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Review of Climate Change Adaptation and Mitigation in Agriculture in the United Republic of Tanzania

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Programme

Background report 7



Review of Climate Change Adaptation and Mitigation in Agriculture in the United Republic of Tanzania

MICCA Programme

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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

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For more information: www.fao.org/climatechange/micca

ABBREVIATIONS AND ACRONYMS

ACRP	Agriculture Climate Resilience Plan
AGITF	Agricultural Input Trust Fund
AIDS	Acquired Immuno-Deficiency Syndrome
AFOLU	Agriculture, Forestry and Other Land Use
ARI	Agricultural Research Institute
CAIT	Climate Analysis Indicators Tool
CCIAM	Centre for Climate Change Impacts, Adaptation and Modelling
CDM	Clean Development Mechanism
COP	Conference of Parties
CBFM	Community Based Forest Management
DNA	Designated National Authority
EMA	Environmental Management Act
FAO	Food and Agricultural Organization of United Nations
FOLU	Forest and Other Land Use
FRL	Forest Reference Level
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GHG	Greenhouse gas
GIS	Global Information System
GTZ	German Technological Cooperation
ICRAF	World Agroforestry Centre
IDRC	International Development Research Centre
IPCC	Intergovernmental Panel on Climate Change
JFM	Joint Forest Management
MAFC	Ministry of Agriculture, Food Security and Cooperatives

MRV	Monitoring, Reporting and Verification
MKUKUTA	Swahili version of National Strategy for Growth and Reduction of Poverty, NSGRP II
NAFORMA	National Forest Resource Monitoring and Assessment
NAMA	Nationally Appropriate Mitigation Action
NAP	National Adaptation Plan
NAPA	National Adaptation Programme of Action
NCMC	National Carbon Monitoring Centre
NCCFP	National Climate Change Focal Point
NCCS	National Climate Change Strategy
NCCSC	National Climate Change Steering Committee
NCCTC	National Climate Change Technical Committee
NEP	National Environmental Policy
NFC	Net Forest Conversion
NICFC	Norway's International Climate and Forest Initiative
NIMP	National Irrigation Master Plan
NSGRP	National Strategy for Growth and Reduction of Poverty
PFM	Participatory Forest Management for state owned forests
REDD	Reducing Emissions from Deforestation and Forest Degradation
R&D	Research and Development
REL	Reference Emission Level
SUA	Sokoine University of Agriculture
UNFCCC	United Nations Framework Convention on Climate Change
UNEP	United Nations Environment Programme
URT	United Republic of Tanzania
USD	United States Dollar
VPO DoE	Vice President Office, Division of Environment

EXECUTIVE SUMMARY

This report assesses and identifies policies, strategies and initiatives led by the Tanzanian government to address the impact of climate change in agriculture. Agriculture supports 80 percent of the population and is therefore the main contributor to the country's economy. Hence, any negative impact resulting from climate change would have a significant effect on the country's economy and community livelihoods.

The greenhouse gas emissions in Tanzania are reported to be mainly from land use, land use change and forestry (87 percent), with energy and agriculture ranking second and third (6 percent and 5.68 percent respectively). The expected growth in the agricultural sector may trigger an increase in greenhouse gas emissions which might surpass other sectors. Currently natural forests and woodlands are being rapidly converted into agricultural land. The rate of deforestation reported by the government is currently 400 000 ha/year and the agricultural sector is a key contributor to deforestation and forest degradation.

The policy framework for mainstreaming climate change in agriculture and forestry policies, strategies and programmes is in place. In terms of climate change mitigation, the forest sector is more advanced than the agricultural sector, thanks to REDD+ Readiness and the National Forest Inventory activities. Some lessons and achievements from the forest sector can provide guidance to the other sectors; including the establishment of the National Carbon Monitoring Centre and the road map for establishing the Reference Emission Levels/Forest reference Levels. In the agricultural sector, important steps have been taken in resilience building and climate change adaptation by launching and planning the implementation of the Agriculture Climate Resilience Plan.

Keywords: agriculture, greenhouse gas emissions, climate change mitigation, adaptation to climate change, food security, climate-smart agriculture

INTRODUCTION

Tanzania has been a signatory to the United Nations Framework Convention on Climate Change (UNFCCC) since 1992. It has undertaken various initiatives at local and international level to affirm its commitment to combat the impacts of climate change, including efforts leading to the reduction of greenhouse gases (GHG). In 2003, Tanzania submitted its initial communication on the status of GHG emissions in the country. Understanding such a status is important as it can be used as a basis for targeting reductions. However, regular estimation of emissions has been a challenge. Until now the country has not submitted the latest GHG emission levels due to various reasons, mostly associated with the methodological approach and other constraints.

Tanzania is one of two countries that participated in the implementation of the pilot projects led by Food and Agriculture Organization of the United Nations (FAO) under the MICCA Programme. In Tanzania, the MICCA pilot project (2011–2014) was implemented in collaboration with the World Agroforestry Centre (ICRAF), CARE International Tanzania and FAO. The pilot project site is located in the Morogoro region, on the southern slopes of the Uluguru Mountains.

1. OVERVIEW

1.1 Objectives of the Country Review

Two major components of the MICCA pilot project in Tanzania were an assessment of GHG emissions in smallholder farming systems, and a climate-smart agriculture pilot project at local level. Similar studies are very rare in Tanzania and tend to be conducted in an isolated manner. The efforts to aggregate lessons and information from these studies are vital in compiling country-specific emission levels and recommendations for carbon reduction options.

This review looks at the status of GHG emissions in the agricultural sector. The main objective is to define the proposed climate change adaptation and mitigation options by reviewing the policies and initiatives in the country to see what the enabling environment is for climate-smart agricultural planning in Tanzania.

1.2 Climate Change and Tanzanian Agriculture

Background

Tanzania is located in Eastern Africa between 29⁰–41⁰ E and 1⁰–12⁰ S (URT, 2007). It covers an area of 95 million ha, of which 44 million ha is suitable for agriculture. It has a population of almost 45 million with current GDP of \$74 billion and per capita income of \$599 (Watkiss *et al.*, 2011; URT, 2012). Agriculture is the mainstay of the country's economy contributing to 25 percent of the GDP and employs 80 percent of the workforce. Only 23 percent of the arable land is currently put into use and the majority of the users are the smallholder farmers (85 percent) with an average plot size of 0.2–2 ha (Lyimo, 2011). Shifting cultivation is very predominant in most parts of the country. Policy frameworks on the agricultural sector provide momentum towards addressing good agricultural practices (URT, 2013b).

Low mechanization and the use of a hand hoe in crop farming is the most common farming system carried out by smallholder farmers in Tanzania. A growing trend towards mechanization has however very recently become evident due to significant government efforts. These have included reducing import taxes for agricultural machinery such as tractors. Furthermore, the government of Tanzania through '*Kilimo Kwanza*' (Simply Agriculture First) has made an additional push into mechanization by widespread importation of tractors and other farm equipment. This has made the farming tools readily available and thus triggered more to the current demand and usage. Currently, 64 percent of farmers use the hand hoe, 24 percent draught animal power and 12 percent tractors. Annual demand and implementation for *single axle* tractor has risen to a range of 1 500–1 800 while the *double axle* tractor power is 1 500–2 000 (Lyimo, 2011).

Moreover, the government has established Agricultural Inputs Trust Fund (AGITF) to provide long term and affordable loans for agricultural machinery to individual farmers, farmers groups and private entities.

Rain-fed agriculture is the dominant type across all agro-ecological zones where unimodal and bimodal rains are experienced. The utilization of the irrigation potentials of various

existing water bodies and storm water is still very low. Only five percent of the potential irrigation land has been put into use, mostly from traditional irrigation systems. The potential of major river basins and wetlands has not yet been fully utilized for irrigation. Low investment and inadequate policy support is holding back irrigation in spite of the country’s large resources of water bodies. Despite the launching of the National Irrigation Master Plan (NIMP) in 2002 (URT, 2002), only 450,392 ha were set up by 2013 out of the 29 million ha identified. Fertilizer use is still very low in Tanzania. This is a key feature experienced in the whole of sub-Saharan Africa (Figure 1). Inadequate efforts by farmers to sustain soil fertility and low input of fertilizer have led to poor crop yield. The government of Tanzania has put in place a fertilizer voucher subsidy program to make leverage efforts. It has also established the Tanzania Fertilizer Regulatory Authority (TFRA), which is responsible for regulating and facilitating fertilizer import, distribution and quality monitoring. Among the bottlenecks of low fertilizer use in Tanzania are farmers’ bad experiences in the 60s and 70s which led to the perception that inorganic fertilizer destroys the soil. Extension packages have tried to disprove this perception but it is still widely maintained by farmers in most parts of the country. Overall, this translates into to very low input of chemical fertilizers into the agricultural soils, which in turn reduces the quantity of GHG emissions.

