermine food security. Additional vulnerabilities include the destruction of crops and infrastructure resulting in famine; siltation and sedimentation of rivers and streams; soil erosion resulting in gullies across roads and agriculture fields; reduction in arable land; a proliferation in epidemics such as malaria; destruction of livestock; displacement of people; and the destruction of grass, reeds and certain plants.

The impact of floods on the country's agriculture and vulnerable communities is grave. Communities report that the effects of the floods include hunger due to the destruction of crops; reduction in arable land and soil erosion; loss of shelter and displacement of people; reduced nutrition; and loss of livelihoods earned from livestock. It was found that the most vulnerable groups were rural households. Flood reports revealed that despite various communities' coping strategies, and in addition to flooding occurring in areas that had never experienced floods before, floods had come earlier than usual and had significantly disrupted livelihoods.

A large number of adaptation measures were proposed to address the drought affecting regions 1 and 2, particularly the eastern, central, western and southern provinces;

- Water harvesting;
- The use of technologies for fertility improvement and moisture storage (including soil conservation measures);
- The building of dams and dip tanks and ensuring a sustainable supply of feed to mitigate the effects of droughts;
- The promotion of improved crop and livestock management practices;
- The introduction of well-adapted livestock; improving the Zambezi River water system to increase delivery;
- Fish breeding to restock the lakes, rivers and dams; and
- The promotion of aquaculture.

Several adaptation measures were also proposed to address both droughts and floods affecting regions I and 2, particularly the eastern, central, western and southern provinces. These included improving the post-harvest storage and marketing of produce; strengthening the early warning systems and preparedness; application of GIS/ remote sensing in the mapping of drought- and flood-prone areas; and using species suitable for aquaculture in vulnerable areas. Some of these proposals have been implemented.

3.1.4 Impact of climate change food security

Across the three countries, Tanzania, Uganda and Zambia, the prevalence of food insecurity-related challenges are increasing and the causes of these insecurities are mainly related to the frequency of climate change-related adverse weather events such as drought, flooding, changing rainfall seasons, cyclones etc. The increase in food insecurity emphasises the importance of adaptive management of climate change which enables local populations to build resilience so that they are cushioned against the impacts of climate change. The table below shows the changes in food insecure population from 2015 to 2019 and the prevalence of stunting (indicating acute malnutrition).

Table 3: Food insecurity and prevalence of stunting

Country	Food-insecure population in 2015	Food-insecure population in 2019	% change in food-insecure population	Prevalence of stunting among children (0-5yrs)
Tanzania	358 000	740 000	87%	35%
Uganda	6 700 000	8 800 000	31%	39%
Zambia	798 000	2 300 000	127%	40%

Source: FAO 2020, WFP 2020, SADC 2019

3.1.5 Implication for adaptation plans on adaptive management of climate change.

Despite the NAPAs, policies and strategies in the three countries, the key elements necessary to enable adaptive management of climate change are lacking. First, despite the NAPAs providing the requisite actions/measures, they fail to show a clear theory of change which explains how the adaptation actions/measures facilitate the intended outcomes and impacts. Second, the policies, strategies and NAPAs Tanzania and Zambia fail to provide specific indicators or to explain how active learning will take place – both of which are key to adaptive management of climate change. Third, NAPAs, policies and strategies in all three countries fail to explicitly identify the collaborative structures for stakeholder participation and collaborative learning. Fourth, given the uncertainty of climate change, NAPAs, policies and strategies do not factor in real-time decision making and also fail to include plans for the evaluation of the actions/measures taken for climate change adaptation. The implication is that those implementing adaptation actions in these countries are not afforded the opportunity to change course in response to variations in climate change interventions. Without making a deliberate effort to address these important factors, these three countries will find it difficult to adaptively manage climate change.

4. FINDINGS

4.1 Institutional arrangements for climate change adaptation/adaptive management of climate change

4.1.1 Uganda

In Uganda, climate change coordination falls under the Climate Change Department (CCD) which reports to the Ministry of Water and Environment. The CCD was created to lead and oversee the implementation of Uganda's climate change policies which were designed to incorporate the country's international obligations to the UNFCCC, the Paris Agreement, the Sendai Framework and the Kyoto Protocol. Besides leading the implementation of climate change policies, the unit also plays a coordination role across all government departments on climate change matters. The coordination role also involves specific M&E responsibilities and the information gathered is disseminated to national leadership and an international audience. The department focuses on two aspects of climate change – climate change mitigation and adaptation. Uganda has a climate changespecific M&E framework which is used as a tool to track implementation of the country's climate change policies. However, it is important to note that the M&E framework at the national level is still project-based and does not reflect the consolidated national climate change adaptation outcomes.

This study did not find any evidence to show that climate change adaptation M&E systems exist in the different sectors affected by climate change. Climate change adaptation and mitigation M&E systems are defined at the national level through the CCD but linkages to the national CCD at sub-national and local level are not clearly defined. The absence of laws and policies to enable sector reporting to CCD was identified as a major impediment. Currently, different sectors such as tourism, infrastructure, health, agriculture etc. report individually to the CCD and are responsible for developing their own M&E systems, setting adaptation outcomes and priorities, and formulating adaptation indicators. However, respondents highlighted that this poses a challenge as, in addition to the non-alignment of M&E systems and indicators to national systems, sector priorities and adaptation outcomes are also not aligned to national priorities. Sectors also have different reporting templates making it difficult for CCD to consolidate information. These challenges are compounded by the absence of laws and policies defining the procedures to be followed for the coordination of the CCD's climate change function. There is no evidence to show how non-state entities contribute to national decision making or how their M&E systems engage with the national M&E system despite considerable investments having been made by these organisations to address adaptation to climate change. It is important to note that adaptive management of climate change is not mentioned in any of the country policies and the adaptation system itself is devoid of any adaptive management features.

4.1.2 Zambia

The Zambian climate change institutional arrangements are more elaborate and complex. Heading the institutional arrangement is the vice president's office to which the Council of Ministers and the Disaster Management and Mitigation Unit (DMMU) report. The Council of Ministers is constituted by ministers from various sectors and is mainly responsible for climate change policy guidance and mainstreaming climate change at all levels of the state. The DMMU is responsible for the development and implementation of climate change-related disaster preparedness and response programming. Besides the vice president's office, there are also two other government ministries, the Ministry of Lands and National Resources which reports to the Steering Committee of Permanent Secretaries and is responsible for the implementation of climate change policies. The Ministry of National Development Planning is responsible for coordination, oversight and mainstreaming of climate change in the national development planning process. In addition to these departments, there is a recently created Climate Change and Natural Resources department, which falls under the ministry responsible for Land and Natural Resources. The department assumed the overall coordination role of the Interim Climate Change Secretariat which previously reported to the Ministry of National Development Planning. The department is still in its infancy and is at the development stage for various M&E policies and tools.

Currently the Climate Change and Natural Resources Department is developing a Measuring, Reporting and Verification (MRV) system. This MRV system focuses more on climate change mitigation than it does on adaptation. Interviewees indicated that the MRV will include M&E indicators to monitor adaptation measures and that these will not focus exclusively on agriculture and food security but also on other sectors affected by climate change. The main objective for the development of this system is to assist the country in the revisions and updating of its NDC (Nationally Determined Contribution). The system offers a mechanism for tracking and measuring progress, facilitating the achievement of the adaptation goals, and building resilience against climate change, as enshrined in the NDC.

4.1.3 Tanzania

In Tanzania, the coordination of climate change and adaptation is the responsibility of the vice president's office which sets the policy and is responsible for international engagement on climate change issues. Within the vice president's office, a minister is responsible for the Division of Environment (DoE) which links directly with regional sub-national environmental units. The Division of Environment also links with other sectors but the ways in which coordination takes place is not clearly articulated. The DoE is both the National Climate Change Focal Point (NCCFP) and the Designated National Authority (DNA) for the clean development mechanism under the Kyoto Protocol. The DoE is the key coordinating agency mandated to deal with all issues of the environment and currently this includes climate change. The Tanzania climate change strategy directs all government ministries and agencies to establish a climate change desk that will address climate change-related issues at the sector level and relay the information to the VPO as the national coordinating unit.

Concerning monitoring and evaluation, the Division of Environment has a monitoring and evaluation framework for climate change adaptation which was designed in 2012. According to the framework sector environmental sections (sector coordinators), regional environmental experts, and the town/city/municipal/district environmental management officers, are responsible for monitoring performance and reporting on climate change and adaptation to the Division of Environment. Despite these policy directives, the capacity for adaptive management of climate change at the local level is not known. Agricultural field extension officers are the link between the community and the sub-national level of government. It is important to note that the framework is more of a guide and contains no specific indicators/outcomes for climate change adaptation. Sectors and various state programme implementers are expected to use the framework as a tool when developing programme monitoring and evaluation plans.

In Tanzania, as is the case in Uganda and Zambia, despite coordinating units having been established, the influence of the units in other sectors is limited due to poor coordination, lack of human capacity, and constrained financial resources. This has a direct impact on the information which is received by the VPO and the minister responsible for the environment leading to decision making which is not informed by actual evidence of the context and prevailing conditions at the local level.

