REPUBLIC OF RWANDA

Rwanda Environment Management Authority (REMA)

Guidelines for Mainstreaming Climate Change Adaptation and Mitigation in the Agricultural Sector

(FINAL VERSION)

Sustaining Rwanda's food security and economic productivity through effective and timely climate change adaptation and mitigation

Prepared by:

CRA
BREAKING COMPLEXITIES IN DECISION MAKING

craconsult@yahoo.com

November 14, 2011

Contents

LIST OF TABLES

LIST OF FIGURES

Foreword

Rwanda has come a long way on its Vision towards a medium income country by 2020, with major achievements made in all sectors. In agriculture, the country has managed to achieve food security and has now embarked on commercializing the sector so that it can support employment creation, export diversification and overall socioeconomic transformation. However, climate change, threatens to undermine the achievements, especially in the agricultural sector which is highly sensitive to weather changes. Although Rwanda in particular and Africa in general, have contributed very little to global warming, they will be disproportionately impacted by the negative impacts of climate change. Rwanda's agricultural sector is particularly vulnerable to climate change, given the country's relief, population density and over-dependency on agriculture. Thankfully, investing in adaptation measures can reduce the country's vulnerability and significantly lower the costs of responding to climate change.

Rwanda Environment Management Authority (REMA) has been leading the national response to climate change, working with stakeholders to build adaptive capacity at all levels. Indeed, these guidelines are part of on-going efforts to build national resilience and capacity to mitigate and adapt to climate change. The guidelines complement existing tools, and are informed by recent work on climate change, environmental mainstreaming and preventive health care. These guidelines are intended for use by policy makers, planners, technocrats and analysts in the public health sector, especially those involved in the conception, formulation, financing, implementation, monitoring, evaluation and reporting of policies, strategies, plans, projects, budget, and activities for service delivery in the agricultural sector. While REMA continues to play its statutory role of coordination, regulation and support, the Ministry of Agriculture and Animal Resources (MINAGRI) will be the lead agency in the integration of climate change concerns in all agricultural policy processes, working with Local Governments, other relevant state and non state institutions. This is why REMA has prepared sector-specific guidelines to facilitate the process.

Finally, I would like to recognise the team from the Centre for Resource Analysis (CRA), who assisted us in preparing these guidelines. I also applaud the staff of REMA, especially those associated with the Integrated Management of Critical Ecosystems (IMCE) project which made the production of these guidelines possible and the World Bank which provided the financing. Other national institutions and stakeholders who contributed to developing these guidelines are gratefully acknowledged.

Finally, I argue the relevant institutions and individuals to make use of this document to climate-proof Rwanda's agricultural sector, not only to increase productivity but also assure sustainable development in Rwanda.

Dr. Mukankomeje Rose
Director General, REMA

ACRONYMS AND ABBREVIATIONS

CCMA	Climate Change Mitigation and Adaptation
DRR	Disaster Risk Reduction
EDPRS	Economic Development and Poverty Reduction Strategy
FAO	Food and Agriculture Organisation
GDP	Gross Domestic Product
GoR	Government of Rwanda
IPCC	Intergovernmental Panel on Climate Change
ISAR	Agricultural Research Institute of Rwanda
IWRM	Integrated Water Resources Management
MDGs	Millennium Development Goals
MINAGRI	Ministry of Agriculture and Animal Resources
NAEB	National Agricultural Export Board
NAP	National Agricultural Policy
NAPA	National adaptation programs of action
REMA	Rwanda Environment Management Authority
SPAT/PSTA	Strategic Plan for the Agricultural Transformation
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
GDP	Gross Domestic Product
CIP	Crop Intensification Programme
GHGs	Greenhouse Gases
MINELA	Ministry of Environment and Lannds
DPs	Development Partners
SWAp	Sector-Wide Approach
CVCA	Climate Vulnerability and Capacity Analysis
NGO	Non Governmental Organisation

1. INTRODUCTION

1.1 Background

Climate change is an environmental change, but given that human societies are affected directly and indirectly by the climate system – and given that human activities are driving climate change – it is fundamentally a human issue. The impacts of climate change and variability are expected to seriously and disproportionately affect the world's poor people. Poor people are especially vulnerable to climate change due to their heavy reliance on climate-sensitive sectors such as rain-fed agriculture and fisheries, their tendency to be located geographically in more exposed or marginal areas such as mountain slopes, drier areas or flood plains and their limited asset base. Poverty therefore increases exposure while also limiting their ability to cope and adapt to climate change impacts.

The impacts of climate change present a new set of challenges in our efforts to reduce poverty and promote social justice. Changing temperatures, erratic rainfall, floods, landslides and droughts all have significant consequences for the livelihoods, health, food security, educational opportunities and the survival of people living in poverty, and of recent first-hand the effects of a changing climate are evident. There is need therefore, to understand how climate change affects a community – who is vulnerable to the effects, and why, and we need to apply this information in order to design programs that will reduce people's vulnerabilities to risks. To remain effective development programmes must be able to manage risks posed by both current and future climatic factors. Thus, development programmes need to ensure that they are enhancing coping capacities of poor people as well as enabling adaptation to future shocks and stresses. Mainstreaming or 'integrating' climate change adaptation into agricultural sector can increase the sustainability and impact of interventions in poverty reduction programs and improve people's livelihoods.

In recent years, Rwanda has made significant progress in both economic and broader development terms. The last decade has seen GDP average growth of 6.5 percent per annum, per capita income increasing to $540 and national poverty level standing at 60 percent (World Bank, 2011). Rwanda has made good progress in achieving a number of the Millennium Development Goals (MDGs). Despite these achievements there is increasing concern that climate change and its associated impacts are likely to worsen poverty situation causing economic and human costs that slow or even reverse future growth and development in Rwanda.

Green House Gas (GHG) emissions, which are the main causes of climate change, arise principally from human activities although anthropogenic factors contribute too. The types of activities also determine the kinds of GHGs emitted. The agriculture sector contributes to global warming through carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) gas emissions. In a predominantly rain-fed agrarian economy, where poverty and food insecurity are rife, climate variability regularly inflicts social and economic setbacks. Climate change, of whatever direction or degree, will therefore exacerbate this vulnerability and its impact is already being felt in Rwanda. Thus there is need to: (i) mitigate climate change by undertaking actions that reduce GHG emissions; and (ii) implement adaptation measures to protect the population from climate change effects.

The Government of Rwanda (GoR) has undertaken a number of measures to address climate change, beginning with ratification of the United Nations Framework Convention on Climate Change (UNFCCC) in 1992, developing a National Adaptation Action Plan (NAPA) in 2000, and climate change and low carbon growth strategies in 2010.

1.2 Objectives and Scope of the Guidelines

These guidelines are designed to provide basic and flexible guidance on how to:

i) conduct impact and vulnerability assessments in the agricultural sector;
ii) identify opportunities and entry points for integration of climate change mitigation and adaptation (CCMA) measures;
iii) identify, analyse and integrate options for CCMA into the agricultural policy formulation, financing, implementation and evaluation at national, local and community levels.

The guidelines will assist to improve service delivery, productivity and resilience of Rwanda's agricultural sector to climate change effects.

1.3 Why Mainstream Climate Change into the Agricultural Sector Policy Processes?

Reliance on agriculture for livelihoods under increasingly unpredictable seasons and extreme weather events such as irregular dry spells and floods, may lead to crop failure threatening food security, nutrition and livelihoods. The resilience of the agricultural systems (including infrastructure, policies and programmes) to climate risks will depend on the extent to which they incorporate flexible adaptive and mitigation measures. The National agricultural policies, strategies and programmes, are designed on the basis of stable climatic conditions. These need to be adapted to the risks associated with extreme weather conditions, disruption in seasonal trends and climate variability. The ability to respond adequately in time to potential climate-related hazards is of critical importance to the success of agricultural programmes and their contribution to national development, especially with a country like Rwanda which heavily relies on agriculture.

2.0 CLIMATE CHANGE AND DEVELOPMENT: RISKS AND VULNERABILITIES

2.1 Overview

According to the IPCC IV (2007) report, the impacts of climate change and their associated costs will disproportionately affect developing countries threatening to undermine achievement of the Millennium Development Goals, i.e. poverty reduction and safeguarding food security. A major component of development assistance is support to agricultural production worldwide, which is increasingly under pressure to meet the demands of rising populations. Economic impacts of weather related extremes - and the costs of these to the growth and development in East Africa and Rwanda - are already significant. At the same time, there is concern about the contributions that the agriculture sector makes to greenhouse gas emissions and climate change. The impact of climate change on agriculture and allied sectors in relation to national development is presented in Figure 1.

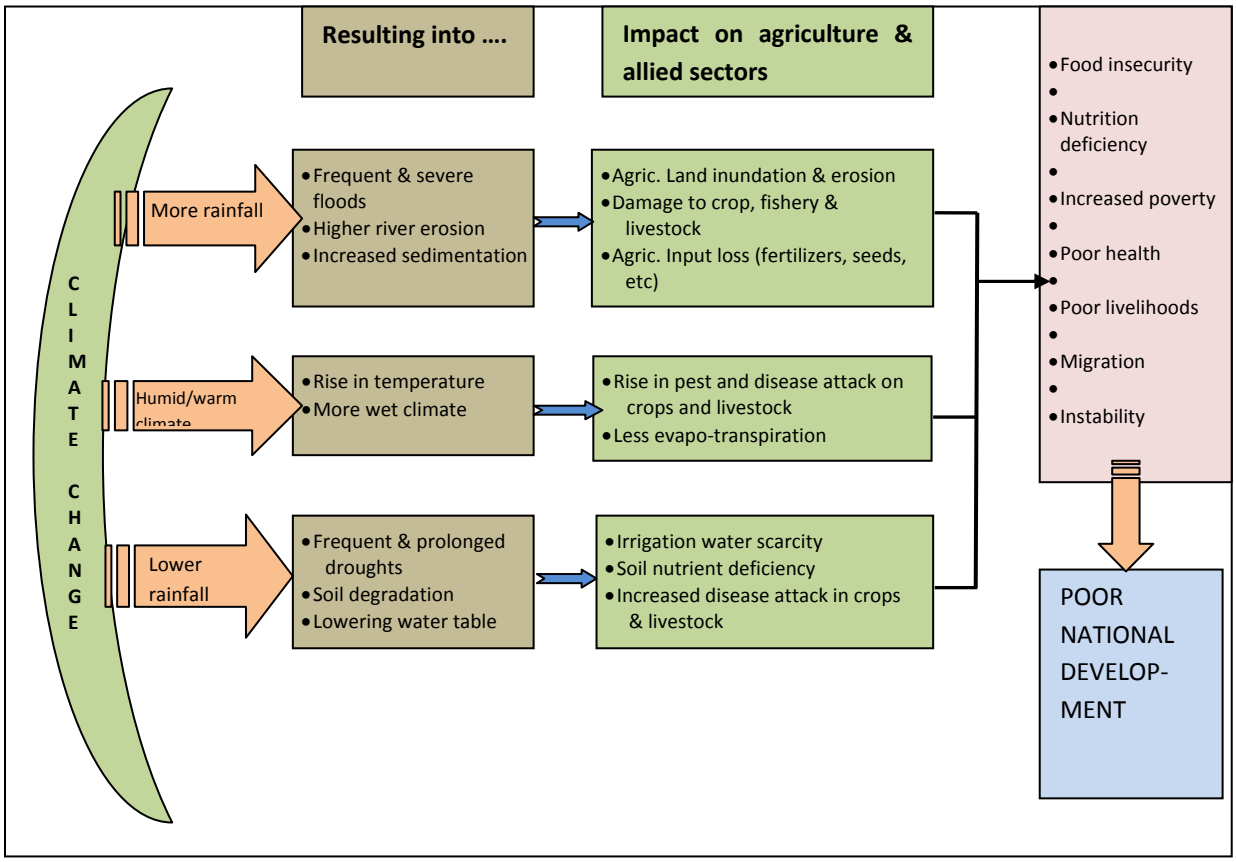


Figure 1: Climate change effects and related impacts in agriculture and allied sectors

2.2 Vulnerability of the Agricultural Sector to Climate Change

Climate vulnerability in the crop production

The observed shift in rainy seasons (September-November) and (March-May) and short or prolonged dry seasons in some regions distorts growing seasons confusing farmers on planting dates. As a result, this affects timing of field preparation and planting affecting crop growth, intensification of crop diseases and pests resulting in lower yields.

The shift in rainfall patterns on the other hand leads to reduction in amounts of rain water harvested therefore affecting both hillside and valley irrigation projects, through either decreased water levels in ponds/dams or high amounts of water destroying dam/pond embankments and causing erosion and silting.

Floods observed in the Northwest and , in the marshes of the Nyabarongo and Akanyaru rivers have not only resulted in loss of food production, property and leaving people homeless and without food, but has also lead to serious soil erosion and has potential for destruction of irrigation infrastructure both on the hill slopes and down the valleys.

The prolonged and cyclical droughts which is a major factor of vulnerability encountered in the Southeast of the country resulting from decreasing annual rain-fall (from 1000 mm to 700 mm) lead to food insecurity and displacement of communities. This calls for relief supplies and resettlement which will have budgetary implications.

The intense rains in Northwest and droughts and erratic rainfall in the districts of Bugesera, Nyanza, Gisagara, Huye, Rusizi-Nyamasheke where 60-90% households are affected will not only affect food production causing rising prices of staple foods, but also result into food and nutrition insecurity, worsening the already poor situation especially with the most vulnerable groups of the elderly, children and women.

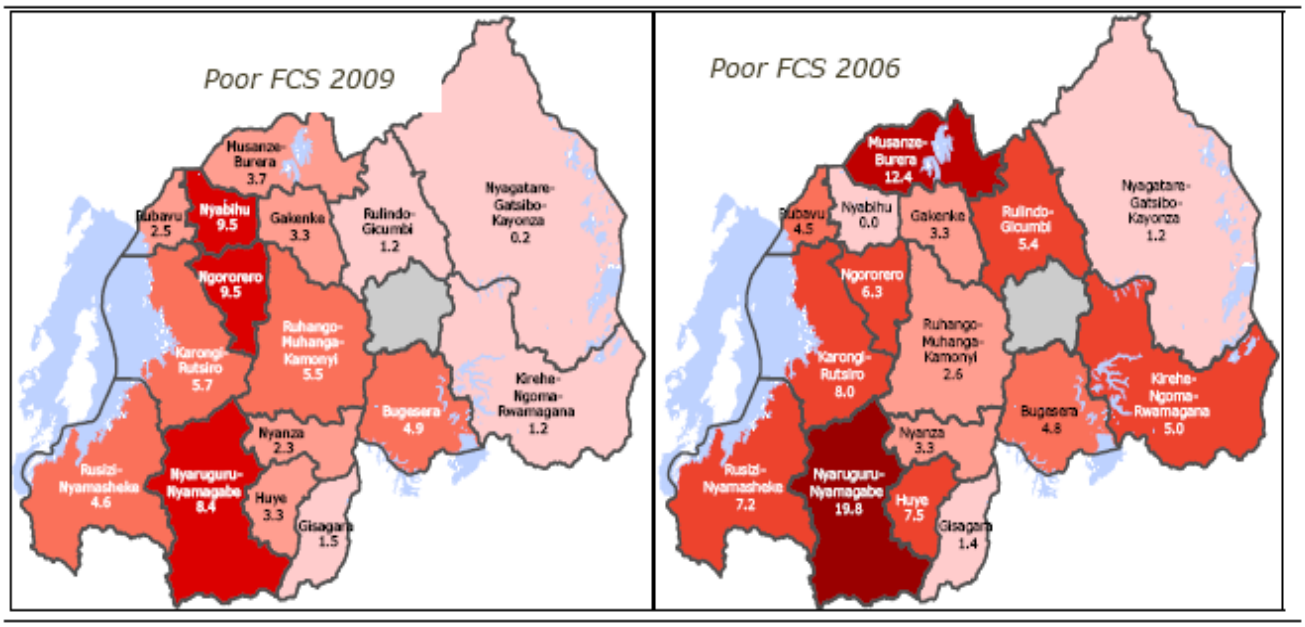


FIGURE 2: FOOD INSECURITY PER DISTRICT IN 2009. Source: CFSVA, 2009.

Figure 2 above shows that five regions are food insecure with the Districts of Ngororero**,** Nyabihu**,** Nyaruguru and Nyamagabe in Congo-Nile Crest **(**8.4-9.5%) the most vulnerable, representing 14% of the national population and 42% of the overall national population in terms of food insecurity. Increased weather vagaries are expected to aggravate the food insecurity problem not only in the reported areas but also in new ones.

The intense rains in western region, Congo-Nile crest**,** the eastern edge of Lake Kivu and the South East (as noted in the 2009 assessment)**,** presents a extreme rainfall case causing soil erosion and floods that have had a negative impact on agriculture and other sectors.

Projection of agricultural production in Rwanda for the period 2000-2100 show increase in acreage for grain crops. However**,** with predicted temperature increases**,** the expected production may decline unless irrigation is maximized**.** This will require more water.

Climate vulnerability in the area of livestock and fish farming

According to climate scenarios for Rwanda**,** air temperatures will increase by 1 to 3^{o}C by the year 2100**.** This shall have several following implications:

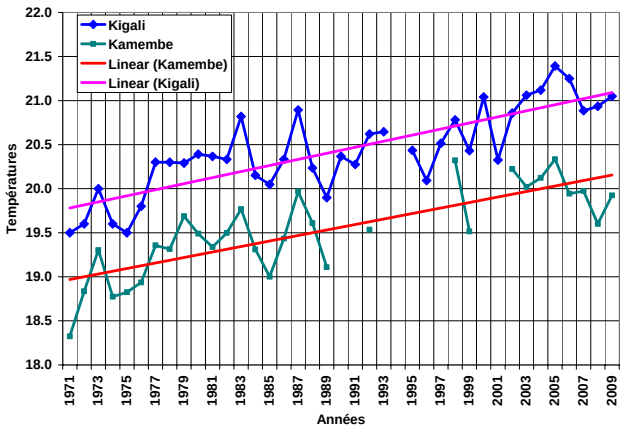
- Displacement of wet and dry seasons and therefore displacement of livestock in the eastern region of the country in search of pasture and water; drought leads to dehydration causing the fatigue of livestock and the occurrence of respiratory diseases;
- The occurrence of respiratory diseases and foot rot in the northwest of Rwanda with higher rainfall.
- Decrease in milk production resulting in the decrease of sources of income for the population;
- Important overland runoff (resulting from drying out) on slopes under cultivation and overgrazing causing high sedimentation in lakes for fishing.
- The increased temperatures leading to high surface evaporation and evapotranspiration rates, coupled with reduced rainfall leading to lowering water levels and drying of water sources. This will severely impact on livestock production and fish farming.

2.3 Rwanda's Vulnerability and National Response to Climate Change

What makes a country vulnerable to climate change? The degree of populations' and economies' vulnerability to extreme climate events will depend on their coping ability. Poorer and natural resources-dependant countries like Rwanda, are the most vulnerable.