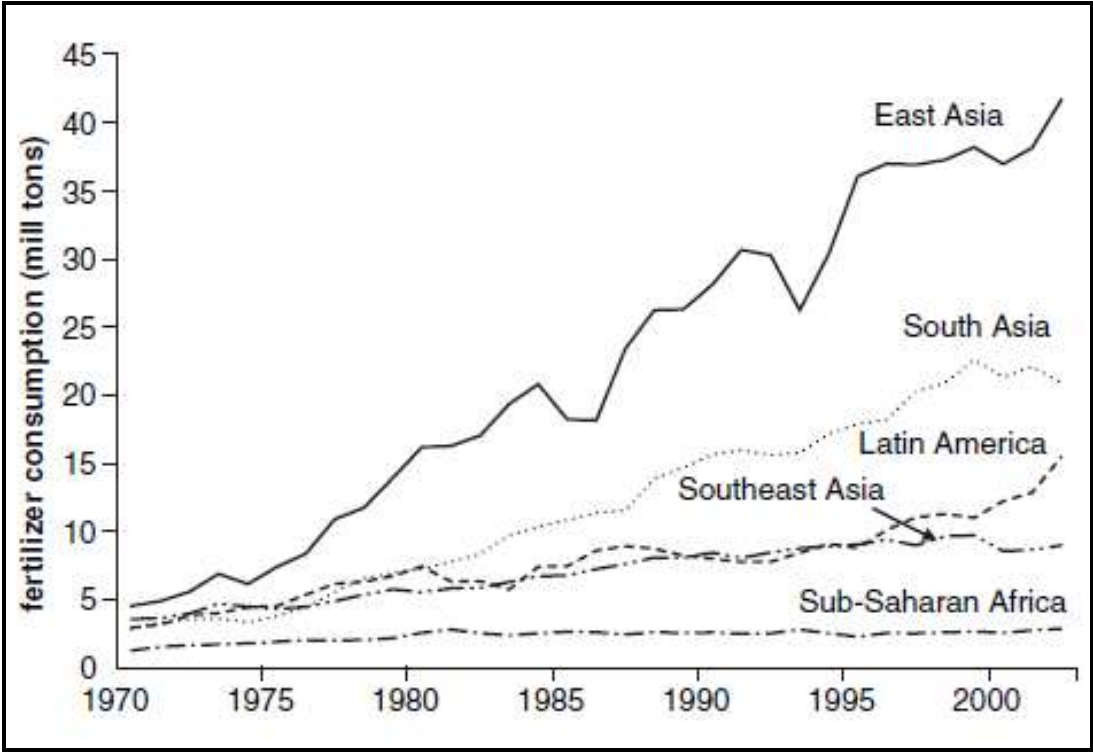


Figure 1: Fertilizer consumption in Tanzania 1970–2004

Source: Morris *et al.* 2011

The use of improved seed is still uncommon in Tanzania. Several varieties of drought and disease tolerant food crops have been made available to improve yield. The Agricultural Research Institutes (ARI) breeding programs within the Ministry of Agriculture, Food Security and Cooperatives (MAFC) and in collaboration with regional and international seed companies and research institutions have witnessed the release of many varieties suitable for Tanzania. In rural areas, a program on producing quality seeds was led by MAFC and its

respective ARIs. However, most farmers still keep and recycle traditional stocks despite their low yield.

Increasing the decentralization and network of protected areas in Tanzania has been carried out as part of the efforts to address over-exploitation of forests (Kajembe *et al.*, 2008; URT, 2009a). While the state increased its grip on protected areas with strict rules and regulation (Mpanda *et al.*, 2011; URT, 2002), it also introduced participatory forest management (PFM) through joint forest management (JFM) for state owned forests and community based forest management (CBFM) for community owned forests (Blomley *et al.*, 2008). By 2008 about 2 328 villages in Tanzania were involved in PFM, out of which 1 457 villages engaged in CBFM (URT, 2008). At one point the country was considered by many as a leader in PFM in Africa. As decentralization and institutionalization of PFM were parallel through policy reforms and ground testing, both positive and negative lessons were learnt. Issues such as improved forest resources (e.g. Mbwambo *et al.* 2012) have been observed, while unclear benefit sharing and the denial of access to resources for adjacent forest communities were reported (Jambiya and Sosovele, 2001). In conclusion, good governance and strong institutional function is the key to proper management regardless of the ownership (Mpanda *et al.*, 2011; Mbwambo *et al.*, 2012).

Forests and woodlands that are under a certain form of protection such as CBFMs and private and state owned forests are in a better condition than those in other all-purpose lands and unprotected areas that have been neglected and heavily exploited. Pressure has been put on forests by settlement and agricultural expansion, overgrazing, firewood and charcoal production, uncontrolled fires, timber extraction, development of infrastructure/industry, mining, refugees and most recently the introduction of large scale cultivation of bio-fuel crops (URT, 2013a).

Climate Change and Agriculture in Tanzania

In Tanzania, deforestation, at its worst has been estimated at reaching 400,000 ha per annum (URT, 2013a). A large part of this land is being converted to other land uses such as agriculture, especially through shifting cultivation. This change of land use and associated disturbances in the forests are responsible for GHG emissions. Land use change and forestry (LUCF) is the major contributor of GHG emissions in Tanzania and accounts for 87 percent of emissions (URT, 2003). Tackling deforestation and land use change is likely to depend on interventions on the drivers, mainly in the agricultural sector. Agriculture is the mainstay of the country's economy contributing to 25 percent of the GDP and employing 80 percent of the workforce. Only 23 percent of arable land is currently put into use and the majority of the users are smallholder farmers (85 percent) with an average plot size of 0.2–2ha. Shifting cultivation is very predominant in most parts of the country. Policy frameworks in the agricultural sector are in place for addressing good agricultural practices (URT, 2013b). Good governance and strong institutional function are essential in proper land management regardless of the ownership (Mpanda *et al.*, 2011; Mbwambo *et al.*, 2012). Tanzania has over 14 000 villages; however, only 1 200 of them have land use plans. This highlights why land management and sustainability have been a problem. Villages with operational land use plans have proved to be a solution in the adoption of climate-smart agricultural practices by controlling their land use and minimizing the abuse of local ecosystem services.

In general, agricultural production in Tanzania is less mechanized and a large part is controlled by smallholder farmers. Under the smallholder setting, agriculture is still at subsistence level characterized by very low inputs and thus very low productivity. In order to improve agricultural productivity the government of Tanzania set out a sector strategy stating that by the year 2025, agriculture should be modernized, commercialized, highly productive and profitable and should utilize natural resources sustainably. Such a strategy has the potential to have the following impact on GHG emissions:

- Increased input of fertilizers and energy resulting in higher emissions as production per ha increases.
- Increased export market, as non-domestic markets are sought, potentially resulting in higher emissions from the transport and processing sector emissions.
- The reduction of cultivated land expansion, as agriculture modernizes, potential movement to larger scale farms with an increase in productivity per ha, thus reducing GHG emissions.

A low carbon agricultural development pathway advocated by the policy framework to contribute to adaptation and mitigation of climate change is yet to be realized at grassroots level (Watkiss *et al.*, 2011). This would aim to both improve agricultural productivity as well as reduce GHG emissions. Furthermore, attempts to estimate GHG emissions in Tanzania need to take into account the difficulties in place to obtain accurate information due to uncertainties and scattered individual estimates. This is essential following the commitments Tanzania has made to the international community regarding the environment and climate change related agreements (Table 1).

Table 1: Climate change and other international agreements ratified by Tanzania

S/n	International Agreements	Rectification (year)
1	The Basel Convention on the Control of Transboundary Movements of Hazardous Waste and Their Disposal	1989
2	Convention on Biological Diversity	1992
3	The United Nations Framework Convention on Climate Change (UNFCCC)	1992
4	United Nations Convention to Combat Desertification (UNCCD)	1994
5	The Kyoto Protocol	1997
6	Stockholm Convention on Persistent Organic Pollutants	2001
7	The Cartagena Protocol on Biosafety to the Convention on Biological Diversity	2000

chen of e imate-smart agriculture assessed. d Mitigation: The United Republic of TanzaniaSource: *Agricultural Sector Five-Year Environmental Action Plan (SEAP) 2012–2017*

2. POLICY ENVIRONMENT FOR CLIMATE CHANGE AND AGRICULTURE

The Tanzania government has put in place several policies, strategies and plans that are directly addressing issues pertaining to climate change and their impacts on various sectors. These sectors, which are highly affected by climate change, have put in place policy statements and directives that seek to provide the solutions to the impacts of climate change. These policies, strategies and plans further provide policy directives, guidelines and steps towards addressing adaptation and mitigation priorities by the various sectors that are affected by climate change.

