



United Nations
RWANDA
Unity in Diversity

Potential Impact of Climate Change on the Economy: Building Climate and Economic resilient societies

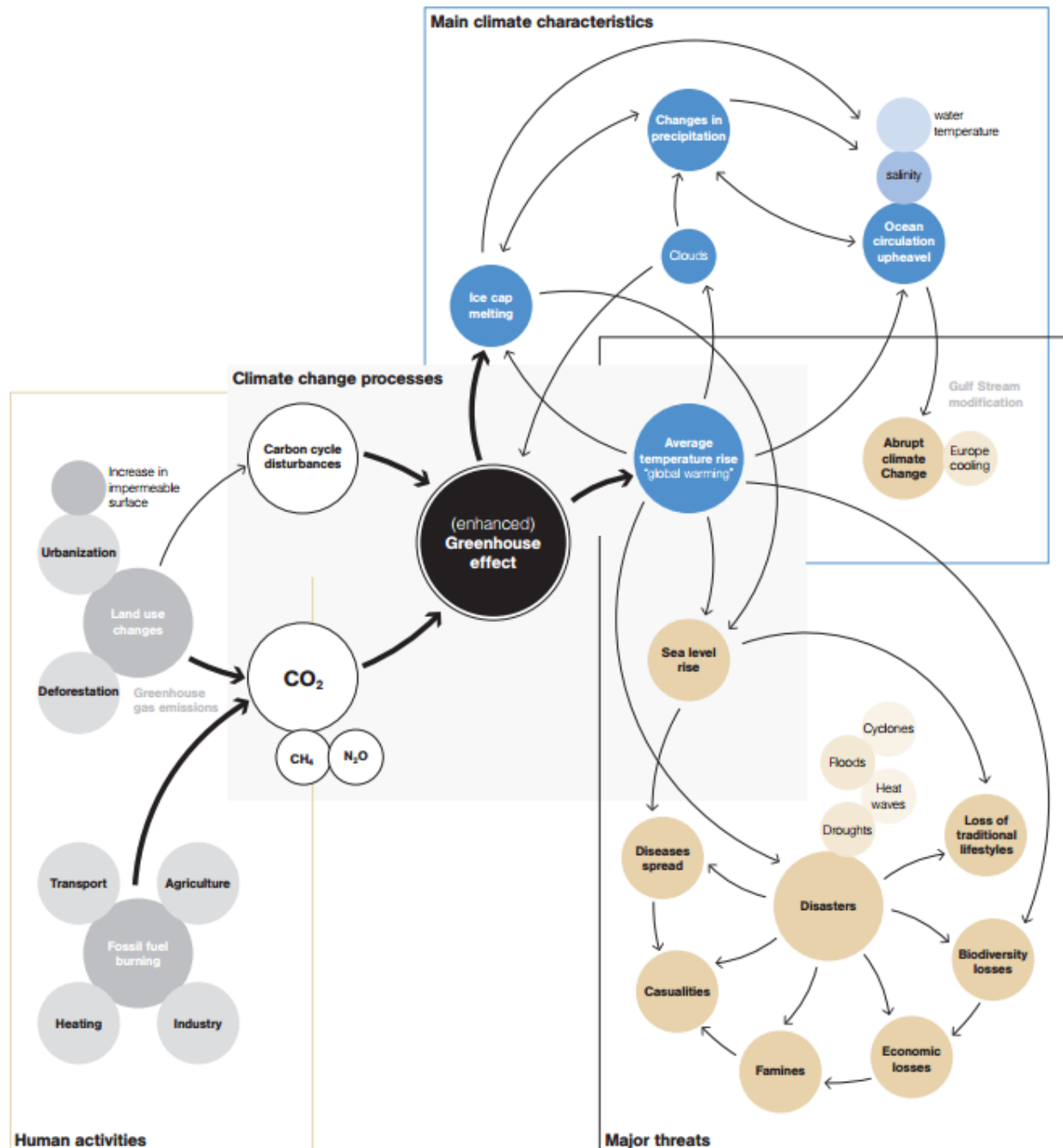
5th IPAR Annual International Research Conference,
24th March 2016



