Climate Change Adaptation and Mitigation Initiatives for Agriculture in East Africa

Working Paper No. 60

CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)

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Abstract

National governments across East Africa are in the process of formulating and implementing adaptation and mitigation strategies to assist farmers cope with climate change. These include formulating actions, frameworks and programs to address climate change and embedding these within the long-term national development plans. This working paper provides understanding of the current state of national climate change adaptation and mitigation efforts in Ethiopia, Kenya, Tanzania and Uganda for agriculture and provides baseline information for subsequent assessments of climate change adaptation and mitigation.

In each country, specific government departments such as Environmental Protection Authority (Ethiopia), Ministry of Environment, Water and Mineral Resources (Kenya), Vice President's Office (Tanzania) and Ministry of Water and Environment (Uganda) are mandated to coordinate climate change initiatives. In all countries, the Ministry of Agriculture is the focal point for all climate change initiatives related to agriculture. Agricultural Sector Development Plans that provide strategies to boost agricultural productivity and spur economic growth have been prepared either as standalone plans or as part of National Development Plans (NDP). Irrigation, capacity building, enhancing private-public partnership for market development, and creating legal and regulatory environment that can attract investments are some of the priority areas identified for attention in agriculture to enhance climate resilience.

All countries have submitted draft National Adaptation Plan of Actions (NAPAs) and Nationally Appropriate Mitigation Actions (NAMAs) to UNFCCC, indicating priority interventions. Due to ineligibility to UNFCCC funding, Kenya initiated the National Climate Change Response Strategy (NCCRS) and prepared a detailed National Climate Change Adaptation Plan (NCCAP) that identified priority immediate, medium and long-term adaptation strategies in agriculture and other sectors.

Government research institutions are equally actively involved. The Kenya Agricultural Research Institute and Uganda Ministry of Water and environment have established Climate Change Units, while the Ethiopian Institute of Agricultural Research is taking pivotal role in developing livestock and crop programs geared towards contributing to a Climate Resilient Green Economy. Other initiatives include enhancing capacity of researchers and professionals

in climate change in East Africa, where training is offered by universities as part of their curriculum and short courses in selected research institutions. However, the effectiveness of these initiatives is hampered by lack of a clearly defined strategy and national policy. In addition, there is lack of documentation of completed and on-going projects thus making it difficult to coordinate initiatives and avoid duplications.

To fund climate change initiatives in agriculture, all governments across the region are sourcing financing from various sources (other governments, foundations and research and development organizations). However, Kenya also seeks financing from local sources within the country such as the Local Authority Transfer Fund (LATF) and the Constituency Development Fund (CDF).

Keywords

Agriculture; action frameworks; institutions; capacity building; financing; East Africa.

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Contents

Acronyms

AfDB	African Development Bank
ASALs	Arid and Semi-Arid Lands
ASDS	Agricultural Sector Development Strategy
CAADP	Comprehensive African Agriculture Development Programme
CDM	Clean Development Mechanism
COMESA	Common Market for Eastern and Southern Africa
COP	Conference of Parties
CRGE	Climate Resilient Green Economy
DFID	Department for International Development
DSIP	Development Strategy and Investment Plan
EIAR	Ethiopian Institute of Agricultural Research
EPA	Environmental Protection Authority
EU	European Union
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Green House Gas
GoK	Government of Kenya
GTP	Growth and Transformation Plan
IFAA	Innovation Fund for Agriculture and Agribusiness
IPCC	Intergovernmental Panel on Climate Change
KMD	Kenya Meteorological Department

LDC	Least Developed Countries
MEMR	Ministry of Environment and Mineral Resources
MNRT	Ministry of Natural Resources and Tourism
MoA	Ministry of Agriculture
MRV	Monitoring, Reporting and Verification
MTP	Medium Term Plan
NAMAs	Nationally Appropriate Mitigation Actions
NAP	National Adaptation Plan
NAPAs	National Adaptation Programme of Actions
NCCAP	National Climate Change Action Plan
NCCRS	National Climate Change Response Strategy
NDP	National Development Plans
NEMA	National Environment Management Authority
NVF	National Vision Framework
PMA	Plan for Modernization of Agriculture
REDD	Reducing Emissions from Deforestation and Forest Degradation
R-PIN	Readiness Plan Idea Note
R-PP	Readiness Preparation Proposal
TDV	Tanzania Development Vision
UNDP	United Nations Development Programme
UNEP	United Nations Environment Program
UNFCCC	United Nations Framework Convention on Climate Change

1. Introduction

Changing climatic conditions are causing significant impacts on livelihoods, health, food security, economic opportunities and the survival of humanity, especially in developing countries. The poorest populations who are mainly rural based will be seriously and disproportionately affected by the changing climate. Despite lack of sufficient scientific data, there is no dispute that climate change is occurring right now across East Africa (Conway 2009). As the region strives to achieve sustainable development, national governments are immensely grappling with difficult tradeoffs and opportunity costs with regard to climate change (Müllera et al. 2011). The region will be hard hit by changing climate because of the lack of economic, development and institutional capacity to deal with it (IPCC 2007). Indeed, the effects of climate change are already being felt and its impacts have the potential to undermine and even undo progress made in improving the socio-economic well-being of residents of East Africa (Davidson et al. 2003).

The negative impacts associated with climate change are also compounded by many factors including widespread poverty, human diseases, and high growth rates which are estimated to double the demand for food, water, and livestock forage within the next 30 years (Davidson et al. 2003). The above is reflected in the high percentage of people living below the poverty line, ranging from 24.5% in Uganda to 45.9% in Kenya 45.9%[1]. The agricultural sector contributes over 40% to the Gross Domestic Product (GDP) in East Africa (Kadi et al. 2011). In Ethiopia, agriculture remains the main contributor to GDP, contributing over 45% of the GDP (Table 1). However in Kenya, Uganda and Tanzania, the rapid development of the service sector[2] has outpaced agriculture, contributing up to 61% of the GDP in Kenya. Nevertheless, agriculture still accounts for over 75% of the labor force in all the four

[1] The statistics were collected in different years: Kenya in 2005, Tanzania 2007, Ethiopia 2011 and Uganda 2009.

[2] East Africa countries experienced rapid economic growth rates of 7.3% between 2005 and 2008, attributed to relatively stable macroeconomic conditions, reduced conflict since the mid-1990s, improved governance and market liberalization, and increased

[2] East Africa countries experienced rapid economic growth rates of 7.3% between 2005 and 2008, attributed to relatively stable macroeconomic conditions, reduced conflict since the mid-1990s, improved governance and market liberalization, and increased private sector involvement (AfDB/IFAD, 2009). Furthermore, institutional advancements, stronger regional partnerships, and stronger civil society and community networks have made governments more accountable (World Bank 2009).

countries, accentuating the importance of the sector in creating employment and poverty reduction.

Table 1. Contribution of agriculture, industry and service sectors to GDP in East Africa

GDP and employment	Kenya	Tanzania	Ethiopia	Uganda
GDP in Billions USD (2012)	37.3	28.3	43.1	19.9
Contribution to GDP by sector in 2012 (%) Agriculture Industry Service	 29.3 17 53	 28 25 47	 46.6 11 43	 23 25 51
Agricultural workforce employment[3] (%)	61.10	76.5	79.3	65.6

Source: World Bank 2012

Despite the importance of smallholder agriculture in these countries, there is limited government effort to revitalize agriculture. For example, agriculture is mainly rain-fed and total acreage of land cultivated under irrigation is very low. Yet, governments have made no efforts to invest in irrigation. In Kenya and Uganda, for instance, the percentage of land under irrigation is less than 4% (Kenya Vision 2030 2007, Republic of Uganda 2011). Moreover, strategic empirical analysis that can guide policymakers and development practitioners in their efforts to revitalize agriculture is scarce. This increases the vulnerability of the agricultural production systems in the region to changes in climate

Smallholder farmers in East Africa pursue a wide range of crop and livestock enterprises that vary across and within the major agro-ecological zones. Over 75% of the total agricultural outputs are produced by smallholder farmers in Africa on an average farm size of about 2.5ha (FAOSTAT, 2009). Forestry, horticulture and fishing are also important economic activities in East Africa. In particular, horticulture is becoming the largest sector in the Kenyan economy comprising of 240 large scale and 150,000 small scale farmers, with an annual revenue of about USD 2 billion (English et al. 2004). Unfortunately, these activities face a myriad of compounding challenges including low productivity (due to declining land quality), inaccessible markets and information, prohibitive credit services, political instability, volatile commodity prices among others. All these constraints deter smallholder farmers from realizing their full potential and climate change adds onto these challenges.

[3] The figures are for different years as follows: Kenya and Ethiopia 2005, Tanzania 2006 and Uganda 2009.

Climate modeling scenarios suggest an accelerated warming environment for East Africa at a rate of about 0.05°C per decade with slightly more warming in the June–November seasons than in December–May (Hulme et al. 2001, Christensen et al. 2007). Increase in the intensity of high-rainfall events, associated in part with the increase in atmospheric water vapor, is also expected (Christensen et al. 2007). In Ethiopia, climate models suggest drier conditions (KNMI 2006). For Kenya and Uganda, climate models indicate a positive shift in rainfall distribution during both rainy seasons (KNMI 2006, Thornton et al. 2006). Future climate predictions from global climate models into the year 2100, show evidence of an increase in the intensity of extreme rainfall events in much of East Africa, particularly in Kenya and Uganda, whereby excess of 50% in 10-year high rainfall events are expected (KNMI 2006). In southern Tanzania the wettest rainfall events are projected to decrease by 0% to 20% (KNMI 2006). Average temperatures in Uganda are likely to increase by up to 1.5°C in the next 20 years and by up to 4.3°C by the 2080s. This increase will lead to more frequent intense rainfall, heat waves, droughts, floods and storms. However, uncertainty still exists in relation to future projects of precipitation for East Africa.

Changes in climate coupled with poor market access, credit and skills, volatile commodity prices, small land size, population pressure, low GDP and low investment in East Africa will contribute to severe reduction in subsistence and commercial crop yields and livestock products (IPCC 2001). It will further contribute to loss of food stock, land degradation and fertility loss, high pre and post-harvest losses, increased incidences of pests and diseases and invasive weeds (Simms 2005, Funk et al. 2005, IPCC 2001). In the livestock sector, the changes in climate will contribute to inadequate pasture and water during drought, increased incidence of livestock diseases and pests, conflict over water and grazing resources and livestock death (Seo and Mendelsohn 2008, Jones and Thornton 2009). The fishery industry will also be affected by receding water levels, silting and pollution of water bodies, loss of fish species, reduction in fish quantity and quality, reduction in breeding grounds, depletion of oxygen supply, and nitrification of water (Funk et al. 2005, Roessig et al. 2004). For water bodies, climate change will lead to decreased water quantity in rivers and streams, disappearance of glaciers on mountains by 2015 are equally projected (Vice President's Office 2003, Thompson et al. 2002). Warming sea surface temperatures and sea-level rise in the Indian Ocean will lead to the destruction of coral reefs, which are crucial for coastal

protection (IPCC 2001). Due to the changes in sea characteristics, mangroves trees are being threatened and are becoming vulnerable.

In terms of human health, climate change in East Africa is expected to exacerbate the occurrence and intensity of future disease outbreaks and may increase the spread of diseases (IPCC 2001). Rainfall and unusually high maximum temperatures, for example, are positively correlated with the number of malaria cases while the Rift Valley fever outbreaks are positively correlated with El Nino events (Githeko and Ndegwa 2001, Zhou et al. 2004, Craig et al, 2004, Patz et al. 2005). Biodiversity is also threatened as plant and animal species struggle to adapt to changing climatic conditions (Malcolm et al. 2002, Lovett et al. 2005, Hely et al. 2006, Thirgood et al. 2004). Reduction in resilience of plants to droughts has been reported as well (Vanacker et al. 2005, Channel and Lomolino, 2000). Impacts of climate change at national level will further affect local and international prices, in turn affecting food demand, calorie availability, and ultimately human well-being (Herrero et al. 2010). Furthermore, decline in agricultural productivity will certainly lead to increased food imports leading to high food prices that most families cannot afford. This will translate into increased child malnutrition, susceptibility to diseases and in some cases death. These scenarios present the four countries in East Africa with the major task of increasing the adaptive capacity of smallholders[4]. Therefore, these countries need to embrace and mainstream climate resilient development pathways to reduce GHG emissions.