2.1 Tanzania Development Vision 2025

Tanzania has put forward its Development Vision 2025 to foster its development agenda. Five key thrusts have been identified for emphasis in the Vision 2025, including;

- High quality livelihoods
- Peace, stability and unity
- Good governance
- A well-educated and learned society
- A competitive economy capable of producing sustainable growth and shared benefits

This vision is at the centre of the economic and social development of the country and provides the country's long term strategic focus. All other government policies and programs are expected to fall in line with this vision. For instance, climate change impacts, which cut across all the five thrusts are supposed to be addressed by each sector.

2.2 National Environmental Policy of 1997

National Environmental Policy (NEP) is the umbrella policy where general directives in natural resource management are built. Climate change, as one of the cross cutting issues in natural resources management, is thus embedded in this umbrella policy. Therefore, only one Climate Change Strategy exists in the country to enforce and operationalize climate-related issues of concern as directed by this NEP and its 2004 Environmental Management Act (EMA). Other line sectors, which are directly or indirectly interacting with NEP and EMA, have their own policies, acts, guidelines and strategies.

A particular emphasis of the NEP is the commitment of the government of Tanzania to address issues that are man-made and that go beyond country boundaries. All these conventions address issues caused by an increase in the emission of GHGs. It further highlights the need to undertake studies on the climate for potential adoption and mitigation interventions.

As further explained in section 3.2 on NAPAs, the NEP 1997 conducted a vulnerability study on the impacts of climate change and variability, and hence these suggested intervention options should not jeopardize national development endeavours.

2.3 National Strategy for Growth and Reduction of Poverty (NSGRP II)

MKUKUTA II (Swahili version of National Strategy for Growth and Reduction of Poverty, NSGRP II) was launched in July 2010 by the Ministry of Finance and Economic Affairs, as a guiding tool towards growth and enhancement of productivity in the country. This second phase is building on MKUKUTA I (2005) which was praised for its high achievement, though it lacked any mention of climate change. MKUKUTA II has addressed this error due to the fact that climate change has an enormous impact on people's livelihoods and therefore cannot be ignored. For instance, the country's droughts in 2005/06 affected millions of Tanzanians and had an estimated cost of at least one percent of GDP.

MKUKUTA II has three clusters, among which the first cluster is on '*Growth for Reduction of Income poverty*' which is the one concerned with climate change. This cluster has three broader outcomes and five goals. The fourth goal is "*ensuring food and nutrition security, environmental sustainability and climate change adaptation and mitigation*". The five operational targets/goals are in place:

- Pursuing sound macroeconomic management;
- Reducing income poverty through promoting inclusive, sustainable and employment-enhancing growth;
- Ensuring creation and sustainability of productive and decent employment, especially for women, youth and people with disabilities;
- Ensuring food and nutrition security, environmental sustainability and climate change adaptation and mitigation; and
- Leveraging returns on national resources to enhance growth and benefits for the country and communities, especially in rural areas.

Several cluster strategies to operationalize goal number IV have been put in place, including:

- Supporting research in introducing and promoting adoption of crops, livestock & fish varieties and breeds suited to adverse conditions brought about by climate change;
- Applying technologies in pest & disease management (IPM, breeding, biotechnology);
- Increasing farmers, livestock farmers, fishers and aqua farmers' awareness on the full impacts of climate change on agriculture;
- Designing sustainable crop production and farming systems reflective of climate change scenarios such as breeding pest resistant crops and livestock;
- Increasing carbon sequestration on farms through reduced tillage, high carbon crops and agroforestry;
- Improving soil and water conservation measures including irrigation development.
- Providing specific adaptation and mitigation options according to regional conditions.
- Strengthening weather projection and early warning systems;
- Facilitating development of market-based financing mechanisms for climate change mitigation and adaptation and leveraging private sector resources;
- Supporting accelerated development and deployment of new technologies that ensure adaptation and mitigation actions; and
- Enhancing policy research, knowledge and capacity building in areas of climate change and its impacts.

Therefore, MKUKUTA II laid a foundation to which climate change issues are articulated in the government policies and strategies that aims to improve livelihoods and increase incomes.

2.4 Agricultural Environmental Action Plan (2011–2017)

Agricultural Environmental Action Plan (AEAP) was prepared by MAFC as a way of mainstreaming the environmental protection in their development planning and project implementation. This reinforces the Environmental Management Act (2004) and it was further prepared as a requirement by the General Budget Support Performance Framework in 2010. Management of natural resources in the agricultural sector have been the main emphasis for action. Key issues identified for intervention related to mitigation include:

- land degradation due to deforestation and livestock overgrazing; and
- lack of agricultural land use management plans.

The AEAP was structured to address impacts of climate change through joint efforts with other sectors including the livestock and forestry sector.

2.5 Revised National Forest Policy (2012 draft)

The draft version of the revised Forest Policy reiterates how forests will be affected as climate is projected to change towards drier regimes. Key policy areas relevant to climate change include Forest Land Management and Ecosystem Conservation and Management. Several policy statements related to climate change and REDD+ have been established. These policy statements are instrumental in putting forward the roadmap for engagement in activities beyond forests to address both mitigation and adaptation measures.

Policy statement 32 states that research into forestry and development will be strengthened as a basis for the sustainable development and management of the forest sector. The preceding policy directive emphasises that high priority will be given to understanding the effects of climate change on forests and the environment and the measures needed to adapt to and mitigate climate change. This provides the legal basis on which in-depth research on climate change issues can be strengthened and can thus support other initiatives in place. This extends to forest users and their economic activities such as agriculture which is by far the greatest pressure through forest encroachment.

Interventions advocated by the *draft* forest policy deal with mitigation and adaptation. Activities such as reforestation, afforestation and enrichment planting to fill vegetation gaps directly contribute to mitigation. Activities relating to the use of efficient cooking stoves, efficient charcoal kilns and agroforestry in adjacent local communities are adaptation strategies that also reduce the GHG emission.

2.6 National Climate Change Strategy 2012

Launched in 2012, the National Climate Change Strategy (NCCS) in Tanzania covers a broader natural resource base in addressing issues pertaining to climate change. It covers interventions in adaptation, mitigation and cross-cutting issues that are affecting the social, economic and physical environment. The main goal of the strategy is to enable Tanzania to efficiently adapt to climate change and participate in global efforts towards mitigation in order to achieve sustainable development. This goal is in-line with Tanzania Development Vision 2025 and other sectoral policies. The implementation arrangement for this NCCS will be based on the National Environmental ACT 2004. The National Climate Change Focal Point (NCCFP) is the overall coordinator of the implementation of the NCCS and is responsible for preparing climate change frameworks such as National Adaptation Plans (NAPs), NAMAs (Nationally Appropriate Mitigation Actions) and Monitoring and Evaluation.

The National Climate Change Steering Committee (NCCSC) and the National Climate Change Technical Committee (NCCTC) are cross-sectoral committees responsible for facilitating the implementation of the NCCS interventions in various sectors. The NCCSC is responsible for policy guidelines and ensuring the participation of various sectors. The NCCTC is responsible for providing technical advice to the NCCFP. The sectoral ministries and Local Government Authorities are responsible for reporting annually to the NCCFP, on the implementation of the NCCS so they can make this information available for public consumption.

At implementation level the NCCS has a special emphasis on the agricultural sector, its strategic goal being *'to enhance the resilience of the agricultural sector to climate change for sustainable livelihoods'*. Achieving this goal means following strategic objectives and interventions (Table 2) that are key in Tanzania's agricultural sector.