2.3.1 Overview of Climate Change in Rwanda

Recent events and meteorological data provide glaring evidence that climate change is happening in Rwanda and that it will have disastrous effects. The 1997 floods and prolonged drought of 2000 associated with El Nino and La Nina (MINITERE, 2006) are some of the extreme climate change events that Rwanda has suffered recently. Over the next century, annual temperatures in Rwanda are projected to be 1.0 °C to 2.0° C higher (MINELA, 2010). Analysis



of the mean annual temperatures of Kigali Airport Station (1971-2007) in Kigali city and Kamembe in the Western Province (figure 3) reveals consistent temperature increase. For Kigali, the average temperature rise of 1.2°C from 19.8°C in 1971 to 21.0°C in 2009 is worrisome as it exceeds the 0.8°C reported to have been caused by global warming over a period of 150 years.

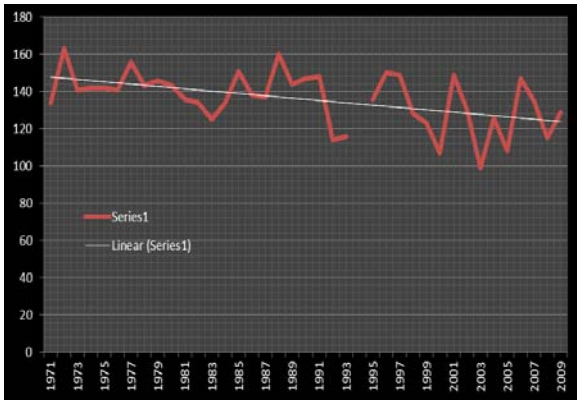


Figure 3: Variation of the annual average temperature at Kigali and Kamembe stations

Figure 4: Annual Number of rain days at Kigali station.

Data Source: Mutabazi (2010). Assessment of Operational Framework related to Climate Change.

An analysis of the daily rainfall data from Kigali Airport station for the period 1971-2010 shows that annual average total number of rain days has reduced from 148 days in 1971 to 124 days in 2009, Figure 4. These data indicate not only reduction rainy season period, but also increasingly poor distribution and reliability of rainfall with negative impact on agricultural productivity since crops require adequate amounts of soil water within the growing season.

Observations in Rwanda since 1990s, point to probability of having intense rainfall, less rainfall days, impacting crop phenology, resulting in increased incidences of floods, landslides and associated impacts. An analysis of the monthly and annual total rainfall at Kigali-Airport station for the period from 1961 to 1990 shows a clear downward trend as compared to previous years. However, the analysis of annual average temperatures (Kigali-Airport and Kamembe stations seem to indicate a clear upward trend (0.9°C within 27 years). According to climate scenario projections, temperature is expected to increase gradually in Rwanda during the 21st century (Ruosteenoja et al., 2003). The expected increase varies from 0.75 to 3.25°C during the shorter dry season (December to February) and from 1 to 3.25°C during the longer dry season (June-August). Drought problems are expected to intensify through increased variation in rainfall and increased evaporation triggered by rising temperatures. Like elsewhere in Eastern Africa, Rwanda has since the 1980's been confronted with prolonged droughts episodes or serious floods.

2.3.2 GHG Emissions and underlying Causes of Climate Change in Rwanda

One of the current major concerns of mankind is about climate change. These are attributed directly or indirectly to a human activity that is the emission of greenhouse gases (CO_2, N_2O, CH_4, CO, NOx, NMVOC) which come from the economic development. The agriculture sector contributes to global warming through carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) gas emissions. The main sources of the gases are nitrogen fertilizers, flooded rice fields, soil management, land conversion, biomass burning and livestock production and associated manure management. The main sources of GHGs are: agriculture (which contributed 78%), energy (17.8%), industrial processes (3%), wastes (0.9%) and land use, land use change and forestry with 10.9Gg CO_2eq (0.2%).

Rwanda's Second National Communication to the UNFCCC (MINELA, 2010), reported that although the balance between emissions and absorption remains negative, GHG emissions continue to increase. Based on recent emission (5010.4Gg) and absorption (-8545Ggr) records indicate that Rwanda is a net sink with capacity to absorb more (-3534 Grg) GHGs than it is producing. The main concern, however is that emissions from agriculture increased by nearly 1.5 times, moreover, the strong agricultural sector growth planned in the Vision 2020 will increase future GHG emissions and per capita emissions significantly becoming an issue of concern given that agriculture as the biggest source of livelihoods and major contributor to growth in the medium and long term.

2.4 Future Climate Projections for Rwanda

Climate model scenarios show future increases in mean annual temperature of up to 3.25°C by the end of the century. Changes in rainfall are more uncertain, though most of the models show that rainfall will increase. These projections are based on downscaling of global climate models to a single station in Rwanda (Kigali Airport); limited regional climate modeling has been carried out that captures Rwanda's unique regional setting and climatology.

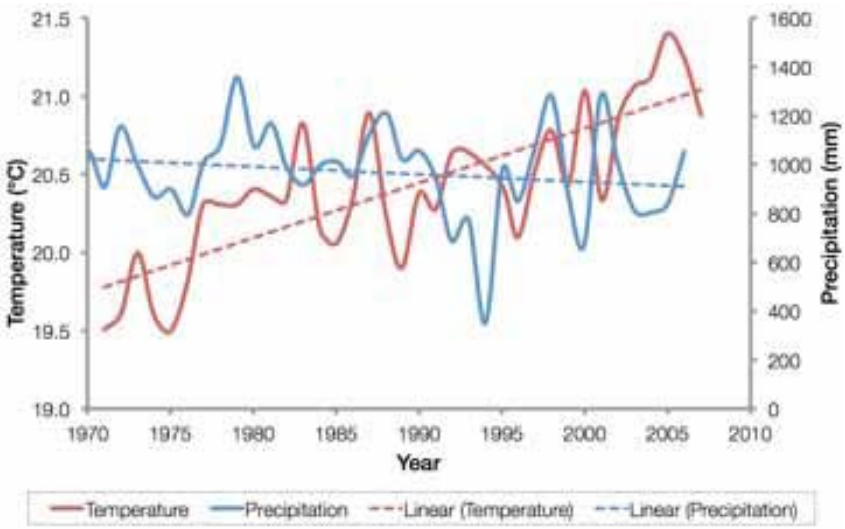


Figure 3: Variation of annual average temperature and rainfall at Kigali Airport Station.

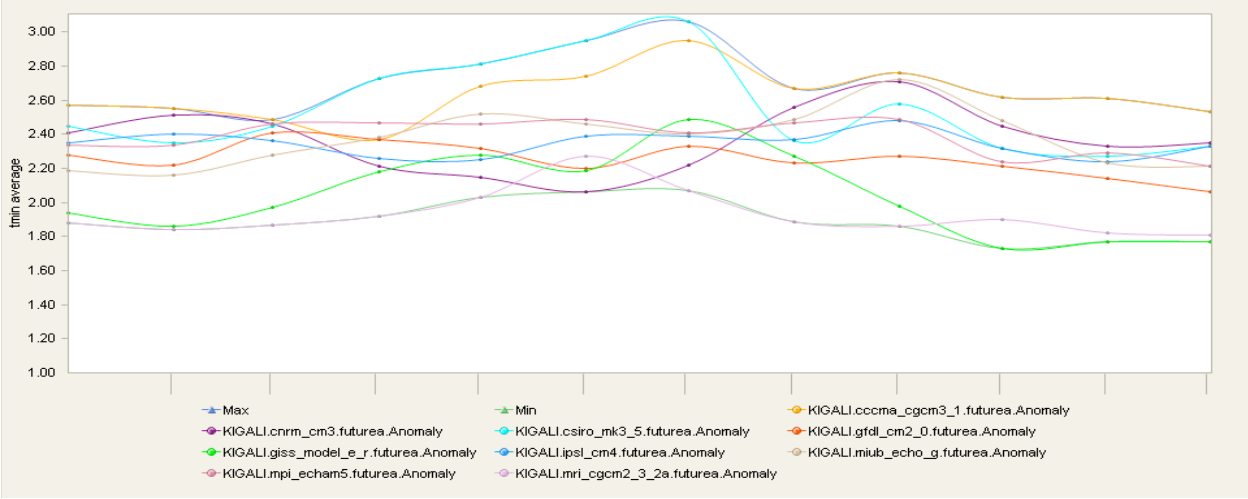


Figure 4. Projected changes in average monthly minimum temperature anomalies across nine GCM models for period 2046-2065 (A2 scenario), statistically downscaled to Kigali. Climate Change Explorer tool, Climate Systems Analysis Group and SEI, 2009.

Analysis of historical temperatures at Kigali indicates that minimum temperatures have been rising faster than maximum temperatures, but with a general overall rise in temperature particularly since 1992. All of the climate model scenarios show future increases in mean annual temperature in future years. The CCE data, based on downscaled data for Kigali's airport station, reports an increase of average maximum monthly temperatures of around 1.5 to 2.7 ºC (for a business as usual, no mitigation, scenario) over the range of models by the 2050s (2046 -2065), with greatest warming from July to September. The trends in monthly average minimum temperatures project a rise of between 1.7 to 2.8 ºC for 2046-2065, with the most warming occurring in June to August.

Changes in precipitation are more uncertain. Although the intensity, frequency and spatial distribution of precipitation are unknown, all the climate model scenarios show that average rainfall regimes will change, ranging from positive and negative anomalies across the models. The majority of the projections indicate that average annual rainfall will actually increase, particularly in some seasons, indicating a potential strengthening of the rains which is important in relation to flood risk. However, some models show reductions in rainfall in some months. A shift in the timing of seasons is already being reported in certain regions and this has a significant impact on agriculture. The range of model results highlights the considerable uncertainty in predicting future changes and the need to consider a robust approach to adaptation decision making to deal with uncertain future climate scenarios.

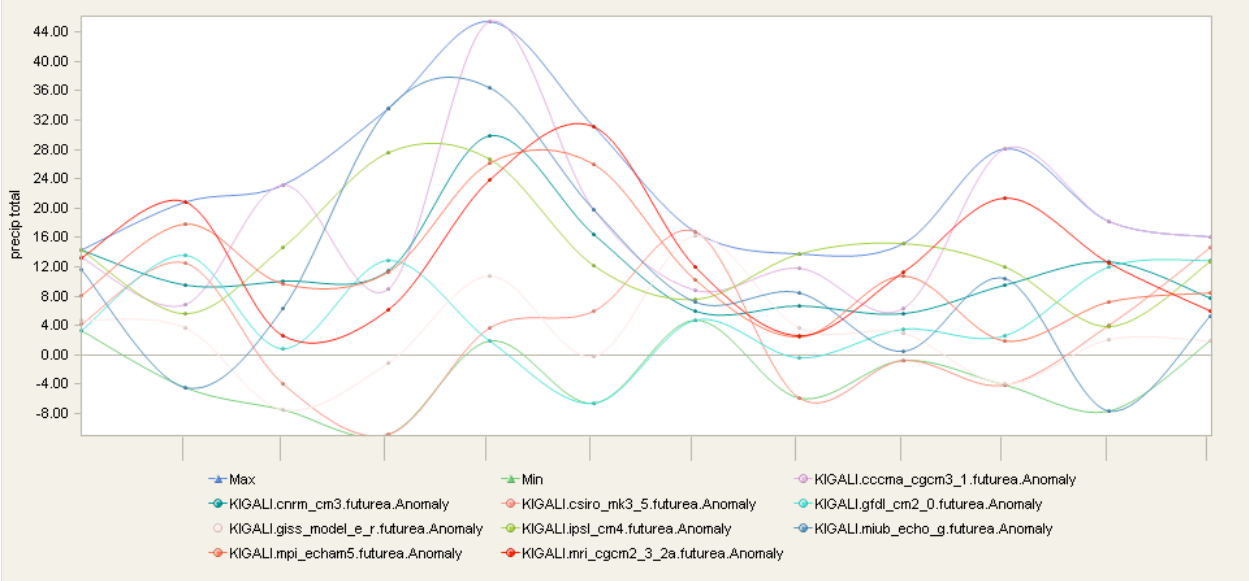


Figure 5. Projected changes in average monthly precipitation anomalies across nine gcm models for period 2046-2065. This is statistically downscaled to Kigali. Climate change explorer tool (Climate Systems Analysis Group and SEI, 2009).

2.5 Climate Change Impacts on Rwanda's Agricultural Sector

Extreme weather events (high temperatures, drought, floods, heavy erratic rains, humidity) will affect Rwanda's agricultural sector in several ways. The southern and eastern regions situated along Akagera and Akanyaru valleys are more sensitive to current climate variability and future climate change if

observed tendencies continue. These vulnerable regions receive migrating populations from regions with high population density and natural resources have reached a critical level of degradation. These migrating populations in search of new agricultural lands and pastures are already presenting a high economic and social vulnerability. Table 1 and 2 below summarizes the types of physical impacts, negative effects and consequences of climate change identified in vulnerable regions by sector.

Table 1 – N**egative effects of climate change (Rainfall) in most vulnerable regions**

Most vulnerable regions	**Phenomenon**	**Risk or immediate Consequence**	**Negative effect**	**Catastrophe registered**
1. East (Umutara, Kibungo). **South East** (Bugesera and Mayaga).	Prolonged absence of precipitation.	Drought	-Reduced agricultural production; lack of water and food for the population. -Decrease of levels of lakes and rivers. Lack of pasture for livestock. -Soil and forests degradation.	-Famine and disseminated population. -Drop in hydro electrical production. -Disappearance of aquatic life (Hippopotamus…). -Decimated domesticated animals. -Desertification tendency.
2. North (Gisenyi, Ruhengeri and Byumba). **Centre/West** (Gitarama, Kibuye and Gikongoro).	High precipitation. Landslides and landslips.	-Floods. -Soil degradation & impoverishment -Destruction of habitat. -Destruction of road infrastructures and bridges.	-Destruction of biodiversity of humid zones -Destruction of plants in swampy and river zones. -Destruction of infrastructures in low zones.	-Environmental degradation and disappearance of rare species. -Famine. -Human loss. -Economic loss. -Erosion. -Threatened human and animal lives. -Disturbed transport and threat to economic and commercial sectors.

Table 2 - Causes of impacts, vulnerable regions and affected sectors

Climate hazards	**Vulnerable regions**	**Consequences on most affected sectors**
Increase of temperature, prolonged droughts and high evapotranspiration.	Swamp complexity of Akagera river. Akagera park, Rugezi swamp.	**Water resources** Low river flows and disturbance of hydraulic cycle in general. Low water level of lakes and rivers; • Drying up of water sources. • Loss of aquatic ecosystems (hippopotamus deaths due to drying of Gabiro-Akagera valley in the Akagera National Park during la Nina 1999-2000).
	Bioclimatic region of East and Southeast and some zones of the Central plateau (Umutara, Kibungo, Bugesera, Mayaga, Gitarama)	**Land Ecosystem and Agriculture** • Decrease banana production. • Cereal and leguminous production especially maize and beans growth becomes almost impossible. • Favourable conditions to parasites (caterpillars on sweet potatoes and beans). • Pastures without perpetual water or from irrigation become threatened and extinct.
	Bioclimatic region of East and Southeast and some zones of the Central plateau (Umutara, Kibungo, Bugesera, Mayaga, Gitarama)	**Food security** Fluctuations in the production, risks of food insecurity and favourable conditions to famines.
	High mountainous regions, Congo Nile crater regions, valleys and shallows (peat bogs, altitude meadows); North (Cyeru,	**Economy** Reduction of production, and GDP. Reduction of rural population revenues. Increase of foodstuff cost. Movements of the population in search of food.

Heavy rains, floods, frequent landslides and landslips.	High altitude regions of West, South-West, North, Centre and Congo Nile crater foothills (Budaha, Ndiza and Buberuka highlands).	**Agriculture** Erosion becomes an important factor for low agricultural production and food insecurity. Crops destruction risks and high silting-up particularly in swamps and shallows.
	High altitude regions of West, South-West, North, Centre and Congo Nile crater foothills (Budaha, Ndiza and Buberuka highlands).	**Infrastructures** Destruction of anti erosive systems, destruction of economic infrastructures (roads, bridges, schools, hospitals, houses, etc.).
	High mountainous regions, Congo Nile crater regions, valleys and shallows (peat bogs, altitude meadows); North (Cyeru, Nyamugali).	**Economy** Reduction of production, and GDP. Reduction of rural population revenues. Increase of foodstuff cost. Movements of the population in search of food.
	Protected zones, national parks, cultivated lands, Affluents and swamps: Nyabarongo, Rugezi, Akagera and Mukungwa rivers.	**Ecosystems** • Water pollution and invasion of aquatic pollutants; • Invasive species (e.g. water hyacinth…); • Loss of soil fertility by leaching of arable lands; • Increase of arable land sediments; • Local risks of landslides; • Risks of irreversible land leaching • Soil erosion and degradation; • River, lake and reservoir sedimentation.

The main agricultural concerns resulting from climate change are summarized in the Table 3 below and discussed:

Table 3: Impacts, Risk level and Significance of Extreme Weather Conditions on Agriculture

Impact manifested in Rwanda	**2nd Order Impact**	**3rd Order Impact**	**Risk or opportunity**	**Significance (Likelihood x consequence) High/Low**
More hot days and heat waves	Increased frequency of fire danger index reaching high-extreme, coupled with windy conditions	Risk of major loss of livestock, grazing, crops and infrastructure. Threats to financial sustainability of existing commercial and subsistence farming operation and rural livelihoods; Reduced food security.	Risk	Extreme
Higher mean temperatures	Increased evaporation and decreased soil water balance	Reduced net revenue per hectare for existing crop types and shifting/ shrinking ranges for certain crops types and cultivars	Risk	High
	Increased evaporation (from both soil and open water sources) and decreased soil water balance	Increased irrigation requirements per hectare. Net water requirements of crops are projected to increase	Risk	High
	Increase in ranges and vigour of pests, diseases and vectors	Increased infestation of pests and diseases and reduced net revenue per hectare	Risk	High
	Increase in heat units	Changes in the ranges, planting times, flowering and harvest times of crops.	Risk	Medium
	Alteration to the ranges of certain species of plant and animal	Potential for introduction of new species for commercial exploitation	Opportunity	Low
	Increased evaporation of surface water resulting in increased salinisation of irrigated lands.	Reduced yields from irrigated crops in marginal areas.	Risk	High
Increased storm	Threats to infrastructure due	Increased damage to hydroponics/shade	Risk	High

severity/ Extreme weather events.	to wind damage	tunnels.		
	Crop damage from hail and wind and heavy rain	Increased risk of crop failure; threats to financial sustainability of operations. Threats to viability of subsistence agriculture.	Risk	High
More hot days and heat waves	Increased heat stress for crops and livestock,	Risk of crop failure and poorer livestock performance per hectare.	Risk	High
	Increased heat stress in dryland and irrigated crops	Reduced crop productivity and quality, and consequent threat to viability of commercial and subsistence farming.	Risk	High
	Increased heat stress among livestock	Reduced productivity and product quality among non-indigenous breeds, and consequent threats to viability of commercial and subsistence farming	Risk	High
	Increased risk of heat events damaging certain crops	Increased risk of crop failure and reduced net revenue per hectare	Risk	High
More intense Rain	Increased soil erosion	Loss of soil resources and fertility, silting up of dams and irrigation infrastructure	Risk	High
	Increased flood run off	Threats to crops, livestock and infrastructure	Risk	High
Longer dry spells and increased likelihood/severity of droughts	Impacts on yield	Increased risk of crop failure and loss of livestock. Threats to financial sustainability of farming operations.	Risk	High
	Decreased water quality	Poorer quality of irrigation water may reduce net revenue per hectare	Risk	Medium
	Increased evaporation and decreased water balance	Increased stress to existing crop regime. Reduced average revenue per hectare over time	Risk	Medium
Change in precipitation patterns	Increased inter- and intra-annual variability of rainfall	Reduced viability of dryland crops; Increased economic risks to dryland crop-farming.	Risk	High

Climate change effects will not only affect individual households but will also influence achievement government programmes goals. The climate change related impacts and policy implications are presented in Table 4 and discussed below;

Table 4: Implications of Climate-Change related risks to the agricultural sector

	Climate-related risk/event	Impact on agricultural sector	Policy implications
1	Prolonged drought	Reduced availability of water for irrigation, watering animals Disruptions in water supply and power production. Reduced availability of water and inadequate power for farms and running agro-industries.	Reduced crop productivity with potential soil salinisation of irrigated land. Increased morbidity & mortality to water-related diseases in livestock. Limitation to growth of agro-processing and horticultural sectors.
		Food security and access to adequate and balanced diet: Incidences of crop failures have been reported with direct consequence on individual and community health.	Increased incidences of malnutrition & related illnesses. Poor nutrition increases susceptibility to illnesses reducing work force efficiency.
		Reduced incomes & livelihoods of agricultural households	Increased rural-urban migration affecting urban infrastructure. Increased famine and malnutrition and exposure to illnesses.
		Poor economic performance as a result of agricultural failure	Lower budget allocation to agricultural sector.
2	Intense & frequent floods	Loss of people and their property reported in Western Province; destroyed infrastructure and economic assets e.g. agricultural fields, and left many people homeless. Increased incidences food insecurity, malnutrition and ill health.	Increased exposure to water-related ailments in humans and livestock. Relief costs to sustain affected people increases. Increased cost of maintaining agricultural infrastructure e.g. irrigation systems)
3	Extreme weather conditions – temperatures, seasonal patterns	*Disease and pest incidences & changing geographical range for crops*; Changing pest and pathogens' lifecycles will disrupt crop and livestock production systems affecting their performance and survival in changed climatic conditions.	Increased livestock morbidity, as new cases of livestock diseases may be recorded at Veterinary centres; New pests and diseases attack to crops, bees, trees and/ or fish, resulting in reduced performance of traditional crops or livestock breeds. Increased burden on the agricultural system including staff, facilities and budget to develop new technologies.
		Reduced social and economic assets. More people are likely to lose homes, property or get internally displaced by floods, storms, landslides and/ or fires.	Reduced ability to meet their nutritional & social needs.
4	Global scale disasters	*Reduced donor funding and direct foreign investments*, as development partners divert resources to meet climate-related disasters elsewhere.	Reduced agricultural sector budget and ability to implement health sector activities. Reduced funding for disaster budget to undertake relief services.