United Nations
RWANDA
Unity in Diversity

Plan

- **Introduction: Climate Change Process and Characteristics**
- **Impacts of Climate Change:**
 - **Agriculture**
 - **Infrastructure**
 - **Health**
 - **Tourism**
 - **Aggravating factors**
- **Resilience and Adaptation to Climate Change**

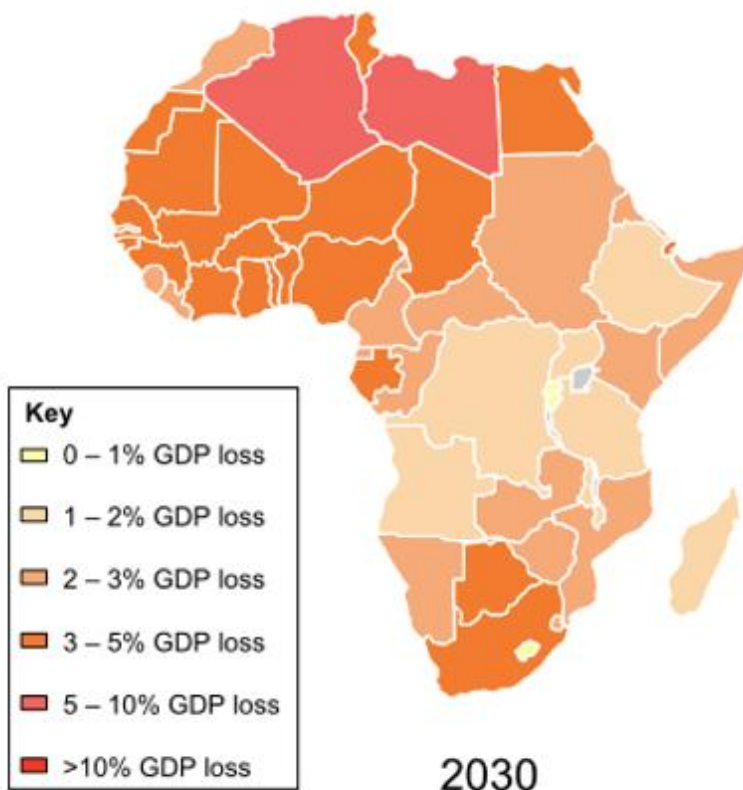




United Nations
RWANDA
Unity in Diversity

Table 1: Impact of Climate Change and Vulnerabilities in Africa

Figure 1: Annual Impact from climate change (% of GDP) in Africa in 2030



| Impacts | Sectoral vulnerabilities |
|---|---|
| <p>Temperature</p> <ul style="list-style-type: none"> - Higher warming (x1.5) throughout the continent and in all seasons compared with global average. - Drier subtropical regions may become warmer than the moister tropics. <p>Precipitation</p> <ul style="list-style-type: none"> - Decrease in annual rainfall in much of Mediterranean Africa and the northern Sahara, with a greater likelihood of decreasing rainfall as the Mediterranean coast is approached. - Decrease in rainfall in southern Africa in much of the winter rainfall region and western margins. - Increase in annual mean rainfall in East Africa. - Increase in rainfall in the dry Sahel may be counteracted through evaporation. <p>Extreme Events</p> <ul style="list-style-type: none"> - Increase in frequency and intensity of extreme events, including droughts and floods, as well as events occurring in new areas. | <p>Water</p> <ul style="list-style-type: none"> - Increasing water stress for many countries. - 75–220 million people face more severe water shortages by 2020. <p>Agriculture and food security</p> <ul style="list-style-type: none"> - Agricultural production severely compromised due to loss of land, shorter growing seasons, more uncertainty about what and when to plant. - Worsening of food insecurity and increase in the number of people at risk from hunger. - Yields from rain-fed crops could be halved by 2020 in some countries. Net revenues from crops could fall by 90% by 2100. - Already compromised fish stocks depleted further by rising water temperatures. <p>Health</p> <ul style="list-style-type: none"> - Alteration of spatial and temporal transmission of disease vectors, including malaria, dengue fever, meningitis, cholera, etc. <p>Terrestrial Ecosystems</p> <ul style="list-style-type: none"> - Drying and desertification in many areas particularly the Sahel and Southern Africa. - Deforestation and forest fires. - Degradation of grasslands. - 25–40% of animal species in national parks in sub-Saharan Africa expected to become endangered. <p>Coastal Zones</p> <ul style="list-style-type: none"> - Threat of inundation along coasts in eastern Africa and coastal deltas, such as the Nile delta and in many major cities due to sea level rise, coastal erosion and extreme events. - Degradation of marine ecosystems including coral reefs off the East African coast. - Cost of adaptation to sea level rise could amount to at least 5–10% GDP. |

