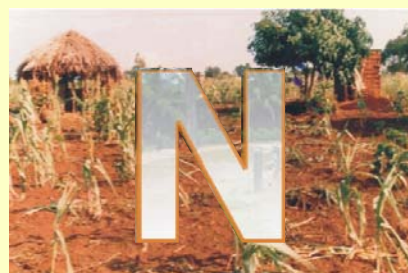




REPUBLIQUE DU BURUNDI



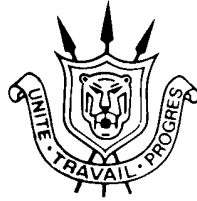
MINISTRE DE L'AMENAGEMENT DU TERRITOIRE,
DU TOURISME ET DE L'ENVIRONNEMENT



National Adaptation Plan of Action to climate change "NAPA"

January 2007

REPUBLIC OF BURUNDI



**MINISTRY FOR LAND MANAGEMENT,
TOURISM AND ENVIRONMENT**

**NATIONAL ADAPTATION PLAN OF ACTION
(NAPA)**

Original: FRENCH

BUJUMBURA, January 2007

CONTENTS

ACRONYMS	IV
FOREWORD	V
EXECUTIVE SUMMARY	VII
I. INTRODUCTION AND SETTING	1
I.1. BURUNDI GENERAL FEATURES	1
<i>I.1.1. Biophysical Features</i>	1
<i>I.1.2. Socio-economic Features</i>	5
I.2. ENVIRONMENTAL STRESSES	7
I.3. CLIMATE VARIABILITY AND CLIMATE CHANGE DISTURBANCE	8
II. FRAMEWORK FOR ADAPTATION PLAN	10
II.1. CURRENT / POTENTIAL CLIMATE VARIABILITY AND CLIMATE CHANGE	10
<i>II.1.1. Current Climate Variability and Climate Change</i>	10
<i>II.1.2. Potential Climate Variability and Climate Change</i>	11
II.2. REAL /POTENTIAL ADVERSE EFFECTS OF CLIMATE CHANGE	12
II.3. RELATIONS OF NAPA TO NATIONAL DEVELOPMENT GOALS	19
<i>II.3.1. Climate Change and National Economy</i>	19
<i>II.3.2. NAPA and National Development Policy</i>	19
<i>II.3.3. Synergy between NAPA and U.N. Environmental Conventions Policies</i>	20
<i>II.3.4. Burundi NAPA Goals, Objectives and Strategies</i>	21
<i>II.3.5. NAPA Burundi Barriers to Activity Implementation</i>	21
III. INVENTORY OF PRINCIPAL ADAPTATION NEEDS	22
III.1. PAST AND CURRENT PRACTICES OF ADAPTATION	22
III.2. RELEVANT SOLUTIONS OF ADAPTATION	23
IV. CRITERIA FOR SELECTING PRIORITY ACTIVITIES	24
IV.1. SELECTION OF ANALYTICAL METHOD	24
IV.2. SELECTION OF SCREENING CRITERIA	24
IV.3. ASSESSING PRIORITY OPTIONS	25
V. PRIORITY PROJECTS	31
VI. NAPA PREPARATION PROCESS	63
VI.1. GOVERNMENT INPUT	63
VI.2. CONSULTATIVE PROCESS	63
VI. 3. MECHANISM OF ADOPTION BY THE GOVERNMENT	65
VI.4. FINAL NAPA DISSEMINATION AND IMPLEMENTATION	65
VI.5. COUNTRY COMMITMENT AND MONITORING & EVALUATION	65
BIBLIOGRAPHY	66
APPENDICES	69
APPENDIX 1: NAPA LIST OF EXPERTS AND CONTRIBUTORS	69
APPENDIX 2:	71

Acronyms

AIDS	Acquired Immuno-Deficiency Syndrome
CBA	Cost-benefit Analysis
CBD	Convention on Biological Diversity
CDC	Communal Development Committee
CEA	Cost-efficiency Analysis
DPAE	Provincial Directorate for Agriculture and Livestock
DPSP	Department for Seed and Plant Promotion
GCM	General Circulation Model
GDP	Gross Domestic Product
GHG	Greenhouse Gases
IGEBU	Burundi Geographical Institute
INECN	National Institute for the Environment and Conservation of Nature
ISABU	Burundi Institute of Agronomic Science
MCA	Multi-criteria Analysis
MINAGRIE	Ministry for Agriculture and Livestock
MINATTE	Ministry for Land Management, Tourism and Environment
NAPA	National Adaptation Plan of Action
PAN-LCD	National Plan of Action to Combat Desertification
PDNE	National Water Master Plan
PRSP	Poverty Reduction Strategic Paper
REGIDESO	Water and Power Production and Distribution Company
SCENGEN	Scenario Generator
SNPA-DB	Biological Biodiversity National Strategy and Plan of Action
SP/REFES	Economic and Social Reform Permanent Secretariat
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
BDI	Burundi
UB	University of Burundi
AFEB	Burundi Women Environmental Association

Foreword



Nowadays, the major challenge to be tackled by the processes of activity planning in the field of climate change is to promote capacities of community adaptation to the adverse effects of climate change.

Burundi is obviously subjected to the adverse effects of climate change. Several areas witnessed clear rupture of the rainfall and hydrometric series. The rainfall deficit resulted notably into aggravated aridity and significant reduction of the principal wetlands and the drying up of several rivers and lakes. The torrential rains and extreme temperatures are other climate phenomena that today reveal the ever-growing vulnerability of our country. The fall in production, losses in human lives, repetitive floods, landslides, increased risks of diseases, loss of biodiversity, etc are among the consequences recorded following climate disturbance in Burundi.

In this context, the preparation of a climate change National Adaptation Plan of Action (NAPA) is essential in order to evaluate the vulnerability of the country and put forward priority measures and activities aiming at reducing the adverse effects of climate change and apply forecast policies in order to be able to react to future disasters.

As a financial mechanism of the conventions signed in Rio de Janeiro, the Global Environmental Facility (GEF) also recognised this need by launching a project entitled: “**Preparation of the climate change National Adaptation Plan of Action (NAPA)**”. This is a mechanism designed to assist the least developed countries to identify priority activities with a view to meet their urgent and immediate needs and concerns relating to adaptation to the adverse effects of climate change.

Since the ratification of the United Nations Framework Convention on Climate Change (UNFCCC) in April 1997 and the Kyoto Protocol in 2001, Burundi successfully tried and made two planning exercises that led to the elaboration of two important documents in this sector.

These include the First National Communication on Climate Change produced in 2001 and, presently, the climate change National Adaptation Plan of Action.

Throughout the development process of these two complementary instruments, the major challenge was to adopt a step that could contribute to reach a broad consensus nationwide on the climate change issue.

In the specific case of the recent exercise of developing the climate change National Adaptation Plan of Action that started in July 2005, the question was to identify a series of priority solutions of adaptations to the adverse effects of climate change through the most vulnerable various socio-economic sectors of the country, i.e.:

- Water resources
- Agriculture
- Energy;
- Landscapes and natural ecosystems;
- Health

With reference to the diagnosis made by Burundi about these sectors, our clear conviction is that capacity building for adaptation constitutes a real reason for hope for better adaptation to the various disasters induced by climate change and will develop accrued awareness on climate change issues at all levels.

Thus, efforts must be deployed in the implementation of these adaptation development policies with the active participation of Burundians and the friends of both Burundians and Burundi.

We should therefore express our thanks towards the Burundian population and the national institutions that took part in the development of the climate change National Adaptation Pan of Action. Our thanks are also addressed to the United Nations Development Programme (UNDP), the Secretariat of United Nations Framework Convention on Climate Change (UNFCCC) and the Global Environment Facility (GEF), which continually accompany Burundi in its splendid mission of implementing the obligations endorsed by the country by ratifying this Convention.

Mrs Odette KAYITESI

***Minister for Land Management,
Tourism and Environment.-***

Executive Summary

Introduction and setting

Burundi general features

Burundi, a landlocked country in the middle of Central Africa covers an area of 27,834 km². Its relief forms a complex of five geomorphologic zones including the Imbo floodplain, the Congo-Nile watershed, the central plateaus and the depressions of Bugesera and Kumoso.

The climate varies according to altitude. The altitudes above 2000 m, materialised by the Congo-Nile watershed have mean precipitation ranging between 1400 mm and 1600 mm and annual mean temperature oscillating around 15°C with the minima sometimes going as down as 0°C. The central plateaus, whose altitude oscillates between 1500 and 2000 m, receive approximately 1200 mm of annual precipitation with 18 to 20°C of average temperature. The zones of altitudes below 1400 m in the Imbo floodplain and the depressions of Kumoso and Bugesera have annual mean precipitation below 1200 mm and sometimes below 1000 mm, and average annual temperature above 20°C.

The country is divided into two large catchments areas: the Nile basin that includes on the one hand the Ruvubu and its tributaries and on the other hand the Kanyaru, Kagera tributaries, and the Congo River basin.