1. ***Climate change is increasing hazards resulting from crop loss or failure***: Frequent floods and landslides have already exposed many areas to erosion, crop loss and increase in crop and animal diseases. Erosion affects at least 50% of all farmers in hilly areas, with 30% decline in farm productivity. As a result of soil erosion, deterioration of soil is detrimental to Rwanda's food security for over 90 % of the people who depend solely on agriculture. On the other side, Rwanda's agriculture is highly dependent on climatic conditions and drought becomes an important

vulnerability factor. Drought, irregular rains and dry spells commonly reported shocks for households with increasing frequencies across the country in Bugesera, Nyanza, Gisagara, Huye and Rusizi-Nyamasheke) pose a big threat to agricultural productivity, food security and nutrition and people's health.

2. ***Government capacity to deliver on agricultural outcomes in MDGs and Vision 2020 will be undermined***: increased disease prevalence – both in frequency and diversity- could strain the agricultural production system. Extreme weather events will affect the economy, thereby reducing budgetary allocation and ability to deliver on set targets.
3. ***Climate change will increase social vulnerability of poor households***: Poverty level indicators show higher incidence of poverty in rural areas in Rwanda (66% below poverty line). Therefore, climate change, particularly extremes weather conditions resulting in climate-related disasters such as floods, droughts, and high temperatures increases vulnerability of the poor people, who have limited coping capacity, may be pushed beyond their coping range. As a result of displacement, loss of economic assets and food insecurity, more people could be exposed not only to famine, malnutrition, but also health and social challenges.

Policy makers, planners and development activists need to understand the potential impacts of climate change on the agricultural sector, the effectiveness of current adaptation and mitigation policies, and the options available for addressing them.

3.0 CLIMATE CHANGE IN RWANDA: ADAPTATION RESPONSES IN THE AGRICULTURAL SECTOR

The magnitude of the challenge to stabilize greenhouse gas (GHG) concentrations in the atmosphere and limit average temperature increases makes it imperative that the contributions of all sectors with significant mitigation potential be tapped to the fullest extent possible. Agriculture is recognized as a sector with such potential and farmers, ranchers, herders and other land users around the world can and should be part of the solution to climate change.

3.1 Basis for Response to Climate Change and recent initiatives in Rwanda

Agriculture is highly sensitive to climate variability and extreme weather conditions such as droughts, floods and severe storms. This is especially so in Rwanda where nearly all farming activities are dependent on nature. Human activity has already changed atmospheric characteristics such as temperature, rainfall, levels of carbon dioxide (CO2) and ground level ozone. It is expected that such trends will continue. Several factors directly connect climate change and agricultural productivity:

- Average temperature increase
- Change in rainfall amount and patterns
- Rising atmospheric concentrations of CO2
- Pollution levels such as tropospheric ozone
- Change in climatic variability and extreme events (landslides, strong winds, prolonged droughts, floods, intense and destructive rains,..)

The increased potential for droughts, floods and heat waves will pose challenges for farmers and agri-business operators most. Additionally, the enduring changes in climate, water supply and soil moisture could make it less feasible to continue or expand crop production in certain regions, hence affecting the country's ability to realise its Vision 2020 targets.

The basis for action on climate change is enshrined in international and national legal provisions. Article 4(f) of the UNFCCC to which Rwanda is signatory argues Governments to "*take climate change considerations into account, to the extent feasible, in the social, economic and environmental policies and actions, and employ appropriate methods with a view to minimizing adverse effects on the economy, public health and the quality of the environment, of projects or measures undertaken to mitigate or adapt to climate change*".

Climate change is recognized at the highest level of Government as a potential threat to productivity and sustainability of the agricultural sector and livelihoods of Rwandans. As a result, GoR has implemented a number of policy initiatives including: mechanisms to implement provisions of international climate change conventions (implementation of NAPA); reforming public institutions to include climate change management functions; and mainstreaming climate change within policy processes – the environment and natural resources, and low carbon growth strategy are recent policy strategies that reflect climate change adaptation priorities.

3.2 Specific climate change actions in the agricultural Sector

The NAPA report suggested immediate and urgent actions to be undertaken in different socio-economic sectors of the country**.**
In agriculture**,** the following priorities were identified**;**

- Integrated management of water resources;
- Establishment of information systems, for hydro-agro-meteorological warning and rapid intervention;
- Promotion of income generating activities other than agricultural ones;
- Promotion of intensive agri-farming;
- Introduction of varieties resistant to environmental conditions;
- Development of alternative energy resources to replace fuel wood.

The EDPRS 2007-2012 incorporated the NAPA priorities and developed the following strategic actions:

- Diversification and intensification of crop production, livestock and fisheries;
- Organization, mobilization and capacity building for producers and professional organizations;
- Promotion of gender approach and reduction of vulnerability of disadvantaged groups;
- Diversification of sources of income and employment for rural communities;
- Linkage of production with the market and integration of the agricultural economy in the national and regional economy;
- Capacity building for service providers, privatization and promotion of private sector;
- Sustainable water and land management as well as natural resources;
- Creation of an enabling environment for productive investment, entrepreneurship and employment development in agribusiness.

The second national communication recommended a number of strategies for **climate change adaptation** in agriculture summarized in table 5.

Table 5: Climate change adaptation recommended by the Second National Communication.

Sub-sector	**Climate change adaptation strategies and actions**
Crop production	• Investment in early warning systems and seasonal forecasts; • Development of early varieties (maize, beans, cassava, soybeans and potatoes) that give high yield, resistant to drought, diseases and harmful insects; • Improved farming and agro-industrial technologies e.g. irrigation on the hills and use of non organic and organic fertilizers and change in sowing dates; • The Agricultural Intensification Program (CIP) intends to cultivated 150,000 ha during the growing season 2010 B east and north of the country; • Introduction of vegetable gardens at the household level.
Animal husbandry	• Adopt stall feeding and provide a cow per family to produce organic manure; • Develop small livestock (goats, sheep, rabbits and poultry) for the production of meat; • Apply modern agriculture by introducing animal traction.
Fish-Farming	• Protection of lake shores and wetlands by prohibiting farmers from growing crops within 50 m from the lake and within 10 m from river banks in order to avoid sedimentation due to crop growing on hill slopes. • Introduction of adapted fish species in lakes, ponds and rivers.
Soil Conservation	• Plantation of trees; • Practice of agroforestry;

	• Practice progressive and radical terracing according to the nature of the ground.

Up to 2020, the Government has set a target program to make radical terraces on 80%. Currently 6.2% are already developed (Source: RADA). All progressive terracing will be transformed into radical terraces where it is practicable to fight against erosion, landslides and floods and one hectare of radical terraces has a potential productivity of 25 tons of potatoes.

Table 6 below gives in details the list of recommended measures and adaptation strategies under implementation, while Table 7 shows National action plan for adaptation and implementation of recommended adaptation measures in the agriculture sector**.**

Table 6: Key climate change adaptation measure for agriculture approproate for Rwanda

Sector	**Adaptation strategies**
Agriculture	• Improved soil conservation techniques especially in highlands (North-West Rwanda and in areas of Congo-Nile Crest) and introduction of agro-forestry; • Introduction of new crop varieties, especially early, resistant and adapted to climate; • Improved technology including water efficient irrigation systems; drought tolerant and fast growing crop varieties; information dissemination to farmers and links with researchers and extension workers; • Promotion of income generating and mutual development activities; • Empower farmers and farmers' groups with climate information and adaptation toolkits;
Livestock	• Promotion of animal husbandry in stalls; • Development and exploitation of modern pastures; • Improvement of conditions for feeding and watering; • Fight against contagious animal diseases and development of health surveillance; • Dairy development focusing on indoor high value cows and goats; • Support for veterinary research and animal husbandry; • Revival of the livestock –beef line; • Support to organization of professionals in the livestock sector; • Support for privatization of the zoo-veterinary profession. • One cow per poor household
Fish Farming	• Protection of water resources and aquatic ecosystems; • Increase the productivity of fishing communities through the development and implementation of integrated development plans of watersheds and aquaculture production; Restoration of fish stocks; • and professionalization of the fisheries sector • Conservation of biodiversity; • Development of private initiative and professionalization of the sector fish.
Soil Conservation	• Integrating efficient methods of erosion control, restoration and improvement of soil fertility adapted to the environment and socio-economic conditions of beneficiaries; • Collection of rainwater to keep it on the farm and concentrate it on the root zone to meet the highest crop water needs; • Work out an integrated management plan at the watershed scale that takes into account the peculiarities of family farms;

	• Put in place land-flow zones that will limit the speed of water flow, facilitate derivation when the water is abundant and stabilize works located downstream.

Table 7: National action plan for adaptation and implementation in agriculture

Objectives	Expected results	Indicators	Activities	Period	Institutions responsible
1. Develop irrigation techniques	Irrigation on hills is practiced in vulnerable regions.	Number of hectares with irrigation on hills	-Increase irrigation practices on hills in vulnerable zones -Develop marshes	2011-203	MINAGRI BD
2 Improve soil conservation techniques	Erosion control is practiced in highlands	Erosion control is carried out at 70%	-Sensitize the population on practices of soil conservation -Build big holes on hills to retain water for agropastoral activities - Invest in radical terraces	2011-2014	MINAGRI/ RADA BD
3. Help poor population	A rapid warning system is put in place	Food security is improved	-Distribute early and resistant seeds (beans, maize, soybeans cassava cuttings) –Distribute small livestock (goats, poultry) -Educate communities on irrigation in marshes.	Indeterminate	MINAGRI, MINALOC, FAO MINICOM BD
5. Strengthen the hydro-agrometeorological information system.	Regular warnings on climate manifestations	Number climatological bulletins published per year.	Rehabilitate and equip equitably 150 stations meteorological stations in climatic regions	2011-2013	MININFRA BD MINAGRI
		Number of hydrological directories published per year	Rehabilitate 80 st hydrological and limnimetric damaged stations	2011-2013	
		Number of publications of hydrometeorologi cal data in media	Involve media in the publication of hydrometeorological data especially in vulnerable regions.	2011-2013	
		Number of meteorological experts	Recruit and train qualified personnel for the National meteorological Service	2011-2013	
		5 thematic maps showing vulnerable regions are developed and updated each year.	To make maps of climate phenomena in regions with high climate risks	2011-2013	

PSTA II encourages changes in production techniques for agriculture to move from subsistence to market oriented agriculture through the use of promising modern agricultural technologies. The GoR has also adopted a strategy for the crop intensification in which the emphasis is placed on selected strategic food crops with high value such as rice, maize, beans, potatoes and wheat and fruits and vegetables. However, the promoted production practices and agro-processing activities have direct and indirect effects on global warming and climate change. The risks, impacts and potential mitigation measures for the agricultural sector programmes and sub-programes under implementation are presented in Table 8 below.

Table 8: Risks and mitigation strategy matrix for adaptation sub-programmes under implementation

PROGRAMME/ PROJECT	NATURE OF RISKS	IMPACT	LIKELIHOOD OF THE IMPACT	MITIGATING STRATEGY
Development of Irrigation	• increased water loss. • Salt build-up in the soil. • Increased pollution through agrochemicals.	• Reduced water flows for other users downstream. • Reduced water quality. • Failure of growth of some crops with high salinity.	• Medium/Severe	• Use of irrigation methods which minimize evaporation. • Judicious application of agrochemicals.
Marshland Development	• Water drainage • Loss of organic matter • Ecosystem changes (loss of biodiversity) with drainage • Emission of GHG gases	• Reduced productivity in the long run • Further enhanced climate change • Global warming and climate change	• High/Severe	• Grow crops that tolerate high water table or water logged conditions • Water drained to reservoirs when not required
Supply and Use of agricultural inputs (inorganic fertlisers, pesticides and herbicides)	• Environmental chemical pollution and soil physical structure destruction. • Emission of GHG gases (N_2O)	• Negative environmental and health effects • Global warming and climate change	• High/Moderate	• Effective timing and application of right quantities. • Use of organic soil improvement practices.
Sustainable Management of Natural Resources and Water and Soil	• Environmental degradation. • Soil erosion	• Reduced productivity	• High/Severe	• Use of selected sustainable methods. • Agroferestry practices
Transformation and Competitiveness of Agricultural Products	• Increased use of agrochemicals in order to meet market quality demands (Horticulture industry) • Use of improved certified seed.	• Pollution and biodiversity loss • May require use of high levels of external agro-inputs	• Moderate/Severe	• Regulated use of agrochemicals. • Use of appropriate application techniques to minimize losses.
Rainwater harvesting (Hillside irrigation)	• Over flow with high rainfall intensities • Damage to dams/ ponds	• Soil erosion • Damage to crops and pasture • Silting in the valleys	• Moderate	• Collaboration with MINAFRA in design & construction. • Training of farmers on management of systems.
Agricultural mechanisation	• Soil structure destruction (compaction) • Limitation to microbial activity.	• Poor crop root growth & productivity. • Soil run-offs and erosion. • Nutrient cycling limited requiring fertilizer use.	• Moderate	•
Land law and land reform (*Imidugudu*)	• Organised settlements with increased run-off • Large expanse of land under one crop (e.g. Rice fields)	• Soil erosion • High risk of crop failure due to disease or pests due to mono cropping	• Moderate/Severe	• Water harvesting and use for other purposes. • Planned crop rotation system.

Some of the potential policies to enhance agricultural productivity and agricultural intensification will have some potential conflict with low carbon growth, i.e. on their own they may increase GHG emissions. Highlights of some key issues for the agricultural sector practices are:

- ✓ The ambition to intensify agricultural production could increase GHGs through more intensive use of land for crops. This could be through increase use of nitrogen based fertilisers, which are carbon

intensive to produce. Intensification needs to consider good nutrient management, low impact farming measures (reduced tillage), and ways of ensuring carbon storage in soils is maintained / enhanced. This of course has to be balanced against the critical issue of food security.

- ✓ *There is already a deficit in livestock production supply relative to demand*. Furthermore increasing population and growing income will lead to increasing demand. Livestock is a high source of methane emissions. Careful management of an increasing livestock herd will be needed to minimise methane (CH_4) emissions per unit of livestock production.
- ✓ *Agriculture is an important sector to Rwanda*, and will continue to remain so for the foreseeable future. Developing a low carbon strategy in tandem with any adaptation strategy will be key to ensure that Rwanda's agriculture moves further to become a lower GHG emitter whilst coping with climate change impacts.
- ✓ Some of the existing policy in the agricultural investment plan (increased livestock herds and increased fertilizer use) will have consequences for baseline emissions and there is a need for further assessments of the GHG impact of agricultural policies.

3.3. Climate Change Mainstreaming in the Agricultural Policy Process

3.3.1 Overview of Rwanda's Agricultural Policy Process

Rwanda's Agricultural sector is structured in a decentralized framework that comprises of 3 levels: the central administrative and planning level; regional level and the peripheral level (community service providers). An important area to consider is the Local Performance Contracts (*Imihigo*). Rwanda's policy process is initiated through a complex interaction of national aspirations, international commitments and local health challenges.

Rwanda's Policy is designed and implemented in the context of the country's Vision 2020, the need to translate Government Political Plan (2010-2017) into actual results, and achieving the Millennium Development Goals (MDGs) targets related to agriculture. These are; eradicate extreme poverty and hunger – malnutrition (MDG 1); promote gender equality and empowerment of women (MDG 3); health related goals aimed at reducing infant mortality and improving maternal health, combating major diseases (MDGs 4, 5 and 6) and ensure environmental sustainability (MDG 7) are of major importance to agriculture. Rwanda's policy process is initiated through a complex interaction of national aspirations, international commitments and local agricultural and development challenges. The policy process and various instruments are outlined in Figure 5.

