

PHASE TWO (2) REPORT: FIELDWORK AND EMPIRICAL CASE STUDIES

**IMPACT ASSESSMENT OF CLIMATE CHANGE ADAPTATION INTERVENTIONS IN
EAST AFRICA**

SUBMITTED

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To

FOREIGN COMMONWEALTH AND DEVELOPMENT OFFICE (FCDO)

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1.0 INTRODUCTION

East Africa is experiencing severe impacts of climate change due to its dependency on climatically sensitive sectors and relatively low adaptive capacity. While predictions are uncertain, it is expected that many areas of East Africa will become wetter (with more intense but unpredictable rain) and warmer, increasing the risk of flooding and drought. Therefore, climate adaptation and resilience investment are critical to reduce future losses and create positive economic, social, and environmental outcomes. It is a crucial priority for the United Kingdom's Foreign Commonwealth Development Office (FCDO) FCDO, which is in the process of scoping potential future programming to support climate adaptation in East Africa; as well as a high priority for regional governments, as reflected in their Nationally Determined Contributions (NDCs) and broader climate, development, and nature strategies and policies. The above impacts underscore the urgent need to scale up adaptation in East African countries, as outlined in their updated NDCs and National Adaptation Plans (NAPs).

This report synthesizes findings from the empirical research (phase 2) of a broader study on the *Assessment Effectiveness of Climate Change Adaptation Interventions in East Africa* funded by FCDO through the East Africa Research and Innovation Hub (EARIH). The study primarily aims to inform FCDO's future adaptation programming across the region by generating evidence on the effectiveness of climate change adaptation interventions in the East African region covering nine countries: Kenya, Tanzania, Uganda, Rwanda, Burundi, Ethiopia, Eritrea, Somalia, and South Sudan. It includes two phases, set out below.

Phase 1 of the study 'Scoping, Evidence Synthesis and Appraisal', now complete, involved landscape analysis, intervention mapping and evidence appraisal to identify gaps. The first phase delivered: i) an inception meeting held between ARIN and FCDO, following which an inception report was submitted ii) a regional workshop bringing together stakeholders within East Africa iii) a scoping desk review and evidence synthesis of adaptation interventions in East Africa iv) evidence gaps in the adaptation interventions have been identified v) potential case studies for further assessment of effectiveness for the phase two of the project.

This phase 2 involved in-depth empirical research and case study analysis to unpack more specific insights on the impacts of adaptation interventions in East Africa and opportunities for scaling up through further investments. This report describes the methodological approach for delivering the empirical research including the deployment of participatory data collection through Key Informant Interviews (KIIs) targeting stakeholders aligned to selected case studies. The specific objectives of this phase are to: Address some evidence gaps by providing empirical data on the effectiveness of adaptation interventions, essential adaptation needs, and existing institutional frameworks to accelerate adaptation actions. Identify potential opportunities for adaptation investment across the four focus areas.

2.0 METHODOLOGY

Phase two (2) of the study involved empirical research aided by a deep dive into a few specific thematic areas/sectors identified in Phase 1 of the study. **(Figure 1)**

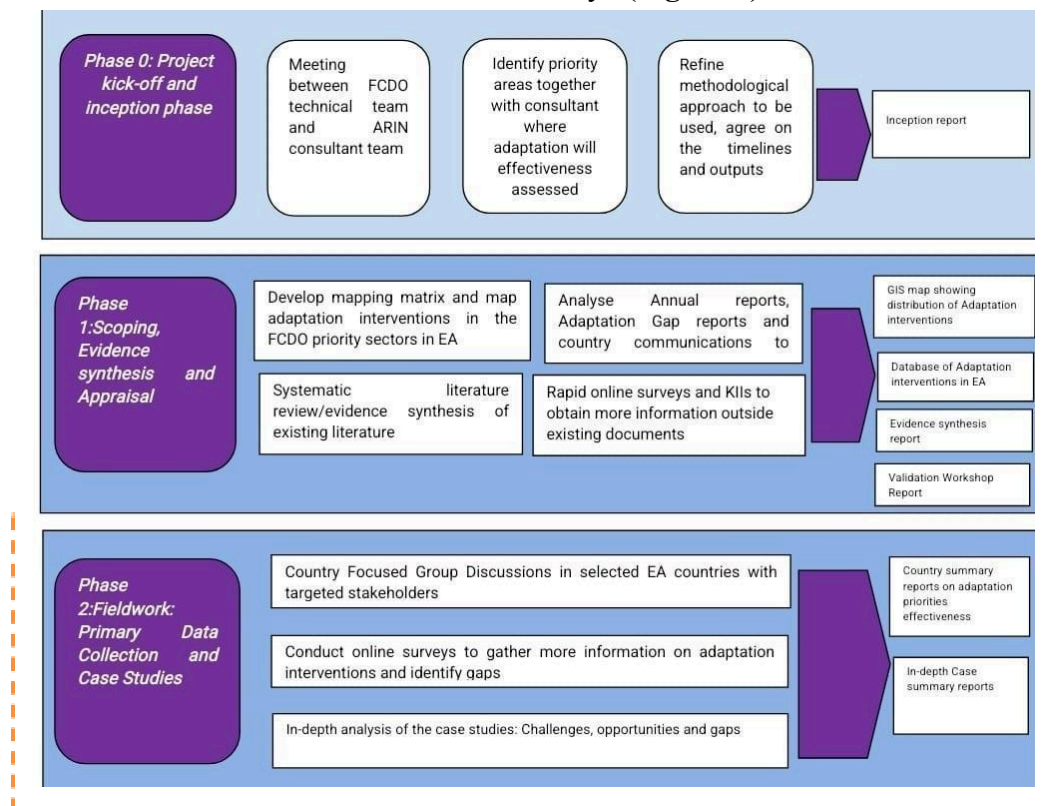


Figure 1: Data collection framework

2.1 Case Studies for in-depth analysis

Case studies are critical for capturing complexities of contexts and provide insights into which climate discourses interact hence contributing to providing reliable and actionable climate information (Terrado et al., 2023). The case studies selected were largely informed by the insights from the scoping study and specifically guided by the following set of criteria detailed in Annex 2 (KII guides). Summarily, the criteria included: multi-country presence, 3-5 years implementation period, data availability and accessibility, and potential for Investment. Based on these criteria, seven case studies were identified to provide empirical data on the effectiveness of climate change adaptation interventions (Table 1).

Table 1: Case studies for in-depth analysis

| Case study | NbS | WEFE | CR Inf. | Governance |
|---|-----|------|---------|------------|
| Kenyan Climate Change Adaptation Programme (KCCAP) | x | x | x | |
| Upscale project | x | x | | |
| Promoting climate smart agriculture for Improved improved rural livelihoods and climate resiliency in the climate vulnerable Eastern province of Rwanda | x | x | x | |
| Strengthening climate resilience of rural communities in Northern Rwanda (Green Gicumbi) | x | x | x | |
| Building Resilient Communities, Wetland Ecosystems and Associated Catchments in Uganda; | x | x | x | |
| Implementation Of Concrete Adaptation Measures to reduce Vulnerability Of Livelihood and Economy Of Coastal Communities In Tanzania; | x | | x | x |
| Arusha Sustainable Urban Water and Sanitation Delivery Project | | x | x | |

For each case study, key Informants associated with the various project activities were interviewed to gain diverse insights on the impacts of interventions and factors underpinning the impacts and outcomes. Four categories of respondents were considered as described in Table 2 below:

Table 2: Description of the categories of stakeholders targeted for the KII engagements

| Key Informant | Description and topic | Sample per case |
|---|--|-----------------|
| Project Implementers (in-person) | Project implementers have expectations in designing and executing adaptation projects. The interview here will target project managers with good oversight of the project in terms of design, implementation, impacts, challenges, and opportunities. Project leaders might however be biased in their observations around project impact – however engaging beneficiaries as discussed next will help triangulate information from the project leaders. | 1 |

| | | |
|--|--|------|
| Project beneficiaries (in-person) | <p>Communities benefiting from projects were interviewed in two parts, individual interviews to identify household level perspectives and joint community dialogues bringing together the interviewees to discuss insights collectively. Considering diversity of beneficiaries including men, women, elderly was critical to ensure inclusivity of diverse experiences. Communities/beneficiaries showcased information about the adaptation interventions pursued and the extent to which they felt the projects/interventions are contributing to building their resilience equitably and sustainably, key challenges, and opportunities for enhancing effectiveness/impact among others. The respondents in this case were selected based on their direct engagement with project activities. Further, respondents were sampled with the help of project implementers who have information on where the beneficiaries are. To avoid bias in the selection of respondents, snowballing sampling was leveraged where possible, especially on the sites where the interventions have been implemented</p> | 5-10 |
| Policymakers (virtual) | <p>Policies governing project implementation can enable or impede project impacts. Policies set priorities and steer the direction of investments thus it was critical to engage policymakers that helped shed clarity on how and which existing policies are enabling or impeding project impacts and investment opportunities. This includes but is not limited to the policy priorities and direction and how this is likely to shape relevant investments around particular technologies, and innovations promoted by the specific case studies. The target informant here will be a director at the local government or national government overseeing adaptation policies relevant to the project.</p> | 1 |

| | | |
|-----------------------------|---|---|
| Funder (virtual) | Funding expectations, objectives, and conditions affect how adaptation projects deliver outputs and outcomes. Funder expectations often vary from one project to the other and based on a set of criteria, the rationale behind funding particular adaptation projects needs to be understood and how some of these criteria shape impacts, sustainability, and inclusivity. The KII here targeted a particular officer/funder who oversees the particular project. | 1 |
| TOTAL Per case study | | 8 (Total of at least 28 KIIs for the 7 case studies) |

The KII guide shows the key issues and topics tackled by each category of informants. The guide specifically incorporated inquiries that delve deep into the operational designs and impacts of various interventions guided by a set of indicators that define impact/effectiveness to determine the extent to which interventions achieve their objectives and results for different social groups. Additionally, the KIIs paid attention to key cross-cutting principles including.