To address the above challenges posed by climate change and variability, governments in East Africa have initiated various programs and projects. Climate change issues have been integrated into the national development plans. Implementation of climate change adaptation and mitigation strategies are underway to enhance agricultural productivity and economic development. Examples include priority research, development and dissemination of drought, heat and disease resistant crop varieties and livestock breeds. Other agricultural mitigation and adaptation practices focus on tillage (such as minimum and/or no till), water conservation and improving soil fertility. At the national policy level, efforts to ensure that climate change activities and programs are integrated into and implemented in the development process are at

[4] Not all changes in climate will be negative in East Africa. In some areas, e.g. parts of the Ethiopian highlands, its estimated that climate change (increased temperatures and rainfall) might extend the agricultural growing seasons (Thornton et al. 2006).

an early stage. In Kenya and Uganda, climate change units have been established within the ministry of agriculture. Apart from government ministries and institutions, Non-Governmental Organizations (NGOs), and donor agencies are also actively involved in research and development as well as financing of projects and programs on climate change adaptation and mitigation.

This report is a synthesis of a larger report based on a study undertaken by CAMCO Advisory Services. The initial study combined review of existing literature and country case studies on Kenya, Ethiopia, Uganda and Tanzania. Information was collected from various governmental departments such as agriculture and climate change coordinating departments, research institutions, donor agencies and NGOs through open ended questionnaires and key informant interviews. Different techniques were used to administer the questionnaires and included face-to-face meetings, email inquiries and telephone interviews. In addition secondary information from government documents were used.

2. Integrating climate change into national development plans and sector strategies

In the last couple of years, efforts have been made by governments in East Africa to improve adaptive capacity and resilience of farming communities. Several projects and policies have been initiated independently or embedded within National Development Plans (NDPs) and/or governmental departments. These projects and policies mainly aim at reducing the negative effects of climate change are gaining momentum across different sectors and institutions. The projects are widely spread in various government ministries and institutions, NGOs, civil society and even the private sector albeit in an uncoordinated manner. Despite all these initiatives that run into millions of dollars, coming across an inventory of the projects and programs on climate change and agriculture is still not easy. There is need for documentation of the current and planned initiatives to facilitate coordination, avoid duplication, and inform future projects and sharing of lessons (both successes and failures).

2.1 National development plans

Each country in East Africa has developed a national development plan (NDP) that targets transforming their economies from low to medium-income status, as summarized in Table 2. Ethiopia's NDP is a five year Growth and Transformation Plan (GTP) that has defined seven pillar strategies, one of which is maintaining agriculture as a major source of economic growth. Of particular interest within this pillar, is promotion of multiple cropping and better coping strategies to manage climate variability through expansion of different irrigation systems and effective water management practices. In Ethiopia, the agricultural sector contributes significantly to GDP. Consequently, the government expects agriculture to meet the country's food security and serve as a key sector in transforming the economy (8.6% average growth is expected) through adequately supplying inputs for industrial growth. To support this, the government allocated more than 10% of its national budget to agriculture in line with the Maputo Declaration on Agriculture and Food Security in Africa of 2003 and managed average growth rate of 6% in line with the Comprehensive African Agriculture

Development Programme (CAADP)[5].

Table 2. National development plans and budgetary allocations to agriculture in East Africa

Country	NDP	Coordinating agency	Budget allocation to agriculture (%)	Supporting plans, programs and policies
Ethiopia	Growth and Transformation Plan (2010-2015)	Ministry of Finance and Economic Development	10% (2011-2012)	▪ Agricultural Sector Policy & Investment Framework (PIF)
Kenya	The Kenya Vision 2030	Ministry of State for Planning, National Development & Vision 2030	11% (2012-2013) 7.8% (2013-2014)	▪ National Climate Change Response Strategy (NCCRS) ▪ Agricultural Sector Development Strategy (ASDS)
Tanzania	Tanzania Development Vision – 2025	Planning Commission of Tanzania	6.8% (2011-2012) 7.2% (2012-2013) 5.7% (2013-2014)	▪ ASDS ▪ Participatory Agricultural Development and Empowerment Project (PADEP) ▪ Sustainable Development and Poverty Reduction Program (SDPRP)
Uganda	National Vision Framework - 2010/11-2014/15	National Planning Authority	4.7% (2011-2012) 3.5% (2012-2013) 3.2% (2013-2014)	▪ Plan for Modernization of Agriculture (PMA) ▪ ASDS and Investment Plan

Source: Federal Democratic Republic of Ethiopia 2010, GoK 2007, United Republic of Tanzania 2011, Republic of Uganda 2012

In Kenya, the government unveiled a long–term development plan towards the end of 2007 that aspires to transform the country into an industrialized middle-income country by 2030 – Kenya Vision 2030. Kenya's Vision 2030 is being implemented through a successive five Medium Term Plans (MTP). Vision 2030 recognizes agriculture as the most important driver of Kenya's economy, thus prompting the government to allocate 11% of its budget to agriculture in the 2011/12 financial year, surpassing the minimum allocation set by Maputo Declaration of 2003. Since Kenya's agricultural sector is highly vulnerable to climate change due to its low adaptive capacity, Vision 2030 proposed climate change adaptation and mitigation options in the agriculture and forestry sector—in tandem with proposed mitigation and adaptation interventions in the National Climate Change Response Strategy (NCCRS). These include supporting the establishment of crop and livestock insurance schemes; enhancing knowledge and skills of farmers and extension staff through training and knowledge sharing; improving seed quality and livestock productivity; better management of water; increasing agricultural productivity through provision of widely-accessible inputs and services to crop farmers and pastoralists; irrigation intensification and expansion to increase

[5] CAADP is an agricultural programme of NEPAD and focuses on improving food security, nutrition, and increasing incomes in Africa's largely farming based economies. It aims to do this by raising agricultural productivity by at least 6% annually and increasing national government investment in agriculture to 10% of the annual national budget.

agricultural production; livestock development; livestock disease-free zones; disaster preparedness; and strengthening research and development.

Uganda has the National Vision Framework (NVF) that provides plans and strategies to transform Uganda from a peasant to a modern and prosperous country by 2040. Similar to Kenya's Vision 2030, NVF will be implemented in six five-year National Development Plans. Uganda has already prepared the first one that covers fiscal period 2010/11-2014/15. Under the NVF, the government plans to allocate an average of 5.4% of the annual budget to agriculture, far less than the CAADP target of 10% annual budgetary allocation to agriculture. Within The NVF, climate change has been mentioned under the agricultural sector and is expected to affect agricultural production, food security and employment levels. NVF advocates for building capacity to respond to climate change through various interventions such as identifying climate effects, vulnerabilities and coping measures as they relate to various agricultural production strategies across Uganda; improving climate forecasts along with procedures for use in agricultural management; integrating climate risk management in agricultural business strategies; and strengthening national and local capacity to integrate climate change into planning processes.

Tanzania's NDP popularly known as 'Vision 2025' provides a national framework for attaining sustainable development and natural resources management (URT 2001). Tanzania Development Vision (TDV) 2025 has several targets and agriculture is listed under the improved livelihoods target where food self-sufficiency and food security are the key goals. These goals can be achieved by transforming the economy into a strong, resilient and competitive one, and strengthened by science and technology. The strategy to be adopted is that of transforming the economy from a predominantly agricultural one with low productivity to a diversified and semi-industrialized economy. To achieve this vision, the government allocated a total budget of USD 574.1 million (slightly over 8% of the total annual budget to agriculture for the 2010/11 financial year. This reflected a 35.5% increase from the previous financial year (2009/10) that allocated USD 423.6 million. Despite the increase, the budget allocated to agriculture represented is still short of the 10% proposed under the CAADP initiative.

All the countries in East Africa are working towards shaping climate change solutions. The countries aim to respond and adapt to climate change along with efforts to reduce emissions

through low carbon growth pathways. All the countries in the region are formulating and implementing climate change policies, projects and plans in line with their overall NDPs. The next section looks at how national governments are responding to climate change in agriculture, forestry and land use, and land use planning.

2.2 Climate change initiatives by sector

2.2.1 Agriculture

All countries have initiated various climate change actions (Table 3). Ethiopia's national GTP is expected to pursue carbon neutral and climate resilient development and is currently in the process of implementing a Climate Resilient Green Economy (CRGE). Equally, Kenya has integrated climate change issues into Vision 2030 that proposes to develop improved water storage infrastructure (e.g. dams) for irrigation in areas that experience extreme flooding and arid and semi-arid lands (ASALs). Another important climate change response proposed in 2030 Vision is farmland and dry land tree planting at farm level (an agroforestry system that intends to incorporate bee-keeping) that will contribute to a 10% forest cover nation-wide.

The Ministry of Environment and Mineral Resources (MEMR) is the main body for all climate change issues, including agriculture. Other major actors in climate change with directives and coordination from MEMR in relation to agriculture are:

- Ministry of Agriculture (MoA) where a Climate Change Unit (CCU) has been set up to monitor effects of climate change and to support agricultural advisory services.
- Kenya Agricultural Research Institute (KARI) also set up a CCU in 2010 with financial support from the Rockefeller Foundation, to mainstream climate change into the agricultural research programmes.

Tanzania's Five year development plan (2011/2012-2015/16) has placed priority on climate-smart economic policies. Agriculture is identified as one of the key areas for intervention by focusing on the transformation from food self-sufficiency to export, development of irrigation and high value crops.

In Uganda, the government intends to integrate climate change adaptation and mitigation and ensure climate proof development planning in all government sectors, including agriculture. The Ministry of Water and Environment is the national coordinating body on climate change issues in Uganda. The ministry established a Climate Change Unit for ease of coordinating

activities. However, CCU's coordination capacity is crippled by lack of clear defined strategy or national policy on climate change since it has lacked the capacity to supervise and coordinate climate change activities across different sectors. Other research bodies, institutions, NGOs involved in climate change issues in East Africa are summarized in Appendix I.

2.2.2 Forestry

The forestry sector in East Africa features prominently in climate change debates, especially its role in provision of environmental services and protection. Most of the forests are being depleted through slash and burn for agricultural activities, thus reducing their ecosystem functions as carbon sinks (Verchot et al. 2007). Despite this, data collected at continental level shows that East Africa's emission of CO_2 is low, estimated at less than 0.1 metric ton of carbon per person per year (Africa emits 3% of the world's total emissions of GHG) (IPCC 2007). All the countries in the region have recognized the importance of forestry in climate change mitigation in their various NDPs. With a forest cover of 38% of the total land[6], Tanzania's development Vision (TDV) has given priority to mainstreaming future policy measures alongside climate smart economic development policies. TDV has allocated funding towards this effort as well as REDD initiatives and development. These activities will be under the National Forestry Program (NFP) in the Ministry of Natural Resources and Tourism (MNRT). Unfortunately, climate change is not a priority for NFP. Equally, climate change is not mentioned in the Forest Act of 2002. The NFP and the Forest Acts are under revision with support from Finland and German Technical Cooperation (GIZ), and so it is expected the revised policy plans will address this gap.

The Kenya Forest Service is responsible for climate change adaptation and mitigation in the forestry sector. Kenya Forest Services' efforts to reduce CO_2 emissions include through the REDD Readiness plan (with support from Forest Carbon Partnership-FCPF) and support to rural communities to encourage the sustainable use of forest resources through REDD+ mechanisms. Kenya's Vision 2030 has set specific goals addressing climate change in forestry sector and includes increasing forest cover from less than 3% to 4%, applying natural resource

[6] 13.5 million hectares are gazetted as national forest reserves, of which 1.6 million ha are managed as catchments forests and 90,000 ha, 150,000 ha and 120,000 ha are managed by the Government, private industrial and small-scale woodlots, and medium-sized plantations owned by smallholders, respectively. Others are managed as local authority forest reserves (600 reserves) and 200 local authority forest reserves. A total of 2.1 million ha are currently under community based forest management and 4.2 million ha are gazetted as village forest reserves.

accounting in national accounts, piloting five initiatives on climate change adaptation and desertification in ASALs, and developing natural resource database. To achieve the goals, several strategies are outlined and include rehabilitation of degraded forest areas and promotion of on-farm forestry (to complement the agricultural sector), securing global payment for ecosystem services such as Clean Development Mechanism (CDM) and user compensation for environmental services.