Across the three countries, only the ministries where the coordinating units are located, such as the ministry of the environment, have a holistic perspective about climate change adaptation and are privy to all the approaches to climate change mitigation and adaptation. It is important to emphasise that adaptation occurs at the local level and that therefore institutional arrangement for climate change adaptation should also extend to local level in order to function efficiently as coordinator of adaptive management of climate change. Institutional arrangement is key as it influences how households are affected by climate change impacts, shapes the ability of households to respond to climate change, and facilitates the flow of external interventions. Such institutions provide platforms for collaboration, learning, setting the agenda, and course correction. Evidence from the three countries shows that the climate change coordination units have limited local reach and hence cannot influence what is happening at the local level. It is important that the three countries are aware that adaptive management of climate change does not occur in an institutional vacuum and that the institutional arrangement of adaptive management of climate change should create

institutions which are sources of knowledge, or knowledge brokers who facilitate multiway interaction and engagement among the various stakeholders involved in climate change adaptation. These institutions should be supported by efficient M&E systems and other sources of data. These three countries should also create institutions which connect households to available information and thereby create a basis for further collaboration.

4.2 Food security and climate change adaptation process

Despite the clearly stated vulnerabilities, key priorities and policies for climate change adaptation, respondents indicated that climate change adaptation programmes are expensive for governments to implement and therefore the bulk of these programmes are donor-funded. International agencies such as the UNDP, WFP, World Bank, African Development Bank, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), Oxfam, Save the Children and other various international funding platforms are implementing programmes in sub-Saharan Africa to address the adverse effects of climate changes. The majority of the interventions are focused on addressing food security by increasing agricultural production. The approach by these organisations is to focus on specific areas of vulnerability and to design interventions which are aimed at addressing the impacts of climate change. Areas of focus include adapting food production to climate change, providing food aid to food-insecure communities, implementing new farming techniques (smart agriculture), and by providing extreme events crop and livestock insurance etc.

In Tanzania, climate change adaptation programmes exist in sectors such as agriculture, governance, disaster risk management, human health, and freshwater supply. The study found that a variety of projects have been implemented at the national level including the Global Climate Change Alliance's project on integrated approaches for climate change adaptation, the United Nations Environment Programme (UNEP) to reduce livelihood and economic vulnerability in coastal regions, the government's project on building adaptive capacity in productive coastal zones, and the UNDP's efforts to strengthen climate change governance in Zanzibar. The purpose of these projects includes increasing the capabilities of institutions to manage climate change impacts through improved climate information, technical capacity, monitoring capabilities, and early warning systems. The intention of these projects is to mainstream climate change adaptation in the implementation of national policies and development planning. Monitoring and evaluation of these programmes focus on project work and the M&E products focus on improving project performance.

In Zambia, several programmes focus on addressing the impact of climate change on food security, especially as a result of drought and flooding. Other programmes focus on building food security resilience by improving agricultural practices. Some programmes focus on climate-smart agriculture, climate-proofed agriculture, improving service delivery on weather and climate information, provision of crop insurance for farmers, developing drought-resistant crop varieties etc. In Uganda, there are similar programmes which address food production and also implement agricultural practices which mitigate the impacts of drought and flooding.

It is also important to note that besides programmes which build resilience for climate change, there are also programmes being implemented by international organisations that focus on providing humanitarian relief in areas where communities are food insecure. The respondents highlighted that if climate change adaptation has been successful, there should be fewer food-insecure households and communities. Respondents highlighted that the general perception is that climate change adaptation at both state and non-state institutions concentrates mainly on reactive adaptation programmes (addressing the impacts of climate change) compared to anticipatory interventions aimed at enhancing the resilience of social and natural systems. One of the respondents described such an approach as a "firefighting approach instead of fire prevention". Reactive approaches in most cases do not build resilience but only serve as a coping mechanism in response to climate change shocks and stresses. Respondents highlighted that the response of these organisations is not widespread but rather focuses on areas which are hardest hit by extreme climate change events such as drought, floods and prolonged dry weather.

Respondents emphasised that despite the known vulnerabilities and key priorities for climate change adaptation, the focus appears to be on specific priorities and sectors such as agriculture and neglects other areas key to food security. Programmes largely target food system activities rather than adaptation outcomes. In Tanzania and Uganda, interventions for building resilience concentrate on crop farming (mainly staple crops) compared to other key priorities such as aquaculture and other areas that strengthen food security resilience. Zambian interventions are integrated and the entire agricultural spectrum of crops, livestock, fisheries, and agro-forestry are all prioritised indicating that there is more focus on resilience building. Apart from enhancing production, Zambia is working on ensuring access to markets and reducing post-harvest losses as well as promoting value addition to these products, all of which promote the building of resilience. The dominance of the non-state sector has shaped the climate change adaptation actions. The implication is that sources of information focus more on crop farming than on other key priorities.

4.3 Sources of information for adaptive management of climate change

One of the objectives of this study was to explore the sources of information/data for adaptive management of climate change. To address a complex and serious problem such as climate change, this study sought information on the sources of information used for decision making on adaptation actions. The expectation was that countries make use of dedicated systems to generate information which is then used for adaptive management of climate change. Although there was recognition and concurrence in the three countries of the need for adaptive management of climate to be supported by sound sources of information, in practice this did not happen. Respondents emphasised that several sources of information are needed for adaptive management of climate change or to inform decision making on climate change issues. All respondents agreed that climate change adaptation is an iterative process which needs a continuous supply of information to inform decision making. However, it was reiterated that the information available is limited because some sources of information are the sole preserve of the state and that access to information is further hindered by a lack of human capacity, constrained financial resources, and lack of capacity to produce the required information. The main sources of information regarded as key to adaptive management of climate change are performance monitoring systems, evaluations, early warning systems, national and sub-national level M&E systems, indigenous knowledge systems, scientific research and development, and climate change modelling and prediction information.

4.3.1 M&E systems

Monitoring systems

Performance monitoring plays a key role in the adaptive management of climate change. As alluded to earlier, AM is an iterative process which depends on various sources of data one of which is performance monitoring. Across the three countries, there are no fully operational systems specifically designed to collect, analyse and inform climate change adaptation actions. However, efforts are being made to develop performance monitoring systems which are aligned to climate change mitigation. Uganda has developed a monitoring and evaluation framework/policy with specific climate change adaptation indicators. However, the framework faces implementation challenges such as lack of human capacity and resources across sectors and sub-national levels. It is commonly the case in Uganda, Zambia and Tanzania that transition from the national scale to the sector, sub-national and local scales does not make provision for specific sector or localised adaptation outcomes and priorities which serve to inform adaptation actions. Within state institutions and scales the focus is on collecting administrative data. The implication is that performance monitoring systems are designed to capture sector or programme specific administrative data which may not align with national adaptation outcomes and priorities. The implication is that this data and information is unsuited for the purpose of consolidation and reporting to the national climate change coordination units and neither is it suitable for adaptive management of climate change. The national coordinating units therefore fail to receive the necessary information on adaptation actions at these scales. At lower level scales such as at sector and sub-national scales, the absence of mainstreaming climate change adaptation and

clearly defined adaptation outcomes and priorities means that the M&E systems that are in place are not able to capture the appropriate data for decision making at that scale.

The non-state sector (multilateral organisations and other NGOs) has performance monitoring systems that supply information for their adaptive management of climate change. It was indicated, however, that these systems are designed to account to the programme leadership, funders and donors and that the system allows very limited room for mistakes, non-performance or deliberate changing of course on programmes. This is effectively a lost opportunity to learn from implementation as performance monitoring systems have been designed to meet accountability requirements. In cases where learning occurs, it is within the organisations and not in collaboration with the other involved stakeholders as performance monitoring data is rarely shared with the state, the communities and the households who could potentially be the beneficiaries of such interventions. One respondent explained that the non-state sector is the beneficiary of learning opportunities in the countries which depend heavily on foreign funding for adaptation actions and that the governments are deprived of the opportunity to lead the adaptation process and coordination role. Overall, across the three countries, there are no M&E systems which generate data for adaptive management of climate change. Without functional M&E systems, the iterative processes to refine approaches becomes difficult to execute as there is no information to support the processes.

Evaluations

Evaluations in climate change help determine what works well, what kind of adaptive capacity has been built, what the following step should be, and what could be improved upon in future adaptive actions. As is the case in other development areas, the trend in all three countries is that evaluations commissioned by the state are scarce (although multilateral organisations speak of joint evaluations with the state) and when they are commissioned their focus is limited in scale and scope. International organisations are predominantly commissioned to conduct evaluations. However, these evaluations are usually related to specific localised programmes and focus on assigning attribution rather than on making a contribution and hence they are limited in scope and scale. Respondents indicate that it is difficult to make decisions at the national level based on evaluations which focus on localised programmes concerned with the specific ecological and socio-economic consequences suffered by communities which have been victims of extreme events. Such evaluations are relevant in the local context and may not necessarily be applicable in the national context. Respondents also indicate that the majority of the adaptation actions are reactive and hence the evaluations are largely short-term localised actions (more humanitarian) implemented to cushion the community and households and are therefore less useful for building long-term resilience for food security. Evaluations are scarce, they focus on narrow programme achievements, and neglect the broad impact of the adaptation actions on building adaptive capacity.

4.3.2 Early warning systems (EWS)

Respondents across all the three countries concur that early warning systems play a critical role in adaptive management of climate change. They argue that climate change is an unpredictable and long-term phenomenon hence the need for an EWS which generates climate change models, provides information on what is likely to happen in future, and informs decision makers about the available adaptation alternatives. Respondents from all three countries note that country early warning systems are mainly meteorological departments which have varying capacities. It is important to note that there are other types of systems warnings for specific climate change impacts such as food insecurity and other climate change disasters. The Tanzania Meteorological Agency (TMA) plays a key role in providing information on impending droughts, flooding, fluctuations in seasonal norms, and daily weather updates. In Zambia, the Meteorology Department (ZMD), under the Ministry of Transport and Communication, fulfils the early warning system role, especially for the agricultural sector. In addition to the meteorological department, Zambia also has the National Early Warning Systems (NEWS). The role of NEWS is to assist the government in the planning and execution of food production and supply management programmes to ensure food security in the country.