- a. Local leadership and community ownership.
- b. Transformative approaches for gender, equity, and social inclusion.
- c. Nature and ecosystem-based solutions.
- d. Application of both scientific innovation and, where relevant, Indigenous knowledge
- e. Sustainability beyond donor funding – e.g. innovative finance, and institutional mainstreaming into existing structures among others.

2.2. Site Visits and Rapid Appraisals

While visiting project sites to engage or interview beneficiaries, the research team executed a rapid appraisal of project activities through tailored transect walks and observations to have some visual appraisal of conditions within which the projects are operating and witness some of the tangible initiatives. The appraisals/transects were undertaken together with beneficiaries. This aided practical understanding and triangulation of insights from interviews.

3.0 Findings of the Deep Dive Analysis of the Case Studies

3.1. Description of the case studies

Based on our case study selection criteria as described in section 2.2.2.1, the following seven (7) case studies were mapped and successfully evaluated for their effectiveness against climate risks. The case studies run through, Kenya, Uganda, Tanzania, Rwanda, and Ethiopia.

a. Kenya Climate Change Adaptation Programme (KCCAP)

KCCAP was a 5-year, USD 10 million intervention (2018-2023) funded by the Adaptation Fund implemented by the National Environment Management Authority (NEMA) in 14 counties. The project aims to build resilience in agricultural resilience through climate-resilient water management systems (effective irrigation schemes, water pans, integrated Shoreline, and Mangrove Ecosystem Management). Modelled around the concept of adaptation village, the interventions aim to integrate community-led infrastructure to support water- food nexus – facilitated by capacity building for local communities on this nexus. As part of promoting WEF, the project anchors several adaptation practices (pastoralism, irrigated horticulture) on solar-powered bore-holes serving communities within a 10-kilometre radius in the adaptation village.

b. The Upscale Project

The Upscale project is a 5 year (2020-2025) Euros 7.66 million project funded by the European Union and implemented by the International Centre of Insect Physiology and Ecology (ICIPE) in East Africa (Kenya, Uganda, Tanzania, Ethiopia, and Rwanda). It aims to execute climate-smart agricultural practices through integrated agroecological management anchored on the push-pull technology . The push and pull approach aim to deliver climate-resilient agriculture and leverage nature-based solutions for the benefit of biodiversity and a sustainable environment. The study focused on the project’s activities in Kenya, (Vihiga County, Ebukola Village. More details are available on the project website:

c. Building resilience of communities living in Degraded wetlands, forests and savannas of Rwanda through an Ecosystem-Based Adaptation Approach (Green Gicumbi)

This was a 5-year (2017-2022), US\$ 14.7 million project funded by the Green climate fund (GCF) and implemented by the Rwandan Environmental Management Authority (REMA). The project’s aim is to promote NbS in enhancing the adaptation capacity of local communities in Northern Rwanda and by implementing Ecosystem-based Adaptation (EbA) actions in forests, savannas and wetlands. Based on four integrated components i.e. i) Watershed protection and climate resilient agriculture, sustainable forest management and sustainable energy through improved cooking stoves and biogas digesters in the community to reduce the biomass of trees

consumed as firewood, as well as reafforestation iii) Government-led Climate resilient settlements, which seek to relocate 100 households from high climate risk zones to new durable and green buildings in Northern Rwanda, Gicumbi district and iv) Knowledge transfer and mainstreaming aimed at capacity building vulnerable communities against the existing climate risks such as floods and landslides.

d. Promoting Climate Smart Agriculture for improved rural livelihoods and climate resiliency in the climate-vulnerable Eastern Province of Rwanda

This is a 3-year (2022-2025) programme with a budget of 883,457 USD. It has been funded by the Africa Development Bank and implemented by the International Center for Research in Agroforestry (ICRAF), in partnership with the Center of Excellence in Biodiversity & Natural Resource Management at the University of Rwanda (CoEB) and Rwanda Agriculture and Animal Resource Development Board (RAB). This programme's main objective is to leverage solar-powered irrigation systems, climate-smart agriculture and support small agri-business through grants to enhance food security and act as an incentive to adopt climate-smart agricultural practices. It also promotes the adoption of drought-resistant crops, and fruit tree farming as an Agroforestry adaptation intervention against food insecurity. Beekeeping and composting are prioritised as well.

e. Implementation of concrete adaptation measures to reduce vulnerability Of livelihood and economy of coastal communities in Tanzania

This intervention was funded by the Adaptation Fund at USD 5 million and implemented by the office of the Vice President over a 5-year period (2012-2017). With a focus on climate resilience infrastructure, the intervention's aim is to lessen the negative impacts of sea level rise and changes in precipitation patterns and floods on coastal infrastructures and settlements in Ilala and Temeke Districts of Dar es Salaam. The project also supports early warning systems by creating and operating a climate change observatory for Tanzania; documenting lessons learned, capacity building of local authorities in developing Integrated Coastal Area Management Plan.

f. Arusha Sustainable Urban Water and Sanitation Delivery Project

This was a 6-year project (2016-2022) intervention with a budget of US\$170 million funded by the Africa development bank and implemented by the Arusha Urban Water Supply and Sanitation Authority (AUWSA) charged with the mandate of coordinating the provision of safe, reliable and sustainable water and sanitation services in Arusha city, Tanzania. With a focus on WEFE, the intervention involves improving sanitation infrastructure and services improvement, supporting water supply infrastructure and services improvement and (c) providing institutional

support and project delivery. About 600,000 people in Arusha city and 250,000 additional people, benefited from the project.

3.2. Key Highlights from the Case Studies

This section articulates the findings across case studies evaluated from Kenya, Uganda, Tanzania, Rwanda, and Ethiopia. Assessment of their effectiveness is guided by the 11 principles of effective climate change adaptation interventions as outlined by Singh et al., (2022). These principles broadly lie along the continuums of process-based frames and outcome-based impacts. We, therefore, highlight insights from across the case studies and about the three broad thematic areas: Nature-based solutions for adaptation, Water, Energy, Ecosystem, Food – nexus, and Climate Resilient Infrastructure thematic areas. Annex 3 of this report shows the result matrix highlighting the findings across case studies. Here we summarise the insights.

3.2.1. THEME 1: Water Energy Food and Ecosystems (WEFE)

WEFE provides a Framework for balancing the demands and needs of water, energy, food and sustainable ecosystems to achieve effective adaptation among vulnerable communities in the East Africa region.

a. Innovation

The innovation lies in harnessing technological and outcomes synergies between water, energy, and food security based on local resources thereby reducing operational costs and maximising impacts: There is increasing technological invention targeting to utilise renewable energy (i.e. solar energy) to address the water, energy, and food security challenge, building on local resources. The case of the *Kenya Climate Change Adaptation Programme (KCCAP)* is a pathway to achieving effective adaptation in Eselenkei village, Mosiro ward, Kajiado county. This was realised through the establishment of an adaptation village model a solar-powered borehole as an intervention against water and food insecurity. This has enabled the local communities to access clean and sustainable water resources throughout the year for household use as well as for their livestock. As for the Upscale project, it seeks to upscale the Push-pull technology across East African regions. This technology is leveraged to biologically control pests and diseases using the *Desmodium* plant species which repels pests such as striga and stem borers while the *Bracharia* attracts and traps pests. The key innovation notable is the building of synergies across water, energy, and food security building on local resources.

The Ugandan case study on *Building Resilient Communities, Wetland Ecosystems, and Associated Catchments* introduced climate-smart agricultural practices, such as adopting drought-resistant crop varieties, implementing water-efficient irrigation techniques, and integrating agroforestry systems. This has contributed to the conservation of the surrounding ecosystems and the enhancement of food productivity and security. The communities have also

benefited through targeted trainings such as Start and Improve Your Business (SIYB) and GET AHEAD ILO, which have further enhanced off-farm livelihood interventions. This is a case study according to the KII engagement, which has been effective in Ntungamo, Mitooma, Bushenyi, Sheema, Namutumba, Pallisa, Kibuku, and Ngora.

The Tanzania case study on *Implementation of Concrete Adaptation Measures To Reduce Vulnerability Of Livelihood and Economy of Coastal Communities* has worked with coastal communities to introduce and promote climate-resilient aquaculture and sustainable fishing practices, such as the adoption of climate-smart aquaculture technologies, the diversification of aquaculture species, and the implementation of community-based fisheries management. These interventions have aimed to enhance food security, provide sustainable livelihoods, and reduce the vulnerability of coastal communities to the impacts of climate change, while also maintaining the health of the marine ecosystems. In addition, introduced renewable energy technologies, such as solar-powered desalination units and energy-efficient cookstoves, led to a reduction in the reliance on traditional energy sources and addressed the energy needs of coastal communities. This enhanced improved energy access and reduced energy-related costs in addition to contributing to the mitigation of greenhouse gas emissions and the conservation of coastal ecosystems.

