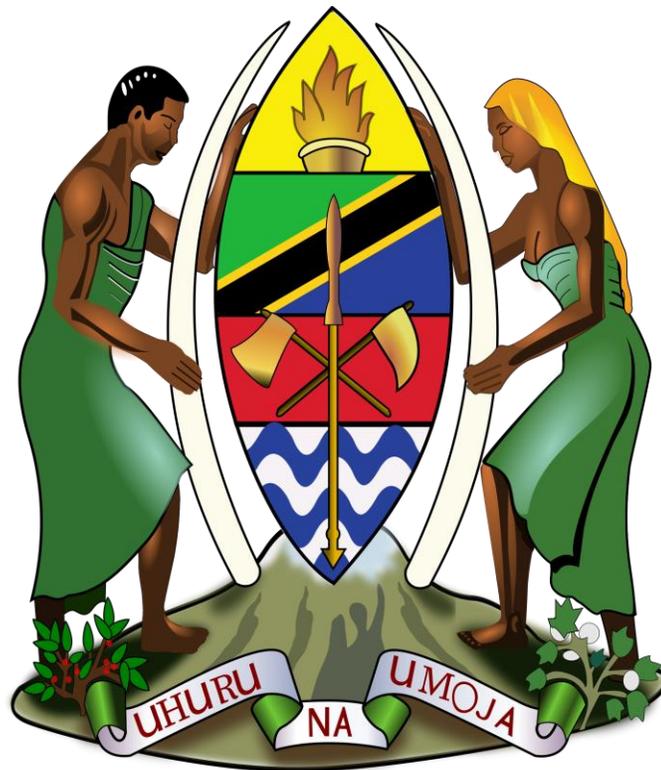


Perspectives on Climate-Smart Agriculture from Across the Globe

Tanzania Country Case Study Report



United Republic of Tanzania

August 2016

Acknowledgments

The Food, Agriculture and Natural Resources Policy Analysis Network (FANRPAN) have produced this Case Study in partnership with the Government of Tanzania for the Enabling Environment Action Group (EEAG) of the Global Alliance for Climate-Smart Agriculture (GACSA).

In 2015, the Enabling Environment Action Group commissioned six case studies assessing the state of Climate-Smart Agriculture (CSA) implementation in Costa Rica, France, Ireland, Malawi, Tanzania and Vietnam. The EEAG works to identify the technical, policy and investment conditions needed to scale up CSA approaches, and to promote the harmonization of community-based national agriculture, climate change and food system policies.

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We greatly appreciate the contributions of **Mrs Shakwaanande Natai, Head of Environment Management Unit of the Ministry of Agriculture Livestock and Fisheries (MALF), Tanzania** whose experience in the preparation of the Tanzania CSA Programme and CSA guidelines has greatly benefited this study. We thank the staff of the FANRPAN Tanzania Node, **the Economic and Social Research Foundation (ESRF)** for coordinating the national CSA policy dialogue, which was convened to validate the findings of this study.

We would like to thank the following colleagues for their contributions in developing the Case Study:

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Table of Contents

Acknowledgments	ii
Acronyms	1
Summary	2
1. General Overview; Agriculture and Climate in the Context of National Economy	3
2. Climate-Smart Agriculture Interventions	4
2.1. Country level policies/enabling environment for CSA, goals/targets, institutions	4
2.2. Climate change investments including the flow of public and private investments	5
2.3. Technologies, practices, and services relevant to the country	6
2.4. Status of extension services	6
2.5. Metrics and methodologies in place to measure success and delivery	7
2.6. Planning and priority-setting for strengthening climate-smart food production systems	7
2.7. Ongoing action by Civil Society Organizations and the private sector	8
3. Projected impacts of existing CSA interventions	8
3.1. Effects on productivity and income and implications for food security	8
3.2. Adaptation potential achieved	9
3.3. Mitigation benefits achieved	9
4. Challenges and opportunities for further implementation of CSA	9
4.1. Challenges to implementation or adoption	9
4.2. Opportunities for additional interventions of climate-smart/sustainable practices	12
5. Outlook/conclusion	13
5.1. Addressing policies challenges/gaps	13
5.2. Addressing knowledge sharing, capacity building, and extension challenges/gaps	13
5.3. Addressing investments and financial flows challenges/gaps	13
6. References	14
7. Annexes	16
Annex 1: CSA Policies for Tanzania	16
Annex 2: Institutions involved in CSA	25
Annex 3: CSA Technologies, practices and services	39

Acronyms

ACRP	Agriculture Climate Resilience Plan
ACSAA	African Climate Smart Agriculture Alliance
AEZs	Agro-ecological zones
ASA	Agricultural Seed Agency
ASDP-2	Second Agriculture Sector Development Programme
BNPP	Bank-Netherlands; the Partnership Programme
CAADP	Comprehensive Africa Agriculture Development Programme
CCAFS	Climate Change, Agriculture and Food Security
CGIAR:	Consultative Group on International Agricultural Research
CIAT	International Center for Tropical Agriculture
CSA	Climate Smart Agriculture
DADPs	District Agriculture Development Plans
DFID	Department for International Development
DLUP	Director for Land Use Planning
DPP	Director for Policy and Planning
EAC	East African Community
EMU	Environment Management Unit
FANRPAN	Food, Agriculture and Natural Resources Policy Network
FAO	Food and Agriculture Organization of the United Nations
GACSA	Global Alliance for Climate Smart Agriculture
MICCA	Mitigation of Climate Change in Agriculture
NAPA	National Adaptation Plan of Action
NDV	National Development Vision
NEPAD	New Partnership of Africa's Development
NGOs	Non-governmental Organizations
OUT	Open University of Tanzania
R&D	Research and Development
S&WC	Soil and Water Conservation
SACCOs	Saving and Credit Community Organizations
SUA	Sokoine University of Agriculture
TOSCI	Tanzania Official Seed Certification Institute
UK	United Kingdom
UN-REDD	United Nations collaborative initiative on Reducing Emissions from Deforestation and Forest Degradation
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
URT	United Republic of Tanzania
WUGs	Water User Groups

Summary

Agriculture is Tanzania's main economic activity that employs about 77% of the total population. With the unequivocal changing of the climatic system, the rising concern is on how best natural resources can be utilized to sustain and increase productivity of crops and livestock. Embracing Climate-Smart Agriculture (CSA) is one way of reducing agricultural production risks and vulnerability to a changing climate. In response to current and projected climate change impacts, national CSA adaptation strategies and action plans have been developed. For examples, the National Adaptation Plan of Action (NAPA) was designed to build the adaptive capacity to address causes of vulnerability and facilitate adaptation needs and responses to disaster, and the Tanzania Agriculture Climate Resilience Plan (ACRP, 2014–2019) aims to implement strategic adaptation and mitigation actions. Currently, there are around 25 policies related to CSA, which are aligned to the National Development Vision 2025 (NDV, 2000), and about 46 institutions involved in CSA programmes, interventions or initiatives in the country. This report presents an analysis of existing policies, programs and initiatives, and discusses challenges of implementing CSA programmes in Tanzania. Opportunities for additional interventions of climate-smart/sustainable practices are also suggested. Also, two key recommendations that emerge include: the development of robust monitoring and evaluation systems to demonstrate CSA interventions results; and, the coordination of institutions working on CSA.

Keywords: adaptation, climate change, food and nutrition security, mitigation, resilience

1. General Overview: Agriculture and Climate in the Context of National Economy

Agriculture employs about 75–77% of the total population of Tanzania, contributing about 95% of the national food requirements (United Republic of Tanzania (URT), 2013; Massoy, 2016). Like many countries in sub Saharan Africa, Tanzania’s agriculture is mostly rain fed, leaving it vulnerable to the negative impacts of climate change. Some adverse impacts of the changing climatic system already being felt in Tanzania include poor crop yields because of droughts and floods, reduced water availability, increased occurrence of crop and livestock pests and diseases, among others (Rwehumbiza, 2014).

Tanzania has a rich base of land and water resources, with high crop diversity (Natai, 2016). About 88.6 million hectares of land is suitable for agricultural production, including 60 million hectares of rangelands suitable for livestock grazing (NAPA, 2005). However, part of this land is only marginally suitable for agricultural production and livestock grazing because of factors such as drought proneness and tsetse infestation. In 2002, only 23% of the arable land was under cultivation, and of that, about 97% was rain-fed (World Bank, 2002). As for the rangelands, 50% was used for livestock grazing (URT, 2001).

More than 80% of Tanzania’s population depends on climate sensitive rain-fed agriculture as a source of livelihood (Natai, 2016). Rainfall in about 75% of the country is erratic and only 21% of the country can expect an annual rainfall of more than 750 mm with a 90% probability. As a result, crop and livestock production under such conditions remains vulnerable to the adequacy, reliability and timeliness of rainfall. The mean annual rainfall varies considerably, ranging from less than 400 mm to over 2,500 mm per annum. A majority of farmers in the country are smallholders (0.2 to 2.0 ha farm size) and are characterized by very low inputs use and very low output (Majule et al. 2015). Natai (2016) stated that these smallholder farmers who control a large part of the country’s agricultural production are currently experiencing adverse climate change impacts. Reducing vulnerability of the agriculture sector to climate change will significantly contribute to socio-economic development and ensure food security. Embracing CSA is one way of reducing the risks and vulnerability because of changing climate.

The current challenge in Tanzania is how to sustainably use available resources or even improve on crop and livestock production. As a demand driven response to current and projected climate change impacts, Tanzania has developed national adaptation strategies and action plans. Adaptation strategies are typically high level documents that set out overarching government

approaches to adaptation (often as part of national climate change policies), while adaptation plans go further by setting out concrete adaptation actions, such as sectoral adaptation policies, programmes and projects and specific measures to address identified vulnerabilities.

2. Climate-Smart Agriculture Interventions

The wide-ranging impacts of climate change demand tailored responses for specific locations and sectors. Climate change does not affect everyone in the same way: for example, most African women experience the effects of climate change more acutely due to gender inequalities and structural disadvantages (Deering, 2016). In fact, 79% of economically active women are engaged in producing food and women constitute 43% of global agricultural labour force, yet only 10-20% own land (globally) and 5% of extension and advisory clients are women (Turrall *et al.* 2011).

2.1. Country level policies/enabling environment for CSA, goals/targets, institutions

Tanzania ratified the United Nations Framework Convention on Climate Change (UNFCCC) in 1996, and was a signatory to the Kyoto Protocol in 2000. The country also made two National Communications on Climate Change under the UNFCCC in 2003 and 2015, discussing the effect of climate change on food security with special emphasis on vulnerable groups (URT, 2015).

