



UNITED REPUBLIC OF TANZANIA

VICE PRESIDENT'S OFFICE

CLIMATE CHANGE ADAPTATION INFORMATION TOOLKIT FOR FARMING COMMUNITIES IN TANZANIA



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FOREWORD

Climate change is happening and will continue to be the real challenge for mankind survival and sustainable development. The impacts associated with climate change are already experienced in many systems and sectors essential for human livelihood in the most vulnerable communities. On the other hand, the impacts of climate change pose a direct threat to people's survival and different ecosystems, particularly in developing countries. It is expected that the frequency and intensity of extreme weather events will increase causing severe socio-economic consequences particularly to the least developing countries due to low adaptive capacity. In Tanzania, we have witnessed incidences of severe and recurrent droughts hitting many parts of our country leading to food insecurity, massive deaths of livestock, dwindling of water resources and destruction of human settlements and infrastructure due to floods. All of these had consequences to communities retarding their efforts to alleviate poverty. Farming communities are among the vulnerable groups that have been suffering seriously as a result of climate change due to the fact that their activities are climate sensitive.

In this regard, adaptation to the impacts of climate change is absolutely important in order to enable the farming communities to cope with the changing climate. Appropriate adaptation measures are important in strengthening the resilience of these communities in their local setting. For this to be effective, it is therefore imperative that communities are assisted with information that will enable them to understand climate change, its associated impacts and measures which can be employed in addressing the impacts of climate change through participatory climate change adaptation planning approach.

Cognizant of the fact that information on climate change is of paramount importance in assisting farmers to plan for adaptation actions, the Vice President's Office in consultation with stakeholders prepared this climate change adaptation information toolkit for farming communities in Tanzania. The toolkit is the first resource to the farming communities for the purpose of learning about what climate change is, what are the expected impacts to farming communities, and more importantly, it provides some preliminary ideas on options for adaptation that farming communities can apply to start dealing with the threats of climate change. It is a starting point for developing targeted information and resource materials to farming communities. Generally, this toolkit provides basic understanding on climate change, how it affects farming communities and equips them with ideas or tools to address climate change impacts. It is designed in the form of a resource book that will be made available directly to local farming communities, Extension Officers as well as other experts.

It is my sincere hope that you will find this Toolkit useful to guide adaptation awareness, planning, management and implementation of climate change adaptation measures for the farming communities. I urge you to use this Toolkit in undertaking planning, management and implementation of climate change adaptation actions, as it will contribute towards improving people's livelihood and sustainable development in the country.



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ACKNOWLEDGEMENT

The preparation of the Climate Change Adaptation Information Toolkit for Farming Communities in Tanzania is a result of commitment, full participation and cooperation of many individuals and institutions. It is not possible to mention all of them, but I would like to take this opportunity to express our heartfelt appreciation and assure them that we value their cooperation and support.

I would like to thank sector ministries, departments, agencies, local government authority, civil society and other institutions for participating in the development of the Toolkit. Their full commitment to participate in one way or the other in the establishment of baseline information, consultations, formal and informal discussions and finally in building a consensus by coming up with a final version of this Toolkit are highly appreciated.

Special thanks should go to the team of experts who worked tirelessly under the leadership of the Assistant Director - Environmental Assessment for his efforts and dedication. The general guidance of the Director of Environment that has made this work possible is highly appreciated as well. Thanks also to several countries whose work could be accessed for reference. Wide-ranging general information of a complex subject of climate change must inevitably be drawn from special works of others who are experts and experienced in such field. That's why in putting up this Toolkit, references were made to other similar Toolkits and documentations with information relevant to Tanzania. I wish to convey my sincere gratitude to all.

Finally, I wish to thank the Government of Japan through the United Nations Development Programme for providing financial support to the Africa Adaptation Programme which enabled the preparation of this Toolkit. Without its pioneering lead, the preparation would certainly not have materialized by this time.



Sazi B. Salula

**PERMANENT SECRETARY
VICE PRESIDENT'S OFFICE**

PART 1

INTRODUCTION

1.1 Background

Climate change poses greatest threats for mankind survival and sustainable development. The impacts associated with climate change are already happening in many systems and sectors essential for human livelihood in the most vulnerable communities. The irony of climate change is that its negative impacts fall disproportionately on poor communities, who have contributed least to its causes within poor communities, women and marginalised groups particularly vulnerable often due to lack of capacity to adapt. Climate change impacts have already been witnessed in Tanzania. Such impacts include recurrent droughts hitting many parts of our country leading to food insecurity, massive deaths of livestock, dwindling of water resources; and destruction of human settlements and infrastructure due to severe floods.

Furthermore, efforts to address climate change are imperative to the national economy of Tanzania, in which about 80% of the population live in rural areas where their livelihoods depend on agriculture (i.e. crop production, livestock keeping, fisheries and forestry). The agriculture sector is mainly dominated by subsistence farmers who are characterized with low capital investment that operates under rain-fed condition. These farmers grow a wide range of varieties of annual and perennial crops including maize, cassava, beans, banana, paddy, sorghum, millet; coffee, spices and tea. Despite being largely small scale farming, it supports 95% – 97 % of the food consumed locally.

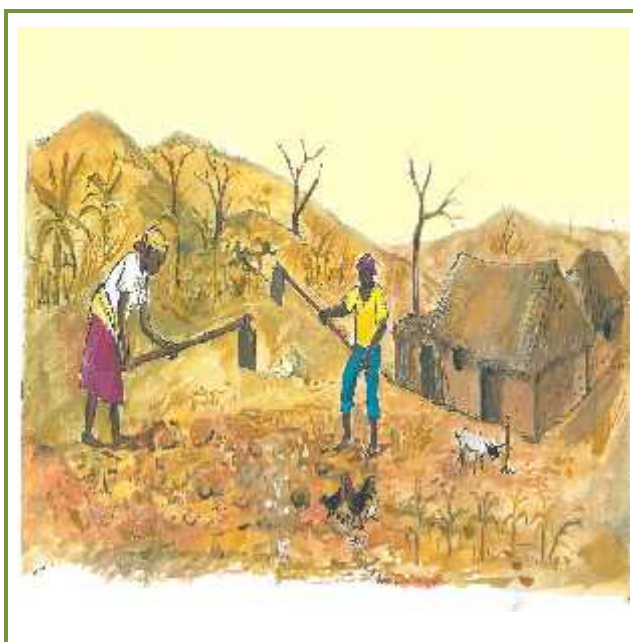
Moreover, Tanzania possesses about 60 million hectares of rangelands which is ideal for livestock grazing with carrying capacity potential of 20 million Livestock Units. It is estimated that the country has about 22.8 million cattle, 15.6 million goats, 7.0 million sheep, 2.01 million pigs, 35.5 million local chicken and 24.5 million improved chickens. Most of the ruminant livestock are concentrated in the semi arid areas due to low infestation of tsetse-flies and less competition for land for agriculture.

In addressing climate change, the global community has put in place a UN Convention on Climate Change known as United Nations Framework Convention on Climate Change (UNFCCC) in 1992. Tanzania is a Party to this Convention and ratified it in 1996. Since ratification of the Convention, Tanzania has undertaken several initiatives, including development of National Climate Change Strategy (2012); Guidelines for Integrating Climate Change Adaptation into National Sectoral Policies, Plans and Programmes (2012); National Adaptation Programme of Action (NAPA, 2007); National Adaptation Strategy and Action Plan (2009), In-depth analysis of climate change impacts on Agriculture, Health and Water sectors (2008); Strategy for Urgent Actions on Land Degradation and Water Catchments (2006), and National Strategy on Conservation of Coastal and Marine Environment, Lakes, Dams and Rivers (2010). Other initiatives include developing Climate Change Technological Needs Assessment and implementation of some adaptation programmes and projects.