In Uganda and Tanzania, IGAD Climate Prediction and Application Centre (ICPAC) acts as an early warning system which serves as a regional bureau for climate change information. Across the three countries, there is no direct link between early warning systems and climate change coordinating units. Early warning systems are directly linked to specific sector ministries such as agriculture, tourism, environment, energy etc. The early warning systems mainly provide information relevant at the national level and, to some extent, at a regional level. Respondents emphasise that it would be useful for early warning systems to provide information at a local level since adaptation actions take place at local level rather than at the country level. If early warning system information is available at the local level (instead of national or regional blanket level), farmers, for example, would have the opportunity to devise a localised response. The manner in which the information is packaged and disseminated was considered an impediment to the effective use of such information at local level e.g. in Zambia, community information which is key to decision making was disseminated by radio despite certain areas having no radio coverage.

Early warning systems such as Famine Early Warning Systems Network (FEWS NET), created by USAID in 1985, is a leading provider of early warning and analysis on food insecurity. FEWS NET discontinued the provision of its services in Tanzania and Zambia in 2017 but it is still active in Uganda. The FEWS NET information shown below shows the food security situation in Uganda from July 2020 to January 2021. The study did not find evidence that there is a mutual sharing of such information with their state counterparts.

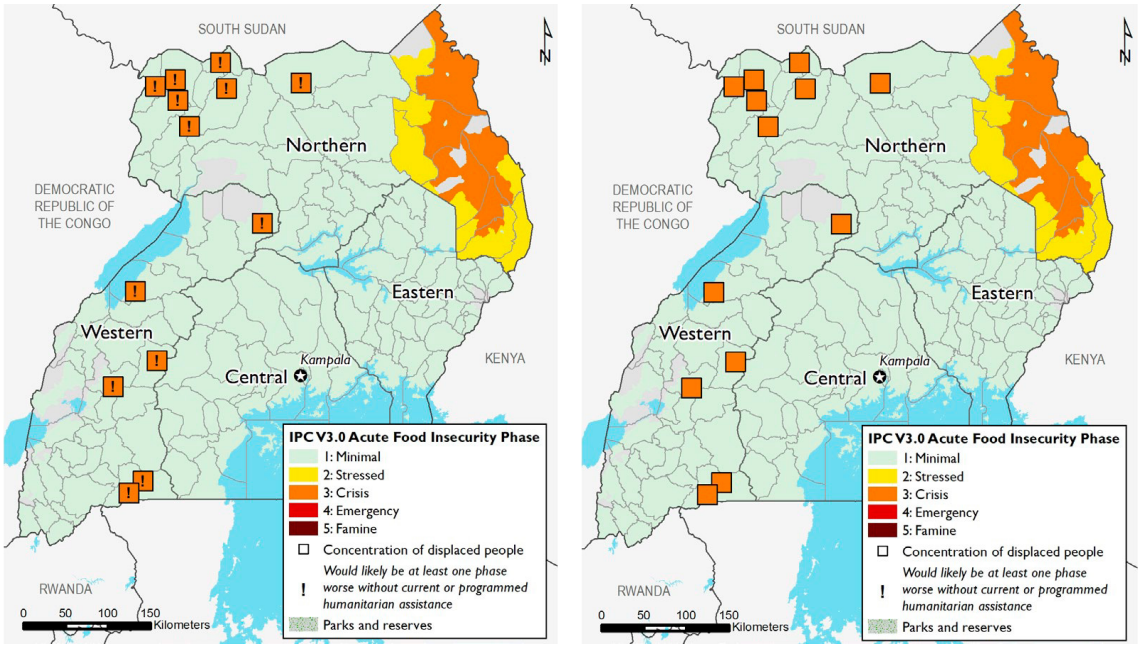

Figure 2: Uganda food security outcomes EWS 2020–2021. Left, February to May 2021; right: June to September 2021

Source: *The Famine Early Warning Systems Network (FEWS NET) (2020)*

4.3.3 Scientific research and development (SRD)

There is agreement across the three countries that scientific research and development is key to adaptive management of climate change. SRD involves the creation of climate-proofed and climate-resistant products such as drought-resistant crops, the development of early maturing varieties of crops, new animal breeds, new crop hybrids and other processes and products which stakeholders can use to adapt and build resilience to climate change. Respondents stated that information on these types of solutions is not yet readily available and that the use of such innovations is limited by a lack of resources to fund the purchase of equipment needed for the development of climate-related products and services. Human capacity is also lacking within institutions such as universities and state institutions mandated to devise such solutions. Without the necessary information to adapt to changed climatic conditions, farmers, for example, might not be aware of scientific innovation in terms of which crops to grow under which ecological regions. This could result in a failure to use scientifically proven adaptation strategies compatible with local contexts.

4.3.4 Indigenous knowledge systems

Respondents explained that across the three countries adaptation actions are being designed and implemented without a clear and thorough understanding of the local context on which the communities and households base their adaptation actions. It was highlighted that there tends to be an overreliance on expert technical inputs which are more highly valued than the lived experiences or perceptions and indigenous knowledge of the people directly affected by climate impacts. It was indicated that indigenous knowledge systems play a critical role in shaping how communities and households respond to climate shocks and stressors. This is information such as traditional practices, indigenous early warning systems for drought, rainy season length, floods, and prolonged dry spells. Also highlighted by respondents as being key to climate change adaptation are the traditional cultural beliefs and practices and socio-economic status which have traditionally determined the adaptive response of households or communities to climate change. Across the three countries, there is no evidence to show that the state and non-state institutions tap into these indigenous knowledge systems. An example was given for Zambia where farmers insist on growing maize although other drought-resistant crops such as cassava are available because maize traditionally is their staple food. In Tanzania, an example of 'imported' adaptation actions is the advice given to communities to plant cash crops (more drought resistant) instead of food crops. This is to dissuade communities from planting crops which are more susceptible to the impacts of climate change.

4.3.5 National and sub-national surveys

Respondents across the three countries concurred that national, sub-national and sector-specific surveys are key sources of information for adaptive management of climate change. Food security resilience surveys which produce information such as livelihood data on community coping strategies, crops, livestock, fish production, population health information, and household and socio-economic data are key to creating a baseline at all scales of climate change adaptation process. Surveys such as a national census, demographic health surveys, MICS, annual agricultural surveys and other sub-national level periodic surveys were cited as valuable sources of information for adaptive management of climate change. However, respondents across the three countries indicated that despite the importance of climate change issues in the development nexus, current surveys are not designed to capture baseline data for adaptive management of climate change. This poses a challenge where the baseline of adaptive capacity, vulnerability, coping strategies, crop and livestock production are unknown leading to difficulties in measuring progress at all scales. Respondents stated that while other sectors such as agriculture and environment might have baseline data, this data is only a part of the information necessary for effective adaptive management of climate change.

4.3.6 Integrating other sources of information into M&E systems

As highlighted in the conceptual framework, adaptive management of climate change requires M&E systems with the ability to enable accountability, facilitate learning, provide real-time information and synthesise evidence from sources such as early warning systems, indigenous knowledge systems, national surveys, and to incorporate information on scientific research and development. Such M&E systems are expected to analyse information and create models/scenarios with specific assumptions, baselines, and progress expected, and also to identify information gaps. This would enable decision makers to make informed decisions based on available information. In the three countries, the findings of this study show that, where available, M&E systems are traditionally designed, are not integrated with other sources of information, they generally collect administrative data, are conducted primarily for accountability purposes, and offer limited opportunities for learning. It is also important to note that there is little collaboration with key stakeholders such as the communities themselves who depend largely on indigenous knowledge systems. Such a scenario makes adaptive management of climate change impossible without significant changes to the M&E systems in these countries.

4.4 Enabling factors to access and use information for adaptive management of climate change

4.4.1 Presence of systems and policies and deliberate efforts to create coordination units

Respondents across the three countries highlighted that a key enabling factor is that these countries have developed climate change adaptation policies and. to some extent, have implemented the policies and are active participants on the global climate change space. All three countries have national climate change adaptation policies/strategies which define the national vulnerabilities, climate change impacts, and key adaptation and mitigation priorities. The three countries have also made efforts to mainstream climate change issues across the state institutions. It must be noted that climate change adaptation policies appear to have suffered the same fate as other development policies in the African context which is the failure of implementation due to capacity and resource constraints (human and financial).

4.4.2 Presence of early warning systems and national surveys

Respondents from all three countries report that they have early warning systems which provide information about impending climate change disasters such as droughts and floods. The early warning systems are used at national and regional level to plan interventions to enable communities to adapt to impending disasters. In some cases early warning systems have disseminated information to farmers and communities on measures that should be taken. Although early warning systems are an enabling factor, it is necessary to invest more and expand these systems to provide localised information in addition to regional information which is of limited value to communities and farmers when they are making specific decisions such when to plant or which type of crops to plant. It was also highlighted by the respondents that early warning system information is currently not being disseminated to communities and farmers in a comprehensible way making it difficult for communities and farmers to use the information for adaptive management of climate change.