The *Arusha Sustainable urban water and sanitation delivery* focused on improving the management and governance of water resources in the Arusha region, including the development of integrated water resources management plans which were co-created with the community members. This has involved the assessment of water availability, quality, and demand, as well as the coordination of water use among different sectors including domestic, agricultural, and industrial to ensure the sustainable and equitable allocation of water resources. In addition, there was evidence from the engagements of integrated energy-efficient technologies and renewable energy solutions to power the water supply and sanitation infrastructure, like the installation of solar-powered pumping systems and the use of energy-efficient treatment processes. These interventions have aimed to reduce the energy consumption and carbon footprint of the water and sanitation services, while also improving the reliability and resilience of the systems.

Similar innovation efforts were noted in Rwanda's case study on *Promoting Climate Smart Agriculture for Improved rural livelihoods and climate resiliency in the climate-vulnerable Eastern Province of Rwanda*. This intervention aimed to leverage Climate-smart Agriculture practices such as the introduction of drip irrigation systems, solar-powered pumps for the drilled boreholes, and introduction to drought-tolerant crops supplied by the project implementers. The introduction of drip irrigation systems culminated in effective water utilization and management in the Eastern province of Rwanda. Moreover, the tapping into renewable energy for pumping water speaks to the efforts of mitigating GHG emissions in the energy sector. Further, this intervention has an element of creating an agricultural value chain that not only seeks to ensure that small-scale farmers are food secure but also puts money into their pockets through a robust

Agribusiness model. This model involved providing grants to farmers who had adopted climate-smart agriculture components into practice.

b. Impact (Well-being)

Social impact i.e. livelihoods are highly determined by context and vulnerability level while economic impact requires further investments in the value chain and market linkages: The KCCAP showed greater impact in the pastoralist community in Kajiado where water scarcity is a major vulnerability. The project eased access to clean water resources, therefore playing a major role in improved health and sanitation among the local community. The beneficiaries were trained on constructing fodder storage structures for fodder banking to be utilised during the drought season hence mitigating their nomadism which often translates to strengthening the existing social structures. The love and couch grass are the most common pasture in the region. Further, the KCCAP project has been able to promote drought-resistant fruit trees such as mangoes and micro irrigation systems in Masinga hence enhancing agricultural productivity. In Kitui, the construction of a sump well in River Tiva and an underground water storage system improved water security while dykes at River Asawo in Homa Bay are enhancing water control and access while mitigating flooding in nearby farmlands- enabling better harvest compared to previous years when farms were being swept by the waters. Likewise, the adaptation interventions in Marsabit County about improved storage facilities of fodder for livestock and the sinking of boreholes have improved the chances of their survival during drought seasons. Consequently, these interventions in Marsabit county, Masinga region, and Eselenkei village, Kajiado county have significantly reduced the number of people seeking food aid during drought.

The upscale project in Vihiga County has significantly reduced the use and need for pesticides hence pushing the East Africa region a step forward to abiding by the Rotterdam Convention and Stockholm Convention on Persistent Organic Pollutants (POPs). In addition, improved soil health has been attributed to the leguminous nature of desmodium which plays a key role in nitrogen fixation. Consequently, this intervention has greatly improved the biodiversity in the area, hence minimizing soil erosion, especially during the rainy season. Besides this, the push-pull technology is proven to be effective against pests and diseases by significantly reducing input costs hence farmers can improve on their profit margin. It is important to note that, *Bracharia* grass and desmodium plant species are also being utilized as nutritious livestock pastures since they are rich in carbohydrates and proteins respectively. It is therefore evident that besides Push-pull technology being an effective measure against pests, the 2 plant species can be leveraged as livestock forage. Moreover, the forage surplus is often sold at Ksh 250 per hay bundle hence enhancing household incomes and livelihood.

Building Resilient Communities, Wetland Ecosystems, and Associated Catchments in Uganda's case study promoted the introduction of climate-resilient agricultural practices, such as the use of

drought-tolerant crop varieties, improved irrigation techniques, and the integration of agroforestry systems. These interventions have helped to diversify and strengthen the livelihoods of community members, boosting their food production, income generation, and overall food security. Improved access to resources, diversified livelihoods, and strengthened community organization have increased the communities' ability to withstand and recover from climate change and associated shocks, leading to more sustainable well-being. The project was able to sensitize, mobilize, and capacity-build different communities on on-farm and off-farm livelihood interventions, resulting to enhanced food security.

The Arusha Sustainable urban water and sanitation delivery in Tanzania enhanced the provision of sustainable water supply for access to clean and safe water for domestic use, agriculture, and other livelihood activities, reducing the burden on women and children who often bear the responsibility of water collection. The involvement of the community members in the areas of infrastructure construction, operation, and maintenance created employment and income-generating opportunities. This contributed to the diversification of livelihood options and the enhancement of the economic well-being of the local population.

Tanzania project on construction of a sea wall reduced flooding of farmlands enhancing food security of the communities within the project implementation areas. Provision of energy cookstoves reduced pressure by women to look for firewood, mentally these reduced cases of respiratory diseases occasioned by the use of firewood to cook. The provision of labour by the locals during the construction of the wall and planting of the mangroves provided to them an alternative livelihood, enhancing livelihoods.

Reflecting on Rwanda's *Promoting Climate Smart Agriculture for Improved Rural Livelihoods and Climate Resiliency in the Climate-vulnerable Eastern Province*, the introduction of drought-tolerant crops such as the sorghum, fonio, and Bambara groundnut and sweet potato accelerated the enhancement of the local communities' food security. Utilization of the solar pumps culminated in significantly cutting down on the operation costs of the water assets in the area. This intervention took a step further to enhance the household incomes of the farmers by linking them to the market through the already set up linkages with prospective buyers of farm produce. Adoption of terracing while planting the drought-resilient and high-yielding crops against soil erosion, and water retention, led to an increased harvest hence additionally enhancing the area's food security. To increase farm production, the implementing entity, availed grants to selected farmers with a potential to agribusiness. This is a major contributor to the sustainability of such adaptation programs in the water and food security sector.

Discussions with the beneficiaries reveal that the extent of vulnerability determines the level of perceived social impact especially on livelihoods. The WEFEE interventions analysed are reported to be more impactful in contexts where vulnerabilities are severe i.e. in pastoralist contexts where water scarcity is a major challenge or in dryland areas where drought-resistant crops are needed. As such, greater social impact can be realized when interventions are targeted at

vulnerabilities. A combination of various technologies i.e. renewable energy for water supply and irrigation generates multiple benefits that respond to the complex challenges these vulnerable communities face. While this might mean that interventions addressing prominent contextual social vulnerabilities might yield greater impact and be interpreted as effective, these social impacts require time to mature into economic returns. Transforming social impacts associated with WEFE interventions into economic returns requires time to nurture the resilience and stability of these vulnerable communities to be able to meet their immediate needs before linking into markets. Additional investments in value chains and technology efficiency to enhance productivity can accelerate the transition from, social to economic impacts.

c. Adoption Enablers & its Impediments

Affordability and community ownership are key enablers of technology adoption, but these require sustained engagements and empowerment programmes: The water security project in Eselenkei village is cost-efficient due to the low maintenance and operating costs. Public participation in the implementation of the intervention has led to co-ownership of the initiative through the formulation of the Community Project Committee (CPC) that has inculcated stewardship among the local community. This has played a key role in preventing vandalism of the water infrastructure.

In the Upscale project, sustained effort in engaging the local community on awareness creation in applying push-pull technology in their farms has enabled adoption. The awareness creation and capacity building are often done in demo farms, hence mitigating issues to do with maladaptation. The introduction of local community investment groups for table banking has been a bridge for most homesteads to acquire dairy cows to improve their food systems and diversify their nutrition. Besides this, the local communities are sustainably being provided with high-yielding seeds such as; maize, beans and vegetables such as the *black nightshade* for growing.

To sustainably improve soil health, mitigate soil erosion, and stabilize the slopes of the eastern part of Rwanda, the project beneficiaries formed cooperatives to consolidate voices in managing forests as well as their rehabilitation. Their consolidated voices further were paramount to negotiating reasonable prices for their farm produce and access to Agri-finance credit facilities. It was realized that establishing market linkages and agri-finance facilities in the adaptation impact chain under this intervention was effective in generating and improving household incomes for the local community. Therefore, establishing market linkage frameworks in the last mile of adaptation interventions is crucial for the sustainability of the outcomes as well as for improving the well-being of the beneficiaries and eventually the local economy.

In the context of Rwanda's *Promoting Climate Smart Agriculture for Improved Rural Livelihoods and Climate Resiliency in the Climate-Vulnerable Eastern Province* project, the adoption uptake was accelerated by regular training and meetings by the project volunteers and

the selected lead farmers. These approaches towards adoption uptake built the capacity of the beneficiaries to enable them to transition towards practising effective WEFE adaptation practices. Similarly, in Uganda's Building Resilient Communities, Wetland Ecosystems, and Associated Catchments, the adoption uptake success was anchored on sustained stakeholder engagement and consistent community participation which enhanced and built trust, fostered collaboration that ensured the project's interventions were aligned with the contextualized needs and priorities of the local communities. As such, this translated to a more resilient community who are well informed on crop diversification, and climate-resilient agricultural practices against climate risks such as drought.