Table 2: Adaptation strategy for the agricultural sector, Tanzania

Strategic statement	Strategic objectives	Strategic interventions
<p>More than 80% of population of Tanzania depend on climate sensitive rain fed agriculture as a source of livelihood. Reducing vulnerability of the sector to climate change will significantly contribute to socio-economic development and ensure food security</p>	<ol style="list-style-type: none"> 1) To identify suitable crops for new agro-ecological zones 2) To promote appropriate agricultural practices that increase resilience to climate change 3) To promote use of appropriate technologies for production, processing, storage and distribution 	<ol style="list-style-type: none"> I. Assess crop vulnerability and suitability for different agro-ecological zone; II. Promote early maturing and drought tolerant crops; III. Strengthen weather forecast information sharing with farmers; IV. Strengthen post-harvest processes and promote value addition; V. Address soil and land degradation by promoting improved soil and land management practices/techniques; and VI. Strengthen integrated pest management techniques.

Source: National Climate Change Strategy (2012).

The National Climate Change Strategy has been the main strategy document driving the implementation of the climate change and variability agenda as well as being responsible for guiding other sectoral strategies in this thematic area.

2.7 National Agricultural Policy of 2013

Development of the agricultural sector in Tanzania is founded on a base of natural resource management. The policy admits that there are a number of unsustainable farming methods and systems in the country that include deforestation, land clearing and bush fires, which also contribute to GHG emissions. The sustainable development of agriculture is a priority for the government of Tanzania and it should be based on safeguarding the environment. Agricultural intensification led by the government should entail a low carbon pathway in order to contribute to the mitigation of climate change. The following policy statements have been put forward by the government to address environmental and climate change issues pertaining to the agricultural sector:

- In collaboration with relevant ministries, coordination of sustainable environmental early warning and monitoring systems will be strengthened;
- The Government in collaboration with other stakeholders will strive to improve measures to adapt to the effects of climate change and deal with the risks involved;
- Public awareness on sustainable environmental conservation and environmentally

friendly crop husbandry practices (sustainable agriculture) will be promoted;

- The Government will enforce environmental laws and regulations that minimize environmental degradation resulting from agricultural activities;
- Activities that enhance the carbon storage capacity such as conservation agriculture and agroforestry will be up-scaled;
- Public awareness of agriculture as a potential carbon sink and mechanism to benefit from the carbon market will be established according to international protocols; and
- Efficient use of renewable natural resources will be strengthened.

2.8 The National REDD+ Strategy 2013

The REDD+ institutionalization process in Tanzania could support the mainstreaming of sustainable agricultural practices. It seems to follow the same trend as PFM (Participatory Forest Management) but with a stronger incentive package attached and formalized (URT, 2013a).

Tanzania established a REDD+ Strategy in 2013 after a long process of consultations on how to address climate change mitigation in the forest sector. As part of the global efforts to reduce GHG emissions, the REDD+ package is a standalone effort focusing on the forestry sector. Institutionalization of the REDD+ initiative is based on the long term commitment of the Tanzanian government to forest management and to addressing issues of climate change. The REDD+ Strategy gives an additional thrust to forest policy on the management of forest resources in the country especially those on private, community and general land that previously received little attention from the government.

The REDD+ strategy identified eight key factors responsible for deforestation and forest degradation that need to be dealt with. These include:

- I. Charcoal and firewood demand for domestic and industrial use
- II. Illegal and unsustainable harvesting of forest products
- III. Forest fires
- IV. Agricultural expansion
- V. Overgrazing and nomadic pastoral practices
- VI. Infrastructure development
- VII. Settlement and resettlement
- VIII. Introduction of alien and invasive species

In making the REDD+ initiative ready for the implementation phase, two key instruments have been put in place with the assistance of a clear strategy:

- Establishment of the National Carbon Monitoring Centre (NCMC); and
- Establishment of the MRV system.

Furthermore, the REDD+ Strategy formulated an institutional arrangement for coordination of REDD+ activities that is entrenched in the existing government structure established by NEP (1997) and EMA (2004) on the coordination of climate change programs.

2.9 Agriculture Climate Resilience Plan (2014-2019)

A new plan, the Agriculture Climate Resilience Plan (ACRP) was recently developed by the Tanzanian MAFC and signed in November 2014 covering the period 2014–2019. It seeks to:

- Respond to the most urgent impacts posed by climate change variability in the crop sub-sector;
- Mainstream climate change in agriculture policies, strategies, initiatives and plans; and
- Build the resilience of current crop productivity and future investment.

The main objective of the Plan is to provide Tanzania’s agricultural sector and stakeholders with a roadmap for:

- implementing a participatory, risk-based approach to climate actions;
- developing time-bound, prioritized and targeted actions;
- identifying entry-points to mainstream climate change adaptation and mitigation;
- strengthening the institutional framework for addressing climate change issues; and
- leveraging additional financial resources from government, bilateral and international sources.

3. ADAPTATION AND MITIGATION TO CLIMATE CHANGE IN AGRICULTURE

3.1 Agricultural greenhouse gas emission estimates

In Tanzania, deforestation and land use change contribute significantly to the GHG emissions, while the main agricultural GHG emissions are from enteric fermentation, rice cultivation and manure management.

Early attempts by Tanzania to undertake measurements of GHG emissions date back to the 1990s, when two studies were carried out:

- In 1993–1994, an inventory of GHG emissions, where the main GHGs studied were carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O), was funded through the Global Environmental Facility (GEF) by the United Nations Environmental Program (UNEP) and the Canadian IDRC (International Development Research Centre).
- In 1994–1995, technological and other options for GHG mitigation, mitigation cost analysis and other parameters were studied, funded by the German Technical Cooperation (GIZ).

Estimates were established for both direct GHGs such as CO₂, CH₄ and N₂O and indirect GHGs such as nitrogen oxides (NO_x) and carbon monoxide (CO). The studies mentioned above were very important precursors to the official Tanzania GHG emissions reported to the UNFCCC in 2003 (URT, 2003).

According to the initial communication (URT, 2003), with data from 1990, higher GHG emissions per capita are from Land use Change and Forestry (87 percent). Of particular importance is agriculture which was ranked third in its contribution to GHG emissions in Tanzania by 5.7 percent on a sectoral basis as shown in Figure 2.

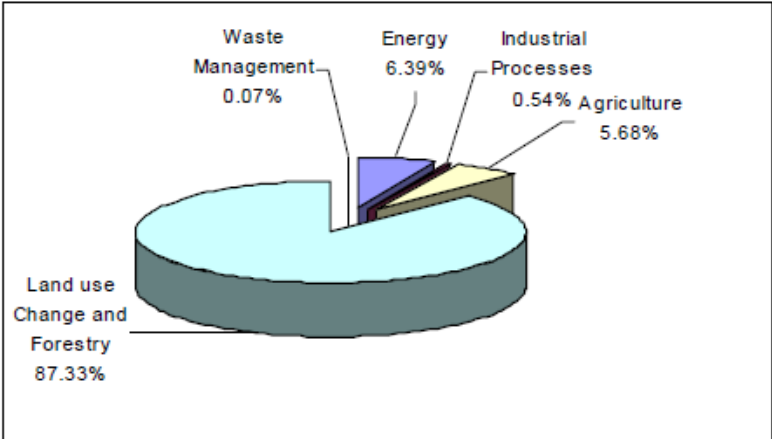
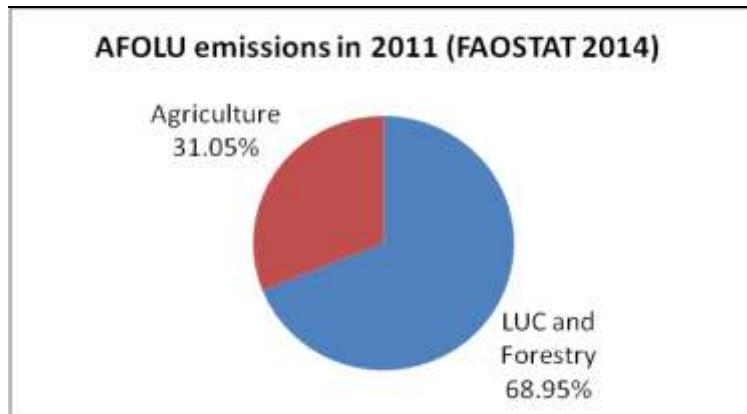


Figure 2: Tanzanian GHG emissions by sector in 1990.

More recent estimates from FAOSTAT can be seen in Figure 3 below; Land use change and Forestry still have a higher percentage of emissions compared to Agriculture. However, it has decreased over the last decade due to efforts made in forest conservation and landscape management.