Despite these wealthy water resources, water in Burundi is a vulnerable resource, limited by a variety of factors including particularly the frequent unfavourable climate conditions in some areas and the unequal space-time distribution of rain water.

The terrestrial ecosystems include forest ecosystems and aquatic ecosystems. A considerable sample of these natural ecosystems has a formal statute of protection.

Environmental stresses

The current environmental situation in Burundi shows three major problems, i.e. degradation and exhaustion of soils, degradation of forestry resources and human environmental degradation. The impoverishment of soils results from several causes; the most important of them are the strong demographic growth that entails excessive pressure on the arable lands and natural resources, as well as reduced natural spaces. The degradation of forestry resources also relates to the natural vegetation and artificial woodlots. The human environmental pollution is related to the precarious state of the sanitation infrastructures and consequently the degradation of sanitary conditions for most of inhabitants.

Variability and climate change disturbance

In Burundi, climate disturbance was recorded in the various areas of the country and had more or less important consequences on man and his environment.

In the area of Imbo, long dryness is at the origin of gradual reduction in water resources, with an important fall in the level of Lake Tanganyika, and drying up of water sources in the area, and a certain tendency to desertification. In case of heavy rains, one witnesses serious floods and a recrudescence of waterborne diseases such as cholera and bacillary dysentery, etc.

In the area of Mumirwa, dryness entails reduced water resources and a fall in agricultural production; heavy rains cause local strong erosion and flood in the Imbo floodplain below followed by destruction of the infrastructure, especially roads and houses in the city of Bujumbura.

In the central plateaus area, dry seasons tend to be long and go up to 5 - 6 months. The late beginnings of the rainy season and the early end of the same are at the origin of disturbance of the farming seasons and the drying of crops. Dryness causes the drying up of a considerable number of drinking water points, whereas the too abundant rains cause floods with important losses in agricultural production.

In the northern and eastern depressions of the country with existing weak rainfall, the irregularity and reduction in precipitations already caused drying up of the shallow water sources and reduction in the agricultural productions, with consecutive malnutrition, diseases, exodus and begging practice. In the event of heavy rains, floods are observed in the marshes of Malagarasi and Kanyaru, causing enormous losses in agricultural production.

FRAMEWORK FOR ADAPTATION PROGRAMME

Current/potential variability and climate change

Current climate variability and climate change

Analysis of the temporal evolution of precipitations in Burundi during the last 60 years reveals a cyclic character, at intervals of more or less 10 years, of alternated periods of surplus with those of rainfall deficit compared to the normal. Conversely, analysis of the change in mean temperature shows a persistent rise of temperature compared to the normal. The average temperature in the area increased from 0.7 - 0.9° C since the 1930s.

Since 1999, one observes strong variability of rainfall with a tendency towards a long dry season from May to October (6 months) in the lower altitude areas and the central plateaus.

Potential climate variability and climate change

Simulation results of the climate change at the 2000-2050 temporal horizons (First National Communication, 2001) give, in the case of the high sensitivity corresponding to the top emission of greenhouse gases (GHGs), the following projections:

- A total rise in rainfall varying from 3 to 10%, with however a reduction by 4 to 15% for May (end of the rainy season) and October (beginning of the rainy season). The cyclic character of rainfall, with alternation of poor precipitations periods and those of periods of dryness should continue.
- A rise in the average temperatures by 0.4°C every 10 years, i.e. an increase of 1.9 °C in the 2050s.

Real /potential adverse effects of climate change

In the event of rainfall deficit, the effects will include dryness, late rains, famine, deficit of water for various uses, fall in livestock and agricultural production, loss of human lives and biodiversity, degradation of vegetable cover, bush fires, migrations of the population and cattle, drying up or reduction of the level of dams and rivers, and reduced hydropower energy.

In the event of rainfall excess, the effects will include rain erosion, losses of harvests, losses in human and animal lives, losses of habitats for the species, destruction of the infrastructures, landslide,

windfall of the trees, eruptions of parasitic diseases, intestinal diseases and nutritional deficiency diseases, sandbanks/silting of rivers and lakes, floods of lowlands and marshes and deterioration of water quality.

In the event of high temperature, the adverse effects will include the thermal stresses, recrudescence of respiratory diseases and vector-borne diseases, higher consumption of water, increased evapotranspiration and evaporation, acceleration of bush fires.

In the event of lightning, thunder and hail, one will see the following effects: death of cattle and people, bush fire in forests and woodlots, food insufficiency, falling of blossoms in crops, destruction of large trees and lower agricultural output.

NAPA FRAMEWORK

Relations of NAPA compared to national development goals

Climate change and national economy

The synthesis of vulnerability studies shows that all the vital sectors of the national economy are affected by the phenomena of variability and climate change. The socio-economic consequences are very much felt since they relate to people living primarily from natural resources.

Agriculture, especially rain fed agriculture, occupies 94% of the working population, contributes to more than 50% of the GDP, provides 95% of the food contributions, and more than 80% of the foreign income. Wooded forests and woodlots constitute the main source of timber for construction and forest energy and industry, and rain water is vital for the arable lands and the regulation of rivers on which depend hydropower stations and irrigated farming. All these sectors of crucial importance in the economic life of Burundi are dependant on rainfall conditions. They are thus very vulnerable to climate variability. Climate shocks always result into food crisis, shortage of energy resources and many other calamities.

NAPA and national development policy

The objectives of the Poverty Reduction and Growth Strategy Paper (PRWSP), which clarifies the overall macro-economic, structural, thematic and sectoral policies in order to determine a vision and objectives of the long-term development. The PRWSP provides axes of interventions whose majority deal directly or indirectly with the attenuation of the adverse effects of climate variability and climate change. NAPA, which therefore materialises a clear political will, finds here an enabling environment for its application by the Government of Burundi.

Synergy between NAPA and U.N. environmental policies

Research of synergy is a requirement in the development of NAPA. According to the NAPA guidelines, the articulation of this programme must be done in conjunction with the other country priority programmes, especially those governed by two other U.N. environmental conventions, i.e. the United Nations Convention to Combat Desertification (UNCCD) and the Convention on Biological Diversity (CBD); the objective of this is to make the most of the activities envisaged by each agreement while avoiding duplication.

NAPA goals, objectives and strategies in Burundi

The objective of NAPA is to produce a list of priority actions that are urgent and immediate and that contribute to the efforts of adaptation of the country to the adverse effects of climate change, and

which are integrated in the country development strategies, and which can benefit from the support of interested donors, since Burundi has very limited capacities of adaptation. The actions will also include human and institutional capacity building.

NAPA Burundi barriers to activity implementation

Barriers in the implementation of NAPA activities might be financial, and might also derive from the weakness of institutional framework of implementation.

INVENTORY OF MAIN ADAPTATION NEEDS

Past and current practices of adaptation

The traditional practices of adaptation to the adverse effects of climate variations consist in the displacement of population towards areas less affected by the extreme events; judicious succession of the species cultivated according to the intensity of precipitations; adaptation of the agricultural calendar to the changing cycle of seasons; introduction and adoption of new cultivated species; conservation of the genetic resources in the form of spikes and seeds and by repetitive planting out and propagation by cuttings for the adequate crops; cattle transhumance; replacement of the bovines by the smaller livestock; traditional and religious respect of certain wooded zones and thickets; maintenance of practices introduced by the colonial government like firewalls, protected areas, and state woodlots.

Relevant solutions of adaptation

Some options are proposed for adaptation to the periods of rainfall deficit with the subsequent dryness, while other solutions concern adaptation to periods of precipitations above the normal, but most of actions are valid in both situations.

Options suggested by the sector or under-sector under review are presented at Table 3. Regroupings and analysis made it possible to draw fourteen (14) options.

SELECTION CRITERIA OF PRIORITY ACTIVITIES

The fourteen selected options of adaptation have been weighted for criteria and prioritised. The resulting list is as follows:

- Improve the seasonal early warning climate forecasts;
- Preserve existing woodlots and reforest the stripped zones;
- Reinforce the management of the existing protected areas and protect the threatened and vulnerable natural ecosystems;
- Popularise rainwater harvesting techniques for agricultural or domestic use;
- Set up erosion control mechanisms in sensitive areas;
- Establish and protect strategic buffer zones in the floodplain of Lake Tanganyika and around the lakes of Bugesera;
- Identify and popularise dryness resistant forest species;
- Popularise short cycle and dryness resistant food crops;
- Popularise the zero grazing techniques;
- Identify and popularise the improved techniques of wood use and new renewable energies;
- Control the river dynamics of watercourses and the torrents in Mumirwa, including the city of Bujumbura;

- Train and inform the decision makers and other partners, including the local communities, on the methods of adaptation to climate variability;
- Identify and popularise the breeding of species adapted to local climate conditions;
- Multiply hydropower micro stations.

PRIORITY PROJECTS

Based on these prioritised options, a set of 12 priority projects were formulated. The other projects considered to be important at the sectoral level are indicated at Table 4 in appendix.

NAPA PREPARATION PROCESS

The development of NAPA followed a participatory process, both at national and local levels.