Despite a forest cover of 24% of total land, Uganda does not explicitly target climate change in its NDPs and the Forestry Policy of 2001. However, the government is currently in the process of reviewing and revising the legal framework for the forestry sector to ensure, among others, that carbon is stored through forestry. This is one of the key agreements under the UNFCCC. In Ethiopia, the regional governments are responsible for managing forest resources. However, Ethiopia's GTP indirectly addresses climate change in forestry sector by pledging to disseminate use of improved alternative energy sources that minimize deforestation.

2.2.3 Land use and land management

Appropriate land policies are important instruments to address climate change. In East Africa, land issues are often complex, ethnically and politically contentious. These complexities make land policies difficult to implement. National government must therefore, play a key role in formulating and implementing land policies that are favourable to its people, to enable them adapt to climate change. Only Tanzania and Uganda have addressed land use policies to deal with climate change in their NDP (Table 3).

Uganda's Land Use Policy-2011 recognizes the impact of climate change, especially in exacerbating the already degraded, fragile natural ecosystem. Through the policy, the government intends to address climate change mitigation and adaptation by: a) mainstreaming sustainable management of the environment and natural resources in its plans and programs; b) putting in place climatic change adaptation strategies to reduce impact on people and the economy and c) developing a framework for compliance with all international climate change commitments. These activities will be spearheaded by Ministry of Lands, Housing and Urban Development.

Table 3. Government ministries and departments responsible for climate change adaptation activities in agriculture

Country	Lead government ministry	Lead government department/unit	Subsidiary institute and supporting ministries
Ethiopia	▪ Ministry of Agriculture & Rural Development – MARD (*for Agriculture, land use and land use change*) ▪ Ministry of Culture and Tourism and, MARD (*forestry*)	▪ Environmental Protection Authority ▪ Ethiopian Wildlife Conservation Authority	▪ Climate Resilient Green Economy ▪ EIAR ▪ Ethiopian Rural Energy Development and Promotion Centre ▪ Institute of Biodiversity Conservation ▪ Ministry of Mines and Energy ▪ National Meteorological Agency
Kenya	• Ministry of Environment and Mineral Resources - MEMR	▪ NEMA ▪ Environment Secretary ▪ MoA (CCU) ▪ KARI (CCU) ▪ National Climate Change Activities Coordinating Committee	▪ ACTS ▪ Practical Action Eastern Africa ▪ German Technical Cooperation ▪ Kenya Climate Change Working Group ▪ SCC Vi-Agroforestry ▪ CARE International ▪ UAP ▪ Kilimo Salama Plus
Tanzania	• Vice-President Office *(Agriculture and Land Use)* • Ministry of Natural Resources and Tourism *(Forestry)*	▪ The National Climate Change Steering Committee[7] and National Climate Change Technical Committee ▪ National Forestry Programme	▪ National Environment Management Council (NEMC) ▪ Institute of Resource Assessment ▪ National Land Use Planning Commissions
Uganda	▪ Ministry of Water and Environment *(Agriculture & Forestry)* ▪ Ministry of Land, Housing and Urban Development (Land use) ▪ Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) (*Agriculture and Land Use)* ▪ National Forestry Authority *(Forestry)*	▪ Climate Change Unit ▪ Climate Change Policy Committee	▪ Ministry of Agriculture, Animal Industry and Fisheries[8] ▪ Multi-sectoral National Climate Change Committee ▪ National Climate Change Steering Committee ▪ Inter-sectoral technical committee ▪ Climate change desk officers ▪ Water and Environment Sector Working Group ▪ National Forest Authority ▪ National Environment Management Authority ▪ National Forestry Resources Research Institute ▪ National Agricultural Research Organization ▪ Forest Sector Support Department

Source: Federal Democratic Republic of Ethiopia 2010, GoK 2007, United Republic of Tanzania 2011, Republic of Uganda 2012

[7] The National Climate Change Steering Committee is an inter-ministerial committee comprised of Permanent Secretaries from 13 ministries: Energy, Finance, Industry, Natural Resources, Justice and Constitutional Affairs, Land, Agriculture, Livestock Development, Foreign Affairs, and International Cooperation.

[8] MAAIF in its ASDS and Investment Plan for 2010/11-2014/15 will establish a climate change planning facility with a budget of about USD 8,000, with the following functions: a) identify climate impacts, vulnerabilities and coping measures; b) improve the quality and distribution of forecasts; c) integrate climate risk management in agri-business strategies; d) strength district capacity to integrate climate change issues into planning

The government of Tanzania is preparing to integrate climate change in its land use/environmental policy that will guide mitigation and adaptation measures. Kenya has two ministries that are linking land use policy and climate change. The MEMR has set up a REDD, Land use and land use change division to assist different sectors of Kenya economy to use innovative technologies that can reduce GHG emissions while sustaining economic growth and livelihoods. The Ministry of Lands, the designated department dealing with land use issues is in the process of formulating and implementing a National Land Use policy that will, among other things, create a national spatial data infrastructure that will facilitate tracking of land use patterns in the country.

2.3 Climate change action frameworks

Climate change action frameworks are roadmaps that guide the implementation of various climate change adaptation and mitigation projects and programs. The frameworks provide a range of options for action on climate change through a clear overview of on-going and planned activities at the national levels, responsible government departments and sources of funding.

Kenya has two specific climate change action frameworks, developed through a consultative process involving stakeholders from government, private sector, NGOs, civil society organizations, and local communities and these are the NCCRS and the ASDS (Table 4). Both frameworks reinforce the importance of agriculture as the second largest contributor to Kenya's GDP and acknowledge the sector's vulnerability to climate change. NCCRS emphasizes three major pathways: prioritizing the most vulnerable sectors of the economy for immediate action, providing explicit measures for addressing climate change and, defining criteria for monitoring the effectiveness of such measures (GoK 2010). NCCRS developed a resource mobilization plan to source funds from local sources (LATIF, CDF and the private sector), other governments, international funding agencies (e.g. World Bank and International Monetary Fund) and development partners and regional funding agencies such as the African Development Bank.

Table 4. National climate change action frameworks - preparations and financing plans

Country	Climate change frameworks	Preparations	Resource mobilization plans
Ethiopia	Agricultural Sector Policy and Investment Framework (PIF) 2010-2020	Collaborative process involving key stakeholders	Government (60%) and development partners (40%). Annual cost estimates for agriculture USD 2.74 billion (16.5% of total cost)
Kenya	National Climate Change Response Strategy - 2010	National participatory and consultative process coordinated by MEMR and CAMCO NEMA organized regional consultative workshops & Environment Secretary coordinated publication of the Strategy	Local and international sources. Cost estimates for agriculture USD 132.5 million
	Agricultural Sector Development Strategy - 2010–2020		Innovation Fund for Agriculture and Agribusiness and establish an Agricultural Development Fund
Tanzania	ASDS Environmental Managament Act - 2005	Several agricultural sector aligned ministries - Ministry of Agriculture, Food Security and Cooperatives (MAFC), Ministry of Livestock Development (MLD), Ministry of Industries, Trade and Marketing (MITM) and PMO-RALG.	Global Environment Facility

Source: Federal Democratic Republic of Ethiopia, 2010; GoK, 2010a & 2010b; United Republic of Tanzania, 2001 & 2004

Apart from Kenya, all the other three countries (Ethiopia, Uganda and Tanzania) do not have broad frameworks. Tanzania has the ASDS and the National Environmental Policy (1997) that serves as the framework for implementing both the adaptation and mitigation measures in agriculture. As previous mentioned, Uganda is in the process of developing a climate change policy that will help to coordinate action on climate change, increase awareness and funding of priority interventions. The Uganda CCU will initiate this policy with a legislative framework that will adapt the UNFCCC and the Kyoto Protocol. Ethiopia's Agricultural Sector Policy and Investment Framework (PIF) is a 10-year plan from 2010/11 financial year to 2019/20. PIF is anchored in and aligned with the national vision, and provides a strategic framework for prioritization, and planning of investments that will drive Ethiopia's agricultural growth and development.

2.3.1 Agricultural sector development strategy and policies

All the countries in East Africa have developed their ASDS as operational strategies within the NDPs (Table 5). Kenya's ASDS was launched in 2004 and targets an annual growth rate of 7%. However, since growth in the sector depends on favourable climatic conditions, ASDS has incorporated efforts to support the NCCRS and Vision 2030.

Table 5. Agricultural sector development strategy (ASDS) for East Africa countries

Country	Prepared by	Priority intervention areas	Status
Uganda	Ministry of Agriculture, Animal Industry and Fisheries (2010/11-2014/15	▪ Entrenching sustainable land and water management practices ▪ Building capacity	▪ Process of planning for climate change has begun. ▪ Trainings on climate change conducted for national and local government staff
Tanzania	Agriculture Sector Lead Ministries & Ministry of Industries, Trade and Marketing and PMO-RALG	▪ Policy, regulatory, and institutional framework ▪ Agricultural services including research, extension, training, information and communication ▪ Investments at district and local levels	▪ Appointment of three stakeholder task forces and working Groups in April 2003 ▪ Commissioned studies & reports published in November 2003
Kenya	Government of Kenya 2010-2020	▪ Promote on-farm forestry and conservation of natural environment ▪ Develop irrigation schemes and soil & water conservation ▪ Improve and strengthen support services e.g. access to affordable credit, market-information and appropriate technologies ▪ Promote urban forestry development	On-going
Ethiopia	Ministry of Agriculture and Rural Development	▪ Sustainable increase in agricultural productivity and production ▪ Reduce degradation and improve productivity of natural resources ▪ Achieve food security and protect vulnerable households from natural disasters.	On-going

Source: Federal Democratic Republic of Ethiopia 2010, GoK 2010b, United Republic of Tanzania 2001, Republic of Uganda 2010

Tanzania's ASDS targets a 5% annual growth through transformation from subsistence to commercial agriculture mainly by the private sector, facilitated through public-private partnerships with participatory implementation of the District Agricultural Development Plans. The ASDS provides the government with a sector-wide framework for overseeing expenditure and investment in the agricultural sector. Uganda's ASDS was formulated in the context of an assessment of the effects of climate related risks on agricultural development. Ethiopia's 10-year Sector Policy and Investment Framework focuses on planning of investments to enable the country achieve sustainable agricultural growth and development. The formulation of the framework was overseen by the PIF steering committee and its being implemented within the MoARD.

2.3.2 Low carbon development plans

Unsustainable use of natural resources and the increasing reliance and inefficient use of fossil fuels threatens economic growth and development in East Africa. A sustainable pathway needs to be adopted to ensure that each country is developing whilst protecting its natural resource base and environment. Unfortunately, Kenya is the only country in the region with a

low carbon plan in place[9]. A sub-component of the Kenya NCCRS is the development of Long-term National Low Carbon Development Pathway that will identify important elements to guide the country towards a low-carbon and climate resilient growth. The pathway will be used as a baseline to identify climate change impacts and identify GHG mitigation opportunities.

The other three countries have not fully developed their low carbon development plans. For instance, Uganda's NDP intends to promote a low carbon economic development pathway through provision and promotion of incentives for clean development with the following interventions:

- Intensify public education on the role of emissions in global warming;
- Develop and implement incentive mechanism for reduced or avoided emissions;
- Build capacity of private sector to effectively participate in clean energy development initiatives;
- Reduce overheads for CDM project formulation and development.

Tanzania and Ethiopia have draft low carbon plans. Ethiopia is in the process of developing a strategy towards low carbon development pathway — the CRGE, that addresses mitigation and adaptation across many sectors of the economy. Within the CRGE, thematic areas related to agriculture include livestock, soil-based emissions and REDD.

[9] Kenya is already a low carbon economy with a per capita emission of 1.2 tCO_2 compared to the world's average of 7 tCO_2 (WRI 2011). However, this is expected to increase as the country gears towards attaining an average annual economic growth rate of 10% by 2030. Total GHG emissions currently estimated at 42 million tCO_2e are also expected to increase to 90 million tCO_2e due to an expanding economy and a rapidly increasing population (GoK 2007, SEI 2009).

3. National climate change policies

To effectively address climate change in East Africa, adaptation and mitigation strategies are necessary at several levels simultaneously, that is local to national level, involving private and public sectors. For these efforts to succeed, they must be guided and supported by national policies and strategies. What policies do countries in the region have in place to support their efforts for climate change adaptation and mitigation? To support East Africa countries formulate policies, UNFCCC advocates for building capacity to assess climate vulnerability and identification of adaptation needs and options such as supporting the development of comprehensive national adaptation strategies (Klein et al. 2007). Despite UNFCCC assistance, all the countries have faced challenges in developing and implementing sector specific policies incorporating climate change. The challenges include lack of technical capacity, finance and infrastructure limitations.