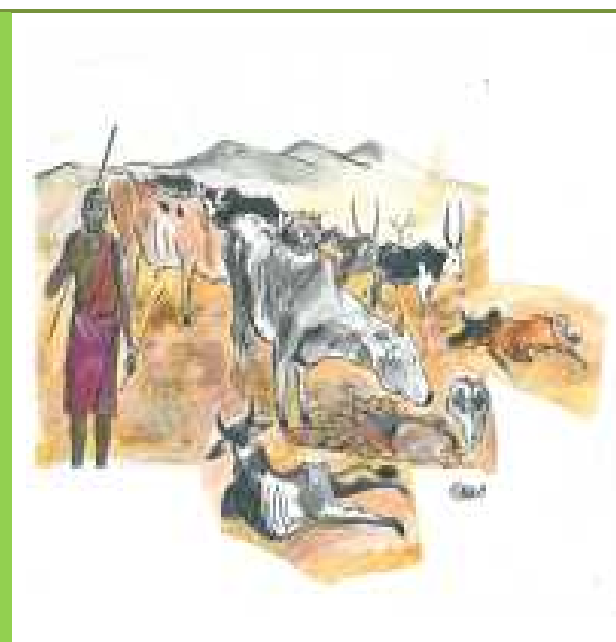
Despite these international and national initiatives, climate change is still one of the most critical challenges affecting agriculture and livestock production in Tanzania. Its effects include increased temperatures; changes in precipitation patterns; rising sea levels; and more frequent weather-related disasters posing risks for food, and water

supplies. One of the measures to tackle this immense challenge is to involve communities in adaptation to manage the unavoidable climate change impacts. Therefore, in order to strengthen resilience of vulnerable farming communities to adapt well to the impacts of climate change, a Climate Change Adaptation Information Toolkit has been prepared. In the context of this Toolkit, farming communities include local crop producers and livestock keepers.

This climate change adaptation information toolkit is designed to equip the farming communities with information and knowledge to adapt adverse impacts of climate change. This includes integrated approach that combines indigenous knowledge with innovative strategies to address the current vulnerabilities and build resilience to face new and dynamic challenges related to climate change.



Farmers are forced to till on a dry land as a result of recurrent and severe drought



Livestock deaths due to prolonged and severe drought

1.2 Why climate change is a concern to farming communities?

Agriculture and livestock keeping are climate sensitive activities. As the impact of climate change continues to increase, the communities which depend on these sectors are becoming more vulnerable. For Tanzania, in most agro-ecological zones, trends show declining crop and livestock production as a result of severe, recurrent and prolonged droughts. In recent years, there have been frequent incidences of food insecurity in many parts of the country due to drought. Other negative impacts of climate change which can affect farming communities include pests and diseases, increased energy insecurity, land degradation and floods. Currently, the livelihood of farming communities is in jeopardy and this may impact on the national and local community long term plans for sustainable development. As a result, this poses concerns to both farming communities and the nation as a whole. Cognizant of this fact, climate change adaptation for farming communities is very crucial in order to strengthen resilience and to build adaptive capacities to cope with the changing climate.



Crop failure due to drought in Mbinga



Remains of livestock which died due to severe drought in Longido

1.3 Why do we need climate change adaptation information toolkit?

Climate change adaptation information toolkit is meant to assist farming communities to understand, plan for and adapt to the impacts of climate change within their local setting. The goal is to strengthen resilience of vulnerable farming communities to adapt well to the impacts of climate change. It is a community-driven approach towards climate change adaptation that complements top-down planning and programmes.

1.4 What is the purpose of the Toolkit?

The purpose of this Toolkit is to serve as an information kit and guide for climate change adaptation awareness, planning, management and implementation of climate change adaptation measures in farming communities.

1.5 Who are the target users?

Local farming communities: The Toolkit will be used by local farming communities in planning and implementation of climate change adaptation interventions. This will also inform decision-making at the community, household or individual level, and help them to recognise and lobby for appropriate support for effective climate change adaptation.

Extension Officers: The Toolkit will be used by Extension Officers engaged in designing and implementing community-based climate change adaptation projects and programmes. This group can use the Toolkit as guidance on how to develop a participatory planning and evaluation system in partnership with the communities with whom they work.

Other partners: Other partners including private sector, civil society organizations and experts can also use this toolkit to inform and implement a more flexible and responsive approach to adaptation planning locally. The Donor countries and development partners may also use this toolkit.

PART 2

CLIMATE CHANGE, CLIMATE CHANGE ADAPTATION AND ITS CONTEXT

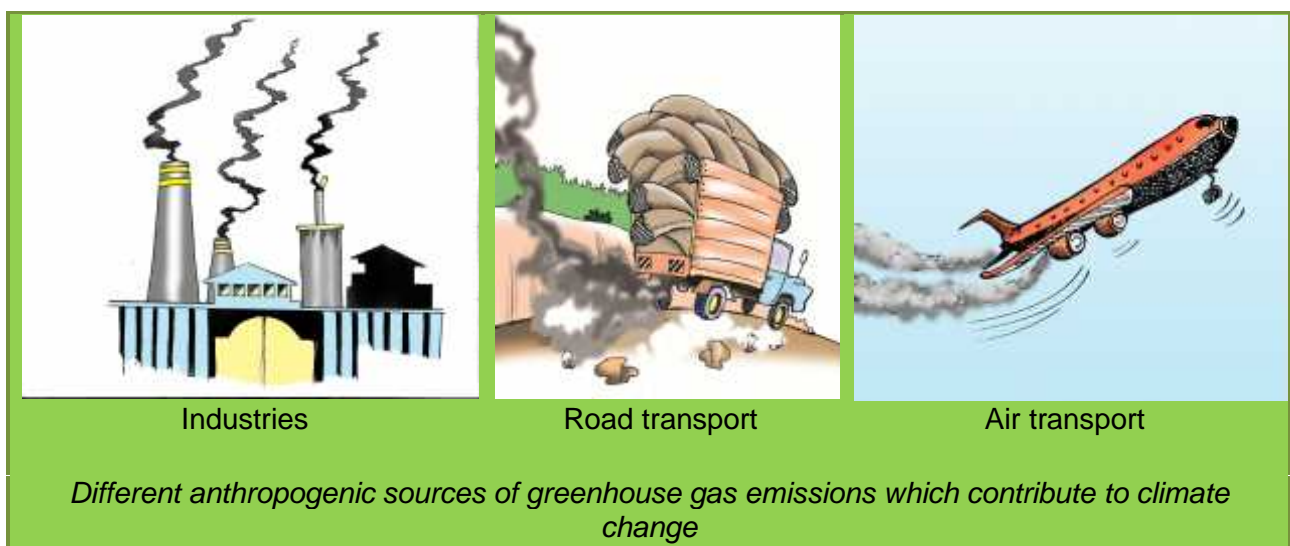
2.1 What is climate change?

Climate change is “a change of climate which is attributed directly or indirectly to human activities that alter the composition of the global atmosphere and which are in addition to natural climate change variability observed over comparable time periods”. The change may occur over decades or even millennium. It may affect one or more seasons and involves changes in one or more aspects of the weather such as rainfall, temperature or winds. Climate change poses a serious threat to countries in developing countries who are already struggling to sustain their livelihoods and maintain food security.

2.2 What causes climate change?

Climate change arises from both natural and human (anthropogenic) activities. Natural phenomenon that causes climate change includes continental drift, volcanic eruptions and differences in ocean currents. However, the recent changing climate is mainly attributed to anthropogenic activities.