The final NAPA document, drafted by the National Coordination with the assistance of two consultants, was also validated according to the same procedure before being submitted to the Government for endorsement and incorporation into other national policies.

I. INTRODUCTION AND SETTING

The climate change National Adaptation Plan of Action (NAPA) is a mechanism, within the United Nations Framework Convention on Climate Change (UNFCCC), specific to the Least Developed Countries (LDCs) and designed to assist them to identify priority options of adaptations to face the adverse effects of climate change. NAPA also constitutes the lever to a dynamics of financing the priority options thus identified by development partners. Burundi belong to these LDCs and is at the same time signatory, having ratified all conventions resulting from Rio, i.e. the UNFCCC and its protocol known as “Kyoto Protocol”, the Convention on Biological Diversity (CBD) and the Convention to Combat Desertification (CCD). Burundi also made its first national presentation on climate change in 2001.

For this reason, since August 2005, Burundi successfully started an exercise of preparation of NAPA, a process that followed all the stages envisaged through related guidelines.

Considering the climate disturbances (dryness, floods, and heavy rainfalls) observed last years over the region, Burundi is very much concerned about working out an action plan of adaptation to the adverse effects of climate change. For this, it is crucial to clearly understand the Burundi climate system and its new trends in order to suggest suitable actions of adaptation. Having this view in mind, vulnerability studies were undertaken in the sectors considered to be a priority, i.e. agriculture, water resources, energy, health, natural landscapes and ecosystems. The conclusion of these various studies is that Burundi is most vulnerable to climate change and presents a very low capacity of adaptation given its precarious socio-economic situation for a country that is stepping out of war that lasted for more than ten years.

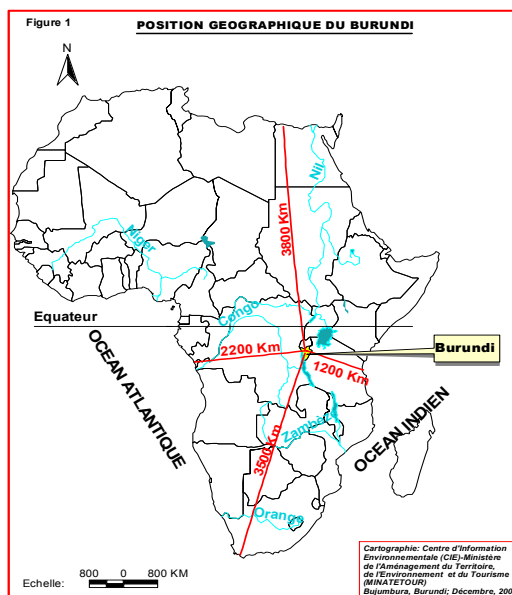
Thus, this NAPA document comes at the right moment, and, hopefully constitutes a baseline document making it possible to carry out reasoned interventions of adaptations to climate change.

I.1. Burundi General Features

I.1.1. Biophysical Features

Geographical situation

Burundi is a landlocked country in the middle of Central Africa with a highly diversified environment (Fig.1). It covers an area of 27,834 km² including 25,200 terrestrial km² and extends between the meridian lines 29°00' and 30°54' East and the Southern parallels 2°20' and 4°28'. It is bordered to the North by Rwanda, to the East and the South by Tanzania and to the West by the Democratic Republic of Congo.



Burundi NAPA

Fig. 1 Burundi Geographical situation in Africa

Relief

The relief of the country is typical of the Eastern Africa great rift region that gave place to the formation of Lake Tanganyika in a trough fault in the West and a set of plateaus with a strongly cut out relief in the East.

The whole of this relief forms a complex of 5 geo-morphological zones that are diversified enough, including the Western plain located between 775 and 1000 m of altitude, the Western highlands forming the Congo-Nile watershed and located between 1000 and more than 2600 m of altitude, the central plateaus covering most of the country and located between 1400 and 2000 m of altitude, the Eastern depression of Kumoso located between 1200 and 1400 m of altitude and the depression of Bugesera at the North-East of Burundi and located between 1200 and 1500 m of altitude.

Climate

The topographic design of Burundi is accompanied by the variation of climate according to altitude, which confers important geo-climate diversity on the country (Fig.2). Altitudes above 2000 m, materialised by the Congo-Nile watershed, are sprinkled with mean precipitations ranging between 1400 mm and 1600 mm and have annual mean temperatures oscillating around 15°C with minima temperature sometimes going as down as 0°C. These climate conditions (high rainfall and low temperature) make of this milieu in the tropical zone of mountain, a place privileged for the formation of rain forests. The mean altitudes, grouped under the term of central plateaus and oscillating between 1500 and 2000 m, receive approximately 1200 mm of annual precipitations with 18 - 20°C of annual average temperatures. Altitudes below 1400 m represented by the plain of Imbo and the depressions of Kumoso and Bugesera have annual average precipitations below 1200 mm and sometimes below 1000 mm like Imbo, with minima temperatures reaching 500 mm. Annual mean temperatures are above 20°C.

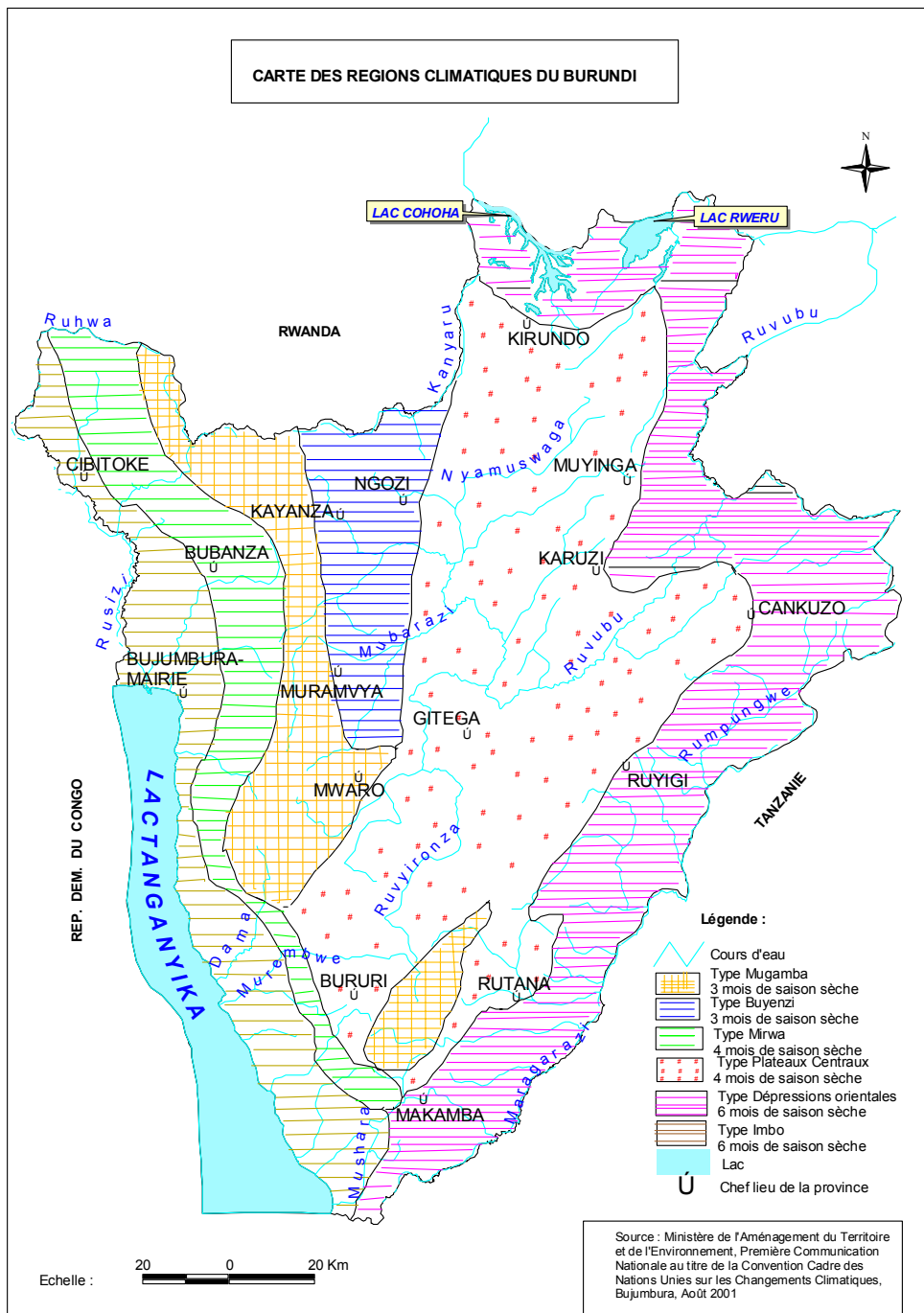


Fig. 2: Burundi Climatological Regions

Hydrology

The country is divided into two large catchments areas: the Nile basin that includes on the one hand Ruvubu and its tributaries and on the other hand Kanyaru, tributary of Kagera; and the Congo basin made up of two sub-basins: a sub-basin located to the West of the Congo-Nile watershed formed by Rusizi and its tributaries and Lake Tanganyika; and the sub-basin of Kumoso located to the East of the country where runs Malagarasi and its tributaries.

