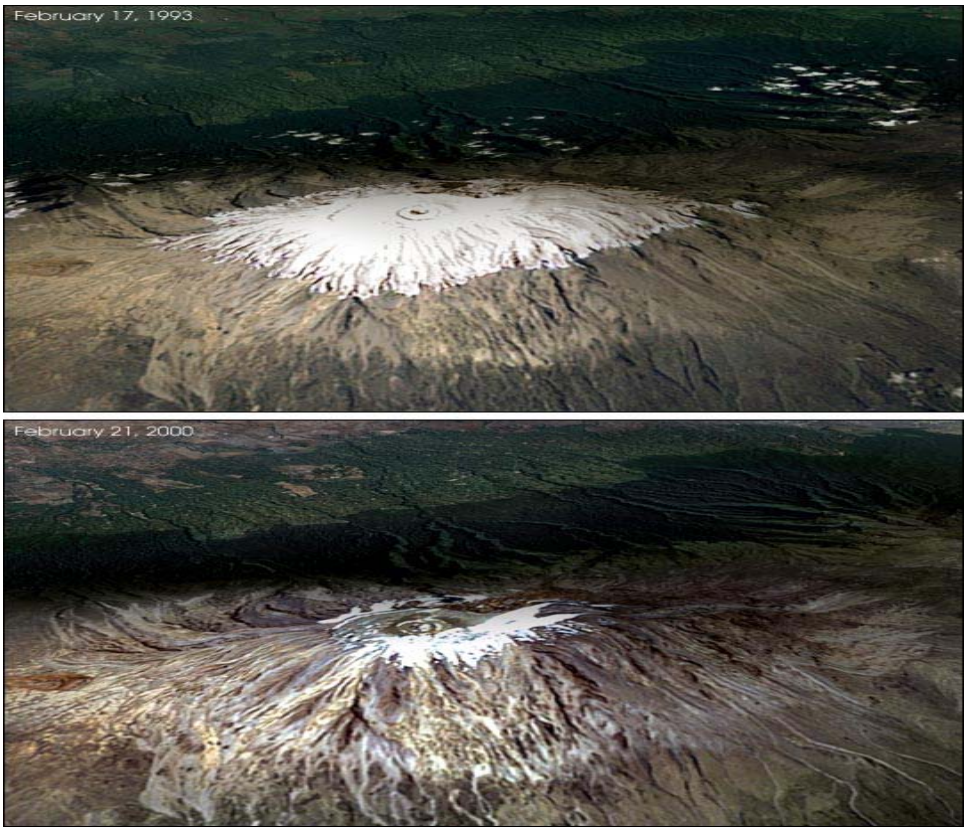
UNITED REPUBLIC OF TANZANIA

NATIONAL ADAPTATION PROGRAMME OF ACTION (NAPA).



VICE PRESIDENT'S OFFICE,

Division of Environment, January 2007

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LIST OF ABBREVIATIONS

CBD	Convention on Biological Diversity
INC	Initial National Communication
LDCs	Least Developed Countries
MDGs	Millennium Development Goals
NAP	National Action Plan to Combat Desertification
NAPA	National Adaptation Programme of Action
NBSAP	National Biodiversity Strategy and Action
NEAP	National Environmental Action Plan
NEP	National Environmental Policy
NFP	National Forestry Policy
NSGRP	National Strategy for Growth and Reduction of Poverty
PMO	Prime Minister's Office
TMA	Tanzania Meteorological Agency
UNCCD	United Nations Convention to Combat Desertification
UNFCCC	United Nations Framework Convention on Climate Change
VAR	Vulnerability Assessment Report

FOREWORD

Climate change is now a global issue posing challenges to the very survival of mankind and sustainable development. The adverse impacts of climate change are now evident almost everywhere. Climate change poses a serious risk to poverty reduction efforts and threatens to undo decades of development efforts. It is widely accepted that the impacts of climate change are, and will continue to be more pronounced in poor countries. These countries have contributed the least to the problem and are the ones least able to cope with the impacts.

Tanzania's economic base is dependent on the use of natural resources, rain-fed agriculture and biomass for household energy. The economy is highly vulnerable to the adverse impacts of climate change and to extreme weather events. The impacts are already vivid. Through the NAPA preparation process, recent temperature measurements from 21 meteorological stations in the country have shown a steady increase in temperature for the past 30 years. Due to the increasing temperatures, the adverse impacts are now felt in all sectors of the economy and are threatening human life. Severe and recurrent droughts in the past few years have triggered the recent devastating power crisis. The extreme drop of water levels of Lake Victoria, Lake Tanganyika and Lake Jipe in recent years and the dramatic recession of 7km of Lake Rukwa in about 50 years, are associated, at least in part, with climate change, and are threatening economic and social activities. Eighty per cent of the glacier on Mount Kilimanjaro has been lost since 1912 and it is projected that the entire glacier will be gone by 2025. The intrusion of sea water into water wells along the coast of Bagamoyo town and the inundation of Maziwe Island in Pangani District, off the Indian Ocean shores, are yet another evidence of the threats of climate change.

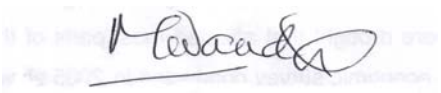
These impacts have already affected not only the local communities but also economic development. In 2005 the GDP was targeted to grow by 6.9% but it grew by 6.8%. This was attributed to severe drought that affected most parts of the country, triggering food shortage and power crisis. An economic survey conducted in 2005 showed that the agricultural sector (which is the main economic stay of the country) grew by only 5.2% compared to 5.8% growth in 2004 and this was again attributed to the prolonged drought in 2005/2006. Recent surveys indicate that malaria (a climate-related disease) prevalence has been reported to occur in areas where it

was not commonly found in previous decades such as some parts of Kagera region on the shores of Lake Victoria with an estimated altitude of about 2,500m above sea level as well as Lushoto and Amani in Tanga region which are part of the East Usambara Mountain Ranges along the North-East coast of the country.

Climate change is thus poised to undermine national efforts to attain the Millennium Development Goals (MDGs) and places poverty reduction efforts in jeopardy. The loss of human, natural, financial, social and physical capital, caused by the adverse impacts of climate change, especially severe droughts and floods, among many other disasters, are indeed of great concern to Tanzania.

The impacts of climate change on sectors such as agriculture, water, health, energy and others have been the driving force for the preparation of the Tanzania National Adaptation Programme of Action (NAPA). After two years of comprehensive information and data collection and analysis as well as wide consultations, Tanzania's NAPA preparation project has been finalized. This document has been prepared with the primary objective of identifying and promoting activities that address urgent and immediate needs for adapting to the adverse impacts of climate change. The focus of this work has been on adaptation needs in the agriculture, water, energy, health and forestry sectors. While we understand the importance of a comprehensive analysis covering all sectors, financial constraints has necessitated the restriction of this work to these sectors only.

NAPA forms a basis for support not only from the LDC Fund under the UNFCCC as required, but also from the international community at large. It is with great pleasure that Tanzania submits this document to the United Nations Framework Convention on Climate Change (UNFCCC) for funding, realizing the urgency and immediacy of addressing the adverse impacts of climate change. It is my sincere hope that many other development partners will find this document useful and use it to assist Tanzania to implement the identified priority adaptation needs with the urgency they deserve.



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ACKNOWLEDGEMENT

The United Republic of Tanzania is one of the countries that are continuing to suffer from the impacts of climate change and related hazards such as floods and droughts, which have substantially affected economic performance and undermined poverty reduction efforts. The 2004/05 drought and subsequent poor crop yield in many parts of the country have negatively impacted on Tanzania's efforts to address poverty and ensure food security and has led to severe power shortage. In order to reduce such impacts, appropriate plans and programmes that constitute the local community adaptation strategies are required at both local and national levels. The preparation of the National Adaptation Programme of Action (NAPA) is thus a timely and essential opportunity for Tanzania to enhance her ability to deal with climate change.

The Government of the United Republic of Tanzania takes this opportunity to convey its gratitude to the Global Environment Facility (GEF) for providing financial support through the United Nations Environment Programme (UNEP). In particular special gratitude go to Liza Lerclec, Task Manager, Adaptation to Climate Change, Division of GEF, UNEP for her technical guidance during the preparation of the project proposal and finalization of the Programme. Special thanks also go to the Least Developed Countries Expert Group (LEG) and the UNFCCC Secretariat for their valuable contribution to this work.

Lastly, I thank my colleagues in the Division of Environment, the Director of Environment Mr. E.K. Mugurusi, the Coordinator of this process Mr. R.S. Muyungi and the National NAPA Team for the efforts and dedication that has made this work possible.

Ruth H. Mollel
PERMANENT SECRETARY, VICE PRESIDENT'S OFFICE.

EXECUTIVE SUMMARY

Tanzania National Adaptation Programme of Action (NAPA) preparation has been a timely opportunity to look at the country's climate change related vulnerabilities in various sectors which are important for the economy. Tanzania NAPA document is informed by the aspirations of National Development Vision 2025 for high and shared growth, quality livelihood, peace, stability and unity, good governance, high quality education and global competitiveness. Since Tanzania's economy is largely dependent on agriculture, it is deemed that sustainable development can be achieved when strategic actions, both short term and long term are put in place to address climate change impacts on agriculture and other key economic sectors. The process of NAPA preparation involved looking at the effects of climate change as a threat mainly to the agrarian population that still depends on subsistence agriculture for their daily livelihood. The past trend on droughts and floods; and recent poor harvest in 2005 which caused hunger in most parts of the country and disappearance of the ice cap at Mount Kilimanjaro is now more than ever imminent evidence of climate change due to evident temperature increases caused by global warming. The frequency of extreme weather events such as El Nino floods in 1997/98 and the recent drought are few but important reminders of the deadly effects of climate change to Tanzania. In this context, the Tanzania NAPA identifies priority areas in various sectors, and further prioritizes project activities in those sectors. These activities need immediate and urgent actions for the country to adapt to such climate change effects on a short term basis as well as putting in place mechanisms for addressing long-term adaptation initiatives.

Tanzania NAPA has been prepared as part of the overall integrated plans, policies, and programs for sustainable development at national level. The process not only adhered very closely to the Annotated Guidelines agreed at the conference of the Parties in 2001 and elaborated by the LDC Expert Group, but also was conducted in a transparent and participatory manner. The process started with the formation of a team of experts which composed the NAPA Team. Then the team undertook climate change vulnerabilities assessment across key sectors clustered in seven working groups (Agriculture, Energy, Forestry and Wetlands, Health, Human Settlements, Coastal and marine and fresh water resources). A total of 20 team members were involved in undertaking the consultations at various stages. After identification of vulnerabilities in each sector, key adaptation options and strategies that would best address those vulnerabilities were developed. The consultations were undertaken at national, regional as well as district levels. The consultations allowed for exchange of information on climate change hazards and created an opportunity for the NAPA Team to learn and gain insight on the sector specific hazards and adaptation techniques that were translated into proposed project activities. Furthermore, the invaluable stakeholder consultations at grassroots level helped to prioritize the fourteen top most possible adaptation activities that would address the country's most urgent needs from all sectors.

Initially, 72 project activities were proposed with a breakdown of 11 in agriculture sector; while water, energy, forestry, health and wildlife sectors had 7 project activities each. Industry and coastal and marine resources sectors had 6 project activities each; human settlements had 9 and finally, tourism had 5. Using a list of agreed criteria that best suits Tanzania conditions and local environment, these were later narrowed down into 14 priority project activities. These are the most effective and efficient ways to cope with and benefit from the impacts of climate change. The project activities were further ranked in accordance with their importance regarding impacts on

poverty reduction and health, reliability, replicability of the technique and sustainability. In the final analysis, the 14 selected projects activities are:

1) Water efficiency in crop production irrigation to boost production and conserve water in all areas
2) Alternative farming systems and water harvesting
3) Develop alternative water storage programs and technology for communities
4) Community based catchments conservation and management programs
5) Explore and invest in alternative clean energy sources e.g. Wind, Solar, bio-diesel, etc. to compensate for lost hydro potential
6) Promotion of application of cogeneration in the industry sector for lost hydro potential
7) Afforestation programmes in degraded lands using more adaptive and fast growing tree species
8) Develop community forest fire prevention plans and programmes
9) Establishing and Strengthening community awareness programmes on preventable major health hazards
10) Implement sustainable tourism activities in the coastal areas and relocation of vulnerable communities from low-lying areas.
11) Enhance wildlife extension services and assistance to rural communities in managing wildlife resources
12) Water harvesting and recycling
13) Construction of artificial structures, e.g., sea walls, artificially placing sand on the beaches and coastal drain beach management system
14) Establish good land tenure system and facilitate sustainable human settlements

The proposed project activities form the basis of required financial and technical assistance from national level as well as the international community. Given the current subsistence farming and status of natural resources which the large community depend on for their daily livelihoods, delaying the implementation of these projects will further negatively affect development in health care and nutrition, life expectancy, primary education, improvement in agriculture and livestock development, roads and communication infrastructure, which are top agenda of the fourth phase of the Tanzanian government.

In order to implement those projects, the relevant key sectors in collaboration with the Vice President's Office will be the main custodian of the NAPA while project activities will be implemented by relevant sectors local communities. However, this NAPA program is not perceived as an end product but a living document that will need to be updated from time to time in order to adapt to the changing environmental conditions of the country.

1. 0 INTRODUCTION & SETTING

1.1. Country Background

The United Republic of Tanzania is the largest country in the East Africa. It is located between 1 degrees South and 12 degrees South latitude and 30 degrees East and 40 degrees east. It is constituted by Mainland Tanzania and Tanzania Zanzibar. It is a vast country with a total area of 945,087 Sq. km comprised of land area of 883,749 sq. km (881,289sq.km mainland and 2,460sq.km Zanzibar), plus 59,050 sq. km inland water bodies (URT, 2002a). It shares borders with eight countries. Its neighbours include Kenya and Uganda in the North, Rwanda, Burundi and Democratic Republic of Congo in the West, Zambia and Malawi in the South West and Mozambique in the South. [Figure 1`- Political Map of Tanzania] Mainland Tanzania borders the main water bodies of Africa. To the east is the Indian Ocean, to the north Lake Victoria, to the west Lake Tanganyika and to the south-west Lake Nyasa. Mainland Tanzania also has the highest point in Africa. The snow caped Mount Kilimanjaro is 5,950 metres high.

Based on the 2002 Population and Housing Census, the country was reported to have about 34,569, 232 people: 33,584,607 from mainland Tanzania and 984,625 from Zanzibar with an annual average intercensal growth rate (1988 – 2002) of 2.9 (URT, 2002b). By 2005 the country has about 36.2 million people (17.7 million people were males and 18.5 million people were females).

Agriculture (including livestock) is the dominant sector in Tanzanian economy, providing livelihood, income and employment to over 80% of the population and it accounted for 56 percent of GDP and about 60 percent of export earnings in the past three years making a significant contribution to the National GDP compared to other sectors. It is the main source of employment and livelihood for more than two-thirds of the Tanzanian population. It is an important economic sector in terms of food production, employment generation, production of raw materials for industries and generation of foreign exchange. The Gross Domestic Product in real terms grew by 6.8 percent in 2005, compared to 6.7 percent in 2004, however this was lower than the targeted growth of 6.9% and the drop was attributed to severe drought which affected most parts of the country in the last quarter of last year leading to severe food shortages, food insecurity and hunger.