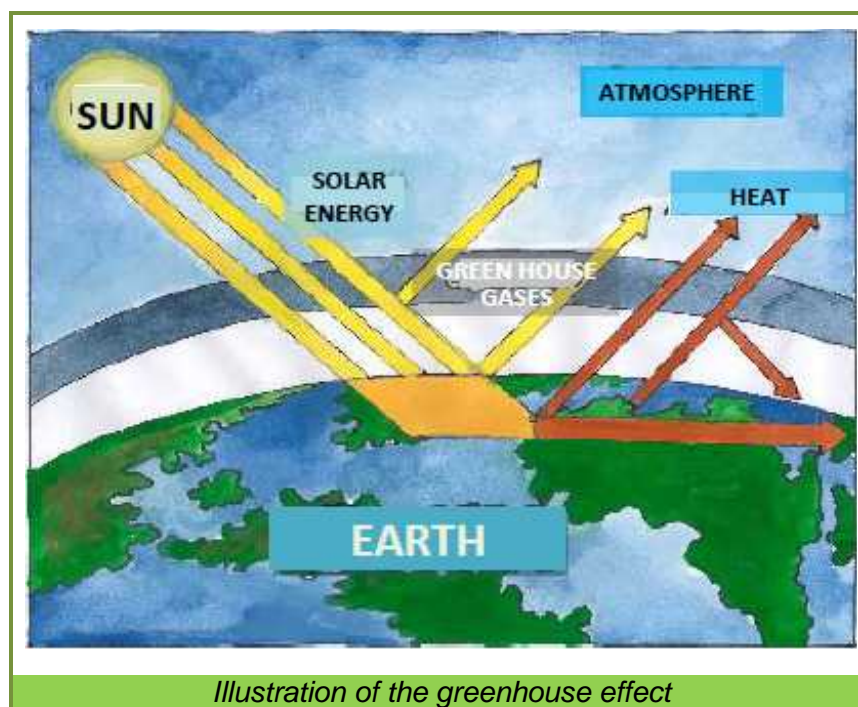
We are more renewed with anthropogenic activities. Anthropogenic activities that lead to climate change include burning of fossil fuels such as coal and oil from industrial activities and transportation. Other activities such as bushfires, deforestation, unsustainable agricultural practices and animal husbandry may contribute to climate change but at a relatively lower level than fossil fuel sources.



Both natural and anthropogenic activities lead to increase of atmospheric greenhouse gases such as carbon dioxide (CO_2), Methane (CH_4), Chlorofluorocarbons (CFCs), Nitrogen tri-fluoride (NF_3) and Nitrous Oxide (N_2O) that cause an increase in global temperature resulting into global warming.

In the recent years, the global climate has been changing faster than expected, mainly due to the fact that over the last 200 years human development and industrialisation in developed countries have led to faster changes in the atmosphere caused by increased concentration of greenhouse gases that result to increase in average earth temperature. The phenomenon which causes the average earth temperature to increase is known as the “greenhouse effect”.

Greenhouse effect refers to a situation where the short wavelengths of visible light from the sun pass through a transparent medium (a greenhouse gases layer) and are absorbed, but the longer wavelengths of the infrared re-radiation from the heated objects are unable to pass through that medium. The trapping of the long wavelength radiation leads to more heating and a higher resultant temperature.



2.3 How climate change affects farmers in Tanzania?

The effects of climate change to the farmers are associated with extreme weather conditions which can cause adverse impacts on various sectors and the livelihood of the communities at large. The aspects of adverse impacts can be categorized into short-term, medium and long-term impacts. Short term impacts require short term activities. Whereas long term impacts require proper planning including stages related to integrating climate change into the planning processes.

a) *Short term impacts*

These impacts are associated with extreme weather events which can occur within a short period of time. Such events may include floods, drought, heat waves and windstorms. Under such a situation, most communities in the country including farming communities often fall victim due to their inadequate preparedness and lack of adaptive capacity.

b) Medium term impacts

These manifest themselves through slow onset of climate change adverse impacts such as gradual changing of cropping seasons (seasonal calendar). In this context, farming communities in Tanzania may find it difficult to cope with appropriate farming practices arising as a consequence of the changing environment.

c) Long term impacts

These are the impacts of climate change which can be noticeable after a long term experience of such a situation. Such impacts may eventually lead to gradual changes of ecosystem and agro-ecological shifts which may as well affect crop production and livestock keeping.

These adverse impacts can lead to loss and damage of both property and life, trade imbalance arising from ecosystem and agro-ecological shift allowing non tradition crop production, and outbreak of new pests and disease. Such trends altogether can contribute to increased risks and vulnerability to farming communities whose adaptive capacity is already low.

2.4 How climate change affects agro-ecological zones in Tanzania?

Tanzania comprises of diverse climatic and agro-ecological conditions. There are 49 agro-ecological zones, which can be generalized into 7 main zones. These zones as listed below are prone to adverse impacts of climate change as a result of ecosystem shift.

- i) **Zone I - Coastal belt.** Below 750 meters (m) above sea level (a.s.l.) with soils of variable fertility, rainfall (precipitation) ranging from 750 to 1,200 mm per year. In the north is usually bi-modal while in the south is unimodal.
- ii) **Zone II - Arid lands:** Range from 500 - 1,800 m a.s.l. with relatively infertile soils highly susceptible to erosion, with characteristically low and unreliable unimodal rainfall (below 600 mm per year).
- iii) **Zone III - Semi-Arid Lands:** Low to medium undulating plains (200 - 1,500m a.s.l.), with rocky hills and low scarps in central and south-eastern areas, with soils of variable fertility, localized salinity and hard-pan problems, and unreliable unimodal rainfall (500 - 800 mm per year).
- iv) **Zone IV - Plateaux:** Medium altitude plains (800 - 1,500 m a.s.l.) in western and southern areas with some rocky hills, Rift Valley scarps and swamps, characterised by marked variations in soil fertility (e.g. High fertility soils in alluvial plains, and infertile soils on sandy plains), and generally reliable unimodal rainfall (800 - 1,300 mm per year).
- v) **Zone V - Southern, South-western and Western Highlands:** High altitude plateaux (1,200 - 2,300 m a.s.l.) and dissected hills and mountains with soils of low to moderate fertility, rainfall in the southern and south-western areas are generally

reliable and unimodal (800 - 1,400 mm per year), rainfall in the western areas is bimodal and higher (1,000 - 2000 mm per year).

- vi) **Zone VI - Northern Highlands and Granitic Mountains:** These are volcanic uplands, and high plateaux (1,000 - 2,500 m a.s.l.). They have deep and moderately fertile to fertile soils, with bimodal rainfall of variable reliability (1,000 - 2,000 mm per year).
- vii) **Zone VII - Alluvial Plains:** Flooded plains with alluvial fans and swamps comprising of seasonally flooded alluvial and lacustrine sediments, rainfall is unimodal of variable reliability and ranges between 500 - 1,800 mm/year.

The major agro-ecological zones of Tanzania has been affected and will continued to be affected differently by the impacts of climate change. This is due to the fact that these zones have different characteristics. While some of the zones might receive more rains other zones might be drier. For example, in the northwest and coastal regions which used to get bimodal rains, the situation has changed such that the areas are now getting unimodal rainfall. Due to this change, crop production in these areas is expected to decrease by about 30% in the next 20 years. This situation is expected to become even more pronounced in most of the agro-ecological zones, including southern highlands which were major producers of food crops e.g maize and beans. This has a bearing on both crop and livestock production sectors as follows:

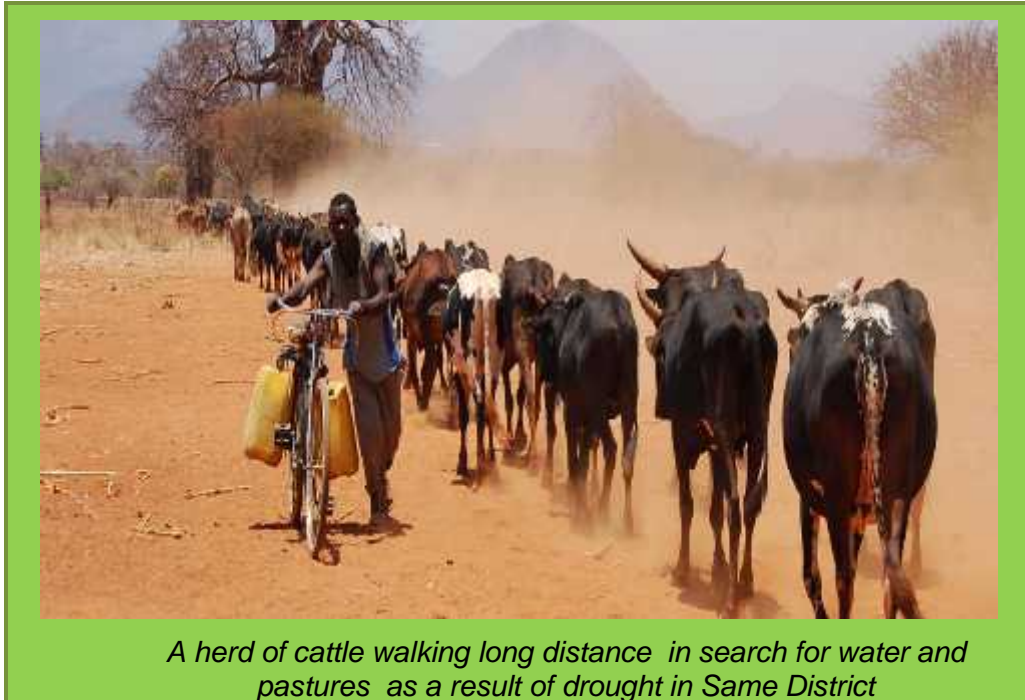
a) Agriculture

The majority of the Tanzanians depend largely on rain fed agriculture which employs about 75% of the population. Therefore, any form of climate change impact brings significant challenges especially to the small-scale farmers. Due to this, the adverse impacts of climate change are already having their toll in the livelihoods of people and in all sectors of the economy. Frequent and severe droughts in many parts of the country are being felt with their associated consequences on food production and water scarcity among others. In most parts of the country, onset of the rain season is unpredictable and thus farmers are uncertain when to plant. There have been evidences of increased and new pest and diseases causing massive crop losses. This could be also associated to climate change.



b) Livestock and rangelands

Most of the ruminant livestock are concentrated in the semi-arid areas (parts of Arusha, Dodoma, Iringa, Kilimanjaro, Manyara, Shinyanga, Mwanza, Singida, Mara, Tabora, Simiyu, Geita Rukwa, and Katavi regions) which are more suitable for livestock than any other form of agriculture. In these areas climate change has led to prolonged dry seasons resulting in reduced water, pastures and crop residues for livestock.



A herd of cattle walking long distance in search for water and pastures as a result of drought in Same District

Climate change is predicted to increase disease vectors which will consequently increase the incidences of vector-borne diseases of livestock such as Trypanosomiasis, East Coast Fever (ECF) and Rift Valley Fever (RVF). The increases of livestock mortality due to diseases and starvation may have considerable impacts on the local economies and the overall community livelihoods, particularly given the shortages of livestock dipping facilities and low financial capacity of people to afford various livestock medications. Prolonged droughts have led to severe loss of livestock in the past few years particularly in the northern part of the country.

2.5 How climate change affects other sectors

Climate change similarly impacts other sectors of economy, thus directly and indirectly affecting agriculture and livestock production sectors. These impacts are described briefly as follows;

a) Water resources

Water resources in Tanzania includes; rivers, lakes, wetlands, springs, reservoirs, groundwater aquifers; and many water bodies that are shared with neighbouring countries,. Severe and recurrent droughts in the past few years has led to a decrease in water flows in rivers, hence shrinkage of receiving lakes, declines of water levels in satellite lakes and dams. In some areas, perennial rivers have changed to seasonal rivers and as a consequence leading to shrinkage or disappearance of subsequent wetlands. In addition, sea water intrusion into freshwater wells has been experienced

especially in coastal areas due to sea level rise which is associated with climate change.



Severe drought has forced communities to fetch water from unsafe and unreliable sources in Igunga District, Tabora region.



Hippopotamus congested in small water pools due to water shortage in the Katavi River system.

b) Fisheries

The impact of climate change in fisheries is mainly associated with destruction or degradation of fish nursery grounds, breeding and feeding areas. One of the most striking signs that climate change has an impact to marine fisheries is the destruction of coral reefs which is a critical habitat for fish in the coastal environments. Destruction of coral reefs due to coral bleaching caused by rise of sea surface temperature is among the factors impacting marine fisheries. Sea level rise which is associated with global warming may cause sea water to rise above optimal levels of some corals. Increased water depth, for example, can restrict amount of sunlight needed for coral growth. Further climate change is impacting fish migration patterns thereby affecting fish recruitment and stocks in traditional fishing sites, especially for artisanal fisher folks. Sedimentation in freshwater bodies is negatively affecting fisheries by destroying breeding and feeding sites. This problem can be aggravated by drought and frequent floods resulting from climate change.

c) Forest Ecosystems and Biodiversity

Forests and woodlands are the sources for most of the wood and non-wood products. Wood products include timber, poles, firewood and charcoal. Non-wood products include ropes, resins, tie and dye colourings, wildlife, fruits, plant medicines (herbs), natural vegetables, palm leaves for making baskets and mats, honey, beeswax and mushrooms,. Furthermore, forests and woodlands do provide other goods and services such as food, water and other protective functions to people.

Climate change impacts on forest ecosystems and biodiversity are expected to vary depending on vegetation type. The common impacts to all forests types include loss of biodiversity; disappearance of wildlife habitats, increased risk of bush fires, limited availability of forest products and ecosystem shift for example forest to woodlands or woodlands to grasslands. Species that are expected to be more vulnerable are those

with limited geographical range and heat intolerance; low germination rates; low survival rate of seedlings; and limited seed dispersal or migration capabilities.

Given the high dependence on forests by large number of population in Tanzania, particularly as source of energy and livelihood, climate change impacts on this sector will affect socio- economic and cultural setting of both urban and rural communities.

Human-wildlife conflicts are becoming common phenomenon in some areas, especially in years with drought. The main reason for these conflicts is crop raiding by wild animals when migrating and searching for pastures and water. The animals commonly involved in these conflicts are hippopotamus, monkeys, elephants and buffaloes. This may be aggravated with changing climate.

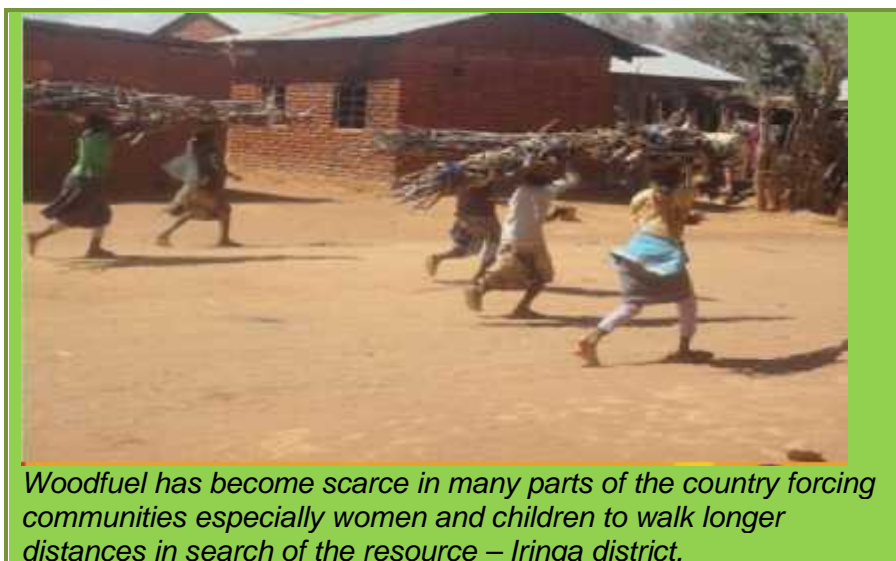
d) Human health

The tropical climate is favourable to most major vector-borne diseases, including malaria, schistosomiasis, onchocerciasis, trypanosomiasis, filariasis, leishmaniasis, plague, Rift Valley Fever, Yellow Fever and tick-borne haemorrhagic fevers.