Compared to most African countries, Burundi enjoys relatively abundant water resources. During years with normal rainfall, Burundi receives abundant precipitations except in its peripheral parts in the West, the East and the North-East.

The surface waters, which include the whole of rivers and lakes, constitute the country internal resources available. According to the National Water Master Plan, surface waters amount is approximately 10 billion m³ for the whole country.

Regarding the underground water resources, Burundi has sources of approximately 6,600 litres of water per second (MINATTE, 1998). Imbo, Kumoso and Bugesera are the natural regions with the weakest sources. Conversely, the high altitude regions of Mugamba, Mumirwa and Bututsi are well provided with spring water with specific flows above 0.3 l/s/km² (MINATTE, 1998).

In-depth sources are on the other hand more abundant in the natural regions of Imbo and Kumoso. The region of Bugesera (in the North-East) is most underprivileged with regard to the total water resources.

Despite this wealth of hydrous resources, water in Burundi is a limited and vulnerable resource: it is limited by diverse factors, including the often unfavourable climate conditions in certain regions, the unequal space-time distribution of rains and the need for sharing the water resources available with neighbouring countries.

Pedology

The soils, usually feral-soils or ferri-soils, are poor in altitude. One witnesses tropical brown soils and litho-soils on the slopes and the peaks. Organic and boggy soils characterise the lower marshy valleys.

Flora and Fauna

The vegetation of Burundi is distributed in diversified ecosystems and under several phyto-geographical influences. Typically, it can be distributed into terrestrial and aquatic ecosystems.

The terrestrial ecosystems include forest ecosystems with rain mountain forests on the highlands located between 1600 and 2600 m of altitude, forests of mean altitude appearing as clear forests and gallery forests located between 1000 and 1600 m of altitude, and low altitude forests located between 775 and 1000 m of altitude.

Savannas occupy part of the East, the North and the plain of Rusizi. Thickets are met in the North of Burundi (Bugesera) and in the Rusizi floodplain. Lawns and steppes are types of vegetation forming mainly the pastures of Bututsi and part of Mugamba and Kirimiro. The aquatic ecosystems include marshes, lakes (Lake Tanganyika and Northern Lakes), ponds and watercourses.

A considerable sample of these natural ecosystems benefits from a formal statute of protection. Burundi has 14 protected areas distributed in 4 categories: National parks, Natural Forest Reserves, Natural Monuments and Protected Landscapes. These areas cover a surface of approximately 127,662 hectares.

The vascular flora of Burundi is estimated at 3500 species. Fauna is represented by vertebrates relatively well known and invertebrates very little studied. For vertebrates, the inventory reports 163 species of mammals, 716 species of birds, 52 species of reptiles, 56 species of amphibians, 215 species of fish and several invertebrates, including insects, arachnids, crustaceans and molluscs.

Regarding the artificial forest resources, 67 species whose total is quite exotic, constitute the forestry and agro-forestry area. Woodlots represent more than 120,000 ha.

Cultivated species are mainly dominated by food crops with 23 species, foreign income crops with 7 species, as well as fruit-bearing and market-gardening crops. Globally, food crops account for 87% of the production, coffee: 8%, cotton, tea and sugar cane: 1.7%, and the rest: 3.3%.

The domestic animals met in Burundi are, by order of numerical importance, mainly made up of goats (2 breeds), poultries, bovines (5 breeds), sheep (1 breed), rabbits and porcine.

I.1.2. Socio-economic Features

Population

Burundi currently counts approximately 7, 2 million inhabitants. The average demographic density is 280 inhabitants by km². With a demographic growth of approximately 2.96% and an average 7 births per woman, it is certain that this density will continue to increase and could double in 20-23 years. The death rate is relatively high. With the crisis, it increased from 15 to 17 per thousand between 1993 and 1998. The Burundian population is young. The population below 15 years is estimated at 46.2%, while that of 65 years of age is approximately 2.3% (SP/REFES, 2006).

Socio-political situation

Burundi undergoes, since approximately 15 years a crisis that is the base of amplification of the poverty level for the Burundian population. The recent evolution of the political situation materialised by the cessation of hostilities between the Government and the principal rebellious movements and the installation of the democratically elected institutions makes that Burundi can, currently, face its challenges of fighting against the extreme poverty and promoting a sustainable development.

Socio-economic situation

Burundi is subjected to generalised poverty that worsened since 1993. Primarily agricultural, with an average density of more than 280 inhabitants per km², Burundi appears among the poorest countries of the planet with a Gross National Product (GNP) per capita of about US\$110.

The gravity of this poverty constitutes a major risk for economic and social recovery of the country (Table 1). Approximately 58.4% of the population lives with less than US\$1/day, and approximately 89.2% of the population lives with less than US\$2/day.

The Burundian economy goes through important structural rigidities, such as dominant food agriculture but with very low productivity, a limited exporting capacity and clear regression with regard to its principal foreign income generating product, i.e. coffee, or a secondary industry with very limited fabric and heavily handicapped by its isolation.

The data in Table 1 also highlight poor educational levels, access to modern health services, and drinking water, especially in rural areas. The single source of energy in this same rural area is wood. The young people are obliged to exert little remunerated work for individual and family survival.

The social sector was seriously affected by the socio-political conflicts that prevailed in the country since the 1993s. This situation entailed considerable fall of production in almost all the sectors of the national economy and resulted into aggravated poverty.

The GDP decreased by 3% on average per annum, bringing to date the cumulated fall of production at 30%, and a reduction of the per capita income up to US\$ 83 in 2004, whereas this was US\$ 214 in the early past decade, which was already definitely below compared to other African countries and the average sub-Saharan Africa that is estimated to be above US\$ 500 (Fig.3).

Life expectancy birth fell from 51 years in 1993 to less than 42 years in 2005. This deterioration of living conditions is reflected in the graph below that shows the evolution of per capita incomes (Fig.4).

Table 1: Burundi Socio-economic Indicators

Indicators	Year 1998	Year 2002
<i>1. Data on the population</i>		
Population	6,025,000	7,032,000
Density (inhab/km ²)	251.6	280.9
Natural growth rate (in %)	3.0	3.0
Rate of fertility	6.7	6.5
<i>2. Related health and services</i>		
Life expectancy	48.5	48.0
Pop. by doctor (in thousands)	29.2	40.1
Vaccine cover rate	47.2	91.0
Rate of morbidity (in ‰)	20.7	38.1
<i>3. Access to drinking water</i>		
In rural area (in %)	42.9	43
In urban environment (in %)	75.8	95
<i>4. Access to energy</i>		
Wood, charcoal and sub-products		96,8
Hydropower (in %)		0.5
Oil products		2.5
<i>5. Education</i>		
Rough rate for all levels (in %)	44.7	40
Literacy above 15 years of age (in %)	49	45.2
<i>6. Other data</i>		
Gross national product (GNP/inhab. in US\$)	129.3	110.0
Children 7-14 years/labour market (in %)	30.6	23.5

Source: UNDP, 2005

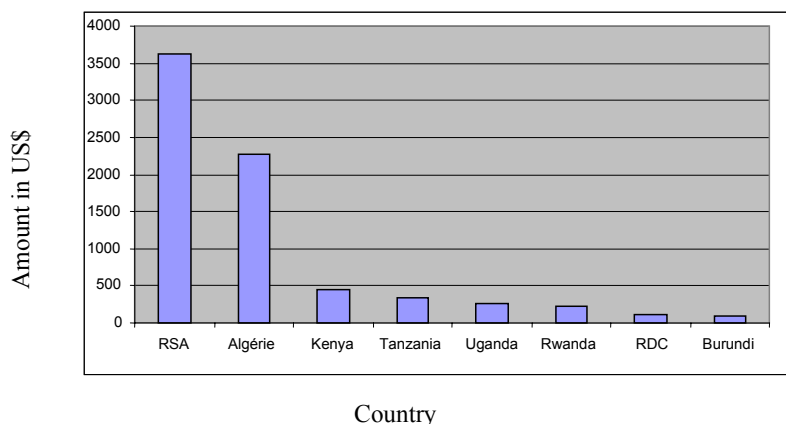


Fig. 3: Comparison of per capita income in some African Countries

Source: Mini Atlas of the Millennium Development Goals, the World Bank, (2005) in SP/REFES, (2006)

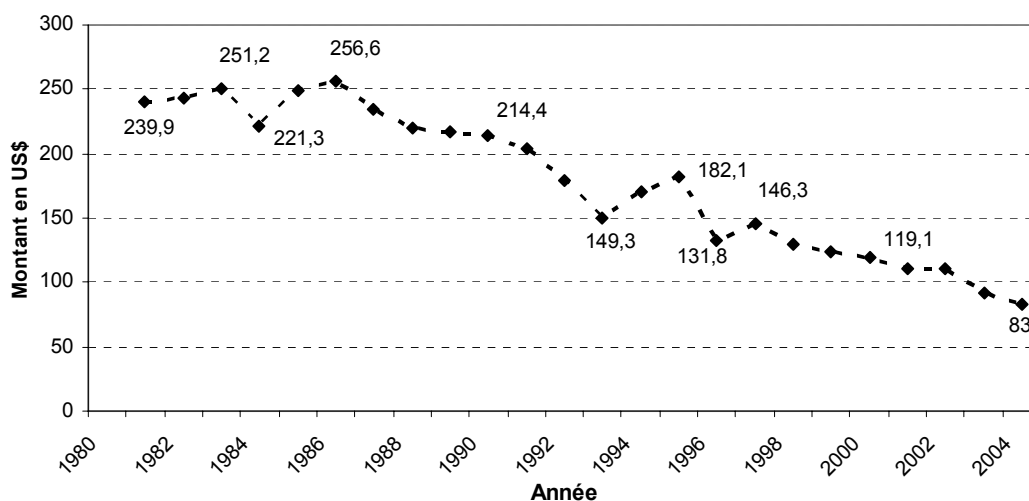


Fig. 4: Evolution of per capita income.