Currently, Tanzania has around 25 policies related to CSA that are aligned to the National Development Vision 2025 (NDV, 2000). Six of these policies directly address issues of CSA (see Annex 1 for more details). The National Adaptation Plan of Action (NAPA) is designed to build the adaptive capacity to treat some of the underlying causes of the country's vulnerability, and enable it to address those needs that would facilitate future adaptation needs and disaster response (Rwehumbiza, 2014). The Tanzania NAPA promotes activities that address urgent and immediate needs for adapting to the adverse impacts of climate change in agriculture, water, energy, health and forestry sectors. Of the 14 identified priority project activities in the NAPA, the top four (in order of importance) are in agriculture and play a key role in enhancing CSA (URT, 2007).

According to the National Climate Change Strategy (NCCS) of 2012, agriculture is the most vulnerable and severely affected sector of the country's economy to climate change. The strategy notes that the effects of climate change on agriculture includes crop failure, increased incidents and severity of pests and diseases as well as shifting agro-ecological zones (AEZs). The strategy proposed interventions that are among the tools found in the CSA package. The NCCS (2012) then presents an opportunity to address climate change adaptation and participate in the global efforts to reduce greenhouse gas emissions (GHG) emissions in the context of sustainable development. This policy strategy also sets out strategic interventions for government-wide

climate change adaptation measures and GHG emissions reductions including agriculture sector on issues related to crops and crop varieties, water, on-farm practices, information and markets.

The Tanzania Agriculture Climate Resilience Plan (ACRP, 2014–2019) was developed to implement strategic adaptation and mitigation actions in the crops sub-sector. It presents a wide range of adaptation options including, but not limited to: improving agricultural land and water management, accelerating uptake of CSA, reducing impacts of climate-related shocks through risk management, and strengthening knowledge and systems to targeted climate action (URT, 2014).

At a regional level, there are about three policies, which Tanzania subscribes to: The Comprehensive Africa Agriculture Development Programme (CAADP), East Africa Community (EAC) Food Security Action Plan and the EAC Climate Change Policy. The latter directly relates to CSA and aims at guiding EAC Partner States and other stakeholders on the implementation of collective measures to address climate change impacts and causes in the region through adaptation and mitigation actions while assuring sustainable social and economic development.

Under a changing climatic system, strong and coordinated institutional support is required to improve the dissemination of information, provide financial support and access to markets, and coordinate the work of a large number of farmers over a wide area, to capacitate smallholder farmers' transition to CSA (Food, Agriculture Organisation -FAO, 2013). According to Lamanna (2016), there are about 46 institutions involved in CSA programmes, interventions and/or initiatives in Tanzania. For more information on the involvements of some of those institutions in CSA refer to Annex 2. The Division of Environment (DoE) under the Vice President Office is the Focal Point for Climate Change issues in the country.

2.2. Climate change investments including the flow of public and private investments

Generally, the flow of funds into climate change research is irregular and limited, which stifles the on-going research and development work in Tanzania (Rwehumbiza, 2014). Availability of internally generated funds is limited. This, coupled with poverty levels in the country limits the pace and scope of implementation of CSA programmes and initiatives. According to the Tanzania Climate Smart Agriculture Program (2015-2025), the Government, through the national budget, is the main funder of the agricultural sector, supplemented by development partners, private sector and civil society organizations.

The Agriculture Climate Resilience Plan (2014-2019) and the Tanzania Climate-Smart Agriculture Program (2015-2025) are supported by multiple sources. Current donors include: FAO; the World Bank; UK Department for International Development (DFID); Bank-Netherlands; the Partnership Programme (BNPP); Open University of Tanzania (OUT); Sokoine University of Agriculture (SUA); NEPAD, CGIAR Research Program on Climate Change, Agriculture and Food Security (CGIAR-CCAFS), International Center for Tropical Agriculture CIAT, International Non-Governmental Organizations (INGOs); and, the Tanzania Government (see Annex 2 for more details).

A number of United Nations (UN) collaborative initiatives aimed at addressing climate change challenges in Tanzania are ongoing. These include the Mitigation of Climate Change in Agriculture (MICCA) programme, a FAO initiative implemented by World Agroforestry Centre (ICRAF) and CARE in Tanzania (Majule *et al.* 2015), and the UN collaborative initiative on Reducing Emissions from Deforestation and forest Degradation (UN-REDD) programme, supported by the governments of Finland, Germany and Norway.

2.3. Technologies, practices, and services relevant to the country

Tanzania has largely embraced the use of CSA technologies, practices and services (see Annex 3 for a list of CSA technologies, practices and services in Tanzania) (Majule *et al.* 2015). The process of developing CSA guidelines for Tanzania is led by MALF – formally known as the Ministry of Agriculture, Food Security and Cooperatives (MAFC). CSA practices potentially suitable for different agro-ecological zones and socioeconomic environments already exist, including conservation agriculture, soil and water conservation, resilient crop varieties, crop and grazing land management, livestock management, soil fertility management and agro-forestry (FAO, 2015). The selection, combination and tailoring of these practices need to be based on site-specific agro ecological, cultural and socio-economic conditions.

2.4. Status of extension services

The national extension services and NGOs are in the forefront in the promotion of a wide range of agriculture practices in Tanzania. According to CCAP PARTNERS (2013), the government emphasises and injects significant amounts of money to support agriculture; most of which run by small-scale farmers. Some extension workers have been sent to work at ward level. Total trained extension workers from 2014 to date is 3189 (2187 Certificate and 1002 Diploma qualifications) of which only about 20% only employed. The government of Tanzania estimates that the country will need close to 20,000 extension workers by 2020 to attain a ratio of 1:1 at village and ward level (i.e., One extension worker per village and one per every ward). Cooperatives have been revitalised to give farmers stronger marketing power and there are supportive environments for farmers to establish and manage their own financial institutions

such as Saving and Credit Community Organizations (SACCOs). However, more work still needs to be done.

2.5. Metrics and methodologies in place to measure success and delivery

According to the Ministry of Agriculture, Food Security and Cooperatives (2014), the establishment of a monitoring system for CSA interventions in Tanzania is the responsibility of the Department of Policy and Planning (DPP), Department of Land Use Planning (DLUP) and Environment Management Unit (EMU). The Plan also acknowledges that robust monitoring and evaluation will be key to demonstrating results. Systems need to be in place to track delivery of the ACRP for national reporting, to scale up good practices, and to give confidence to funders that agricultural stakeholders can deliver on climate-resilient investments.

The Tanzania Climate Smart Agriculture Program, 2015-2025 outlines a Participatory Monitoring and Evaluation (PM&E) framework that ensures the project targets are met and learning achieved is the emphasis of the proposed investment plan. Capacity building in PM&E and mentoring process for site team and other core members will be done in each target area.

2.6. Planning and priority-setting for strengthening climate-smart food production systems

Priority actions for strengthening climate-smart food production systems are aligned with the Tanzania Development Vision 2025, the National Five Year Development Plan and the Second Agriculture Sector Development Programme (ASDP-2) (Massey, 2016). Below are the action areas for ensuring productivity and food security as described by the ACRP, 2014-2019 (URT, 2014).

i. Improve agricultural land and water management

Priority investments include water use efficiency and water storage, improvements in catchment management in agricultural planning, and adoption of sustainable agricultural land and water management to reduce degradation.

ii. Accelerate uptake of climate-smart agriculture

Priority investments include building an evidence base for climate smart agricultural practices and incentives to offset the cost of adoption, promoting practices at the District level, and generating awareness and capacity for these practices.

iii. Reduce impacts of climate-related shocks through improved risk management

Priority investments include measures to prepare for, respond to emergencies, and weather related shocks, and better integration of pests and diseases into these measures, building

resilience through livelihood diversification activities targeted to the most vulnerable areas, and piloting risk management instruments such as finance instruments.

iv. Strengthen knowledge and systems to target climate action

Priority investments include filling key research gaps, undertaking a comprehensive climate change and agriculture vulnerability assessment, developing systems for information management and communication campaigns, especially more accurate and timely weather and climate information, and strengthening gender considerations into climate change action for agriculture.

2.7. Ongoing action by Civil Society Organizations and the private sector

The role of Civil Society Organizations (CSOs) is to provide various services to farmers that include sharing of information; Monitoring and Evaluation; supporting vulnerable farmers to have a voice (i.e., advocacy); and, testing and up-scaling innovations. The private sector on the other hand focuses on testing, disseminating and up-scaling technologies, imparting business skills to farmers and supporting the provision of extension services. Further, according to the Tanzania Climate-Smart Agriculture Program; 2015-2025, the CSOs, private sector and development partners supplement Agricultural Finance and Investments.

3. Projected impacts of existing CSA interventions

3.1. Effects on productivity and income and implications for food security

CSA interventions are projected to create a sustainable integrative approach to address interlinked challenges of food security, poverty and climate change. CSA will provide a platform for promoting collaboration amongst various institutions and government departments in exploring sustainable solutions, knowledge and research findings sharing, networking, best practices and market transformation especially for vulnerable poor communities.

By the end of 2019 (URT, 2014) in line with ASDP-2, CSA initiatives must have contributed to national economic growth, reduced rural poverty, improved people's livelihoods and food and nutrition security in Tanzania. The main objective of the ACRP, 2014-2019 is to transform the agricultural sector towards higher productivity, commercialization level and smallholder farmer income for improved livelihood, poverty reduction, food security and nutrition.

One example of implications of existing CSA interventions is the improvement of food security and household incomes in the Semi-Arid Lands (SAL). Through the traditional irrigation technologies, Bunded basins (*Majaruba*), rainwater harvesting for crop production, smallholder

farmers have managed to engage in stable and less risky production (Rwehumbiza, 2014). In fact, many other CSA initiatives promise sustainable production of food and increased generation of income for farmers at a household level while leaving the environment conserved with reduced greenhouse gas emission and increased resilience (see Annex 3).

3.2. Adaptation potential achieved

Adaptation measures for improved water, soil and land management are urgently needed to build resilience to current variability and future climate change by both smallholders and commercial farmers. According to the Ministry of Agriculture, Food Security and Cooperatives (URT, 2014-2019), adaptation measures in Tanzania should focus on: (i) boosting productivity of cereal crops, especially building capacity of smallholder farmers to increase yields and engage best management practices; and (ii.) researching the impact of temperature rise and rainfall variability on key crops. Thus, the coordination of various institutions and government departments presents an opportunity to establish CSA in Tanzania.