1.2 General Overview of NAPA development in Tanzania

Tanzania National Adaptation Programme of Action (NAPA) document is informed by the aspirations National Development Vision 2025 for high and shared growth, quality livelihood, peace, stability and unity, good governance, high quality education and international competitiveness. Since Tanzania's economy is largely dependent on agriculture, it is deemed that sustainable development can only be achieved when strategic actions, both short term and long term are put in place to address climate change impacts on agriculture and other key economic sectors.

NAPA identifies climate change related vulnerabilities of key economic sectors, which form basis of the livelihood of the rural community and backbone of the national development and prosperity. Thus information in NAPA is a concise disc, action oriented towards priority on the ground activities.

1.3 The NAPA Vision

The overall vision of Tanzania's NAPA is to identify immediate and urgent Climate Change Adaptation Actions that are robust enough to lead to long-term sustainable development in a changing climate. It will also identify climate change adaptation activities that most effectively reduce the risks that a changing climate poses to sustainable development.

1.4 Objectives of NAPA

The main objectives of NAPA are:

i. To identify and develop immediate and urgent NAPA activities to adapt to climate change and climate variability;
ii. To protect life and livelihoods of the people, infrastructure, biodiversity and environment;
iii. To mainstream adaptation activities into national and sectoral development policies and strategies, development goals, visions and objectives;
iv. Increase public awareness to climate change impacts and adaptation activities in communities, civil society and government officials;
v. To assist communities to improve and sustain human and technological capacity for environmentally friendly exploitation of natural resources in a more sustainable way in a changing climate;
vi. To complement national and community development activities which are hampered by adverse effects of climate change; and
vii. To create a long-term sustainable livelihood and development activities at both community and national level in a changing climatic conditions.

1.5 The NAPA Process:

The NAPA process was based on consultation with sectors and literature review. However a number of consultations were done at community level especially the farmers in some parts of the country mainly to verify and concretize the information from the sectors. In this regard, NAPA team members were able to obtain communities' perception and views regarding the adverse impacts of climate change on sustainable rural livelihoods and a range of coping and adaptation measures that have evolved through the use of indigenous knowledge and modern science and technology initiatives. In the final analysis, through this consultative process a large number of people participated in the development of this NAPA document and are aware of what the project intends to do and achieve for vulnerable rural communities.

Cognizant of the adverse impacts of natural disasters and calamities such as floods, droughts, landslides and insect pests outbreak to the economy of Tanzania, the government created a Disaster management Department to deal with these issues. This highlights the importance that the Government attaches to initiatives aimed at dealing with climate-related disasters and calamities among the most vulnerable communities in rural areas. Thus, the NAPA report is actually addressing the priority needs of all Tanzanians, especially in the needs of rural communities, and complementing existing government initiatives.

The NAPA preparatory process involved the participation of many stakeholders. The multi-disciplinary team used participatory approaches to ensure that national plans and strategies are integrated in the document. This approach ensured that the NAPA document was developed in a transparent and participatory manner, a feature that would further ensure that the proposed activities are implemented and adopted by target vulnerable communities.

1.5.1 Guiding Principles:

In line with annotated guidelines for the preparation of NAPA (LEG, 2002), Tanzania NAPA preparation process was guided by the following principles:-

a) A Participatory process:

Tanzania being a large country, a sectoral participatory approach was employed during consultation exercise. The process started by establishment of a muti-disciplinary and multi-sectoral NAPA team. This was important to ensure that all the relevant sectors participate in the process. Consultations were done which involved the participation of various stakeholders from the public and private sector organizations, such as government ministries and departments, the academic and research institution, NGOs and Media. The main objective of the consultative process was to publicize the project activities, and solicit inputs and feedback from all stakeholders, including rural communities who will be involved in project implementation.

b) Multidisciplinary approach

This was taken into account in the formation of a NAPA team. The NAPA team comprised of experts from various government institutions (Ministries, Universities, Agencies, etc) and private institutions and NGOs.

c) Complementary Approach at all levels

The NAPA complements other existing national programmes including National Strategy for Growth and Reduction of Poverty, Agricultural Sector Development Strategy (ASDS), Rural Development Strategy, National Action Plan to Combat Desertification (NAP) and National Biological Diversity Strategy and Action Plan (NBSAP).

d) Sustainable development

The project activities that will enhance sustainable development were given a great consideration during preparation of Tanzania NAPA Framework.

e) Country-Driven Approach

Since Tanzania is party to a number of Multilateral Environmental Agreements (MEAs), the NAPA Framework has been designed to suit the needs of Tanzanians to combat local and global impacts of climate change. Sound Environmental management

The NAPA Framework has been formulated strategically to be inline with the Environmental Management Act, 2004, which came into force on July 1, 2005.

f) Cost-effectiveness

NAPA has taken into consideration the feasibility and implementation costs, based on past and ongoing projects, strategies and plans, e.g. tree planting projects, impregnated mosquito nets programmes, etc.

g) Simplicity

NAPA process is intended to create simple and sustainable activities that are appealing to communities, which will be recipients of the project-based activities.

i) Flexibility

NAPA framework allows for the implementation of the activities by private sector as well as NGOs, CBOs, individuals and government institutions.

1.5.2 Criteria for Selecting Priority Project Activities

The following criteria were and are expected to be the basis for the ranking:-

- Level or degree of adverse effects of climate change;
- Poverty reduction to enhance adaptive capacity;
- Cost effectiveness;
- Improvement of the livelihood of the rural communities;
- Vulnerable groups in the communities, e.g. the rural poor;
- Cost of the project;
- Complementality to national goals and objectives; and
- Locally driven criteria (country driven).

The overriding principle was the immediate and urgent needs that was disclosed and/or argued by stakeholders.

2.0 DEVELOPMENT LINKS OF NAPA

NAPA is linked with other national development policies, goals, objectives, plans, strategies and programme and supports/complements strategies and programmes of other multilateral environmental agreements that Tanzania is Party. These include: the United Nations Convention to Combat Desertification (UNCCD), United Nations Framework Convention on Climate Change (UNFCCC), the Convention on Biological Diversity (CBD), Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, Vienna Convention on the Protection of Ozone Layer and Montréal Protocol on Substances that Deplete the Ozone layer, among others. A number of strategies and action plans related to some of these conventions are in place. These encompass the National Biodiversity Strategy and Action Plan (NBSAP), the National Action Programme (NAP), and the National Biosafety Framework (NBF). Indeed, the NAP provides useful information for development of NAPA.

Other relevant strategies and action plans relevant to the NAPA development include the Rural Development Strategy, the Agriculture Sector Development Strategy, and Local Government Reform Strategy (to implement the 1999 Local Government Act – which re- created the concept of decentralisation by devolution). More important, the government has recently adopted the National Strategy for Growth and Reduction of Poverty- NSGRP (MKUKUTA in Kiswahili), which is a second national organizing framework for putting the focus on poverty reduction high on the country's development agenda. The NSGRP /MKUKUTA strives to widen the space for country economic ownership and effective participation of civil society, private sector development and fruitful local and

external partnerships in development and commitment to regional and other international initiatives for social and economic development.

The NSGRP builds on the Poverty Reduction Strategy Paper (PRS(P)) (2000/01-02/03), the PRS Review, the Medium Term Plan for Growth and Poverty Reduction and the Tanzania Mini-Tiger Plan 2020 (TMTP2020) that emphasize the growth momentum to fast-track the targets of Vision 2025. The NSGRP is expected to last 5 years, i.e. from 2005/06 to 2009/10. The end point of the strategy coincides with the targets of the National Poverty Eradication Strategy (NPES - 2010); it is two thirds of the way towards the MDGs (2015) and 15 years towards the targets of Vision 2025. All these development strategies conforms well with the commitment of the Fourth Phase of the government which has strongly committed itself towards stable economic development and better life to every Tanzanian thereby reducing vulnerability to the adverse impacts of climate change and other stresses. The government has been creating enabling environment that will speed up the implementation of these development strategies in order to realize the intended goals.

Furthermore, the National Environmental Action Plan (NEAP) of 1994 led to formulation of National Environmental Policy (NEP) in 1997. The NEP provides a framework for mainstreaming environmental considerations into the decision making process in Tanzania. Though NEP does not pay explicit attention to climate change, the primary environmental issues brought forward include many of the concerns that would be addressed by non-regrets climate change adaptation measures. In particular, the NEP highlights the importance of integrating environmental management in several sectoral programmes and policies. In addition, National Forestry Policy (NFP), 1998 which is a review of the 1953 version, gives no direct reference to climate change despite the vulnerability of Tanzanian forests to changed climatic conditions. One of the main objectives of the NFP is to ensure ecosystems stability through conservation of forest biodiversity, water catchments, and soil fertility. The policy states that new forest reserve for conservation will be established in areas of high biodiversity value and that biodiversity conservation and management will be included in the management plans for all protected forests.

3.0 VULNERABILITY TO CLIMATE CHANGE AND SECTORAL ANALYSIS

The adverse impacts of Climate Change are already having their toll in the livelihoods of people and in the sectors of the economy in the country. 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. The recent severe droughts which hit most parts of the country leading to severe food shortages, food insecurity, water scarcity, hunger and acute shortage of power signify the vulnerability of the country to impacts of climate change.

Predictions show that the mean daily temperature will rise by 3^0C – 5^0C throughout the country and the mean annual temperature by 2^0C – 4^0C. There will also be an increase in rainfall in some parts while other parts will experience decreased rainfall. Predictions further show that areas with bimodal rainfall pattern will experience increased rainfall of 5% – 45% and those with unimodal rainfall pattern will experience decreased rainfall of 5%– 15%. All these changes will aggravate the situation leading to increased vulnerability of the communities to the impacts of Climate Change and also affecting the sectors of the economy especially Agriculture, water, Energy, Health and forestry. Sectoral vulnerability analysis ha indicated the extent of vulnerability for each sector as illustrated in the following section.

3.1. Agriculture

Tanzania has about 88.6 million hectares of land suitable for agricultural production, including 60 million hectares of rangelands suitable for livestock grazing. Based on altitude, precipitation pattern, dependable growing seasons and average water holding capacity of the soils and physiographic features, Tanzania has 7 agro-ecological zones (Table 1).

Table 1: Tanzania Agro ecological zones

Zone	Sub-Zone and areas	Soils and Topography	Altitude	Rainfall (mm/yr)	Growing season
1. COAST	North: Tanga (except Lushoto), Coast and Dares Salaam South: Eastern Lindi and Mtwara (except Makonde Plateau	Infertile sands on gently rolling uplands Alluvial soils in Rufuji Sand and infertile soils Fertile clays on uplands and river flood plains	Under 3000m	North: Bimodal, 750-1200mm South: Unimodal, 800-1200mm	North: October-December and March-June South: December- April
2.ARID LANDS	North: Serengeti, Ngorogoro Parks, Part of Masailand Masai Steppe, Tarangire Park, Mkomazi Reserve, Pangani and Eastern Dodoma	North: Volcanic ash and sediments. Soils variable in texture and very susceptible to water erosion South: Rolling plains of low fertility. Susceptible to water erosion. Pangani river flood plain with saline, alkaline soil	North: 1300-1800m South 500-1500m	North: Unimodal, unreliable , 500-600mm South: Unimodal and Unreliable, 400-600mm	March- May
3. SEMI-ARID LANDS	Central Dodoma, Singida, Northern Iringa, some of Arusha, Shinyanga Southern: Morogoro (except Kiliombero and Wami Basins and Uluguru Mts). Also Lindi and Southwest Mtwara	Central: Undulating plains with rocky hills and low scarps. Well drained soils with low fertility. Alluvial hardpan and saline soils in Eastern Rift Valley and lake Eyasi. Black cracking soils in Shinyanga. Southern: Flat or undulating plains with rocky hills, moderate fertile loams and clays in South (Morogoro), infertile sand soils in center	Central: 1000-1500m Southeastern 200-600m	Central: unimodal and unreliable: 500-800mm Southeastern: Unimodal 600-800mm	December - March
4. PLATEAUX	Western: Tabora, Rukwa (North and Center), Mbeya North: Kigoma, Part of Mara Southern: Ruvuma and Southern Morogoro	Western: Wide sandy plains and Rift Valley scarps Flooded swamps of Malagarasi and Ugalla rivers have clay soil with high fertility Southern: upland plains with rock hills. Clay soils of low to moderate fertility in south, infertile sands in North.	800-1500m	Western: unimodal, 800-1000mm Southern: unimodal, very reliable, 900-1300mm	November- April
5. SOUTHERN AND WESTERN HIGHLANDS	Southern: A broad ridge of from N. Morogoro to N. Lake Nyasa, covering part of Iringa, Mbeya Southwestern: Ufipa plateau in Sumbawanga Western: Along the shore of Lake Tanganyika in Kigoma and Kagera	Southern: Undulating plains to dissected hills and mountains. Moderately fertile clay soils with volcanic soils in Mbeya Southwestern: Undulating plateau above Rift Valleys and sand soils of low fertility Western: North-south ridges separated by swampy valleys, loam and clay soils of low fertility in hills, with alluvium and ponded clays in the valleys	Southern: 1200-1500m Southwestern: 1400-2300m Western: 100-1800m	Southern: unimodal, reliable, local rain shadows, 800-1400mm Southern: unimodal, reliable, 800-1000mm Western: bimodal, 1000-2000mm	Northern: December – April Southwestern: November- April Western: October-December and February-May
6.NOTHERN HIGHLANDS	Northern: foot of mt Kilimanjaro and Mt. Meru. Eastern Rift Valley to . Eyasi Granite Mts Uluguru in Morogoro, Pare Mts in Kilimanjaro and Usambara Mts in Tanga, Tarime highlands in Mara	Northern: Volcanic uplands, volcanic soils from lavas and ash. Deep fertile loams. Soils in dry areas prone to water erosion. Granite steep Mountain side to highland plateaux. Soils are deep, arable and moderately fertile on upper slopes, shallow and stony on steep slopes	Northern: 1000-2500m Granitic Mts: 1000-2000m	Northern: Bimodal, varies widely 1000-2000mm Granitic mts. Bimodal and very reliable 1000-2000m	Northern: November-January and March-June Granitic Mts. October-December and March-June
7. ALLUVIAL PLAINS	K-kilomberao (Morogoro) R- Rufuji (Coast) U- Usangu (Mbeya) W- Wami(Morogoro)	K-Cental clay plain with alluvial fans east and west R- Wide mangrove swamp delta, alluvial soils, sandy upstream, loamy down steam in floodplain U-Seasonally Flooded clay soils in North, alluvial fans in South W- Moderately alkaline black soils in East, alluvial fans with well drained black loam in West		K—Unimodal, very reliable, 900-1300mm R-Unimodal, often inadequate 800-1200mm U-Unimodal, 500-800mm W-Unimodal, 600-1800mm	K-November-April R- December-April U-December-March W-December-March

Studies undertaken during INC indicate that increase in temperature by 2^{o}C -4^{o}C would alter the distribution of the agro ecological zones. Consequently, areas that used to grow perennial crops would be suitable for annual crops. In addition, global warming would tend to accelerate plant growth and hence reduce the length of growing seasons.