While there is no direct policy dealing with climate change across the East Africa countries, each country has set out guidelines and frameworks for addressing climate change. Kenya has developed a NCCRS that provides a roadmap for climate change adaptation across the different sectors of the economy, and the development of a policy is in the pipeline. Currently, the NCCRS serves as a policy guideline on climate change and focuses on ensuring integration of adaptation and mitigation measures in all government planning and development initiatives (Nzuma 2013). As stated earlier, policy formulation is on-going in the agricultural sector (e.g. the ASDS) through participatory processes involving relevant stakeholders from development partners and government ministries. Already, a National Climate Change Action Plan (NCCAP) that will implement the NCCRS is in place and will be revised every 5 years in line with Vision 2030 (GoK 2013).

Mitigation policies have not yet been developed in all countries in East Africa. Kenya does not have direct policies on climate change mitigation, but there are two policies that address climate change. These are the draft National Environmental Policy of 2008 (MEMR), and the National Land Policy (Ministry of Lands) that guides the country towards a sustainable and equitable use of land. The policy states that it will '*encourage a multi-sectoral approach to land use, provide social, economic and other incentives and put in place an enabling*

environment for agriculture and livestock development'. The policy also aims to involve all stakeholders, especially local communities in forestry management.

In Tanzania, the National Environmental Policy (NEP) was formulated to provide a framework for mainstreaming environmental considerations into decision-making processes. Though NEP does not explicitly address climate change, it highlights the importance of integrating environmental management in several government departments such as energy and agriculture. Another policy Tanzania that does not give direct reference to climate change but is important is the National Forestry Policy (NFP). This policy aims to engage government, local communities and other stakeholders in joint management of forests.

Due to the cross-sectoral nature of climate change impacts in Uganda, two strategic committees were formed. These are the Climate Change Policy Committee comprising of 14 members to provide policy guidance on climate change and the Inter-institutional Climate Change Technical committee that is mandated to bridge the gap between Uganda's CCU and other institutions and facilitate exchange of information. To date, the committee has not proposed a policy yet. Uganda is thus relying on Acts and Regulations that indirectly address climate change issues. For instance, NEMA-Uganda developed a working paper on natural resources, environment and climate change.

Ethiopia has a number of policies on land-use planning (e.g. Plan for Accelerated and Sustained Development to End Poverty) that indirectly have an impact on climate change in the agricultural sector. Improved land tenure security is seen as a vital component of sustainable land use and land-use planning in Ethiopia and has led to successful land reforms.

3.1 National communications to UNFCCC

All the four countries in East Africa are parties to the UNFCCC and Kyoto protocol. UNFCCC requires countries to communicate to the Conference of Parties information regarding human induced emissions by source and removal by sinks of greenhouse gases, technological and policy options for mitigation of greenhouse gas emissions and assessment of vulnerability and adaptation of climate change. Ethiopia was the first country to submit its communication to UNFCCC in 2001, followed by Kenya and Uganda (2002) and Tanzania in 2003 (Table 6). Tanzania and Uganda documents were circulated amongst various stakeholders through workshops for their inputs. Tanzania's first document presented clear

suggestions on adaptation and mitigation policies and measure in the agricultural sector. To estimate GHG emissions, all the countries except Tanzania used Tier-I methodology. Tanzania used Tier-II. Inventory was created for both direct GHGs such as Carbon Dioxide (CO_2), Methane (CH_4), and Nitrous Oxide (N_2O), and indirect GHGs such as Nitrogen Oxides (NO) and Carbon Monoxide (CO).

Most of the communication to UNFCCC cited limitations in acquiring emission statistics. Kenya, for example, reported unavailability of the data particularly on trends and rates of land use change, emissions from the soil were not calculated due to inadequate data and high variability of soil carbon content, lack of information on newly introduced industrial processes and, land use and forest data published in literature emphasizes scientific and not traditional use of forests.

Table 6. Characteristics of national communications to UNFCCC

First Communication	Country			
	Ethiopia	Kenya	Tanzania	Uganda
Date of submission to UNFCCC	June 2001	October 2002	February 2003	October 2002
Preparation of document	National Meteorological Service Agency	National Environment Secretariat	Vice-president Office-Division of Environment	Dept. of Meteorology, Ministry of Water, Lands and Environment
GHG methodology used	Tier I - 1996 IPCC Guidelines	Tier I - 1996 IPCC Guidelines	Tier II – IPCC	Tier I-1995 IPCC Guidelines and IPCC/OECD
CO_2 emissions (kt) 2008-2012	6,494	12,427	6,846	3,784
Challenges in implementing UNFCCC convention	▪ Lack of capacity to effectively respond to climate change	▪ Poor communication amongst relevant stakeholders ▪ Lack of trained expertise, models, software for data collection and analysis	▪ Lack of climate change experts at local level ▪ Limited funding ▪ Long and tedious processes	▪ Lack of capacity to effectively respond to climate change ▪ Lack of a land-use planning system ▪ Low levels of awareness

Source: Federal Democratic Republic of Ethiopia 2001, GoK 2002, United Republic of Tanzania 2003, Republic of Uganda 2002

Ethiopia and Tanzania have both completed the second communication but have not submitted to UNFCCC. For Kenya, preparation of the second communication was started in 2009, however, its current status is not clear. Uganda has also drafted its second communication, but finalization has been delayed due to lack of funds and a slow bureaucratic procurement process. It is expected to be ready by early 2014.

3.2 National adaptation programmes of action (NAPAs)

The national adaptation programmes of action (NAPAs) are guidelines for Least Developed Countries (LDCs) to identify priority activities that respond to their urgent and immediate needs to adapt to climate change — those for which further delay would increase vulnerability. Each eligible country relied on a large team of multi-disciplinary experts to draft the NAPAs and submitted to UNFCCC by or before 2008. Kenya is a Less Economically Developed Country (LECD) and therefore does not qualify for Global Environment Facility (GEF) funds to develop its NAP. Uganda and Tanzania used participatory approaches to gather information from local levels to be incorporated into the NAPA. A total of six projects in Tanzania, eleven in Ethiopia and nine in Uganda were developed under NAPA and were funded through the GEF-Least Developed Countries Fund. These projects range from food security, risk management, human health, carbon sequestration and institutional development (capacity building and infrastructure) and are being implemented in various ecological zones (forests, rangelands, highlands and wetlands). Progress on the Uganda projects[10] has been limited due to lack of funds, inadequate capacity to prepare detailed proposals and mobilizing additional funds from donor agencies.

Implementation of NAPA projects in Ethiopia has not started mainly due to absence of strong coordination mechanisms at the federal and regional level, lack of financial and institutional capacity (particularly the lack of an institution for research on climate change adaptation), lack of efficient outreach mechanism to local communities, and difficulty of mainstreaming climate change adaptation into development process. Since Kenya does not qualify for GEF funding to develop its NAPA, the government through the MEMR developed the NCCRS. The NCCAP, which is a follow-up plan for implementing NCCRS, has eight sub-components. The third sub-component of the NCCAP is to develop a National Adaptation Plan (NAP) to identify priority immediate, medium and long-term adaptation actions. NAPs are successors

[10] Uganda's projects include Land Degradation Management Project (US$ 4.7M); Strengthening Meteorological Services (US$ 6.5 M); Community Water and Sanitation Project (US$ 4.7M); Water for Production Project (US$ 5 M); Drought Adaptation Project (US$ 3M); Community Tree Growing Project (US$ 5.5M); Climate Change and Development Planning Project (US$ 1.2M); Indigenous Knowledge (IK) and Natural Resources Management (US$ 1.2M); and Vectors, Pests and Disease Control Project (US$ 8M)

of NAPAs and enable all developing countries to assess their vulnerabilities, mainstream climate change risks and address adaptation needs.

3.3 Nationally appropriate mitigation actions (NAMAs)

The national appropriate mitigation actions (NAMAs) are a set of policies and priority actions that countries undertake as part of a voluntary commitment to reduce greenhouse gas emissions (UNFCCC 2007). Ethiopia was the first country in East Africa to prepare and submit a NAMA to UNFCCC in 2010. The Ethiopian NAMA covered most sectors of the economy including agriculture, electricity generation from renewable energy, transport, biofuel, forestry and waste management. Specific priority actions for agriculture included increasing use of compost rural communities to increase carbon retention and implementation of agro-forestry practices to improve livelihoods and also for carbon sequestration. In the forestry sector, specific actions included district-level reforestation, sustainable forest and wetland management, and establishment of plantation forests.

In Uganda's draft NAMA funded by the African Development Bank (AfDB), specific mitigation priority actions directly linked to agriculture include promoting mulching, recycling of crop residues and zero burning practice, promoting cultivation of high-yielding upland rice, enforcing legislation and regulation on wetland and forest demarcation and reclamation where necessary, promoting use of organic fertilizers, promoting integrated agricultural zoning, and land-use planning.

Kenya has put in place a process for developing its NAMA to be implemented in the context of the country's wider sustainable development strategy, and with the aim of moving the economy towards a low-carbon pathway. Kenya's projections of GHG emission to 2030 shows that agriculture and forestry sectors (particularly livestock and deforestation) are and will be the largest emitters accounting for about 72% of emission in 2010 and 65% in 2030 (GoK 2013). Climate smart agricultural technologies and practices are among the proposed interventions — agroforestry, conservation tillage and limiting the use of fire in range and crop management, manure management through biogas promotion and pasture rehabilitation, management and conservation.

In Tanzania, NAMAs priority interventions proposed in the NAMA for the agricultural sector include promoting agroforestry, enhancing management of agricultural waste, promoting

manure management practices, promoting efficient fertilizer use, promoting appropriate technology for producing animal feed, promoting waste management in abattoir and improving rangelands productivity and complementary activities. Among the NAMA initiatives being implemented in Tanzania is a programme on Low Emission Capacity Building by UNDP (funded by the European Union). This programme promotes cooperation between relevant institutions, while at the same time engaging the public sector in a concerted effort to address climate change consistent with national development priorities. Activities in this program include Low Emission Development Strategies (LEDS), Monitoring, Reporting and Verification (MRV) procedures and sampling and GHG inventory management systems. Other initiatives that have been completed include inventory of GHG emissions and identification of technological and other mitigation, preparation of the national CDM investor's guide among others.

3.4 Integrating REDD+ initiatives in agriculture

The potential for mitigation through agriculture in Africa has been estimated at 970mtCO_2 per year by 2030 – accounting for 17% of the global total with an additional 14% from forestry (UNFCCC 2008). Therefore, Africa has significant potential to deliver on carbon sequestration and co-benefits such as food security and forest and biodiversity conservation (Albrecht and Kadji 2003). In East Africa, GHG emissions from agriculture and other land uses are expected to increase in the future due to increasing demand for agricultural products (resulting from increasing population) and changing food preferences (Thornton et al. 2009, Thornton and Herrero 2010). Reducing emissions from deforestation and forest degradation (REDD) is a set of steps designed by the UN to use market and financial incentives in order for countries to reduce GHG emissions from deforestation and forest degradation. REDD+ is an improvement on REDD and encompasses not only deforestation and forest degradation, but incorporates conservation, sustainable management of forests and enhancement of forest carbon stocks as well.

In the first communication to UNFCCC, all countries in East Africa except Tanzania acknowledge the agricultural sector is the major contributor to GHG, accounting for about 14% of GHG emissions. Tanzania reported a 5.7% contribution of GHG from agriculture. Information emerging from East Africa regarding status of REDD+ indicates that preparation of the document was through stakeholder participation. Kenya, Tanzania and Uganda are

members of REDD+ partnership — a forum launched in May 2010 and open to all countries willing to support or undertake REDD+ actions. REDD+ maintains a database for all the countries. Kenya and Tanzania have not directly received any funding for REDD+ related activities although the database indicate that the two countries have received funding from other sources for REDD+ activities. Ethiopia and Uganda have received funding for REDD+ activities, though Uganda has also received funding from other sources (Table 7).