Impacts of Climate Change: Agriculture and food security



- Increase in extreme events: The type, frequency and intensity of extreme events, such as tropical cyclones, floods, droughts and heavy precipitation events, are expected to rise (erosion, land degradation);
 - Changes in rainfall pattern are likely to lead to severe water shortages and/or flooding.
 - Rising temperatures are likely to cause shifts in crop growing seasons
-
- Expected decrease in water availability for irrigation
 - Expected shorter growing seasons
 - Expected lower yields
 - Expected increase in damage to Agriculture due to increasing disasters
 - Expected loss insurance sector and number of farmers insured
-
- **Expected decrease in Agriculture and livestock production (increase in commodity prices)**
 - **Expected decrease in agriculture exports (indirect effect on trade balance, balance of payments, exchange rate)**
 - **Expected increase in the number of people at risk of hunger**

Impacts of Climate Change: Agriculture and food security



Table 2: Disaster Occurrence in Rwanda (2011-2015)

| Disaster | 2011 | 2012 | 2013 | 2014 | 2015 | Total |
|---------------------------|-----------|------------|------------|------------|------------|-------------|
| Floods | 3 | 23 | 10 | 35 | 28 | 99 |
| Heavy Rains & Winds | 58 | 60 | 167 | 179 | 186 | 650 |
| Landslides | 5 | 8 | 14 | 17 | 22 | 66 |
| Thunderstorms & Lightning | 15 | 24 | 40 | 66 | 79 | 224 |
| Fire | 0 | 2 | 12 | 30 | 43 | 87 |
| Mine Incidents | 1 | 0 | 4 | 0 | 0 | 5 |
| Earthquake | 0 | 0 | 0 | 0 | 1 | 1 |
| | 82 | 117 | 247 | 327 | 359 | 1132 |

Data: MIDIMAR, 2016

Table 3: Damages caused by Disasters on agriculture in Rwanda 2012-2014

| Disaster | 2012 | 2013 | 2014 |
|---------------------------|---------------|---------------|---------------|
| | Land (Ha) | Land (Ha) | Land (Ha) |
| Floods | 1883.5 | 411 | 487.5 |
| Heavy Rains & Winds | 277.6 | 1494 | 1709.5 |
| Landslides | 399 | 257 | 0 |
| Thunderstorms & Lightning | 0 | 0 | 0 |
| Fire | 20 | 35.45 | 17.5 |
| TOTAL | 2580.1 | 2197.5 | 2214.5 |

Data: MIDIMAR, 2016

Impacts of Climate Change: Infrastructure



- Increase in **extreme events**: The type, frequency and intensity of extreme events (tropical cyclones, floods, droughts and heavy precipitation) are expected to rise
- Increasing **sea levels** mean greater risk of damage to African coastlines (lagoons, mangrove forests), small island States and countries with low lying deltas (Estimation Coastal infrastructure in 30 percent of Africa's coastal countries is at risk of partial or complete inundation) (Cape Town, Maputo, Dar Es Salaam, Mombasa)
- **Example**: major disaster in harbour Dar Es Salaam or Mombasa will have major indirect impact in the region → regional interdependency
- **Expected increased in damage caused to infrastructure (houses, roads, schools, harbours, water infrastructures, hydropower, businesses, etc.)**
- **Indirect costs due to damaged infrastructure (Profits lost, Transport of inputs and outputs, Electricity cuts, alternative source of electricity, etc.)**

Impacts of Climate Change: Infrastructure

Table 2: Disaster Occurrence in Rwanda (2011-2015)

| Disaster | 2011 | 2012 | 2013 | 2014 | 2015 | Total |
|---------------------------|-----------|------------|------------|------------|------------|-------------|
| Floods | 3 | 23 | 10 | 35 | 28 | 99 |
| Heavy Rains & Winds | 58 | 60 | 167 | 179 | 186 | 650 |
| Landslides | 5 | 8 | 14 | 17 | 22 | 66 |
| Thunderstorms & Lightning | 15 | 24 | 40 | 66 | 79 | 224 |
| Fire | 0 | 2 | 12 | 30 | 43 | 87 |
| Mine Incidents | 1 | 0 | 4 | 0 | 0 | 5 |
| Earthquake | 0 | 0 | 0 | 0 | 1 | 1 |
| | 82 | 117 | 247 | 327 | 359 | 1132 |