Malaria has been common in high temperature and humid lowland areas especially during and after rainy seasons but with changes in temperature and rainfall regimes, there are already reported incidences of epidemic malaria especially in highland areas that were traditionally free from mosquitoes and malaria such as highland areas of Tanga, Kilimanjaro, Iringa, Kagera and Mbeya. The epidemics in these areas are also linked with El Niño events. Incidences of food-borne and water-borne diseases such as dysentery, diarrhoea, cholera and typhoid are also on the increase due to extreme weather events such as floods which affect water quality.

e) Energy

Biomass energy accounts for about 90% of total national energy consumption. Over 90% of rural population relies on the energy sources such as wood, charcoal, crop waste and manure for cooking and heating, while kerosene is used for lighting. With increased climate change impacts on the biomass resources, the traditional energy sources may be rendered very expensive and unavailable to the local communities.



As a result of increasing climate change, over the last years, the country has experienced increasing incidents of recurrent and prolonged droughts with severe implications on hydro power generation due to reduced water inflows from catchment areas. Power rationing and black outs have become a common phenomenon in most areas of the country. This affects individuals, households and industrial income generating activities.

f) Infrastructure

Increased extreme weather events such as floods have been and will continue to cause damage to infrastructures including roads, railways, airports and harbours, communication systems and buildings. For example, in December 2009 and January 2010, unusual heavy rainfall associated with El Niño event led to widespread flooding in Morogoro (Kilosa) and Dodoma (Mpwapwa and Kongwa) regions causing severe damage to roads, bridges, water dams, railways, electricity poles, drainage networks, water supply system, and human settlements. In April 2011 also in Morogoro (Kilombero) region heavy rains caused flood which destroyed six bridges, several roads and human settlements.



Extreme weather events such as severe floods may cause deaths and significant damage to human settlement and properties, Dar es Salaam 2011

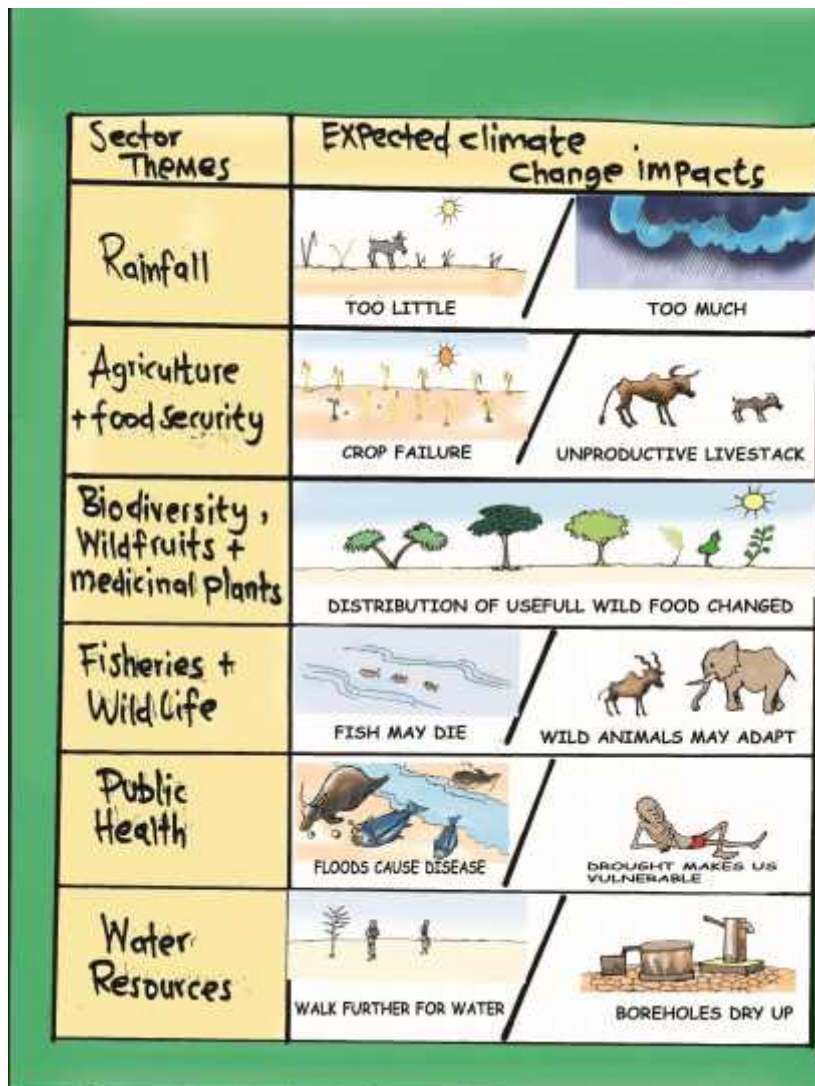


Damaged road infrastructure due to floods along Makuyuni - Karatu Road in 2011

g) Industries

Most of industries are concentrated on manufacturing of simple consumer goods - food, beverages, tobacco, textiles and furniture as well as wood and allied products of which they depend much on agro-products. The large dependence on agricultural raw materials means that the industrial sector is, like agriculture, vulnerable to the impacts of climate change. Despite the agro-based nature of most of these industries, the power supply is mainly from hydro sources which are again vulnerable to climate change impacts, particularly drought. Therefore climate change impacts will adversely affect the sector and peoples wellbeing at large.

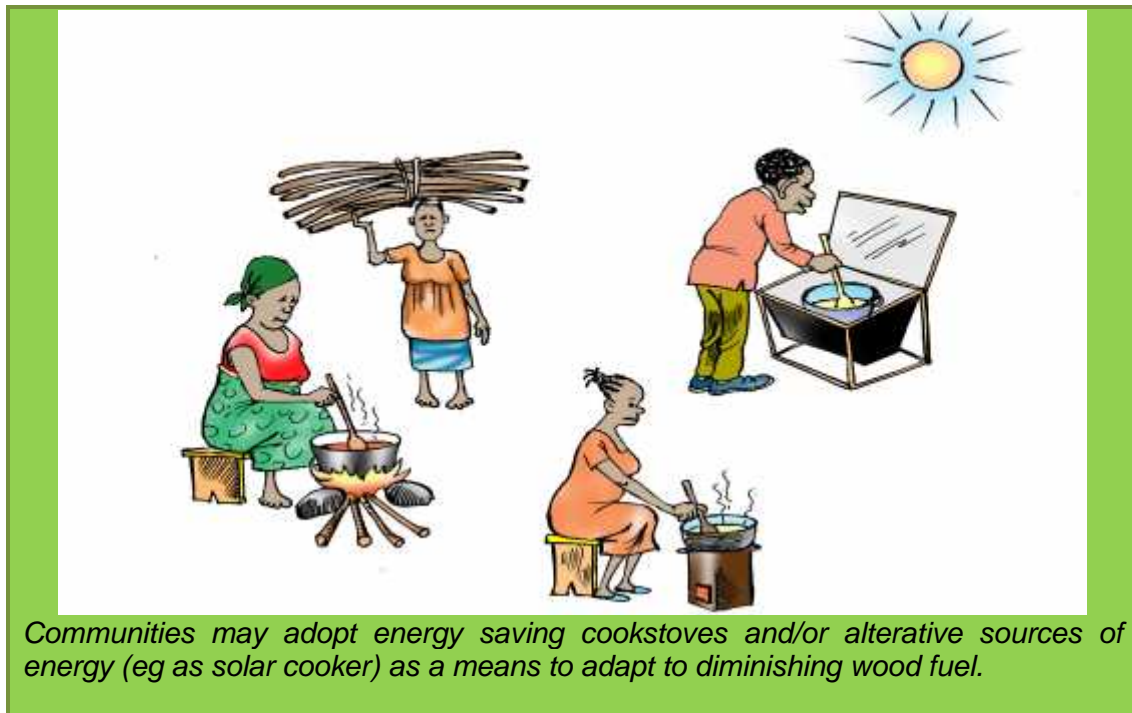
Below is a diagram illustrating a few examples of climate change impacts relevant to the Tanzania farming communities categorized by sector or themes.