Table 7. RPP activities to prepare East Africa countries to implement REDD+ activities

Country	Amount of Fund Received (USD)	R-PP strategy to reduce deforestation and increase yields	Progress and R-PIN
Ethiopia (R-PIN submitted on July 30th 2008 to FCPF)	▪ 3.4 million (World Bank implemented by EPA ▪ 200,000 from FCPF towards R-PP ▪ 116,237 from French and Austrian Development Agency	▪ Utilizing improved seeds ▪ Provision of low-cost irrigation systems ▪ Agroforestry ▪ Increasing use of fertilizers and manure ▪ Adoption of best agronomic practices e.g. pre and post-harvest management	▪ A REDD+ institutional set-up is under development within the CRGE unit ▪ Capacity building activities are planned to strengthen the REDD+ unit ▪ A national forestry body to be set up to oversee implementation of REDD+
Kenya	▪ 19.9 Million (2005 – 2014 unknown source) ▪ 0.2 Million Formulation grant (World Bank through FCPF). ▪ Clinton Foundation to support MRV	▪ Development of a national REDD implementation strategy ▪ Development of a national carbon emission reference scenario ▪ Emission reduction monitoring system	▪ Developing National REDD Readiness Management Arrangements and hiring of a National REDD Coordinator ▪ Piloting of implementation framework ▪ Strategic environmental and social assessment initiated ▪ Development of a reference scenario and MRV framework within a national carbon accounting system ▪ Information sharing & sensitization workshops carried out
Uganda (R-PIN approval by the FCPF in July 2008 & R-PP in June, 2011)	▪ 0.2 million (2008-2015) from FCPF ▪ 2 million (unknown source)	Modernizing Uganda's Agriculture through: ▪ Increasing the use of improved seed and planting materials ▪ Use of organic or inorganic fertilizers ▪ Irrigation for areas with potential ▪ Good crop and animal husbandry	▪ To develop the REDD+ strategy (a taskforce will be establish to oversee and supervise) ▪ Plans to conduct capacity needs assessment before R-PP implementation ▪ Taskforce to design and publish the REDD+ Implementation framework and budget
Tanzania (REDD in 2009 and REDD+ in 2012)	▪ 108.28 million (2005 – 2014) (unknown source) ▪ 17 million from the Royal Government of Norway	▪ Land-use planning programs, e.g. intensifying agriculture and animal husbandry ▪ Tree planting in woodlots, agroforestry and plantation ▪ Improved governance in forest management ▪ Improve domestic energy use and provide alternative energy sources ▪ Promoting alternative income generating activities	▪ A National REDD+ Taskforce formed in 2009 to guide the REDD+ Strategy formulation process and a coordinator ▪ National carbon monitoring center and a national carbon accounting or assessment system to be established ▪ Countrywide stakeholders' consultations organized and will continue ▪ First draft of national REDD+ strategy produced in Dec. 2010, shared with stakeholders and 2nd revised draft in November 2011

Source: Forest carbon partnership database 2012

All countries have developed their Readiness Plan Idea Note (R-PIN) for development of the REDD+ strategy (Table 7). The R-PIN identifies various drivers of deforestation. Agriculture

is a major driver of deforestation across all the four countries. In addition to preparing the Readiness Preparation Proposal (R-PP), Uganda is the first country in Africa to undertake a reforestation project that will help reduce emissions under the Kyoto Protocol (Table 7). The Nile Basin Reforestation Clean Development Mechanism Project is one of the eight reforestation projects world-wide registered under the CDM. Other related projects include the 10,000 ha of forest plantation established under the Sawlog Production Grant Scheme (SPGS) between 2003 and 2008 (Uganda ASDS 2010). Other drivers of deforestation include human settlement, unsustainable charcoal production, insecure land tenure arrangements, overgrazing, forest fires, selective removal of favoured timber trees, institutional failures arising from weak governance structures, inadequate capacity to enforce the law, inadequate forest management plans, lack of community participation in forest management, and poverty. In Tanzania, additional drivers of deforestation include refugees, infrastructure, industry and introduction of large-scale agriculture for bio-fuel.

Under Ethiopia's GTP, the government plans to develop plantation farms that will further increase deforestation. The current rate of deforestation in Ethiopia estimated at 200,000 ha/year. For small-scale farmers, GTP aims to enhance their capacities and promote market oriented agricultural production, thus pushing smallholders to clear forest land. Demand for agricultural land in Ethiopia is expected to increase from 15 million ha in 2008 to 19 million ha by 2030 due to annual population growth of 2-3% and government initiatives to expand agricultural production (Zeleke 2010). These activities and initiatives will lead to increase in GHG emissions.

Kenya and Tanzania REDD+ strategy are in line with the Kissinger Report (Kissinger 2011). Following recommendations from NCCRS that pledges to support REDD+ initiative, Kenya revised its R-PP taking into account the linkages between agriculture and REDD+ and re-submitted to UNFCCC in 2010. In this respect, the proposed REDD+ strategies are designed to complement other related policies and strategies such as the Strategy for Revitalizing Agriculture (SRA), Vision 2030, the Environmental Management and Co-ordination Act (EMCA) of 1999, Energy Policy, Water Policy, and the Policy on Arid and Semi-Arid Lands. Kenya has already started implementing its R-PP activities (Table 7).

Tanzania's REDD+ strategy focuses on nine specific options in agriculture intended to facilitate streamlining of REDD+ implementation into the broader NDPs. The implementation

options include improvements in policies and regulations management and utilization, natural resources management practices and improved technical skills at the national and sub-national levels for various stakeholders involved in the REDD implementation process, strategic linkages and synergies between forestry and other sectors such as agriculture, energy, mining, infrastructure and livestock. Evidence documenting case studies of REDD in Tanzania and Uganda among other countries concludes that although there are many opportunities for REDD+, there is need to overcome legal, policy, and institutional hurdles first, as well as undertake capacity development (Richards 2010). In spite of these hurdles, a number of REDD+ pilots are currently on-going in Tanzania. With the exception of Kenya, Tanzania is relatively ahead of its counterparts in the region in implementing REDD+ activities. The UN-REDD programme in Tanzania, for example, is assisting the government with the establishment of a national forest carbon (MRV)[11] as well as achieving REDD-Readiness. In addition, a national carbon monitoring centre to will be established and hosted by Sokoine University of Agriculture with funding from the Royal Norwegian Embassy.

[11] Countries are required to quantify their achievements in REDD+ through use Measurement, Reporting and Verification system. MRV provides an account for the amount of forest carbon and changes over time.

4. Other climate change issues in East Africa

4.1 Priorities for investment in agricultural development and intensification in the next 5 years

Economies in East Africa mainly depend on agriculture, with low productivity. The aim of the countries in the region is to transform to diversified, high agricultural productivity and semi-industrialized economies that will generate high incomes and ensure food security. Sustained growth in agriculture calls for investment in agricultural sector at all levels, from local to national level. All countries have outlined priority areas for investment in agricultural development and intensification in their national development strategy focusing on food security, private sector and policy development.

4.1.1 Improving food security

Tanzania, Kenya and Uganda have outlined their priority areas in the ASDS. In addition, Kenya has outlined its priorities in Vision 2030. Specifically, Tanzania intends to focus on irrigation and water management, range management, livestock development and animal health, better land husbandry, crop production and protection, mechanization, storage and post-harvest improvement, and agro-processing. In Kenya, the ASDS and Vision 2030 intend to focus on irrigation, biofuels, forest conservation, local carbon development and restoration of degraded lands (Appendix II).

Uganda's priority in the ASDS is climate change policy, specifically focusing on reforestation, food security, irrigation, soil protection, natural resource management and strengthening meteorological services (Development Strategy and Investment Plan 2011, Hepworth 2010). Uganda NAPA and DSIP (2011-2015) have defined priorities for investment in agriculture and only DSIP has allocated fund for the priorities. The priorities include enhancing agricultural production and productivity, improving access to markets and value addition, creating enabling environment, institutional strengthening, improved management of crop pests and diseases, agricultural advisory services, agricultural technology development and regulatory services (Appendix II).

Ethiopia has outlined its priorities in the GTP, focusing on smallholder agriculture and pastoral systems. Three areas have been identified for smallholder agriculture and include scaling up best practices[12], expanding irrigation development and improving natural resource conservation, and production of high value crops. Priorities for pastoral systems will focus on water development for people and livestock — diversion of river waters, drilling of boreholes and development of irrigation schemes. In addition, the government intends to improve and expand livestock marketing system, improve pastures, strengthen animal transportation and market price information systems, strengthen pastoralist extension system and research centres to address the technological needs of pastoralists. The government also plans to voluntarily settle the pastoralists.

4.1.2 Private sector development

Kenya had developed a Private Sector Development Strategy (PSDS-2006-2010) that identified agriculture, industry and services sectors as the three broad areas of investment. While the PSDS does not propose specific financial interventions for climate change adaptation and mitigation for agriculture, the strategy proposes it will complement the actions outlined in the *Strategy for Revitalizing Agriculture*, to support the growth of the agricultural sector. To enhance agricultural productivity and profitability, the Tanzania government will facilitate public-private sector partnership with clearly defined roles. This will be achieved by addressing the constraints to private sector involvement, including market development and infrastructure, increased vertical integration through contract farming, advocating for producer organizations, and supporting financial institutions and services.

In Ethiopia, private sector involvement is driven by the recent success in the floriculture industry. The government plans to address the problems of marketing, infrastructure (logistics and transport) to boost production and exports. Through the GTP, the government intends to expand greenhouse technology and large scale farming into lowland areas, develop irrigation and establish out-growers scheme where farmers have formed associations to assist them

[12] The aim is to strengthen capacities of farmers, agricultural extension officers and development agents through effective utilization of existing technologies and adoption of new technologies that will improve soil fertility (e.g. increasing fertilizer application from 0.04t/ha to 0.25t/ha by 2030, build a fertilizer factory by 2014 and promote use of organic fertilizers to reduce the levels of GHG emissions).

export their horticultural produce. In Uganda, the only private sector involved in climate change issues, though not directly related to agriculture is the Mukwano Industries Limited that invests in tree planting activities among smallholder farmers through its corporate responsibility initiative.

4.1.3 Policy development

All countries across East Africa are committed to creating a favourable legal, regulatory and enabling policy environment for investment in agriculture. In Tanzania, this is expected to facilitate stronger participation of the private sector in agriculture, specifically in development and production of quality seeds.[13] In Ethiopia, the government plans to establish an effective land administration system and implementing agency that would ensure transparent and accountable land leasing and land use practices. In Vision 2030 and ASDS (2010-2020), Kenya has outlined two policies — the fertilizer and national horticultural policy-2010 - to attract investments in agriculture. The fertilizer policy will be implemented through the *Fertilizer Cost-reduction Investment Project*[14], whereby the raw materials will be sourced from the neighbouring countries of Rwanda, Uganda and Tanzania. In the horticultural policy, priorities for investment include capital investment and value addition, partnerships with financial institutions through public-private initiatives, development of appropriate credit packages for seed, fertilizers and pesticides, and development of irrigation schemes.

There are other cross-cutting investment options that the East African countries are targeting to include other sectors of the economy. For example, the governments recognize that linking agriculture and other sectors like rural infrastructure and energy, civil service reform, implementation of land Acts, health (HIV/AIDS, malaria), gender, education, environmental management, forestry and fisheries, and water related sectors is critical in tackling climate change within the agricultural sector.

[13] Tanzania heavily relies on imported seeds. In 2009, Tanzania imported 75% of its seed from USA.

[14] Kenya's MoA commissioned a feasibility study in June 2011 to establish a manufacturing plant in Kenya as a flagship project of Vision 2030.

4.2 Financing for climate change adaptation and mitigation in agriculture

Adapting to climate change, coping with climate variability and reducing GHG emissions requires finance, technology transfer, and capacity building. In order for agriculture to continue providing solutions to climate change and to guarantee food security and development, the three components have to be integrated. Apart from Kenya that sources for funds locally as well, all the other three countries in the region heavily rely on donor agencies, bilateral and multilateral parties and international NGOs to finance climate change mitigation and adaptation initiatives, programs and projects (Appendix III). Projects in Ethiopia and Kenya focus both on mitigation and adaptation in agriculture, while projects in Tanzania and Uganda focus on mitigation (Table 8).