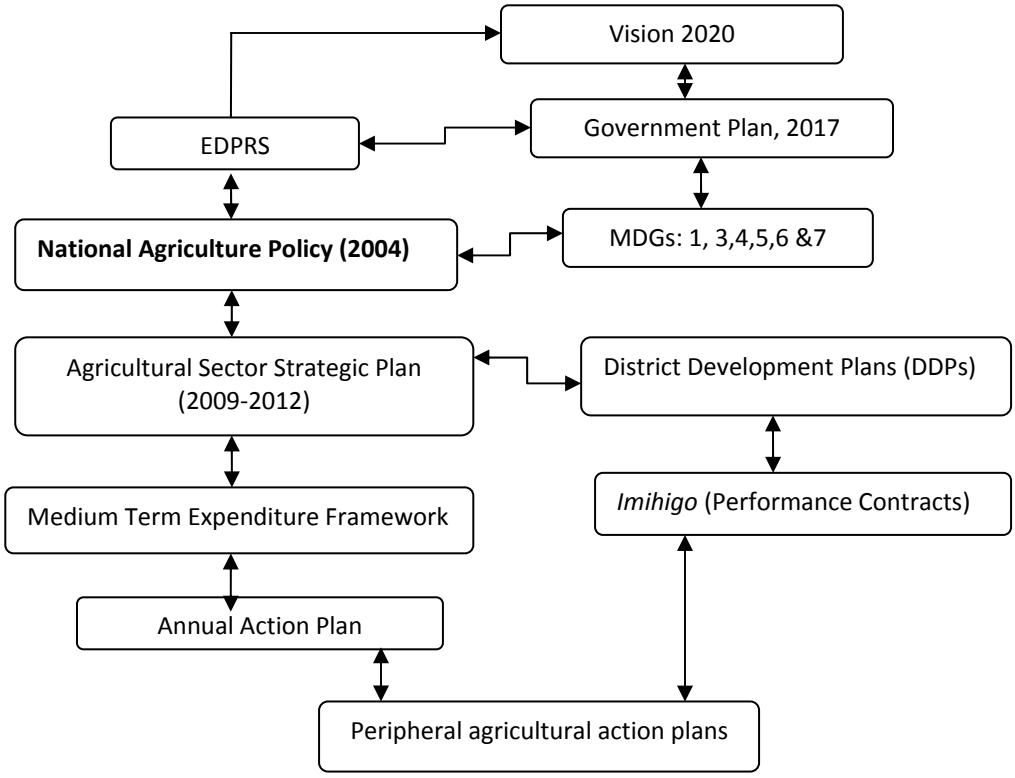


Figure 5: The policy process and related policy instruments

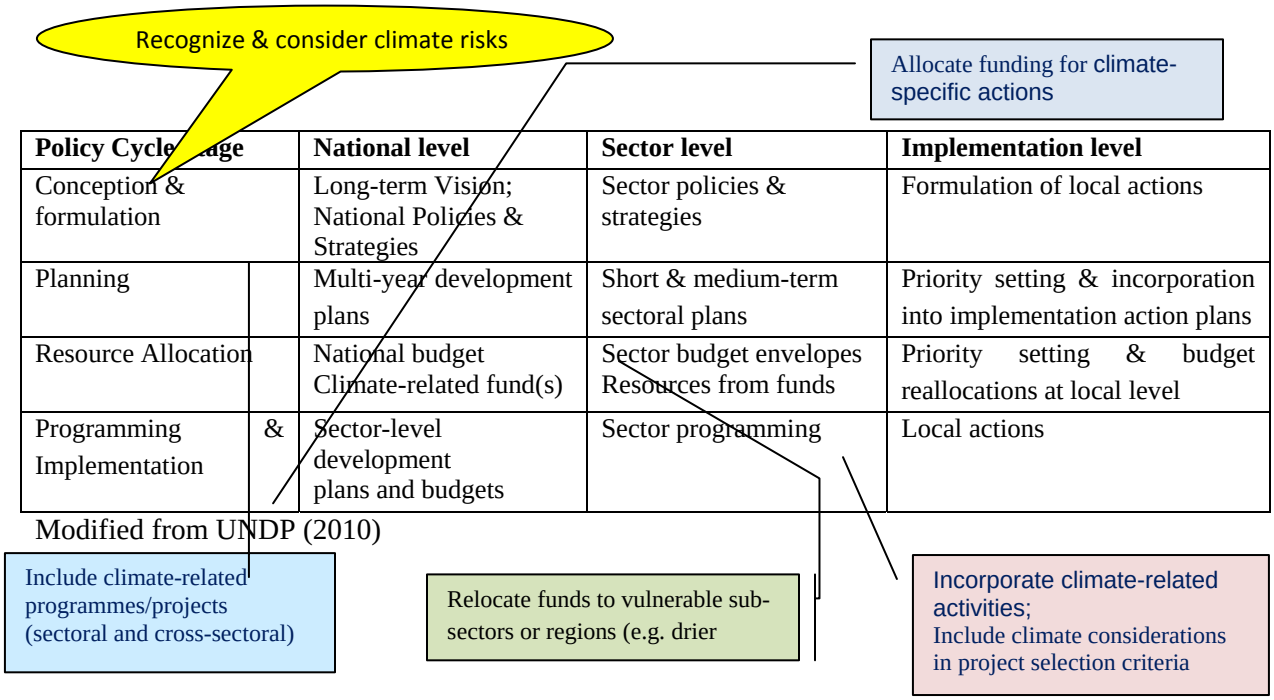
The Strategic Plan for Agricultural Transformation (SPAT/ PSTA) is Rwanda's medium term strategy for rural transformation. The GoR adopted PSTA I and PSTA II strategic plans as strategic and budgetary frameworks with four (4) main programmes and sub-programmes. These four programmes provide the framework for the planning and financing of interventions in the sector for both GoR and development partners (DPs) for programming their assistance to the sector and for aligning the activities they fund through the SWAp.

The priorities outlined in PSTA are translated into action through the Sector Investment Plan (SIP), which estimates the financial requirements for implementing the PSTA II, and thus provides the road map towards achieving the vision for the agricultural sector. First adopted in 2004 and revised in 2008 in the context of EDPRS, PSTA II has four strategic programmes, all of which have important implications for Climate Change mainstreaming in the agricultural sector. The first programme namely, Intensification and Development of Sustainable Production Systems has 6 sub-programs all of which have direct impacts on climate change.

3.3.2 Opportunities and Entry Points for CCMA Mainstreaming in the Agricultural Sector

FAO (2009) identified a number of strategic areas of action to address climate change impacts on agriculture sector all of which are relevant to Rwanda. In general, there are opportunities for mainstreaming climate change concerns in all the four basic stages of the policy cycle (from conception to implementation), and at all the 3 levels of policy processes; from national to local community level. These opportunities are schematically presented in table 9 below.

Table 9: Opportunities for climate change mainstreaming within the Policy process



Policy Cycle Stage	National level	Sector level	Implementation level
Conception & formulation	Long-term Vision; National Policies & Strategies	Sector policies & strategies	Formulation of local actions
Planning	Multi-year development plans	Short & medium-term sectoral plans	Priority setting & incorporation into implementation action plans
Resource Allocation	National budget Climate-related fund(s)	Sector budget envelopes Resources from funds	Priority setting & budget reallocations at local level
Programming & Implementation	Sector-level development plans and budgets	Sector programming	Local actions

Modified from UNDP (2010)

The basic steps in CCMA mainstreaming in the agricultural sector, are schematically presented in Figure 6 below.

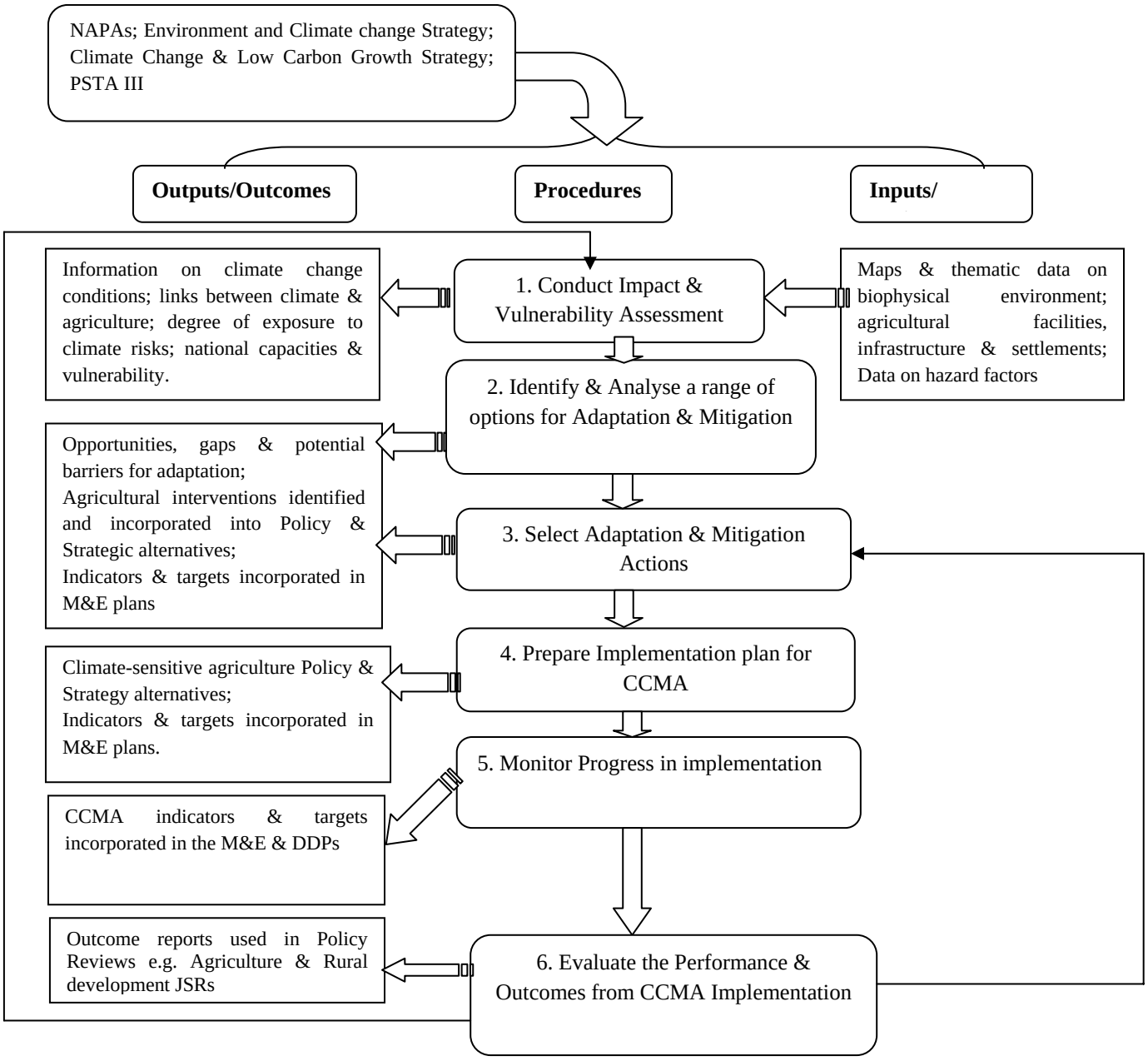


Figure 6: Procedures for CCMA Mainstreaming in the Agricultural sector Policy Process

Taking the Organisation for Economic Cooperation and Development (OECD) model of for integrating climate change considerations into national, sectoral, project/community levels (OECD 2009). Linkages between various climate change mainstreaming levels are presented in Figure 7 below.

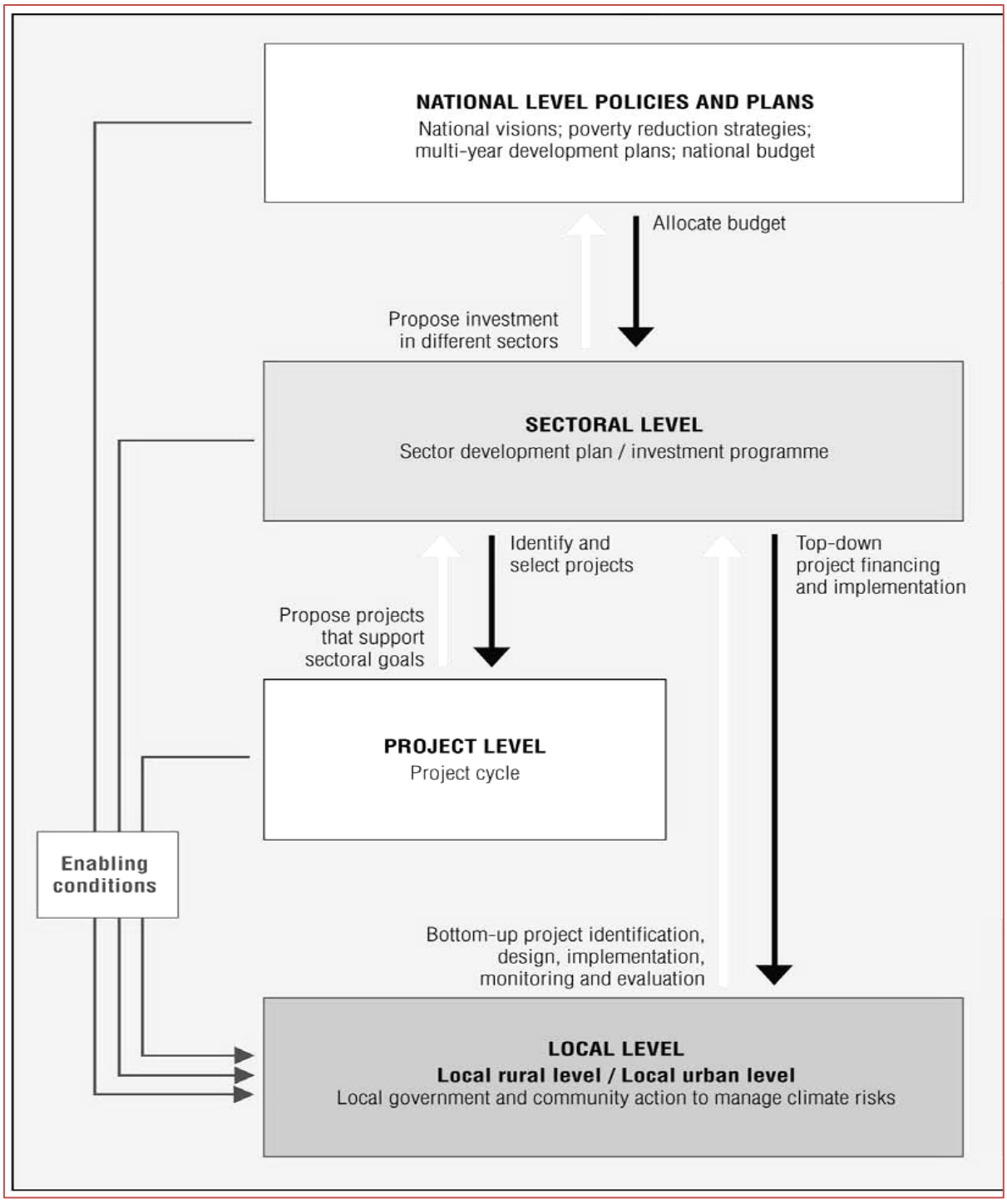


Figure 7: Linking Levels for CC Mainstreaming

Opportunities for CCMA mainstreaming within the agriculture sector policy formulation and implementation process exist in a number of levels:

1) **The Policy formulation and Strategic Planning Process:** the policy objectives are translated into results through subsidiary policies and the Agricultural Sector Strategic Plan. The multi-faceted nature of climate change issues and complexity of climate-sensitive agricultural sector problems, necessitates the policy processes being participatory and consultative. MINAGRI needs to consider climate change threats and link-up with leading climate change management institutions (notably those with policy responsibility for food standards, water, environment, housing), in the initiation and formulation of Agricultural Sector Policies.

2) **Policy Implementation:** the agricultural policy implementation entails a number of strategic actions which present opportunities to mainstream CCMA at all levels:

   ***i) Budgeting, resource mobilization and public expenditure allocation*:** Climate-sensitive agricultural activities are more likely to cause emergencies have low chances of being allocated budgets in an environment of budget constraints. It is therefore, important to integrate climate change response among the criteria for resource allocation; flag climate change threats in resource mobilization, and demonstrate the need for adequate financing for CCMA mainstreaming in the agricultural sector.

   ***ii) Implementation plans, activities and personnel*:** Action plans must be linked to seasons and weather vagaries. It is important to ensure that the peripheral level of the agricultural service delivery system, responsible for policy implementation under decentralization, not only gets an adequate budget, but also skilled personnel to collect data, predict and integrate CC into planning and activity implementation. Agricultural related emergencies are likely to rise as climate change intensifies, thus disaster preparedness will be necessary to reduce the negative impacts, and enhance ability to realise sectoral targets. Ensure that all relevant staff are trained and sufficiently equipped to detect and address climate-related issues.

iii) Monitoring process: the M&E system – particularly the targets, monitoring and reporting schedules and data collection systems, must include key climate change information and its links to agricultural outputs and outcomes. The Agricultural sector M&E system must therefore make use of climate data and develop an analytical framework. All reporting centres need to be prepared for data analysis and report sharing in addressing climate change issues. This requires investment in data and research (a key Policy objective), and partnership with other climate-related institutions. Use of platforms like Joint Sector Reviews (JSRs) and *Imihigo* presentations would enhance climate change information sharing and efficiency across sectors.

Issues, opportunities and actions for Climate Change Mainstreaming in the Agriculture Policy Process are presented in Table 10.

Table 10: Matrix of Issues and Opportunities for CCMA in the Agriculture Policy Process

	Policy Objective/ aspect	Key elements	Opportunities & Actions for CCMA Mainstreaming
1	Human Resources	Increasing numbers & skills of agricultural professionals	Sensitise and train all agriculture Professionals & practitioners in Climate change issues and how to mainstream CCMA; provide climate change information to agriculture professionals. Integrate climate change issues in the agricultural and extension education & training;
2	Improved crop's seeds and planting materials	-improve the availability, affordability and access to quality seed; -ensure seed and other inputs inputs/ consumables are available, accessible, affordable and used sensibly; -to encourage the rational and sensible use of agro-chemicals, implement a system of quality assurance and ensure that new technologies, preliminary registration procedures, and monitor the private agro-inputs sector.	Ensure that seed and agro-inputs are protected from climate-related losses. Strengthen climate change awareness of agro-input dealers and agro-chemical inspection and monitoring teams so that they can detect and deal with the effects of weather change; Reinforce the contents, packaging, storage and transportation and handling of agro-inputs to minimize weather variability and climate change effects;
3	Expand geographical coverage for agro-inputs services	-Expand infrastructure & providing adequate storage facilities for agro-inputs and technical personnel services.	Redesigning infrastructure to include changing climate conditions; ensure that all facilities (e.g. laboratories are climate-proofed and climate factors are incorporated in procurement specifications; Integrate Vulnerability maps into the spatial information guides for agricultural services planning, so that areas with higher vulnerability indices get priority.
4	Financial accessibility to agricultural services	Extending loans/insurance coverage to the poor and vulnerable groups;	Include climate-sensitive agriculture production and agro-processing challenges in financing criteria; provide an emergency fund to deal with climate-related agricultural losses to increase access to the most affected; -Provide for financing gaps arising from climate vulnerability e.g. disasters.
5	Improve the quality and demand for agricultural services	Mobilize communities to use quality agro-inputs and services; Improve the quality and distribution agro-inputs.	Include climate information in the training & communication kits; include climate change issues in procurement & supplies; ensure that each agro-chemical dealers have necessary emergency health kit & climate change vulnerability information/maps.
6	Strengthen national research institutions	-technical & logistical capacity of the National Research institutions to undertake research and development of technologies adapted to changing climate; and training of professionals.	Integrate climate-response issues into the research, infrastructure and capacity development for climate-related research; Increase climate related impact surveillance in vulnerable areas/communities.
7	Strengthen institutional capacity for service delivery	Skilled staff & robust institutional systems; Coordination & partnerships through SWAp that facilitate integration &	Include REMA among participating partners; integrate CCMA targets in each programme; Ensure that sector planning processes use information from other sectors, including natural resources and

	Policy Objective/ aspect	Key elements	Opportunities & Actions for CCMA Mainstreaming
		cross-sectoral planning; financing	infrastructure.