With regards to Tanzania's project on *Concrete Adaptation Measures To Reduce Vulnerability*, the project had stakeholder receptive and public engagement in design and implementation. Many of the pilot interventions of both projects were identified through consultations with local governments, and in several cases, these measures supported environmental priorities from the district development plans. Community participation and commitment were high at most of the project sites. This was reflected in the levels of engagement of JUMKISA, a registered community organization from Kisakasaka (Zanzibar) and the Beach Management Units of Pangani district. However, the level of country ownership was partially undermined by co-financing and institutional factors which acted as impediments. The evaluation assessment of country ownership for the project was influenced by the gap between committed and disbursed co-financing by some of the main project partners, interfering with deliverables.

The Arusha Sustainable urban water and sanitation delivery project was as a result of co-creation process where key stakeholders within the water sector, government departments and communities were involved in the design and implementation of the project. This championed for ownership hence providing a conducive environment for effective achievement of the project deliverables. Further, the project aligned with the existing national and local policies and regulations that prioritised sustainable water and sanitation service delivery, particularly in urban areas. This alignment facilitated effective and all inclusive stakeholder engagement and secured government support.

Overall, the ability to afford adaptation assets and to meet the short- and medium-term operational costs potentially enables long-term adoption of interventions. Strengthening local financing opportunities such as; credit facilities, insurance, and table banking initiatives is critical in enabling community members especially women to access and operate technologies promoted by WEFE interventions. Community ownership is a process and requires continuous engagement, empowerment, and incentives. The institutionalisation of community engagements through village committees or resource committees provides structures for enhancing ownership and co-creation of solutions. In some contexts, existing community structures are valuable foundations to build on even though the philosophy of these existing local institutions needs rebranding to address and align with the new challenges emerging from climate change and other

shockers.

Technological fixes without addressing underlying social vulnerabilities are a major impediment to adoption: The Ololunga Adaptation Village has provided a platform for innovative agricultural practices such as the introduction of growing vegetables in gunny bags. This demonstration illustrated that gunny bag farming maximises productivity per unit area as multiple crops can be grown in the bag, therefore enhancing effective water utilisation, as well as ease in managing pests and diseases. Several homesteads neighbouring the adaptation village have taken up the growing of fruit trees such as paw, mangoes and avocados. This is mainly attributed to the proximity to the water point and the relatively short maturity period of the fruit trees. However, the distribution challenges of the water resource have impeded the uptake of agricultural practices among the pastoral communities distant from the water point. The initial efforts in accelerating the adoption of push-pull technology under the Upscale project were impeded by the labour-intensive nature of setting up the mechanism on the farm. This involves adherence to the measurements involved in spacing the spacing of the *Bracharia* grass from the crops and *Desmodium* plants. Adoption uptake was further hindered by the fact that push-pull technology takes an extensive period before its effectiveness against pests and diseases can be experienced. This case demonstrates the need to address underlying social vulnerabilities in deploying technologies. Technical fixes are effective in the short run but long-term effectiveness requires a proper understanding of socio-technical pathways and the feasibility of resilience building in such settings.

d. Gender and social inclusion (GESI)

Whereas WEF projects are designed with gender and social inclusivity considerations as key outcome areas, the operationalisation of the GESI in practice is shaped by several underlying demographic and cultural orientations that need to be understood and considered: Under the KCCAP, inclusivity in managing the water infrastructure was buttressed by incorporating 6 women in the Community Project committee, 9 youths, and 8 men. This inclusivity criterion was stressed by NEMA the executing entity and adopted by the community leaders in the village. Even though the construction of the solar-powered borehole at the village provided relief to the immediate local community, women and girls within several kilometers away are still disadvantaged in accessing the water point. The harsh temperatures have forced them to fetch water during the early morning hours and late evening which still exposes them to attacks from wildlife and sexual harassment. To this end, there is an urgent need to invest in water distribution infrastructure to enable all homesteads and groups especially women and girls staying distant from the established points, to access water. In Kitui where there is a promotion of drought-tolerant mangoes, most of the beneficiaries are women, girls and youth who receive pieces of training on the grafting of seedlings, and husbandry. This has ensured inclusivity among these vulnerable groups hence realising integral project planning and implementation processes leading to more equitable and effective outcomes. In other projects, e.g. Upscale project, it was noted the Youth were enthusiastic about the push-pull technology hence the

adoption uptake rate was reported to be relatively high. This is partially attributed to the fact that the technology is relatively cheap, reliant on local resources and effective against pests, hence maximising the cost-benefit aspect. The Push-pull technology is also suitable for traditional farming which is largely done by women. However, during the capacity-building sessions, it was discovered that most of the women did not own parcels of land due to the Patriarchal nature of their communities. This denied some women the independent decision to deploy the push-pull technology – thereby slowing adoption and expected impacts. The mandatory gender and social inclusion training modules for project officers in *Promoting Climate Smart Agriculture for Improved Rural Livelihoods and Climate Resiliency in the Climate-Vulnerable Eastern Province* project enhanced the capacity of the project staff on issues to do with social inclusion while executing components of the project. These components include but are not limited to Gender and Social Analysis Tools, the development of inclusive Monitoring, Evaluation and Learning (MEL) to measure outcomes among others. Further, the beneficiaries reported that the project created a safe space for them to confidently express their needs during the needs assessment processes and were engaged actively in the project implementation. The safe spaces were created by having women focus group discussions. It is from these that relevant and unique adaptation actions tailored to build their resilience were conceptualized and executed. As such, these engagement strategies contributed effectively to enhancing women's resilience against climate risks thus sustainability of its outcomes. With regard to amplifying women's voices in climate adaptation, the beneficiaries reported that the project set aside leadership quotas for women. These women's leadership capacities were enhanced through trainings according to the formulated gender and leadership modules. As such, the leadership training enabled women to highlight their plights caused by the impacts of climate change therefore leading to designing effective gender-responsive climate actions.

In Uganda's Case Study on Building Resilient Communities, Wetland Ecosystems, and Associated Catchments, an alarming 26% of the people trained on extension services were women and girls. This involved climate-smart agriculture, integrated soil fertility management, sustainable land management and sustainable soil fertility management, among other climate-resilient technologies. some of the districts covered are Rukungiri, Rubanda, Buhweju, and Rukiga. The extension services training was co-financed by the National Government hence enabling the intervention to exceed its target by approximately 169%. Women and girls in Abale, Kanungu, and Ntungamo districts took on capacity-building training in technical skills for off-farm activities that leveraged ILO methodology for Rural Economic empowerment methodology. One key outcome was to link at least 50% of women and youth to green jobs hence enhancing their household incomes.

The two Tanzania's projects incorporated gender aspects in the design and implementation of the project activities. An engagement with the project implementors during the KII processes and analysis of the project documents did indicate that gender-disaggregated indicators were included in their results frameworks, an indication of gender responsiveness. The targeted

trainings of the different stakeholder categories were inclusive and targeted both men, women and the youth. In the sea wall project, the distribution of jiko cooking stoves in three urban districts of Dar es Salaam engaged women's groups from the participating districts and reduced the time devoted to food preparation (a traditionally female role), while lowering local demand for charcoal.

Therefore, while WEF projects are designed with gender and social inclusivity considerations as key outcome areas, the operationalisation of the GESI in practice is shaped by several underlying demographic and cultural orientations that need to be understood and considered. In other words, achieving GESI in practice should be intentionally pursued and tracked as part of affirmative action.

e. Governance.

The weak linkages and/or connection between national and subnational policy processes and the interventions being implemented impede sustainability even though emerging Public-Private Partnership (PPPs) models could enhance stronger connections with policy processes: Climate change policies and governance shape the effectiveness of adaptation interventions by enabling alignment and attracting additional public resources for action. For instance, the water, agriculture and food security intervention in Eselenkei village, Kajiado County could benefit from the county's climate change fund for scaling the water infrastructure. This translates to improving water proximity to distant homesteads from the main water point and therefore improving the adoption uptake rate in climate-smart agriculture (CSA) being practised at the Ololunga Adaptation Village. The extension of dykes along River Awaso in Homabay County could benefit from the county climate change budget.

We however noted very weak linkages and/or connections between national and subnational policy processes and the interventions being implemented. Based on discussions with project managers and policymakers, the role of policies in the project processes has been limited to project design and approvals. There is limited engagement with the policy process in the implementation of projects. Project managers noted the bureaucracies involved in engaging policymakers in project implementation thus delaying interventions designed and executed within strict timelines. While avoiding policy bureaucracies supports the timely implementation of project activities, the limited project-policy linkage is a barrier to long-term sustainability as projects do not get aligned to existing policy structures/departments etc for continuity. We however noted that opportunities for Public-Private Partnership (PPPs) models could enhance stronger connections with policy processes. In the Upscale project, for example, the International Centre of Insect Physiology and Ecology (ICIPE) the implementing entity, partnered with the Homa Bay County Government to train 54 agricultural extension officers. These extension officers' capacity for push-pull technology was enhanced to accelerate uptake among farmers in the county. The PPPs arrangements enabled multi-Actor Communities (MAC) engagements in