3.3. Mitigation benefits achieved

CSA will help reduce vulnerability of Tanzania's agriculture sector by increasing productivity, enhancing adaptation and resilience of the farming systems and reducing emissions intensity in the context of achieving food and nutrition security, sustainable development and poverty reduction. Agriculture offers major opportunities to mitigate climate change by reducing greenhouse gas emissions from farms via CSA technologies (such as conservation tillage and precision fertiliser use, etc.) and sequestering carbon dioxide, or converting it into physical form and hence removing it from the atmosphere. Carbon dioxide can be sequestered into carbon sinks such as soil or wood through CSA technologies like agroforestry and composting. Carbon sinks account for 90% of agriculture's mitigation potential, which is concentrated in developing countries (Eldis, 2016). However, there is no concrete system in place to measure the emission from the agricultural sector.

4. Lessons, recommendations and opportunities for further implementation of CSA

4.1. Lessons to implementation or adoption

Several lessons were drawn from the challenges identified in the Tanzania CSA case study - from policy to practice. Below are some lessons on challenges encountered.

- A more integrated and multi-sectoral, approach to CSA with activities that fall within separate ministries is imperative.
- Sub-standard and poor quality agricultural inputs negate the impact of CSA efforts.

- Comprehensive land use plans are not in place and there are unresolved land tenure/ rights problems. This has resulted in, mismanagement of the land resource and persistent conflicts among users.
- There is need for establishing adequate water storage and rainwater-harvesting system in terms of construction of storage structures – to secure planned future water supply and irrigation schemes.
- Mobilizing domestic natural, human and financial resources is imperative for generating funds internally. This will limit the dependence on donor funds in the implementation of CSA programs/initiates.
- Strong and reliable linkages among producers of perishable agricultural products in the value chain will ensure successful livelihoods.
- Lack of awareness and information on new CSA practices by farmers is imperative for successful adoption of related initiatives
- Low use of climate information services and agro-weather advisories in agricultural planning and farm management decision making (Highly inadequate agro-climate information services and inappropriate agro-weather products)
- There is need for all men, women and youths to attend trainings on CSA practices
- Better coordination and harmonization of government policies and regulations will encourage cooperation in agriculture operations
- Farmers need to change their mind-set concerning certain customs and taboos such as bush firing, no use of farm yard manures
- Farmers need to realize benefits obtained from application of CSA practices as well as cost of not applying CSA. At this stage, CSA related cost and benefits are not well known.
- Local characteristics are not widely considered when developing, introducing or implementing CSA interventions
- Although good practices are evident in some parts of the country, there are no mechanisms in place to capture and promote positive lessons on a larger scale
- Although CSA has been accepted widely at country level, climate change issues have not been effectively incorporated into the Local Government Authority's (LGAs) development planning (District Agriculture Development Plans – DADPs) and budgeting. According to Majule et al. (2015), this may be caused by the cross-cutting nature of the climate change issues, making it difficult for governments to assign budget to
- No M & E in place to track the implementation of CSA in the country.

4.2. Recommendations to address these challenges

In the context of the existing policies, programmes and strategies it is clear that policy statements are in some cases already in place covering issues that are identified as not performing well

(Rwehumbiza, 2014). The recommendations given are vital to ensure the smooth implementation of CSA activities in Tanzania, and these include:

- Enforce by-laws on Soil and Water Conservation (S&WC), livestock stocking rates and grazing management in areas threatened by degradation due to unsustainable production practices.
- Improved production practices, water management and adoption of water saving (WUE) technologies for irrigation should be promoted more aggressively.
- New Irrigation schemes should adopt a successful model of having Water User Groups (WUGs) and work as cooperatives.
- To improve pastures, proper grazing management on rangelands and the control of livestock numbers, there is need for government to allocate land to individual pastoralists; hence, village land use plans are inevitable.
- Train, equip and deploy adequate numbers of land use planners at grass root level to reduce unplanned land management.
- Tanzania Meteorological Agency (TMA) should train and equip its staff to produce and disseminate timely, relevant, well-interpreted and reliable forecasts to the agricultural community using communication channels that are easily accessible to the targeted stakeholders.
- TMA should replicate the forecast systems that have been successfully implemented in Same and Lushoto Districts.
- The Tanzania Official Seed Certification Institute (TOSCI) should extend its presence in all parts of the country to ensure quality seed is sold to farmers.
- Producers of certified seed including Agricultural Seed Agency (ASA) should embrace irrigation instead of unreliable rain-fed systems to ensure a reliable supply of improved seeds to farmers every season.
- The institutions and companies that are involved in the supply of agricultural machinery should also sustainably provide spare parts.
- Total gender consideration in implementing CSA is of paramount importance i.e. Total involvement of all men, women and youth.
- Private sector need to be given due weight in implementing CSA, hence, public-private partnership (PPP) need to be highly embraced in that case.
- Producers of perishable products e.g. milk should be reliably linked to the value chain (buyers, processors and consumers) to ensure sustainability of markets and their livelihoods.
- Additionally, poor roads that limit access to rural areas should be improved together with constructing new ones where there are no to reduce difficulties in delivering farm inputs, ferrying produces and accessing markets.

- Mechanisms should be established to build capacity at local government level on climate change issues Majule *et al.* (2015) to support incorporation into the local development plans (DADPs) and budgets.
- The Planning Commission and the Ministry of Finance has to allocate GCF Code for climate change in the planning and budgeting system to easy planning and budgeting for climate change in the country.
- The GoT's M&E system for CSA, integration of CSA indicators into the national M&E framework and contribution to its international reporting requirements need to be put in place.

4.3. Opportunities for additional interventions of climate-smart/sustainable practices

To address harmful practices and gaps identified in Tanzania, there are several recommendations that emanate from this case study.

- Firstly, it is imperative for the government to source for funds (internally) to setup structures that will ensure a sustainable supply of agricultural products under a changing climate. One option the government can consider is to fulfill the Malabo declaration of putting 10% of the public expenditure to agriculture, and to ensure its efficiency and effectiveness for evidence based agricultural interventions.
- To harness the water resource and prevent water shortages and losses, there is need to increase construction of storage dams within basins, earth dams within catchments, village and farm ponds and promote rooftop rainwater harvesting (RWH). There is a need to make sure water bodies, water catchments are well protected.
- CSA practices that are already giving good results should also be promoted widely to other areas with similar biophysical conditions/ agro-ecological zones/ livelihood zones.
- In addition, the capacity of the Tanzania Fertilizer Regulatory Authority (TFRA), in terms of labor, skills, knowledge and allocation of funds, should be urgently strengthened so that it can discharge its duties fully and effectively.
- Strong coordination of all the stakeholders practicing CSA in the country and the government intentional pursuance power of involvement of the DPs, private sector, NGOs, CBOs, CSOs, women and youth is of paramount importance.

- Finally, there is need for government to enhance management and control of migration of livestock across Districts and Regions to prevent unnecessary conflicts, which usually disrupts progress and stability of programmes or initiatives.

5. Outlook/conclusion

5.1. Addressing policies challenges/gaps

Robust monitoring and evaluation will be key to demonstrating results. Systems need to be put in place to track delivery of the ACRP for national reporting, to scale up good practices, and to give confidence to funders that agricultural stakeholders can deliver on climate-resilient investments (URT, 2014). The government has to also provide or source funds needed for evidence based agricultural interventions, and provide better coordination and harmonization of government policies to guard against conflicts.

5.2. Addressing knowledge sharing, capacity building, and extension challenges/gaps

For success of CSA initiatives and/or programmes, it is imperative for the coordinating institution to map competencies of key partners to determine how they are qualified and to define roles. The National Climate Change Learning Alliance / National CSA Task Force can also be utilized as a platform, and farmers must be represented across all levels and scales.

5.3. Addressing investments and financial flows challenges/gaps

According to the *Maputo Declaration* of the African Union in 2003, it was agreed that all African countries, including Tanzania strive to commit at least 10% of the national budgets to agriculture. Although Tanzania has not attained the annual target of 10%, over the years, there is been remarkable increase in investments in agriculture currently standing at about 8%. However, development partners, private sector and CSOs, support the government, and it is the responsibility of the government to leverage additional funds for building resilience.

There are some initiatives to mainstream climate change considerations into the Tanzania national development planning and budget under the Development of CSA Programme (Massoy, 2016). The programme is built within six programmatic result areas. These are in line with ASDP-2. Agricultural research funding is covered under the programmatic result area on Research and Development and this area seeks to address issues on investments and financial challenges currently faced in Tanzania.

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7. Annexes

Annex 1: CSA Policies for Tanzania

	Policy	Year Enacted	Description/Objective	Focus Area
NATIONAL POLICIES				
1	Tanzania Development Vision 2025	2000	The National Development Vision 2025 (NDV, 2000) guides economic and social development efforts up to the year 2025. The overall aim of this Development Vision is to awaken, co-ordinate and direct the people's efforts, minds and national resources towards those core sectors that will enable the attainment of the country's development goals and withstand the expected intensive economic competition ahead. The over-arching nature of the NDV (2000) means that it is the main policy document that guides all other programmes and policies.	Capacity Building and Awareness Coordination Adoption and Scaling-up CSA
2	National Adaptation Plan of Action (NAPA)	2007	In relation to climate change, the National Adaptation Plan of Action (NAPA) (URT, 2007) is designed to build the adaptive capacity to treat some of the underlying causes of the country's vulnerability, and enable it to address those needs that would facilitate future adaptation needs and disaster response. The NAPA document has identified and is promoting activities that address urgent and immediate needs for adapting to the adverse impacts of climate change. The focus of NAPA work in Tanzania has been on adaptation needs in the agriculture, water, energy, health, and forestry sectors. Out of the 14 identified priority project activities under NAPA the top four in order of importance are in agriculture and play a key role in enhancing CSA. The focus issues identified under NAPA lack regular	Capacity Building and Awareness Adaptation Mitigation