4.4.3 Presence of active non-state sector

As alluded to earlier, across the three countries, the majority of climate change adaptation interventions are either being funded or implemented by the international community through multilateral organisations, international NGOs and governments of developed countries. The presence of such funding strengthens climate change adaptation as the countries which are the subjects of this study have funding constraints for adaptive management of climate change interventions. Although the majority of the interventions being

implemented by these organisations are regarded more as 'firefighting' i.e. focusing on addressing the impact of climate change rather than the building of adaptive capacity of communities and countries, they do generate information which, if structured more systematically, can be used for adaptive management of climate change. The state can encourage other stakeholders to focus on proactive adaptive actions. Currently, non-state organisations have created information silos among themselves and no formal platform exists for sharing information and collaborative decision making with the government. The other challenge highlighted is that the funding from these organisations is currently not flexible enough to allow experimentation and changing course in the event of droughts in the countries and that project funding should, therefore, make provision should deviations from programmes become necessary in order to address the issue of drought.

4.5 Barriers to accessing and using information for building resilience

The respondents from the three countries, Tanzania, Uganda and Zambia, highlighted several barriers to accessing information on issues which are key to the adaptive management of climate change and building resilience for communities. These barriers hamper the effective use of the information which is essential for climate change adaptation in the three countries. The barriers are common across the three countries and the differences in specific countries will be highlighted.

4.5.1 Lack of baseline data

Across the three countries there is a lack of baseline data/information about climate change adaptation and the resilience status of communities and countries. Baseline data is not available at the national, sector and sub-national levels. As previously highlighted, the approaches to adaptation actions are unsystematic, the data sources are not coordinated, and there is a lack capacity to meet the needs of the various levels at which decision making on adaptation actions takes place. If available baselines are incompatible and/or incomplete, the outcomes of adaptive actions cannot be determined. This creates difficulties when seeking to measure progress and to set priorities and learning. Respondents highlighted that to create a baseline there is a need for specific skills which are currently unavailable. The lack of baseline data is attributable to the absence of climate change adaptation indicators at both national, sub-national and community level. This is compounded by climate change variability which means that baselines are constantly changing and also by the fact that baselines may vary across different sectors and levels.

4.5.2 Fragmented data sources

Respondents across the three countries highlighted that adaptive management of climate depends on various data sources which are located in different government departments and the non-state sector. Data is therefore fragmented and is in unstandardized format making the consolidation of the data/information difficult. For example, in Uganda and Zambia, adaptation to climate change for food security tends to focus on crops and neglects other areas which might improve food security such as fisheries etc. This results in inconsistent data with only a few food crops having the necessary baseline information.

4.5.3 Different reporting approaches and standardisation of indicators

At the national, sub-national, community and sector levels, there are differences in reporting mechanisms and templates. This shortcoming is compounded by the differences in indicators which are being tracked. Across the three countries, respondents highlighted that there are challenges related to the standardisation of indicators and outcomes across the various levels. At the national level, indicators can be standardised but at the sector, sub-national and programme levels the 'one-size fits all' approach is problematic. The challenge for M&E practitioners, in this case, is how to aggregate such indicators for national reporting. Reporting to coordination units in the three countries is not defined by an agreed template making it difficult to consolidate the data. Additionally, in Uganda and Zambia there are no binding reporting mandates applicable to climate change coordinating unit, there is no enforcement element, and sectors report arbitrarily.

4.5.4 Lack of human and financial resources

Human and financial resource constraints are common in all three countries. There is a general consensus that M&E for adaptive management of climate change differs from traditional M&E practices hence the need for different skills and capacity. There is a need for capacity to develop complex data sources, indicators, baselines, reporting mechanisms, aggregation of data from different sources, and coordination of different stakeholders. All these factors directly influence the availability of capacity to implement the country M&E strategies. In Uganda, while there is capacity in the coordinating unit, at sector and sub-national level there is inadequate capacity to collect, analyse and synthesise climate change adaptation data. It was indicated that at local level in Zambia there is a lack of capacity for both the monitoring and implementation of adaptive actions. Respondents highlighted that the main cause of their reduced capacity is the lack of adequate human resource funding necessary to augment the capacity for monitoring and evaluating programme implementation, especially in the state sector.

4.5.5 Parallel state and non-state sector adaptation actions, M&E systems and adaptive management of climate change

In all three countries there are parallel systems for climate change adaptation. One system is led by the state sector and is composed of the national departments and their sub-national departments, whilst the second system is led by the non-state sector which is involved in implementing specific projects either in reaction to climate change shocks or to prepare (anticipatory) communities for future climate change shocks. It is important to note that in all three countries the non-state sector in the form of multilateral organisations and international and local non-governmental organisations have invested considerable sums of money in interventions for the adaptive management of climate change. Some respondents indicated that the majority of climate change adaptation interventions in Uganda, Zambia and Tanzania are funded by non-state organisations. Despite these considerable investments, there is little in-country coordination of adaptation actions and outcomes. This results in disparate adaptation actions and M&E systems which may track different outcomes and comprise incompatible indicators thereby making it difficult to share information with the state sector.

This challenge is compounded by the lack of uniformity of M&E systems able to monitor pre-defined adaptation and resilience indicators at both national, sub-national and community level. In practice, non-state sector programme implementers usually design their M&E systems to enable the collection of data for accountability purposes to their funders and frequently that data is not in a compatible format to enable sharing with the state sector or suitable for use for learning purposes. In cases where data is shared, the incompatibility of the data precludes potential collaborative decision-making. Respondents highlighted that the lack of coordination makes it difficult to determine attribution and contribution to climate change adaptation outcomes.

4.5.6 M&E systems are designed for accountability

M&E systems within government departments are mainly geared towards meeting the administrative data requirements for a specific department or sub-national government department or to comply with international reporting obligations. Little consideration is given to whether the data meets the requirements of the climate change coordination units and the broad climate change adaptation accountability and learning requirements. The incomplete and poor quality data creates problems when attempts are made to consolidate the data at sector level or subsequently at national level. In the non-state sector M&E systems are designed primarily to collect data for accountability and systems are not linked to the outcomes defined at the sub-national or national level making the information difficult to use. There appears to be a general lack of comprehension that adaptive management of climate change outcomes should be system-wide (encompass both non-state and state sector adaptation actions) and therefore needs to be tracked at the system level rather than at programme or project level. Additionally there appears to be a lack of awareness

that climate change adaptation outcomes also extend to indirectly affected areas – social, economic and political – which need to be tracked.

4.5.7 Inadequate location-specific early warning systems for farmers and limited research on the impact of the changing climate patterns in the country

The other barrier to inadequate use of information for adaptive management of climate change is that of the lack of localised early warning systems. Despite the availability of national early warning systems in the three countries, there is a lack of localised early warning systems for climate shocks such as droughts and floods. Without such localised information, farmers have difficulty in adapting their farming habits in response to national early warning systems as the information on shocks is not specific enough; e.g. within the same sub-national level some farmers might not be affected by shocks because they planted early whilst another group may affected because they planted late. The ready availability of localised early warning systems would enable farmers to plant at the correct time and thereby adapt effectively. This barrier is also exacerbated by the limited research and the absence of evaluations on the impact of climate change in the selected three countries. Lack of such information results in inadequate and flawed strategies for adaptive management of climate change.

4.5.8 Exclusion of communities and households in the information and decision-making matrix

In all three countries the dissemination of information is generally restricted to the national level. This failure to share information on the available climate change adaptation options results in the most affected communities being unaware of specific localised information about adaptation and early warning systems and therefore they lack the necessary knowledge on the appropriate measures that should be taken. It is also important to note that information on community socio-economic and cultural practices is not being included in the design of climate change adaptation actions. There is a consensus amongst respondents that building resilience for climate change is largely dependent on the actions taken by communities and households.

5. DISCUSSION

The objective of this study is to explore how M&E data, information and evidence are being used for adaptive management of climate change in Tanzania, Uganda and Zambia. The study further explores the extent to which M&E data, information or evidence is being used for adaptive management of climate change to build resilience for food security. The study also explores the actions that need to be taken to support individuals, organisations and governments for greater food security resilience in the context of climate change. The findings of this study have shown that climate change is not being adaptively managed; sources of information for climate change adaptation lack the capacity to meet the information needs for managing climate change adaptation; institutional arrangement for climate change adaptation is not fully developed; course correction and learning are limited; traditional approaches to monitoring and evaluation are not compatible with adaptive management of climate change; and there are limited collaborative platforms with stakeholders in the adaptation process. The findings of this study revealed four key elements which are critical in adaptively managing climate change. These elements are:

- Climate change adaptation occurs at different levels – national, sector, sub-national, community and household level;
- Climate change adaptation should not be disassociated from the broad development agenda and planning;
- Climate change adaptation actions affect (directly or indirectly) the socio-economic status of the intended targets or beneficiaries; and
- The targeted recipients/consumers of climate change adaptation actions play a key role in decision making which directly affects the success or failure of adaptation actions.

The discussion is based on these four elements. The initial section discusses the implication of institutional arrangement and sources of information on adaptive management of climate change. The subsequent sections discuss and propose what should happen to strengthen adaptive management of climate change.

5.1 Institutional and policy arrangement

The top-heavy status of institutional arrangement, policy and strategy development across the three countries shows that there is inadequate recognition that climate change adaptation occurs at different levels and not only at the national level (Adger, Arnell and Tompkins, 2005). One can argue that the top-heavy development of the policies and institutions is in response to international climate change requirements. This argument is evidenced by the significant efforts being made to meet international climate change obligations such as the development of the NAPAs and the definition of their NDCs. However, these efforts at the national level are not pursued as vigorously at sector and sub-national state levels. Key areas such as national climate change vulnerabilities, climate change impacts, and adaptation priorities, are therefore clearly articulated at the national level whilst the same vigour does not apply at the sector, sub-national and community levels. Despite the existence of these strategies and policies at the national level their implementation is impeded by several challenges. Key impediments are the poor systems of coordination, fragmentation of climate change adaptation strategies, lack of financial and human resource investment in climate, and the limited state role in the implementation of adaptation actions. These key challenges are also mirrored at sector and sub-national levels.