Ethiopia to facilitate the co-creation and mainstreaming of push-pull technology in agricultural policy instruments. This has enabled consideration of the technology in the county government climate plans. Similar collaboration efforts were witnessed in Uganda's case study on Building Resilient Communities, Wetland Ecosystems, and Associated Catchments whereby the chief administrative officers and district natural resources officer participated in the sign-off and distribution of livelihoods such as goats, pigs, and sheep in the districts of Butebo, Butaleja, and Tororo. This was to improve the food systems of the local community through the introduction of animal products. The seawall adaptation project in Tanzania reinforced horizontal and vertical linkages implementation approaches between different stakeholders. Their consistent engagement and cooperation on the part of the District and Municipal Council environmental officers, NGOs and community organizations for the implementation of adaptation initiatives (particularly in the case of mangrove restoration) led to the effective implementation of the project. In the Tanzania urban project that was based on the existing policy frameworks in urban areas, there was consistent engagement between the national and sub-national government officers who offered support and a conducive working environment to the project implementors. They ensured ownership and enhanced coordination. Therefore, partnerships between implementing entities and local governments are vital for the effectiveness and sustainability of adaptation interventions since government officials become familiar with the initiatives thus integrating them into their financial year budgets and workplans.

f. Sustainability

There is a relatively better emphasis on the sustainability of technology, but little attention is given to sustainability in the context of knowledge and policy: Sustainability in projects can take different pathways including policy, technological and knowledge sustainability. Most case studies analysed have focused on technological sustainability i.e. through promoting or pushing for the adoption of technologies amongst community members. However, this technological push is often not linked to knowledge and policy structures thus most farmers/community members can only engage with the technologies in the short run but face operational challenges in the long run. The fact that the implementation of most interventions is not adequately linked to the policy agenda exacerbates the challenge. For instance, farmers in Vihiga County are being sustainably supplied with high-yielding maize, beans, peas, and vegetable seeds yet there are limited long-term investments and policy support for water management skills thus exposing farmers to the drought risks despite the high-yield seeds.

In the KCCAP, the water security intervention in Kajiado County, Eselenkei Village, advocated the formation of a CPC that promoted a sense of ownership among the local community and the formulation of water resource management by-laws. However, the dissemination of repair and maintenance technical skills in the water infrastructure is yet to be done. In the event of an electrical fault or mechanical breakdown of the borehole pieces of equipment, a technician has to be sent from Nairobi which is time-consuming. This was experienced in Musro Adaptation

Village, where the local community stayed without water for approximately 4 months due to an electrical fault in their solar-powered borehole. In addition, it was noticed that the water infrastructure had no pieces of equipment to monitor the water table to inform sustainable water resource management policy in the area. The potential investment area in the KCCAP is the upscaling of the water distribution infrastructures as well as the dissemination of the repair and maintenance expertise among the local community.

In the context of Rwanda's case study, the sustainability of the outcomes is heavily reliant on stakeholder partnerships among community members, organizations, cooperatives, churches and local governments. For instance, in Rwanda, project facilities and assets e.g. solarized boreholes, will be handed over to District authorities for long-term management. This is due to the unavailability of a budget from the project for long-term management and maintenance.

Uganda's Case Study on Building Resilient Communities, Wetland Ecosystems, and Associated Catchments, approached the local community through their community-based structures hence having the buy-in from the local leadership who are critical in mobilization laying the foundation of trust between the intervention beneficiaries and the project implementers. In addition, farmer field schools were established in various regions in the districts for practical training which are effective in the adoption and application of Good agricultural practices. The platform further offered an opportunity for peer learning among the local community members. This further, readily availed extension services to the local farmers throughout the districts. In terms of Influencing. policy and governance, this case study supported the implementation of provisions related to wetlands in the National Environment Act (NEA, 2019) and the national strategy for ecosystem restoration. This was through generating data and best practices that were leveraged to inform the 2 policies.

The Arusha urban water project enhanced sustainability measures in the project design and implementation through different approaches. These included: building the capacity of different staff including local water utility and municipal authorities through training programs and skills development. In addition, through the project, there was continuous monitoring and improvements in the utility's operational performance, such as customer response times, service interruptions, and maintenance schedules. This enhanced the operational efficiency. The project also established a robust asset management system to ensure the long-term maintenance and rehabilitation of water and sanitation infrastructure.

The sea wall rise project was very supportive of the local, national and global priorities. The project was conceived as an instrument to implement Tanzania's National Adaptation Program of Action (NAPA), which outlines the national adaptation policy framework and serves as a key reference document for UNFCCC and the donor community. There was high institutional sustainability among the local governments and NGOs that participated in implementing adaptation interventions. The District and Municipal Councils as was informed during the engagement with the project implementors had established environmental mandates as well as

jurisdiction over the sites where adaptation interventions were implemented. In Zanzibar, district environmental departments had a climate change focal point in their staff and incorporated adaptation measures within their plans. The District Councils in particular represented the main local government partner for implementing adaptation measures and environmental initiatives in general.

Therefore, sustainability in adaptation outcomes under the WEFE thematic area points to the need for such interventions to transition into business models after the funding ends. For instance, the formation of cooperatives like in the case of Rwanda's *Promoting Climate Smart Agriculture for Improved Rural Livelihoods and Climate Resiliency in the Climate-Vulnerable Eastern Province* intervention, enabled the members to negotiate reasonable prices for their farm produce including dairy milk. The fact that the farmers can sell their farm produce at reasonable market rates, and the incomes generated are critical in sustaining the cooperative's administrative operations as well as enhancing individual household incomes. For the solarized boreholes, the community project Committee can opt to charge reasonable prices for the water. The revenue collected will be used to carry out maintenance of the asset including mechanical and electrical faults.

3.2.2. THEME 2: Nature-based Solutions (NbS) for Adaptation

NbS is instrumental in leveraging natural processes and ecosystems to address the impacts of climate change that are known to lead to biodiversity loss, food and water insecurity and disaster risks. This section therefore articulates some of the Nbs interventions adopted in the various case studies under phase 2 of the study.

a. Innovation

Innovation in NbS mainly lies in the harnessing synergies between people and ecosystems services to enhance process and outcome effectiveness: The co-design and joint implementation of coastal restoration with local communities under the *KCCAP* enhanced effectiveness of the process and outcomes. In the other projects, harnessing the synergies between different ecosystem services and co-benefits enhanced the outcomes. For example, the push-pull technology has increased intercropping and biodiversity hence enhancing ecosystem stability and resilience against climate risks such as drought.

Similarly in Uganda, the adoption of nature-based solution to replenish groundwater, improve flood control, and enhance the livelihoods of subsistence farming communities through fishing and agriculture was found to be an innovative action as it has benefited both the communities and also promoted the conservation of the environment through reduced climate risks.

Rwanda, through its *Green Gicumbi Project*, aimed to achieve Sustainable Forest Management and sustainable energy. This was done through the rehabilitation of Old forests. Further,

improved cooking stoves were distributed among the local community members, which significantly conserved and improved the biodiversity of the area since there was a reduction in overreliance on firewood as cooking energy. Lastly, high-quality tree seedlings were grown and planted on the community's land. This was to stabilize the hilly slopes against landslides.

The Building Resilient Communities, Wetland Ecosystems and Associated Catchments in Uganda restored approximately 38,000 hectares, through boundary demarcations between the wetland and catchment areas, removal of exotic trees such as Eucalyptus, and vegetation blocking channels feeding the wetlands. This led to restoring 2 inlet streams into the wetlands. The indigenous species of grasses and herbs growing along the edges of these wetlands were protected by the 126 km boundary demarcation in Mushasha-Kankara Swamp forest, Buhweju district. Digging of trenches along contours and construction of gabion dams along gullies in Kagorogoro and Nyamabaare in Rubirizi districts played a key role in water and soil conservation hence improving the soil fertility and moisture retention. As such this led to significant improvement in soil fertility hence enhancing the productivity of the catchment area. To increase biomass productivity, in the Kidubule wetland ecosystem, 80,000 saplings that are compatible with the wetland environment, were planted to mitigate soil erosion in the area.

The construction of the sea wall measures to reduce the vulnerability of the Livelihood and economy of coastal communities In Tanzania project restored mangrove and coral habitats, both of which act as natural barriers and buffers against wave surges. Through the project around 1,000ha were rehabilitated with mangroves, especially in Rufiji District. This benefited around 31,500 people, another 1,260ha across two sites in Zanzibar, and up to 3,000m² of coral reefs. The restoration was carried out using locally available, climate-resilient species. No-take zones were established with the goal is to reducing this by building and rehabilitating sea walls and planting mangroves and other vegetation to protect important assets along the coastline such as roads, buildings, ports, and markets. The project is rehabilitating storm drains to prevent flooding and providing energy-efficient cookstoves to prevent deforestation.

b. Impact (Well-being)

Impact of NbS activities are largely built on people-driven restoration given the close relationship between people and nature: Besides the KCCAP improving access to clean water hence improving health and sanitation, it has trained farmers to adopt sustainable grazing systems and fodder banks in Eselenkei Village Kajiado county. With regards to the coastal management efforts especially in the Jimbo area, 1000 mangrove trees were planted to control the shoreline aggression, and this was done with the help of the local communities. These restoration efforts have not only protected shorelines but also supported local fisheries by providing critical habitats for breeding.

The beneficiaries of the Upscale project reported an increased soil health status contrary to before due to nitrogen fixation by the desmodium plant species. Training on making organic

manure and liming was done to reduce the acidity of the soil as a result of regular pesticide spraying and the application of synthetic fertilizer over the years. As such, these processes, e.g. liming and application of the organic manure have been credited with enhancing and maintaining the soil's carbon-to-nitrogen ratio hence increasing its fertility and productivity of the soil. Moreover, push-pull technology has increased intercropping and biodiversity hence enhancing ecosystem stability and resilience against climate risks such as drought. Consequently, the enhanced biodiversity has increased water retention during rainfall seasons due to reduced surface runoffs and a significant reduction in evaporation rates. As for the Green Gicumbi project, Agricultural farmlands became resilient to landslides and soil erosion over time because of the adoption of terracing with the help of experts. One farmer testified that the agricultural production could quadruple as a result of applying terracing techniques on his farm. Terracing is effective for water, and nutrient retention, especially in sloppy areas such as Gicumbi district.