3.4 Key Areas for Climate Change Adaptation in the agricultural sector

A number of climate-sensitive issues must be considered in agricultural sector adaptation:

1. *Crop and livestock production technologies*: It is important to note that the majority of the recommended practices for increased productivity leads to GHG emission and environmental pollution further aggravating the climate change effects. Appropriate mitigation measures need to be implemented alongside adaptation practices to minimize the negative effects.

2. Infrastructure design and facilities for irrigation and storage of agro-inputs: These should be adjusted for climate variability, to enable them cope with extreme weather events. Scenario analysis for appropriate infrastructure designs for research and storage of agro-inputs needs to be done based on local climatic conditions. Simple weather factors like airflow, natural light, humidity and heat retention have to be considered.

3. Energy: energy use in the agricultural sector with focus on increased mechanization and agro-processing, energy will highly contribute to GHG emissions. Climate change will also affect power reliability, which is critical for production, processing and research in the agricultural sector. Alternative energy sources may be considered to reduce GHG emission.

4. Water use efficiency and management: At community level, water use and conservation is become key to improved agricultural production, especially those related to hillside irrigation, dryland irrigation and mashland development to minimize the negative effects in use of these fragile areas.

5. Agro-wastes and manure management: management of liquid waste and solid waste materials resulting from agricultural activities is key in reducing their contribution to GHG emissions and pollution affects. Processes that minimize GHG emissions should be considered.

6. Skills and knowledge of agricultural workers, especially extensionists: Their skills and knowledge hould be developed through awareness raising, training and provision of climate information and knowledge management tools. Developing appropriate capacity across the agricultural system will help identify climate-related risks, and ensure timely mitigation and adaptation responses.

The main issues, climate risks and typical adaptation measures are summarized in table 11.

Table 11: Some Adaptation Measures to Climate risks in the Agricultural Policy Implementation

Agricultural Component	Associated climate risk / threats	Adaptation Measures
Institutions (including legislative & policy instruments)	Institutional systems, plans and tools not responsive to extreme climate conditions; inadequate measures to respond to climate change effects.	• Legislate for all mitigation measures in all sectors; • Integrate climate related disaster preparedness in all sectoral policies, strategies & budgets related to agriculture.
Infrastructure & facilities	Agricultural facilities and support infrastructure e.g. road network are likely to be affected by extreme weather conditions, thereby limiting effective sector performance.	• Make agricultural facilities and supportive infrastructure designs climate-sensitive; • Ensure adequate mechanisms to prevent effects of winds, floods, storms; • Install water harvesting facilities.
Transport & communication	• Road networks especially in rural areas may constrain agricultural sector	• Establish alternative routes and telecommunication facilities;

Agricultural Component	Associated climate risk / threats	Adaptation Measures
	performance; • Telecommunication systems may affect access to input and produce market information affecting both production and commodity marketing.	• Localize and strengthen agricultural information knowledge systems at peripheral level, e.g. use of mobile phones to access input and market information.
Energy	Energy efficiency; resilient to power failures; alternative and cleaner power sources.	• Power systems must promote efficiency; alternative energy systems –green & cleaner energy sources should be considered to support growth in the agricultural sector. • Install solar equipment & energy saving systems to maintain steady power supply.
Equipment & materials	Performance failure due to climate insensitivity; Shelf-life of agricultural inputs and performance of equipment may be affected by change in weather conditions; agrochemicals may expire beforehand.	• Climate-sensitive equipment should be considered; • Procurement guidelines should include climate-sensitive specifications
Knowledge & skills	Agricultural staff and communities have inadequate knowledge about effects of climate change on agricultural production system and adequate emergency responses.	• Emphasis on climate-sensitive agricultural research; • Regular, on-the-job training and continuous learning mechanisms ; • Efficient agricultural information system; • Establish knowledge & Resource centres at district level to enhance readiness to climate change.
Budgets	Likely budget overshoots to cater for unanticipated emergencies;	• Include climate-risks in agricultural sector plans; • Train staff & managers to mainstream climate-change into budgets
	Budget cuts arising from poor economic performance	• Improve efficiency in budget execution

4.0 GUIDELINES AND TOOLS FOR CLIMATE CHANGE MAINSTREAMING IN THE AGRICULTURAL SECTOR

4.1 Actions to Mainstream Climate Change Adaptation in Agricultural Sector

A package of at least 6 actions is required to mainstream climate change adaptation and mitigation in the agricultural sector:

1) Comprehensive assessments of the risks posed by climate change on agriculture systems and the economy;
2) Integrated agricultural environment surveillance;
3) Delivery of interventions for the effective management of climate-sensitive agricultural sector concerns;
4) Preparedness for, and response to, the consequences of extreme weather events;
5) Agricultural and climatology Research;
6) Strengthening of human and institutional capacities and inter-sectoral coordination.

The main requirements for CCMA mainstreaming are three-fold:

1) **Tools and techniques** to assist in analysis and simplifying the linkages the linkages between climate change and agricultural sector outcomes; to predict and respond to climate change risks and potential vulnerabilities of the population; undertake scenario building for adaptation options under different conditions; communicate and monitor CCMA processes to decision makers and stakeholders.
2) **Competent human resources and institutional systems**: CCMA in health will require considerable skills, knowledge and systems not currently in place. The systems will include platforms for translating climate change research into knowledge; facilitate inter-disciplinary dialogue and information dissemination.
3) **Budgets**: While the most appropriate and realistic way to budget for climate change response is to integrate CCMA activities and plans within the normal budgeting process, it is obvious that most climate change responses will relate to emergencies, preparedness, and capacity building, research and information management.

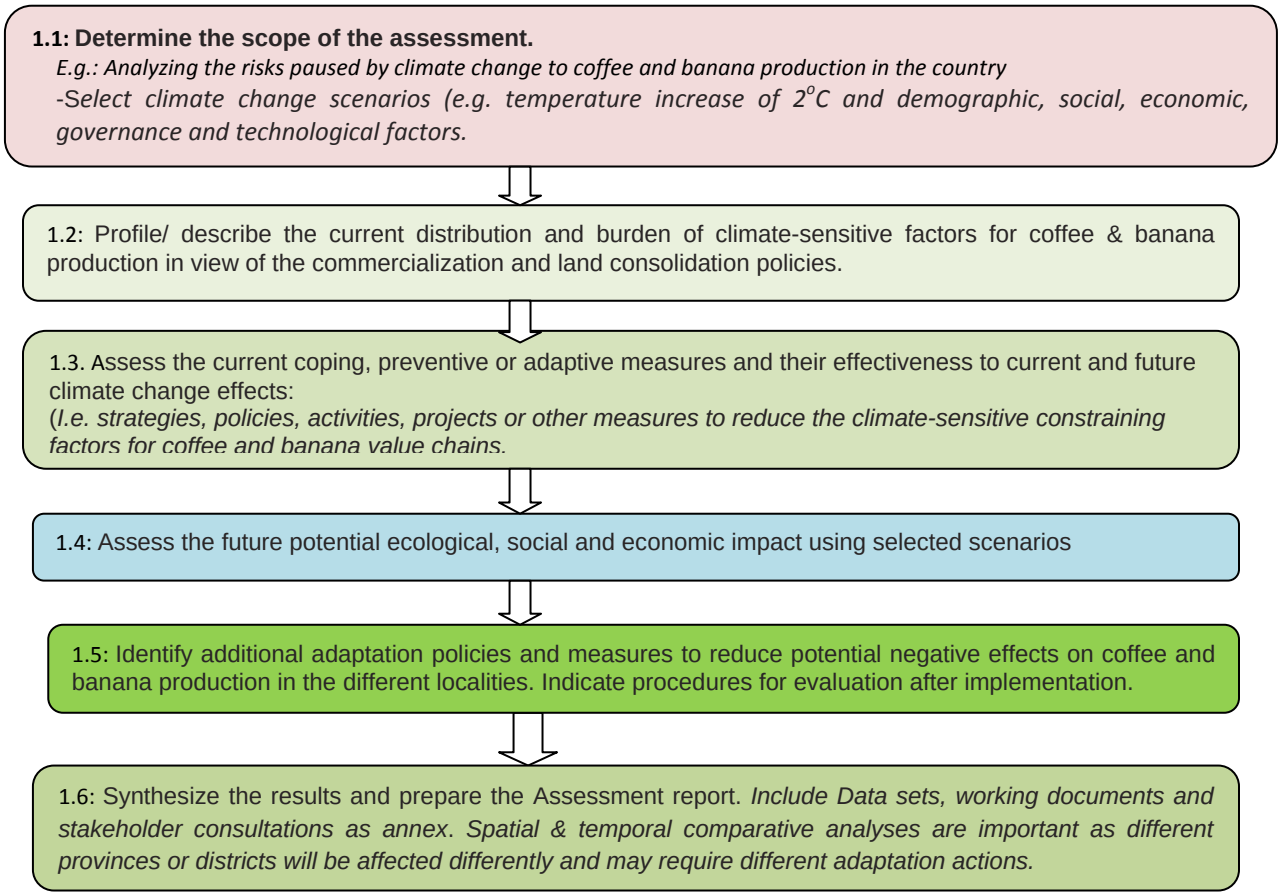
4.2 Basic Steps and tools for CCMA Mainstreaming in the Agricultural sector

The basic steps and supportive tools for CCMA mainstreaming in the agricultural sector, are presented here-below.

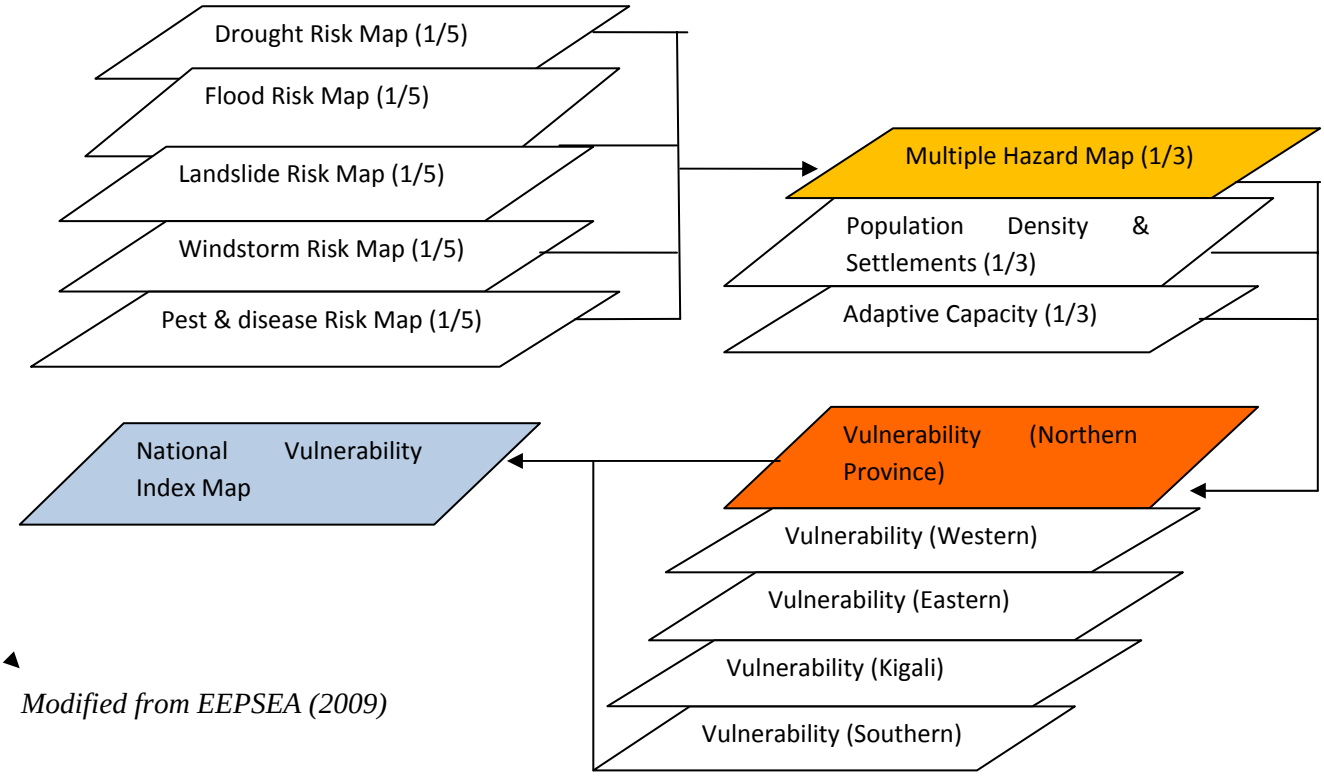
Step 1: Conduct Climate Change Impact and Vulnerability Assessment

Impact and Vulnerability Assessment should be undertaken to determine the extent to which the population in different geographical locations and social strata, as well as the different agro-ecosystems and different components and aspects of the agricultural value chains that exposed to extreme climate variability; are susceptible to the effects of extreme weather events; identify existing responses and determine their effectiveness. The assessment will help to understand who is at risk (e.g. smallholder farmers, commercial farmers, agro-dealers, agro-processors, consumers) where and how to respond appropriately and cost-effectively. It will help identify capacity needs; establish baseline climate conditions, potential barriers to adaptation, and opportunities, and the basis of which to set priorities for climate change adaptation and mitigation in the agricultural sector. The key steps are summarized in figure 8.

Figure 8: Basic steps in Climate Change Vulnerability Assessment in the agricultural sector.



A Vulnerability Index Map is the main output of this assessment. Figure 4 illustrates how a climate change vulnerability index map is developed.



Modified from EEPSEA (2009)

Figure 8: Developing a Climate Change Risk and Vulnerability Index for the agricultural sector

Impact and Vulnerability Assessment should be undertaken to determine the susceptibility of different areas, agro-ecosystems and value chains, identify existing responses and determine their effectiveness. The assessment will identify capacity needs; establish baseline climate conditions, potential barriers to adaptation, and opportunities and priorities for adaptation.

Climate change vulnerability assessment should focus on 4 dimensions:

- **Physical vulnerability** to and influence on weather patterns;
- **Social vulnerability and community resilience**: certain socioeconomic or socio-demographic groups (pastoral communities, fishing communities, urban poor, populations living in steep hill slopes, landless people, smallholder producers, elderly and young farmers) may be at higher risks, and so special attention should be paid to them;
- **Governance** – institutional and policy framework for agricultural value chain development. Aspects of research and response to disasters such as outbreak of pests and diseases; or ability to destroy herds of sick livestock and compensate farmers, are part of the governance capacity;
- **Economic vulnerability** – mostly the costs related to agricultural losses (e.g. as a result of drought, floods, pest or viral attack, etc) and their implications to household, community, regional or national economy. Most of Rwanda's macroeconomic factors e.g. inflation are closely linked to food security and agricultural production.

A fundamental first task in the climate change impact and vulnerability assessment is to establish a clear understanding of the links between climate change and agriculture.

5.0 TOOLS FOR MAINSTREAMING CLIMATE CHANGE ADAPTATION

5.1 Mainstreaming CCMA at the Local level

Community level mainstreaming is the most important level where agricultural sector actors meet with climate change effects. The effects of climate change on agriculture are demonstrated in its impact on agricultural production and allied sectors, community social wellbeing and effects on the physical facilities and infrastructure.

5.2 The Mainstreaming Cycle

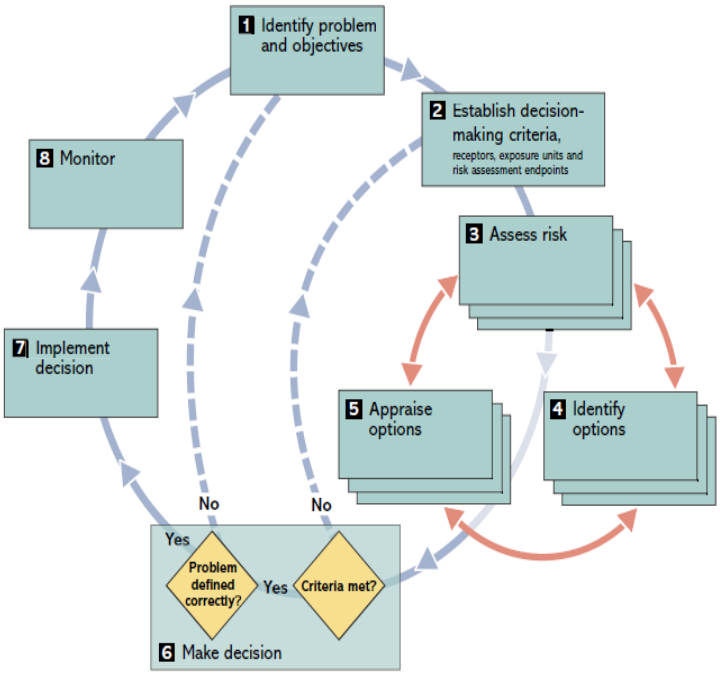


Figure 9: A Framework to Support Good Decision Making in The Face of Climate Change Risk

For each of the first six stages, key structuring questions are provided along with guidance to key tools and techniques to support analysis and decision making at the individual stage.

Simple tools for data collection for climate vulnerability assessment and adaptation at local level are summarized in tables 12A and B below.

Table 12 A: Basic Steps in Local climate screening

	Basic step/ Broad action	Imihigo priorities	Key climate-change issues	
1	Climate Risk screening			
2	Identification & Analysis of Adaptation and Response measures			
3	Verification, Analysis and Selection of Appropriate Response options			
4	Implementation of Adoption measures			
5	Review / Performance evaluation			

Table 12 B: Climate Vulnerability Assessment

Area:……		**Sector ……**						**District ……..…..**		
	Incidences of Extreme climate-agriculture Events	**Likelihood of occurance during the period (year)**			**Frequency of occurance**			**Impact on production**		
		H	**M**	**L**	**H**	**M**	**L**	**H**	**M**	**L**
1	Drought									
2	Floods									
3	Pests and disease outbreak (for crops & trees)									
4	Livestock disease outbreaks									
5	High temperatures									
6	Famine frequency									

5.3 Step by Step Tools for Mainstreaming Climate Change Adaptation: With Examples and Case Studies

STEP 1: Assess project activities for climate risk

TOOL A: ASSESSING THE CLIMATE RISK

Step 1 involves a preliminary screening of a current or proposed project to determine if it might be affected by climate variability or change. The screening of climate impacts determines how climate relates to the proposed program or project. This involves asking three questions:

1. Does my project take place in a climate sensitive location?
2. Are the target groups for the project particularly vulnerable to climate change?
3. Are the project activities vulnerable to climate change?

Does my project take place in a climate-sensitive location?

There are a number of different sources of information to determine if your project takes place in a sensitive location. REMA provides a detailed analysis of climate change predictions and impacts for the different regions of Rwanda and this handbook also provides general information on the potential impacts of climate change. You can look at one or a combination of these to make a decision for your particular project.

Are the target groups for the project particularly vulnerable to climate change?

Vulnerability to climate change varies within countries, communities and even households. Understanding who is vulnerable and why requires detailed analysis of the biophysical, socio-economic and political dimensions of vulnerability. However as this is a preliminary screening there are certain groups that can be identified as most likely to be particularly vulnerable. These include:

- people dependent on agriculture (particularly rain-fed agriculture) for their livelihoods
- women and other marginalized groups
- pastoralists
- landless people

Are the project activities sensitive to climate change?