Table 8. Source of funds for climate change adaptation and mitigation in agriculture in East Africa

Source of funds	Project	Country funded*	Amount (million USD)
Global Climate Change Alliance	Holistic, innovative and integrated approaches in Eco-villages' implemented by Ministry of Finance, Vice-President's Office – Division of Environment, Community Forest Pemba, Institute of Rural Development Planning and Sokoine University of Agriculture	Tanzania	3.03
	Sustainable land management project implemented by AFD, Deutsche Gesellschaft fur Internationale Zusammenarbeit GmbH (GIZ), Environmental Protection Authority, Ministry of Agriculture and Rural Development	Ethiopia	18.9
LDC Fund	Developing core capacity to address climate change adaptation in productive coastal zones	Tanzania	3.10
Denmark	Pilot program on optimizing resources in climate resilient food production	Kenya	0.36
Finland	Adaptation learning programme	Kenya	2.2
Germany	Risk management strategies for adaptation to climate change in the Kenyan highlands agriculture	Kenya	3.06
	Fast start finance of adaptation to climate change in Africa	Uganda	2.8
Netherlands	Partners for resilience programme	Ethiopia, Kenya, & Uganda	82.98
Japan/UNDP	Africa adaptation programme	Kenya	2.58
		Ethiopia	6.5

Source: European Union 2013, Global Environmental Facility 2011, GoK 2013, Africa Adaptation programme 2013

All the countries are calling for investment in capacity building. Uganda is already investing heavily in building capacity of the research organizations. The UN and the government of Uganda, for example, have jointly initiated a project - LEARN for the period 2010-2014. The project aims to foster a systematic and country-driven process to strengthen human resources and skills to advance a green, low emission and climate resilient development. Through the project, a national strategy to strengthen human resources and skills to advance green, low emission and climate resilient development has been developed.

In Ethiopia, projects focus on adaptation in agriculture, specifically use of disease resistant crops, use of seasonal climate forecast and development of weather based insurance. In addition, Ethiopia's CRGE has highlighted seven thematic areas of which agriculture is a priority for promoting low carbon development growth and resilient economy. The above projects are mainly undertaken by government ministries, NGOs at the grassroots level and research organizations. EIAR, for example, is currently undertaking research projects that aim to reduce crops/soil based and livestock GHG emissions.

Future projects in Ethiopia are aimed at reducing the emissions from the soil/crop cultivation, livestock and enhancing of carbon uptake through tree planting and improved cultivation practices. In particular during implementation of CRGE, focus will be on the livestock sector. Ethiopia's Environment Protection Authority (EPA) also drafted a Program of Adaptation to Climate Change (EPACC). The objective of the program is to create a foundation for a carbon-neutral and climate-resilient path towards sustainable development. Through extensive stakeholder consultations, each region prepared their own adaptation plans based on immediate and anticipated climate change threats. Threats identified include human, animal and crop diseases; land degradation; loss of biodiversity; decline in agricultural production; dwindling water supply; and social inequality.

Kenya seeks funds for climate change programs and projects from national and international sources. Kenya's NCCRS developed a resource mobilization plan that ensures finance is available from local and national government (LATIF and CDF), climate change funds, the private sector, World Bank and International Monetary Fund and other development partners (Table 8). Programmes and projects identified in the strategy will be implemented over the next 20 years at an average cost of USD 3.14 billion annually. The annual cost estimates for agriculture is USD 132.5 million, and water and irrigation USD 74.5 million. Kenya's ASDS

2010–2020 framework has equally proposed ways of financing programmes and projects to be shared among government, development partners and the private sector. The strategy proposed the establishment of Innovation Fund for Agriculture and Agribusiness (IFAA). The objective of the IFAA will be to foster ASDS's central objective of commercializing agriculture by catalysing private sector participation in market-oriented production and service delivery, promoting productivity and profitability or commercial viability of sector activities at all levels.

Several international donors are financing climate change projects, initiatives and programs in East Africa. While some of the donors target specific projects, sectors or regions of the country, others are cross-cutting and include several sectors. Climate change adaptation and mitigation projects supported include crop and livestock projects, development and implementation of low carbon strategies, sustainable land management, capacity building and investment in infrastructures (such as irrigation schemes) and markets. The international donors include DANIDA, USAID, SIDA, DFID (the largest bilateral donor), JICA, IFAD, IDRC, World Bank-IFC, Canada Cooperation Office, European Commission and Africare. UN agencies are UNDP, UNEP, FAO, Oxfam-GB, World Food Program and private foundations (e.g. Rockefeller Foundation). Various organizations and associations within East Africa are also funding climate change initiatives. Some of these are Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA), CAADP, Alliance for Green Revolution in Africa (AGRA), and Common Market for Eastern and Southern Africa (COMESA) (Appendix IV).

4.3 Linkages between adaptation and mitigation in agriculture

Mitigation and adaptation has been treated as separate entities within the UNFCCC negotiation process, with adaptation largely ignored in favour of mitigation (Verchot et al. 2007, Ayers and Huq 2008). This created an imbalance in addressing the two strategies, yet both are important in addressing climate change (Ayers and Huq 2008). Mitigation was treated as a priority issue for developed countries with the greatest responsibility for climate change, while adaptation was seen as a priority for developing countries, where mitigation capacity is low and vulnerability is high (Ayers and Huq 2008). It is only recently that adaptation measures were given more importance in the UNFCCC negotiations. For the first

time, IPCC Fourth Assessment Report introduced a chapter dedicated to the interrelationships between adaptation and mitigation (IPCC 2007).

In East Africa, the linkages between adaptation and mitigation projects or activities have not been clearly delineated. However, there is growing recognition of the dual benefits from certain climate change projects and strategies. Tanzania, Kenya and Ethiopia, for instance, have initiated projects that link adaptation and mitigation (Table 9). The promotion of use of compost manure in increasing agricultural productivity instead of chemical fertilizers is one example where mitigation and adaptation are combined in one practice (Table 9). In Ethiopia, the CRGE intends to boost the synergies between adaptation and mitigation.

Despite the formation of the CCU in Uganda, mainstreaming climate change into programmes and projects and linking the various actors remains a challenge. There is disjointed coordination among the line ministries and even within Ministry of Water and Environment where the CCU is located. The budgetary allocation between Water and Sanitation, and Natural Resource sub-sectors which accommodates weather, climate and climate change needs to be harmonized. Moreover, the CCU also has no supervisory mandate to coordinate climate change activities in other ministries. The absence of a climate change policy and strategy in Uganda further compounds the coordination problem.

In Tanzania, many adaptation and mitigation activities are part of sector plans, and are coordinated within specific ministries. Mechanisms are currently in place to ensure coordination and cooperation between the Tanzania government and development partners with regard to activities at the local, sector, and national levels. Accordingly, the main challenge in Tanzania is to consider how existing organizations and institutions can be reinforced to meet the increasing challenges of climate change and variability.

Table 9. Examples of projects linking adaptation and mitigation in agriculture in East Africa

Activity (Agricultural/Forestry)	Country	Synergies between adaptation and mitigation	
		Mitigation	Adaptation
Agroforestry (improved fallow system)	Kenya, Ethiopia, Tanzania	▪ High potential to sequester carbon ▪ Soil uptake of CH_4 ▪ Enhancing soil organic matter & additional benefit of increasing carbon sequestration ▪ Moderate & develop microclimate	▪ Deep root systems able to explore a larger soil volume for water and nutrients during drought ▪ Increased soil porosity & soil cover, reduced runoff, increased water infiltration and retention, reduced moisture stress ▪ Tree-based systems have higher evapotranspiration rates than row crops or pastures and thus can thus maintain aerated soil conditions even during floods ▪ Tree-based production systems often produce crops of higher value than row crops ▪ Enhances soil organic matter content by increasing moisture retention and soil fertility – reduces vulnerability to drought ▪ Increase crop diversity and productivity per unit of land while converting the farms into greener landscapes
Compost and organic manure	Tanzania, Kenya, Ethiopia	▪ Reduction of methane emissions from the aerobic processes of decomposition ▪ Reduce GHG emissions associated with inorganic fertilizers	▪ Indirectly through contribution to carbon sequestration of crops benefiting from compost manure ▪ Enhancing soil organic matter to increase moisture retention and soil fertility thus reducing vulnerability to drought ▪ Increases agricultural productivity
Rice cropping	Tanzania Kenya	• Improved organic matter and flooding management in irrigated rice can decrease CH_4 emission from paddies	▪ Indirectly from increased rice production and increased household income
Organic agriculture	Kenya	▪ CO_2 mitigation potential in amounts of 3.5–4.8 Gt CO_2 from carbon sequestration and a reduction of N_2O by two-thirds	▪ Soils capture and store more water thus able to withstand drought ▪ Highly diverse farming systems, thus increasing diversity of income sources and flexibility to cope with adverse effects ▪ Low-risk farming strategy with reduced input costs and lower risks of partial or total crop failure
Bioenergy	Kenya	▪ Use of forest products for bioenergy to replace fossil fuel use	▪ Diversified farms yield a range of products e.g. fuel wood thus reducing burden on women and generating income
Create new agricultural land in degraded areas	Ethiopia	▪ Reduces pressure on forest through reduced deforestation and GHG emissions	▪ Increase production through irrigation ▪ Provide crop and livestock insurance mechanism
Promoting area closure through rehabilitation of degraded pastureland and farmland	Ethiopia	▪ Increases above and below ground carbon sequestration	▪ Increase soil fertility that will increase productivity

Source: AfDB 2010, GoK 2010a, The Federal Democratic Republic of Ethiopia 2010, The United Republic of Tanzania 2011.

4.4 Capacity development for climate change adaptation and mitigation

In order for developing countries to implement climate change strategies and establish effective institutions and systems, there is need to strengthen human capacity. This is reflected in the objectives of the Cancun Agreement at COP16 in Mexico on capacity building that stressed the need to speed up country plans to adopt sustainable paths to low emission economies as well as cope with the negative impacts of climate change. In 2004, 32 Universities in Eastern, Central and Southern Africa, formed a regional consortium—Regional Universities Forum for Capacity Building in Agriculture (RUFORUM). RUFORUM aims to play a key role in contributing to the well-being of small-scale farmers and economic development of countries throughout the sub-Saharan Africa region, including addressing the emerging challenge of climate change. RUFORUM has strengthened the capacity of African universities to provide rigorous and relevant training in agriculture to new generations of scientists. Of the 32 universities participating in RUFORUM, 10 are from East Africa.[15]

Among the climate change related degrees that members of the consortium benefit from include Masters and Doctoral degrees from the Institute for Climate Change and Adaptation (ICCA) at the University of Nairobi. ICCA provides formal training on climate change and adaptation; professional short courses on climate change and adaptation for public and private sectors including NGOs; climate change and adaptation research and knowledge exchange; action-oriented community outreach programmes for implementation of appropriate adaptation options; and policy advice on climate change and adaptation. In Uganda, Makerere University is integrating climate change topics into the curriculum to equip the students with relevant knowledge and skills in climate change and agriculture.

Other universities that are not members of RUFORUM such as University of Dar es Salaam (Institute of Resource Assessment) and Ardhi University in Tanzania have shown commendable efforts in trying to build capacity in the field of climate change and disaster management. University of Dar es Salaam is among the first institutions in East Africa to mainstream climate courses into its curriculum. Currently, the university offers a course on

[15] Egerton, Kenyatta, Nairobi, Moi and Jomo Kenyatta Universities in Kenya; Gulu, Kyambogo, Makerere and Uganda Martyrs Universities in Uganda; Sokoine University of Agriculture in Tanzania; and Haramaya and Makelle Universities in Ethiopia.

"Strengthening Capacity of Agriculture Sector to Adapt to Climate Change Impacts in Africa". In Ethiopia, Arba Minch University started an MSc program on climate change and development, Addis Ababa University established a Climate Change Research Group (CCRG) within the Faculty of Science, while the Ethiopian Development Research Institute focuses on adaptation and impacts of climate change on the Ethiopian agriculture.

All the East Africa countries have identified and proposed urgent areas for capacity strengthening:

- Climate change mitigation and adaptation strategies and strengthening institutions particularly for academic, policymakers and researchers;
- Incorporating climate change science into disciplines such as fisheries and agriculture;
- Capacity building in monitoring, reporting and verification in climate change adaptation and mitigation;
- Training in technology transfer of climate smart technologies to various actors including farmers, extension officers using different mediums;
- Capacity building on how to train extension agents to implement early warning systems in their operations;
- Capacity building in financing for climate change mitigation;
- Development of spatial-data infrastructure, GIS and web-based delivery systems for national forest monitoring and carbon reporting/MRV; and
- Acquisition, processing and use of remotely sensed data for effective national REDD monitoring.

Various donors are supporting the capacity building initiatives for climate change adaptation and Mitigation. UNDP/GEF supported the first capacity building project to strengthen the technical and institutional capacity in the four countries to effectively respond to their obligations under the UNFCCC. While the project was planned for 2 years (1996-1998), it did not meet all its objectives due to implementation difficulties and short time allocated. In the end, the project was implemented for 5 months instead of 2 years.