Reflecting on the Building Resilient Communities, Wetland Ecosystems and Associated Catchments in Uganda, the restoration of the wetlands in Bushenyi, Kisoro, and Rukungiri, districts led to a significant increase in ecosystem services. The local communities in these districts reported an increase in water availability, and forage for their livestock and aquatic life thus fishing activities taking place. To this end it can be argued that the wetland restoration efforts have diversified food systems among beneficiaries in the districts. Food systems in these districts were further enhanced by the introduction of apiculture in adjacent catchments. With linkages to the established markets, apiculture, fishing activities as well as vegetable surplus, were key in improving the livelihood of the beneficiaries.

Concrete Adaptation Measures to reduce Vulnerability Of Livelihood and Economy Of Coastal Communities In Tanzania project successfully reduced the vulnerability of human settlements, infrastructure and ecosystems to climate change threats. These are important achievements that were accomplished through the rehabilitation of coastal infrastructure and ecosystems at vulnerable coastal sites.

c. Adoption Enablers or its Impediments

Enabling the adoption of NbS practices requires strengthening the institutional and cultural connections between local communities and ecosystems: The main adoption enablers for NbS were the deliberate efforts to engage the local communities in the implementation process hence creating a sense of ownership of the intervention. For instance, in the Upscale project, the beneficiaries adopted peer learning processes in disseminating the technical know-how of setting up push-pull technology in their farms. For coastal restoration interventions such as the KACCP, communities were involved in the planting of 1000 mangrove trees to stabilise the shorelines against erosion and sea level rise. It was reported that some community members are experts in deep-sea diving. Therefore, they were engaged in coral reef restoration leading to increased coastal aquatic life because of the restoration of their habitats and erosion.

The adoption of NbS is highly contextual and defined by the functionality of community engagement framework: Interviews with local communities in Eselelenkei Village, Kajiado County, revealed that local pastoralists are unable to adopt NbS adaptation practices such as Afforestation and Agroforestry due to water stress and competing domestic versus restorative uses. To this end, the adoption rate of some of the restorative Nbs in the pastoralists' context is relatively low due to ensuring vulnerabilities. There are opportunities for natural restoration in pastoral ecosystems including rotational grazing introduced at the Adaptation village by NEMA and adopted by the CPC hence there is an improved pasture management framework within the village. Additionally, the adoption of peer learning through field schools and bringing social groups to learn successful cases from each other through demonstrations, (i.e. demo farms) have played a key role in enhancing adoption accordingly.

For the Green Gicumbi project, farmers whose forests were rehabilitated formed a cooperative to help manage these forests. These cooperatives served as a collective force to protect their forest from unsustainable exploitation. In addition, the project also trained community volunteers to provide extension services to farmers hence significantly reducing maladaptation. Besides this, beneficiaries explained that the adoption uptake was partly attributed to the increased frequency of environmental shocks such as landslides. This compelled them to quickly adopt adaptation actions against landslides, soil erosion and floods. Further peer learning especially in demo fields for practical learning experiences, offered first hand and tangibles benefits of adaptation actions demonstrated. This learning approach encouraged the local community to take up new adaptation techniques such as terracing across the slopes to build their resilience against landslides, soil erosion and floods. Regular monitoring and evaluation activities in the intervention measured the success rate of its adaptation actions. The regular monitoring and evaluation of the Gicumbi project generated evidence of the success achieved against climate risks. This was further leveraged to create awareness of the benefits hence accelerating the adoption rate among the local community as they were confident in the outcomes. In addition, the longevity of the project (6 years) convinced the local community that the adaptation actions they were being engaged in, pointed to an element of commitment among the project implementers. This culminated in trust between the local community and the project implementers due to their scheduled long-term commitment to building the resilience of the community, therefore accelerating the adoption uptake.

The adoption enablers among the beneficiaries, in Uganda's case study, is hinged on efforts put in place for community engagements during the demarcations and restoration exercises. Grievances and concerns from the local community were addressed in redress committees that were constituted by community representatives and District Local Government officials (DLG) from departments such as; agriculture extension, environment, forestry, fisheries, livestock, veterinary and commercial sectors. These efforts contributed significantly to the wetland restoration buy-in

by the local community members who were extensively informed on the merits of the intervention activities to be undertaken as well as the aspect of co-implementation.

Adoption enablers that contributed to the Implementation Of Concrete Adaptation Measures to reduce the Vulnerability Of Livelihood and Economy Of Coastal Communities In Tanzania project included: the consistent engagement of district and community stakeholders in the implementation of project activities. This encouraged commitment and ownership on the part of district council focal points, NGOs and community organizations. In addition, strong community participation supported a larger number of ecosystem restoration initiatives and facilitated the registration of community organizations to create local networks.

d. Gender and social inclusion

Culture in a patriarchal society where NbS is common remains a major driver of gender imbalances but emerging models for gender representation and equitable benefits sharing incentivise gender integration in NbS: In a patriarchal society such as the one at Eselenkei village in Kajiado County, it was a great step forward to having women and young girls in the CPC whereby discussions and decisions on the modalities of rotational grazing were being made. In the Upscale project, both women and youth are actively engaged in the learning, and eventually adoption of the push-pull technology.

In reference to the Gicumbi project, besides the men, the women, young girls and the youth were inclusively engaged in the needs assessment stage of the project. They were then consulted extensively on the project design meant to build the resilience of the local community in the Gicumbi district. By involving the women, young girls and youths in the initial stages of the intervention, the project implementers were able to incorporate their voices into the design of the project. Consequently, their needs were taken note of in building their resilience against extreme weather events such as; landslides that are frequent in the area during the rainy season. The Gicumbi project further encouraged women to take up leadership in various community-based groups engaged in the co-implementation of the project. To this end, women's voices were amplified in highlighting their needs (access to clean water, knowledge in terracing etc) and most importantly, NbS adaptation actions were implemented with consideration to their priorities and sensitive needs. To this end, it was evident that involving women, young girls and youth in the NbS adaptation actions in the Gicumbi district, led to the designing and implementation of interventions that addressed unique challenges facing this vulnerable group.

Gender considerations in Uganda's *Building Resilient Communities, Wetland Ecosystems and Associated Catchments*, were evident when it came to constituting the Wetland Management Committees in Rubanda, Rukiga, Rubirizi, Kumi, Tororo, Butaleja, Budaka, and Kaliro districts. To ensure women and youth inclusion and participation in the Wetland Management committee, several seats were reserved for them hence adopting inclusivity in restoration efforts of the wetlands. Besides gender considerations in the wetland committees, 41% of the trained wetland

conservationists, were women. Therefore, the case study aimed to target women for the training, making them wetland restoration specialists. Peer to peer learning then took place in their social groups thus the emergence of conservationists in the target districts.

The two Tanzania's projects incorporated gender aspects in the design and implementation of the project activities. An engagement with the project implementors during the KII processes and analysis of the project documents did indicate that gender-disaggregated indicators were included in their results frameworks, an indication of gender responsiveness. The targeted trainings of the different stakeholder categories were inclusive and targeted both men, women and the youth. In the sea wall project, the distribution of jiko cooking stoves in three urban districts of Dar es Salaam engaged women's groups from the participating districts and reduced the time devoted to food preparation

e. Sustainability

Knowledge awareness and peer learning among local communities are key in sustaining NbS impacts and learning: The training of the local communities in implementing NbS activities, and peer learning among the local community hence not heavily relying on the extension services by the field assistants who are short-staffed. To avoid maladaptation in NbS, the KCCAP's Adaptation village at Ololunga is a reference point for the local community on the modalities of rotational grazing as a NbS activity towards range land management. The co-implementation of this activity with the local community members has brought about a sense of ownership of the interventions hence enhancing sustained adoption uptake. Further, NEMA sustained the provision of fruit tree seedlings as well as indigenous trees for growing both at the adaptation village and the surrounding homesteads. However; there is a need to invest in disseminating the grafting skills among the community members for a sustained supply of seedlings as well as indigenous trees for growing. Therefore, establishing tree nurseries can be a viable venture in the area. The construction of a strategically positioned dam across the Eselenkei River which is seasonal can be essential in reducing surface runoff hence accelerating sustainable recharging of groundwater reservoirs, triggering microclimatic conditions such as regulating local temperatures and enhancing the overall water security in the region.

Rwanda's Gicumbi project sustainability is anchored on the political goodwill from the government to build a climate-resilient economy by tackling the impacts of climate change. This is because the project objective and intended outcomes were derived from the country's National Adaptation Plan (NAP) and its Vision 2023 Umerenge program. As such, the Gicumbi project earned the backing of the political class which led to adequate budgetary allocation from the mobilized climate funds. In addition, the sustainability aspect was buttressed by the involvement of the local government as they play a key role in ensuring continuity of the adaptation actions and achievement of the intended outcomes. Further, the commitment among the local community to upholding biodiversity conservation within the locality laid a firm foundation for ownership of the ongoing program. This is because of their contextual understanding of climate change

impacts in the Gicumbi district.