Among the vulnerability in the agricultural sector include decreased crop production of different crops exacerbated by climatic variability and unpredictability of seasonality, erosion of natural resource base and

environmental degradation. The following list shows the percentage of decrease of two selected crops; maize and coffee:-

- Maize: with increase in temperature and reduced rainfall as well as change in rainfall patterns, average yield will decrease by 33% country wide. Furthermore, yield of the same crop will decreases by up to 84% in the central regions, 22% in Northeastern highlands, 17% in the Lake Victoria region, and 10 – 15% in the Southern highland;

- Coffee and Cotton: As a result of temperature increase of 2-4 ^{o}C, coffee production is projected to increase by 18% in bimodal rainfall areas and 16% in unimodal rainfall areas.

Furthermore, climate change is expected to further shrink the rangelands which are important for livestock keeping communities in Tanzania. This shrinkage will be more aggravated by the fact that about 60% of the total rangeland is infested by tsetse fly making it unsuitable for livestock pastures and human settlements. Shrinkage of rangelands is likely to exacerbate conflicts between livestock keepers and farmers in many areas. Surveys show that existing number of cattle in Tanzania has already surpassed the normal carrying capacity in most of the areas as shown in Table 2. As a result, most livestock keepers are shifting their herd towards southern Tanzania in search for pastures.

Table 2: Livestock Carrying capacity for selected regions

Region	Carrying Capacity		Excess
	Existing	Recommended	
Mwanza	2, 180,275	63,360	2,116, 915
Shinyanga	3, 806,677	87,800	3, 718, 877
Dodoma	798,105	160,167	637, 938
Singida	727,930	117,983	609, 947

Source: Ministry of Livestock Development, 2005

3.2. Water

Tanzania is endowed with many river basins which are economically important. Among these, the major ones are Rufiji, Pangani, Ruvu, Great Ruaha, Malagarasi, Kagera, Mara, Ruvuma, and Ugalla River Basins. Apart from being economically significant, these river basins also form an important part in sustaining the daily livelihood of the local communities through fishing and traditional farming irrigation systems.

The INC shows that rainfall pattern and soil moisture will vary due to changes in mean temperature hence affecting the runoff of these rivers. For instance the increase in temperature between 1.8 ^{o}C - to 3.6 ^{o}C in the catchments areas of River Pangani in the North and North East of the country, hence decrease in rainfall, will lead to a decrease of 6-9% of the annual flow of the river. Rufuji River, which houses Mtera and Kidatu hydropower stations, is expected to experience an increase in river flow by 5-11% due to low temperature fluctuation of between 3.3 ^{o}C to 4.6 ^{o}C and hence increase in rainfall. Floods on Rufiji and Pangani Rivers would cause damage to major hydropower stations and human settlements found along these river basins in the country.

Furthermore, the second Vulnerability Assessment Report (V.A.R II) on the other hand reveals that majority of households use more than one source of water supply, although (62%) depend on traditional sources of water supply. By ranking the values are wells (26%), rivers (24%) rain harvest (9%) and lakes (6%). Two thirds of the households depend on undergdound water wells, rain water and Lakes for water supply while only one third is served by piped water. Change in the precipitation will automatically affect each source and the consequences might be devastating depending on the magnitude. V.A.R I indicates that civil conflicts have been occurring between livestock keeper and farmers over grass and water for the animals in Morogoro, Mara and Kilimanjaro regions. Similarly due to mass exodus of cattle keepers in search of animal feeds school attendance has gone down. On more commercial basis, crop and animal production has been affected negatively in areas with decreasing rainfall and vise versa.

3.3 Health

Malaria is the largest cause of loss of lives in the country accounting for about 16% of all reported deaths. Under the current trend in both rainfall and temperature, the frequency of occurrences and impacts of malaria will further rise. The V.A.R study further reveals among four major health hazards reported at village, district and national level, Malaria is one of them. Other major diseases in Tanzania are: Dysentery, Cholera, and Meningitis (Table 3).

Table 3: Human Health Hazards reported at Village, District and National Levels

S/N	Disease	Village %	District %	National estimate %
1	Dysentery	83	95	56
2	Malaria	98	93	85
3	Cholera	60	93	24
4	Meningitis	54	85	24

Source: Disaster Vulnerability Assessment Phase II by PMO and UCLAS 2003

Malaria transmission is said to be at its peak during high temperatures and humidity, after the rain season. As a result of change in temperature and rainfall regimes, malaria epidemic has been observed to extend to some parts of Tanga, Kilimanjaro and Arusha highlands (non-traditional malaria areas) where the disease was not prevalent. As more areas receive more rains, it will in turn attract more malaria vectors, leading to increased incidences of malaria diseases across the country.

Furthermore, the study conducted by Kangalawe and Yanda (2004) indicate that malaria is endemic in the lowlands but unstable in the highlands of the Lake Victoria region, there is creeping-up of the disease towards the highlands. The study further indicates that women and children are more vulnerable to malaria than men due the roles they play in the society, and that poverty influence adaptation to malaria/cholera in the area.

3.4 Forestry and Wetlands

Tanzania is well endowed with forest resources such that by 2002, 38.8 million hectares, (35% of the total land) were covered by forests and woodlands. However, all forest areas and types are under major threat of deforestation. The deforestation rate was estimated to be 91, 276 hectares per year in 2002. The main reasons for deforestation include clearing for agriculture and settlement, overgrazing, wildfires, charcoal burning and over-exploitation of wood resources for commercial purposes. All these activities contribute a great share to the increase of CO_2 in the atmosphere as the carbon sink is progressively

reduced. Predictions show that the mean daily temperature will rise by 3^0C – 5^0C throughout the country and the mean annual temperature by 2^0C – 4^0C. There will also be an increase in rainfall in some parts while other parts will experience decreased rainfall. Predictions further show that areas with bimodal rainfall pattern will experience increased rainfall of 5% – 45% and those with unimodal rainfall pattern will experience decreased rainfall of 5%– 15%.

The expected change of vegetation types in the forest zones due to increase in temperature are summarized in Table 4.

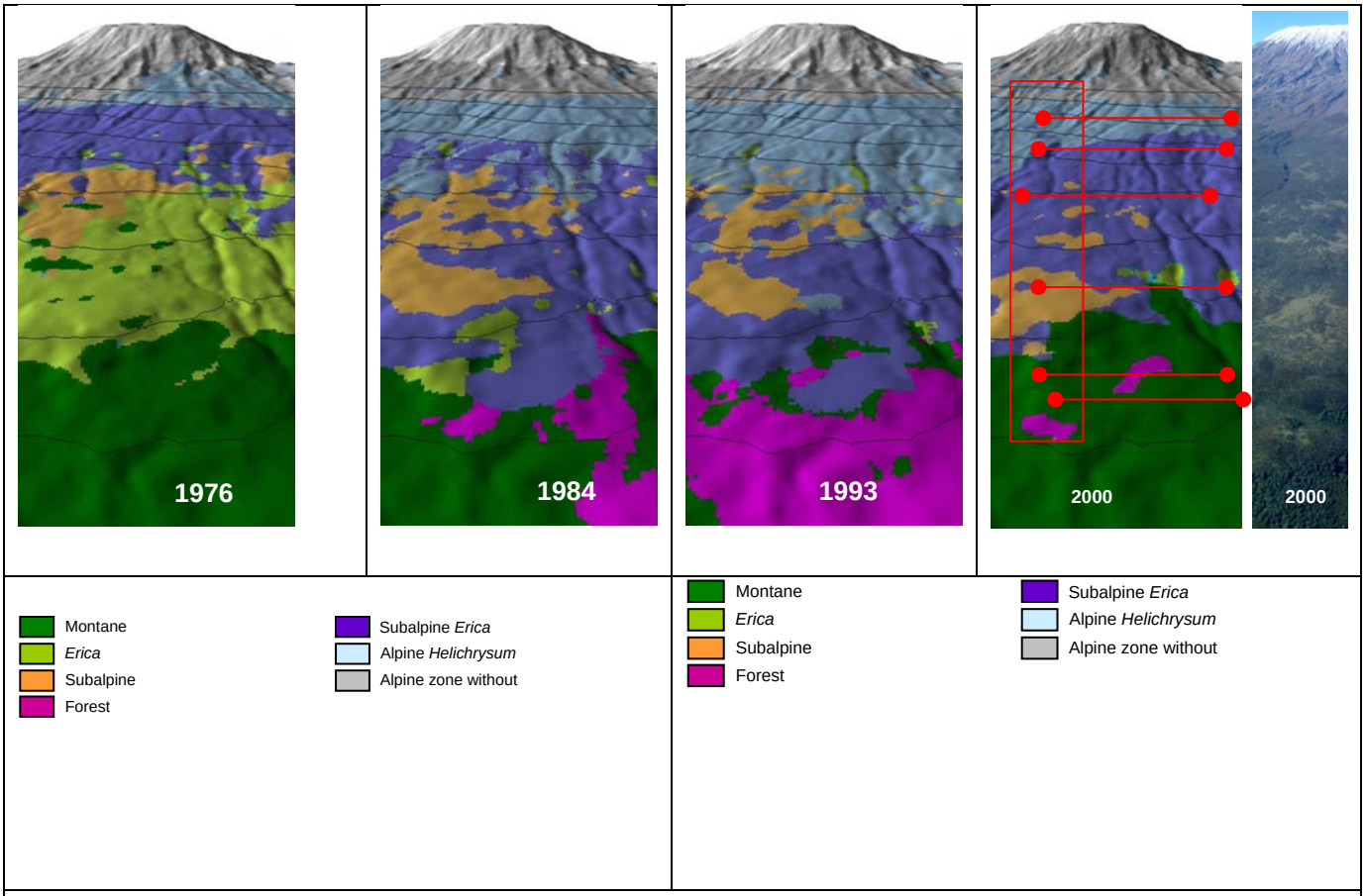
Table 4: Predicted changes in forests

Type of vegetation	Expected change
Sub tropical dry forest and subtropical moist forest life zone	Change to tropical; very dry forest, tropical dry forest and tropical moist forest
Subtropical thorn woodland	Completely be replaced/ disappear
Subtropical dry forest	Decline by 61.4%
Subtropical moist forest	Decline by 64.3%;

Species that will be more vulnerable are those with: limited geographical range and drought/heat intolerant; low germination rates; low survival rate of seedlings; and limited seed dispersal/migration capabilities.

Furthermore, recurrent forest fires have contributed to the diminishing of forests and forest resources in various parts of the country and ecosystems. More ecosystems and natural agro ecological zones are vulnerable as a result of bushfires emanating from impact of climate change. Among the chronic areas where bush fires have caused negative rampart effects are Mountains Uluguru and Kilimanjaro. At Mount Kilimanjaro vegetation cover has not only changed but has also been diminishing year after year due to frequent occurrence of fires, such that the Montane type of forest disappeared in year 2000 as is shown in Figure 1. As a result of these changes the catchment forests has been disturbed along the slopes of Mount Kilimanjaro.

Figure 1: Changes in vegetation cover at Mt. Kilimanjaro



Source : TMA, 2005

3.5 Energy

Tanzania has a good number of energy sources including solar, wind, biogas, coal reserves, natural gas, hydropower, biofuel, wood fuel, and geothermal power. Of all these, the most exploited source is wood fuel because it is considered both cheap and accessible to the poor majority in rural and urban areas.

Petroleum, hydropower and coal are the major source of commercial energy in the country. The biomass energy resource, which comprises of fuel-wood and charcoal from both natural forest and plantations, accounts for 93 per cent of total energy consumption. Tanzania installed Hydro electricity generation capacity" of 561 MW. It is reported that Tanzania has an estimated 4800 MW of economic hydro potential capacity, which accounts for 90 percent. However, not all this hydro-potential has been taped. In addition, due to drought, the highest water levels in most of the hydropower stations have progressively been declining in recent years. Data from the Ministry of Energy and Minerals show that the highest water level in Mtera Dam declined from 695.8m asl in 2003 to 690.5m asl in 2004 689.5m asl in 2005 and 688m asl in march 2006. Similar case was experienced in the Nyumba ya Mungu Dam where the level declined from 686.2m asl to 683.8m asl, 683m asl and 680m asl in 2003, 2004 and 2005 respectively thereby affecting hydropower production.

Blackouts and power rationing as a result of low water levels in the hydropower dams have forced Tanzania Electric Supply Company (TANESCO) to rely on gas-powered generators and to look increasingly at thermal projects for future capacity increases. Power rationing for both domestic and industrial use makes Tanzania's economy more vulnerable to climate change related disasters; and leads to inefficiency in service provision to the public. The current information from the Governor of the Central Bank of Tanzania showed that the economy will grow at a rate of 5.9% instead of 7% and this drop of the rate of economic growth is attributed to the serious shortage of electricity affecting all pillars of economy.

Tanzania has 1,200 million metric tons of coal, which could provide energy for paper mills, cement factories, agriculture and household consumption as well as generation of power. The current coal generated electricity capacity is 6MW. As an adaptive strategy, Tanzania plans to increase this capacity to 200MW in the short term and up to 600MW in the long term as adaptation to the drought situation of HEP dams. Wind and solar energy is another sources of energy. However, very little attempt has been made to utilize this source of energy which could be a viable alternative sources to reduce the dependency on wood and oil for heating purposes, hence reduction of CO_2 emissions. Solar Photovoltaic Market Transformation pilot project for off-grid areas in Mwanza region is an attempt to utilize the widely available solar potential for the production of energy. Moreover, it is an indigenous alternative source of energy which can be exploited to enhance Tanzania's energy sector so that to boost economic growth.

3.6 Coastal and Marine resources

The coast of Tanzania is characterized by a wide diversity of biotopes and species, typical of the tropical Indowest Pacific oceans. The peoples living there utilize a variety of its natural resources. These coastal and marine resources of Tanzania have for generations had profound influences on the socio-economic well being and health status of not only the immediate communities but also those far removed from them. They constitute a significant component of the country's rich heritage, and the highly productive ecosystems play a substantial role in the economic and social development of the country. Coral reefs are an important coastal resource. In addition to being complex ecosystems and habitat to a wide diversity of marine flora and fauna, they are also important for the tourism and fisheries industries with the former industry serving as one of the main markets for fish products.

Rise in temperature as a result of climate change is expected to cause various impacts including rise in sea level which in the final analysis will lead to coastal resources and infrastructure destruction such as mangroves and houses. This will in turn further impoverish the local communities which depend on these resources.

Wetland habitats are important integral parts of the coastal fisheries industry and provide critical spawning and nursery grounds for many marine and freshwater organisms. Estuarine and lagoon fisheries are therefore the basis for livelihood in many communities. The mangroves, in addition to providing physical protection for the coast against erosion, are used as firewood, building poles, boat building, fish smoking, and in making several domestic appliances (beds, drums, carts, etc.).

Due to the importance of the sea and coastline, the welfare of the population living by the coast and the socio-economic value to the country, the coastline has to be protected against any effect of climate change.

3.7 Wildlife

The wildlife of Tanzania is one of the richest and most diversified in Africa. Approximately 19 % of the country is protected as national parks or game and forest reserves. The country has a diverse spectrum of fauna and flora including a wide variety of endemic species and sub-species. The biological diversity and degree of endemism consist of primates, (20 species and 4 endemic), antelopes (34 species and 2 endemic) fish (with many endemic in Lake Victoria, Tanganyika and Nyasa and other small lakes and rivers), reptiles (290 species and 75 endemic), amphibians (40 endemic), invertebrates and plants caround 11,000 species including many endemic).