			<p>funding including the research component. Long-term investment through R&D is required for example in the production of new crop cultivars adapted to changed climatic conditions. However the flow of funds into research is irregular and limited stifling the ongoing R&D work. Availability of internally generated funds is limited, this coupled with poverty at individual level limits the pace and scope of implementation.</p>	
3	National Strategy for Growth and Reduction of Poverty (NSGRP)		<p>National Strategy for Growth and Reduction of Poverty (NSGRP, 2005) or translated in Kiswahili reads as '<i>Mkakati wa Kukuza Uchumi na Kupunguza Umasikini Tanzania</i>' (MKUKUTA). This strategy -MKUKUTA phase I was the development framework for (2005 -2010) and still is for MKUKUTA phase II (2010-2015) putting poverty reduction high on the country's development agenda. It is part of Tanzania's efforts to implement its national Vision 2025. Goal 2 of MKUKUTA – the agriculture section has activities related to CSA including extending subsidized inputs (fertilizer and improved seed) to smallholder farmers so as to increase production of major food crops e.g. maize and rice.</p>	Capacity Building Adaptation Mitigation
4	National Water Policy	2002	<p>The National Water Policy (NAWAPO) (URT, 2002) sets out the direction for the water sector in achieving sustainable development and utilization of the Nation's water resources, putting special emphasis on an integrated approach to water resources management, which allows for the development and utilization of resources in ways that balance the needs of upstream and downstream users and guarantees water availability for all sectors of the economy. It thus establishes a comprehensive framework for sustainable development and management of water resources and for participatory agreements on the allocation of water for different uses. The Policy integrates principles of multi-sectoral use,</p>	Capacity Building and Awareness Adaptation Mitigation Water efficiency

			<p>treats water as a social, economic and environmental good, recognizes financing of Water Resources Management (WRM) through the application of a Water User Fee, and promotes autonomy at the river basin level. Each basin has a Water Basin Office that controls water allocation.</p> <p>The Water Policy recognizes different sources of water including groundwater and harvesting of rain, however investment on these is disappointingly low. Limited investment in water storage dams within basins is creating highs and lows in water supply. Floods causing destruction and scarcity of water prompting suspension of hydropower generation have become annual events. Water is a resource only if it can be controlled and made available when required. The absence of water storage infrastructure threatens the existing irrigation schemes and future implementation of the country's irrigation master plan.</p>	
5	Rural Development Strategy	2001	<p>The Rural Development Strategy (2001) was part of the effort to improve the living standards of the rural people. About 80% of Tanzanian population lives in the rural areas under conditions of severe poverty. The strategy for rural development consists of four strategic interventions: promoting widely shared growth; increasing opportunities and access to services; reducing risks and vulnerability and good governance.</p> <p>With regard to irrigation development, the Rural Development Strategy (RDS) proposes specific long-term objectives, which are to promote profitable irrigation infrastructure through encouragement of farmers to form irrigators' organizations, assistance for the irrigators' organizations to access credit and organization and delivery of relevant training modules</p>	Capacity Building and Awareness Adaptation Mitigation

			for members of the farmers' organizations. The above is based on the fact that schemes that are currently performing well (e.g. Mwege in Morogoro) do have: water user groups (WUG), are operating as cooperatives, and use a 'receipt in ware house system' of marketing of agricultural produce.	
6	The Agriculture and Livestock Policy	1997	<p>The Agriculture and Livestock Policy (URT, 1997) was formulated to re-align the agriculture sector following major policy changes by the government since the mid-1980s. Since then, the Tanzanian economy has undergone gradual fundamental transformation that has redefined the role of the government and the private sector. Under the new environment most of the production, processing and marketing functions have been assigned to the private sector while the government has retained regulatory and public support functions. The public sector support functions include among others, <i>research, training, extension, policy formulation, information services, sanitary regulations, quality control, protection of environment, creation of optimal market conditions and promotion of agricultural growth.</i></p> <p>Climate Smart Agriculture should be made part and parcel of the Agriculture and Livestock Policy in order to make sure that food production is done in a sustainable way using practices that incorporates increased productivity, mitigation and adaptation of climate change. Constraints to the implementation of the policy are mainly because of issues related to land tenure, water, markets that are mandates of other ministries namely Land, Water, and Trade respectively. Agricultural activities on mountainous areas continue without fully observing conservation agriculture or enforcing existing regulations.</p>	Capacity Building and Awareness Adaptation Mitigation

7	Agricultural Sector Development Programme		Main objectives are to enable farmers to have better access to and use of agricultural knowledge, technologies, marketing systems and infrastructures for higher productivity and profitability; and to promote involvement of the private sector in agricultural transformation under improved regulatory and policy frameworks.	Capacity Building and Awareness Adaptation Mitigation
8	National Livestock Policy	2006	The mission of the livestock industry given in the National Livestock Policy (NLP) of 2006 and its Livestock Sector Development Strategy (LSDS) of 2009 in the context of KILIMO KWANZA, Comprehensive Africa Agriculture Development Programme (CAADP), Tanzania Development Vision 2025 and the National Strategy for Growth and Reduction of Poverty (NSGRP), is stated as: <i>“To ensure that livestock resource is developed and managed sustainably for economic growth and improved human livelihoods”</i> . Management of livestock sustainably necessitates the adoption of CSA given the changing climate that is leading to the scarcity of both water and pasture.	Capacity Building
9	The Livestock Sector Development Programme (LSDP)	2011	The Livestock Sector Development Programme (LSDP, 2011) is a five-year programme and the vehicle through which all that is pointed out in the National Livestock Policy (NLP) of 2006 is to be implemented. Key strategic areas for implementation of LSDP outlined in the Livestock Sector Development Strategy (LSDS) of 2009 include: - (i) Sustainable use of land, water, pastures and rangelands; (ii) Public/Private sector investments and financing for improvement of livestock value chain productivity and efficiency (production, marketing and processing); (iii) Control of livestock diseases leading to reduced the high calf and local chicken mortality in the traditional sectors.	Capacity Building and Awareness Adaptation Mitigation
10	The National Strategy for		Sets targets and goals on accelerating economic growth,	Capacity Building

	Growth and Reduction of Poverty II		reducing poverty and improving living standards and social welfare of Tanzanians	
11	Fishery Sector Development Programme (FSDP)		Designed to take on board interventions that are geared towards ensuring sustainable fisheries resources management, development, conservation and utilization that will be implemented at national and local levels as well as by the public and the private sector	
12	The National Land Policy		The National Land Policy (URT, 1995) recognizes the rights and interests of citizens in land that cannot be taken away without due process of law. The policy guarantees women's access to land and security of tenure. Women are thus entitled to acquire land in their own right not only through purchase but also through allocations. Customary land rights and village land are also recognized. However, not many smallholder farmers have tenure land rights although the policy advocates the same. The situation is made worse by lack of land use plans in many parts of the country. This has resulted into bloody conflicts between farmers. According to Inter Press Service (2012), land conflicts pitting poor villagers against powerful investors numbered more than 1,000 reported incidents. The recurrence of land conflicts both in rural and urban areas is an indication that the National Land Use Planning Commission (NLUPC) that was established to harmonize and co-ordinate all land use related policies, legislation and as well as promote effective protection has not performed well in its mandates.	Capacity Building and Awareness - Gender Adaptation Mitigation
13	Environmental policy		One of the objectives of the Environmental Policy (1997) is to ensure sustainability, security and equitable use of resources e.g. land and water for meeting the basic need of the present and future generations without degrading the environment or risking health or safety. Land degradation due to unsustainable production practices	

			continue because of main factors namely: (i) Non enforcement of existing rules and regulations, and (ii) absence of secure land tenure have to a large extent prevented investment by individuals into land and pasture improvements including establishment of animal water points.	
14	National Climate Change Strategy (NCCS)	2012	The National Climate Change Strategy (NCCS) of 2012 recognizes that agriculture is the most vulnerable and severely affected sector of the country's economy to climate change. The strategy notes that the effects of climate change on agriculture includes crop failure, increased incidents and severity of pests and diseases as well as shifting agro-ecological zones (AEZs). The strategy proposed interventions that are among the tools found in the climate smart agriculture package. They include: promoting conservation agriculture technologies e.g. minimum tillage and efficient fertilizer utilization, promoting best agronomic practices, promoting integrated nutrients management and addressing soil and land degradation by promoting improved soil and land management practices/techniques.	Capacity Building and Awareness Adaptation Mitigation
15	Government subsidy on inputs		The Government has extended subsidy on fertilizer and improved seed through the National Agricultural Input Voucher System (NAIVS) and this has improved yield in many parts of the country especially of maize in the Southern Highland zone regions (Mbeya, Rukwa, Iringa, Ruvuma) as well Morogoro and Kigoma regions where climatic conditions are conducive. Farmers have traditionally planted local seed from one season to the next without applying fertilizer. Most traditional cultivars that some small-scale farmers continue to use are low yielding. This limits the range of results that can be obtained with improved agronomic practices including fertilizer, pesticides and irrigation	Adoption of CSA

16	National Agricultural Policy		Aims at setting instruments for the development of an efficient, competitive and profitable agricultural industry that contributes to nation's economic growth and wellbeing of Tanzanians.	Capacity Building and Awareness Adoption of CSA
17	Tanzania Agriculture and Food Security Investment Plan (TAFSIP)		Ten-year investment plan, which maps the investments, needed to achieve the CAADP target of six % annual growth in agricultural sector GDP. It aims to contribute to the national economic growth, household income and food security in line with national and sectoral development aspirations.	Capacity Building and Awareness Adoption of CSA
18	Tanzania Agriculture Climate Resilience Plan (ACRP)		Developed to implement strategic adaptation and mitigation actions in the crops sub-sector. It presents a wide range of adaptation options including, but not limited to: improving agricultural land and water management, accelerating uptake of CSA, reducing impacts of climate-related shocks through risk management, and strengthening knowledge and systems to targeted climate action	Capacity Building and Awareness Adoption of CSA Adaptation Mitigation
19	Southern Agricultural Growth Corridor of Tanzania (SAGCOT)		The goal is to expand investment in agribusiness leading to income growth among smallholders and employment generation across agribusiness value chains in the Southern Corridor	Capacity Building - Finances
20	Big Result Now (BRN)		The objective is to address critical sector constraints and challenges and to speed-up agriculture GDP, improve smallholder incomes and ensure food security by 2015, mainly through smallholder aggregation models for main cereals and high potential crops contributing to import substitution, farm income and food security.	Capacity Building and Awareness Adaptation
21	National Environmental Policy (NEP)		Aims at ensuring sustainable and equitable use of resources for meeting basic needs, preventing and controlling degradation of land, water, vegetation and air, and improving the condition and productivity of degraded rural and urban areas	Capacity Building and Awareness Adoption of CSA
22	The National Strategy for		The strategy aims to facilitate effective and coordinated	Capacity Building and