Sustainability of the NbS for Adaptation outcomes in Uganda's *Building Resilient Communities, Wetland Ecosystems and Associated Catchments* is hinged on the formation of wetland management committees and the training of approximately 2000 beneficiaries on wetland restoration processes and techniques. This was done in Rubanda, Rukiga, Rubirizi, Kumi, Tororo, Butaleja, Budaka, and Kaliro districts. Consequently, the restoration efforts in these districts actively engaged the District Local Government (DLG) technical teams who were critical in spearheading and sustaining the awareness creation on wetland restoration among the local community members. The DLG was further engaged in setting up Community Based Organizations (CBOs) as a sustainability and project exit strategy for the wetland restoration efforts. The sustainability of this case study's outcomes is also hinged on the formulation of community-based wetland and catchment management plans to inform future interventions.

The Tanzania urban water project adopted the community-based approach to foster a sense of ownership and to ensure the long-term sustainability of the NbS. This was attributed to the fact that the local stakeholders were more empowered to take an active role in the stewardship of their water and sanitation resources. *The sea wall rise construction against sea rise project in Tanzania* prioritized the restoration and sustainable management of coastal ecosystems, such as mangrove forests, as a nature-based solution to climate change adaptation. This approach not only enhanced the resilience of coastal communities but it also provided important ecosystem services, such as coastal protection, biodiversity conservation, and livelihood support. By involving local communities in the planning, implementation, and monitoring of ecosystem-based adaptation measures, the project ensured their long-term ownership and stewardship of these natural resources.

3.2.3. THEME 3: Climate Resilient Infrastructure.

Sustainable development of the East Africa Region's Economy is majorly reliant on climate resilience infrastructure that is key in ensuring the delivery of essential services such as health and education, market products and the overall reduction in vulnerability of the local communities. This section, therefore, unpacks the discussions had with the project beneficiaries as well as the project implementers on the issues regarding the effectiveness of intervention in climate-resilient infrastructure.

a. Innovation

The innovation in climate resilience infrastructure is embedded in building the resilience of the infrastructure to remain functional amidst varying climatic conditions: Initially, NEMA established a water pan near Eselenkei River, however, the trapped water did not last the community for 2 months. This is attributed to the constant variability of climate conditions that accelerated the evaporation of the water. It is at this juncture that, NEMA turned to sinking

boreholes as an intervention for water security. This intervention has proven to be effective in Arid Semi-Arid areas such as Kaijiado so long as the water tables are monitored regularly to inform policies on accessing and utilising the water resource.

In Rwanda's Green Gicumbi project the construction of check dams to control floods and soil erosion. This significantly reduced flooding events that often destroyed farms, caused injuries, displaced the population and caused aggravating mental health among the flood victims. The beneficiaries of the *promoting Climate-smart Agriculture for Improved Rural Livelihoods and Climate Resiliency in the climate-vulnerable Eastern Province of Rwanda*, project were able to get 2 cold rooms as part of the post-harvest infrastructures. This facility is critical for the storage of farm produce while significantly reducing postharvest losses. Furthermore, the facility guards the farmers against exploitation from brokers who often offer below-market rate prices for their farm produce. To this end, besides the cold rooms reducing post-harvest losses, and maintaining the nutritional value and quality of the farmers' produce in Eastern Rwanda, it has empowered them with negotiation skills for fair market rate prices hence improving their household incomes through the profit margins. In addition, the project constructed a solar-powered irrigation system that was used to pump water to farms from the man-made dam. The solar-powered irrigation system was leveraged to irrigate farms located in hilly areas hence improving water proximity to the beneficiaries for both household and agricultural use.

Tanzania's concrete adaptation to reduce vulnerability of Livelihood and Economy of Coastal Communities In Tanzania, built groynes and dikes in seven locations along Tanzania's coast to stop the shores from eroding and prevent saltwater intrusion and flooding. This resulted in a total of 2,400m of sea-defence structures being built. This included investments in Zanzibar towards five 100m groynes in Kilimani to protect houses and crops from floods and two 50m segments of seawall in Kisiwa Panza that protect 300 villagers. 10 boreholes were successfully drilled and 15,000 litres of storage tanks were constructed for each borehole. Rainwater harvesting devices were installed to achieve at least 20% increases in year-round water availability for local communities. The relocation of wells and the construction of rainwater harvesting devices benefited over 10,000 people in Bagamoyo District. Additionally, about 3,000 efficient cook stoves were purchased and distributed to households to address the issue of deforestation of mangroves for fuel. *The Arusha Sustainable Urban water and sanitation project* designed and implemented a comprehensive flood management system for Arusha, which included the construction of detention basins, retention ponds, and drainage channels. These flood management structures were engineered to withstand increased rainfall and extreme weather events projected under climate change scenarios, ensuring they could continue to function effectively in the face of climate impacts.

In Uganda's case study, *Building Resilient Communities, Wetland Ecosystems and Associated Catchments*, there were investments in climate information and early warning systems. This

was done through procuring equipment and software to train selected community members on the functionality of Early Warning systems (EWS). This was majorly against oncoming floods or drought seasons. The EWS initiates the disaster preparation strategic plans to mitigate the impacts. In addition, the EWS infrastructures were synergised with the installation of Automatic weather stations for collecting data that will be utilised in the region's climate modelling. To ensure water security and accessibility in the region, water retention facilities were constructed at the edge of wetlands. storage water facilities were constructed as well for distribution within the households in the region. As a result, small-scale irrigation schemes were established in Kabale, Pallisa, Namutumba, Kibuku, and Butebo districts. For efficiency in water management, 5 water-saving irrigation schemes were set up in these districts.

b. Impact (Well-being)

Climate resilience infrastructure provides greater ecological impact with potential social co-benefits that can be enhanced: The construction of sea walls in Kilifi County against the sea level rise has also been effective against ocean waves that are known to erode coastal lines hence triggering sea level rise. In Homabay County, the construction of dykes at River Asawo has been critical to mitigating the floods, however, due to limited funding, the construction of the dyke did not cover a considerable section of the riverbank. This has exacerbated flooding downstream. The availability of clean water for the local community, has significantly improved health and sanitation, especially among school-going children in Ololunga Primary School. Moreover, the water infrastructure has enabled the school to realize the feeding programmes, hence significantly improving the overall student attendance and their class performance. In addition, due to water availability, the school planted maize and beans to feed its growing population of students hence maximising the cost-effectiveness of the project. Furthermore, the CPC formulated in the village has promoted a sense of ownership and stewardship of the water infrastructure set up in the village. To this end, the shared water infrastructure has promoted peace and cohesion among the local community hence creating a conducive environment for adaptation.

In the *Green Gicumbi project*, a notable impact was the well-being of households living in climate-resilient settlements. Project beneficiaries reported that they are no longer afraid of any climate-related hazard. They feel safe. In addition, tea farmers who always suffered loss and damage to their tea when it rained are now harvesting 800-900 Kg of tea/hectare due to terracing and contour farming techniques undertaken hence reducing incidences of flooding and landslides. The *promoting Climate-smart Agriculture for Improved Rural Livelihoods and Climate Resiliency in the climate-vulnerable Eastern Province of Rwanda* project, significantly improved the food security status in the region through the adoption climate climate-smart agriculture. This involved investments in solar-powered water irrigation systems that contributed to sustainable water resource management. In addition, the construction of Post-harvest infrastructures such as cold rooms became an important asset in the villages' agricultural value

chain. This infrastructure significantly reduced post-harvest losses hence safeguarding the Eastern Province's food security as well as improving the beneficiaries' livelihood because of circumventing the brokers who offered below the market rate prices for their produce. Further, the project constructed 2 selling points for fruits and vegetables hence contributing significantly to the last mile of the adaptation impact value chain in the food and agriculture security.

The *Arusha Sustainable Urban Water and Sanitation project* provided safe, reliable and sustainable water and sanitation services in Arusha City, Tanzania thereby contributing to the improvement in the health, social well-being and living standards of the beneficiaries. The project also improved the quality of water supply and sewerage services in the service area under the Arusha Urban Water Supply and Sanitation Authority (AUWSA). *Tanzania project on construction of a sea wall* reduced flooding of farmlands enhancing food security of the communities within the project implementation areas. The provision of energy cookstoves reduced pressure on women to look for firewood, mentally this reduced cases of respiratory diseases occasioned by the use of firewood to cook. The provision of labour by the locals during the construction of the wall and planting of the mangroves provided them an alternative livelihood, enhancing livelihoods.

The establishment of water retention facilities constructed in Uganda's *Building Resilient Communities, Wetland Ecosystems and Associated catchments* revived agricultural activities through the set up of water-saving irrigation schemes and the provisions of Pumps and irrigation kits. In retrospect, the provision of these irrigation infrastructures was a step towards food security in the Kabale, Pallisa, Namutumba, Kibuku, and Butebo districts. These irrigation schemes were powered by solar energy. Furthermore, the diversification of the beneficiaries' nutrition was further enhanced by the construction of 5 fish ponds which leveraged the waters from the retention facilities established in respective districts. Besides water security diversifying their nutrition, the beneficiaries significantly improved their household incomes from fish sales.

c. Adoption Enablers or its Impediments

Climate resilient infrastructure is capital intensive, and therefore availability of adequate funding for the infrastructure is a key variable to achieving effectiveness in interventions. CPCs often provide the local governance aspects in adaptation interventions hence instilling stewardship among community members on assets such as the solarised boreholes constructed by NEMA through the *KCCAP*.