While climate change has been on the development agenda of these countries for more than two decades, this is not reflected in the availability of efficient systems for adaptive management of climate change and neither has climate change been fully mainstreamed into the development agenda of these countries. The researchers are of the opinion that the climate change coordinating units across the three countries function as national-level structures and have very little influence on adaptive management of climate change at sector and sub-national levels and, by implication, have no control on the design of climate change strategies being formulated in government departments at the sector or sub-national levels. This also extends to the

non-state sector where the climate change coordinating units and national and sub-national government departments have no control over the design of climate change adaptation strategies being implemented. To address these challenges and gaps, there is a need to acknowledge that climate change adaptation occurs through collaborative public policymaking. In LDCs where non-state stakeholders play a significant role in funding and implementing adaptation actions, there is a need to include these stakeholders in the processes of public policymaking. Climate change adaptation can be improved through collaboration between relevant and affected stakeholders, including public officials (political and bureaucratic), service providers, citizens, communities, and civic interest organisations. Collaboration between state and non-state policy actors across the various levels will not only promote processes of mutual learning and policy innovation but will also help to ensure a flexible adaptation of the content of public policies and the plans for their implementation with the ultimate aim of producing a localised adaptation response to climate change.

The disjuncture in the institutional arrangement is also mirrored in how information is used for the adaptive management of climate change. The institutional arrangement fails to incorporate accepted climate change adaptation key issues such as the need for long-term planning, long-term interventions, learning opportunities, and the need for adaptability of interventions if and when necessary. The institutional arrangement is also not supported by a robust M&E system which allows learning across sectors and all levels of adaptation. At the sector and sub-national levels, there should be what is termed a continuum of adaptation activities which are specific, systematic and directly linked to the outcomes but this can only be achieved if there are clearly defined outcomes at national, sub-national and community levels (Janowiak *et al.*, 2014). To address the institutional arrangement and its challenges, the researchers argue that there is a need to move away from treating climate change adaptation as a separate development problem and mainstream it into the overall development planning process. The state should create and coordinate collaborative platforms at all levels where different stakeholders come together, define their interests and roles, and develop common adaptation outcomes. This addresses challenges related to the lack of resources for setting up new systems, the fragmentation of adaptation actions, and the lack human capacity. However, the researchers note that mainstreaming is not a panacea for all adaptive management problems because, as highlighted earlier, the general institutional arrangements and systems of these countries are not yet fully developed. The figure below shows the proposed institutional arrangement for adaptive management of climate change.

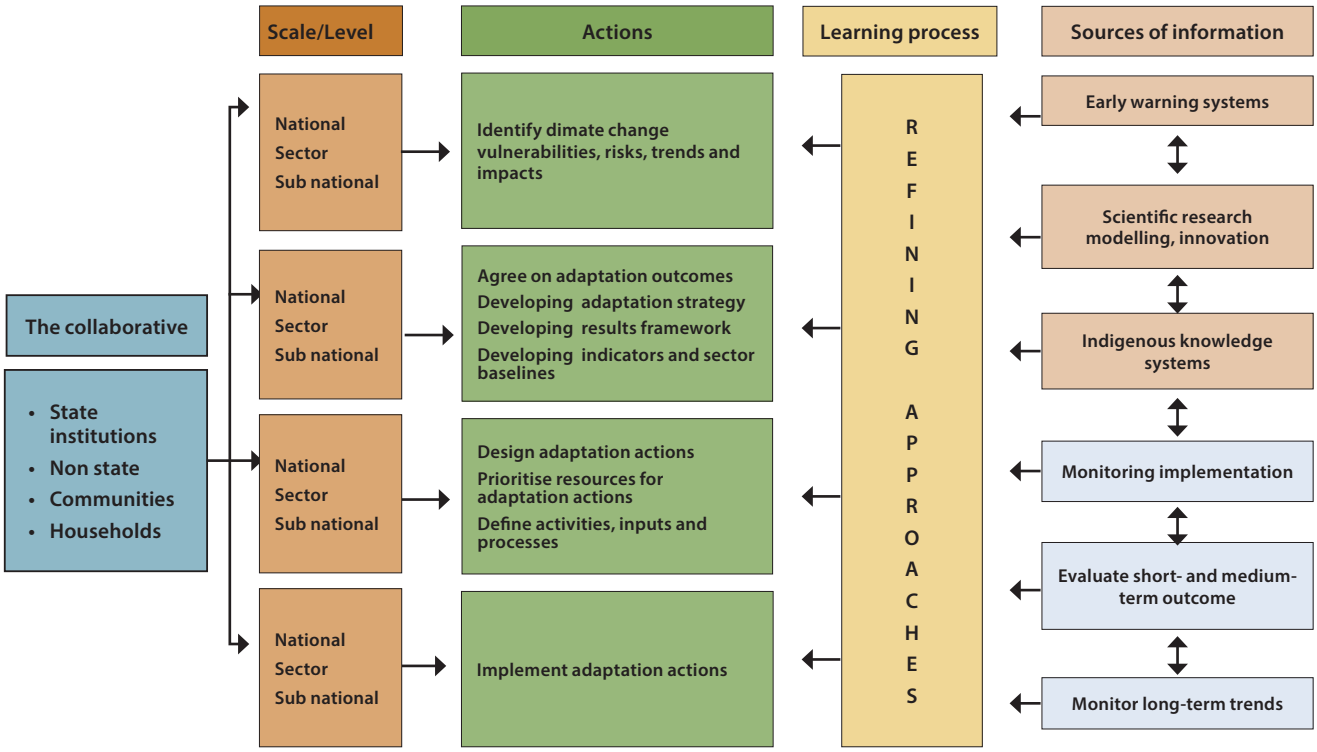

Figure 3: Proposed institutional arrangement for AM

In Figure 3 above the so-called 'collaborative' is composed of different stakeholders involved in climate change adaptation. The collaborative should be available at all levels of adaptation and should take the lead in deciding all actions and refining adaptation approaches using various sources of information. A further discussion of the sources of information will be expanded upon in the next section.

5.1.1 Sources of data, information and evidence to support adaptive management of climate change

The study has shown that in the three countries, unlike other areas of development which largely depend on monitoring and evaluation, adaptive management of climate change requires various sources of information and evidence. As highlighted in the results section, key sources of information such as EWS, scientific research, monitoring and evaluations, and community contextual evidence (including indigenous knowledge, socio-cultural, socio-economic, socio-political and ecological information), are needed for effective adaptive management of climate change. It is important to note that this information has limited availability at different national and sub-national levels scales and levels (region, province or district), programme levels, and at the community level. It is argued that due to the complexity of the different sources of data, the state should be responsible for designing systems which foster linkages across all the sources of information so that the availability of data at all levels is streamlined. The researchers are of the opinion that sources of information should meet the following conditions for effective adaptive management of climate change:

- Sources of information should be accessible at all levels where adaptation takes place;
- The information produced should be relevant and respond to the specific needs of the level of adaptation;
- The information should be presented in an agreeable user-friendly and digestible format and should cater for different literacy levels, languages and contexts;
- The information should be produced timeously to inform decision making; and
- The M&E system should be responsible for consolidating and analysing information from different sources.

The fact that EWS does not provide data to the various levels of decision makers effectively deprives the decision makers of the opportunity to devise a localised response to a localised climate change challenge. Information from the EWS is also not packaged and communicated in manner that the rural farmer can easily understand.

Several studies have shown that climate change adaptation is not divorced from indigenous knowledge systems, socio-cultural practices, socio-economic status, and the social capital available to households and communities (Osbahr and Allan, 2003; Beckford and Barker, 2007; Dube and Sekhwela, 2008; Djoudi and Brockhaus, 2011; Becken, Lama and Espiner, 2013; Mugi-Ngenga *et al.*, 2016). In all three countries no systems exist to capture such information which is essential for informing adaptive management of climate change. Without this information, there is no baseline for household and community adaptive capacity. In addition, contextual factors which also influence adaptive capacities are unknown meaning that uninformed assumptions are made on how communities are expected to respond to climate change and adaptation actions are designed with the use of inaccurate assumptions.

When building resilience for food security in the context of climate change, cognisance of current scientific research is essential as products and methods may be available to enable farmers and communities to adapt efficiently. Research on drought- flood-resistant crops, livestock, climate change modelling etc. is key to informing adaptation actions taken at different levels. Climate change modelling presents decision makers with options to consider when designing adaptation actions e.g. in cases where livelihood diversification actions are needed, such decisions must be supported by robust information. The limited availability of such key services and information compromises the effective design and implementation of adaptation

actions. As highlighted earlier, adaptively managing climate change is an iterative process which addresses the uncertain impacts and unpredictability of climate change by making informed decisions in real-time thereby emphasising the ongoing need for scientific research and climate modelling.