In Uganda, Rockefeller Foundation is supporting a project to strengthen NARO's capacity to develop and adopt climate change adaptation interventions and policy recommendations. In its NDP 2011-2015, the Ugandan government has planned to develop national capacity for coordination and implementation of climate change adaptation and mitigation activities. The ASDS and Investment Plan (DSIP 2010/11- 2014-15) of Uganda has a budget of USD 19.35 million allocated for capacity building in MAAIF sub-programmes, and USD 13.355 million for capacity building in climate change at the district level. This will support social welfare and national development, and also the Uganda CCU as an institution that needs urgent capacity building. These initiatives are being supported by the UN Joint Programme on climate change through the UNDAF. A key feature of adaptation interventions is that they will build on on-going Disaster Risk Reduction work.

In Tanzania, the government has established three institutes with a mandate of providing scientific information and advice to government on matters relating to the sustainable management of natural resources: Tanzania Fisheries Research Institute (TAFIRI), Tanzania Forestry Research Institute (TAFORI), and Tanzania Wildlife Research Institute (TAWIRI).

4.5 Research priorities on adaptation and mitigation in agriculture

Evidence shows that agriculture especially livestock is a major source of GHG (Herrero and Thorton 2009, Herrero et al. 2008, Verchot et al. 2008, Palm et al. 2010). Governments in East Africa have identified agricultural research and development as a priority to address climate change. In Ethiopia, the CRGE strategy proposes USD 11 million budget annually for agricultural research to be coordinated by EIAR, indicating the importance placed on the agriculture-climate change nexus. The government has also created a Climate Change Unit (CCU) in the Ministry of Agriculture. The CCU will coordinate and implement projects and policies related to agriculture and climate change, working with EIAR. The research focuses on developing crop varieties and livestock breeds that can withstand increased temperatures, using seasonal climate forecast, reducing GHG emissions through sustainable land management strategies, value chain efficiency, mechanization and, rangeland and pastureland management.

The Kenya Agricultural Research Institute (KARI) launched the CCU through a grant from the Rockefeller Foundation to serve as a focal point for climate change related research. The

overall goal of the KARI CCU is to mainstream climate change into the agricultural research programmes. Specific objectives of CCU are:

- To develop a climate change focal point in KARI in order to increase opportunities for collaborative work and develop capacity of researchers to understand and develop adaptation technologies and techniques;
- Increase awareness of climate change issues and concerns internally and externally in order to contribute to and facilitate knowledge development and information sharing;
- Coordinate and direct funding for climate change adaptation research in order to mainstream climate change efforts across KARI research stations countrywide; and
- Engage external partners and stakeholders on climate change issues.

KARI's CCU has not yet prioritized specific research areas that address climate change However, some preliminary activities documenting all adaptation and mitigation projects across the 36 KARI Centres have already begun. A process of developing a climate change strategy for KARI has also been initiated and this will be a valuable document in guiding climate change activities and sourcing for funds for implementing proposed interventions. The MoA also has a CCU, independent of KARI's CCU. The two CCUs sometimes cooperate especially in areas such as capacity building in climate change.

In Uganda, research priorities on agricultural adaptation and mitigation have not yet clearly been defined in government plans or institutions. As previously discussed, the need to tackle the effect of climate change on agriculture is mentioned in the NDP and DSIP. Tanzania's National Agricultural and Livestock Research Master Plan (1992) set priorities for research on crops and livestock. The plan privatized or devolved to semi-public commodity boards research on traditional crops (tea, coffee, tobacco, cashew, cotton, and sugar) with a significant amount of financial and administrative autonomy. However, due to the importance of smallholder agriculture, the government maintained research responsibility for food and livestock sub-sectors. In addition, the Tanzania Agriculture and Food Security Investment Plan (TAFSIP 2011/12 to 2020/21) proposes a number of instruments that need to be considered for adaption to climate change: research on new crops or varieties and farming systems suited to hotter or drier conditions, improved short and long-term weather forecasting, and risk management measures to cope with increasing climatic variability. With

regard to mitigation, carbon sequestration through conservation agriculture and reforestation are highlighted by the TAFSIP.

Across the region, there is an imbalance in addressing adaptation and mitigation, with more projects focusing on adaptation compared to mitigation. There is need for a balance in addressing adaptation and mitigation in agriculture through financial, technical and capacity building support. For example, the CCUs in MoA and KARI in Kenya should map and create a database for all climate change related activities. Similarly, all the other countries in the region need to develop their own databases as well as establish a climate change plan that would prioritize interventions and also for the purposes of leveraging funds for these interventions. As noted previously, climate change data and documentation is lacking in all countries in the region. Documentation of donors and financing sources is equally poor, making it difficult to assess the state of climate change financing. While Tanzania has made an effort in setting up an inventory of climate change activities, an up to date inventory of projects and financing sources is still necessary to help identify the strengths, gaps and opportunities.

Some of the proposed activities to complement existing climate change adaptation and mitigation projects and programs in East Africa countries include:

- Providing linkages and balance between adaptation and mitigation projects by setting up a functional structure for coordinating all climate change initiatives in each country and the region;
- Creating a platform for exchanging information amongst researchers, policy makers and farmers. A survey on appropriate information dissemination channels that meets the needs of the different audiences needs to be carried out.
- Identifying research and policy gaps in climate change adaptation and mitigation in agriculture; and
- A survey on the relative importance given to climate change adaptation and mitigation in agriculture to ensure that projects developed create a win-win situation where the emissions are reduced and farmer's adaptive capacity is increased.

4.6 Other major actors on climate change adaptation and mitigation in East Africa

4.6.1 International and national organizations

Apart from government institutions and departments, various international and national NGOs in East Africa have vested interest in dealing with climate change adaptation and mitigation. The activities of these organizations include research, development, capacity building (for farmers, scientists, students and policy makers), dissemination and scaling up of climate-smart technologies, water resource management, renewable energy, natural resource management, advocacy and policy and protecting biodiversity. Some of the international organizations work in selected countries. CARE, for example, works in Kenya and Uganda, while World Vision works in all the countries in East Africa.

In Kenya, CARE has established a Climate Change Information Centre with programs on climate change adaption and mitigation. Some of these programmes include Adaptation Learning Programme for Africa (ALP), LIFT-UP programme and a carbon mitigation project "Making Carbon Finance for Sustainable Agriculture Work for Poor People" in Western Kenya. Other international organizations working on climate change in East Africa include UN agencies (UNDP, UNEP, FAO and International Organization for Migration) and donor agencies (Danish International Development Agency, EU, DFID, United States Agency for International Development, Japan International Cooperation Agency, Swedish International Development Agency, German Development Cooperation, and World Bank), research organizations (International Union for Conservation of Nature, African Centre for Technology Studies, Practical Action and Worldwide Wildlife Fund), emergency response and development agencies (Oxfam, SCC VI-Agroforestry Centre, and Heinrich Boell Foundation).

There are also a number of national organizations working in each country with similar activities as the international organizations. In Uganda, the national organizations include Climate Change Concern; Climate and Development Initiatives; Environment Management for Livelihood Improvement, Uganda Coalition for Sustainable Development and the

Participatory Ecological Land Use (PELUM)[16]. In Kenya, national organizations include Climate Network Africa, Indigenous Information Network, Kenya Climate Change Working Group. In Tanzania, the national organizations include Tanzania Traditional Energy Development and Environment Organization-TaTEDO, Center for Energy, Environment, Science and Technology (CEEST), Tanzania Forest Conservation Group, Carbon Tanzania, Wildlife Conservation Society of Tanzania, Environment Protection Management Services-EPMS. In Ethiopia, the national organizations include Climate Change Forum, Ethiopian Catholic Secretariat, Ethiopian Orthodox Church-Development and Inter Church Aid Commission, Forum for Environment, and Pastoralist Forum for Ethiopia.

4.6.2 Private sector

Private sector involvement in climate change and agriculture in East Africa is very limited. A private company Cafédirect (the leading British Fairtrade company for hot beverages) and German Technical Cooperation (GIZ) have jointly piloted a project in Uganda, Tanzania and Kenya[17]. The project known as "Adaptation for Smallholders to Climate Change (AdapCC)" supports coffee and tea farmers in developing strategies to cope with the risks and impact of climate change.

In Kenya, a consortium of three companies, UAP Insurance, Syngenta Foundation and Safaricom (mobile phone company) launched an innovative and affordable crop insurance program known as *Kilimo Salama Plus*. The insurance program covers crop producers and livestock keepers against climate related risks such as drought and flooding. In Ethiopia, a few private companies are pursuing mitigation activities. For instance, Ethan Biofuels PLC is involved in connecting industries with international carbon markets to derive benefits from GHG reduction strategies within their operations. McKinsey & Co in collaboration with UNDP is currently helping the government to develop National Adaptation Plan under CRGE

[16] PELUM is a regional network of over 220 civil society organizations in 10 countries in East, Central and Southern Africa working on participatory ecological land use management. PELUM works to improve the livelihoods of small-scale farmers and the sustainability of farming communities, by fostering ecological land use management. Country chapters include Uganda, Kenya, Tanzania, Rwanda, Malawi, Zambia, Zimbabwe, Lesotho, Botswana and South Africa.

[17] This project is also being piloted in Mexico, Peru and Nicaragua. Other auxiliary roles played by private sector in climate change project, policy and institutional development in Uganda are mainly consultancy services. The consultancy are involved in developing carbon projects and programs for energy and forestry sectors.

initiative. McKinsey mainly provides technical assistance and training of government officials on climate change adaptation and mitigation. In Tanzania, Green Resources ASA and Carbon-Tanzania are working on afforestation and re-afforestation programs and CDM. The Tanzania Private Sector Organization (TPSO) and Tanzania Chamber of Commerce, Industry and Agriculture (TCCIA) are supporting climate innovations (such as financing, capacity building and entrepreneurship) into their institutional programmes. Finally, the Zanzibar Seaweed Cluster Initiative is encouraging farmers to practice organic farming and value addition.

A final category of private sector actors include the agricultural input providers. Seed companies in Uganda and Ethiopia are involved in breeding and development of new seed varieties that are drought tolerant. The companies include Nalweyo Seed Co., Mt. Elgon Seed Co., East Africa Seed Company in Uganda, Pioneer Hi-Bred Seeds in Ethiopia and Monsanto (in Uganda and Ethiopia). Other private companies involved in seed production in Tanzania are Cargill hybrid seeds, Pioneer hybrid, INCOFIN Tanzania Ltd, Rotian Seeds Company, Alpha Seed, Paunar, and East African Seed Company (Appendix V).

5. Conclusion and recommendations

Climate change affects almost every sector of the economy in East Africa, with potential negative impacts on food security and economic growth. This calls for a multi-faceted approach and multi-stakeholder involvement. Across the region, various government departments are leading climate change programs. New climate change units solely charged with addressing climate change have been formed. The climate change units and programs are playing a key role in initiating development and research projects, sourcing for funds, advocating for change and building expertise in climate change.

At the same time, the NAPAs and NAMAs are helping government to direct efforts and finance towards developing climate change adaptation and mitigation strategies. However, countries in the region are still are ill-equipped to address climate change mainly due to huge financial investment required, lack of human capacity and lack of policies and legal frameworks. Majority of the climate change projects in agriculture developed mainly focus on adaptation, with few mitigation projects. Furthermore, the potential for collaboration and synergy between climate change actors are yet to be fully explored. Based on the findings of the study, we propose a number of recommendations for consideration by the countries in East Africa:

- Policies on climate change need to be formulated, enacted and legislated for the projects to get local and financial support as well as improve the coordination of the activities in the different sectors;
- There is need to establish a climate change plan that would prioritize interventions. Kenya has developed the National Climate Change Response Strategy and the National Climate Change Action Plan;
- Mainstreaming climate change into government sector plans, projects and programs is one option that can be explored to holistically address agricultural development in East Africa. In particular, mainstreaming climate change programs into gender, poverty and food security initiatives is desperately needed;
- Capacity building of all stakeholders and actors in agricultural sector and affiliated institutions should be strengthened at all levels. Furthermore, each country should create

synergy and set priorities among the players in climate change and identifying potential areas for collaboration;

- Strengthen coordination and collaboration between different climate change actors to maximize the desired outcomes. Even though all governments have designated lead agencies for climate change, there is lack of information sharing and lack of inventory in terms of coordinating and collaborating in tackling climate change in various sectors in all the countries. Mapping of all past and current adaptation and mitigation initiatives in agriculture, programs and projects should be undertaken and made publicly available;
- There are opportunities to link and mainstream existing poverty reduction and food security projects and programs with climate change initiatives to realize their full potential and derive some carbon financial incentives;
- Majority of climate change projects and programs in agriculture and forestry are mainly financed by donor agencies and international organizations and mostly dispersed in the rural areas, away from government limelight. Since most donor-funded programs are short-term, the governments need to play a proactive role in financing and implementation of these programs to achieve sustained and lasting results;
- Agriculture contributes significantly to East Africa economies, and driven mainly by women, special consideration need to be given to women as they will be adversely affected by climate change;
- Increasing food production and ensuring food security requires agricultural intensification on existing cropland. However, without appropriate agricultural technologies, intensification might contribute to land degradation. Therefore, formulation of a comprehensive land and water management strategy needs to be in place;
- There are opportunities for different stakeholders involved in agricultural research to undertake research on climate smart technologies, develop extension and dissemination strategies to improve adoption of climate smart technologies and, strategies for linking farmers to carbon markets and financing.