Source: ISTEERU, Databases, (2005) in SP/REFES, (2006)

I.2. Environmental Stresses

The current environmental situation in Burundi emphasises three major problems, i.e.:

- Soil impoverishment;
- Biodiversity degradation;
- Human environmental pollution.

Soil impoverishment is a result of several causes, the most important of which remains the strong demographic growth that implies excessive pressure on the arable lands and the natural resources, as well as reduced natural spaces. Other factors are in particular related to topography, climate, nature of soils, farming methods, overgrazing, succession mode, etc. After testing several techniques, without

success, to face this degradation, the option currently seems to be the mainstreaming of agro-sylvo-pastoral activities.

The degradation of forest resources relates to both natural vegetation and artificial woodlots.

The principal constraints as regards conservation of the natural vegetation particularly include:

- Pressure of the population on resources;
- Persistence of poverty in the population;
- Shortage of financial resources allocated to nature conservation;
- Insufficient environmental education.

To counter this degradation, the Government of Burundi recommends the installation of a policy of implication of the population in the management of protected areas and vulnerable ecosystems.

Regarding artificial woodlots, these were subjected to the pressure related to the installation of disaster victims following the crisis, and the meeting of wood-energy needs and agricultural speculation.

The human environmental pollution relates to the precarious state of the sanitation infrastructure and consequently the degradation of sanitary conditions for most of inhabitants. The level of the services in charge of collecting domestic waste in cities is low and sometimes non-existent.

I.3. Climate Variability and Climate Change Disturbance

In Burundi, climate disturbances were particularly recorded in the various regions of the country and had more or less important consequences on man and his environment (Fig.5).

Burundi went through periods of climate change related famine that are still engraved in the memory of Burundians (Bigirimana and al, 1992, and 1999, UNDP, 2005). These include in particular the famines of the years 1917, 1923, 1931, 1933, 1943 and 1958 nationwide, and 1989-1990 in the regions of Bujumbura Rural, Bururi, Gitega and Muramvya, and 2000 – 2005 in the North-East of the country. Some of these famines are a result of climate change (dryness, excess of rains, hail), whereas others result from calamities such as the invasion of predator insects, including migrating grasshoppers and locusts.

For the calamities of climate origin, one can quote:

- The dryness of the years 1905-1909, 1921-1923, 1925-1928 (40,000 deaths), 1941-1944, 1950, 1974, 1984 and 1999-2000 in the North-East of the country;
- The hail that caused losses in food crops especially in the central plateaus, Muramvya (Mbuye) and Kayanza in 1990, Ngozi (Gashikanwa) and Bujumbura (Kanyosha) in 1989, and in Gitega (Nyamugari and Magarama) in 1991;
- The torrential rains in 1937, 1941, 1950, 1960, 1961 - 1964, 1983, 1986, 1989 and 1991 and especially floods in the city of Bujumbura, particularly in the Asian District in 1964, and Bubanza in 1989, 1997, 1998 and today, which caused regular cuts of roads combined with landslides and enormous damage on the infrastructures and the population. The most important damage was caused by the rise of the level of Lake Tanganyika between 1961 and 1964; its level increased by 4 m and the highest coast arrived at 777.6 m in May-June 1964. The districts of Bujumbura neighbouring the lake and the village of Gatumba were all flooded, whereas the roads Bujumbura-Uvira and Bujumbura-Rumonge were cut in several places. A food crisis in 2004 and 2005 was compounded by the floods that have occurred in full vegetative period for crops and a few days before bean harvests nationwide.

- In the region of Bugesera, since 1999, there is strong disturbance of the climate mode that results into very late beginning of precipitations resulting in the loss of harvests, famine, loss of human lives, displacement of population, etc. All the Northern lakes saw their level decreased with a water regression on more than 400 m.
- Violent winds in Bujumbura in 1982 that caused destruction of a part of Bujumbura International Airport and accident of a small plane.
- Since the years 1999 to 2006, the annual evolution shows a shortening of the rainy season in the North-Eastern regions of the country, but with punctually violent rains coupled with thunders and lightning, and an extension of the dry season.

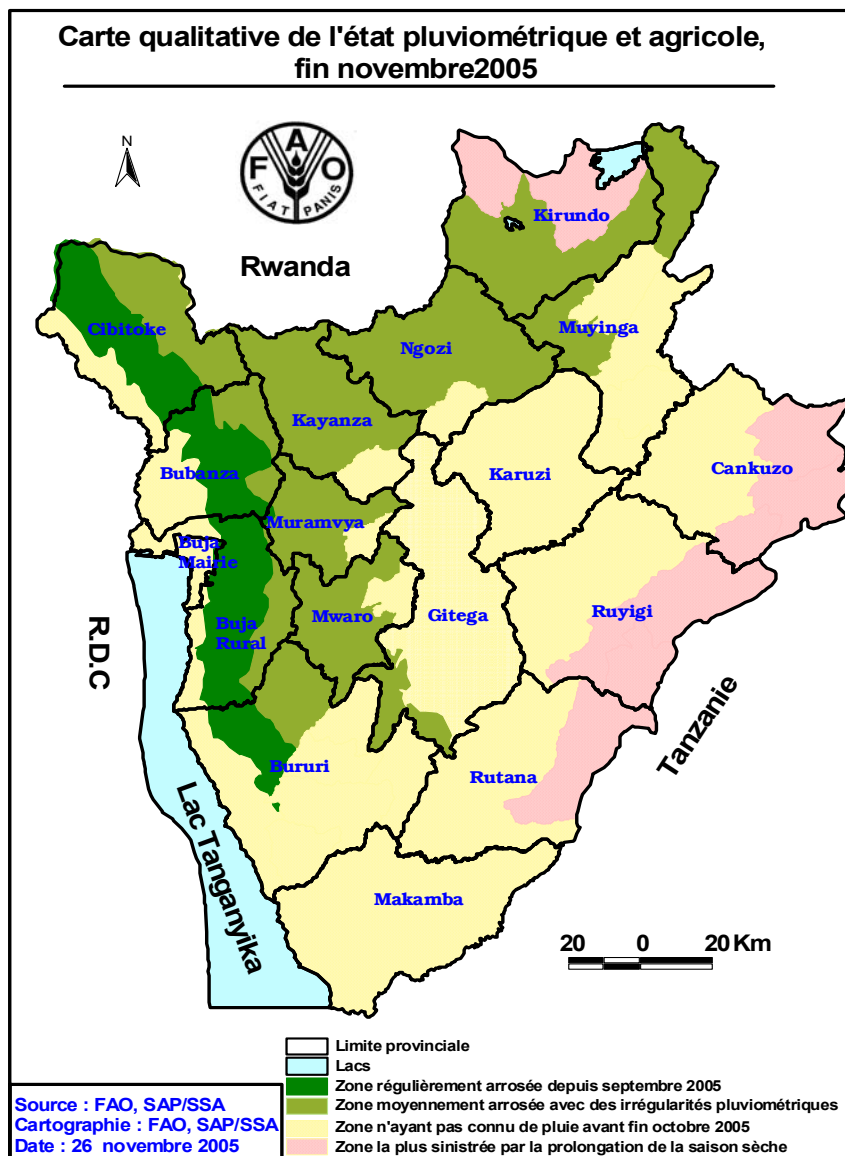


Fig. 5: Rainfall and agriculture qualitative map in 2005

II. FRAMEWORK FOR ADAPTATION PLAN

This chapter describes the witnessed /projected climate variability and climate change as well as the adverse, real and potential effects of these changes. The results are based on studies and research already carried out on various sectors considered in this process, in particular during the preparation of the First National Communication on Climate Change (2001), and on historical information and traditional knowledge.