Despite the existence of climate change coordinating units in the three countries, performance monitoring of adaptation actions at various levels is poorly defined. This is compounded by a lack of assessment of climate adaptation vulnerability, current climate risks, future climate risks, current and changing socio-economic conditions, and adaptive capacities at different levels of adaptation. The absence of these assessments indicates that M&E systems focus mainly on tracking programme/project level outputs instead of focusing on tracking adaptation outcomes. There is a scarcity of national state-commissioned evaluations on programmes which focus on addressing the impact of climate change on food security. While the non-state sector has commissioned several programme evaluations, these evaluations are at programme level and concern the interventions for specific climate change stressor or shocks and they fail to reflect the general adaptation process. These M&E challenges are exacerbated by the M&E silos that exist in state and non-state sectors effectively limiting the opportunities for collaboration and the sharing of data and evaluation findings.

5.2 What must be done to support adaptive management of climate change?

Building resilience for food security in the context of climate change depends on two processes, climate change adaptation actions and adaptive management of climate change. As stated earlier, adaptation actions are the steps taken to live with the effects of climate change. Adaptation actions must underpin the building of resilience at national, sub-national, community and household levels. Adaptive management is the process whereby decisions makers take action in the face of climate change uncertainty and consider a range of possible future outcomes and may even involve taking advantage of unanticipated events. There are specific actions which need to be taken by all the stakeholders involved in building resilience through adaptive management of climate change. Adaptive management of climate change in the three countries is not progressing as envisaged. The researchers argue that the process of adaptive management of climate change in the context of building resilience for food security is more developed at the top levels than it is at the lower levels where adaptation actions and adaptation actually take place. The implication is that the national systems have become ineffectual with policies, strategies and M&E systems and strategies not being implemented at the local level thereby hampering the adaptive management of climate change. It is recommended that the following steps be implemented to support adaptive management of climate change.

5.2.1 State leadership in collaboration and coordination of adaptive management of climate

The complexity, long timelines and the uncertainty involved in climate change require that the state plays a central role in coordinating the adaptive management of climate change. This is critical especially where there is a heavy presence of international organisations implementing short-term climate change adaptation actions. The state is in a position to take a long-term view and its continuing presence serves to ensure that adaptive management takes place. The state can act as an institutional repository for information on adaptive management of climate change. The coordination should promote the development of climate change strategies at all levels of the state (national, sector and sub-national levels) creating cross-sectoral/multi-level coordination. The cross collaboration should lead to the key assessments mentioned in the section above being conducted at all levels (vulnerability assessments have only been assessed at the national level) to identify who and what is exposed and sensitive to change. The vulnerability assessments should be followed by the development of intended climate change adaptation outcomes and the design of adaptation actions which are appropriate at all levels. State coordination should extend to the implementation at all levels of the adaptation actions and the adaptive management iterative processes, the documenting of lessons, and the

facilitation of learning. Overall, the collaborations should recognise that climate change adaptation should be aimed at sustainability rather than short-term outcomes and that successful adaptive management of climate change depends to a large extent on the capabilities of individuals, organisations, and communities to create and mobilise the adaptive capacity of their socio-ecological systems and the ability to respond to climate change shocks and stressors.

5.2.2 Address information gaps at all sectors and adaptation levels

As highlighted earlier, sources of information for adaptive management of climate change are more geared towards providing information and data at the national level and, to a much lesser extent, the other levels. Cognisance is taken of the barriers to the generation of information by early warning systems and scientific research and development especially the barriers attributable to limited human and financial resources. The researchers argue that parties involved in climate change adaptation should work in synergy with all producers of information and data including early warning systems and scientific research and development in order to understand the respective needs of the various partners. Adaptation actions should not only focus on strengthening adaptive capacities but should also strengthen sources of information such as EWS and scientific research which are key to reaching sustainable climate change adaptation.

Challenges related to a lack of baseline data on adaptive capacity and resilience can be addressed by mainstreaming climate change into the periodic national and sub-national surveys in the three countries. This will provide the necessary critical baseline data to provide a panoramic view of the vulnerabilities, adaptive capacities, vulnerable groups, and resilience at all levels. There is also a need to design M&E systems which capture the localised indigenous knowledge and contextual information currently not being used to inform policy and facilitate informed decision making – a top-down approach to building resilience.

5.2.3 Develop relevant M&E systems for adaptive management of climate change

The inability of the three countries to measure improvements in resilience and adaptation is directly linked to the absence of M&E systems designed for the collection of empirical evidence on adaptation actions. Empirical evidence is essential to determine the factors contributing to adaptation, under what contexts, and for what types of shocks and stressors. It is necessary to develop the ability of the three countries to measure the relationship between the different components that constitute adaption and resilience i.e., measuring the relationship between shocks, responses, and future states of adaptation capacity. The challenges which are faced in M&E can be attributed to the adoption of a traditional approach to M&E which leans heavily on accountability functions and tracking of outputs. The researchers argue that while tracking outputs is important, the tracking of outcome trends of climate change adaptation is critical for learning and effective decision making. The researchers propose that the building and strengthening of M&E for adaptive management of climate change can be accomplished in two ways.

The first approach to strengthening M&E systems involves working collaboratively with the state and other stakeholders to develop a broad M&E system. The system should enable the collaborative to carry out assessments, develop adaptation priorities, outcomes and actions, to set indicators and develop baselines, conduct the required assessments, and to set priorities and indicators (see Figure 4 below). It is important to note that this is a general system, which is not programme specific but is proposed to suit a particular level of adaptation such as local, sub-national, sector or national levels. Such a system will provide an overview of vulnerabilities, risks and adaptation actions at a particular level, and the system also provides a platform for the various stakeholders to identify their contribution, learn, evaluate and synchronise their adaptation actions. Use of this approach enables level-specific evaluations to be conducted and also provides a means to learn, track adaptation outcomes, and refine implementation approaches.

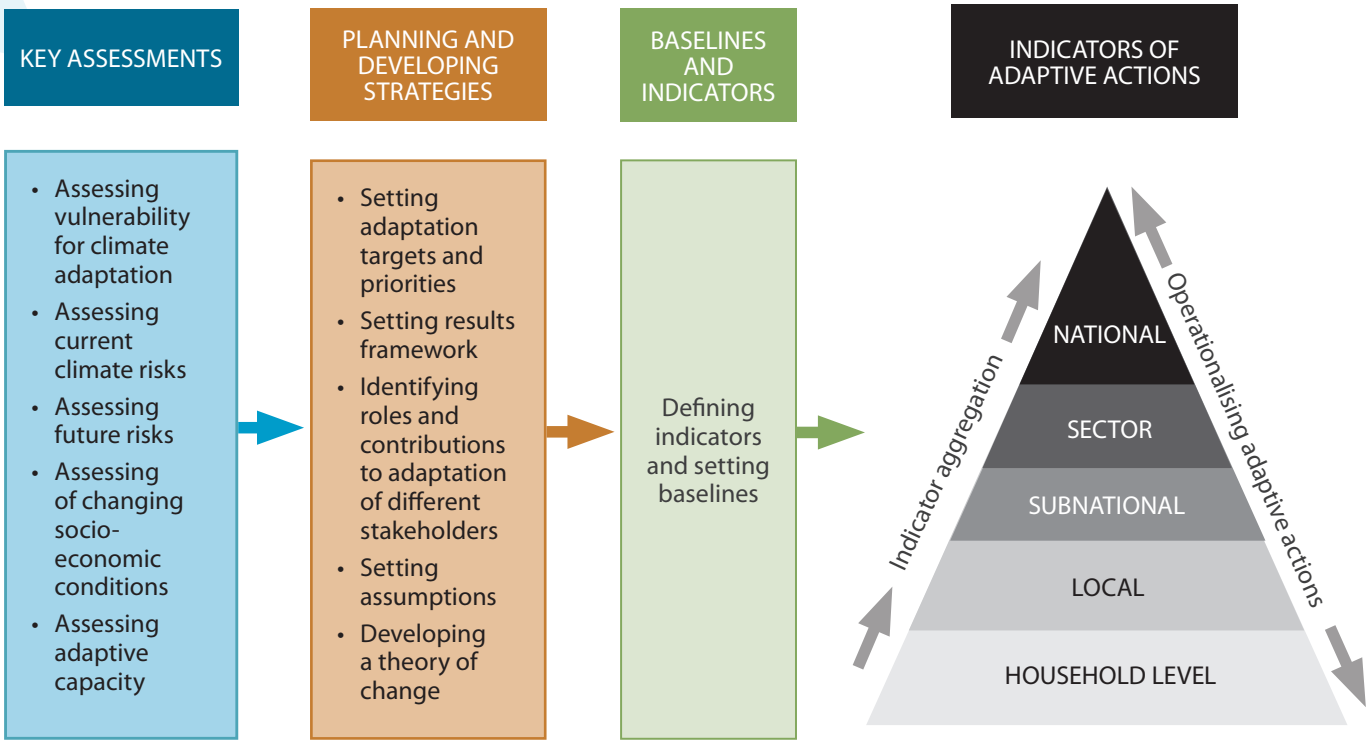

Figure 4: Setting up an M&E system for adaptive management of climate change

The second approach is to develop a level-specific M&E framework which can be adapted to the programme- or project-specific M&E needs. The level-specific M&E framework should facilitate horizontal linkages across all the adaptation actions under that level and vertical linkages will facilitate vertical data aggregation.