Tanzania's great reservoir of wildlife and biological diversity is increasingly under threat as a result of ecosystem fragmentation, over utilization of resources and conflicts between agriculture and wildlife. Persistent drought due to increase in temperature and unreliable rainfall pattern in the country is expected to affect the lifestyles of most of the migratory wild species, in particular the wildebeest and some bird species. The wildlife forms an important source of food and income for some local communities in Tanzania. Change in ecological systems will lead to disappearance of some wild animal species.

3.8 Tourism

With a vast land area covered by forests as well as various species of flora and fauna, Tanzania is considered to be one of the premier tourism destinations in Africa. The country has beautiful natural resources including extensive tracts of wilderness and a rich diversity of scenery. Among the tourist attraction is 12 National Parks, including the famous Serengeti, 34 Game Reserves, and 38 Game Controlled Areas. Among many tourism sites, the prime tourist attractions include Mount Kilimanjaro, Zanzibar's historic Stone Town, the Olduvai Gorge archaeological site and clean white sand beaches fringed by palm trees. However, due to increase in temperature some of these attractions such as the ice cap of Mount Kilimanjaro are under threat of smelting. The studies undertaken showed that the ice cap of Mt. Kilimanjaro has decreased between 50-80%.

Figure 2 shows the shrinking ice caps of Mt. Kilimanjaro between 1993 and 2000 (Source TMA 2005). It is estimated that about 80% of the snow at Mt. Kilimanjaro has disappeared leading to reduced water flow at the feet of the mountain where the local community live.

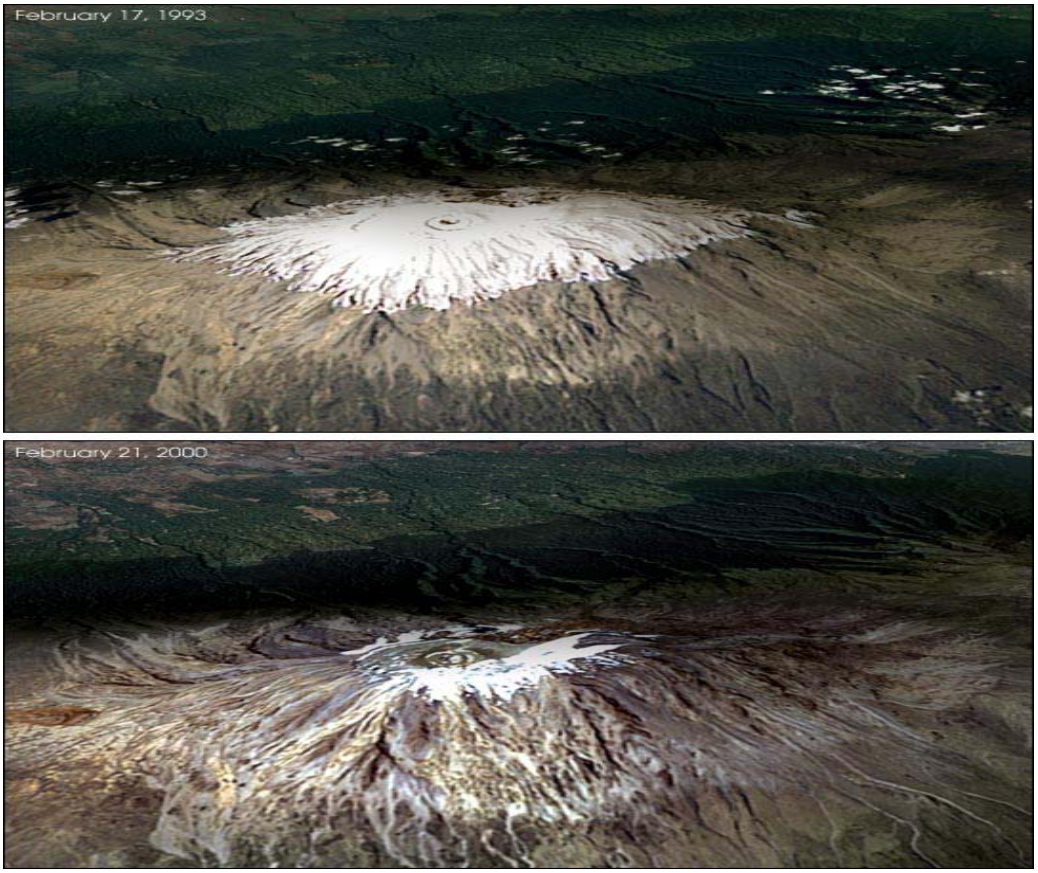


Figure 2: Shrinking ice caps of Mt. Kilimanjaro

3.9 Industry

Manufacturing activities in Tanzania are relatively small and at an infancy stage. Its contribution to GDP has averaged 8% over the last decade, with most activities concentrated on manufacture of simple consumer goods - food, beverages, tobacco, textiles and furniture and wood allied products. However, the growth of industrial sectors is threatened by unavailability of sustainable and cheap energy source. Coping strategies in the energy sector are important for the growth of the economy in Tanzania.

3.10 Other Assessment of Vulnerability and Adaptation in Tanzania

Assessment of vulnerability and adaptation to climate change in various sectors also form part of the Initial National Communication (INC). In addition, there are twodisaster vulnerability assessments reports conducted in 2002 and 2003 by the Prime Minister's Office (PMO) and University College of Lands and Architectural Studies (UCLAS) which reveal the situation at the grassroots. All of these assessments contain very valuable information which contributes to an increased understanding of Tanzania's vulnerability to Climate Change.

Furthermore, there are two Food Assessment Reports conducted by Food Situation Investigation Team (FSIT) which shows that North Eastern and coastal regions received very little or no rains in Vuli season, a situation which led to food relief distribution to more than 56 districts out of 120. Kilimanjaro is now one of the hardest-hit regions although it used to be a heavy rain area in the past two decades.

The major causes of these vulnerabilities at village, district and national levels is climate change associated with prolonged heavy rainfall or drought. According to the V.A.R, the top four hazards in the country as indicated in Table 5 are: epidemics (43%), drought (47%), pest/vermin/plant diseases (50%) and floods (13%). These high ranked hazards have also been observed as commonly occurring in a

period of less than five years, and have a positive correlation with the climate change observed throughout the country within the same time period. During the survey, the perception recorded from the local communities regarding the occurrence of these extreme weather events are:

a. Drought: At household level drought was reported as a problem and 83% mentioned prolonged low rainfall to be the cause, followed by climatic variability in terms of onset of rainfall for cropping seasons 60% and increased deforestation 53%.

b. Pests: Out of 995 respondents at village level who mentioned pest as a problematic hazard (37%) mentioned climate change to be a cause increased and new pests and diseases and prolonged rainfall/dryness (31%) and poverty 14%.

c. Epidemics: Out of 852 respondents who were affected by diseases outbreak, 42% reported prolonged rainfall and drought to be the cause, climatic variability 30% health related 41% and poverty10%.

d. Floods: Was mentioned as been caused by prolonged rainfall (83%) while climate change scored (19%). Table 5 summarizes these findings.

Table 5: Major causes of Hazards at village and district level

S/N	Hazard type	Causes	Village %	District %
1	Strong winds	Desertification, poor farming methods, overgrazing	67	50
		Climate change	67	33
		Prolonged low rainfall/dryness		33
2	Drought	Desertification, poor farming methods, overgrazing	10	87
		Climate change	10	67
		Prolonged low rainfall/dryness	8	67
3	Diseases outbreak	Prolonged low rainfall/dryness	40	42
		Health related	28	45
		Poor house plan and drainage	-	50
		Climatic change	16	-
		Poverty	25	70
4	Floods	Prolonged heavy rainfall	53	75
5	Pest	Climatic change	27	45
		Prolonged low rainfall and dry spell	23	40
		Poverty	28	55
		Lack of expertise and technology	23	36

Source: Disaster Vulnerability Assessment Phase II by PMO and UCLAS 2003

4.0 CLIMATE AND ITS TREND IN TANZANIA.

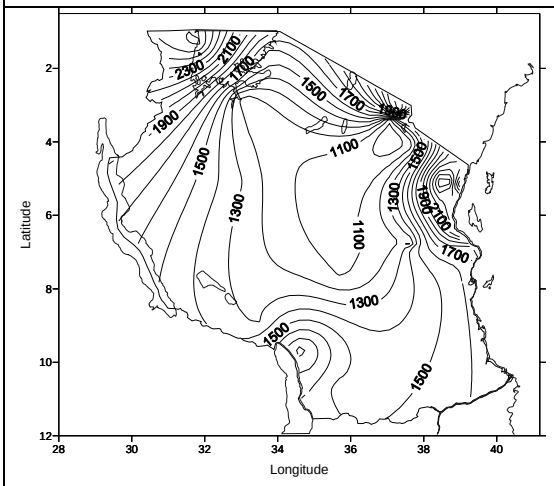
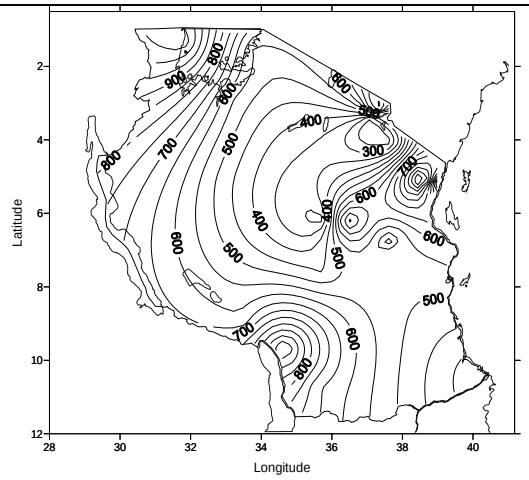
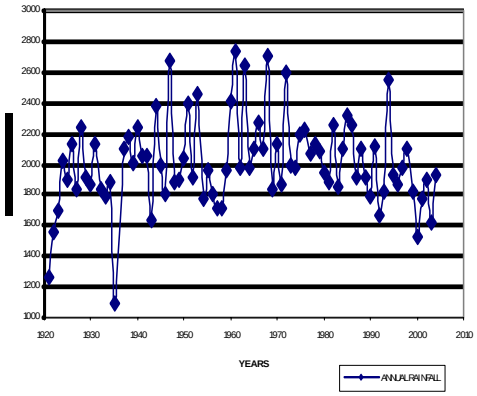
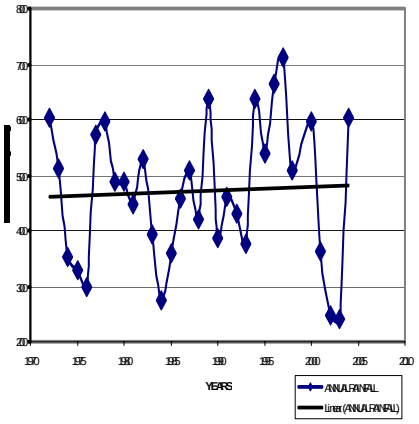
The climate of Tanzania varies from place to place in accordance with geographical location, altitude, relief and vegetation cover. Predictions show that the mean daily temperature will rise by 3^0C – 5^0C throughout the country and the mean annual temperature by 2^0C – 4^0C. There will also be an increase in rainfall in some parts while other parts will experience decreased rainfall. Predictions further show that areas with bimodal rainfall pattern will experience increased rainfall of 5% – 45% and those with unimodal rainfall pattern will experience decreased rainfall of 5%– 15%.

4.1 Rainfall Pattern

Rainfall patterns in the country are subdivided into: tropical on the coast, where it is hot and humid (rainy season March-May): semi-temperate in the mountains with the short rains (*Vuli*) in November-December

and the long rains (*Masika*) in February –May: and drier (*Kiangazi*) in the plateau region with considerable seasonal variations in temperature. The mean annual rainfall varies from 500 millimeters to 2,500 millimeters and above. The average duration of the dry season is 5 to 6 months. However, recently, rainfall pattern has become much more unpredictable with some areas/zones receiving extremely minimum and maximum rainfall per year. Figures 3 a-b show the map of Tanzania indicating areas experienced maximum and minimum rainfall for two selected stations and their associated time series (Figures c-d) from 1921 to 2005.

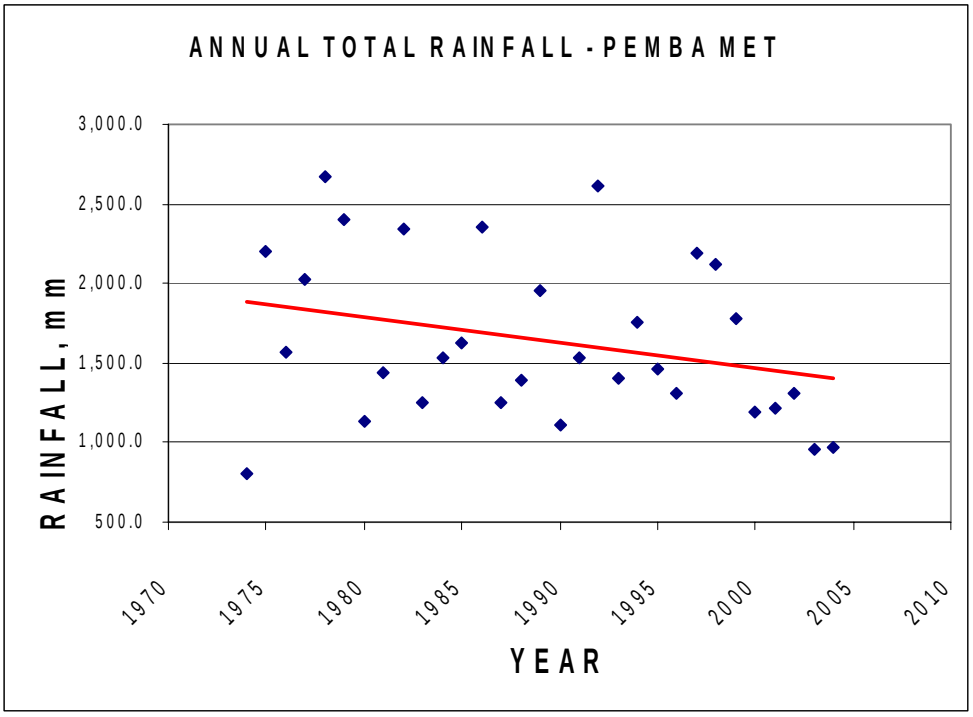
Figure 3 a-b: Map of Tanzania showing areas of Maximum and Minimum rainfall

3a: Extreme Maximum Rainfall	3b: Extreme Minimum Rainfall
	
Source: TMA, 2005	
3c: Bukoba annual maximum rainfall time series 1921-2005	2d: Kongwa annual minimum rainfall time series 1921-2005
	
Source: TMA, 2005	

Furthermore, analysis of total annual rainfall for 21 meteorological stations in selected regions of Tanzania indicated that there is a decreasing trend for over 13 stations (61.9%) whereas an increasing rainfall trend was observed over 7 stations (33.33%) and 1 station had almost a constant pattern. The most affected stations were Pemba, Zanzibar, Moshi and Arusha. However, one common feature of the

rainfall pattern was a greater variability in cycles. Figure 4 shows the trend of rainfall observed from 1970 to 2005 at Pemba meteorological station, Zanzibar.