Data: MIDIMAR, 2016

Table 4: Damages caused by Disasters on Infrastructure (houses) in Rwanda 2012-2014

| Disaster | 2012 | 2013 | 2014 |
|---------------------------|----------------|----------------|----------------|
| | Damaged houses | Damaged houses | Damaged houses |
| Floods | 1163 | 266 | 4 |
| Heavy Rains & Winds | 1834 | 3275 | 2911 |
| Landslides | 177 | 378 | 12 |
| Thunderstorms & Lightning | 1 | 0 | 0 |
| Fire | 1 | 6 | 40 |
| TOTAL | 3176 | 3925 | 2967 |

Data: MIDIMAR, 2016

Impacts of Climate Change: Tourism



- Likely to add stress to already threatened habitats, ecosystems and species and is likely to trigger **species migration** and lead to **habitat reduction**.
- Temperature increases will potentially severely **increase rates of extinction for many habitats and species** (up to 30 per cent World with a 2°C rise in temperature). Particularly affected will be coral reefs, and mountain habitats.
- Up to **50%** of Africa's total biodiversity is at risk due to reduced habitat and other human-induced pressures (Boko et al. 2007) (land-use conversion due to agricultural expansion and subsequent destruction of habitat; pollution; poaching; civil war; high rates of land use change; population growth, etc.).
- **Example:** The habitat of the western lowland/mountain Gorilla – critically endangered on the World Conservation Union's (IUCN) red list of threatened species, is likely to seriously decline.