Developing indicators

The findings of this study have shown that challenges such as lack of baseline data, difficulties in aggregating data from various levels of adaptation, and differing approaches to developing and setting adaptation indicators are prevalent across the three countries. The researchers propose that when indicators are developed they should be classified into three categories – the *ex-ante*, the climate change level and the *ex-post* categories. This will allow the M&E system to continuously capture dynamic baselines, monitor uncertainty and non-events, and allow the decision makers to make iterative adjustments to their adaptation actions. To create a baseline, the *ex-ante* level will collect data on indicators which reflect the initial state, adaptive capacities, and vulnerabilities. The climate change level should set indicators and collect data on climate change state, risks, shocks and stressors. The *ex-post* component indicators should focus on post stress shocks and trajectories and compare the adaptive capacities and vulnerability to the initial state. These categories should apply at all levels of adaptation (national, sector and sub-national levels) and should enable all stakeholders to monitor, evaluate, review their contributions, and learn collaboratively. The figure below illustrates the process of setting indicators for adaptive management of climate change.

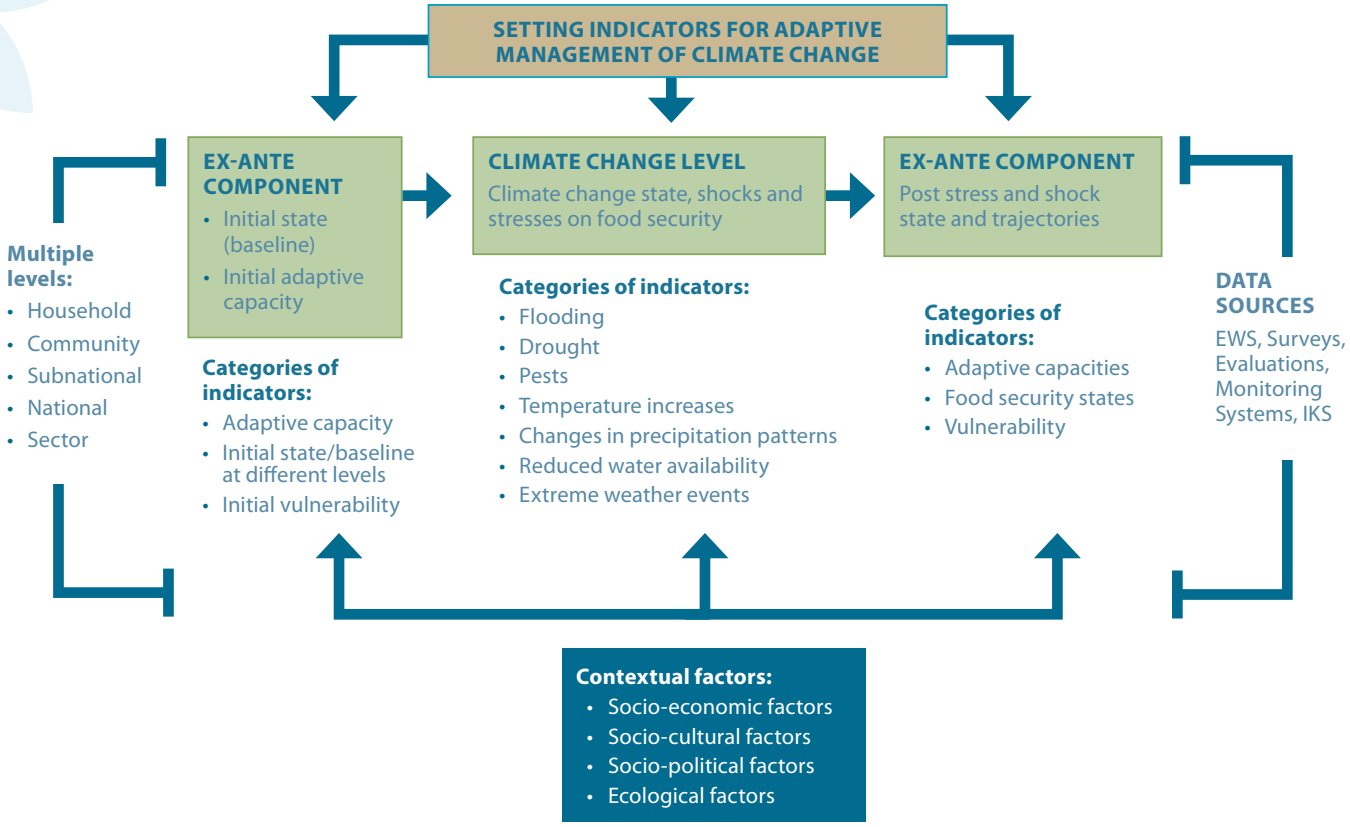

Figure 5: Developing indicators for adaptive management of climate change

5.3 Learning and course-correction platforms

Evidence has shown that few learning opportunities currently exist and that the current practice is premised on establishment of rigid strategies, policies and procedures for implementing adaptation actions. The researchers argue that countries, funders, donors and programme implementers do not necessarily need to choose between accountability and learning as these two processes should be complementary. Instead of taking advantage of learning opportunities, programme implementers steadfastly follow set rules and procedures, detecting and correcting any procedural deviations from adaptation action protocols. This is not compatible with adaptive management of climate change where M&E should ideally create an enabling environment for learning so that programming can be corrected as trade-offs become evident, interventions fail in their intended impact, or key previously held assumptions prove to be incorrect (Chesterman and Ericksen, 2013). Ideally, M&E should actively and positively inform 'transformational' climate change adaptation where purposeful actions are made in response to defined impacts and emergent opportunities.

In a context where food insecurity and its related impacts are proliferating, there is an urgent need to move to double-loop and triple-loop learning by all stakeholders involved in adaptation actions. Double-loop learning in adaptive management of climate change will encourage the necessary dynamism, creativity and critical thinking that allows stakeholders to reflect and question their adaptation actions, re-assess their assumptions, and reflect what could have occurred. Double-loop learning also allows stakeholders to reframe their systems, programme rules and procedures. Such an approach will promote counterfactuals which are currently lacking in performance monitoring and evaluation and in evaluation systems. When M&E systems have achieved a level of maturity appropriate for adaptive management of climate change, they can then move to triple-loop learning, which focuses on transforming the contextual factors such as values, cultural practices, policies etc.

5.4 Policy and practice recommendations

The policy and practice recommendations presented in these sections are premised upon the state playing a key role in in the climate change adaptation coordination and creation of an enabling environment which sets the place for adaptive management of climate change. The recommendations presented below are not one size fits people, but should be adapted to the country contexts.

Recommendation 1: *Strengthen state leadership to promote collaboration and coordination of the adaptive management of climate change*

There is a need to raise awareness within state leadership and other strategic level stakeholders on the cost vs. benefit of investing in M&E systems. The state also needs to take the lead in creating an enabling environment and collaborative spaces and platforms at all levels of adaptation for the various stakeholders who are involved in adaptive management of climate change. The platforms and spaces should be used to define the vulnerabilities, key priorities and outcomes for climate change adaptation at all levels. Stakeholders such as funders, donors, programme implementers and producers of information should collaborate at all scales and levels – national, inter-sectoral and sub-national – and should be involved in decision making and collaborative learning to refine approaches and enhance the design of adaptation actions.

Recommendation 2: Mainstream climate change and M&E systems into the broad national development planning

Although a specific focus is required, climate change adaptation and M&E systems should be mainstreamed into the broad development planning with clear mandates and should not be treated as separate from the development planning programme implementation process because climate change directly and indirectly affects development outcomes. Mainstreaming will integrate climate change adaptation and the needs of the related M&E systems into the available structures and systems thereby reducing administrative costs.

Recommendation 3: Integrating indigenous knowledge systems and community contextual information into the adaptive management of climate change information matrix

All the stakeholders involved in adaptive management of climate change/climate change adaptation should view indigenous knowledge systems as complementary to modern knowledge systems and should integrate the indigenous knowledge into the information matrix for adaptive management of climate change.

Recommendation 4: Strengthen the available sources of information to address information gaps at all sectors and adaptation levels

All levels of climate change adaptation should work in tandem with all the producers of information critical for adaptive management such as early warning systems, scientific research and development so that information needs may be clearly defined and understood. Efforts should also be made to review, revise and mainstream climate change into the national, sectoral and sub-national periodic surveys to obtain key data which can be incorporated in the national planning process. Challenges that are related to lack of adaptive capacity and resilience baseline data can be addressed by mainstreaming climate change into the periodic national and sub-national surveys across the three countries.

Recommendation 5: Strengthen collaborative learning platforms

Evidence has shown that few learning opportunities currently exist and that current practice is premised on the establishment of rigid accountability-focused M&E strategies, policies and procedures for implementing adaptation actions but this approach limits learning to a single loop. The state must take the lead in developing collaborative learning platforms which facilitate iterative adaptive management processes leading to the realisation of double- and triple-loop learning cycles.

Recommendation 6: Strengthen country M&E systems

Across the three countries the general state-run M&E systems are still in their developmental stages and there is a need to strengthen these systems and to prime them for adaptive management of climate change. The strengthening of country M&E systems should be done in a collaborative manner with the state leading and the non-state entities providing the required support.

6. CONCLUSION

Climate change is a significant problem requiring a studied and informed approach to effectively address its impacts. LDCs need support to develop the necessary systems to address this serious challenge. It is necessary for countries to go beyond simply developing and implementing national policies by taking measures to improve the adaptive capacities of their citizens and to reduce vulnerabilities to climate change. Adaptive management of climate change systematises and reshapes the adaptation process in the pursuit of sustainable outcomes. Although the study revealed that non-state organisations play a critical role in climate change adaptation, further research and discussion is necessary on how non-state organisations can play a role in strengthening the capacity of the state to adaptively manage climate change and to ensure the sustainability of the adaptation actions. Given the complexity of the process of adaptive management of climate change, it is essential that well-researched guidelines are formulated to assist LDCs to establish systems for effective adaptive management of climate change.