Figure 4: Rainfall Pattern at Pemba Meteorological station



In addition, the Disaster Vulnerability Assessment Report further shows that rainfall in some parts will increase (both short and long rain seasons) especially those areas getting bimodal rainfall particularly North Eastern, North West, Lake Victoria basin(e.g. Bukoba, Kagera) as shown in Figure 2c and Northern parts of coastal belt. On the other hand in areas experiencing unimodal pattern, rainfall will decrease. Such areas include parts of South Western, Western, Central (e.g. Dodoma, Singida) and Eastern parts of the country. However, some anomalies are expected to happen in these areas as shown in Figures 4(a&b) for Bukoba and Kagera Annual rainfall anomalies.

Figure 4 a&b: Graphs showing rainfall anomalies time series of some selected regions in Tanzania

Figure 4a: Bukoba annual rainfall anomalies

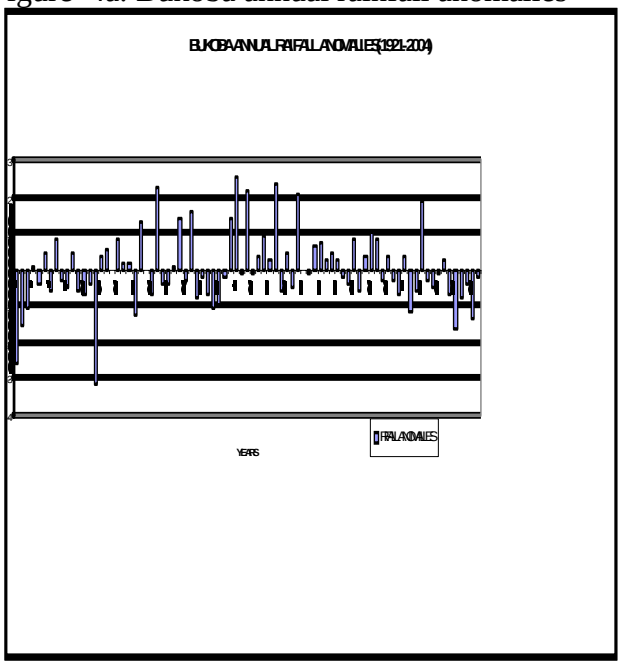
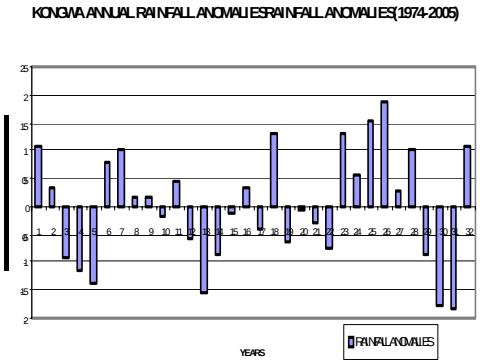


Figure: 4b:Kongwa annual rainfall anomalies series



Source: TMA 2005

4.2 Temperature Pattern

As explained in section 4.1, temperature in Tanzania also varies according to the geographical location, relief and altitude. In the Coastal Regions and the off-shore Islands the average temperatures ranges between 27 ^{o}C and 29 ^{o}C, while in the Central, Northern and Western parts temperatures range between 20 ^{o}C and 30 ^{o}C and higher between the months of December and March. In the Northeast and Southwest where there are mountainous areas and Makonde Plateau, the temperature occasionally drops below 15 ^{o}C at night during the months of June and July. In some parts (Southern Highlands) temperature can reach as low as 0 ^{o}C - 6 ^{o}C. This temperature variation has significant impact on the agro-ecological zones described in Table 1 section 2.4.1 and the adaptation strategies in the agriculture sector.

According to the INC, the mean temperatures will increase throughout the country particularly during the cool months by 3.5^{o}C while annual temperatures will increase between 2.1^{o}C in the North Eastern parts to 4 ^{o}C in the Central and Western parts of the country. Figures 5 (a&b) are maps of Tanzania showing areas experiencing extreme temperatures (Maximum and Minimum), while Figures 5c&d are graphs showing time series of these temperatures for Kilimanjaro and Mbeya regions, respectively. These changes in temperature can affect the coping strategies of the local communities for various sectors.

Figure 2a&b: Extreme Maximum and Minimum Temperatures in Tanzania

Figure 5a: Extreme Maximum temperature areas in Tanzania

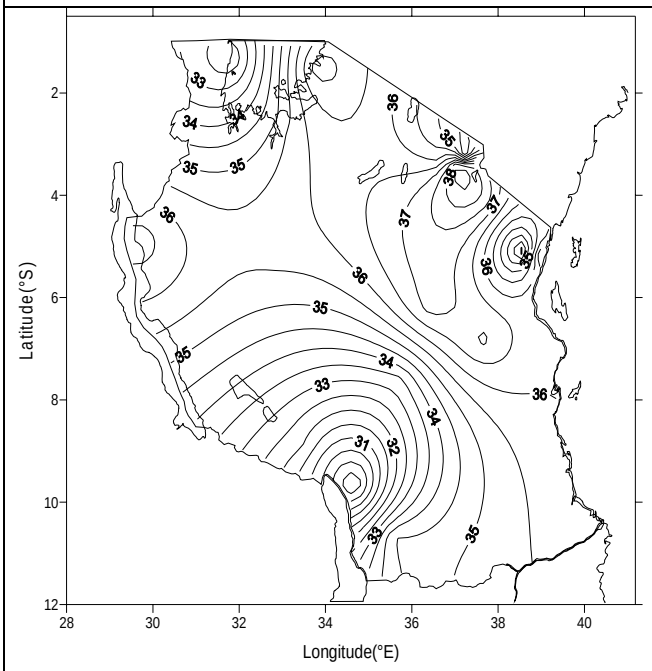


Figure 5b: Extreme Minimum Temperatures areas in Tanzania

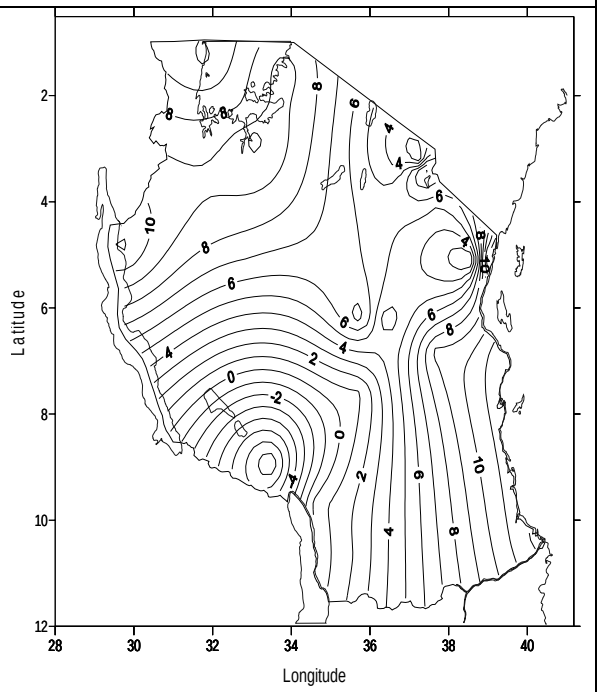


Figure 5c: Kilimanjaro airport time series for extreme maximum temperature

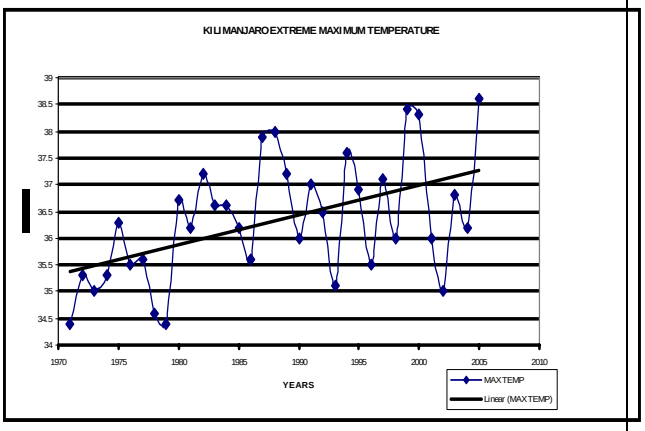
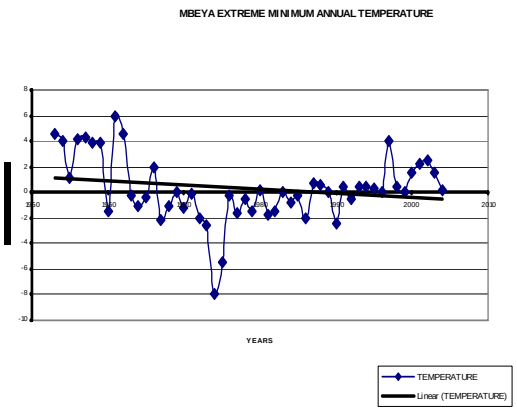


Figure 5d: Mbeya time series for extreme minimum temperature



Source: TMA, 2005

Moreover, monthly minimum and maximum temperatures over the last 30 years (between 1974 and 2004) show upward trend at the analyzed meteorological stations located in regions of Arusha, Bukoba, Dodoma, Iringa, Kilimanjaro, Mbeya, Morogoro, Mwanza, Songea, Tanga, Zanzibar and Shinyanga. The increasing trend was mostly associated with the months of January, July and December. Samples of increase in temperature are shown in Figure 6 for Morogoro meteorological station monthly minimum

temperatures and Figure 7 for Bukoba meteorological station monthly maximum temperatures respectively. It is most probable that this is an indication of climate change. Although rainfall does not show significant changes for the past 30 years, there is no doubt that, increase in temperature increases evaporation rates of soil, water bodies as well as transpiration rate of plants.

Figure 3: Trend of monthly minimum temperatures at Morogoro Meteorological station

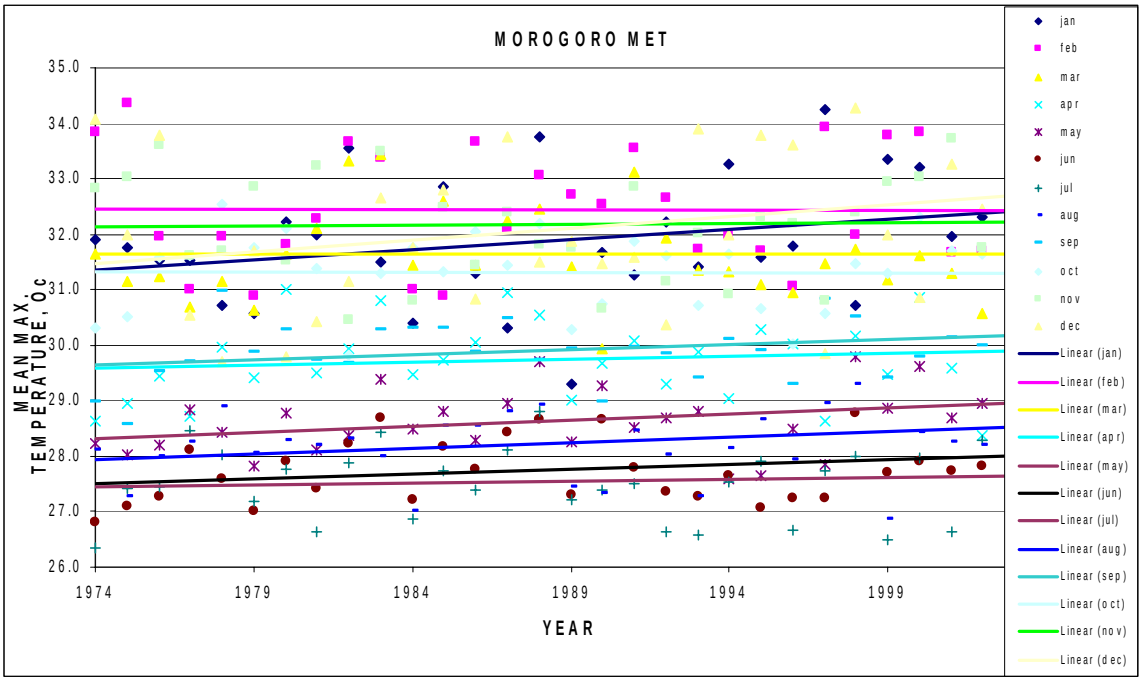
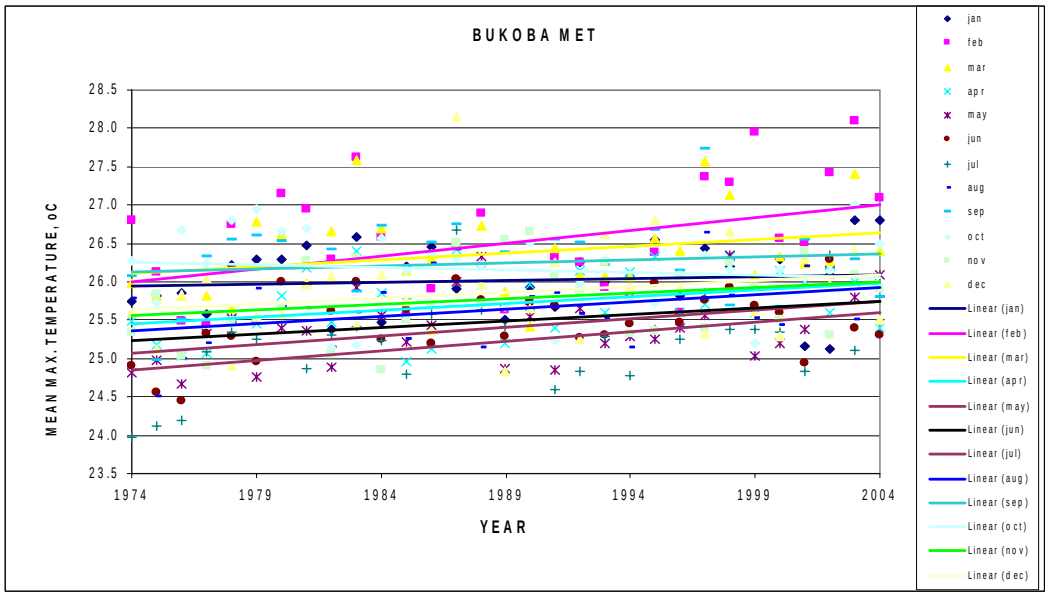


Figure 4: Trend of monthly minimum temperatures at Bukoba Meteorological station



5.0. Potential barriers to implementation

Tanzania recognizes the importance and urgency of addressing the problems associated with climate change because these affect the sustainable livelihoods of all Tanzanians. Hence the need to urgently implement the proposed adaptation options listed in the NAPA document. However there are several barriers that may hamper the implementation of these activities. There is need to address these for the smooth implementation of the proposed activities.

Apart from limited internal capacity to fund adaptation activities, Tanzania is also constrained by several factors, including (i) extreme poverty of the most vulnerable groups, (ii) poor infrastructure , especially poor rural roads making it difficult to access rural areas, hence difficulties in delivering farm inputs and accessing markets (iii) limited credit opportunities fro rural communities to allow family house holds easily access farm inputs, (iv) the impact of HIV/AIDS creating a major drain on family energy, cash and food, (v) poor health conditions of resource-poor rural communities and (vi) Limited analytical capability of local personnel to effectively analyze the threats and potential impacts of climate change, so as to develop viable adaptation solutions.

6.0 ADAPTATION STRATEGIES AND PRIORITIZATION

Adequate food, good health, access to clean and safe drinking water, and sufficient energy for domestic and industrial use are critical factors for sustaining livelihoods and economic growth. The current drought led to critical food shortages leading to food insecurity and hunger. Thus major effort is required to achieve food security at national and household levels, and also to enable rural communities generate cash from farming activities.