	Reduced Emissions from Deforestation and Forest Degradation (REDD+)		framework for reducing deforestation and forest degradation. It guides the implementation and coordination of mechanisms required for Tanzania to benefit from a post-2012 internationally approved system for forest carbon trading, based on demonstrated emission reductions from deforestation and forest degradation and other aspects of REDD+	Awareness Coordination Adoption and Scaling-up CSA
REGIONAL POLICIES				
23	Comprehensive Africa Agriculture Development Programme (CAADP)	2003	The goals of CAADP are very much in harmony with Tanzania's goals of creating a modernized and commercialized agricultural sector that will contribute to economic growth and poverty reduction in the country.	Capacity Building and Awareness Coordination Adoption and Scaling-up CSA
24	EAC Food Security Action Plan	2011	Analysis of food security and nutrition issues in the region Review policies, legislation and strategies related to food security and nutrition for each partner state Develop a regional Food security and nutrition policy Public awareness campaigns Develop regional water use policy Development of an EAC Regional Pastoral policy	Capacity Building and Awareness Coordination Adoption and Scaling-up CSA
25	EAC Climate Change Policy	2009	The purpose of the EAC Climate Change Policy is to guide EAC Partner States and other stakeholders on the implementation of collective measures to address climate change impacts and causes in the region through adaptation and mitigation actions while assuring sustainable social and economic development.	Capacity Building and Awareness Coordination Adoption and Scaling-up CSA

Annex 2: Institutions involved in CSA

No.	Organization/ Institutions	Project	Project Timeframe	Roles/ Description	Focus Area	Supported (Financially and/or Technically) by:
1	Ministry of Agriculture Food Security and Cooperatives (MAFC) - Environment Management Unit (EMU)	TANZANIA CLIMATE- SMART AGRICULTU RE PROGRAMM E	2015 – 2025	<ul style="list-style-type: none"> • Coordinate with entities such as SAGCOT Centre, BRN Presidential Delivery • Bureau, etc to leverage private sector contributions to promote climate resilience • Build capacity to develop proposals for international climate finance • Coordinate with ASDP secretariat on mainstreaming and supporting recurrent costs of action plan implementation • Generate revenues through levies or fees, for example on irrigation schemes 	<ul style="list-style-type: none"> • Coordination and building partnerships • Leveraging financial resources • Reporting • Capacity building and awareness • Productivity and food security • Mainstreaming 	<ul style="list-style-type: none"> • Government • World Bank (the Bank) • UK Department for International Development (DFID), • Bank-Netherlands • Partnership Programme (BNPP), • Open University of Tanzania • FAO
		Agriculture Climate Resilience Plan	2014 – 2019	<ul style="list-style-type: none"> - Implementing Programmatic Result Area - Coordination - Monitoring and Evaluation 		<ul style="list-style-type: none"> • IDRC-funded climate change project under the Sokoine University of Agriculture (SUA)
2	Vice President's	TANZANIA	2015 – 2025	<ul style="list-style-type: none"> • Provide capacity building to MAFC on 	<ul style="list-style-type: none"> • Capacity building Financial 	<ul style="list-style-type: none"> • Government

	Office – Division of Environment	CLIMATE-SMART AGRICULTURE PROGRAMME		<p>accessing international climate finance</p> <ul style="list-style-type: none"> Ensure that funds flow to sectors from projects on climate change mainstreaming and eventual funding from preparation of NAMAs and NAPs 	assistance	<ul style="list-style-type: none"> World Bank (the Bank UK Department for International Development (DFID), Bank-Netherlands Partnership Programme (BNPP), IDRC-funded climate change project under the Sokoine University of Agriculture (SUA)
3	Ministry of Finance	TANZANIA CLIMATE-SMART AGRICULTURE PROGRAMME	2015 – 2025	<ul style="list-style-type: none"> Integrate Action Plan into MTEF Potential role in developing a financing framework for climate change 		<ul style="list-style-type: none"> Government World Bank (the Bank UK Department for International Development (DFID), Bank-Netherlands Partnership Programme (BNPP), IDRC-funded climate change project under the Sokoine University of Agriculture (SUA)
4	NIC	Agriculture Climate Resilience Plan	2014 – 2019	<ul style="list-style-type: none"> Develop guidelines to ensure that irrigation expansion and rehabilitation plans and designs consider water 	<ul style="list-style-type: none"> Capacity building and awareness 	<ul style="list-style-type: none"> Government

	National Irrigation Commission			<p>availability, climate variability and climate change</p> <ul style="list-style-type: none"> • Develop policy briefs to update policies to emphasize water use efficiency improvements and embed climate change • Use environmental assessment and enforcement strategically to integrate water availability and climate change into irrigation projects and planning • Promote the sustainable use of groundwater resources for irrigation • Support traditional and improved rainwater harvesting techniques • Support on-farm water storage facilities • Accelerate uptake of sustainable irrigation and water use efficiency technologies to smallholders 	<ul style="list-style-type: none"> • Adaptation and Mitigation 	<ul style="list-style-type: none"> • World Bank (the Bank • UK Department for International Development (DFID), • Bank-Netherlands • Partnership Programme (BNPP), • IDRC-funded climate change project under the Sokoine University of Agriculture (SUA)
5	LGA(s) Local Government Authorities	TANZANIA CLIMATE-SMART AGRICULTURE PROGRAMME	2015 – 2025	<ul style="list-style-type: none"> • Support traditional and improved rainwater harvesting techniques • Support on-farm water storage facilities • Accelerate uptake of sustainable irrigation and water use efficiency technologies to smallholders • Support innovative paddy rice production techniques • Demonstrate good CSA practices in the field 	<ul style="list-style-type: none"> • Adaptation and Mitigation 	<ul style="list-style-type: none"> • Government • World Bank (the Bank • UK Department for International Development (DFID), • Bank-Netherlands • Partnership Programme (BNPP),

						<ul style="list-style-type: none"> IDRC-funded climate change project under the Sokoine University of Agriculture (SUA)
6	MoW Ministry of Water	TANZANIA CLIMATE- SMART AGRICULTURE PROGRAMME	2015 – 2025	<ul style="list-style-type: none"> Promote the sustainable use of groundwater resources for irrigation 	<ul style="list-style-type: none"> Adaptation and Mitigation 	<ul style="list-style-type: none"> Government World Bank (the Bank UK Department for International Development (DFID), Bank-Netherlands Partnership Programme (BNPP), IDRC-funded climate change project under the Sokoine University of Agriculture (SUA)
7	NEMC	TANZANIA CLIMATE- SMART AGRICULTURE PROGRAMME	2015 – 2025	<ul style="list-style-type: none"> Use environmental assessment and enforcement strategically to integrate water availability and climate change into irrigation projects and planning 	<ul style="list-style-type: none"> Adaptation and Mitigation 	<ul style="list-style-type: none"> Government World Bank (the Bank UK Department for International Development (DFID), Bank-Netherlands Partnership Programme (BNPP), IDRC-funded climate change project under the Sokoine University of Agriculture (SUA)
8	DMECH, Department of	TANZANIA CLIMATE- SMART	2015 – 2025	<ul style="list-style-type: none"> Build the evidence base to promote CSA Develop clear guidelines and policy 	<ul style="list-style-type: none"> Capacity building and awareness Adaptation and Mitigation 	<ul style="list-style-type: none"> Government World Bank (the Bank

	Mechanization	AGRICULTURE PROGRAMME		<p>briefs for CSA technologies and practices</p> <ul style="list-style-type: none"> • Build capacity at the District level for mainstreaming • CSA in planning • Increase awareness and capacity for CSA practices through practical training • Demonstrate good CSA practices in the field 		<ul style="list-style-type: none"> • UK Department for International Development (DFID), • Bank-Netherlands • Partnership Programme (BNPP), • IDRC-funded climate change project under the Sokoine University of Agriculture (SUA)
9	DLUP, Department-Land Use Planning		2014 – 2019	<ul style="list-style-type: none"> • Build the evidence base to promote CSA • Develop clear guidelines and policy briefs for CSA technologies and practices • Establish an emissions baseline for the agriculture sector • Build capacity at the District level for mainstreaming • CSA in planning • Promote CSA in DADPs planning process • Establish a monitoring system for CSA interventions • Develop incentives to offset the costs 	<ul style="list-style-type: none"> • Capacity building and awareness • Adaptation and Mitigation 	<ul style="list-style-type: none"> • Government • World Bank (the Bank • UK Department for International Development (DFID), • Bank-Netherlands • Partnership Programme (BNPP), • IDRC-funded climate change project under the Sokoine University of Agriculture (SUA)

				<p>of CSA</p> <ul style="list-style-type: none"> • Increase awareness and capacity for CSA practices through practical training • Demonstrate good CSA practices in the field 		
10	DPP, Department of Policy and Planning	TANZANIA CLIMATE-SMART AGRICULTURE PROGRAMME	2015 – 2025	<ul style="list-style-type: none"> • Build capacity at the District level for mainstreaming CSA in planning • Promote CSA in DADPs planning process • Establish a monitoring system for CSA interventions 	<ul style="list-style-type: none"> • Capacity building and awareness • Adaptation and Mitigation 	<ul style="list-style-type: none"> • Government • World Bank (the Bank) • UK Department for International Development (DFID), • Bank-Netherlands • Partnership Programme (BNPP), • IDRC-funded climate change project under the Sokoine University of Agriculture (SUA)
11	DNFS, Department of Nutrition and Food Security	TANZANIA CLIMATE-SMART AGRICULTURE PROGRAMME	2015 – 2025	<ul style="list-style-type: none"> • Implement the TAFSIP disaster management plan • Strengthen integration of pests and diseases into monitoring protocols and early warning systems, and develop research programmes on the links between climate change and pest and disease outbreaks • Develop a programme to establish value adding industries for farm products 	<ul style="list-style-type: none"> • Adaptation and Mitigation 	<ul style="list-style-type: none"> • Government • World Bank (the Bank) • UK Department for International Development (DFID), • Bank-Netherlands