II.1. Current / Potential Climate Variability and Climate Change

II.1.1. Current Climate Variability and Climate Change

The geographical position of Burundi (closeness to the Equator, i.e. 2° South), should normally confer to Burundi an equatorial climate characterised by abundant precipitations almost all the year long and low thermal amplitudes. However, the climate of Burundi is completely modified by altitude and depends largely upon the general circulation of the atmosphere in the inter-tropical zone dominated by the convergence of the Trade wind on the South-East and that of the North-East. From June to September, we have a dry season whereas from October to May, we have a great rainy season. In January, one generally sees a small dry season which lasts for 15 days.

In spite of this general outline of the seasons, one witnesses local modifications under the influence of the relief like the presence of plains, plateaus, mountainous massifs and the depressions of the North-East. These physical factors determine the distribution of the climate parameters, namely the temperatures of the air and precipitations.

Space distribution of the temperature accurately matches the great oro-graphical sets of the country in the following way:

- The region of Imbo with altitude below 1000 m shows average temperatures between 23 and 24, 5°C;
- The regions of Mumirwa, Kumoso, Buragane and Bugesera record average temperatures between 21 and 23°C;
- In the central plateaus, the temperature varies from 18 to 21°C;
- On the Congo-Nile watershed, the average temperature varies from 15.8 to 18°C.

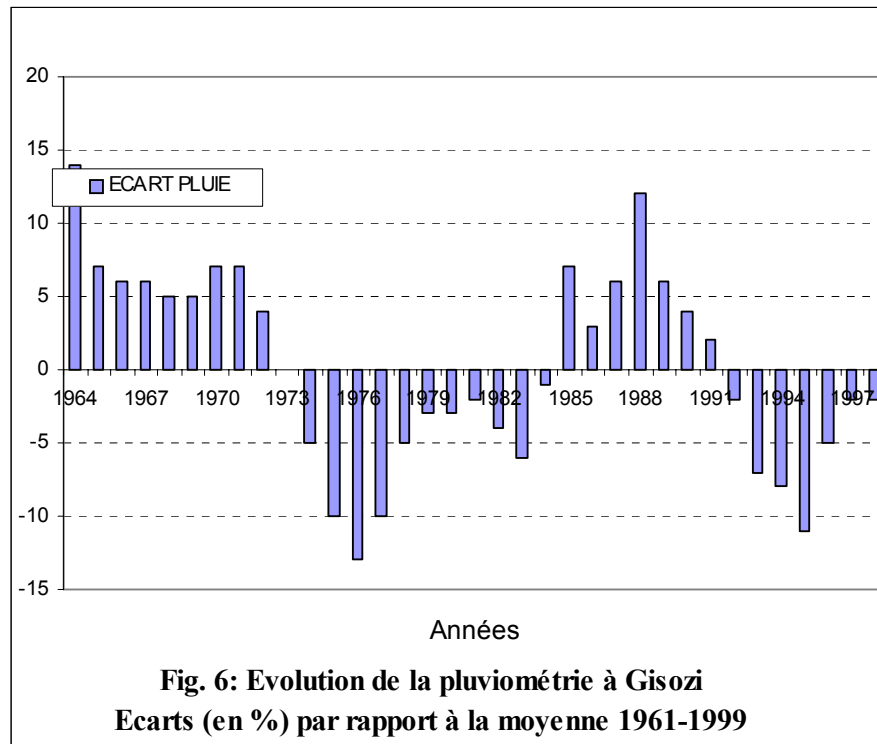
In the same oro-graphical sets, average precipitations are distributed as follows:

- The zone of Northern Imbo with less than 900 mm/year;
- The zone of Mumirwa, Kumoso, Buragane and of Bugesera with a rainfall ranging between 1000 and 1300 mm/year;
- The broadest zone of the central plateaus, with an annual average rainfall ranging between 1200 and 1600 mm/year;
- The zone of the Congo-Nile watershed, which records more than 1600 mm/year.

It is important to note that since 1999, there is a strong variability of rainfall mode with a tendency of a long dry season from May to October (6 months) in the lower altitude outlying areas (Kumoso, Bugesera, Imbo). In the communes of Bugesera (Busoni, Bugabira in Kirundo Province and Giteranyi in Muyinga Province), the environment tends towards desertification.

Analysis of the temporal evolution of precipitations in Burundi over one longer period reveals a cyclic character, at intervals of more or less than 10 years, and alternation of periods of surplus with

those of rainfall deficit compared to the normal (Fig.6). On the other hand, analysis of the change of the average temperature shows a persistent rise of temperature compared to the normal. The average temperature in the region increased from 0.7 to 0.9°C since the years 1930.



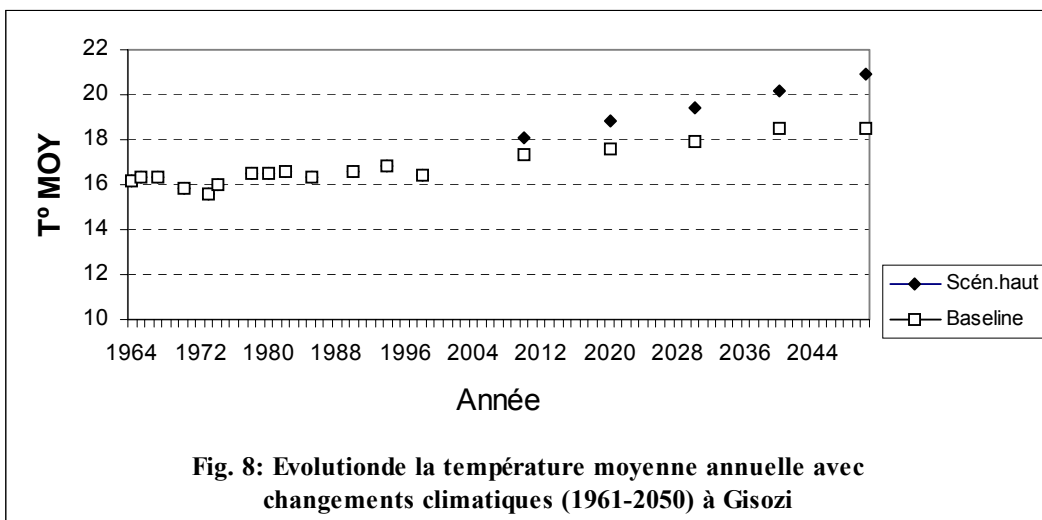
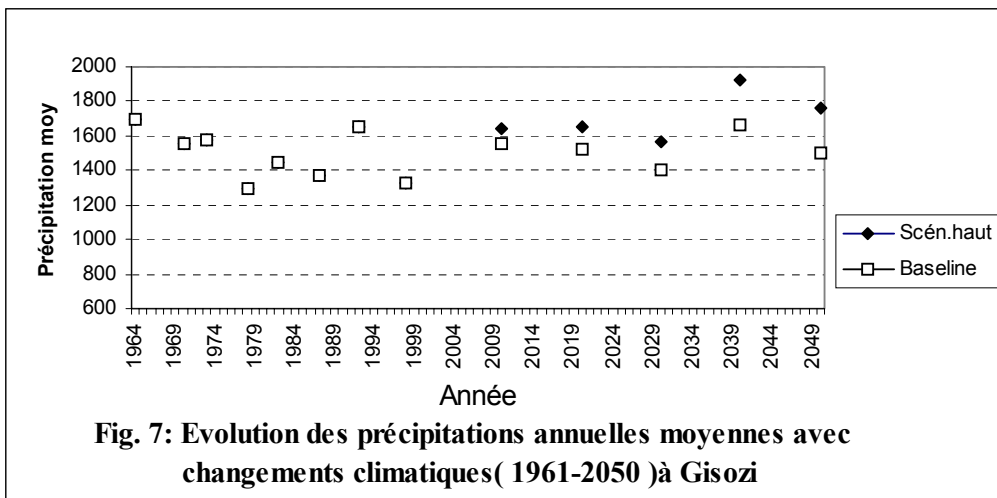
**Fig. 6: Evolution de la pluviométrie à Gisozi
Ecarts (en %) par rapport à la moyenne 1961-1999**

Source: MINATTE, (2001)

II.1.2. Potential Climate Variability and Climate Change

The simulation results of climate change at the temporal horizons 2000-2050 according to MAGIC SCENGEN model (First National Communication, 2001) give, in the case of the high sensitivity corresponding to the top emission of GHGs, the following projections (Fig.7 and Fig.8):

- One should get a total rise of rainfall varying from 3 -10%, with however a reduction by 4 - 15% for May (end of the rainy season) and October (beginning of the rainy season). The cyclic character of rainfall, with alternation of periods of deficit precipitations and those of dryness periods should continue.
- Average temperatures should increase by 0.4°C every 10 years, i.e. an increase of 1.9°C in the year 2050.