2.6 What can we do about climate change?

i) *Learn to live with the changing climate - adaptation*

Even if the world stops emitting greenhouse gases today, we would not escape the impending effects of climate change. Significant changes in the type, frequency, intensity, duration and distribution of climate-induced hazards can still be expected, even under relatively modest scenarios of climate change. Further physical impacts include changes in temperature extremes (such as heat waves) and an increase in the frequency and intensity of storms. Such impacts combined with high dependence on natural resources and rain-fed agriculture means that many parts of Tanzania will continue to be vulnerable in the coming decades. Therefore, local communities need to learn how to live and sustain their livelihoods in the changing climate. For this reason, effective strategies and plans for adaptation to both climate change and climate variability are of central importance to the communities to ensure continued development in vulnerable areas and resilience of the communities to the impacts of climate change. A detailed explanation of climate change adaptation is given in section 2.7 below.



Communities may adopt energy saving cookstoves and/or alternative sources of energy (eg as solar cooker) as a means to adapt to diminishing wood fuel.

ii) Reduction of greenhouse gas emission through ensuring sustainable development – Mitigation

Climate change is associated with both opportunities and challenges. While communities are struggling to live in the changing climate, efforts and measures should also be undertaken to promote farming activities that can enhance co-benefits through efficient production. This can enable the farming communities to exploit opportunities that can contribute to reduction of greenhouse gases as a means to support their livelihood. Such mitigation measures include upland rice cultivation and other sustainable agricultural practices. For livestock, this may include improved animal feeds and breeds.



Solar home system can be used to light households as well as powering other income generating activities Zanzibar



Upland rice farming in Missenyi – Kagera as one of the mitigation option that can also have adaptation benefits.



Conservation of natural forests can contribute to community energy security as an adaptation strategy while such forest can also sequester greenhouse gases as a mitigation measure, Tabora region.



children need to be taught how to conserve their environment at their early stages as one of the adaptation measures that have multiple benefits Ukerewe district, Mwanza region

Box 1: Key concepts related to climate change mitigation

Greenhouse effect

Greenhouse effect is the rise in the average temperature of the Earth because certain gases form a layer in the atmosphere that stop the heat generated by the earth and other bodies on earth from leaving the atmosphere to outer space.

Climate change mitigation

Climate change mitigation refers to ways of reducing the emissions of greenhouse gases that form a layer responsible for not allowing heat from the earth to leave the atmosphere, hence increasing the average atmospheric temperature leading to climate change.

Sequestration

Sequestration refers to the removal of greenhouse gases from the atmosphere e.g. by forest. Investments into reforestation or afforestation and forestry can foster sequestration.

2.7 What is Climate change adaptation?

Climate change adaptation refers to an adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. It aims to reduce vulnerability and improve the capacity of people, especially those who depend on climate-sensitive activities for their livelihood and sustainable development.

a) Why adaptation is necessary?

Adaptation is necessary in order to increase the resilience of the communities to the impacts of climate change. People have always adapted to variations in their climate by making preparations based on their resources and knowledge acquired through experience of past weather patterns. Often, people reacted to extreme events such as floods or droughts as they occurred. However, the current measures are no longer adequate for coping with the expected long term impacts of climate change. Current coping strategies could be, for example, the storage of agricultural produce for future use, especially during difficult periods of drought or flood.

Generally, it is believed that, without adaptation, living conditions will severely degrade, while with good adaptation measures, prosperous life can still be achieved even under difficult climatic conditions expected. Adaptation demands an understanding of the existing vulnerability of individuals, households, and communities in order to build their adaptive capacity.

Through effective adaptation measures, threats to human health, economic development, property, infrastructure and ecosystems can be reduced. Lives will be salvaged and the cost of climate change can be reduced. It is clear that people have already in the past been adapting to changing conditions, and we continuously do so. There is a lot we can learn from past experiences, and perhaps can improve on them.

For effective implementation of adaptation measures, it is necessary to address climate change impacts across its spectrum.

b) How can adaptation planning be achieved?

Adaptation is a continuous process which entails learning, understanding, planning and implementing activities which can include the following:-

- i) Organize a farming community planning meeting;
- ii) Problem identification;
- iii) Identify the causes of the problem;
- iv) Identify appropriate actions/adaptation measures;
- v) Identify responsible authorities;
- vi) Identify resources required and sources of such resources;
- vii) Identify key barriers and remedial measures;
- viii) Develop indicators;
- ix) Develop Action Plan;
- x) Implement strategy and priority adaptation measures/actions; and
- xi) Monitor and evaluate the implementation of activities.

These steps are further elaborated in Part 3 of this Toolkit.

c) What are some possible adaptation options?

Farming communities in various agro-ecological zones can develop different adaptation strategies depending on the climatic challenges they face. The following Table provides an overview of such adaptation options which may be feasible to farmers.

Sector	Adaptation Options
Agriculture	<ul style="list-style-type: none"> i) Small scale irrigation ii) Crops diversification iii) Water harvesting iv) Terracing, contour farming v) Use of organic manure vi) Improved seed/crop varieties vii) Disease resistant and drought tolerant seed varieties viii) Conservation agriculture
Livestock	<ul style="list-style-type: none"> i) Breeding for resistant breeds ii) Species diversification iii) Tick and tsetse control iv) Livestock extension services v) Livestock marketing infrastructure vi) Zero grazing system vii) Construction/rehabilitation of charco dams
Forestry	<ul style="list-style-type: none"> i) Community Based Forest Management ii) Ecosystem conservation of forest biodiversity, water catchment and soil fertility iii) Household/village woodlots iv) Use of traditional knowledge in forest conservation v) In situ conservation of indigenous species
Water	<ul style="list-style-type: none"> i) Integrated water resource management ii) Exploitation of underground water iii) Protection of water Catchments iv) Rainwater harvesting v) Construction of water dams
Fisheries	<ul style="list-style-type: none"> i) Management of geographical areas of concerns and critical habitats, ii) Management of fresh water iii) Monitoring of fisheries habitat and species iv) Integrated data management system in the fisheries sector v) Promoting aquaculture vi) Protection and conservation of aquatic ecosystems vii) Supporting alternative livelihood initiatives for fisheries community
Coastal and Marine Environment	<ul style="list-style-type: none"> i) Protection and management of mangroves ii) Conservation of lowland coastal forests iii) Protecting the seashore by building barrier sea walls iv) Coastal erosion control v) Promoting sustainable coastal land use planning vi) Enhancing protection and conservation of coastal and marine ecosystems vii) Supporting alternative livelihood initiatives for coastal communities
Health	<ul style="list-style-type: none"> i) Promote conservation (in-situ and ex-situ) and sustainable use of traditional/alternative medicines ii) Use of treated mosquito nets
Wildlife	<ul style="list-style-type: none"> i) Conservation of Wildlife Resources ii) Establishment of Wildlife Management Areas(WMA) iii) Protection of wildlife corridors

Sector	Adaptation Options
	iv) Wildlife conservation awareness activities i.e. publicity v) Establish wildlife zoos and sanctuaries
Energy	i) Protection of water catchments ii) Increasing availability of biomass resources iii) Improvement of biomass to energy conversion efficiency iv) Increased use of modern biomass to energy technologies v) Fuel switching
Wetlands	i) Conservation and protection of lakes, dams, swamps, rivers, and catchment areas
Tourism	i) Diversification of livelihood and tourism attraction ii) Promotion of eco-tourism
Land use	i) Land use planning and management ii) Promote landscape management/conservation

d) What are some typical examples of community based adaptation measures?