In view of the above and basing on the sectoral consultations done by the NAPA team, various existing/coping strategies were identified in each sector of the economy depending on vulnerability and proposed the potential adaptation strategies for each sector (Table 6.)

Table 6: Summary of vulnerabilities and adaptation activities (existing & potential) of the sectors			
Sector	Vulnerability	Existing Adaptation Activities	Potential Adaptation Activities
Agriculture Sector	• Unpredictable rainfall, uncertainty in cropping patterns • Shifting in agro-ecological zones • Prolonged dry spells beyond normal patterns • Increased weed competition with crops for moisture, nutrients and light • Ecological changes for pests and diseases • Decline of maize yields, the national food crop nationwide by 33% due to temperature rise; highest decline reported for Dodoma and Tabora	• Small scale irrigation • R&D on drought tolerant seed varieties • Agriculture extension activities • Diversification of agriculture: growing different types of crops on different land units • Water harvesting	• Alternative farming systems • Promote indigenous knowledge • Change planting dates in some agro ecological zones • Increase irrigation to boost maize production in selected areas • Drip irrigation for specific regions • Reduce reliance on maize as staple food by growing short-season and drought tolerant crops such as sorghum and millet • Shift crop farming to more appropriate agro ecological zones • Change crop rotation practices • Integrated crop and pest management • Make better use of climate and weather data, weather forecasts, and other management tools • Create awareness on the negative effects of climate change • Sustainable water management to boost food crop production • Strengthen early warning system
			• Follow standard agronomic practices • Promotion of annual and short term crops
	• Cotton yields could decrease by 10%-20% due to the impact of		

Table 6: Summary of vulnerabilities and adaptation activities (existing & potential) of the sectors			
Sector	Vulnerability	Existing Adaptation Activities	Potential Adaptation Activities
	pests and diseases.		
Livestock Sector	Increased temperature and rainfall could result in: • Changes in plant species composition • General increase in Dry matter yields • Favorable condition for pests and disease • Livestock deaths due to heat waves	• Strengthen cross breading for resistant breeds • Strengthen tick and tsetse control programmes • Strengthen livestock extension services • Improve livestock marketing infrastructure • Enhance research and development • Promote zero grazing	Reactive adaptation measures: • Change land use patterns • Tsetse fly control • Integrated pest and disease control • Sustainable range management • Infrastructure development • Research and development • Education of farmers/livestock keepers • Advocate zero grazing • Control movement of livestock
Forestry Sector	• Deforestation and desertification • frequent forest fires • Changes in forest types, species composition and distribution • Disappearance of medicinal plants vulnerable species are those with: • limited geographical range	• Collaborative forest management in various districts • Ensured ecosystem stability through conservation of forest biodiversity, water catchment and soil fertility e.g., SECAP usambara, Eastern Arc conservation project • National wide tree planting	• Develop community Forest fire prevention plans and programmes • Strengthen community based forest management practices • Afforestation programmes in degraded lands using more adaptive species • Establish multiple fast growing tree species in community woodlots • Control habitat destruction and fragmentation in high biodiversity areas.

Table 6: Summary of vulnerabilities and adaptation activities (existing & potential) of the sectors

Sector	Vulnerability	Existing Adaptation Activities	Potential Adaptation Activities
	and drought/heat intolerant • low germination rates • low survival rate of seedlings and • limited seed dispersal/migration capabilities • Unsustainable supply of forest products and services • Decrease in employment and foreign exchange earnings through forest based industries and trade	campaign • Participatory forest management	• Enhance the development of buffer zones and wildlife migratory routes • Promotion of alternative sources of energy for both domestic and industrial use • Promotion of appropriate and efficient technologies to reduce use of wood • Promotion of natural forest regeneration • Enhance participatory forest management through benefit sharing from forest resources • Ex-situ conservation of important plant genetic resources • Promotion of use of non-timber forest products • Promotion of lesser unknown timber species
Water Sector	• Decreased and/or increased runoff in river basins • encroachment into stream ecosystems • water pollution • water logging due to increased water flow	• Integrated water resource management • New Infrastructure • Conjunctive water Use • Inter-basin transfers • Protection of water Catchments • Rainwater Harvesting • New dam sites	• Develop alternative water storage programs and water harvesting technologies for communities • Strengthen integrated water resources management • Development of both surface and subsurface water reservoirs • Promotion of Community based catchments conservation and management programs • Promote new water serving technologies in irrigation • Development of recycle and reuse facility in industrial sector and potentially in households

Table 6: Summary of vulnerabilities and adaptation activities (existing & potential) of the sectors

Sector	Vulnerability	Existing Adaptation Activities	Potential Adaptation Activities
			• Develop early warning systems • Desalinization and defluoridation of water in areas with fluoride and saline content
Coastal and Marine Resources	Sea-Level Rise • Land losses • Coastal erosion and damage to coastal structure and properties • Loss of coastal and marine habitats and resources (mangroves, sea grass-beds, fishes and corals) • Saline intrusion in fresh water bodies • Inundation of low-lying coastal areas and small islands • coral bleaching	• Marine and coastal environment management programmes and projects e.g : • Tanga Coastal Conservation and Development Programme (TCCDP) • The National Integrated Coastal Environment Management Strategy, • Rural Integrated Project Support Programme (RIPS) • Mangrove Management Programme (MMP) • Rufiji Environment Management Project (REMP) • Conservation of Lowland Coastal Forests Project • Zanzibar Coastal Zone Management Programme	• Raise awareness on climate change • Desalination of saltwater where possible • Relocation of services, properties and existing infrastructures due to sea level rise • Establishment of protected areas • Restoration of degraded habitats *e.g.,* beach nourishment*, vertiva* grass planting, mangrove replanting, stimulation of coral reefs growth • Construction of artificial structures, e.g., sea walls, artificially placing sand on the beaches and coastal drain beach management system • Reduction or elimination of non-climate stress and monitoring; *e.g.,* Elimination of destructive fishing practices and over-fishing, Reduction of pollution and damaging extraction, proper management of salt production and seaweed farming, Coastal ecosystem monitoring

Table 6: Summary of vulnerabilities and adaptation activities (existing & potential) of the sectors			
Sector	Vulnerability	Existing Adaptation Activities	Potential Adaptation Activities
		• Sustainable Dar es Salaam Project • Kinondoni Coastal Area Management Programme Conservation of marine and coastal resources measures:- • Mafia Island Marine Park • Mnazi bay Marine Park • Menai Bay Conservation Area • Misali Island Conservation Area • Chumbe Island Coral Park	
Health Sector	• More cases of malaria diseases due to higher temperature across the country • Emergency of highland malaria • Water-related diseases such as schistosomiasis and cholera • Severe shortage of food and high increase in the rate of malnutrition, especially to children. • Increased the rate of outbreaks of	• The Ministry of Health has an Integrated Diseases Surveillance Response System (IDRS) in place to prevent, mitigate and respond to epidemics in the country. • Available Infectious Disease Weekending (IDWE) reports at the Health Centres and	• Strengthen malaria control programme. • Strengthen phyto-medicine programmes • Establishing and Strengthening community awareness programmes on preventable major health hazards • Establish Health & Climate collaboration & synthesis programs • Develop early warning system and emergency measures • Establishment of efficient and well coordinated early warning system in all

Table 6: Summary of vulnerabilities and adaptation activities (existing & potential) of the sectors			
Sector	Vulnerability	Existing Adaptation Activities	Potential Adaptation Activities
	water-borne diseases such as cholera and other gastro-intestinal diseases.	District/Regional Hospitals. . • Presence of Emergency Plan Response Unit (EPRU) that coordinate and manage all health related hazards, which include epidemics, accidents, drought and floods. • Use of traditional/alternative medicines • A Traditional Medicines Research Unit established at Muhimbili Medical Research Institute .	districts. • Provide efficient communication equipment to assist early diagnosis in the health centre. • Ensure availability of sufficient trained staff at all health facilities.
Wildlife Sector	• Reduction in productivity of ungulates in different protected areas • Increase in production of DM and thousand production of animal biomass in some areas.	• Wildlife management policy to ensure conservation of wildlife resources • enhanced legal, regulatory, institutional environment for rural communities and private	• Development of migratory corridors and buffer zones for wildlife species • Development and implementation of management plans for protected and conserved areas. • Support implementation of Community Based Management (CBM) programmes of wildlife

Table 6: Summary of vulnerabilities and adaptation activities (existing & potential) of the sectors			
Sector	Vulnerability	Existing Adaptation Activities	Potential Adaptation Activities
	• Shrinking of wildlife area with resultant habitat loss • Disappearance of wildlife corridor that impair wildlife movement and dispersal with impact on the productivity	sector to participate in wildlife conservation through establishment of Wildlife management areas(WMA) • Developing appropriate regulatory mechanisms that will continue to set aside PAs where wildlife and natural areas will be conserved	management areas surrounding the national parks and game reserves • Combating illegal hunting and forest fires • Developing wildlife information database • Enhance wildlife extension services and assistance to rural communities in managing wildlife resources • Enhance capacity building on wildlife management for sustainable development
Industry Sector	Poor rainfall and increased drought will lead to: • Shortage of raw materials • Shortage of power supply • Shortage of water supply	• Diversification of process lines, importation of raw material and semi processed raw material • Application of cleaner production technologies	• Promotion of efficiency energy saving technologies • Promote industrial self-energy production and use • Promote cleaner production technologies
Energy Sector	Biomass and Hydropower power are vulnerable due to reduced rainfall and high temperatures	• Improving and increasing clean thermal power generation	• Explore and invest in alternative energy sources • Develop community based mini-hydropower • Harness the proven coal reserves

Table 6: Summary of vulnerabilities and adaptation activities (existing & potential) of the sectors			
Sector	Vulnerability	Existing Adaptation Activities	Potential Adaptation Activities
		• Protection of hydropower water catchments • Increasing availability of biomass resources • Improvement of biomass to energy conversion efficiency • Increased use of modern biomass to energy technologies • Energy switching • End-use energy efficiency programmes	• Support programmes to develop alternative source of energy which is feasible and less polluting e.g. Wind, Solar, bio-diesel, etc. • increase use of geo-thermal power generation • Appropriate and efficient use of biomass resources • Enhance natural gas utilization • promotion of application of cogeneration in the industry sector
Wetlands sector	• In areas where there will an increase in temperature and decrease in rainfall will result to shrinking and actually drying of the wetlands • Destruction of breeding sites for fishes and other aquatic life	• Assessment, inventory and monitoring of the types and spatial distribution of the wetland ecosystems and their component	

Table 6: Summary of vulnerabilities and adaptation activities (existing & potential) of the sectors			
Sector	Vulnerability	Existing Adaptation Activities	Potential Adaptation Activities
	• Reduction in surface runoff hence drying of some water springs and small tributaries that originating from wetland		
Human Settlement sector	• Coastal erosion and loss of settlements in the coastal areas. • Loss of infrastructure e.g. roads, buildings, crop loss in agricultural land. • Migration of people and livestock to other areas. • Land conflicts • Development of unplanned settlements	• Coastal and beach erosion: there are plans for development of tourist hotels or buildings situated along the seashore (mainly in Dar-es-Salaam) • Poor urban transport and drainage systems: preparation of town plans (Central Business District Schemes) • Unplanned settlements: Regularization and upgrading of unplanned settlements. This also includes low lying-flood prone areas, wetlands, hilly areas, and coastal areas along the oceans and lakes. • Housing Development	• Relocation of vulnerable communities to other areas • Establish good land tenure system and facilitate sustainable human settlements • establish rural areas improvement plan • sensitize the communities on the climate change related hazards • formulate a database for hazard prone areas and plan for appropriate measures - • Zoning planning • Establish disaster committee and plans at village level. • Establish a Disaster planning framework • Improve building codes

Table 6: Summary of vulnerabilities and adaptation activities (existing & potential) of the sectors			
Sector	Vulnerability	Existing Adaptation Activities	Potential Adaptation Activities
		Schemes in different regions of the country. • Implementation of the National Land Policy (1995), • Implementation of the National human Settlements Development Policy (2000), • Implementation of the Land Acts No. 4 and 5 (1999), • The review of Town and Country Planning Act (2004	
Tourism sector	• Shift in the preference from important tourist destinations such as Serengeti to less important areas. Coastal erosion may also result to the displacement of coastal communities. • Coral bleaching and related reduction of marine biodiversity.	• The establishment of national parks, forest, game and marine reserves to ensure the sustainability of tourism industry. • Protecting the seashore by building barrier walls, e.g. along the Ocean Road. • Implementation of the National Tourism Policy and	• Relocation of people living in wildlife corridors • Development of buffer zones around the national parks and game reserves • Establishment of Community Based Fire Protection and Control Programme • Establish alternative source of income for the community in the tourist area • Implement sustainable tourism activities

Table 6: Summary of vulnerabilities and adaptation activities (existing & potential) of the sectors			
Sector	Vulnerability	Existing Adaptation Activities	Potential Adaptation Activities
	• Submerging of small islands e.g. Zanzibar, Mafia and Kilwa which are important tourist destinations. • Retreat of the ice cap at Mt. Kilimanjaro • . This alone, has not been shown to have a • Fire risk is a more serious threat to tourism since the effect may result to the loss of endemic biodiversity. • Changes in the hydrological cycles may affect the availability, patterns and distribution of endemic plants and animal species e.g. in the eastern Arc Mountains, and hence the income from these. • Prolonged droughts may result in the change of vegetation and ecological zones, thus affecting the distribution of wildlife in some areas.	Action Plan. • Protection of the wildlife corridors (such as the Derema corridor in Amani Nature Reserve) and along Kilimanjaro National Park. • Existence of Community Based Management Programmes in areas surrounding the National Parks and game reserves. • Strengthening Community Based Management Programmes in areas surrounding the national parks and game reserves	

Table 6: Summary of vulnerabilities and adaptation activities (existing & potential) of the sectors			
Sector	Vulnerability	Existing Adaptation Activities	Potential Adaptation Activities
	• Increase in the frequency of floods, drought and land degradation will reduce the frequency of recreational activities and wildlife safaris. For example, hydrological changes in Lake Manyara may alter the migration and breeding patterns of the existing bird species such as flamingos.		
Land use	• Soil erosion • Degradation of soil structure • Declining soil fertility • Extinction of some animal and plant species • Limited pastures as a result of long droughts and outbreak of diseases • Low soil pH due to paddy cultivation • Variability of rainfall, floods & drought affecting land management especially on slopes of Mt. Kilimanjaro	• Terracing, contour farming • Use of organic manure • Zero grazing	• encouraging Terracing, contour farming • Use of organic manure • Zero grazing • Specific land uses to be allocated for various development and informal sectors

It is important to note that Agriculture, livestock and Energy sectors play an important role in the development and functioning of the industrial sector in country by providing raw materials and energy for industrial production. In this context adverse impacts of climate change to these sectors will for a large extent impact the industrial sector.

Most of the existing adaptation strategies in the table above are on-going and they incorporate the potential or anticipatory adaptation activities. However due to barriers such priority attached to the existing adaptation strategies, resources availability, poverty, awareness and inadequacy in terms of addressing adaptation better. The proposed potential adaptation strategies aims at improving further the adaptation of communities to the adverse impacts of climate change and hence reduce vulnerability since they were conceived with climate change in mind.