The stewardship in climate resilient infrastructure is often dependent on whether the asset addresses the communities' immediate needs. This points to the need to conduct a consultative needs assessment process with the community being at the centre of the conversations. To this end, since the scarcity of water resources was a major challenge for the people of Eselenkei village, the establishment of the solar-powered borehole was well received by the community as

it addresses their immediate water needs. This approach applied to the constructed Kilifi Sea wall as the sea waters had already robbed off the local's lands and ancestral homes hence gradually eroding their culture as they will have to move from their ancestral lands.

In Rwanda, the adoption uptake of the *promoting Climate-smart Agriculture for Improved Rural Livelihoods and Climate Resiliency in the climate-vulnerable Eastern Province of Rwanda* project was achieved through raising well-seasoned community champions on matters of climate-smart agriculture and its technologies therein hence enhancing extension services to the local community. The community champions were pivotal in demonstrating how to effectively use solar-powered irrigation equipment and avail extension services in the uptake of new farming techniques. Similarly, in the Green Gicumbi project, the training by field assistants, on the management of the dams at Muvumba Stream and the Akagera River was also done hence instilling the aspect of community ownership. This led to the establishment of the community management committee overseeing the utilization of water at the dam as well as its infrastructure. Further, the facilitation of access to high-yielding and drought-resistant seeds was done. Not only do community champions avail of extension services, but they are instrumental in building trust among community members and addressing any scepticism among the targeted beneficiaries on taking up new farming practices such as terracing and contour farming. This was done by facilitating practical pieces of training at demo farms, especially on the utilisation of the adaptation assets. As such, the community champions and field assistants played a key role in informing the monitoring and evaluation of the project. For instance, they would inform the project implementers on what adaptation actions are working and why, as well as those that are not working and why. This information was critical in informing adaptation actions that would result in sustainable outcomes and adaptation effectiveness.

The Arusha Sustainable Urban Water and Sanitation delivery project was a result of a co-creation process where key stakeholders within the water sector, government departments, and communities were involved in the design and implementation of the project. This championed for ownership hence providing a conducive environment for effective achievement of the project deliverables. Further, the project aligned with the existing national and local policies and regulations that prioritized sustainable water and sanitation service delivery, particularly in urban areas. This alignment facilitated effective and all-inclusive stakeholder engagement and secured government support. Through the sea wall construction project in Tanzania, targeted training and resources for alternative income-generating activities, such as seaweed farming, small-scale aquaculture, and the production of eco-friendly handicrafts have been provided. This has led to the expansion of the range of livelihood opportunities, making the communities less dependent on a single, climate-sensitive source of income, improving their overall economic well-being and resilience. Additionally, the infrastructure improvements have helped to safeguard the homes, businesses, and public facilities of coastal communities, reducing the risk of damage and disruption during extreme weather events. Further, the construction and

maintenance of these infrastructure projects have provided employment opportunities and income sources for community members, contributing to their overall economic well-being.

In Uganda's case study of *Building Resilient Communities, Wetland Ecosystems and Associated Catchments in Uganda*, the adoption enablers in the context of climate resilience infrastructure, was mainly based on the training of 130 farmer groups on the operations and maintenance of the irrigation infrastructure including the water retention centres, the water storage assets and the overall technical skill in ensuring water efficiency.

d. Gender and social inclusion

To realise the effectiveness of adaptation interventions in the context of climate-resilient infrastructure, women and the youth should be integrated into the management of the assets. This inculcates a sense of responsibility among the vulnerable demographic groups in ensuring the water infrastructures are not vandalized for selfish reasons. In *promoting climate-smart agriculture for improved rural livelihoods and climate resiliency in the climate-vulnerable eastern province of Rwanda project*, in the constructed selling points for vegetables and fruits, a bigger percentage of the stations was set aside for women and youth. This points to the deliberate actions taken by the project management team to safeguard this vulnerable group's livelihoods. It was also noted that in the Green Gicumbi project and the KCCAP women and youth were included in the committees responsible for managing the adaptation assets established in their villages.

The *Arusha Sustainable Urban Water and sanitation delivery* project design and implementation processes actively incorporated a gender perspective, ensuring the needs, priorities, and participation of both women and men were considered. Gender-disaggregated data was collected and analysed to understand the differentiated impacts of water and sanitation challenges on women and men, informing the design of project interventions. Gender-responsive budgeting was practised, allocating resources to address specific gender-based needs and promoting equitable access to project benefits. *The construction of the sea wall to reduce the vulnerability of the Livelihood and economy Of Coastal Communities project in Tanzania* invested in capacity-building and skills development programs that specifically target women and marginalized community members. Through that their technical, organizational, and leadership capabilities. were enhanced. These programs empowered women and marginalized groups to enable them to be actively involved in the operation and maintenance of adaptation-related infrastructure and services that were being implemented, governance, and management of natural resources. In addition, the planning process has involved the inclusion of local community-based organizations, particularly those representing women, youth, and other marginalized groups, to ensure their voices are heard and their perspectives are integrated.

In the *Building Resilient Communities, Wetland Ecosystems and Associated Catchments in*

Uganda, gender considerations were mainstreamed across all project activities hence resulting in outcomes that were gender-responsive, sensitive and well as transformative. This included; the incorporation of women into the management committees hence providing them with a platform to advocate for the unique needs of women in the phase of climate risks. As a result of this, gender-responsive approaches were adopted in building the resilience of women of women against impacts of climate change. For instance, since women have the societal responsibility of fetching water in patriarchal communities, they were allowed to co-identify suitable locations for solar-powered irrigation systems in respective districts. The location identification was also informed by views from PWDs and the youth. Further, a considerable number of women were trained on the maintenance and operations of the established water infrastructures. This transformational approach in the context of water security, equipped the women with technical skills that can be leveraged in providing maintenance services of water infrastructures at a fee. To this end, it is important to note, that gender considerations in such adaptation intervention initiatives are effective when the focus is on the whole adaptation impact chain with a great focus on the last mile delivery. In this case study, the monitoring and reporting of project activities was gender disaggregated. This activity was critical in informing revisions of the project design for optimisation of the outcomes among the beneficiaries.

e. Sustainability

Strengthening the resilience of climate resilience of infrastructure is key to enhancing sustainability: The water infrastructure settled up in Eselenkei village is vulnerable to wildlife attacks as it sits on the migratory route of the elephants. Therefore, the members of the CPC group suggested provisions of solar batteries for an electric fence. It was noted that the metal pillars used to elevate the 10,000-litre tank were galvanized rods hence not susceptible to rusting and eventually collapse. Besides this, the sustainability aspect of the water asset is being sabotaged by the fact that no one in the village can rise to the occasion when there is an electric or mechanical fault. To this end, there is an urgent need to capacity-build the youth at the village to be able to repair and maintain the solar-powered borehole. This is a potential investment area.

In the Green Gicumbi project, it was concluded that the ingredient to the sustainability of the project is the continued partnership and collaboration between the stakeholders, vulnerable communities, cooperatives, churches, and local governments. This is to sustain the NbS for adaptation actions such as; awareness creation on contour and terracing farming, supply of tree seedlings, and overseeing the resettlement program of the local community from the high-risk landslide areas to low-risk regions. However, in the relocation efforts, at the beginning, some local community members resisted moving from their ancestral lands to climate-resilient settlements. *“I was born here. Why can I move from home to another location”*. This reflects fears of being disenfranchised from their ancestral land thus the need for a multi-stakeholder approach in engaging the local community members objectively in buying into the resettlement program.

The sustainability of adaptation outcomes in *Promoting climate-smart agriculture for improved rural livelihoods and climate resiliency in the climate-vulnerable eastern province of Rwanda project* is pegged on the readily available extension services by community champions have played a key role in the avoidance of maladaptation and mismanagement of the adaptation assets. Established infrastructures such as farm produce cold rooms and produce selling stations have played a key role for farmers to tap into the market hence improving their overall household income and well-being.

The construction of the sea wall to reduce the vulnerability of the Livelihood and economy Of the Coastal Communities project in Tanzania invested in capacity-building programs for community members, local authorities, and other stakeholders. Through the programs, the different stakeholder categories were equipped with the knowledge, skills, and tools to sustainably manage and maintain the adaptation measures. These capacity-building efforts also enhanced the development and dissemination of knowledge products, such as training manuals, best practices, and lessons learned, to facilitate the sharing and replication of successful approaches across other coastal communities. Fostered partnerships with local and national authorities, research institutions, and civil society organizations to leverage resources, technical expertise, and policy support to enhance the sustainability of adaptation interventions. *The Arusha Urban Water project* enhanced sustainability by ensuring that the implementation activities are captured within the local and national policy framework on urban spaces. Collaboration and active engagement among the different stakeholders ensured ownership and sustainability. The development of catchment plans is a key indicator in ensuring the communities are part of the implementation of the project activities.

In the context of Uganda's case study of *Building Resilient Communities, Wetland Ecosystems and Associated Catchments in Uganda*, the sustainability, efficiency and effectiveness of the established water infrastructures relies on the formulation of an inclusive community managerial committees in charge of the maintenance and operation of the assets. This strategy was fostered by extensive and comprehensive training of 130 farmer groups across the selected districts on the technical know-how and management of the infrastructures. Furthermore, the community were engaged in the co-identification of the site where the water infrastructures were to be constructed. the co-identification process significantly contributed to the community's buy-in to the initiative, hence averting acts of vandalism.

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