Ideally this step would involve an extensive review of the climate context including recent climate trends, and climate change scenarios, preferably analysed at the same geographic scale as the proposed project. In reality the time and resources available are limited and climate data for Rwanda is available at national and regional scales. Therefore programme/projects must rely on available information and use general principles in making a determination on whether a project is climate sensitive.

Two useful principles are:

Principle 1: If a project is sensitive to climate variability then it is likely to be sensitive to climate change.

Some development sectors are more sensitive to climate variability than others. Projects in the following areas may be particularly sensitive: agriculture, water resources, natural resources management (forestry, fisheries, landuse management), construction, health, energy, and coastal management.

Principle 2: Long-term climate changes can introduce other risks to projects

Climate change involves not only changes in extreme weather and patterns of wet and dry, hot and cool periods, but also changes to average climate. That means that systems and activities that are adapted to an average climate can be affected. Crops are grown in particular locations because the range of temperatures and precipitation is right for those crops. Natural vegetation, such as forests or grasslands, exists in certain locations because the climate is favourable for particular species. Coastal development is close to high tide because land above high tide is dry, yet close enough to the ocean to allow access. Climate change is altering average climate conditions and sea levels, meaning that certain activities may have to be moved to other locations or modified in other ways.

TOOL A: ASSESSING CLIMATE RISK EXAMPLE

TIME:	**2 hours**
PURPOSE:	Using a summary of climate trends, forecasts and impacts undertake
PARTICIPANTS:	Programme and component managers and project officers.
MATERIALS:	• flip chart and markers or computer and projector • project log frame and workplans • climate change predictions for Rwanda • table template: Impact of Climate Change on Project Activities
PROCESS	**STEP 1:** • The identification of potential impacts and adaptation measures will be most effective if participants have a clear understanding of climate change concepts. • This guidebook provides information on the expected impacts for agricultural sector. If available, facilitators may present additional information specific to the targeted areas of the project. • Characterize current climate variability including short-term events (extreme weather events) and long-term events (trends in seasonal and annual variations) in the geographical area. Sources may include historical weather records (if available), stakeholder input, and climate change projections. **STEP 2:** For the relevant project or program activities, determine which activities are likely to be impacted by the various types of short- or long-term climate variability events. It is important to remember that work plans are generally quite detailed and describe everyday management processes which will not be affected by climate change or disasters. It is therefore useful to group activities into a few general categories (such as problem analysis, planning, training, raising awareness, or implementing natural resource management measures) and focus on those key activities or outputs that are climate-sensitive. **STEP 3:** Identify any potential maladaptations (project designs that create or exacerbate a problem) in the current and planned projects that increase exposure to climate related hazards. **STEP 4:** For each category or activity, discuss how climate change should be taken into account. The following sample questions can be asked:
	Project implementation period (disasters) • How would a flood/drought/storm affect the project implementation (e.g. transportation, timing of activities)? • Which materials would best withstand a flood/drought/storm? • Project results (climate change) • Which expected impacts of climate change should we include in our analysis? • Will livelihood resources become more or less plentiful in the future? • Which resources are more vulnerable? • How will increased temperatures or intense rainfall affect land use? • If temperatures rise or seasons change, which crop varieties are most appropriate for which area?

Complete the table below as the discussion progresses.

	Activity	**Impact of climate change**
Example: Output 1: Community analysis and vision building *(awareness raised on livelihood strategies and natural resource management activities, and community goals identified)*		
	Design process and facilitate participatory mapping of current land use and land allocations	Implementation progress affected by flood, storm, typhoon. Climate change may lead to decreases in water runoff and agricultural patterns.
Output 2:		
KEY OUTCOMES:	A clear outline of the main climate change impacts that will affect project activities and results.	

CASE STUDY ONE: SCREENING FOR CLIMATE RISK

The case study below shows an excerpt from discussions regarding the Participatory Watershed Management (PWM).

Activity	Impact of climate change
Output 1: Community analysis and vision building ***(awareness raised on livelihood strategies and natural resource management activities, and community goals identified)***	
Design process and facilitate participatory mapping of current land use and land allocations	Implementation progress affected by flood, storm, land degradation. Climate change may lead to decreases in water run-off and agricultural patterns.
Conduct a detailed participatory mapping of current livelihood strategies, natural resources management practices and their constraints and measures using for example seasonal calendars, ranking, history lines etc. in selected villages	Implementation progress affected by flood, storm. Climate change may affect resources available for livelihood strategies and natural resource management practices.
Output 4: Community watershed protection ***(watershed management and protection plans agreed and implemented in each community)***	
Facilitate farmer implementation of sustainable agro-forestry practices	Establishment and implementation models affected by drought, flood, temperature and rainfall. Crop varieties, livestock, seasonal calendar, and locations may be affected by increased temperature and rainfall changes.
Explore options for eco-tourism, design, and test in one commune	Eco-tourism attractions may be affected by climate change.

Step 2: Decide whether to follow the CVA Pathway

TOOL B: CHECKLIST: SHOULD WE FOLLOW THE CVA PATHWAY?

If Step 1 indicates that climate impacts are likely to affect your project, you now need to decide whether to continue on the CVA pathway taking into account any existing risk management practices, human and financial resources, donor conditions and the local and national context for adaptation.

TOOL B CHECKLIST: SHOULD WE FOLLOW THE CVA PATHWAY?

TIME:	**2 Hours**
PURPOSE:	If Step 1 of the CVA Pathway indicates that climate impacts are likely to affect your project, you now need to decide whether to commit to additional steps. This tool will assist you to create a list of projects for which you will complete the remaining steps of the CVA Pathway.
PARTICIPANTS:	Programme and component managers and project officers.
MATERIALS:	• Large sheets of paper and markers or a computer and projector • Project work plan • Results from Step 1 • Checklist: Should we follow the CVA Pathway?
PROCESS	The decision should consider any existing risk management practices, human and financial resources and the local and national context for adaptation. The factors you might consider in making this decision are outlined below in a checklist, and divided into three groups of questions: • Project Characteristics • Planning for Adaptation • Context for Adaptation These questions can be answered as either Yes or No. The table template below makes suggestions for priority areas but ultimately the weighting given to questions and answers will need to be decided by program and component managers and project officers. However in general a high number of yes answers particularly in the critical questions area indicates you should complete the remaining steps of the CVA Pathway.

CASE STUDY TWO: Following the CVA Pathway

The case study below links to the previous PWM case study which indicated that the program was likely to be significantly impacted by climate change. Using the checklist above component managers and project officers concluded that the program should follow the CVA pathway to ensure development gains are sustainable.

	Priority One		**Priority Two**		**Priority Three**	
	Project Characteristics	*Y/N*	*Context for Adaptation*	*Y/N*	*Planning for Adaptation*	*Y/N*
CRITICAL FACTORS	What is the length of the project? Is it long-term (one year or more?)	Y	Is there support for adaptation design and implementation among decision makers and beneficiaries?	Y	Is there experience with adaptations in the region or province?	Y
	Will the project perform poorly under current and predicted climate change scenarios?	Y	Are the human and financial resources available to implement potential adaptation measures?	N	Have any preliminary adaptation policies and strategies been identified in Vietnam?	Y
	There may be existing risk management measures in the project design. Are there any unmanaged risks posed by climate change?	Y	Does the project have the technical expertise required to implement potential adaptation measures?	N	Are the human and financial resources available to conduct climate vulnerability and capacity assessments?	Y
	Is there donor flexibility to modify the project for adaptation?	Y	Are experienced consultants available to assist the project?	Y	Are there any cost analyses available for potential adaptation measures?	N
Other factors	Consider the proposed or current budget of the project. Is adaptation feasible in terms of project finances?	N	Can any legal, political, institutional, or financial barriers to adaptation able to be overcome through reasonable means?	Y		

Adapted from USAID, 2007. *Adapting to Climate Variability and Change: A Guidance Manual for Development Planning*, USAID, Washington.

Step 3: Identify Adaptation Measures

TOOLS:

• Tool C: Climate Vulnerability and Capacity Analysis (CVCA) Handbook.
• Tool D: Resource table on best-practice community-based adaptation experiences.

Step 3 is to identify adaptation measures for modifying the project in response to the vulnerabilities identified in Step 1. Once you have decided to continue on the CVA Pathway it is expected that you will work closely with implementing partners, local authorities and stakeholders, to identify a wide range of potential adaptation measures to reduce the climate risks facing a project and target communities and for ensuring the project increases or at least does not decrease, community adaptive capacity and resilience. This will involve information reviews and using participatory tools. The process for identifying adaptation measures might proceed as follows:

Information Reviews

1. Review information on climate impacts and vulnerabilities identified in Step 1
2. Review similar previous and current programs and projects conducted by other players e.g. NGOs, donors, multi-lateral and bi-lateral agencies to determine if adaptation measures were identified and whether implementation was successful.
3. Review national policies that are relevant to community-based adaptation

Participatory Tools

4. Within the project area assess community vulnerability to climate change and identify community capacity to adapt,
5. Climate Vulnerability and Capacity Analysis (CVCA) methodology. The CVCA can also be used to gather information as it includes methods and guidance for secondary research including policy analysis, and institutional mapping.

The CVCA methodology assists component managers and officers to analyse the implications of climate change for the lives and livelihoods of project beneficiaries.
The main objectives of the CVCA are:

- analyse vulnerability to climate change and adaptive capacity at the community level
- link community knowledge to scientific data on climate change to build an understanding of climate change impacts at the local-level
- identify practical adaptation measures to facilitate community-based adaptation to climate change

The CVCA applies a climate change perspective to livelihoods analysis and incorporates an analysis of the underlying causes of vulnerability (remembering that climate change adaptation cannot be separated from poverty reduction and sustainable development goals). Such an approach not only focuses on technological measures to address climate change but also on existing adaptive capacity and the underlying causes of vulnerability. The CVCA can be used to mainstream climate change adaptation across all relevant program sectors to ensure they are contributing to adaptive capacity.

TOOL C: THE CLIMATE VULNERABILITY AND CAPACITY ANALYSIS (CVCA) HANDBOOK

CARE's Climate Vulnerability and Capacity Analysis (CVCA) methodology helps to understand the implications of climate change for the lives and livelihoods of the people we serve. By combining local knowledge with scientific climate information, the process builds people's understanding about climate risks and adaptation strategies. It provides a framework for dialogue within communities, as well as between communities and other stakeholders.

The results provide a solid foundation for the identification of practical strategies to facilitate community-based adaptation to climate change. The CVCA methodology can also be used to gather and analyse information essential to integrating climate change into livelihoods and natural resource management programs. It can also provide practical evidence for advocating pro-poor climate change policies. The CVCA Handbook provides an overview of the methodology, as well as practical guidance for using it in the design and implementation of adaptation actions.

The CVCA handbook can be downloaded at the following website: www.careclimatechange.org

TOOL D: RESOURCE TABLE ON BEST-PRACTICE COMMUNITY BASED ADAPTATION EXPERIENCES

The table below outlines some examples of best-practice community-based adaptation measures. However it should be noted that whilst adaptation measures are not unique e.g. diversifying livelihoods and sources of income, improving traditional irrigation techniques, they are context-specific. The adaptation measures implemented will depend on the specific climate change impacts experienced and the vulnerability, resilience and capacity of the affected community to cope with those impacts. It is also important to remember that communities vulnerable to climate change are diverse not homogenous – different groups such as men and women, the elderly and people with disabilities will experience climate change differently. Adaptation measures appropriate for one vulnerable group may not be appropriate for others. An illustration of climate change adaptation options and corresponding impacts are summarized in table 13.

Table 13: Proposed Adaptation Options for the Agricultural Sector

Impacts	Adaptation Measures
• An estimated 80% of the population depends directly on agriculture, which also relies on natural resources, which makes them vulnerable to climate change. • Large areas of the country may suffer from drought, floods and agriculture crops will be heavily lost.	• Diversify income generation sources • Implement sustainable resource management • Build resilient infrastructure **Land use** • Diversified land use systems, including agro-forestry, dry land farming and vegetable production would be promoted to reduce risk and increase the capacity of farmers to cope with droughts; • Mixed farming (crop + livestock) would be promoted as a drought coping strategy and for income generation; • Regeneration forestry would be promoted to rehabilitate degraded forest sites • Alternative livelihood systems are proposed to reduce pressure on the land

	• Rangeland management to sustain fodder production would be promoted **Livelihood strategies** • Support and protect livelihoods, and livelihood diversification (carpentry, petty shops, handicraft, etc.), so that people have a safety net to rely on during all stages of drought • Establish/strengthen micro-credit system **Crop husbandry** • Enhancing erosion control • Improve and changing management practices and techniques such as planting date, seedling rate, fertilizer application rate, etc • Engagement in obtaining food from other sources and income generating activities in times of crises • Proper use of climate information for land use planning and early warning systems, etc • Grow crops which requires less water • Conservation of water and use of river basin planning and coordination • Flood control • Combating drought • Capacity building and institutional strengthening of the local community • Community empowerment for improved agricultural production and natural resources conservation • Developing drought resistant crop varieties • Provision of know- how on dry season cropping techniques • Ensuring appropriate crop seeds in place before rains • Develop village seed bank with seeds of traditional and improved drought resistant crops/varieties • Impart training on economic water use • Subsidize/facilitate supply of seeds/irrigation equipment • Establish farmer field schools and mobile libraries • Meteorological forecasts and corresponding cultivation advise • Improved soil moisture management • Reduce run-off and increase rain water infiltration by planting barriers such as lemon grass, Agave, etc. • Increase fertility and water holding capacity of the soil through organic farming practices • Promote proper land use planning as per the land capability classification • Promote the mulching practices so that the limited available soil moisture is saved during critical stages of the crop growth. **Animal husbandry** • Store crop residues in barns for use during scarcity • Grow seasonal grasses/perennial fodder trees in community forest, fallow lands, and permanent pastures • Recommend farmers to avoid burning of crop residues in the field and use them as animal feed by treating them • Establish fodder bank at community/household level • Improve the quality and productivity of the existing livestock population either through artificial insemination or other breeding practices or replacing them with exotic breeds • Preserve endangered productive and drought resistant local animal breeds • Promote rearing goat, sheep and dry ducks in areas of feed and water scarcity • Construct rainwater harvesting structures (mini-ponds, tanks)

CASE STUDY THREE: Identifying adaptation measures

The case study below links to the previous case study which indicated that the program was likely to be significantly impacted by climate change. Using the checklist above component managers and project officers concluded that the program should follow the CVA pathway to ensure development gains are sustainable.

Activity	Impact of climate change	Potential adaptation option
Output 1: Community analysis and vision building ***(awareness raised on livelihood strategies and natural resource management activities, and community goals identified)***		
Design process and facilitate participatory mapping of current land use and land allocations	Implementation progress affected by flood, storm. Climate change may lead to decreases in water run-off and agricultural patterns.	Incorporate climate change and disaster information into planning. Determine how land use patterns may change after a disaster and with future climate change.
Conduct a detailed participatory mapping of current livelihood strategies, natural resources management practices and their constraints and options using for example seasonal calendars, ranking, history lines etc. in selected villages	Implementation progress affected by flood, storm, typhoon. Climate change may affect resources available for livelihood strategies and natural resource management practices.	Take climate change information into consideration during planning. Identify more than one suitable time period for implementation of these tasks (e.g. shifting between field work and office work or vice versa depending on disaster risk). Determine how livelihood strategies may change and rank livelihood strategies for climate-resilience over next decades.
Output 4: Community watershed protection ***(watershed management and protection plans agreed and implemented in each community)***		
Support community tree planting and forest enrichment planting for water source, river bank and steep slope protection using economic trees	Transportation and quality of seedlings may be affected by flood, drought, rainfall and temperature.	Use of local service providers Use of indigenous species. Use tree species that will be least affected by climate change, and plant them in areas to minimize impacts from disasters and climate change.
Explore options for eco-tourism, design, and test in one commune	Eco-tourism attractions may be affected by climate change.	Feasibility assessment of these options should include disasters and climate change. Identify measures for continuing the eco-tourism service in case of a disaster, and identify attractions that will be resilient to climate change.

Step 4: Prioritise Adaptation Measures

TOOL E: PRIORITY ADAPTATION MATRIX.

The purpose of Step 4 is to assist programme and component managers and project officers to prioritise each of the adaptation measures identified during Step 3. Measures should be evaluated in terms of their effectiveness at building resilience to the climate risks identified in Step 1 and their feasibility in terms of project budget, timeframes and the technical requirements for implementation. Step 4 will assist project managers and officers to answer two questions:

1. How do I prioritise adaptation measures?
2. Should you undertake the adaptation measures identified?

The process involves choosing a range of criteria on which to prioritise the range of potential adaptation measures. Whilst this step is not intended as a clear-cut means for determining priorities the final outcome should be a ranked list of adaptation measures. This process is intended to stimulate discussion over the identified measures and also any additional activities for integration into project or programme objectives, and how to integrate implementation into the project cycle.

TOOL E: PRIORITY ADAPTATION MATRIX

TIME:	**3 – 4 hours**
PURPOSE:	Once a wide range of adaptation measures have been identified you will need to evaluate the benefits and feasibility of implementing the various options and priorities which measures to implement. Using the Priority Adaptation Matrix below will help you answer two questions: 1. How do I prioritise adaptation measures? 2. Should the project undertake the adaptation measures identified?
PARTICIPANTS:	Programme and component managers, project officers and partner organisations.
MATERIALS:	• Flipchart and markers or a computer and projector • Project work plan • Tool D Resource Table on Best-Practice Community-based Adaptation Experiences • List of potential adaptation measures
PROCESS:	**STEP 1**: Identify the criteria relevant for your analysis from the list below. Criteria chosen should evaluate the economic, social and technical feasibility of the adaptation measures. The list is intended as a guide only and criteria are not arranged in any order or particular importance. Consultation with stakeholders and decision-makers may identify additional factors to be considered.

CRITERIA TO PRIORITISE THE BENEFIT AND FEASIBILITY OF ADAPTATION MEASURES

- **Cost**: cost to implement adaptation measures; cost of not modifying the project
- **Effectiveness**: effectiveness of adaptation measures in reducing vulnerability to climate variability and climate change (benefits, damages mitigated, costs avoided, lives saved, etc.)
- **Ease of implementation**: includes issues such as barriers to implementation and the need to adjust other policies to accommodate the adaptation option
- **Acceptability to local stakeholders**: not all measures will be equally attractive to all stakeholders for political, economic, social, or cultural reasons
- **Acceptability to donors**: any measures that donors are unwilling to support should be identified and the reasons communicated to stakeholders
- **Endorsement by experts**: in some cases, decision-makers will partly base their selection on consistency of proposed adaptation measures with international best practices
- **Timeframe**: for implementing the adaptation measure
- **Capability:** how much additional capacity building and knowledge transfer is required for the adaptation option to be implemented
- **Adequacy for current climate**: are there negative consequences of the adaptation option in the current climate? Some adaptations may be targeted at the future climate but have costs and consequences under the current climate
- **Size of beneficiaries group**: adaptations that provide small benefits to large numbers of people will often be favoured over those that provide larger benefits, but to fewer people.

Once you have chosen your criteria list them across the top row of the matrix and list your adaptation measures down the first column. An example is provided below.