6.1 Ranking of Sectors

Following a consultation done by the NAPA team to the stakeholders, the sectors were then ranked in their order of importance based on the criteria listed in the previous section. Table 7 shows the ranking.

Table 7: Ranking of sectors according to priorities

Sector	Rank order
Agriculture and food security (including livestock)	1
Water	2/3
Energy	2/3
Forestry	4
Health	5
Wildlife	6/7
Tourism	6/7
Industry	8
Coastal and marine resources	9

Sector	Rank order
Human settlements	10
Wetlands	11

6.2 Ranking of project activities

Regarding the activities in each sector, the ranking was also done as a result of NAPA team consultation with the stakeholders. Table 8 clearly shows this ranking in order of importance.

Table 8: Ranking of project activities per sector

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

Sector	Activities	Rank
	Community based catchments conservation and management programs	4
	Develop new water serving technologies in irrigation	5
	Develop early warning systems on drought and floods	6
	Development of recycle and reuse facility in industrial sector	7
Energy	Explore and invest in alternative clean energy sources e.g. Wind, Solar, bio-diesel, etc.	1
	Develop community based mini-hydropower	2
	Improve biomass to energy conversion efficiency *(improved charcoal production technology, improved charcoal and wood stoves, use of biomass waste briquettes, biomass waste gasification, promote fuel crop)*	3
	Increase use of geo-thermal power generation	4
	Harness the proven coal reserves	5
	promotion of application of cogeneration in the industry sector	6
	Enhance natural gas utilization	7
Forestry	Afforestation programmes in degraded lands using more adaptive and fast growing tree species	1
	Develop community forest fire prevention plans and programmes	2
	Strengthen community based forest management practices	3
	Promotion of alternative sources of energy for both domestic and industrial use	4
	Promotion of appropriate and efficient technologies to reduce use of wood	5
	Control habitat destruction and fragmentation along coast forest resources	6
	Enhance the development of buffer zones and wildlife migratory routes	7
Health	Establishing and Strengthening community awareness programmes on preventable major health hazards	1
	Ensure availability of sufficient trained staff at all health facilities	2
	Strengthen malaria control programme	3
	Develop early warning system and emergency measures	4
	Establish Health & Climate collaboration & synthesis programs	5
	Establishment of efficient and well coordinated early warning system in all districts.	6

Sector	Activities	Rank
	Provide efficient communication equipment to assist early diagnosis in the health centre.	7
Wildlife	Enhance wildlife extension services and assistance to rural communities in managing wildlife resources	1
	Support implementation of Community Based Management (CBM) programmes of wildlife management areas surrounding the national parks and game reserves	2
	Combating illegal hunting and forest fires	3
	Developing wildlife information database	4
	Development of migratory corridors and buffer zones for wildlife species	5
	Development and implementation of management plans for protected and conserved areas.	6
	Improve wildlife and ecological surveillance systems	7
Tourism	Establish alternative source of income for the community in the tourist area	1
	Establishment of Community Based Fire Protection and Control Programme	2
	Development of buffer zones around the national parks and game reserves	3
	Implement sustainable tourism activities	4
	Relocation of people living in wildlife corridors	5
Industry	Improve energy efficiency in industrial energy consumption	1
	Efficient use of raw materials	2
	Alternative use of raw materials	3
	Water harvesting and recycling	4
	Create better and permanent drainage systems	5
	Promote use of renewable energy sources such as solar, wind etc	6
Coastal and marine resources	*Construction of* artificial structures, e.g., sea walls, *artificial*ly placing sand on the beaches *and coastal drain beach management system*	1
	Restoration of degraded habitats *e.g., beach nourishment, vertiva grass planting, mangrove replanting, stimulation of coral reefs growth*	2
	Reduction or elimination of non-climate stress and monitoring; *e.g., Elimination of destructive fishing practices and over-fishing, Reduction of pollution and damaging extraction, proper management of salt production and seaweed farming, Coastal ecosystem monitoring*	3
	Relocation due to sea level rise of small island communities	4
	Establishment of protected areas	5
	Desalination of saltwater where possible	6

Sector	Activities	Rank
Human settlements	Establish good land tenure system and facilitate sustainable human settlements	1
	Relocation of vulnerable communities to other areas	2
	Establish disaster committee and plans at village level.	3
	Formulate a database for hazard prone areas and plan for appropriate measures	4
	sensitize the communities on the climate change related hazards	5
	establish rural areas improvement plan	6
	Establish a Disaster planning framework	7
	Zoning planning	8
	Improve building codes	9
Wetlands	Assess and conduct inventory of the types and spatial distribution of the wetland ecosystems and their components	1
	Develop wetlands monitoring programmes	2
	Propose more Ramsar Sites for sustainable management of wetlands	3
	Provide adequate capacity building, awareness and education on wetland management issues related to climate change	4

6.3 Proposed top most urgent and immediate projects

The following project activities were ranked (by the NAPA team in consultation with stakeholders) as the top most in terms of priorities

i. Increase irrigation by using appropriate water efficient technologies to boost crop production in all areas
ii. Alternative farming systems and relocation of water sources including wells along the low lying coastal areas
iii. Develop water harvesting and storage programs for rural communities particularly those in dry lands
iv. Community based catchments conservation and management programs
v. Explore and invest in alternative clean energy sources e.g. Wind, Solar, bio-diesel, etc.
vi. promotion of application of cogeneration in the industry sector
vii. A forestation programmes in degraded lands using more adaptive and fast growing tree species
viii. Develop community forest fire prevention plans and programmes
ix. Establishing and Strengthening community awareness programmes on preventable major health hazards

x. Implement sustainable tourism activities
xi. Enhance wildlife extension services and assistance to rural communities in managing wildlife resources
xii. Water harvesting and recycling
xiii. Construction of artificial structures, e.g., sea walls, artificially placing sand on the beaches and coastal drain beach management system
xiv. Establish good land tenure system and facilitate sustainable human settlements

Basing on these activities five project Profiles were prepared as indicated in the section below

7.0 PRIORITY PROJECT PROFILES

1 IMPROVING FOOD SECURITY IN DROUGHT-PRONE AREAS BY PROMOTING DROUGHT-TOLERANT CROPS.

1.0 Rationale/Background

Shinyanga, Dodoma and Singida regions are top in the list of drought stricken areas of Tanzania. Recent crop surveys have revealed that rainfall shortage has become an outstanding cause of crop failure and in effect recurrent food insecurity has become rampant in a number of regions and districts. It has been reported that although Tanzanian farmers have been able to actively feed 100% of the country's population per annum on average, pockets of food shortages continue to exist in 37 districts (nearly one third of all districts) in an average of 8 regions (MAFSC, 2006)[1].

During the period (2001/02-2005/06), Tanzania was self-sufficient at different levels - the lowest level (88%) was recorded in 2003/04 while the highest (103%) was recorded in 2004/05 the lowest number of deficit regions (4) was recorded in 2002/03 while the largest number (14) was recorded in 2003/04. Over the same period the lowest number of districts showing pockets of food shortage (13) was recorded in 2002/03 while the highest number (62) was recorded in 2003/04. Currently 2006/07, while the country is 110% food self sufficient, 5 regions were (50 districts) are earmarked as having pockets of food shortage.

These changes are particularly of interest when thinking of climate change causing a shift in agro-ecological zones thereby affecting crop calendar and performance. Understanding these changes is also important in understanding poverty environment surrounding farmer's purchasing power, which is basically associated with management of food security at household level. Knowledge of these changes will also assist in policy decisions associated with improved management of agricultural practices as efforts are made towards raising farmer's income as a source of farmer incentive to invest towards increased productivity and production. It will also assist in appropriate policies to increase consumer's purchasing power and hence enhance everybody's food security.

[1] Ministry of Agriculture Food Security and Cooperatives (2006), *AGSTATS for Food Security(Table 5)*

In view of working towards these efforts it is hereby advocated that drought tolerant crops such as sorghum and millets may be most appropriate where adverse weather and degradation of soils are increasingly becoming a common feature. Consistent with this, deliberate efforts need to be made towards relocating agro-ecological zones, identifying appropriate crops for the zones, addressing water/moisture availability, and addressing fertilizer availability. The areas in these pool of failing agriculture and probably attributed to negative effects of climate change include Shinyanga, Singida, Dodoma, Arusha, Tabora, Kilimanjaro and the northern part of Iringa region. If anything is to be done to address rampant and probably chronic food insecurity associated with negative effects of climate change these areas could provide an appropriate starting point.

2.0 Objectives:

2.1 General Objective:

To promote use of drought tolerant food crops in drought prone areas of Shinyanga, Dodoma and Singida regions for sustainable food production.

2.2 Specific objectives:

- To create awareness to local communities of the negative impacts of climate change on maize production.

- To ensure production and supply of food to local community in the drought-prone areas by replacing maize with the relevant drought tolerant crops.

3.0 Activities:

- Creating awareness of the negative impacts of climate change to local communities.
- Identification of suitable crops to climate change induced AEZ
- Capacity building in terms of acquisition of typical crop varieties, input package, market availability and utilization of drought tolerant crops
- Enhancing extension services relevant to the identified drought tolerant crops

4.0 Inputs:

Human resources, financial resources and materials

5.0 Activity-Indicative Budget:

Activity	Year 1	Year 2	Year 3	Total
	US$	US$	US$	US$
Project Planning and Appraisal	900,000			900,000
Farmer training and facilitation	1,800,000	900,000	900,000	3,600,000

Extension services and facilitation	1,200,000	800,000	800,000	2,800,000
Public outreach	400,000	400,000	400,000	1,200,000
TOTAL	4,300,000	2,100,000	2,100,000	8,500,000

6.0 Institutional arrangement:

The Project will be implemented under the leadership of Ministry of Agriculture and Food Security in collaboration with Local Government Authority, Tanzania Meteorology Authority, local communities, NGOs and CBOs.

2 Project Title: Improving Water availability to drought-stricken Communities in Central part of the country.

1.0 Justification/Rationale:

The government recognizes that water is an important component in the development of the country. This is proclaimed the various policies including: Vision 2025, the Poverty Reduction Strategy, Agricultural Policy, Environmental Policy, Forestry Policy, Energy Policy, etc. The Tanzania Poverty reduction strategy Paper recognizes the heavy dependence of the people on the environment (soil, water and forest).

Large areas of the country are water scarce areas and do not enjoy adequate supplies of the water resources all the year round. Rivers are dry half of the time in the larger part of internal drainage basin. The high temporal and spatial variability in rainfall has resulted in endemic drought in some part of the country particularly the central regions. As a result these regions are frequently hit by extreme droughts posing a major challenge to water availability in these communities. This situation has lead into frequent food insecurity and aggravated poverty in respective communities thereby increasing their vulnerability to the adverse impacts of climate change. Rainfall in these regions is very erratic, unimodal and unreliable. Recurrence of frequent drought in these areas has lead to extreme weather events and rainfall has been reduced to a minimum of 400mm per year. The rainfall period is usually short and is followed by a long dry season of six to eight months. Coupled with water scarcity problem, still the little amount of water available in these regions is unsustainably utilized through poor and inefficient traditional irrigation practices, lack of storage facilities and degradation of water catchments by human activities.

In view of the above, the challenge of ensuring adequate availability of water for various uses in these regions remains very daunting. Interventions are needed in order to enable the communities to adapt and cope with that magnitude of water scarcity in the regions. It is against this background, interventions in this envisaged project are being proposed mainly to improve water availability in these communities for sustainable livelihood.

2.0 Objectives:

2.1: Overall objective:

- To provide water and ensure sustainable utilization of water in the drought-stricken areas

2.2 Specific objectives:

- Ensure water availability to all communities in drought-stricken areas;
- Ensure sustainable use of available water;
- Ensure that communities participate in conservation and management of catchment's areas.

3.0 Expected Outcomes:

- Improved water harvesting techniques and storage facilities;
- Well established water reservoirs and increased utilization of underground water sources;
- Improved sustainable utilization of water for various purposes;
- Increased participation of communities in conservation and management of water catchments;

4.0 Activities:

- To establish water harvesting and storage techniques;
- To develop reservoirs and underground water abstraction;
- To promote community-based catchments conservation and management;
- To promote sustainable utilization of water in small-scale traditional irrigation practices;

5.0 Activity-Indicative Budget:

S/N	Activity	Costs (USD)
1.	Promotion of water harvesting and storage techniques	200,000
2.	To develop reservoirs and underground water abstraction	300,000
3.	To promote community-based water catchments conservation and management	100,000
4.	To promote sustainable utilization of water in small-scale traditional irrigation practices	200,000
	GRAND TOTAL	800,000

6.0 Institutional arrangement for project implementation:

The project will be implemented by Ministry of Water in collaboration with Prime Ministers Office- Regional Administration and local Government, Ministry of Natural Resources and Tourism, Ministry of Agriculture and Food Security, Ministry of Lands and Human Settlement Development, local communities and NGOs/CBOs.

3.	Project Title: Shifting of Shallow Water Wells Affected by Inundation on the Coastal Regions of Tanzania Mainland and Zanzibar.

1.0 Rationale/Background

The five coastal regions of mainland Tanzania encompass about 15% of the country's land area and are home to approximately 25% of the country's population. Recent estimates indicates that the population of the five coastal regions now number about 8 millions, with a growth rate ranging between two and six per cent. A doubling of the coastal population is expected in as little as twelve years. That could mean 16 million people will be living on the coastal areas by 2010, which is about 110 people per square kilometre.

Despite this huge number of the population on the coast due to its potential aesthetic value and other unique natural resources which have attracted such a big number of people, coastal areas are most vulnerable to climate change due to the anticipated rise in sea level, floods and other consequences. Unfortunately, the effect of sea level rise is already being experienced in Coast region, in Bagamoyo District. In this region sea level rise has resulted into inundation of some traditional water sources.

This process has resulted into salinization of shallow water wells, the only source of domestic water supply. As a consequence, the process has caused both social and economic problems associated with lack of reliable safe drinking water to rural communities.

These problems include:

i. Women have to walk very long distances to fetch water. This consumes a lot of their time which could be spent on other productive activities. The burden is more on women and school children particularly girls who seem to be the main water courier; and

ii. In some households, they have to set up a budget for buying water which is about US $ 0.2 for 20 litres. Considering the poverty levels of these communities, normal African family of about 8 people, consumes the minimum amount of about 200 litres of water per day which is equivalent to US $ 0.8. For a poor family living under US $ 1 a day the budget for water is a challenge. As a result people are forced to avoid some productive activities such as animal keeping by zero grazing and farming of cash crops that needs irrigation.

Looking at this trend, there is an immediate need to take action to curb the situation, otherwise if unchecked; people living along the coast will be forced to migrate to other areas, something which may cause social conflicts and other environmental degradation due to overpopulation and utilization of resources. This will be impairing the targets of the Johannesburg Plan of Implementation (JPOI) especially target 10 to cut half by 2015 the population without reliable access to safe and clean drinking water and the UN millennium Development Goals 1,2,3,4, 6 and 7 on poverty eradication, achieving universal education, gender equality, reducing child mortality and improving maternal health, combating diseases (water borne diseases in this case), and environmental sustainability respectively.

2.0 Overall Objective:

The overall objective of this project is to construct new water wells to enable people have reliable access to safe and clean drinking water and for other development processes.