II.2. Real /Potential Adverse Effects of Climate Change

Studies on the evaluation of adverse effects of climate change on various sectors show that the periods of rainfall deficit/prolonged dryness and strong precipitations will have several consequences, including (Table 2) (Fig.9):

- Degradation of the vegetable covers;
- Loss of biodiversity and modification of the settlements;
- Bad agricultural outputs and loss of harvests leading to famines in rural areas;
- Slimming of animals and loss of livestock production,
- Shortage of water for domestic use;
- Famines and displacement of population;
- Proliferation of vector-borne diseases like meningitis and paludism;
- Recrudescence of water-borne diseases like dysentery and cholera;
- Silting of dams;
- Non-producible discharges affecting productive facilities of the population downstream from the hydropower stations;
- Landslides and destruction of electric pylons in some localities.

- Reduced level and useful volume of the dams of the existing hydropower stations resulting into huge energy deficits;
- Etc.

Table 2: Inventory of the most common climate risks and related impacts in Burundi

CLIMATE RISKS	Adverse effects and related risks	Economic impact	Losses in human lives	Duration, days	Spatial area, km ²	Frequency	Tendency
Rainfall deficit (Dryness)	Dryness, late rains, famine, deficit of water for various use, decreased livestock and agricultural production, loss of human lives and biodiversity, degradation of vegetable cover, bush fire, migration of population and cattle, drying up or lower level of dams and rivers, reduced hydropower energy.	3	3	3	4	2	Important
Rainfall excess: Pouring rain/Floods, hail	Rain erosion, losses of harvests, losses in human lives, losses of habitats for species, destruction of infrastructures, landslide, wood windfall, eruptions of parasitic diseases, waterborne diseases and nutritional deficiency diseases, the blocking/silting of rivers and lakes, floods of lowlands and marshes, deterioration of water quality	3	2	1	3	2	Important
Excessive temperatures (extreme)	Thermal stress, recrudescence of respiratory diseases and vector borne diseases, high consumption of water, increased evapotranspiration and evaporation, acceleration of bush fires.	2	1	2	4	2	Average
Flashes, thunders and lightning	Death of people and cattle, fire to forests and woodlots, food shortage, falling of blossoms in crops, destruction of large trees and infrastructures (communication and power), reduced output	1	2	1	2	1	Average

Caption: a. Economic impacts: 1 = not very prejudicial; 2 = Fairly prejudicial; 3 = too prejudicial

b. Losses in human lives: 1 = 1-9 people per event; 2 = 10-99 people by event; 3 = 100-999 people by event; 4 = more than 1000 people per event.

c. Duration, days: 1= 1-9 days, 2 = 10-99 days, 3 = 100 days (1 season), 4 = more than one year

d. Space extent (km²): 2 = 10-99 km²; 3 = 100-999 km²; 4 = 1000 - 9999 km²; 5 = 10.000 km² and above

e. Frequency: 1 = 1-20 % probability; 2 = 20-40%; 3 = 40-60%; 4 = 60-80%; 5 = 80-100%.

f. Indicators of tendency: = Important increase; Average increase;

- **Water resources**

For ten years ago, these water resources are in gradual reduction due to bad space-time distribution of precipitations, and the North-East regions (Kirundo-Muyinga) are severely affected by dryness tending towards desertification.

Climate models of general circulation of the atmosphere show that in the absence of climate change, water resources in Burundi will continue to decrease gradually. This dryness tendency will spread and the consequent reduction in the water resources was confirmed in the First National Communication on Climate Change by 2050.

In the absence of climate change, the projection of the tendency of the flows series over the period 1961-1990 by 2050 shows a gradual reduction in the levels and flows of the rivers and lakes in the country.

The annual average flows of the principal rivers of the country, namely Rusizi and Ruvubu, will be respectively decreased by 24% and 30% over the period 2000 - 2050. In the presence of climate change, the developed scenarios show an increase in precipitations and temperature accompanied by an increase in the flows. In the case of high scenarios of climate change, the flows of the Rusizi and Ruvubu rivers might increase respectively by 36% and 44% from the year 2000 to 2050.

For the periods of pronounced rainfall deficit/dryness, the effects on the water resource are immediate:

- Draining of the terrestrial environments, starting with the increasingly stripped hills
- Drying up of water sources
- Fall of the levels of river courses and lakes
- Draining of the marshes

For the periods of precipitations above the average, the effects of volumes of surplus water are multiple:

- Rise of the level of river courses and lakes;
- Wiping of hills and correlative loss of soil fertility;
- Amplification of erosion on catchments with loss of soil fertility and discharge of solid materials in the lower valleys;
- Floods and silting in lower valleys;
- Deterioration of the quality of water;
- Sedimentation.

- **Terrestrial ecosystems**

The most visible form of climate change events on the terrestrial ecosystems in Burundi is the occurrence of aridity, soil degradation and its corollaries.

Regarding the sub-alpine stage of mountain forests starting from 2500 m of altitude, the increase in the temperature by 2°C involves attenuated rigor of the climate. The sub-alpine vegetation primarily made up of Ericaceae and the alti-mountain meadows will have to move back and even to disappear on extended areas.

Concerning the afro-mountain stage, gaps on very considerable extents that are occupied by the vegetation of reconstitution of various stages or crops should find barrier to the evolution towards the forest stage following climate change.

Concerning the clear forests and savannas of Eastern Burundi in rather arid zones, the future climate change, combined with frequent farming close-cropped cuts and repetitive bush fires, would pave the way to very acute aridity that will cause very important loss of the biomass and will render aggressive many herbivores and rodents, especially the termites that become uncontrollable in the region. Thus, rock peaks and soils rich in termite tumulus will settle.

Regarding the xerophilous thickets and sclerophyllous forest in the Rusizi floodplain, climate change, combined with the action of man in a very coveted and very arid plain, will induce the installation of a sandy desert.

The xerophilous thickets of Bugesera that is very adapted to the most severe aridity of the country and very degraded milieus and the very rigorous and long dryness will not be able to allow regeneration of the vegetation. The major problems to be envisaged are the gradual disappearance of the thickets with losses of species and aggravation of desertification.

With climate change, the very rigorous and long dryness will worsen the scope of bush fires, which, in their turn will weaken the terrestrial ecosystems.

Wet ecosystems

In Lake Tanganyika, in the event of temperature rise, the current tendency to reduced braced waters (epilimnion) should continue. The permanent availability of nutrients in shallow layers should support more important primary production that might reach eutrophication. This phenomenon of eutrophication, with anarchistic development of algae and floating plants on the surface of water, already observed locally in the offing of Bujumbura in October of each year, should thus extend on the surface with time. Eutrophication should have substantive incidence on the composition of fish fauna. The favoured species will be the surface microphages fish, but the selective predators and the species preferring well oxygenated water depths should rarefy or disappear.

In the littoral zone of the lake, for the surplus periods of precipitations, the average level of the lake will exceed 777 m, with annual amplitudes of more than 130 cm. The lake should cover several hundreds to several thousands of hectares in the sector. In the event of continuation of the climate tendencies mentioned above, the ecosystems of the semi-flooded zone of the Rusizi delta should continue in their current cycle, i.e. flooding of the lagoons of Gatumba during the rainy season, with development of vegetable associations according to the gradients of moisture, and retreat of waters during the dry season till complete draining of the ponds.

During years with heavy rainfall, Bugesera marshes and lakes are full of water, sometimes with strong floods, the return to normal taking more than one year. The principal threat on the wet ecosystems is related to over-silting in lower valleys following intense erosion on steep slopes.

Conversely, during years with rainfall deficit as this was observed since the years 1999, the complex of Bugesera rather loses water with a spectacular reduction in the level of lakes and marshes.

The final disappearance of the lakes of the Akanyaru system could occur even more quickly, if the farmers destroy the vegetable barriers that separate them from the principal river.

- **Agriculture**

The most crucial adverse effect on productivity of crops, following the climate change, is the modification of the agricultural calendar following the disappearance of the small dry season (January and February). With climate change, there might be disturbance of the rainfall mode that will be

finally composed of 2 large 6-month seasons, one rainy season lasting from November to April and a dry season covering May to October.

The disappearance of the small rainy season should be reflected on crops that are very sensitive to fungic diseases. These are crops that were reserved for this season characterised by less intense rains with relatively low relative humidity of the air.

The large rainy season was especially devoted to farming of cereals, crops that are not very sensitive to fungic diseases with a vegetative cycle of about 5 months. Their maturity intervenes during the large dry season and their drying poses no problem. With climate change, the farm, during the large dry season that become very long, will become very difficult, even impossible following the drying of the groundwater before maturity of crops and with high increase in the evapo-transpiration.

In addition to the losses in the agricultural productions resulting from the absence of the small rainy season and harnessing of marshes during the large dry season, with climate change, the productivity of crops should undergo gradual fall in the yields of corn, beans and sweet potatoes, which are the principal crops of food diet in Burundi.

- **Forestry**

As regards forestry, the rises of temperature and the strong precipitations resulting from climate change should appear through the modification of the periods and the rhythm of growth of trees, but also the rhythm of their distribution and their productivity according to the ecological.

The disturbance of the rainfall mode, as in the case of agriculture, should be reflected over the periods of preparation of seedbeds. The period of preparation of seedbeds (May-June) would have certainly to change to allow the seedlings to continue growing in rainy seasons. One could also consider abandoning the production in seedbeds of some vegetable species that are unable to resist high temperatures. However, some very resistant species should see their space of predilection increased.