- i) *Matengo* Pit cultivation – “*ngoro*” farming

In southern Tanzania, for a long time, farmers have developed a system of farming on steep slopes. This system, called the *Ngoro* system entails cultivation on a hillside by making series of small pits. Earth from the pits is piled in heaps at the side, and in these heaps crops (mostly maize) are grown. Weeds and crop residues are thrown into the pits. For the next season’s crops the heaps are broken down into the pits and fresh pits dug along side. Hillside cultivated in this way present an unusual honey-comb like appearance. The system is most effective way of preventing erosion and maintaining the fertility of the soil. Apart from this, the system helps in soil biodiversity and soil moisture conservation.



ii) “*Ngitiri*”

“*Ngitiri* is an indigenous natural resource management system which involves conservation of fallow and rangelands through vegetation regeneration and controlled livestock grazing for use in the dry season in response to acute animal feed shortage. *Ngitiri* is a major source of dry season fodder supply for livestock, fuelwood, poles and thatch for roofing. This practice assists communities especially livestock keepers to adapt to adverse weather during dry season. The technique is widespread in the Sukuma land. A similar system is also practised in Maasai land where it is known as ‘*Alalili*’.

iii) Traditional irrigation furrows

In some communities, traditional irrigation furrows are used as a means to ensure food security in the face of erratic rainfall. For instance, bamboo sticks can be laid as pipes to convey water to farming fields for irrigation. This reduces water loss and can contribute to increased yield and enhance food security.

iv) Rain water harvesting

Community can develop rainwater harvesting structures to enhance water availability during dry season. This can include harvesting rainwater from rooftops, construction of charco dams which can provide water for both domestic and livestock use and therefore enhance community adaptive capacity to adverse impacts of climate change.



Rainwater harvesting from rooftop in Ibwera Village, Kagera Region,

v) Use of improved seeds

Use of improved seeds can contribute to increased yield and food security. They can be resistant to diseases and pests; and also drought tolerant. Communities can use these improved seeds in order to enhance their capacity to adapt to the impacts of climate change.

vi) Improved livestock breeds

Improved livestock breeds stands a better chance to survive to the impacts of climate change associated with increased animal diseases. This considerably contributes to increased animal production and reduced loss of livestock due to deaths, and therefore increasing the resilience or adaptive capacity of the farmers in the wake of climate change.



vii) Livelihood diversification

Livelihood diversification can help communities to adapt to impacts of climate change and other environmental shocks as it widens available options and reduces reliance on particular natural resource. Livelihood diversification strategies include integration of on-farm and non-farm activities to enhance adaptive capacity and ensure sustainable livelihood in a changing climate. Such non-farm activities may include beekeeping, petty trading and small scale entrepreneurship.



Box 2: Key concepts related to adaptation

Adaptive capacity

The ability of a system (natural or human) to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.

Vulnerability

The degree to which a system (natural or human) is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude and rate of climate variation to which a system is exposed, its sensitivity and its adaptive capacity.

Resilience

The ability of a system (natural or human) to resist, absorb and recover from the effects of hazards in a timely and efficient manner, preserving or restoring its essential basic structures, functions and identity.

Climate change risk

The actual climate changes that are predicted for an area and the specific risks these changes pose.

Climate change impacts

Climate change impacts are the consequences of climate change on natural and human systems.

Preparedness

Preparedness is the state of being ready or prepared for action, which, in the climate change context, relates to adaptation.

Coping strategies

Coping strategies are a range of climate sensitive actions put into place, with outcomes being beneficial or negative but tolerable; beyond the “coping range”, the damages or loss are no longer tolerable and the society (or system) is said to be vulnerable.

Hazard

A dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.

Sustainable livelihood

The ability of human being or society to cope with and recover from external shocks and stresses, and maintain or enhance its capabilities and assets now and in the future.

PART 3

COMMUNITY CLIMATE CHANGE ADAPTATION PLANNING

The key element in community climate change adaptation planning is the full involvement of the community in the whole exercise of climate change adaptation planning. In this case the community members participate right from the identification of the problem(s) of their relevance in their particular locality and design ways and means of addressing the problem. The community climate change adaptation planning should be community-driven in order to ensure ownership by the community.

What are the steps in community climate change adaptation planning?

The community climate change adaptation planning process consists of a number of key steps that every community should go through to prepare for dealing with climate change adaptation. Important features of the approach are recognising the wide range of stakeholders and their diverse interests in natural resource management and; engaging them fully, where community members are involved from the identification of the problems related to climate change, design and implementation of adaptation measures. The figure below summarizes the key steps in undertaking a community climate change adaptation planning process.



Key steps in community climate change adaptation planning

Step 1: Organize a farming community planning meeting

As a first step, it is important to organize a community meeting to discuss and share issues on climate change and climate change adaptation. The agenda of the meeting should be prepared in advance (refer an example in Box 3). The purpose of the meeting would be to develop an effective community adaptation action plan in a participatory manner following the guidance provided in this Toolkit. It is important that the meeting include a wider spectrum of stakeholders, interested parties and experts to ensure that the action plan to be developed accommodates concerns of the farming communities in that particular locality without jeopardizing significantly the interest of other stakeholders. The agreed action plan should be shared and recognized among the community members and other interested stakeholders.



Box 3: Example of Agenda of a Community Meeting on Climate Change

- 1 - Opening of the meeting
- 2 - Introduction to climate change and climate change adaptation
- 3 - Development of community adaptation action plan
- 4 - Way forward and recommendations
- 5 - AOB
- 6 - Closing of the meeting



Participatory community planning meeting

Step 2: Problem identification

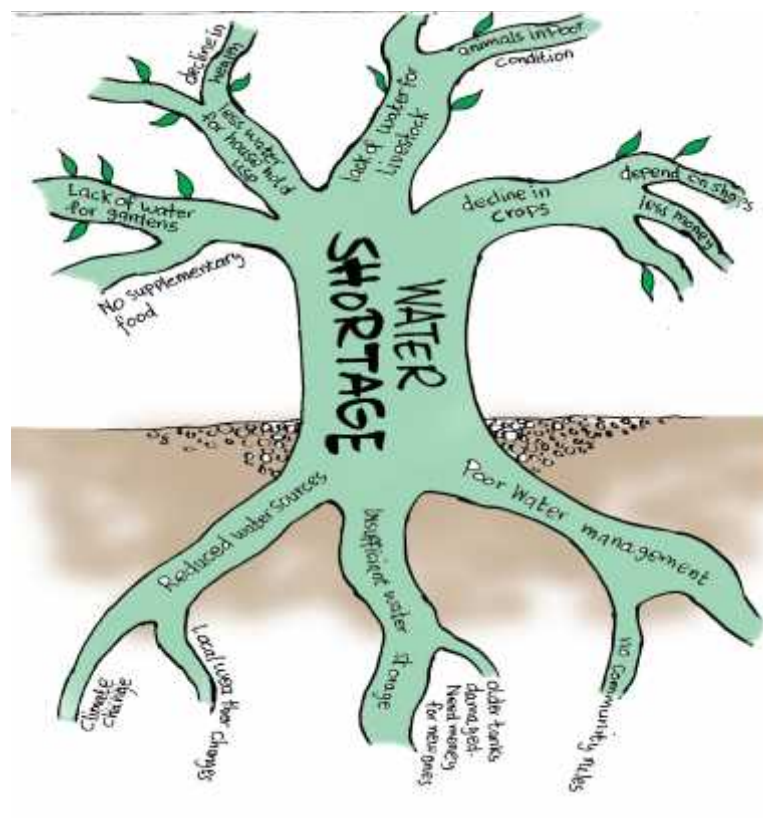
After a general discussion on climate change and climate change adaptation, it is important to focus on the challenges related to environmental, farming and natural resource use of the respective community.

Through participatory approach, members of the community should brainstorm and list issues of concern or problems related to climate change that they think are impacting the farming communities and need to be addressed. Wherever possible, a set of criteria may be developed to assist in prioritizing the most pressing problems. A group consensus can also be used to arrive at an agreed priority problems facing the community.