						<ul style="list-style-type: none"> • Partnership Programme (BNPP), • IDRC-funded climate change project under the Sokoine University of Agriculture (SUA)
12	<p>PMO-DMD Prime Minister's Office – Disaster Management Department</p>			<ul style="list-style-type: none"> • Implement the TAFSIP disaster management plan • Inventory lessons from EWS and DRM projects and scale up successful interventions 	<ul style="list-style-type: none"> • Adaptation and Mitigation 	<ul style="list-style-type: none"> • Government • World Bank (the Bank • UK Department for International Development (DFID), • Bank-Netherlands • Partnership Programme (BNPP), • IDRC-funded climate change project under the Sokoine University of Agriculture (SUA)
13	<p>DCD, Department of Crop Development</p>			<ul style="list-style-type: none"> • Strengthen integration of pests and diseases into monitoring protocols and early warning systems, and develop research programmes on the links between climate change and pest and disease outbreaks • Improve communication of weather and early warning system information to farmers • Inventory lessons from EWS and DRM projects and scale up successful 	<ul style="list-style-type: none"> • Adaptation and Mitigation 	<ul style="list-style-type: none"> • Government • World Bank (the Bank • UK Department for International

				interventions			Development (DFID), <ul style="list-style-type: none"> • Bank-Netherlands • Partnership Programme (BNPP), • IDRC-funded climate change project under the Sokoine University of Agriculture (SUA)
14	TMA, Tanzania Meteorological Agency	TANZANIA CLIMATE- SMART AGRICULTURE PROGRAMME	2015 – 2025	<ul style="list-style-type: none"> • Strengthen integration of pests and diseases into monitoring protocols and early warning systems, and develop research programmes on the links between climate change and pest and disease outbreaks • Improve communication of weather and early warning system information to farmers • Inventory lessons from EWS and DRM projects and scale up successful interventions • Develop and coordinate a campaign using ICT to raise awareness and disseminate targeted climate and weather information 	<ul style="list-style-type: none"> • Research/ Assistance, • Adaptation and Mitigation 	Technical	<ul style="list-style-type: none"> • Government • World Bank (the Bank • UK Department for International Development (DFID), • Bank-Netherlands • Partnership Programme (BNPP), • IDRC-funded climate change project under the Sokoine University of Agriculture (SUA)
15	DRD	TANZANIA CLIMATE- SMART	2015 – 2025	<ul style="list-style-type: none"> • Strengthen integration of pests and diseases into monitoring protocols and early warning systems, and 	<ul style="list-style-type: none"> • Research/ Assistance, 	Technical	<ul style="list-style-type: none"> • Government

	Department of Research and Development	AGRICULTURE PROGRAMME		<p>develop research programs on the links between climate change and pest and disease outbreaks</p> <ul style="list-style-type: none"> • Undertake a research programme on building resilience through postharvest processing and value addition • Conduct a stocktaking on water use efficiency, water lifting technologies, rainwater harvesting and water storage techniques 	<ul style="list-style-type: none"> • Capacity building • Awareness • Adaptation and Mitigation 	<ul style="list-style-type: none"> • World Bank (the Bank) • UK Department for International Development (DFID), • Bank-Netherlands • Partnership Programme (BNPP), • IDRC-funded climate change project under the Sokoine University of Agriculture (SUA)
16	SUA Sokoine University of Agriculture	TANZANIA CLIMATE-SMART AGRICULTURE PROGRAMME	2015 – 2025	<ul style="list-style-type: none"> • Undertake a research programme on building resilience through postharvest processing and value addition 	<ul style="list-style-type: none"> • Research/ Technical Assistance, • Capacity building • Awareness • Adaptation and Mitigation 	<ul style="list-style-type: none"> • IDRC
17	Universities and Institutions			<ul style="list-style-type: none"> • MAFC partnering with key institutions such universities and research institutions to coordinate on climate change projects • Seek opportunities for co-financing of climate-related projects and programmes 	<ul style="list-style-type: none"> • Capacity building Financial assistance 	

				<ul style="list-style-type: none"> • Conduct a stocktaking on water use efficiency, water lifting technologies, rainwater harvesting and water storage techniques 		
18	Other Development Partners			<ul style="list-style-type: none"> • Potential source of initial financing for Action Plan activities • MAFC to ensure that DP-funded agriculture projects are aware of and consider financing Action Plan activities • Technical assistance to MAFC for implementation of the ACRP, including climate finance readiness, project feasibility studies, and institutional strengthening • Financing implementation of linked activities such as the SAGCOT • Greenprint and REDD+ Strategy 	<ul style="list-style-type: none"> • Capacity building Financial assistance 	<ul style="list-style-type: none"> • World Bank (the Bank) • UK Department for International Development (DFID), • Bank-Netherlands • Partnership Programme (BNPP), • IDRC-funded climate change project under the Sokoine University of Agriculture (SUA)
19	Other funding sources			<ul style="list-style-type: none"> • Increased private sector investment in Tanzania brings opportunity to leverage • PPPs that could finance resilience actions • NGOs, foundations and research institutions are heavily engaged in areas such as climate smart agriculture and natural resources management. These relationships could be leveraged to harmonize with the action plan 	<ul style="list-style-type: none"> • Capacity building Financial assistance 	<ul style="list-style-type: none"> • REDD+, UN

20	MIS			<ul style="list-style-type: none"> • Develop a framework to target climate adaptation projects in vulnerable areas • Develop and operationalize an Information Management System and web portal for climate change and agriculture • Establish stakeholder engagement and communication networks • Develop a gender and agriculture coordination mechanism • Develop and coordinate a campaign using ICT to raise awareness and disseminate targeted climate and weather information 	<ul style="list-style-type: none"> • Capacity building • Awareness 	
21	DAHR Department of Administration and Human Resources			<ul style="list-style-type: none"> • Develop a gender and agriculture coordination mechanism 	<ul style="list-style-type: none"> • Capacity building 	<ul style="list-style-type: none"> • Government • World Bank (the Bank) • UK Department for International Development (DFID), • Bank-Netherlands • Partnership Programme (BNPP), • IDRC-funded climate change project under the Sokoine University of Agriculture (SUA)
22	MCDGC			<ul style="list-style-type: none"> • Develop a gender and agriculture coordination mechanism 	<ul style="list-style-type: none"> • Capacity building 	<ul style="list-style-type: none"> • Government • World Bank (the Bank) • UK Department for International

						<ul style="list-style-type: none"> Development (DFID), Bank-Netherlands Partnership Programme (BNPP), IDRC-funded climate change project under the Sokoine University of Agriculture (SUA)
23	Development partners (UNEP, IFAD, WB, USAID, AfDB, Tanzania Agricultural Development Bank-TADB, Tanzania Investment Bank-TIB)				<ul style="list-style-type: none"> Resource mobilization and Technical Assistance 	
24	Regional initiatives (CCAFS, COMESA, EAC and SADC)				<ul style="list-style-type: none"> Resource mobilization and Technical Assistance Scaling-up CSA 	
25	FAO MICCA - Tanzania	FAO Mitigation of Climate Change in Agriculture (MICCA) Programme	2010 -	<ul style="list-style-type: none"> Building a knowledge base on what it will take to put climate-smart agriculture into practice Develop a selection of climate-smart agricultural practices for smallholder farmers based on participatory assessments and consultative processes at multiple levels Development of the “menus of practices” - specific assessments of the adaptation, mitigation and food 	<ul style="list-style-type: none"> Research/ Technical Assistance Capacity building and awareness Adaptation and Mitigation 	<ul style="list-style-type: none"> FAO - UN

				<p>security benefits of a range of agricultural practices</p> <ul style="list-style-type: none"> • Practices are identified based on the given agro-ecological and socio-economic situation of each pilot project • MICCA Programme is a multidisciplinary initiative that builds on FAO's long-standing work carried out by its different technical departments and collaborates with international and national organizations • MICCA complements other FAO and United Nations efforts to address climate change and collaborates with the UN-REDD Programme 	<ul style="list-style-type: none"> • Scaling-up CSA 	
26	Farming communities			<ul style="list-style-type: none"> • ESRF mission is to advance knowledge to the public and private sector entities through sound policy research findings, capacity development and by advocating good development management practices 	<ul style="list-style-type: none"> • Adoption of CSA 	
27	ACSAA - Africa Climate Smart Agriculture Alliance			<ul style="list-style-type: none"> • The Africa CSA alliance is committed to action, and to maximising the efficiency, effectiveness and impact of scaling-up activities. Many of its members and supporters have substantial expertise in scaling-up CSA, and collectively provide a strong foundation for developing effective collaborative approaches 	<ul style="list-style-type: none"> • Scaling-up CSA 	<ul style="list-style-type: none"> • AU and other sponsors
28	Henry Consulting				<ul style="list-style-type: none"> • Research/ Technical 	

					<p>Assistance</p> <ul style="list-style-type: none"> • Scaling-up CSA • Capacity building and awareness • Adaptation and Mitigation 	
29	Economic and Social Research Foundation (ESRF)			<ul style="list-style-type: none"> • ESRF mission is to advance knowledge to the public and private sector entities through sound policy research findings, capacity development and by advocating good development management practices 		
30	International NGOs (CARE, Catholic Relief Service, World Vision, Concern Worldwide, Oxfam)			<ul style="list-style-type: none"> • Scale-up the adoption of CSA practices by the region's smallholder farmers to improve their food and livelihood security and resilience to climate change • Working collaboratively with the Tanzanian Government and Technical partners to design and implement programmes in a way which maximises the efficiency, effectiveness and impact of investments 	<ul style="list-style-type: none"> • Coordination and building partnerships • Leveraging financial resources • Scaling-up CSA • Capacity building and awareness • Productivity and food security 	

Annex 3: CSA Technologies, practices and services

Crop Agriculture

Agronomic practices that harvest rainwater, prevent erosion, encourage infiltration of water and improve soil fertility have been adopted in many areas in Tanzania. Such practices include banded rice fields (*jaluba*), *ndiva*), tied ridges, bench terraces, ripping, trash lines which are a collection vegetation in the form of brush wood or grass arranged along the contour lines or just across the slope to prevent build-up of run-off, incorporation of crop residues, use of farm yard manure and agroforestry (Hatibu *et al.*, 2002). In most cases, a combination of several practices is employed in one farm. The national extension services and NGOs are in the forefront in the promotion of a wide range of practices. SCAPA for example successfully introduced terracing in Arumeru District in Arusha. Terracing and agro-forestry are widely adopted following their introduction in Lushoto District.

Irrigated crop production

Currently project plans and requests for funding small-scale irrigation schemes originate at village level but are submitted through the Agricultural Sector Development Programme (ASDP) and Livestock Sector development Programme (LSDP). Small-scale old and new irrigation projects at village or catchment level have benefited through DADPs programmes. Before the current system, small-scale irrigation schemes were constructed and old one rehabilitated under the River Basin Management and Smallholder Irrigation Improvement Project (1996 -2004). The rehabilitation work involved construction of intakes fitted with gates to control water and water conveyance canals aimed at reducing losses. Under RBMSIIMP Water User Groups/ Associations (WUG/A) were established and WUG leaders trained on how to manage and run irrigation schemes.

The Mwega Irrigation Scheme in Kilosa Morogoro is an example of a well performing community managed system. The operation and maintenance (O&M) of the schemes is under the WUGs using water use fee collected from members and provision of labour through self-help activities. The best smallholder irrigation schemes are those that have WUG, Cooperative societies and depend on gravity for water to flow. The Mwega scheme has all the above key features. Dependence on gravity removes the need and therefore cost for power (electricity or petrol) required to run the pumping units. At Mwega a wide range of crops (e.g. maize, rice, and vegetables such as onions and sweet pepper) are produced thus capturing a broader market.