3.0 Activities:

- Awareness to the communities on the cause and impacts and explore their adjustments to the problems faced due to climate change impacts;
- Training on the sustainable use of water and methods of water harvesting;
- Conducting a survey to identify wells that have been inundated with sea water along the coast. The task of well survey will be conducted by the SSN adaptation team in Tanzania;
- Chemical testing of salts in wells that have been inundated with sea water to verify the extent of the problem. This task will be conducted by SSN Tanzania team in collaboration with other higher learning Institutions, particularly the University of Dar es Salaam;
- Survey for water sources alternatives for communities that need new water sources; e.g. other places for bore holes or possibility of gravity water supply. To achieve this task, water supply experts will be consulted and contracted;
- Rehabilitation of the traditional wells not yet inundated with sea water intrusion;
- Implementation of new water sources and supply. Bore holes drilling agents, and water supply companies will be consulted and contracted to complete the final stage of achieving adaptation goals;
- To reduce pressure on Coastal resources, promotion of alternative income generating opportunities; and
- Promotion of good practice in land management.

4.0 Outputs

The outputs must be Simple, Measurable, Achievable, Realistic and Time Based. Please differentiate between short term and long term outputs of the proposed project.

Short term output:

- The communities at Bagamoyo District are able to express a basic understanding of current climate change impacts and adaptations options available;
- Shallow wells are relocated and new wells are being used;

- Shallow wells which have not been polluted are being used sustainably;

Long term Output:

This intervention will contribute to poverty reduction in the following ways:

- The coastal community will have reliable access to safe and clean drinking water and thus reduce their valuable time and energy spent on fetching water. This time will be devoted to other productive activities such as Small and medium Enterprises (SMEs), cultivation of cash crops, etc;

- Provide more time for school children to attend schools and acquire at least the universal primary education which is essential to every child;

- The cash spent on buying water will be used for other activities probably investing in Small and Medium Enterprises (SMEs); and

- People will be able to grow and irrigate some small vegetable garden for extra income.

In general this intervention will compliment the efforts and objectives of the international communities especially the MDGs and the Johannesburg Plan of Implementation.

5.0 Activity-Indicative Budget

Activity	Year 1	Year 2	Year 3	Total
	US$	US$	US$	US$
Project planning and appraisal	300,000			300,000
Facilitation of farmers	600,000	300,000	300,000	1,200,000
Establishment of tree nurseries	300,000	300,000	300,000	900,000
Establishing alternative income generating activities	300,000	300,000	300,000	900,000
Total	1,500,000	900,000	900,000	3,300,000

6.0 Institutional arrangements

The project will be implemented under the leadership of the Ministry of Water in collaboration with Ministries of Natural Resources and Tourism, Ministry of Agriculture and Food Security, Local Government Authority, Local Communties, NGOs/CBOs.

4 CLIMATE CHANGE ADAPTATION THROUGH PARTICIPATORY REFORESTATION IN KILIMANJARO MOUNTAIN.

1.0 Rationale

Glacier retreat and change of vegetation on the slopes of Mt Kilimanjaro have made the latter one of the climate change hotspots in Tanzania. This has been recognized in the Initial National Communications to the UNFCCC and the NAPA.

In the past dense forests around the mountain used to cause water flows in a number of rivers that originated from the mountain eventually forming the large Pangani river basin comprising Nyumba ya Mungu, Hale and Pangani hydropower stations. Livelihood of surrounding communities depended on the ecosystem over the mountain. Reliable water, forest products (like fuel, timber building material), rain-fed and irrigable agriculture as well as livestock manifested the paradise of Mt Kilimanjaro ecosystem.

In recent past water shortage, failing agriculture, depletion of forest stocks and general unreliability of rainfall has been experienced and in view of persistence of this negative feature it has been attributed to climate change. The negative effect of climate change has been exacerbated by increasing population pressure and poverty. In the project area the agricultural land has been inadequate and the communities have encroached the formally catchment forest area and river valleys for agricultural purposes. Therefore, a considerable amount of forest has been cleared for coffee and banana planting in subsistence farming. In the current land tenure system where family heads distribute the available land as an asset to sons, has led to the allocation of the catchment areas and river valleys as farming land. Under this increasing pressure from human settlement and resource use the need for intervention becomes inevitable.

This project intends to address protection and conservation, together with promoting afforestation programmes to adapt to climate change impacts. This will involve restoration of vegetation cover on the degraded areas and making available forest products to communities living in the area.

2.0 Project Description and general objectives

2.1 General objective

The main objective will be to improve livelihood of communities around Mt Kilimanjaro by providing alternative sources of income and food through replanting of trees and economic diversification.

2.2 Specific objectives:

- To restore degraded areas around Mt Kilimanjaro ecosystem
- To enhance community participation in tree planting

3.0 Activities:

- To create awareness on climate change adaptation, biodiversity conservation and afforestation through community participatory efforts;
- To strengthen community participation through CBOs, schools, churches, youth groups, women groups in conservation activities

- Establishing nurseries and replanting trees in the degraded areas.
- Support alternative sources of livelihoods such as engaging

4.0 Expected Outputs:

Major outputs will include among others:-

- Capacity built in CBOs, schools, churches, youth groups and women groups on climate change adaptation and biodiversity conservation with a special focus on conservation of damaged river valleys.
- Rehabilitated degraded areas
- Awareness to local communities on climate change issues enhanced.
- Livestock and agricultural production improved, and the negative impacts on biodiversity and degradation of environment around the project areas reversed.
- Alternative income sources enhanced

5.0 Activity-Indicative Budget

Activity	Year 1	Year 2	Year 3	Total
	US$	US$	US$	US$
Project planning and appraisal	300,000			300,000
Facilitation of farmers	600,000	300,000	300,000	1,200,000
Establishment of tree nurseries	300,000	300,000	300,000	900,000
Establishing alternative income generating activities	300,000	300,000	300,000	900,000
Total	1,500,000	900,000	900,000	3,300,000

6.0 Institutional arrangements

Ministry of Natural resources and Tourism will play a leading role in the implementation of the project. Other collaborating ministries/institutions to be involved are Ministry of Energy and Minerals, Local Government Authority, Academic and Research Institutions, local communities, Local NGOs/CBOs

5 Title: Community Based Mini-hydro for Economic Diversification as a result of Climate Change in Same District.

1.0 Justifications and Rationale:

The assessment carried out in the Luguru village recognizes that due to climate change the livelihood of the community have been affected by lack of woodfuel and other forest products that have been supporting the livelihood in the community as source of income to the households. Wood fuel has been the main dependable source of energy to these communities and other forestry products. As a result of this, the community have been very vulnerable and the household income has been very unreliable contributing to poverty and increase in the vulnerability.

Thus installation of electricity to the community as an alternative source of energy in Lugulu Village will not only provide the predictable sources of energy but will also enhance the income generating activities by providing an avenue for the alternative sources of livelihood that will reduce the pressure on the use of natural resources and therefore improve their adaptation to the adverse impacts of climate change. Some of the alternative incomes generating activities that will triggered by the availability of electricity will include entrepreneurship in small-scale agro-processing industries, services like battery charging stations, refrigeration, water pumping etc.

The establishment of the community-based Mini-hydro will involve installation of a turbine with a capacity of 75KW at the Yongoma River in the Luguru village. The site is suitable since there exist some structures such as canal and access road and therefore the installation will be done on the already existing structures that will need minor modifications or improvements.

2.0 Overall objective:

The main objective of this initiative is to reduce vulnerability of the local communities by provision of more predictable source of energy.

3.0 Expected Outcomes:

- Reduced pressure on the use of forest and forestry products
- Availability of opportunities for investment in alternative sources of livelihood
- Increased number of households and centres connected to electricity generated from the power plant.

4.0 The Project activities:

Among others, Participatory Rural Appraisal (PPA) should be carried out to identify projects that will generate income for the community in Lugulu Village.

- Awareness creation to the local communities on the adverse impacts of climate change and their vulnerability.

- Promotion of community-based mini-hydro management.
- Enhance community-based conservation of water catchment areas in the village
- Construction/upgrade of access road to the mini-hydro station
- Construction of power house and water ways
- Modifications and reinforcement of the exiting canal
- Installation of machinery;
- Construction of transmission and distribution network

5.0 Activity-Indicative Budget:

S/N	Activities	Cost (USD)
1.	Awareness creation to local communities on the adverse impacts of climate change and their vulnerability.	30,000
2.	Promotion of community-based mini-hydro management	30,000
3.	Enhance community-based conservation of water catchment areas in the village.	40,000
4.	Construction/upgrade of access road to the mini-hydro station.	210,000
5.	Construction of Power House and waterways.	100,000
6.	Modifications and reinforcement of the exiting canal.	20,000
7.	Installation of machinery (Turbine).	40,000
8.	Construction of transmission and distribution network.	150,000
	GRAND TOTAL	620,000

6.0 Institutional arrangements:

The project will be implemented under the leadership of Ministry of Energy and Minerals in collaboration with Local Government Authority, Ministry of Natural Resources and Tourism, local communities and NGOs/CBOs.

6 Project Title: Combating Malaria Epidemic in Newly Mosquito-infested areas.

1.0 Justification/Rationale:

Malaria pandemic is one of the leading causes of death in many regions of the country ranging from 24% of deaths in Rukwa to 48.9% in Dare es salaam. Currently, a malaria problem is evident from national level to the grassroots level of malaria endemicity. Recently, there has been observed increased trends in the occurrence of malaria in non-traditional areas found in highlands such as Kilimanjaro, Arusha, Tanga and Kagera regions. In these areas malaria was not very pronounced in the past and this trend has been attributed to global warming.

It is well evident that global warming exerts impacts on malaria ecosystems in Tanzania. Recent studies done in these areas have revealed the relationship between increase in temperature and occurrence of malaria incidence on these areas. Microclimate changes as a result of global warming such as temperature, rainfall and humidity contribute to the changes in the epidemiology of the disease and this leads to the extension of the disease to new non-traditional malaria areas. Change in climate may have short and long-term impacts on disease transmission as these vectors and species have the potential to redistribute themselves to new climate-driven habitats. Recent studies show that vector species have adapted to ecosystems ranging from humid forests to dry savannahs.

Several initiatives to combat malaria have been put in place at national and local level; most of them have been concentrated to the traditional malaria areas. This leaves the non-traditional malaria areas to be more vulnerable to the impacts of malaria as most of the local communities are not well adapted to the disease since the disease was not prevalent in these areas before. Strategic initiatives targeting these areas need to be put in place in order to assist the communities in increasing their adaptation to the effects of Malaria thereby reducing their vulnerability. Cognizant of this fact and bearing in mind the deadly effects of malaria to human kind, the proposed project seeks to address the vulnerability of the communities to malaria in the non-traditional malaria areas and to strengthen their capacity to adapt to this condition.

2.0 Objectives:

- Ensure community awareness on malaria in newly-malaria infected areas.
- Ensure capacity building for local medical practitioners and selected health centers.
- Ensure increased use of available alternative methods in combating menace of malaria.

3.0 Expected Outcomes:

- Increased awareness and understanding on malaria epidemiology to local communities.
- Increased availability of trained local medical practitioners in the newly-malaria infected areas.
- Improved capacity of selected health centers in early diagnosis of malaria.
- Increased use of local herbs in combating malaria.

4.0 Activities:

- To strengthen awareness and education programmes in newly malaria infected areas
- Strengthen training programmes to local Medical Practitioners
- Strengthen the capacity of selected health centers for early diagnosis of malaria
- To promote the use of traditional herbs in combating malaria.

5.0 Activity-Indicative Budget:

S/N	Activity	Costs (USD)
1	To strengthen awareness and education programmes in newly malaria infected areas	100,000
2	Strengthen training programmes to local Medical Practitioners	150,000
3	Strengthen the capacity of selected health centers for early diagnosis of malaria	300,000
4	To promote the use of traditional herbs in combating malaria.	100,000
	GRAND TOTAL	650,000

6.0 Institutional arrangement:

The project will be implemented by the Ministry of health and Social Welfare taking a leading role. Other collaborating institutions will include Prime Ministers Office – Regional Administration and Local Government, Ministry of Education and Vocational Training, NGOs/CBOs and Media.

7.0 IMPLEMENTATION STRATEGY

The proposed project profiles will be implemented and managed by relevant sectors. However, the coordination role is vested to the Vice President's Office-Division of Environment which is the country's focal point regarding environmental issues. Furthermore, monitoring and evaluation of the projects will be done by the Vice President's Office in collaboration with other relevant stakeholders.

The main sectors that will play a leading role in the implementation of the proposed projects are: Ministry of Agriculture and Food Security, Ministry of Natural Resources and Tourism, Ministry of Water, Ministry of Health and Social Welfare and Ministry of Energy and Minerals. The leading sectors will collaborate with a number of other sector ministries and institutions including Ministry of Education and Vocational Training, Ministry of Lands and Human Settlement Development, Local Government Authority, Tanzania Meteorology Authority, Research and Academic institutions, NGOs/CBOs and Local communities.

8.0 THE PROCESS OF DEVELOPING NAPA

The process of developing the National Adaptation Programme of Action started with the formation of NAPA team by a National Climate Change Focal point, which is the Vice President's Office - Division of Environment. The NAPA team composed of 20 experts from different sectors which were divided into four groups. The four groups of NAPA team were assigned a task of consulting stakeholders of different sectors namely energy and industry; agriculture, livestock, forest, land use, tourism, health, wildlife and wetland; and coastal, marine, and freshwater resources. The sectoral vulnerability and adaptation tools were the main approach used in the country-wide consultation to obtain vulnerability and adaptation information from relevant sector. This approach was adopted because of the size of the country, making it difficult for community approach, except in some sectors like agriculture and water. Thus, the four groups analyzed impact of climate change in the country and came up with a NAPA synthesis report based on past and present studies. The synthesis report was followed by a public consultation (using interviews and questionnaires) with stakeholders including government officials in different ministries, private sectors such as industries, and some communities. Among other areas, consultation with stakeholders was undertaken in 13 districts and 52 villages at local communities including Bagamoyo, Pangani, Rufiji, Mtera, Mbeya, Shinyanga and Dar es Salaam.

The NAPA Team synthesized and reviewed the gathered information on adverse effects of climate change and coping strategies. This information included the past climate change studies, sectoral policies and plans, and national strategies for sustainable development. Also the team conducted a participatory rapid assessment to assess the current vulnerability and potential increase in climate hazards and associated risks of the critical sectors. This was based on clear consensus that there was good information and scientific research at national level that was used to evaluate past, current and future efforts on climate change aspect.

In addition, the information on assessment of vulnerability and adaptation response options for Tanzania due to climate change impact was updated during the NAPA assignment. Based on those information, further analysis was done on the proposed adaptation measures with due regard to the National Action Plan (NAP). Some measures have double benefits, i.e. achieving the objectives of the sector as well as adapting the effects of climate change impacts. Less costly measures were considered as important for implementation in the short-term and medium term programme while those demanding higher investment for further research can form part of the long-term programme in NAPA. A total of 72 adaptation activities were proposed from all sectors which were finally reduced to 14 project activities and from these activities five project profiles were developed. The NAPA document seeks to address Tanzania's urgent and immediate adaptation needs to climate change and extreme weather events for vulnerable area. The document has been endorsed by the Minister of State, Vice Presidents Office - Environment hence government endorsement and approval.

9.0 REFERENCES

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