REFERENCES

Adger, W. N., Arnell, N. W., & Tompkins, E. L. (2005). 'Successful adaptation to climate change across scales'. *Global environmental change*, 15(2), 77-86.

Agrawal, A. (2008) *The role of local institutions in adaptation to climate change*. World Bank.

Atteridge, A., & Remling, E. (2018). 'Is adaptation reducing vulnerability or redistributing it?' *Wiley Interdisciplinary Reviews: Climate Change*, 9(1), e500.

Baird, J. et al. (2014) 'Learning effects of interactive decision-making processes for climate change adaptation', *Global Environmental Change*, 27, pp. 51–63.

Barnett, J. and O'Neill, S. (2010) *Maladaptation*. Pergamon.

Becken, S., Lama, A. K. and Espiner, S. (2013) 'The cultural context of climate change impacts: Perceptions among community members in the Annapurna Conservation Area, Nepal', *Environmental Development*, 8, pp. 22–37.

Beckford, C. and Barker, D. (2007) 'The role and value of local knowledge in Jamaican agriculture: adaptation and change in small-scale farming', *Geographical Journal*, 173(2), pp. 118–128.

Berkes, F. (2003) 'Can cross-scale linkages increase the resilience of social-ecological systems', in *RCSD International Conference, Politics of the Commons, Chiang Mai*, pp. 1–14.

Bours, D., McGinn, C. and Pringle, P. (2014) 'Monitoring & evaluation for climate change adaptation and resilience: A synthesis of tools, frameworks and approaches', *SEA Change Community of Practice, and UK Climate Impacts Programme*.

Bush, R. (2010) 'Food riots: Poverty, power and protest 1', *Journal of Agrarian Change, 10(1), pp. 119–129.*

Chanza, N. (2018) 'Limits to climate change adaptation in Zimbabwe: Insights, experiences and lessons', in *Limits to Climate Change Adaptation*. Springer, pp. 109–127.

Chesterman, S. and Ericksen, P. J. (2013) 'Monitoring adaptation to enhance food security: a survey of approaches and best practice'.

Djoudi, H. and Brockhaus, M. (2011) 'Is adaptation to climate change gender neutral? Lessons from communities dependent on livestock and forests in northern Mali', *International Forestry Review,* 13(2), pp. 123–135.

Dodman, D. and Satterthwaite, D. (2008) 'Institutional capacity, climate change adaptation and the urban poor'.

Dube, O. P. and Sekhwela, B. M. (2008) 'Indigenous knowledge, institutions and practices for coping with variable climate in the Limpopo Basin of Botswana', *Climate change and adaptation*, pp. 71–99.

England, M. I. et al. (2018) 'Climate change adaptation and cross-sectoral policy coherence in southern Africa', *Regional Environmental Change*, 18(7), pp. 2059–2071.

FAO (2020) *The State of Food Security and Nutrition in the World 2020*. FAO, IFAD, UNICEF, WFP and WHO. doi: 10.4060/ca9692en.

FAO. (1996) *World food summit: Rome declaration on world food security and World Food summit plan of action*. FAO.

Fisher, S. et al. (2015) 'Evaluating climate change adaptation: Learning from methods in international development', *New Directions for Evaluation*, 2015(147), pp. 13–35.

Haris, A. V. A. et al. (2013) 'Impact of climate change on wheat and winter maize over a sub-humid climatic environment', *Current Science*, pp. 206–214.

Hassan, O. M. and Tularam, G. A. (2018) 'The Effects of Climate Change on Rural-Urban Migration in Sub-Saharan Africa (SSA) – The Cases of Democratic Republic of Congo, Kenya and Niger', *Applications in Water Systems Management and Modeling, p. 2.*

Holvoet, N. and Dewachter, S. (2013) 'Building national M&E systems in the context of changing aid modalities: The underexplored potential of National Evaluation Societies', *Evaluation and program planning*, 41, pp. 47–57.

Huq, S., Reid, H. and Murray, L. A. (2006) Climate change and development links. IIED London.

Ifejika Speranza, C. (2010) Resilient adaptation to climate change in African agriculture. Studies (54).

IPCC (2012) 'Summary for Policymakers', p. 34.

Janowiak, M. K. et al. (2014) 'A practical approach for translating climate change adaptation principles into forest management actions', *Journal of Forestry*, 112(5), pp. 424–433.

Lankford, B. A. et al. (2007) *From integrated to expedient: An adaptive framework for river basin management in developing countries*. IWMI.

Leiter, T. (2015) 'Linking monitoring and evaluation of adaptation to climate change across scales: Avenues and practical approaches', *New Directions for Evaluation*, 2015(147), pp. 117–127.

Lloyd, S. J., Kovats, R. S. and Chalabi, Z. (2011) 'Climate change, crop yields, and undernutrition: development of a model to quantify the impact of climate scenarios on child undernutrition', *Environmental health perspectives*, 119(12), pp. 1817–1823.

Marmorek, D. et al. (2019) 'Adaptive Management and Climate Change Adaptation: Two Mutually Beneficial Areas of Practice', JAWRA *Journal of the American Water Resources Association*, 55(4), pp. 881–905.

Mugi-Ngenga, E. W. et al. (2016) 'Household's socio-economic factors influencing the level of adaptation to climate variability in the dry zones of Eastern Kenya', *Journal of Rural Studies*, 43, pp. 49–60.

Myers, S. S. *et al.* (2017) 'Climate change and global food systems: potential impacts on food security and undernutrition', *Annual review of public health*, 38.

O'Donnell, M. (2016) *Adaptive management: What it means for CSOs*. London: Bond, www. bond. org. uk/ resources/adaptive-management-what-it-means ….

Omari, S. (2018) *Vulnerability and Adaptation of Farming Households to Climatic and Non-Climatic Stressors in Semi-Arid Ghana*. PhD Thesis. University of Ghana.

Osbahr, H. and Allan, C. (2003) 'Indigenous knowledge of soil fertility management in southwest Niger', *Geoderma*, 111(3–4), pp. 457–479.

Redden, R. J. *et al.* (2014) 'Temperature, climate change, and global food security', *Temperature and Plant Development*, 8, pp. 181–202.

Reser, J. P. and Swim, J. K. (2011) 'Adapting to and coping with the threat and impacts of climate change.', *American Psychologist*, 66(4), p. 277.

Richardson, S. et al. (2020) 'A systematic review of adaptive wildlife management for the control of invasive, non-native mammals, and other human–wildlife conflicts', *Mammal Review*, 50(2), pp. 147–156.

Roudier, P. et al. (2011) 'The impact of future climate change on West African crop yields: what does the recent literature say?', *Global Environmental Change*, 21(3), pp. 1073–1083.

Saito, N. (2013) 'Mainstreaming climate change adaptation in least developed countries in South and Southeast Asia', *Mitigation and Adaptation Strategies for Global Change*, 18(6), pp. 825–849. doi: 10.1007/s11027-012-9392-4.

Sarr, B. (2012) 'Present and future climate change in the semi-arid region of West Africa: a crucial input for practical adaptation in agriculture', *Atmospheric Science Letters*, 13(2), pp. 108–112.

Schmidhuber, J. and Tubiello, F. N. (2007) 'Global food security under climate change', *Proceedings of the National Academy of Sciences*, 104(50), pp. 19703–19708.

Serdeczny, O. *et al. (2017)* 'Climate change impacts in Sub-Saharan Africa: from physical changes to their social repercussions', *Regional Environmental Change*, 17(6), pp. 1585–1600.

STAP (2017) 'Strengthening Monitoring and Evaluation of Climate Change Adaptation: A STAP Advisory Document.' *Global Environment Facility*, Washington, D.C.

Stringer, L. C. et al. (2017) 'Reconsidering climate compatible development as a new development landscape in Southern Africa', in *Making climate compatible development happen*. Routledge, pp. 22–43.

Tendall, D. M. et al. (2015) 'Food system resilience: defining the concept', *Global Food Security*, 6, pp. 17–23.

Thomson, K. J. (2007) 'The State of Food and Agriculture 2006: Food Aid for Food Security? Food and Agriculture Organization (FAO). *FAO Agriculture Series* no. 37. xii+ 168 pp.+ mini CD-ROM. Rome: FAO (2006). US $65.00 (Paperback). ISBN 978-92-5-105600-4.', *The Journal of Agricultural Science*, 145(4), pp. 415–416.

Tschakert, P. (2015) 'The ability of the poor to cope', *Forthcoming as a World Bank Policy Research Working Paper*.

Tschakert, P. and Dietrich, K. A. (2010) 'Anticipatory learning for climate change adaptation and resilience', *Ecology and society*, 15(2).

USAID, L. lab (2018) 'Discussion Note: Adaptive Management', p. 11.

Vermeulen, S. J., Campbell, B. M. and Ingram, J. S. (2012) 'Climate change and food systems', *Annual review of environment and resources*, 37.

Vogel, C., Colvin, J. and Scharfetter, B. (2015) *Adaptation to Climate Change: What May it Mean for the Water Resources Sector?* Water Research Commission.

Wheeler, T. and Von Braun, J. (2013) 'Climate change impacts on global food security', *Science*, 341(6145), pp. 508–513.

Williams, A. (2016) *Options for results monitoring and evaluation for resilience building operations*. World Bank.

Yates, C. J. et al. (2010) 'Projecting climate change impacts on species distributions in megadiverse South African Cape and Southwest Australian Floristic Regions: opportunities and challenges', *Austral Ecology*, 35(4), pp. 374–391.



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