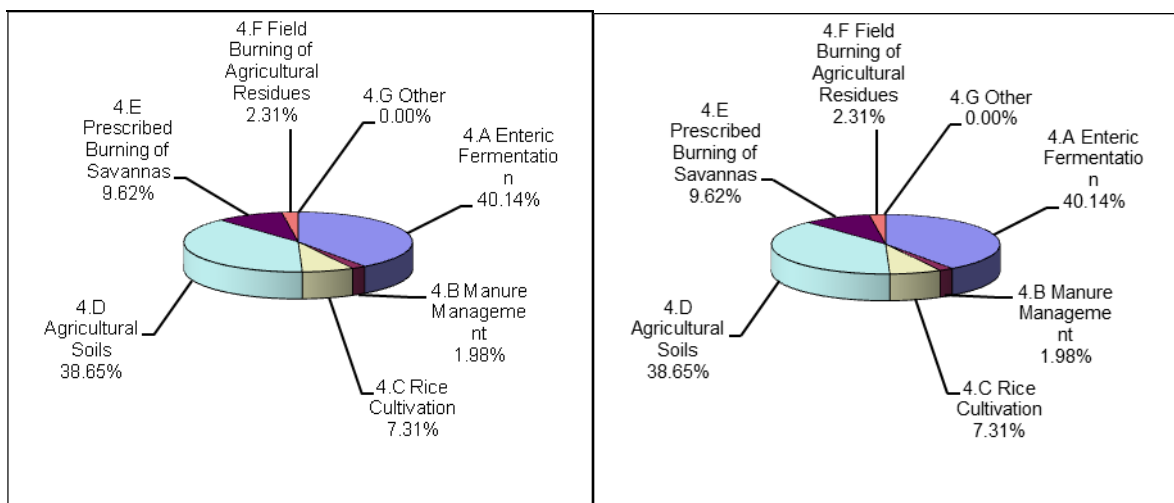


Source: FAOSTAT (2014)

Figure 3: Tanzanian GHG emissions from the AFOLU sector in 2011.

In the previous graph, Land Use Change and Forestry (or FOLU) is made up of burning biomass, cropland, grassland and Net Forest Conversion (NFC). NFC represents the majority (86 percent) of all FOLU.

Regarding the agricultural sector, most GHG emissions are from agricultural soil emissions as shown in Figure 4 for 1990 and 1994 (42.1 and 38.7 percent, respectively). Agricultural soils take into account the application of synthetic fertilizers, manure applied to soils, manure left on pasture, crop residues and the cultivation of organic soils. Another important source is enteric fermentation from livestock (38.5 and 40.14 percent respectively). The rest of the agricultural sources contributed less than 32 percent. Since 2003, Tanzania has not updated its GHG emissions data due to reasons associated with unreliable data collection and compilation. Comprehensive country specific data is expected to be developed during the second UNFCCC communication.

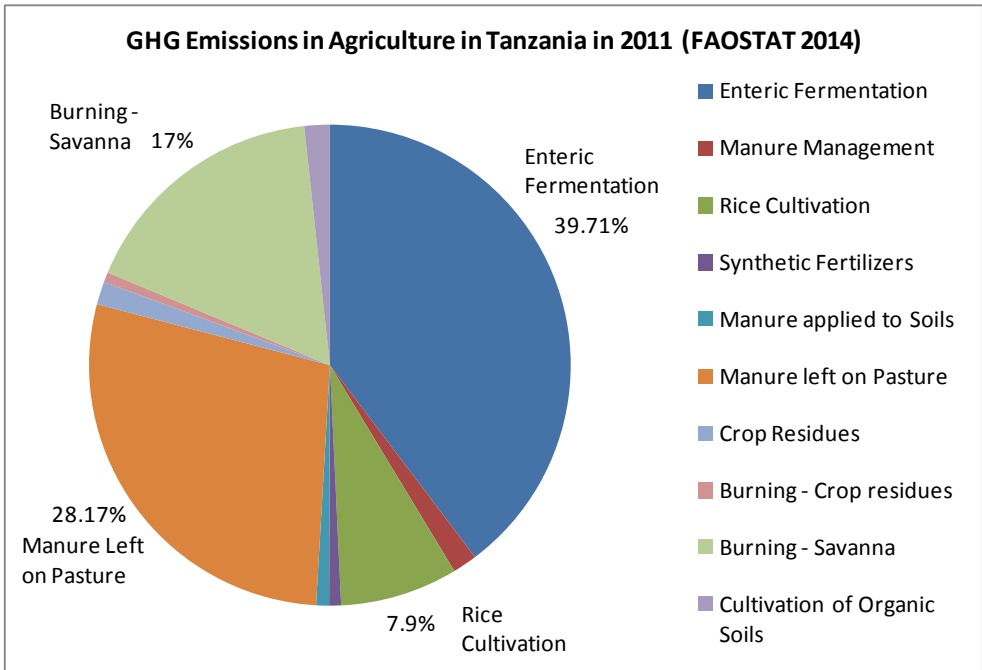


Source: URT (2003). Initial national communication under the UNFCCC.

Figure 4: GHG emissions within the agricultural sector in 1990 and 1994 respectively.

However, previous percentages align with other more recent statistics from FAOSTAT which show that agricultural soils represented 33 percent of agricultural emissions in 2011, just slightly less than enteric fermentation alone (39.7 percent in Figure 5). The main contributor to agricultural soil emissions is the manure left on pasture (28.2 percent from total agriculture) (FAOSTAT 2014).

These data suggest that interventions to lower GHG emission levels in the AFOLU sector need to focus on soils and livestock in order to provide significant reduction and address the drivers of deforestation. Such interventions include: soil and livestock management and reduction of deforestation.



Source: FAOSTAT (2014)

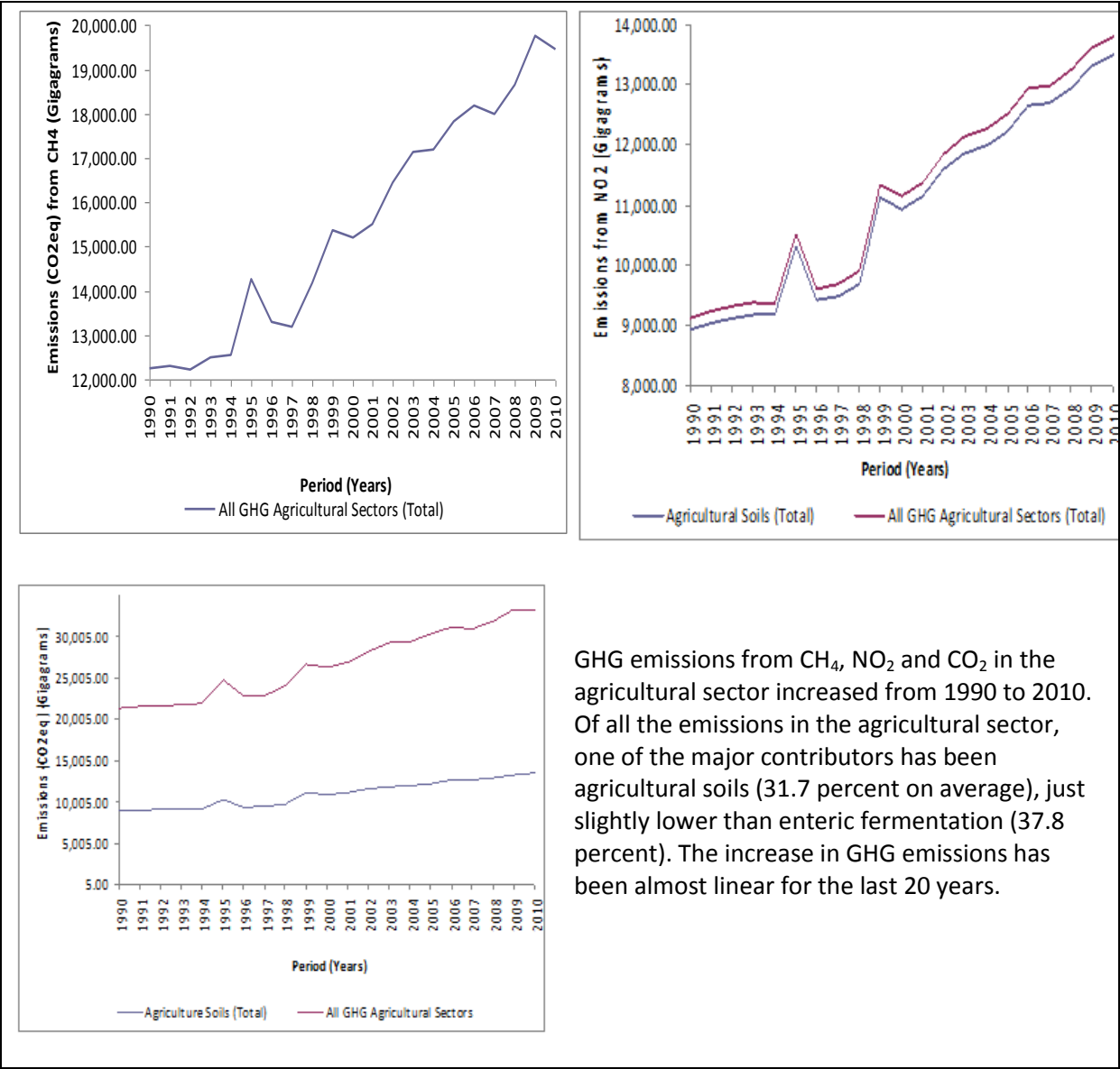
Figure 5: Tanzanian GHG emissions in agriculture in 2011.