Appendices

Appendix I: Major government institutions and departments engaged in climate change in East Africa

Government Units	Roles in agriculture and climate change
Ethiopia	
Ethiopian Institute of Agricultural Research	Assessing the impact of climate on agricultural systems; development of computer based decisions support tool; assessing different adaptation options; and development of drought-tolerant crop varieties
Environmental Protection Authority	Preparing national action plans for climate change mitigation; implementing land rehabilitation projects in arid, semi-arid, dry sub-humid areas
Rural Energy Development & Promotion Centre	Identification and dissemination of renewable energy technologies (solar, energy saving stoves, biogas)
Institute of Biodiversity Conservation	Collection of threatened crop germplasm (especially landraces) and establishment of genebanks in areas affected by drought & flood
National Meteorological Agency	Disseminating weather information to farmers through the local media.
Kenya	
Office of the President– The National Disaster Operations Centre (NOC)	Coordination response and relief during emergencies and disasters (flood and drought); manages a contingency fund for drought response
Ministry of Environment and Mineral Resources	Kenya's climate change focal unit and hosts the national climate change coordinating office that acts as the secretariat for the national climate change activities coordinating committee
Ministry of Agriculture	Set up the climate change unit, which participates in the preparation and implementation of national climate change policies, strategies and action plans
Kenya Agricultural Research Institute	Established a climate change unit to mainstream climate change into the research programmes
Kenya Forestry Research Institute	Research and dissemination of agroforestry practices that sequester carbon and help farmers adapt to climate change
Tanzania	
Vice president's office	National focal point for all climate change adaptation and mitigation activities and also the national designated authority for UNFCCC
Institute of Resource Assessment (IRA)	Facilitates strategy development process coordinated by a task force comprising of representatives from Vice President's Office and, Forestry and Beekeeping Division (Ministry of Natural Resources and Tourism)
Uganda	
Climate Change Unit	Lead climate change coordinating unit under the directive of parliament
Climate Change Policy Committee (CCPC)	Brings together various government ministries and departments and provides policy guidance on climate change
Parliamentary Forum on Climate Change (PFCC)	Addresses the environmental, social and economic pressures of global climate change and have established a timeline of priorities and expected outcomes to be adopted by and implemented by its members
National Environment Management Authority	Developed a working paper on natural resources, environment and climate change
Directorate of Water Resource Management / Directorate of Water Development	The joint water sector review of 2007 established a specific undertaking for the sector to develop a national strategy for adaptation to climate change from a water resources perspective
Ministry of Agriculture, Animal Industry & Fisheries	In its agricultural sector development strategy & investment plan: 2010/11 - 2014/15, the ministry will establish a climate change planning facility
National Agricultural Research Organization	Raising awareness on climate, research on climate change resistant crop varieties and livestock breeds, and policy analysis

Appendix II: Priority investments for a climate resilient agriculture

Issue	Document	Description
	Kenya	
Agriculture (crop, livestock and irrigation) and restoration of degraded land	Kenya Vision 2030 ASDS 2010 - 2020	a) Promote climate-smart agriculture in Kenya b) Up-scaling specific adaptation actions - promotion and bulking of drought tolerant traditional high value crops, water harvesting for crop production, index-based weather insurance, conservation agriculture, agroforestry, and integrated soil fertility management c) Establishment and maintenance of climate change related information for agriculture d) Coordination and mainstreaming of climate change into agricultural extension e) Enhance irrigation and drainage to increase agricultural production and address water requirements for livestock production f) Improve and strengthen climate change information management systems and enhance awareness creation of climate risk management and opportunities g) Finalization and implementation of the national irrigation policy and legal framework h) Intensification and expansion of irrigation to 704, 000 ha i) Improving rainwater harvesting and storage for agriculture j) Promoting on-farm forestry of indigenous and high value trees
	Tanzania	
Commercial agriculture, seed development and production, irrigation, policies	ASDS	a) Investment in irrigation and water management, range management, livestock development and animal health, better land husbandry, crop production and protection, mechanization, storage and post-harvest improvement, and agro-processing b) Increasing area under irrigation through financing smaller schemes, larger and more complex irrigation infrastructure c) Seed development and production that are adaptable to drought d) Creating a favourable regulatory, legal and policy environment to support climate smart agriculture
	Uganda	
Enhancing agricultural productivity	ASDS and Investment Plan 2011-2015	a) Providing farmers with drought resistant and escaping crop seed b) Increased farmer access to relevant climate information, knowledge and technology through effective, efficient, sustainable and decentralized extension service c) human resource development on climate change and agriculture

Appendix III: Examples of climate change adaptation and mitigation projects in agriculture in East Africa

Project	Funding agency and implementing agency
Ethiopia	
Enabling pastoral communities to adapt to climate change and restoring rangeland environments	*Donor:* Spanish Millennium Development Goals Fund Environment *Implementer*- MoARD & EPA, UNDP, FAO UNEP
Coping with drought and climate change	*Donor*- GEF/UNDP *Implementer*- Ministry of Agriculture, EPA, MoFED,
Making Ethiopian Agriculture climate resilient: Towards mainstreaming climate change adaptation into food security and sustainable development	*Donor*-Rockefeller Foundation *Implementer*- EIAR
Reducing the vulnerability of agriculture through climate smart rural development	*Donor*-Rockefeller Foundation *Implementer*-EIAR
Transforming Ethiopia Agriculture through climate change adaptation and lower emitting technologies	*Donor*-DFID *Implementer*- EIAR
SIMLESA pilot projects	Australia Government *Implementer*- EIAR with technical support from CIMMYT
Kenya	
Impacts of climate change in tea production areas	*Donor*-FAO/SIDA
Western Kenya smallholder agriculture carbon finance project	*Donor* – World Bank *Implementer*-Vi Agroforestry Programme and Unique Forestry,
Support to the Sugar Sector	*Donor*-European Commission
Mitigation of Climate Change in Agriculture (MICCA) Programme	*Implementer*-East Africa Dairy Development Project, World Agroforestry Centre and Heifer International
Tanzania	
Hillside Conservation Agriculture for Improved Livelihoods in the South Uluguru Mountains	*Donor-Care International*
Agriculture Sector Development Programme (ASDP)	*Donor*-World Bank - other basket donors are AfDB, IFAD, JICA. Implementer-United Republic of Tanzania
Accelerated Food Security Project	*Donor*-World bank
Trade and Agriculture Support Programme (TASP)	*Donor*-European Commission
Private Agricultural Sector Support Trust (PASS)	*Donor*-DANIDA, EXIM, FBME, NMB, CRDB, ABC, TIB, and Azania bank
Sustainable Management of Land and Environment (SMOLE)	*Donor*-Finland, *Implementer*-Departments of Survey and Urban Planning, Land Administration and Registration, Environment, and Commercial Crops and Forestry
Sustainable Landscapes Pillar	*Implementers*- USAID, African Wildlife Foundation, Worldwide Fund
Uganda	
Ruwenzori Livelihoods and Disaster Preparedness Support Programme	*Donor*-Oxfam GB
COMESA Regional Agricultural Inputs Program (COMRAP)	*Donor*-EU Food Facility Program *Implementer*- Alliance for Commodity Trade in Eastern and Southern Africa
Strengthening NARO's Capacity to Develop Climate Change Adaptation Interventions and Policy Recommendations that ensure their Adoption	*Donor*-Rockefeller Foundation *Implementer*- NARO
Strengthening East African Resilience and Climate Change Adaptation capacity through Training	*Donor*-Rockefeller Foundation *Implementer*- College of Environmental Sciences, Makerere University
Climate change adaptation programs for agriculture research institution	
Territorial Approach to Climate Change in the Mbale Region of Uganda (TACC)	*Donor*-Welsh government *Implementer*- UNDP, Mbale District Local Government and Ministry of Water and Environment
More bananas for Africa-Uganda	*Donor*-DFID *Implementer*- University of Leeds and IITA Uganda

Appendix IV: Examples of research initiatives focussing on climate change in agricultural sector

Research Priorities
Ethiopia
▪ Developing drought and heat tolerant crop cultivars ▪ Application of seasonal climate forecast & downscaling of climate models to be used at national and specific regions of the country ▪ Weather Index based insurance for farmers ▪ Developing improved animal feed variety that can withstand climate variability ▪ Promoting agroforestry, soil and water conservation, sustainable land management practices ▪ Reducing emission from crop residues and promotion of organic fertilizers ▪ Enhancing diversification and intensification. Scaling up production and demand of product from low-emitting animals (poultry, sheep, goat and fishery) to reduce emissions associated with large ruminants including cattle and camels ▪ Rangeland and pastureland management. Introduction and promotion of appropriate techniques to increase soil carbon content and productivity of pastureland in highland areas and rangeland within pastoral areas. ▪ Agricultural through usage of improved inputs and better residue management resulting in a decreased requirement intensification for additional agricultural land that would primarily be taken from forests ▪ Create new agricultural land in degraded areas through small, medium, and large-scale irrigation to reduce the pressure on forests
Kenya
▪ Climate change and water use in Garissa and Trans Mara. This project is yet to be launched and it entails vulnerability assessment of small-scale farmers and pastoralists to climate change. ▪ Food security and climate change ▪ Climate Smart agriculture – 9 small-scale projects of the CCU. The projects' objective is taking 'climate smart agriculture' (agricultural production that reduce greenhouse gas emissions, adapt to climate change, and reduce vulnerability) to farmers ▪ Kenya Agricultural Productivity and Agribusiness Project–research on climate resilient crop varieties and livestock breeds. ▪ Vulnerability and climate change. ▪ Carbon mitigation project – involves assessing the possibility of carbon finance on 15400 acres of land. ▪ Adapt to climate change and Insurance - 3-year pilot project to be implemented in 6 districts in Busia and Nyando counties. The project has 3 core areas: 1) adoption of agricultural practices suitable for climate change adaptation such as growing of drought resistant crops; 2) introduction of agricultural insurance scheme where identification of appropriate insurance products will be done and later discussed with insurance firms; 3) monitoring and evaluation of the impacts of the project on farmers.
Tanzania
▪ New crops/varieties and farming systems suited to hotter/drier conditions ▪ Improved short and long-term weather forecasting and risk management measures to cope with increasing climatic variability. ▪ Carbon sequestration through conservation agriculture and reforestation

Appendix V: Agricultural seed production and providers in East Africa.

Name	Geographic scope	Role
Ethiopia		
Ethiopian Institute of Agricultural Research	National	Development and dissemination of drought and disease resistant seed varieties
Pioneer Hi-Bred Seeds and Monsanto	International	Production of drought resistant seed varieties to the farmers and advisory services
Kenya		
Kenya Seed Company Ltd.	National	Conducts research, promotes and facilitates production of high yielding, better quality certified seeds that are drought resistant.
Syngenta Foundation for Sustainable Agriculture & Seed Trade Association of Kenya		Seed Programme, that aims to professionalize the seeds market in Kenya and facilitate smallholders' access to improved seeds.
MEA Limited		Supplies farm inputs seed and fertilizers for different soil types and agro-ecological zones
Uganda		
National Agricultural Research Organisation	Government	Plant breeding and development of new variety of seeds
Nalweyo Seed Company	National	Production of improved drought resistant seed variety
Mt Elgon Seed Company (Subsidiary of Kenya Seed Company Ltd.)	Regional	Involved in production of improved variety of seeds
East Africa Seed Company (EASCO)	Regional	Development of hybrid seeds mainly drought resistant and escaping maize

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