Adaptation Option	**Cost**	**Ease of Implementation**	**Effectiveness**	**Speed**	**Capability**	**Total**	**Rank**	
Option 1								
Option 2								
Option 3								

STEP 2: Agree on how to assign values to each of your criteria. For example "**high = 3**, **medium = 2**, **low = 1**". You may find that putting very different adaptation measures together in the table is like "comparing apples and oranges". That is, if adaptation measures have significantly different aims or will be implemented on different scales, it may not be easy to compare, for example, how much more cost-effective or easy to implement they will be. In this case, the level of importance assigned to each criterion will be important in ranking these measures.

STEP 3: Determine a cut-off score below which adaptation measures will not be considered. For example the matrix below uses a cut-off score of 10.

Adaptation Option	Cost	Ease of Implementation	Effectiveness	Speed	Capability	Total	Rank
Option 1	3	2	3	2	3	**13**	1st
Option 2	3	3	1	2	3	**12**	2nd
Option 3	1	3	1	1	1	**7**	n/a

STEP 4: Complete matrix to facilitate comparison and selection of adaptation measures. The output of this step should be a completed matrix with a clear priority list of adptation measures.

KEY OUTCOMES:

- List of criteria for determining benefits and feasibility of adaptation measures
- List of adaptation measures ranked in order of priority

CASE STUDY FOUR: Prioritising adaptation measures

An example of an evaluation and ranking of potential adaptation measures identified during a CVCA.

Adaptation Option	Cost	Ease of Implementation	Effectiveness	Speed	Capability	Total	Rank
Adapting existing rice production systems through the introduction of alternative saline and flood resistant varieties	3	2	2	2	2	**11**	**2nd priority**
Develop and pilot low-cost disaster-proof housing scheme	1	1	3	1	3	9	**n/a below cut off**
Diversification of local agriculture systems for example livestock raising and mushroom farming	2	3	3	2	3	**13**	**1st priority**

High = 3 Medium = 2 Low = 1 (Scores below 10 will not be considered)

Step 5: Select Adaptation Option(s) for implementation

TOOL F: STAKEHOLDER WORKSHOP METHODOLOGY

The purpose of this step is to use the results from Step 4 to select one or more adaptation measures for your project to be implemented. This step uses the results of step 4 to select one or more adaptation measures to be implemented, through consultation with project beneficiaries and other stakeholders such as partner organisations and local decision-makers. It is very important to ensure the local ownership adaptation measures as this will ultimately determine the success of implementation. The process will involve holding focus groups and village level meetings to gain consensus and gather information. Such a process is consistent with commitment to participatory and community-based programming.

TOOL F: FOCUS GROUP METHODOLOGY FOR SELECTING ADAPTATION OPTIONS

TIME:	2 – 3 Hours
PURPOSE:	This tool uses the results of CVA Pathway Step 4 to select one or more adaptation measures to be implemented, through consultation with project beneficiaries and other stakeholders such as partner organisations and local decision-makers. It is very important to ensure the local ownership of adaptation measures, as this will ultimately determine the success of implementation. The process will involve holding focus groups and village level meetings and gathering information. Focus groups are fairly small discussion groups (10-15 people) led by a facilitator. They enable us to understand and describe better the range of perspectives in a community or local organisation through small group discussions. Focus groups can be single or mixed gender. Focus groups can be useful where women do not feel comfortable speaking in large group settings or with men present. Even when women do participate in mixed gender groups, they may speak more freely in groups of only women. **Focus Group discussions will identify:** • priorities for community-based adaptation based on gender, class, ethnicity and other markers of identity • women's and men's perceptions of what effective and feasible climate change adaptation measures are for the community • the capacity and options for working with local partners and authorities **The objectives of the Focus Group are:** • to provide information on adaptation measures that is as specific as possible so as to direct the discussion towards a decision • foster interaction that explores participant's feelings and opinions in some depth
PARTICIPANTS:	Project officers, partner organisations and community members.
MATERIALS:	• Prepare the questions you want to ask ahead of time • List of priority adaptation measures • Paper; • Markers; • Dictaphone (optional)
PROCESS:	**STEP 1**: Plan and write out your questions before the meeting. To ensure a structured discussion, five questions are appropriate and you may have more detailed questions under each. **STEP 2**: depending on the number of participants, you may like to ask each individual to make a short statement about themselves. **STEP 3**: begin the structured discussion with a general question not intending to get a full answer, but to lead the direction of the conversation. **STEP 4**: end the discussion with a summary and agreement on which measures the community supports. **SAMPLE QUESTIONS FOR THE PROMOTION OF MIXED FARMING (CROP & LIVESTOCK) IN RESPONSE TO DROUGHT** • How do you think introducing livestock to your farming system would benefit you and your family? • How will having both crops and livestock make things easier when the drought comes? • How will livestock fit into your other livelihood responsibilities? • Who would be responsible for looking after the livestock? Does your family have the time or resources? • How would you like to use your livestock? For food? For money? For labour? • Do you think livestock would be good for the land? Is there enough space for crops and livestock? Is the land healthy enough for both? • Does your community support crop and livestock farming as an option?
KEY OUTCOMES:	• Community support for selected adaptation measures

Step 6: Implement Adaptation Option(s)

Once the priorities for adaptation are selected and supported by the target beneficiaries, responsibilities for the implementation of each measure or activity should be clearly assigned to partners or project officers based on the project work plan or project activity plan. Climate change adaptation may result in modification of the project or programme implementation approach but the target results will not change expect for the magnitude. Budget reallocation and adjustment in timelines approvals may be required.

Milestones and time frame are an important part of the adaptation plan and its implementation process. In mainstreaming climate change adaptation and mitigation in the agricultural sector, the following are key time-bound milestones that must be achieved. Table 14 summarized the key milestones, time frame and responsible institutions in the implementation process.

Table 14: Key Milestones and Institutional Responsibilities in Climate Change Adaptation Agricultural Sector

	Key Task/Milestone	**Time frame**	**Responsible**
1	Conduct Climate change Impact & Vulnerability Assessment for individual sub-sectors (*crop production; livestock development; horticulture; fisheries; agro-processing; etc*)	6- 9 months	MINAGRI; NAEB; NAB; REMA-Climate Change Dept;
2	Identify & Analyse Adaptation Actions	2-3 months	MINAGRI & Agencies; REMA
3	Design costed Programmes for Climate Change Adaptation		MINAGRI & Agencies; REMA
4	Design the adaptation plan and mainstreaming agenda	2-3 months	MINAGRI& Agencies; REMA
5	Mobilise funds for mainstreaming climate change adaptation and implementation of Adaptation actions	-	MINAGRI & Agencies through budget/donor projects; REMA/Climate Financing Facility
6	Raise Awareness of climate change issues within the Agriculture stakeholders and communities	12-36 months	MINAGRI & Agencies; REMA ; NGOs District Authorities;
7	Train Agricultural sector actors on climate change adaptation at all levels	15-24 months	MINAGRI & Agencies; REMA; District Authorities
8	Develop District & Community level Adaptation Plans for agriculture-climate proofing activities.	3-6 months	District Authorities/ Agriculture Officer; Environment Officer; Land Officer
9	Design pilot adaptation actions for each agricultural component and agro-ecosystem	6-9 months	MINAGRI & Agencies; REMA; District Authorities; NGOs
10	Implement the Agricultural sector climate change adaptation and mitigation plan	60 months	MINAGRI & Agencies (NAEB RAB,.)
11	Monitor the mainstreaming process for climate change adaptation in the Agricultural sector	60 months	MINAGRI & Agencies; REMA
12	Evaluate performance and Review the Adaptation and Mitigation Process (including in DDPs and *Imihigo* indicators)	3-6 months	MINAGRI & Agencies; REMA indicators; District Authorities

Format for the Climate Change Adaptation and Mitigation Plan

The adaptation and mitigation implementation plan will normally be based on the climate change impact and vulnerability assessment and the kind of options to be implemented for each sub-sector. The adaptation and mitigation plan will typically have the contents:

Executive Summary

1. Background
   a. *Potential effects of climate change on Rwanda (by province, district/ localities) generally; Potential effect on the Agricultural sector (Draw from the Climate Change Impact & Vulnerability Assessment)*
   b. *Purpose of the Climate Change Adaptation implementation plan*
   c. *How the plan has been developed (include stakeholder consultations and scientific analyses);*
2. Scope and coverage of the plan and implementation process
   a. *What is covered by the implementation plan?*
   b. *Issues for implementation*
   c. *Time frame for major actions and activities*
3. Priority Activities and Actions
   a. *Activities and actions are needed to implement the adaptation and mitigation plan*
   b. *Key barriers to implementation*
   c. *How will the mitigation and adaptation principles be implemented*
4. Stakeholder Roles and Responsibilities and Coordination mechanisms
   a. *Which institutions/agencies/ organizations will do which actions*
   b. *Linkages, Arrangements/ procedures for coordination and support*
5. Resource Requirements and Resource Mobilization Strategies
   a. *Human and technical resources*
   b. *Financing*
   c. *Resource mobilization and capacity building*
6. Monitoring
   a. *Key indicators and framework for monitoring*
   b. *Integration with poverty reduction monitoring*
7. Annexes
   a. *Resource toolkits (Existing guidance documents and other materials)*
   b. *Detailed log-frame*
   c. *Glossary of key terms/ Abbreviations*

It is advised that each component or sub-sector (e.g. Livestock; crop production; fisheries) should have its own mitigation and adaptation plan. Although sector-wide coordination and response is because a sector-wide climate change response plan will be too complex and ambiguous to allow effective priority setting and implementation.

Step 7: Evaluate Adaptation and the CVA Pathway

TOOL G: CHECKLIST: EVALUATING ADAPTATION

After adaptation measures have been implemented, the final step is to evaluate them. The purpose of evaluation is to determine whether adaptation measures delivered intended benefits and/or caused any adverse consequences. Project managers, project officers and partners will need to assess whether the activities undertaken at each step of the CVA Pathway have managed to effectively climate-proof the programs and projects, and raise the adaptive capacity of partner organisations and vulnerable communities. The Information and Knowledge Management section of the CARE International 'Toolkit for Integrating Climate Change Adaptation' provides qualitative and quantitative indicators for strengthened adaptive capacity and M&E methodology and standards that programme and component managers and officers may find useful during evaluation.

Evaluating an adaptation measure for effectiveness in reducing vulnerability to climate variability and change presents a challenge for two reasons. One reason is that the completion of the project may be earlier than any changes in adaptive capacity

can be measured. Secondly in some cases, the adaptation measure may be targeted at building capacity for an event (disasters) or long-term chronic conditions (climate change) that may not occur for some time.

In these cases there are other ways to evaluate a project or activity using an evaluation framework. In establishing the evaluation framework programme and component managers and officers should begin by selecting indicators to measure effectiveness. You may want revisit the criteria used in Step 2 to assess whether they were effective in selecting adaptation measures. For example, sample criteria include cost-effectiveness, capacity, and reduced vulnerability. So you could ask:

• Was the adaptation option cost-effective?
• Was the capacity available to implement the adaptation measure?
• Did the adaptation measure reduce vulnerability?

Tool G CHECKLIST: EVALUATING ADAPTATION

TIME:	2 hours		
PURPOSE:	After adaptation measures have been implemented the final step is to evaluate them. This tool will help you determine whether the adaptation measure implemented: 1. delivered the intended benefit and/or 2. caused any unintended additional benefits or adverse outcomes.		
MATERIALS:	• Flipchart and markers, or computer and projector • Implementation plan and/or work plan • Checklist: Evaluating Adaptation and the CVA Pathway		
PARTICIPANTS:	Programme and component managers and project officers.		
MATERIALS:	Suggested factors you may wish to consider in your evaluation are outlined below in a checklist and divided into three groups of questions: 1) implementation, 2) effectiveness; 3) context		
Implementation		**Effectiveness**	**Context**
• How easy was it to implement the project? Did implementation follow the plan? • Was adaptation cost-effective? • Was the technical expertise required for implementation available and/or accessible?		• Did adaptation produce immediate benefits? • Did adaptation measures reduce vulnerability? • Did adaptation cause any adverse impacts? Were these anticipated? • Do they outweigh the realised or potential benefits of adaptation?	• Were any models for community-based adaptation developed during implementation? • Is there the potential for replication? • Were lessons and best practices for community based adaptation shared with partner organisations, local authorities and policy-makers? • Did local civil society actively participate in the implementation? Did this contribute to local capacity building and awareness raising
KEY OUTCOMES: • Organisational sharing and learning			
• Applied case-studies			

Adapted from: USAID, 2007. *Adapting to Climate Variability and Change:A Guidance Manual for Development Planning*, USAID, Washington.

5.4 Stakeholder Participation and Responsibilities in Climate Change Adaptation

The task of climate change mainstreaming climate change adaptation cannot be undertaken by REMA or MINAGRI alone. All stakeholders, including donors, private sector and individual citizens, have a role to play. Some of the key stakeholders and their roles in mainstreaming climate change adaptation and mitigation in agricultural sector are summarized in the following table 15.

Table 15: Key Stakeholders roles in mainstreaming climate change adaptation in Agriculture sector

	Stakeholder institution	Roles/ responsibilities
	Public Sector institutions	
1	MINAGRI and Agencies (NAEB, RAB, ISAR,..)	• Integrate climate change adaptation into agricultural policy, PSTA III, sector budgets and operational plans; • Conduct climate change adaptation training & awareness for farmers, fishing communities, extension workers and agro-investors throughout the country; • Review agricultural sector indicators to integrate climate change adaptation. • Ensure that appropriate strategies and techniques are adopted to reduce GHG emissions from crop, livestock production and other agricultural activities.
2	REMA	• Provide technical guidance and tools for climate change adaptation and mitigation; • Monitor agricultural policy implementation to ensure that climate change effects are minimized; • Mobilise funding for climate change adaptation.
	Ministry of Natural Resources (MINIRENA)	• Provide policy guidance and technical support on mitigating GHG emissions from agriculture; • Ensure that sustainable land management, biodiversity conservation efficient water management strategies are adopted by the agricultural sector; • Ensure water security to enable the agricultural sector and other uses access adequate water resources while meeting ecosystems' water needs.
3	Ministry of Finance and Economic Planning	• Integrate climate change adaptation within the national budgeting and public finance management processes; • Work with MINAGRI to mobilize external funding for climate change adaptation; • Monitor budget execution to ensure that climate change issues in agriculture sector are given priority.
4	Ministry of Infrastructure	• Integrate climate change adaptation into agricultural infrastructure (e.g. irrigation installations; agricultural markets; silos and agro-industries) are climate-proofed; • Extend and/or maintain roads, communication and energy infrastructure to increase access to climate-prone areas;
5	Rwanda Meteorological Services	• Establish weather monitoring infrastructure at/ around major weather-sensitive agricultural areas and at agricultural research stations in the country; • Provide appropriate climate data/information to farmers, agricultural extension workers and planners;
6	Ministry of Education	• Integrate climate change adaptation into agricultural, forestry and technology courses for undergraduate and graduate courses; • Develop and implement a research programme on climate change risks and adaptation strategies for the agricultural sector
7	District Authorities	• Mobilise communities and sensitise them on climate change effects; • Integrate climate change adaptation into District Development Plans and *Imihigo*; • Incorporate climate change issues into *Ubudehe*, local government financing and social protection programmes; • Develop and implement climate change adaptation micro-projects at the community level; • Monitor and report on national climate change adaptation programmes related to agriculture within their districts.
8	*Non state actors*	
9	Private sector (*including commercial farmers, agro-input dealers, agro-marketing and agro-processors, etc*)	• Develop climate change awareness toolkits for their organizations, clients and farming communities; • Invest in climate change adaptation/ mitigation projects to reduce climate change related risks to their investments. • Generate and disseminate climate change adaptation information and support tools for farmers and other actors in the agricultural value chains;

		• Mobilise funds for adaptation and mitigation;
	Cooperatives	➢ Mobilise farmers and sensitise them on climate change risks and adaptation measures; ➢ Particulate in information collection, planning and monitoring of community driven adaptation micro-projects
	Civil Society Organizations	➢ Mobilize and sensitise community members and leaders about climate change and their effects on health; ➢ Develop and implement community projects for climate change adaptation; ➢ Mobilise financing for climate change adaptation actions at community and health facility level; ➢ Integrate climate change adaptation issues into CSOs' advocacy and communication strategies for farmers and local communities; ➢ Build capacity of local development actors (including cooperatives) in climate change adaptation.
	Donors/Development partners	➢ Incorporate climate change adaptation into health financing guidelines/ strategies; ➢ Provide grant financing for climate risk assessment and climate change adaptation in all projects;

5.5 Major Challenges to climate change adaptation in the Agricultural sector

The agricultural sector in Rwanda is the most sensitive to climate change almost all farming activities are dependent on climate. More than 90% is rain fed and farmers depend on seasonal patterns. The agricultural infrastructure such as roads and markets, are also sensitive to extreme weather conditions. Thus, climate change adaptation and mitigation will be critical to realizing the agricultural development targets. However, the adaptation process is likely to face a number of challenges:

1. ***Availability of reliable data***: High-resolution data on weather, ecosystems, and socioeconomic data needed to assess vulnerability risks and develop adaptation models, are often lacking.
2. ***Information and communication barriers:*** there are gaps in awareness and understanding of risk and climate change projections in the agricultural sector;
3. ***Inadequate climate change risk assessment at sectoral level***. Few sectors undertake risk assessment. In the agricultural sector, investments in irrigation, development and adoption of new crop varieties and livestock breeds, need to be based on clear climate change risk and vlnerability assessments.
4. ***Complex climate regimes***: Rwanda has strong patterns of climate variability and extremes. As no single climate-health response model will work, a multi-pronged framework should be considered;
5. ***Inadequate coordination*** of climate change adaptation mechanisms: Projects that address climate change in Rwanda are fragmented, tend to be short-term, donor-driven and sometimes alien to community needs and interests;
6. ***Financing limitations constrain investments*** in vulnerability assessment, risk monitoring and risk reduction activities. Disaster Management institutions and local agricultural extension services are under-funded.

5.6 Practical Actions for Effective Climate Change Adaptation in the Agricultural Sector

1. Build capacity - starting with awareness raising and information gathering: Capacity development will entail skills enhancement to collect, analyse and report on health and climate change

effects; utilize the research information and foster learning across the health sector. The first step in building capacity is to assess information, knowledge and skills gaps.

2. Mobilise funding: Finding funds for climate change within the budget may be difficult, since the health sector already takes a big chunk of the national budget. There are several climate financing arrangements which the health sector can access. Skills in resource mobilization and project formulation should be developed by MINAGRI and Agencies with support from REMA.

3. Build Climate Change into National Legislation and health monitoring systems: there is need to build the adaptation actions into the legal frameworks – from sectoral laws to local government regulations. This will compel Governments and NGOs to integrate CCMA activities into their plans and budgets. At the district level, bylaws should be formulated to prevent soil erosion, minimize emission of GHG through agricultural practices and enhance carbon sequestration.

Climate change indicators should be included in the agricultural performance monitoring systems right up to the community level. Regular performance assessment e.g. Joint Sector Reviews and Imihigo should include climate change adaptation criteria and indicators.

4. Work at scale and with other sectors to address climate change concerns: Climate change effects occur at wider scale but the degree of impact on individuals, households and communities occurs at local level and are unique. Agricultural sector workers should collaborate with other sectors like environment, water, infrastructure etc. to combat climate change effects. *The impacts of climate change on a sector are secondary i.e. they may result from other sectors.* For example, Agriculture and Urban water supply; – increased incidence of drought may cause agriculture and urban areas to compete over increasingly scarce sources of water.