Proposed mitigation options in agriculture as per initial communication (URT, 2003) included:

- Reduction of methane (CH₄) from crop production. It focused on water management and irrigation, use of improved cultivars and other cultural practices and improved nutrient management; and
- Reduction of methane from animal production. It focused on improved pasture management, animal nutrition, improved breeding, which resulted in the destocking of local breeds which are numerous but unproductive.

However, in agriculture, most of these mitigation options need to be implemented along with improved technology and higher efficiency in production systems.

Tanzania has experienced an annual increase in emissions since the 1990s, as projected by FAO and shown in Figure 4. Projections from arable land are very difficult to estimate even using the Tier 1 methodology of the Intergovernmental Panel on Climate Change (IPCC) due to the number of inputs and the level of uncertainty. The population growth rate has been used as a basis for estimation with very limited inputs related to land use change and fertilizer applications (Watkiss *et al.*, 2011).



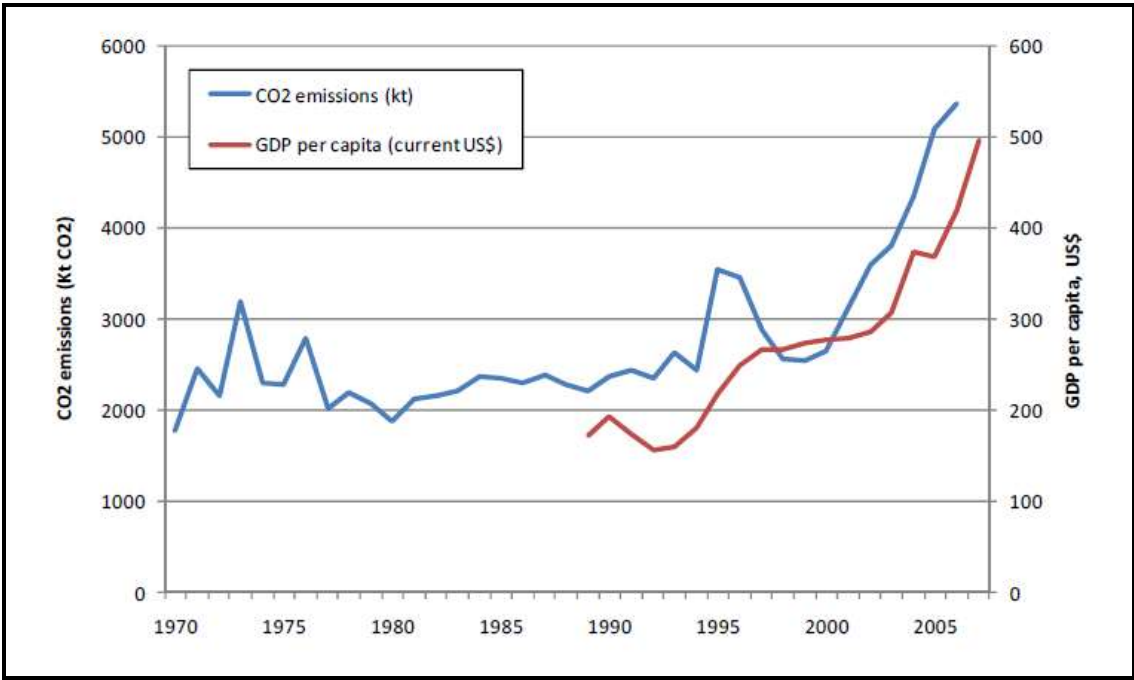
GHG emissions from CH₄, NO₂ and CO₂ in the agricultural sector increased from 1990 to 2010. Of all the emissions in the agricultural sector, one of the major contributors has been agricultural soils (31.7 percent on average), just slightly lower than enteric fermentation (37.8 percent). The increase in GHG emissions has been almost linear for the last 20 years.

Source: FAO (2013). FAOSTAT Emissions Database (<http://faostat.fao.org>)

Figure 6: Estimates of GHG emission from Agriculture from 1990–2010 in Tanzania.

Expected growth in the agricultural sector may trigger an acceleration of GHG emissions not only from the sector itself but also from other sectors such as energy, forestry and transportation. Conversion of natural forests and woodlands into agricultural fields is causing deforestation and GHG emissions. This situation is ongoing in Tanzania due to the expansion of agricultural frontiers and slash and burn practices. The deforestation rate in Tanzania stands at 400 000 ha/year and agriculture contributes significantly to this (URT, 2013). The energy demands of rural communities, which depend on biomass energy, are expected to rise at the same rate as agriculture. Currently, 90 percent of the rural population

depends on fuelwood and the majority of it comes from the surrounding forests. Furthermore, emissions linked to agriculture in terms of infrastructure development, transportation of inputs and agricultural products will increase. A recent study by the World Bank has shown how the increase in GDP corresponds to the overall increase in GHG emissions (Figure 7).



Source: Watkiss *et al.* 2011

Figure 7: Historical trends of GDP and CO₂ emissions per capita in Tanzania.

The study showed that any increase in GDP has a corresponding effect on CO₂ emissions. This is explained by associated factors such as population increase, energy demand and food production. A low-carbon development pathway is thus very important for Tanzania as it will ensure GHG emissions do not increase GDP.

3.2 National Adaptation Programme of Action (NAPA)

Tanzania developed the National Adaptation Programme of Action (NAPA) and endorsed it in 2007 in adherence to the guidelines of UNFCCC, as agreed by the conference of parties (COP) in 2001 and as a tool towards sustainable development, as envisioned by the country’s National Development Vision 2025.

Agriculture is the backbone of the economy, providing raw material for direct consumption and industrial use. Assessment of the vulnerability of various sectors to the impact of climate change and their adaptation strategies (existing and potentials) revealed that the agricultural sector (Table 2) is the most vulnerable. Therefore, in the NAPA, agriculture and food security have been ranked as first priority for adaptation. This is due to the fact that agriculture affects the majority of the country’s population in terms of livelihoods and food security.

Table 3: Vulnerability and adaptation strategies in Agricultural sector in Tanzania

Vulnerability	Existing Adaptation Activities	Potential Adaptation Activities
<ul style="list-style-type: none"> • Unpredictable rainfall, uncertainty in cropping patterns • Shifting of agro-ecological zones • Prolonged dry spells beyond normal patterns • Increased competition between weeds and crops for moisture, nutrients and light • Ecological changes for pests and diseases • Decline of maize yields, the national food crop nationwide by 33% due to temperature rise; the highest decline reported in Dodoma and Tabora 	<ul style="list-style-type: none"> • Small scale irrigation • Development of drought tolerant seed varieties • Agriculture extension activities • Diversification of agriculture: growing different types of crops on different land units • Water harvesting 	<ul style="list-style-type: none"> • Alternative farming systems • Promotion of indigenous knowledge • Change planting dates in some agro-ecological zones • Increase irrigation to boost maize production in selected areas • Drip irrigation for specific regions • Reduce reliance on maize as staple food by growing short-season and drought tolerant crops such as sorghum and millet • Shift crop farming to more appropriate agro-ecological zones • Change crop rotation practices • Integrated crop and pest management • Make better use of climate and weather data, weather forecasts and other management tools • Create awareness on the negative effects of climate change • Sustainable water management to boost food crop production • Strengthen early warning system

Source: National Adaptation Programmes of Action (2007)

Several activities have been proposed through National Adaptation Programmes of Action on agriculture and food security (Table 4) and further ranked in order of importance. The activities cover a wide range of interventions that could address adaptation to the impacts of climate change in agriculture.