Step 3: Identify the causes of the problem

A clear understanding of a problem is essential when trying to determine what effective actions to take to resolve it. However, gaining that clear understanding can be difficult. Root cause analysis is a useful tool that will enable the community to identify the many parts of a problem, the dominant causes and the most effective areas for action. Climate change is a very tricky topic and to remove a possible bias that all community problems are as a direct result of it, you have to obtain a broad overview of all contributing factors to determine whether climate change is, in reality, the dominant factor.

Apart from using problem tree analysis in identifying causes of problems, community experience and wealth of accumulated knowledge can also be used in identifying causes of the problems in the locality.

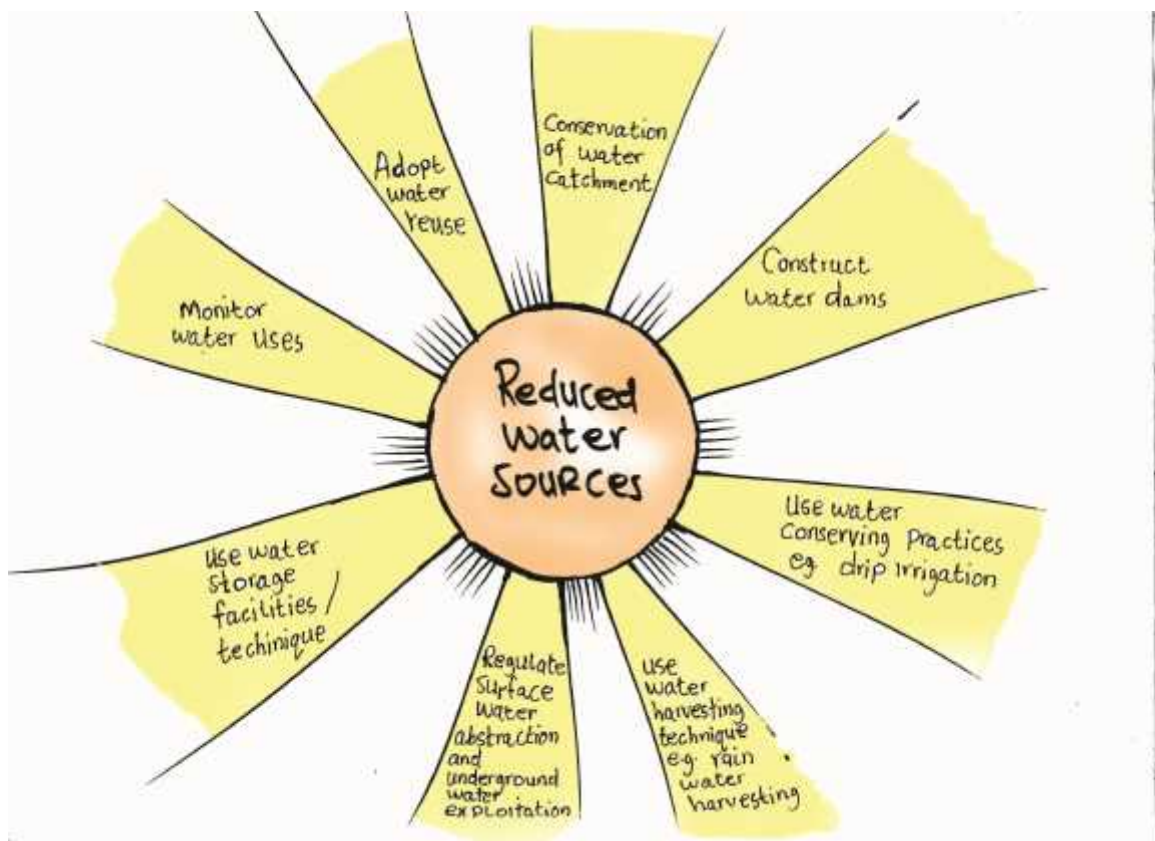


An example of problem tree for water shortage problem

Step 4: Identify appropriate actions/adaptation measures

Depending on the identified and agreed priority problems related to climate change that have a consensus of the community, identification of appropriate action/adaptation measures is an important step towards addressing the problems.

Through participatory approach, members of the community can brainstorm and develop a list of possible actions or adaptation measures that need to be implemented in order to address climate change related problems in that particular farming community . Then the group should discuss which adaptation options, or measures and actions will be more effective than others.



An example of possible actions or adaptation measures to address poor water management problem

Step 5: Identify responsible authorities

As part of planning and to ensure that follow up actions are being implemented, responsible authorities to take lead should be identified and informed. Such responsible authorities may include Village Leaders, Extension Officer, Health Officer or Water Engineer/Technician, depending on the nature of the actions to be implemented.

Step 6: Identify resources required and sources of each resources

Community members can also identify and indicate resources required to implement the identified actions or adaptation measures. Resources may include labour force, financial resources and technical assistance. Potential sources of such resources need also to be identified.

Step 7: Identify key barriers and remedial measures

Once the identified actions or adaptation measures have been articulated, the next step involves identifying the set of barriers that must be overcome to effect adaptation measures. In this case, a comprehensive mapping is required to identify all critical barriers that need to be removed to implement effectively the identified adaptation actions or measures. This exercise builds upon the identification of the causes of a given problem. Refer examples of barriers in Box 4.

Box 4: Examples of possible barriers

- i) Weak institutional capacity of relevant public and private entities to support/facilitate necessary behavioral adjustments.
- ii) Shortage of staff with relevant skills and necessary mandates
- iii) Lack of political will.
- iv) Absence of necessary climate-resilient development strategies and supportive policies.
- v) Financial constraints to support implementation of adaptation measures.
- vi) Overlap of responsibilities between institutions leading to inefficient and ineffective implementation of adaptation measures.
- vii) Limited awareness regarding climate change issues and access to information/knowledge to local communities.
- viii) Poor implementation of policies that have been designed and introduced.
- ix) Cultural beliefs.

Step 8: Develop indicators

Where relevant or applicable, members of the community may develop indicators to assist them in tracking progress in the implementation of the identified actions or measures (see examples in Box 5).

Box 5: Examples of possible indicators

- i) Crop yield.
- ii) Number of charco dams constructed or rehabilitated
- iii) Number of livestock herds.
- iv) Incidences of diseases (crops and livestock).
- v) Community income.
- vi) Area under irrigation/cultivation.
- vii) Water availability/flow.
- viii) Number of community meetings (discussing on climate change adaptation issues).
- ix) Funding level for implementing climate change adaptation measures.
- x) Number of visits of extension officers.

Step 9: Develop Action Plan

This activity helps to arrange systematically the results of the previous steps (step 2-7). Central to this activity is the compilation of a table sometimes called a “log frame” that identifies what we are trying to achieve, how, who is responsible, by when we want to achieve a specific objective or action, and what type of resources are required. Below is a simple logframe that can be used to assist local planning.

Key problem	Adaptation options/actions	Responsible authorities/persons	Timeframe	Resources required	Indicators
Food crop production failure	Use improved seed varieties	Extension officers	To be specified	Fund/Human labour	Crop yields (Kg)
	Increase the area under irrigation	Extension Officer/Village Officials			
	Diversify crop production	Extension Officer/Villagers			

Step 10: Implementation

This step entails implementation of the concrete adaptation measures on the ground. Implementation should follow the agreed action plan where the roles and responsibilities of the involved partners are clearly defined in order to facilitate smooth implementation of the actions.

Step 11: Monitoring and Evaluation (M&E)

Monitoring and evaluation is an important step in tracking progress made in the course of implementation of the action(s). It provides the community or individuals with the opportunity to assess, evaluate and propose remedial measures to improve implementation in order to achieve the intended goal(s). The M&E process is important because among other things, it provides consolidated source of information showcasing progress made in the implementation; it allows actors to learn from each other’s experiences, building on expertise and knowledge; it reveals mistakes and offers paths for learning and improvements and it provides a more robust basis for raising funds and influencing policy.