5. Regularly assess/evaluate adaptation actions: How do you get to know that the adaptation actions being undertaken are making a difference in terms of strengthening resilience? How do you know that the most vulnerable groups are being cushioned from climate change effects? By assessing the likely impact before and evaluating the performance of adaptation approaches and actions regularly.

6. Sustain the communication and knowledge building efforts: Building community knowledge and resilience in Rwanda will require long-term communication strategies. MINAGRI and REMA should make adaptation messages a continuous process. Every agriculture institution and organizations (CBO's, NGO's) working at local levels should have a climate change information toolkit, and there should be at least 2 people (extension agents) with the skills to sensitise farmers and other community members about climate change and what they should do to prevent, hazards related to climate change. The information tools will include fact books, posters, flyers and audio-visuals e.g. film shows. The agricultural extension system, NGO's and CBO's in regular contact with the local communities should be supported.

References

East African Community Climate Change Master Plan. Mid-term Report, Partner State Situational Analyses. 30 May 2011.

EAC Secretariat, 2010. Report on the EAC climate change fund and modalities for its Operationalisation held in Burundi, Bujumbura, September 2010, Annexe III.

EAC, 2011. Report of the National Stakeholders Consultative Workshop on the Development of the East African Community Climate Change Master Plan. Kigali, March 2011.

FAO (2009a). Food Security and Agricultural Mitigation in Developing Countries: Options for Capturing Synergies. Rome. Available at: www.fao.org.

Intergovernmental Panel on Climate Change (2007). Climate change 2007: the physical science basis; summary for policymakers. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, p. 2.

Intergovernmental Panel on Climate Change (2001). Technical and economic potential of options to enhance, maintain and manage biological carbon reservoirs and geo-engineering. In *Mitigation 2001. The IPCC Third Assessment Report*. Cambridge, United Kingdom and New York, NY, USA, Cambridge University Press.

IPCC 2007 Climate change 2007: the physical science basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, UK: Cambridge University Press.

IPCC (2007) Fourth Assessment Report: Climate Change 2007, Section 12.2.4.6 – Mainstreaming climate change into development choices: Setting priorities. Intergovernmental Panel on Climate Change.

Mxolisi E. Shongwe (2009). Projected changes in mean and extreme precipitation in Africa under global warming, Part II: East Africa" (Journal of Climate, November 22, 2010).

MINAGRI (2010).. Agricultural Mechanization Strategies for Rwanda Shifting from Subsistence Agriculture to Market-oriented Agriculture. July 2010.Republic of Rwanda.

MINAGRI, Strategic Plan for Agricultural Transformation in Rwanda (PSTA I), October 2004.

MINAGRI, Agricultural Sector Investment Plan (PSTA II), 2009-2012.

MINAGRI (2004). National Agriculture Policy for Rwanda, 2004.

MINAGRI Land Husbandry, Water Harvesting and Hillside Irrigation (LWH) Project. "Resettlement Policy Framework", July 2009.

MINAGRI, National Seed Policy, October 2007.

MINECOFIN, 2007. Economic Development and Poverty Reduction Strategy (EDPRS) 2008-2012. September 2007.

MINECOFIN (2000).Vision 2020 of the Republic of Rwanda. Kigali, 2000.

MININFRA, Department of Meteorology, 2004. Generation and application of climate information, products and services for disaster preparedness and sustainable development in Rwanda; Kigali, June 2004.

MINIRENA (2009). Five-Year Strategic Plan for the Environment and Natural Resources Sector, 2009-2013. Ministry of Natural Resources Kigali. June 2009

MINITERE, 2005. Initial National Communication under the UNFCCC. Kigali, June 2005.

MINITERE 2006. National Adaptation Programmes of Action on Climate Change (NAPA). Kigali, December 2006.

National Land Centre (NLC), 2009. Preparation of Rwanda Land Use and Development Master Plan; Report on collection of existing data, March, 2009.

National Institute of Statistics of Rwanda (NISR), 2008. Rwanda Development Indicators 2006 Edition, Kigali, May 2008

National Institute of Statistics of Rwanda (NISR), 2010. Statistical Year Book 2010 Edition, Kigali, 2010

OECD (2009) Integrating Climate Change Adaptation into Development Cooperation – Policy Guidance. Paris, France.

REMA (2008). *Etablissement d'un inventaire national rapide desmarais et élaboration de cinq avant projets d'arrêts ministériels relatifs aux marais (4 modules). Draft.* Kigali.

REMA, 2009. Rwanda State of Environment and Outlook Report (REMA, 2009. Kigali. .

REMA, 2010. Assessment of operational framework related to climate change in Rwanda, Kigali, March, 2010

REMA, 2010. Draft Second National Communication to the UNFCCC. Kigali 2011.

REMA, 2010. Evaluation of Greenhouse Gas Mitigation Options for Rwanda. Part of the Second National Communication to the UNFCCC. August 2010.

REMA (2010). Environment Environment sub-sector strategic plan 2010 – 2015, Kigali, May 2010

REMA (20110). Guidance Manual to integrate Climate Change Aspect into the District Development Plan (DDP). February 2011.

UNDP-UNEP (2009) Mainstreaming Poverty-Environment Linkages into Development Planning: A Handbook for Practitioners. UNDP-UNEP Poverty-Environment Initiative.

UNDP (2010) Screening Tools and Guidelines to Support the Mainstreaming of Climate Change Adaptation into Development Assistance – A Stocktaking Report. United Nations Development Programme, New York.

ANNEXES

Annex 1: Likely climate change impacts and their adaptation options

Component	Likely impacts of climate change & environmental degradation	Adaptation option
Water	**Less fresh water availability** ❑ Increased water demands / water shortages, e.g. as a result of temperature rises and drought / disasters such as floods / building dams or diverting rivers upstream / overabstraction of water for industry, for example. ❑ Shortage of water for use in enterprises such as agriculture, laundries and bakeries.	**Conserving fresh water availability** ❑ Integrated Water Resource Management and Water Basin Management. ❑ Conserve and reduce run-off, e.g. uphill dam & reservoir construction, re-use of grey water. ❑ Maximise water capture and storage including rainwater harvesting, e.g. using roof tops and tanks. ❑ Fixation points (including well points). ❑ Train health workers and others to respond to crises such as drought.
	Less fresh water quality ❑ Surface or groundwater quality affected by lower water flows, concentrating pollutants, or high water flows (e.g. flooding or intense rain contaminating groundwater supply). ❑ Salinisation of fresh water systems, soils, wetlands and estuaries due to flooding, and erosion: affects drinking water, flora and fauna.	**Conserving fresh water quality** ❑ Protect water sources and communal water points from pollution. Water plans. ❑ Desalination systems. ❑ Monitor groundwater salinity and abstraction. Over-abstraction can cause salinisation.
Land	**Worsening land productivity – general** ❑ Poverty and increased vulnerabilities due to failure of agricultural livelihoods and food shortages. ❑ Salinisation of soil and irrigation water due to flooding and sea level rise.	**Food security options – general** ❑ Land tenure rights advocacy. ❑ Demonstrate year-round homestead vegetable gardening. ❑ Involve stakeholders in disaster risk reduction activities ❑ Support the diversification of income-generating measures. ❑ Sustainable Natural Resource Management. ❑ Encourage the use of sustainable agriculture techniques to improve food security during dry periods. ❑ Encourage the development of enterprises that are more tolerant of worsening land productivity, drought etc. ❑ Create seed banks to allow replanting if crops fail, are damaged or destroyed. ❑ Build strength of local organisations to adapt to climate change and environmental degradation; build capacity within community to manage activities and finance. ❑ Mainstream adaptation into local community management plans.
Land	**Land degradation** ❑ Desertification e.g. due to overgrazing, intensive farming, extensive logging. ❑ Soil erosion caused by overgrazing, intensive farming and deforestation ❑ Land degradation blocks water channels thereby increasing flooding effects. ❑ Loss of biodiversity e.g. due to over-intensive farming or changes in climate resulting in changes in breeding or migratory routes for flora and fauna.	**Conserve biodiversity, soil fertility and sustainable land use** ❑ Floating gardens. ❑ Crop rotation to maintain soil quality, minimise erosion (reducing the risk of desertification) and plant less water-dependant crops in drier years (rotate legumes and other crops). ❑ Community forest management and reforestation.
	Likely impacts of climate change & environmental degradation	**Adaptation option**
Land	**Crop damage and failure** ❑ Crops can be damaged by increased rainfall or	**Maximise crop yields** ❑ Ask farmers to report on invasive species and changes in

	unpredictable distribution and intensity of rainfall. ❑ Crop damage and failure result in lack of seed for the next planting season. ❑ Reduced crop yields due to disease, pests, soil degradation, lack of water for irrigation, overuse of chemical fertilizers.	growing patterns. ❑ Advance sowing dates; workshops with farmers. Seasonal climate change projections reviewed, decisions taken. ❑ Crop diversification and crop mixing; mix of crops and trees in agroforestry systems to spread risk and increase biodiversity; animals can also be integrated into these systems allowing effective recycling of manure and providing a valuable source of protein. ❑ Introduce drought-, flood- or salt-resistant crops. ❑ Use 'closed loop' agricultural technique, to maximize crop use and soil quality at all stages.
Land	**Too little irrigation water, or too much water (due to intense rainfall or flooding)** ❑ Lack of water eg due to drought, hotter seasons, dams upstream or rivers being diverted upstream. ❑ Flooding and sea level rise mean land cannot be used or crops fail or are lost. ❑ Increased inability to cultivate land due to water logging of soils.	**Maximise irrigation water availability** ❑ Work with communities to develop strategies for water harvesting ❑ Minimise wastage of water used in irrigation by introducing more efficient techniques (e.g. drip feed rather than flood). ❑ Maintain grass waterways to conserve run-off and drain floods. ❑ Use agricultural techniques such as contour bunds[1] and check dams[2] to regulate runoff and improve infiltration. ❑ Treat wastewater for re-use in agriculture. ❑ Protect and reforest water catchment areas to improve groundwater resources.
Land	**Landslides, shoreline level rise and destruction** ❑ Loss of trees and agricultural land due to landslides. ❑ Coastal land used for agricultural purposes is lost to the sea as sea levels rise, impacting livelihoods and food security.	**Protect from landslides and erosion** ❑ Protect and / re-establish vegetation in degraded areas to provide a natural barrier between the rivers, lakes and land. ❑ Protect and / or plant trees and other vegetation along river / lake / lagoon banks to protect them from erosion.
	Likely impacts of climate change & environmental degradation	**Adaptation option**
Livestock	**Worsening availability and quality of livestock** ❑ Reduced livestock production and loss of livestock because of disease, pests and lack of water and feed. ❑ Land degradation reduces land for grazing. ❑ Loss of livestock may vulnerabilities by taking away or damaging livelihoods.	**Protecting and improving livestock** ❑ Community strategies of grain distribution, livestock replenishment and diversification. ❑ Pasture land development. ❑ Community-based animal health; training paravets who can provide services in rural villages and sell drugs locally ❑ Improve pasture and land management
Fish stock	**Availability and quality of fish stocks** ❑ Fish breeding grounds are damaged by rising lake/river temperatures and water levels. ❑ Reduction and degradation of fish habitats (e.g. mangroves and coral reefs) and salinisation of fresh water affects fish stocks. ❑ Reduced navigability of rivers and lakes affect fishing and marketing of produce ❑ Water Pollution can kill fish. ❑ Food deficiencies among communities reliant on fishing leading to increased poverty, illness, and mortality.	**Protecting and improving fish stock** ❑ Protect lakeshores and river and stream banks from degradation, erosion and protect fish breeding grounds. ❑ Identify options for sustainable aquaculture such as fish farming in ponds using crop by-products for feed and integrated livestock-fish farming to improve the supply of protein-rich food in the area.

1 Contour bunding involves constructing low mounds, embankments or 'bunds' of earth or stones along the contour of a field to catch the rain when it falls so that it has time to soak into the ground rather than run off and be lost. The bunds may be planted with vegetation to help fix them, as well as to help delay the rainwater. The bunds can also help prevent valuable soil being washed away.

2 Check dams are small, stone or concrete dams usually constructed across watercourses to delay the flow of rainwater so it has time to soak into the earth and replenish the groundwater table while keeping adjacent land moist.

SECTOR		LEVEL	CLIMATE CHANGE ISSUE/ VULNERABILITY	ADAPTIVE NEEDS	MITIGATION NEEDS	INTERVENTION	INDICATORS
AGRICULTURE	Mash reclamation	National	Lack of awareness	Awareness creation	-	Awareness creation	
		Local/organisational					
	Land reform	National					
		Local/organisational					
	Irrigation	National					
		Local/organisational					

AGRICULTURE					
Monoculture		Mechanization		Use of Agrochemicals	
Local/organisational	National	Local/organisational	National	Local/organisational	National

Annex 3: Building Local capacity for Climate change Adaptation and Mitigation

	Basic Activity	WHAT (specific actions	WHO (Target groups/individuals)	HOW (Methodology)	WHEN (Time frame)	Requirements
1	**Sensitisation**					
2	**Training**					
3	**Participatory tools design and testing**	**Screning checklists**				
4	**Implementation (*Supervision & monitoring support*)**					
5	**Review / Performance evaluation**					

Annex 4. Matrix of Simple tools for Climate Change Impact and Vulnerability Assessment

STEP	MAIN TOOL(S)	PARTICIPANTS	KEY OUTCOME
1. **Screen project activities for climate risk** – using a summary of climate trends, forecasts and impacts undertake a preliminary assessment of whether climate variability/change could impact the project effectiveness, longevity and integrity.	Assess climate risk	Programme and component managers and project officers	A detailed table of the main climate change impacts that will affect project activities and results
2. **Decide on the CVA pathway** – decide whether to follow the CVA pathway, taking into account any existing risk management practices, human and financial resources, donor conditions and the local context.	Checklist – should the CVA pathway be followed?	Programme and component managers and project officers	List of projects that need to progress through the remaining steps of the CVA pathway.
3. **Identify adaptation measures** – work closely with implementation partners, local decision makers and stakeholders to identify a wide range of potential adaptation measures for tackling climate change risks and opportunities for strengthening adaptive capacity.	Climate Vulnerability and Capacity Analysis (CVCA) Hand-book; Resource Table on best practice community-based adaptation experiences.	Component Managers, project officers, partner organizations and Community members.	List of potential adaptation measures for reducing climate risk and strengthening adaptive capacity.
4. **Prioritize adaptation measures** to address vulnerabilities in Step 1 – consider project timeframe, budget, and technical requirements of implementing different adaptation measures.	Priority Adaptation Matrix	Programme and component managers, partner organizations and project officers.	List of criteria for determining benefits and feasibility of adaptation measures; list of adaptation measures ranked in order of priority.
5. **Select adaptation options for implementation** – from step 4, select which options will be implemented; develop local ownership of the process and agreed measures.	Stakeholder workshop methodology	Project officers, partner organizations and community members.	Adaptation measure(s) selected by the community, along with community support and consensus.

6. **Implement adaptation measures** – actively engage stakeholders and partners, build capacity, and monitor and adapt the project according to any new conditions that arise.	Adaptation measures	Project officers, partner organizations and community members.	Community-based adaptation measures are implemented.
7. **Evaluate adaptation and the CVA pathway** – determine whether the project/programme delivers the intended benefits and/or causes any adverse outcomes.	Checklist – evaluating adaptation.	Programme and component managers and project officers	Organisational sharing and learning and applied case studies. Lessons learned to inform future project design/implementation.

Adapted from Huxtable & Yen (2009):

Annex 5: Definition of Key terms in Climate Change Adaptation and Mitigation

Adaptation: action or adjustment taken by society in response to the actual or potential impacts of predicted climate change, which moderates harm or exploits beneficial opportunities.

Climate: Climate in a narrow sense is usually defined as the "average weather" or more rigorously as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. The classical period is 30 years, as defined by the World Meteorological Organization (WMO). These relevant quantities are most often surface variables such as temperature, precipitation, and wind. Climate in a wider sense is the state, including a statistical description, of the *climate system*.

Climate change: Climate change refers to a statistically significant variation in either the mean state of the *climate* or in its variability, persisting for an extended period (typically decades or longer). Climate change may be due to natural internal processes or *external forces*, or to persistent *anthropogenic* changes in the composition of the *atmosphere* or in *land use*. Note that the *United Nations Framework Convention on Climate Change* (UNFCCC), in its Article 1, defines "climate change" as: "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods." The UNFCCC thus makes a distinction between "climate change" attributable to human activities altering the atmospheric composition, and "climate variability" attributable to natural causes.

Climate system: The climate system is the highly complex system consisting of five major components: the *atmosphere*, the *hydrosphere*, the *cryosphere*, the land surface and the *biosphere*, and the interactions between them. The climate system evolves in time under the influence of its own internal dynamics and because of external forces such as volcanic eruptions, solar variations, and human-induced forces such as changing composition of the atmosphere and *land-use change*.

Climate variability: refers to variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the *climate* on all *temporal and spatial scales* beyond that of individual weather events. Variability may be due to natural internal processes within the *climate system* (internal variability), or to variations in natural or *anthropogenic external forces* (external variability).

Impacts of Climate change: consequences of *climate change* on natural and *human systems*. Depending on the consideration of *adaptation*, one can distinguish between potential impacts and residual impacts.

Potential impacts: All impacts that may occur given a projected change in *climate*, without considering adaptation. Residual impacts: The impacts of climate change that would occur after adaptation.
Climate proofing: actions taken to protect infrastructure, systems and processes against projected climate impacts for a period into the future.
Greenhouse effect: the result of certain gases in the atmosphere (so-called greenhouse gases) absorbing energy that is radiated from the Earth's surface, and so warming the atmosphere.

Greenhouse gas: a number of anthropologically produced and naturally occurring gases whose presence in the atmosphere traps energy radiated by the Earth. This property causes the greenhouse effect. Water Vapor (H2O), carbon dioxide (CO2), nitrous oxide (N2O), methane (CH4), and ozone (O3) are the primary greenhouse gases in the Earth's atmosphere.

Informative: where it is inappropriate for local planning authorities to impose conditions or negotiate planning obligations, but where the local planning authorities considers that the developer should be made aware of certain matters, it is possible for them to attach a short statement known as an informative to any consent for planning permission.

Mitigation: activities which seek to reduce the human effects on global warming by reducing the quantity of greenhouse gases released to the atmosphere.

Precautionary approach/principle: a principle which states that where there are threats of serious or irreversible damage, lack of scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation. This approach is promoted by the UNFCCC to help "achieve stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous man–made interference with the climate system".

Sequestration: the process of increasing the carbon content of a carbon reservoir other than the atmosphere. Biological approaches to sequestration include direct removal of carbon dioxide from the atmosphere through land-use change, afforestation, reforestation and practices that enhance soil carbon in agriculture. Physical approaches include separation and disposal of carbon dioxide from flue gases and long-term storage underground.

Sink: any process, activity or mechanism that removes a greenhouse gas from the atmosphere.

Sustainable development: development which meets the needs of the present without compromising the ability of future generations to meet their own needs. Sustainable development tries to reconcile the needs of social and economic development with ecological conservation and environmental protection.

Maladaptation: An action or process that increases vulnerability to climate change-related hazards. Maladaptive actions and processes often include planned development policies and measures that deliver short-term gains or economic benefits but lead to exacerbated vulnerability in the medium to long-term.