Table 4: Ranking of activities in order of importance

Sector	Activities	Ranks
Agriculture and food security (including livestock)	Increase irrigation to boost maize production in all areas	1
	Alternative farming systems	2
	Make better use of climate and weather data, weather forecasts and other management tools and expand the climate and weather data collection network	3
	Create awareness on the negative effects of climate change	4
	Increase the use of manure and fertilizers	5
	Range management for livestock production	6
	Change land use patterns	7
	Dip irrigation for specific regions	8
	Control pests, weeds and diseases	9
	Biological control of tsetse fly	10
	Promote indigenous knowledge	11

Source: National Adaptation Programmes of Action, 2007

Further prioritization with stakeholders identified five projects, one of which is directly linked to agriculture in semi-arid areas of Tanzania. Therefore, NAPA proposed an 8.5 million USD project titled '*Improving Food Security in drought-prone areas by promoting drought-tolerant crops*'. This proposed project was meant to be implemented in Shinyanga, Dodoma and Singida regions, which were top in the list of drought stricken areas of Tanzania. Of particular interest was the direct link between climate change and its effect on the change in the agro-ecological zones in the selected areas, thus affecting the crop calendar and performance.

3.3 Nationally Appropriate Mitigation Actions (NAMAs)

NAMAs involve a set of voluntary actions to facilitate the transition to low-carbon development. This includes policies, projects and programmes that are undertaken at different scales can be used broadly and can be done both unilaterally and with some external support.

In the National Climate Change Strategy of Tanzania, the proposed mitigation actions cover eight sectors which include energy, industry, transport, mining, waste management, forestry and agriculture. Each sector is envisioned to develop its own NAMA together with other interventions. In agriculture, the proposed mitigation actions can be found in Table 5.

Table 5: Proposed mitigation actions in agriculture for Tanzania

Strategic statement	Strategic objective	Strategic intervention
Climate change and its associated impacts on agriculture is a major concern in Tanzania. Agricultural sector can contribute to mitigation as a consequence of improving productivity and sustainability	To enhance efficiency and productivity in the agricultural sector	<ul style="list-style-type: none"> • Promoting agro-forestry systems • Enhancing management of agricultural waste • Promoting efficient fertilizer utilization • Promoting good agronomic practices and technologies

Source: National Climate Change Strategy 2012

In line with the NAMA definition ('set of policies and actions undertaken by developing country Parties in the context of sustainable development, supported and enabled by technology, financing and capacity-building, aimed at achieving a deviation in emissions relative to 'business as usual' emissions'), the country has already engaged in low-emission development pathways through the enabling policies and strategies that have been put in place.

In relation to mitigation, Tanzania is implementing an initiative entitled '*Low emission capacity building program*' aimed at strengthening the national capacity through the following:

- Mainstreamed Environment and Climate Change adaptation in National development planning processes as part of the Second National Strategy for Growth and Reduction of Poverty (MKUKUTA-II) implementation with a focus on agriculture, forestry and livestock sectors.
- Reviewed NAPA as part of the development process of the National Climate Change Response Strategy and NAMA.
- Strengthened Institutional Framework for Climate Change Governance.
- Developed a National Climate Change Financing Mechanism for maximizing Tanzania's potential to access international climate funding.
- Improved level of information availability and awareness on climate change impacts and adaptation strategies, environmental laws and regulation among the general public and rural communities.

3.4 Synergies between NAPA and NAMA

Tanzania has engaged in various adaptation and mitigation projects, programmes and initiatives and has developed policies, programmes and strategies to demonstrate its commitment to contributing to global efforts to combat climate change. Ratification of the UNFCCC and Kyoto protocol enabled enactment of local policies and Acts that reinforced agreements at local level.

The development of the NAPA ensured an adaptation agenda with clear implementation strategies at local and sectoral levels. This provided the benchmark for stakeholders to contribute to their respective areas of operation and expertise in order to build the resilience of both people and ecosystems against the impacts of climate change. On the other hand, mitigation has been implemented through the Clean Development Mechanism (CDM) and REDD+ initiatives. At local level, other initiatives such as Participatory Forest Management and various forms of forest management including farm forestry have been undertaken resulting in net carbon sinks.

At operational level especially in the agricultural sector, there is synergy between adaptation and mitigation actions. Smallholder farmers, who form 80 percent of Tanzania's population, are benefiting more when the synergy is maximized. For instance, a tillage technology for soil and water conservation aimed at adapting to drought can be maximized if water retention and percolation is enhanced through the incorporation of shrubs.

Compatibility between the NAPA and NAMAs in Tanzania especially in agriculture is feasible. As agriculture remains the backbone of the economy, most development pathways that utilize agricultural produce can be streamlined to take a low carbon approach. In the current setting, most of these actions are independently implemented, but with the National Climate Change Strategy coming into force there is more possibility of utilizing the synergy between adaptation and mitigation.

At implementation level, in the majority of large scale programs on sustainable land management in Tanzania, most of the activities benefit from the synergies between adaptation and mitigation especially in areas where climate change impacts are felt e.g. Kilimanjaro, Tabora, along the shores of Lake Tanganyika etc. However, problems can occur in the planning phase where the link is not well acknowledged. If this shortcoming is addressed, a higher impact could be felt by the immediate beneficiaries.

4 REDD+ AS A MECHANISM FOR REDUCING GREENHOUSE GAS EMISSIONS IN AFOLU

4.1 REDD+

In Tanzania, the REDD+ Readiness phase is the most important large-scale mitigation program that has received substantial support. Two significant initiatives funded by the Royal Norwegian government, are described below:

- I. UN-REDD Program–Tanzania Quick Start Initiative (a 24 month project, October 2009 to September 2011). It is part of the Norwegian program on '*Climate and Forest Initiative*', with financial support of 4.2 million US \$. It had four outcomes:
 - *Outcome 1*: National governance framework and institution capacities strengthened for REDD.
 - *Outcome 2*: Increased capacities to capture REDD elements within National Monitoring, Assessment, Reporting and Verification Systems.
 - *Outcome 3*: Improved capacities to manage REDD and provide other forest ecosystem services at district and local level.
 - *Outcome 4*: Broad based stakeholder support for REDD in Tanzania.
- II. The Royal Norwegian Government's '*Climate and Forest Initiative*' supported the REDD+ program with a financial package of 100 million US\$: institutional arrangements, pilot projects on REDD+ and the capacity building program entitled '*Climate Change Impacts, Adaptation and Mitigation program*' (CCIAM 2009–2014) led by the Sokoine University of Agriculture in Tanzania .

The REDD+ readiness phase laid the foundation to most of the ground work for accounting GHG emissions. Lessons from REDD+ pilot projects in Tanzania have indicated that most of the interventions need to be done on agricultural land. It is the inability of agricultural land to sustain livelihoods that leads to encroachment on forests.

As REDD+ invests in addressing forest disturbance, it is anticipated that pressure will return to agricultural lands when people relocate and may inflict more damage. Therefore, addressing GHG emission reduction in all land use sectors has been advocated, embracing a whole landscape approach (van Noordwijk *et al.*, 2009), in which all GHG emissions are considered in the geographical area.

Thus, reducing emissions from all land uses is important due to the following:

- It is effective in bringing major 'leakage' concerns into the accounting rules and accounting for 'leakages' and increased land use intensity outside forests as a contributor to net emission reductions.
- It is efficient in providing many cost-effective options for emission reductions, including tropical peatlands and smallholder agroforestry.
- It is equitable, by applying the same accounting rules for Annex-I and non-Annex-I countries, including low-forest-cover countries on a proportionate basis and rewarding the rural poor.

REDD+ is undertaken as an incentive-based mechanism for mitigation. Two approaches are already under negotiation, both fund and market based. It is envisioned that if the same approach is extended to the agricultural sector, then almost 80 percent of the population of Tanzania will be engaged in GHG emission reduction activities.

4.2 Participatory Forest Management

Tanzania is among the leading countries in Africa embracing Participatory Forest Management (PFM). By 2008, the country had 4.1 million ha of forests engaged in PFM comprising participation from 2 328 villages (URT, 2008). PFM in Tanzania has reduced GHG emissions by combating deforestation and forest degradation. There has been a reported decrease in forest destruction as well as an increase in forest cover and forest resources during the period when the interventions were applied (Mbwambo *et al.*, 2012; Mpanda *et al.*, 2011).

Interventions in PFM have been such that the sustainable use of the forests was advocated with a clear focus on ensuring increased carbon stocks and lowering the unsustainable use of forest ecosystem services through the extension of adaptation and mitigation activities on farm e.g. encouraging agro-forestry approaches, establishing community based income generating activities, promoting ecotourism and elevating the use of non-timber forest products.