Tanzania has a total irrigation development potential of 29.4 million ha. Of this total area, 2.3 million ha are classified as high potential, 4.8 million ha as medium potential and 22.3 million ha as low potential (URT, 2002). However, as of June 2008, 289,245 hectares were estimated to be under irrigation and dominated by small-scale irrigation. The different areas addressed by the Government include: (i) Rehabilitation of traditional irrigation schemes, (ii) Development of water harvesting Schemes and (iii) New smallholder schemes. The constraint is lack of enough funds to implement all the planned schemes.

Another category of irrigation involves individual farmers operating petrol and tridle pumps as well as watering cans along rivers. Similarly watering cans and tap water are used near homesteads to produce

high value crops mainly vegetables for the market or domestic needs. All these strategies are enhancing food and income security.

Overnight storage reservoir (Ndiva)

Ndiva is a traditional irrigation technology among the Pare people in same District, Kilimanjaro Region. It is believed to have been in existence as early as the 18th century. *Ndiva* (Over night storage reservoir) is suitable in mid slopes of mountainous areas, or where the slope is adequate to enable flow of water by gravity. Water should be easily diverted without need for a pump. It reduces the risk of crop failure in Semi-Arid Lands (SAL) by providing supplementary irrigation during dry spells within the rain season. Relatively small areas of high value crops are grown off-season leading to increased income in the households. Because of the slope, adoption of S&WC measures is important to prevent soil erosion.

Water User Groups (WUGs) based on the '*ndiva*' system compel their members to construct bench terraces before they can be allocated water. This precondition has helped to conserve both soil and water in the mountainous areas in Same and Mwanza Districts among the Pare people. Since farmers are guaranteed to harvest whatever they plant, the *ndiva* system makes the individual farmer more food and income secure. Apart from maize, vegetables (tomatoes, egg plants, sweet pepper, cabbage, carrots, cucumber) are the main crops grown during the dry season as these are in high demand and good money can be earned from even a small area. In the Pare Mountains farmers use a combination of technologies in one and same field e.g. bench terraces, farm yard manure, supplementary irrigation, mulching, inter cropping and agro-forestry. The combination of several technologies in one and same piece of land is possibly the key to the success and sustainability of the production system in the Pare Mountains.

Several outside interventions have assisted in the improvement of the *ndiva* system. Examples of institutions include Same Agricultural Improvement Programme (SAIPRO) an NGO, Traditional Irrigation Improvement Project (TIIP), World Vision, Care International, the Tanzania government through DADPs and Sokoine University of Agriculture research cum development projects. The interventions are mainly on (i) expanding the size of the storage structures, (ii) lining of water distribution canals to reduce conveyance losses, and (iii) construction of robust intakes to enable the control of abstraction of water.

Bunded basins (Majaruba) rainwater harvesting for crop production

According to CCAP PARTNERS (2013), the *Majaruba* (plural) (bunded fields) are widely used in many parts of Tanzania for growing different crops and in different soils. They occur in different shapes and sizes. For paddy, clay soils are most ideal because of their poor infiltration, which enables them to retain water for long periods. Since clay soils are difficult to work with, e.g. hard when dry and sticky when wet, they have a very narrow time window during which they can be tilled. Availability of draft power during field operations is thus vital. The occurrence of *Majaruba* in large numbers in Shinyanga, Tabora and Mwanza is attributed to the presence of large livestock numbers in the area and the equally high adoption of draft animal power in these regions.

Majaruba are constructed by digging the field to a depth of about 20cm and the scooped soil is used to build a bund around a rectangular field perimeter. Weeds from the cropped area are placed on the bund thus increasing their heights. Practically, *Majaruba* are located such that diverted water flow by gravity into the system. Run-off water diverted from drainage system of road networks, built up areas, and natural waterways on the farm has enabled farmers in dry areas to reduce occurrence of crop failure. Water discharged from culverts along main roads goes directly into *Majaruba*. Paddy and maize, two high water demanding crops are currently produced in large quantities from Shinyanga, Tabora, Singida and Dodoma regions that are traditionally considered semi-arid. Both maize and paddy double as food and cash crops.

In non-paddy soils, *Majaruba* are used to increase chances for infiltration before planting maize or other crops. Once constructed, a *jaruba* can be used for years with minimal annual repair. Food security and household incomes have improved in SAL as a result of stable and less risky production under the *Majaruba* system. Bunded crop fields increase the time window for diverted and impounded water to infiltrate.

Spate Irrigation

Spate irrigation is a type of water management that is unique to semi-arid environments. Floodwater from mountain catchments is diverted from riverbeds and spread over large areas through a network of canals. Spate irrigation is suitable in areas with gentle to flat slopes, where adequate and reliable runoff from surrounding watershed/ catchment, can be easily diverted from relatively shallow gullies or watercourses (Kahimba et al. 2015). The system is practiced in many regions of Tanzania -Kilimanjaro, Morogoro, Dodoma, Singida, Mwanza, Shinyanga, Coast and Tabora. At Makanya in Same District the system has no permanent infrastructure for diversion.

The runoff from the Pare Mountains concentrated by road culverts and railway bridge is diverted into crop fields using temporary diversion structures to irrigate 300ha of maize fields benefiting more than 780 households at Makanya, Same District. Maize yield has increased from zero to between 2.5 – 5t ha⁻¹ twice a year (SWMR, 1998; Komakech *et al.*, 2010). Nothing can be grown without Rain Water Harvesting since only 300 mm of poorly distributed rainfall are received annually. Floodwater flows, with appreciable discharges usually last for only a few hours, and with recession flows lasting for a day or two. A maximum of three to four such flows are received per season and that is enough to enable maize to grow to maturity. Deep alluvial soils with high water holding capacity capable of storing water for long period enable production of crops such as maize, vegetables, and beans. To take advantage of the reliable moisture regime under spate irrigation, inputs such as Farm Yard Manure (FYM), improved seed and mineral fertilizer are also used to get higher returns. This again demonstrates that CSA is in most cases a product of a combination of technologies and practices. Day to day management, operation and maintenance of the spate irrigation schemes is the responsibility of the members based on self-help labour provided by scheme members. Recently at the Makanya scheme, the WHATER project at Sokoine University of Agriculture (SUA), DADP, NGOs e.g. Same Community Trust Fund have assisted in constructing concrete intakes and water distribution canals that are not easily breached.

Use of systems of rice intensification (SRI)

According to Kahimba et al. (2015) and Rwehumbiza (2014), rice is second to maize as a preferred staple food in Tanzania. Production is facing challenges of low productivity mainly due to scarcity of water, poor agronomic practices and low soil fertility. Agricultural development under the scenario of changing climate requires judicious use of the available resources mainly water. Rice production in Tanzania is both rain-fed and irrigated, and smallholder farmers using poor water and soil management techniques usually do it. Research work on SRI in the country has generated evidence on the superior performance of SRI compared to the conventional paddy production system in relation to water management and input use. For example grain yield has increased almost two fold while using less water and seed including the fact that applied fertilizer is used more efficiently. There are more effective tillers (with filled grains) under SRI than under conventional flooding. SRI has been successfully introduced and promoted in Mvomero at Mukindo and Morogoro rural at Kiloka Districts, Morogoro Region. Use of SRI is still confined in a few areas of the country and thus efforts to promote the system are needed.

Use of fertilizer and improved seed: The Government has extended subsidy on fertilizer and seed through the NAIVS and this has improved yield in many parts of the country especially of maize in the Southern Highland zone (Mbeya, Rukwa, Iringa, Songea) where climatic conditions are conducive. Farmers have traditionally planted local seed from one season to the next without applying fertilizer. Most traditional cultivars that some small-scale farmers continue to use are low yielding. This limits the range of results that can be obtained with improved agronomic practices including fertilizer, pesticides and irrigation.

Integration of crop and animal production

Coffee-Banana-intensive animal keeping system practiced in Kilimanjaro, Kagera and Mbeya regions has demonstrated the sustainability of the system. In Kagera traditional cattle are semi-intensively kept while in Kilimanjaro the system is purely zero grazing of dairy cattle. Manure from the livestock is used on the farm while crop residues (banana peels, pseudo-stem and leaves) are consumed by animals. Additionally, residues from beans, stover left after harvesting of maize is stored and used as animal feed to mainly dairy cattle or goats. The income from sale of milk makes the families food and financially secure. When applied in the farms, FYM is usually covered by soil or mixed with soil to reduce GHG emissions (e.g. methane) and N losses. The practice described above is essentially a multi-storey agroforestry system. A number of crops (beans, cassava, yams, vegetables, leguminous trees and fruit trees e.g. mango, avocado, citrus are commonly also found in the system. Fodder crops as well as trees that are used as fuel wood are additionally planted in the periphery of the farms. The system described above is more common in areas where land is scarce. Bio-gas produced using FYM (cow dung) is providing energy for cooking thereby reducing the need to use fuel wood that leads to deforestation.

"Ngoro" or Matengo pits

"Ngoro" are a type of terraces, also known as Matengo pits that are practiced by the Matengo tribe in southern Tanzania. Ngoro terraces are common in mountainous areas and they are built by collecting and arranging grass and weeds to form a grid of squares. After drying, the grasses/weeds are covered with soil, which is dug from the middle of the squares (Rwehumbiza and Mahoo, 2002). A farm and indeed an entire landscape will look like an egg tray due to many pits and terraces. These types of terraces control

runoff, soil erosion and improve soil fertility. During weeding, weeds are thrown in the depressions where they decompose and add to soil organic matter.

Ripping

Ripping and sub-soiling opens up the soil encouraging both infiltration and percolation of rainwater. In Babati Manyara region LAMP project reversed declining maize yield through ripping and sub-soiling instead of conventional ploughing (Elwell *et al.*, 2000). The yield was 1.7 tons/ha by practicing conventional ploughing and application of manure but only 1.2 tons/ha by just in the absence of manure. However, incorporation of FYM following ripping and sub-soiling increased maize yield to 5 tons/ha, while the yield was only 3.8 tons/ha in the absence of FYM (Rwehumbiza, 2014). Intercropping of maize with pigeon peas a deep-rooted legume also improved maize yield significantly. Ripping enables the root system to explore more soil volume thereby accessing more water and nutrients resources. The pigeon pea crop usually matures much later after the maize crop is harvested. Maize and peageon pea thus do not compete for labour at critical moments.