→ **Expected potential impact on tourism (loss)**

Impacts of Climate Change: Health

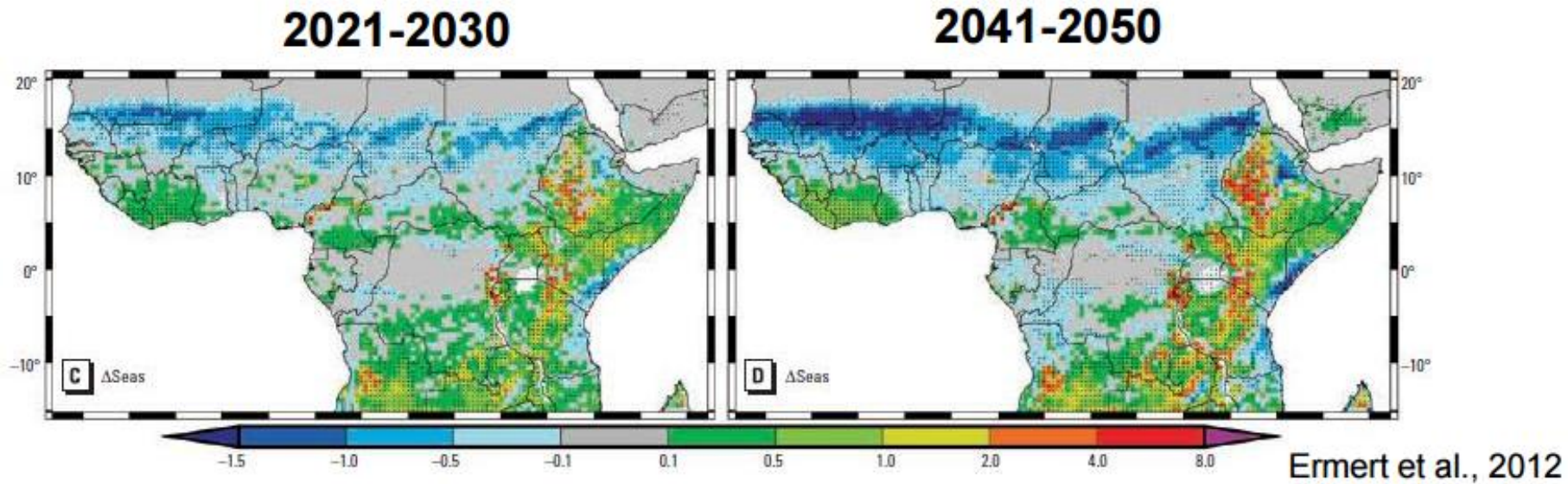


- Increase in extreme events, changes in rainfall pattern and rising temperatures are likely to lead to severe **changes in the distribution of disease vectors**
- Under climate change, rising temperatures are changing the geographical distribution of disease vectors which are migrating to new areas and higher altitudes (Example, migration of the malaria mosquito to higher altitudes risk for densely populated east African highlands (Boko et al. 2007)).
- **Expected increase in number of people and animals at risk from climate sensitive diseases** (vector, water and air- borne diseases) (Malaria, tuberculosis, schistosomiasis, diarrhoea, etc.)
- **Expected increase of malnourishment cases**
- **Expected increase in direct medical costs, health protection costs and indirect costs (lost time at work, etc.)**
- Future climate variability will also interact with other stresses and vulnerabilities (HIV/AIDS, Conflicts) resulting in increased susceptibility and risk to infectious diseases (e.g. cholera and diarrhoea) and malnutrition for adults and children.

Impacts of Climate Change: Health



Figure 3: Expected Incidence of Malaria (2021-2030; 2041-2050)



Example: Rwanda expected potential increase of rural population at risk of malaria by 150% by 2050 at a potential cost of 50millions/year (Economics of Climate change in Rwanda, 2009)

Impacts of Climate Change: Aggravating factors

- Many factors contribute and compound the impacts of current climate variability and will have **negative effects on the cost of the impact and the ability to cope with climate change:**
 - Poverty
 - Increase in population,
 - Illiteracy and lack of skills,
 - Weak institutions,
 - Limited infrastructure,
 - Lack of technology and information,
 - Low levels of primary education and health care, poor access to resources, low management capabilities
 - Conflicts.
 - The overexploitation of land resources including forests,
 - Land degradation



United Nations
RWANDA
Unity in Diversity

Cost of impact of Climate Change

- **Direct costs:**
 - Human lives,
 - Agriculture losses,
 - Damaged infrastructures (houses, roads, schools, Health centres, harbours, businesses, water systems, energy infrastructure, etc)
- **Indirect costs:**
 - Decreased soil productivity due to soil erosion, etc
 - Lost profits for companies affected,(energy cuts, damaged transport infrastructures, etc.)
 - Health-related costs due to increased diseases and disasters (direct medical costs, health protection costs, lost time at work, cost linked to undernourishment and malnutrition, etc.)
 - Decrease in trade balance, balance of payment, exchange rate
 - Decrease in households and businesses insured- increase in insurance costs
 - Alternative source of electricity, etc. ,

→ World: Cost > 2 trillion \$ in the world due to disasters since 1992

→Rwanda: Cost estimated to minimum 1% -1.5% of GDP per year in 2030 (Min of 40million USD/year) (Economics of Climate Change in Rwanda, 2009)



United Nations
RWANDA
Unity in Diversity

Resilience and adaptation to Climate Change

- **Resilience** refers to the capacity of a **system to continue to function despite disturbances**, either by **recovery to its original condition** or by some degree of transformation that changes components in a system or the relationships between components in a system
- **Adaptation** is a process through which societies make themselves better able to cope with an uncertain future. Adapting to climate change entails taking the right measures to **reduce the negative effects of climate change** by making the appropriate adjustments and changes. **Examples:**
 - Technological options such as increased sea defences or flood-proof houses,
 - Behaviour change at the individual level, such as reducing water use in times of drought and using insecticide-sprayed mosquito nets.
 - Establishment of Early warning systems for extreme events, better water management, terracing, improved risk management, various insurance options, biodiversity conservation, etc.