Though PFM lacked a well elaborated MRV system to gauge its contribution to the reduction of GHG emissions, the practices in place ensured protection of the forest resources even in areas that were previously subject to intensive exploitation (Blomley *et al.*, 2008). The benefit sharing stream between the government and adjacent local people has been problematic especially where timber forest resources have been a key economic resource.

4.3 Carbon trading mechanisms in Tanzania

The UNFCCC under the Kyoto Protocol established the Clean Development Mechanism (CDM) to contribute to mitigation activities. One of the mitigation options is offsetting emissions through carbon credits offered to projects undertaking afforestation or reforestation in order to enhance carbon sequestration.

In Tanzania, forest based CDM projects have been undertaken mainly by foreign companies under the auspices of their mother countries. Most of the CDM projects and other CDM-bidders are located in the southern highlands of Tanzania where the tree business and land is readily available for such large investments. One of the challenges that Tanzania has been facing in engaging with the CDM is the high cost of transaction especially in the verification processes, which does not suit smallholder woodlot owners. It requires multilateral companies that have large financial resources to invest in the process.

Furthermore, concerns over the benefit sharing from the CDM have raised questions, as the mechanism does not seem to benefit developing countries (Kalumbiza and Menne, 2011).

4.4 Establishment of the MRV system for REDD+

The setting up of a robust MRV system in Tanzania is essential and different activities are underway to establish this system. A comprehensive MRV system needs to first address basic issues related to forest definition and Reference Emission Levels (REL) or Forest Reference Levels (FRL).

The definition of forest found in policy documents in Tanzania did not fulfil UNFCCC requirements which request that the definition provides a minimum estimate on land area, crown cover and tree height based on a country's circumstances. For instance;

- I. The definition of forest as found in Tanzania's Forest Act of 2002: "Forest means an area of land with at least 10 percent tree crown cover, naturally grown or planted and or 50 percent or more shrub and tree regeneration cover".
- II. The definition of forest as found in the National Forest Policy of 1998 and draft 2009: "Forest means all land bearing a vegetative association dominated by trees of any size, exploitable or not, and capable of producing wood or other products of exerting influence on the climate or water regime or providing shelter to livestock and wildlife".

This encouraged Tanzania to re-evaluate and re-submit a forest definition to the UNFCCC by adopting the FAO definition of 'forest'. The resubmitted definition states that: "Forest refers to land with an area of more than 0.5 hectares and tree crown cover (or equivalent stocking level) of more than 10 percent. The trees should be able to reach a minimum height of 5 m at maturity in situ."

The UNFCCC allows for a more flexible forest definition: minimum canopy cover 10–30 percent, minimum tree height 2–5 m, minimum area 0.1 ha. However, this has been a matter of contentious debate as inconsistencies surfaced among countries, thus questioning the qualifications for deforestation (Van Noordwijk and Minang, 2009).

On the other side, constructing a REL/FRL remains a priority; so far the nation has set a road map towards the realization of REL/FRL through the UN-REDD program. A wide range of stakeholders have been contacted to attract expertise, experiences and approaches. It targeted key areas on methodology development, data collection, institutional arrangements, coordination and capacity building.

Methodology development and data collection

There were several national initiatives that were developed to collect data and support the national and project level carbon accounting system, including:

- I. National Forest Resource Monitoring and Assessment (NAFORMA). This was an extensive tree inventory covering 30 000 plots for measuring and monitoring carbon stock change across above ground woody biomass, soil carbon and dead wood pools. It is the backbone of the MRV system for forestry in Tanzania.
- II. Light Detection and Ranging (LiDAR), research based project implemented jointly by Sokoine University of Agriculture in Tanzania and Norwegian University of Life Sciences (NMBU) in Norway, as well as the Group on Earth Observation's "Forest Carbon Tracking" initiative. Tanzania is a national demonstration country for LiDAR.

- III. Developing Allometric Equations (AE) for emission factor estimation for lowland forests through the support of the UN-REDD program.
- IV. REDD+ pilot projects: Pilot projects have gathered data and developed methodologies on carbon stock assessment in many different ways, such data could be adopted and used in developing the REL/RLs based on either a sub-national or nested approach.

Institutional arrangements and coordination

A National Carbon Monitoring Centre (NCCMC) is being established to serve as a national carbon registry. It will coordinate national carbon activities, including establishing procedures and standards for accounting and verification of carbon at national, sub-national and project levels. The centre is set to be semi-autonomous, overseen by the Ministry responsible for climate change i.e. the Vice President's Office – Department of Environment (VPO DoE). NCCMC is temporarily hosted at Sokoine University of Agriculture (SUA) in the Faculty of Forest and Nature Conservation.

Capacity building

The UN-REDD program supported capacity building for MRV. UN-REDD was working with the Tanzania Forest Service to build the capacity of technical staff on various MRV related issues, including GIS and remote sensing, mapping, allometric equation development and forest modelling. Additionally, the CCIAM program is further engaged in capacity building on MRV related studies.

Therefore, the development of the MRV system in Tanzania for REDD+ is still evolving. However, it will provide a vital role in mitigation activities in the country. The establishment of an MRV system that incorporates the agricultural sector when providing GHG emission estimates in Tanzania is essential in climate change mitigation. Upscaling of the current MRV system for REDD+ to cater for agriculture will require more inputs in terms of data collection.

5. CONCLUSION

Tanzania has the foundation of a policy framework to address climate change adaptation and mitigation in agriculture. Characterized by very low inputs, agriculture in Tanzania is still mostly carried out at subsistence level. This makes the agriculture-dependent communities in the rural areas more vulnerable to the impacts of climate change, due to their limited adaptive capacity. Efforts by the government to modernize agriculture are underway through policy reforms and support from the private sector. The government has also engaged in efforts to reduce GHG emissions.

Tanzania's official communication to the UNFCCC dates back to 2003. This communication is based on 1993/4 data estimates which are twenty years old and need to be updated. In the last 20 years, the country has witnessed significant change in terms of the macro-economic environment, which may have affected various sectors including agriculture, and thus influenced the level of GHG emissions. The engagement of Tanzania in the REDD+ readiness phase has generated key information, tools and infrastructure that can be utilized for updating the estimation of GHG emissions in agriculture. The country is now climate change sensitive due to the impacts already observed in various sectors including agriculture. The projected impacts of climate change on the country's economy are a call for immediate action.

The proportion of GHG emissions in the agricultural sector in Tanzania is still very low, estimated at 5.7 percent. However, agriculture is responsible for accelerating GHG emissions in other sectors especially forestry and energy. Any attempts to modernize agriculture through intensification under a low carbon development pathway will also help to minimize GHG emissions in other sectors. Tanzania is among the front-liners at global level in REDD+ readiness. The establishment of institutions supporting the implementation of REDD+ in Tanzania is also a basis for other mitigation activities. The development of the MRV system, the establishment of the National Carbon Monitoring Centre and the enabling policy environment are essential. The incentive nature of emissions reduction in the forestry sector is very important and could have a greater impact if the agricultural sector was included

The government of Tanzania has shown willingness to address climate change in agriculture through both adaptation and mitigation.

6. RECOMMENDATIONS

The findings of this study form recommendations that are presented in the table below. This is done in acknowledgment of the fact that estimating GHG emissions in the agricultural sector in Tanzania would need complex and accommodating methods and tools to capture differences in agro-ecologies, farming systems, agricultural inputs and other land management. It would also need to include further information gathering, institutional strengthening and financial support.

Table 6: Challenges and proposed recommendations

Challenge	Recommendation
1. Comprehensive, updated and reliable data on GHG emissions are lacking.	VPO-DoE need to find a way of gathering and recording information on GHG emissions from isolated studies in Tanzania as a short term measure. In the long run, VPO-DOE needs to ensure there is a mechanism in place to archive and enable retrieval of GHG emission information readily.
2. The existing MRV system in place is REDD+ oriented and does not accommodate other sectors.	The current development process of the REDD+ MRV system should be widened to include agriculture. The NCMC should be strengthened and become broader based to undertake MRV in other sectors i.e. agriculture, energy and transportation.
3. Cross-cutting nature of climate change issues makes it difficult to track expenditures in the Tanzanian government budget.	Mechanisms should be in place to trace the expenditures allocated to climate change interventions to enable proper assessments and reflections on the impacts of interventions.
4. Disconnection between the central government and local government on climate change coordination and interventions.	Mechanisms should be established to build capacity at local government level on climate change issues and improve coordination.

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