Introducing and planting of suitable cultivars

Some traditional crops and cultivars are succumbing to climate change. Crop improvement through breeding for the cultivars that are suitable under the prevailing climatic conditions has been one of the strategies. Maize, sorghum, cowpea and rice have received more attention in this regard. Introduction of new suitable cultivars from outside or within the country is another option being employed to meet the challenge. In Kagera new bananas cultivars have been introduced (e.g. *Malindi, Mtwike, Fia*) and these are gradually replacing indigenous cultivars in parts of the region where these are performing poorly under the changing climatic conditions. Indigenous crops such as yams, cocoyams remain un-promoted despite their inherent potential to perform well under the changing climate that is irregular and unreliable.

Planting drought tolerant crops is one aspect of CSA. Crops that perform well under limited soil moisture such as cassava, sorghum, millets and sweet potatoes have been promoted through different projects and programmes. Breeding work has already produced high yielding orange coloured sweet potatoes that are also superior in nutrient profile compared to white ones specifically in relation to vitamin A.

Mechanization of farm/ agricultural activities

Agricultural machinery reduce drudgery and thus facilitate timely implementation of various farm agronomic activities. The government has established agricultural machinery and implements for hire at village level to enable farmers to hire and utilize the same for field operations. Power tillers, tractors and trailers have enabled farmers to plough large areas in a very short time, to transport manure and crop produce conveniently and efficiently. There is also an exemption of taxes on most agricultural machinery including tractors to encourage farmers to purchase farm implements at affordable prices. The system described above has been successfully established in areas where livelihood depends on livestock and seasonal crops e.g. cotton, maize and sorghum. Mwanza, Shinyanga, Tabora, Singida, Dodoma, Manyara and drier areas of Kilimanjaro region fall into this category.

Residual Tied-ridges

Ridging is considered time consuming and would force farmers to undertake elaborate ploughing instead of the superficial tillage (*kuberega*) common among the Gogo tribes. Tied ridges are normally constructed every season. This makes the practice laborious and therefore unattractive to the Gogo tribe farmers. The Soil Water Management Research Programme based at SUA introduced 'residual tied ridges' at Hombolo, Dodoma in 1996 in an effort to reduce labour (). A modification was introduced where land is ploughed, FYM applied and tied ridges constructed. In subsequent seasons the ridges are not demolished but receive very limited repair every season, hence the name 'residual tied ridges'. After five seasons, sorghum grain yield from 'residual tied ridges' was comparable to that from annually made tied ridges with grain yield of 2 t/ha while control plots that received no ploughing and no ridging (*kuberega*) had only 0.4 t/ha (Kabanza and Rwehumbiza, 2010). The reduced tillage and the increased sorghum grain yield under the residual tied ridges are making the system attractive to farmers in semi-arid areas. Availability of both draft animal power and FYM has resulted in rapid uptake of tied ridges in the areas. The residual tied ridges as practiced in Dodoma are a CSA technology.

Terracing-crop rotations-agroforestry

Several sustainable production systems in the country use a combination of conservation technologies. Use of *ladder* terraces in Mgeta area in Morogoro that is associated with crop rotations, improved seed, fertilizer, manure and agro-forestry has enabled successful production of vegetables and fruits for many years. Upper Mgeta Development Programme (UMADEP) and other programmes based at Sokoine University have used Mgeta area as an outreach site. The UMADEP programme has linked farmers with reliable markets for their produce, introduced new vegetable varieties and milk goats that are zero grazed. A wide range of crop and animal agriculture problems faced by farmers are given solutions by multidisciplinary teams of scientists from SUA. Permanent demonstration plots specifically for fruits and vegetables have been in place since 1980s. Most households in the area are thus food and income secure.

Mixed cropping and diversification

Mixed cropping is a common practice in most smallholder farms throughout the country with the exception of paddy. In central Tanzania for example in an one hectare farm, one can find maize, sorghum, cow peas, sunflower, beans, groundnuts, cassava and pumpkins growing side by side. This technology is based on the fact that different crops have different seasonal moisture requirements. If one fails another one survives and the system thus guarantees that at least there is something to harvest at the end of the day. This is most practiced at the subsistence level of production. In the 1980s the drive was to promote and at times enforce pure stands. Farmers have however continued with mixed cropping both in seasonal and perennial cropping systems.

Timely and focused forecasts

Weather and climate influence not only the growth and development of agricultural crops but also define the yield quality, the agricultural machine effectiveness, the usefulness of fertilizer, the conditions for the spread of pests and diseases of crops and animals. The role of National Meteorological Services (NMS) is to offer agrometeorological services which would allow farmers, decision makers, researchers, technicians and producers to make timely decisions with a sufficient time lead to mitigate the negative effects of weather on crops and livestock and to take full advantage of the weather whenever possible.

Agricultural production in Tanzania is predominantly rain-fed accounting for more than 90% of the total. Optimization of rain fed agricultural production is dependent on timely and focused dissemination of weather forecasts and advisories to end-users.

Tanzania Meteorological Agency (TMA) is the designated National Meteorological Authority, which is entrusted with the task of providing and regulating weather and climate services in Tanzania. Under TMA, the Agrometeorology and Remote Sensing Section has the mandate to coordinate agrometeorological services in the country. The agro-meteorology and remote sensing section provide general and user specific agro-meteorology, hydrometeorology and environmental advices to the farming community. Availability of forecasts and advisories reduce vulnerability particularly of poor farmers with limited resources.

Animal Farming: Indigenous livestock adapted to harsh environment

Over 90% of the livestock population in Tanzania is of indigenous types (Zebu, Ankole), which are known for their low genetic potential in terms of milk yield and body size for beef production. These animals are however well adapted to harsh environmental conditions and have high resistance to diseases when compared to say exotic temperate cattle breeds (e.g. Friesian and Jersey). Most pastoralist and agro-pastoralists in villages practice extensive grazing on open access unimproved rangelands. The Mpwapwa cattle breed, a product of breeding work at Mpwapwa, produces more milk and has a better body weight than the local zebu. At the same time, it is adapted to harsh environmental conditions when compared to exotic breeds, e.g. Friesian.

Diversification of livestock herd towards small animals

Compared to the 1980s, the Maasai in Simanjiro and Mvomero Districts of Tanzania are having large numbers of goats and sheep instead of cattle (Tumbo et al, 2011). Goat and sheep require for example only a fifth of the water consumed by cattle. Additionally, sheep and goat can survive on brushwood and poor quality pastures that are found in areas considered hostile and inaccessible to cattle. During droughts, pastoralists lose more cattle and few goats and sheep if any. The move to diversify livestock herd towards small animals is thus CSA in practice. This move is by pastoralists rather than a policy by the government. The prevailing policy is to reduce livestock numbers rather than changing the type.

Destocking and diversification of investments

The shrinking of range lands and thus grazing areas has forced pastoralists and specifically the Maasai to sell large part of their livestock herds and use the money to invest in real estate in towns and cities. Some have opted for permanent settlement and practicing of crop agriculture. At Ruvu Mferejini, in Same District, Maasai practice irrigated agriculture growing maize and high value vegetables using a combination of FYM and mineral fertilizers to enhance productivity. Diversification of livelihoods has made pastoralists more food and financially secure. The reduced number of livestock has enabled pastoralists who have opted to destock, to meet water and pasture needs of the smaller herd within the vicinity without the need to migrate seasonally.

Use of charco" ponds"

Livestock productivity under pastoral and agro-pastoral systems in Tanzania is mainly constrained by poor availability of water and pasture especially during the dry period. As a coping mechanism, many smallholder livestock keepers have responded to the water scarcity problem by adopting rainwater-harvesting (RWH) techniques. The RWH technique that has been widely adopted is that of harvesting runoff and storing the water into charco ponds (SWMRP, 2001).

Intensive system of keeping dairy cattle

The intensive system is practiced mainly for keeping of dairy cattle (Friesian and Jersey) under zero grazing, though limited in size. The zero grazing system involves feeds being brought to the animals that are permanently kept in animal sheds. It has been receiving more emphasis in investment and improvement because of its contribution to the market oriented economy. Through the livestock sector development plan (LSDP) the number of improved dairy cattle is projected to increase from 605,000 cattle kept by about 150,000 farm households through annual insemination of about 100,000 doses to about 985,000 cattle kept by about 300,000 farmers by the end of 2016 (LSDP, 2011). The system is similar in many aspects to the "Integration of crop and animal production" described in section 3.3.1.9. This system is practiced mainly as peri-urban agriculture in most cities and towns around the country. Cut and carry and use of concentrates are common features in this system. Push, pull carts and pick-up trucks are used to transport grass cut from nearby green zones. The number of animals kept remains small due to high demand for feeds but the amount of milk produced is substantial. Large scale Dairy farms are found at Kitulo and Iwambi (Mbeya), Kange (Tanga), Ihimbo (Iringa) to mention a few. Most National Agricultural Research Institutes (NARIs) have stocks of improved animals of different categories that are used for breeding and animal nutrition research. On large dairy farms the system is semi-intensive with controlled grazing using paddocks. Thus over grazing and stocking are avoided. Seeding of paddock with improved pasture grass is practiced. Hay making by harvesting grass is also practiced e.g. at Sokoine University farm and at Uyole Agricultural Centre.

Peri-urban keeping of pigs using fruit and vegetable wastes

Pigs are mono-gastric animals consuming almost similar foodstuff like humans. Fruits and vegetables that go bad due to lack of cold storage at markets or get damaged while being transported to towns and cities end up on garbage containers at markets. The partially damaged fruits and vegetables are the main feed used to raise pigs in towns and cities. Pick-up trucks are commonly seen transporting market wastes to peri-urban farms in most cities around the country. Organic waste from city markets would end up producing methane if they were to be disposed of on city dumping sites. This system of using organic wastes is characteristically CSA in design.

The hydroponic system – fodder

The hydroponic fodder system is one of the initiatives pioneered by the Economic and Social Research Foundation in collaboration with the government of Tanzania and UNDP/UNEP through the Poverty Environment Initiative and CD-RBMA (Hassan, 2016). This system is a temperature and humidity controlled growing room that is specifically designed to sprout grains that are very nutritious, without any soil. Selected grains are put into trays without soil and sprayed with water solution at predetermined

intervals. The temperature and humidity inside the hydroponic fodder system are controlled to ensure higher growth and the best nutritional value possible. Hydroponic fodder is young tender grass grown from a cereal grain such as barley, wheat, millet etc. In essence it replaces grains like dairy meal, pig's feeds and poultry feed concentrates. With hay and grain prices reaching record highs, and unpredictable weather patterns damaging pasturelands, hydroponic systems present a viable alternative to sustainable production of fodder. This could help avoid on going fights for land between farmers and livestock keepers can be reduced.