Table 5: Adaptation measures in key vulnerable sectors

| Vulnerable sectors | Reactive adaptation | Anticipatory adaptation |
|-------------------------------------|---|---|
| Water Resources | <ul style="list-style-type: none"> - Protection of groundwater resources - Improved management and maintenance of existing water supply systems - Protection of water catchment areas - Improved water supply - Groundwater and rainwater harvesting and desalination | <ul style="list-style-type: none"> - Better use of recycled water - Conservation of water catchment areas - Improved system of water management - Water policy reform including pricing and irrigation policies - Development of flood controls and drought monitoring |
| Agriculture and food security | <ul style="list-style-type: none"> - Erosion control - Dam construction for irrigation - Changes in fertilizer use and application - Introduction of new crops - Soil fertility maintenance - Changes in planting and harvesting times - Switch to different cultivars - Educational and outreach programmes on conservation and management of soil and water | <ul style="list-style-type: none"> - Development of tolerant/resistant crops (to drought, salt, insect/pests) - Research and development - Soil-water management - Diversification and intensification of food and plantation crops - Policy measures, tax incentives/subsidies, free market - Development of early warning systems |
| Human health | <ul style="list-style-type: none"> - Public health management reform - Improved housing and living conditions - Improved emergency response | <ul style="list-style-type: none"> - Development of early warning system - Better and/or improved disease/vector surveillance and monitoring - Improvement of environmental quality - Changes in urban and housing design |
| Terrestrial ecosystems | <ul style="list-style-type: none"> - Improvement of management systems including control of deforestation, reforestation and afforestation - Promoting agroforestry to improve forest goods and services - Development/improvement of national forest fire management plans - Improvement of carbon storage in forests | <ul style="list-style-type: none"> - Creation of parks/reserves, protected areas and biodiversity corridors - Identification/development of species resistant to climate change - Better assessment of the vulnerability of ecosystems - Monitoring of species - Development and maintenance of seed banks - Including socioeconomic factors in management policy |
| Coastal zones and marine ecosystems | <ul style="list-style-type: none"> - Protection of economic infrastructure - Public awareness to enhance protection of coastal and marine ecosystems - Building sea walls and beach reinforcement - Protection and conservation of coral reefs, mangroves, sea grass and littoral vegetation | <ul style="list-style-type: none"> - Integrated coastal zone management - Better coastal planning and zoning - Development of legislation for coastal protection - Research and monitoring of coasts and coastal ecosystems |



Resilience and adaptation to Climate Change



Macroeconomic effects of climate change with and without adaptation, 2050 (percentage deviation from baseline)

| | No Adaptation | | With Adaptation (net of costs) | |
|--------------------------|---------------|-------|-----------------------------------|-------|
| | Dry | Wet | Dry | Wet |
| GDP | -2.4% | -2.3% | -1.1% | -0.7% |
| Aggregate consumption | -2.5% | -2.5% | -1.4% | -0.8% |
| Agricultural value-added | -13.9% | 13.5% | -3.8% | -3.4% |
| Regional GDP | | | | |
| North Central Coast | -6.6% | -6.1 | 0.5% | -0.3% |
| South East | 1.1% | 0.8% | 0.0% | 1.1% |

→ Adaptation is cost-effective

- Economic growth offers an opportunity to alter for the long term the risk profile of countries with respect to climate change. There is the possibility to build climate resilience into decisions from the outset. To do this, adaptation plans need to systematically identify the opportunities, or 'entry points', where proactive adaptation can be factored into development strategies and long-term investment plans.

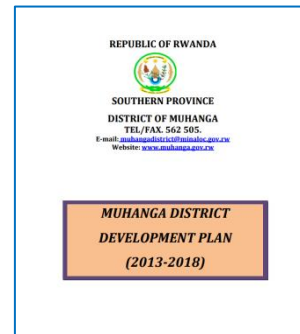
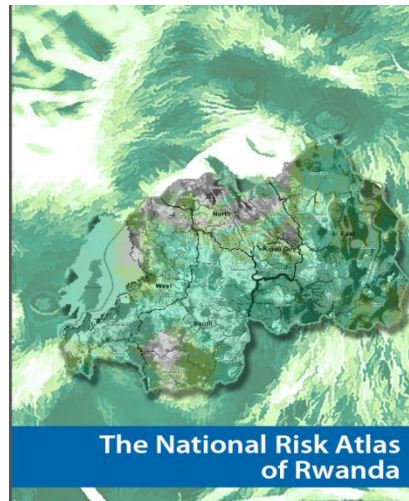


Republic of Rwanda

Green Growth and Climate Resilience

National Strategy for Climate Change and Low Carbon Development

Kigali
October 2011





Murakoze cyane