- **Livestock**

The sector of livestock is also affected by climate change. The extreme climate phenomena (case of prolonged dryness, floods) might modify the limits of the pastoral vegetation, the quality and quantity of fodder, the duration of the season of vegetable growth, the animal productivity and water quality.

In case of prolonged dryness, pastures are not renewed and become rare, which decreases the dairy output and makes the bovines skeletal. The solution of setting fire to hillsides to search for tender grass becomes ineffective and finally degrades pastures. The frequently concerned areas are those of the North-East and the East of the country.

The deficit of pastures and crops composing foodstuffs leads the stockbreeders to migrate towards favourable zones with all the risks of diseases caused by promiscuity.

Fishing and fish farming are also disturbed by climate variability and climate change. The conjunction of several factors unfavourable to the fishing and fish farming practice involved deep modifications in the operation of aquatic ecosystems, hence affecting piscicultural stocks and the life of the artisans-fishermen. In the same way, the high temperatures induce a rise in evaporation, thus contributing to early draining of the water points and causing a fall in the fish-farming production.

- **Energy**

Climate change also affects the hydropower resources and wood-energy. Climate also influences the consumption and transmission of electricity. The hydropower resources are dependant on the flows of the various rivers which depend on their turn upon the height and the frequency of precipitations. An energy deficit is predicted for the periods of weak rainfall, as it is the case for the current rainfall experienced by the country since 2000.

The technical and non-technical losses recorded by the Burundi National Power Company (REGIDESO) were approximately 23% in 2004. The level of these losses could increase with temperature, since the resistance of a conducting material depends on the prevailing temperature.

Wood constitutes the energy resource the most consumed at the national level (95%). The distribution of the temperature induces more or less great use of wood-energy, the cold areas consuming more wood than hot areas.

The use of new and renewable energies (solar, wind energy, biogas) is still negligible in Burundi, but climate change risks could limit the development of these alternative energies:

- Solar energy depends on the level of sunning, which could drop during the uninterrupted rainy periods, thus reducing the output of the photovoltaic installations.
- Precipitations accompanied by violent winds could break the structures of the wind energy.

- **Health**

Human health is also sensitive to the variations in temperatures and the rainfall conditions. With the rise of temperature, the conditions for the development of the vectors of certain diseases like malaria become more favourable. Its aggravation is thus to be feared each time during the periods of high temperature. This could explain the extension of malaria in the area of Burundian Central Plateaus since the years 1990, which were unscathed of this disease. The wettest periods also generally correspond to a recrudescence of the waterborne and diarrhoeal diseases. The falls of temperatures, in their turn, are responsible for acute respiratory infections.

To the dry periods corresponds, on the other hand, a recrudescence of diseases like meningitis, or diseases that indirectly result from the deficit in food production (malnutrition) or lack of water at the disposal of the population. All these problems of health are worsened under anthropic conditions marked by insufficient information on the prevention, lack of basic hygiene and sanitation, and the poverty of target population.



a. Advanced desertification in Bugesera



B. Crops struck by prolonged dryness in Kirundo



C. Fast regression of waters in Lake Tanganyika



D. Malnutrition and diarrhoeal and vector borne diseases



E. Destruction of infrastructure following abundant rains



F. Threats of destruction of a College following crumbling



G. Flood by pouring rains



h. Threats of flood on the dwellings of the Buyenzi district in the major bed of Ntangwa River

Fig. 10: Photographs illustrating the impacts of the extreme climate events in Burundi

II.3. Relations of Napa to National Development Goals

II.3.1. Climate Change and National Economy

The synthesis of vulnerability studies shows that all the vital sectors of the national economy are affected by the phenomena of climate variability and climate change. The socio-economic consequences are all the more felt that they relate to population living primarily on natural resources.

Climate change must be considered in the Burundi socio-economic development strategies. Indeed, they contribute to increased vulnerability of the existing fragile sectors.

All these sectors of cardinal importance in the economic life of Burundi are thus dependant on rainfall conditions. They are thus very vulnerable to climate variability.

Concerning agriculture and livestock, the vulnerability appears through repetitive famines prevailing in the North-Eastern and the Eastern parts of the country. Climate shocks always result into food crisis both for man and cattle. To obtain a sufficient agricultural production, good annual rainfall extended over the year is crucial. From 1999 to 2000, a good part of the herd was decimated in Bugesera following long dryness.

II.3.2. NAPA and National Development Policy

In Burundi, the recent political evolution towards the return to social peace created a context favourable to economic revival. The development of the Poverty Reduction and Growth Strategy Paper (PRGSP) occurs shortly after the general elections that installed democratic institutions. This PRGSP intervenes in a difficult post-conflict economic situation, characterized by insufficient production, fall in incomes, reduced international assistance, collapse of investment, accumulation of public deficit in public finance and the balance of payments, excessive debt of the treasure, accumulation of interior and external arrears as well as the loss of competitiveness of the national economy.

Based on the aforementioned difficulties, the PRSP gives the opportunity to re-examine, in the light of the strategic objective of poverty reduction, the overall macro-economic policies, both structural, thematic and sectoral, with a view to finally determine a vision and long-term development objectives. These objectives are coherent with the priority government programme, the Millennium Development Goals (MDGs) and the prospective 2025 vision of the country.

The PRSP sets forth the following four principal strategic axes:

- Improved governance and security;
- Promotion of sustainable and equitable economic growth;
- Development of the human capital;
- Fight against HIV/AIDS.

As regards poverty reduction, Burundi laid down the objective of reducing the incidence of poverty to 60% from now to the year 2010 and to 40% in the year 2015.

To promote sustainable and equitable economic growth, Burundi intends to develop and improve food production through a regular provision of inputs at accessible prices for the poor, the use of more powerful techniques, popularisation of market gardening, development of food product processing, conservation and marketing techniques, as well as water control.

In the environmental sector, the government will concentrate its efforts on the following actions: inform and train stakeholders on the rational management of natural resources; equip and train water control specialists; train and equip the environmental police force; work out plans of natural resource management, support and accompany local communities in natural resource management; revive the National Environment Commission; reforest and completely develop all the slopes in the catchment's area; identify and introduce substitutes to protect the threatened natural resources; work out a plan of regional planning, and explore the use of community woodlots as a source of income.

With regard to livestock, the government will set up a programme of artificial insemination, likely to give better results compared to the importation of animals that are not adapted to the country climate conditions. The government will also encourage fodder crops growing with emphasis on the herbaceous and woody leguminous species which, while providing fodder of good quality, improve soil fertility.

In the field of energy, the principal objective is to facilitate access of the greatest number of the population to sources of modern energy, to provide energy in sufficient quantity for the industrial and handicraft and mining activities, and to satisfy the essential domestic requirements in energy. The government will also undertake a programme of rural electrification to provide energy necessary to economic activities, in particular by the extension of the network and the connection of the villages close to the lines, and the dissemination of information on alternative energies at accessible cost for households with low incomes or the communities living far away from the national network.

Taking into consideration the country policy guidelines, the PRGSP provides axes of interventions whose majority contribute directly or indirectly to attenuate the adverse effects of climate variability and climate change. NAPA, which thus comes to materialise the political good-will expressed in the PRGSP, finds an enabling environment for its application by the government of Burundi.

II.3.3. Synergy between NAPA and U.N. Environmental Conventions Policies

The research of synergy is a requirement in the development of NAPA. In accordance with NAPA guidelines, the articulation of this plan was done jointly with other country priority programmes, especially the programmes governed by the United Nations environmental conventions, i.e. the United Nations Convention to Combat Desertification (UNCCD) and the Convention on Biological Diversity (CBD); this was done with a view to make most of the activities envisaged by each agreement while avoiding duplication.

Recently, Burundi worked out a Biological Biodiversity National Strategy and Plan of Action (SNPA-DB). Burundi also worked out the first National Communication with regard to the U.N. Framework Convention on Climate Change (UNFCCC). Regarding the Convention to Combat Desertification, Burundi developed a National Plan of Action to Combat Desertification (PAN-LCD).

- ***Synergy between NAPA and the Biological Diversity National Strategy and Plan of Action***

The Biological Diversity National Strategy and Plan of Action (SNPA-DB) aims at responding to the objectives of the Convention on Biological Diversity, which are:

- Conservation of biological diversity;
- Sustainable use of its components;
- Equitable sharing of the benefits arising from the exploitation of genetic resources.

This strategy tries to contribute to the resolution of the priority problems related to biodiversity and natural resources in Burundi. It recommends among other things the conservation of biological diversity, regulation of the conditions of sustainable management of natural resources and environmental risk management.

The links between this strategy and NAPA concentrate on their common objective, which is mainly the sustainable development through improved environmental management.

- ***NAPA and the National Plan of Action to Combat Desertification (PAN-LCD)***

The PAN-LCD aims at attenuating land degradation in Burundi and the effects of dryness. For this, it is based on the base of the experiments already undertaken in the country and the recommendations made by UNFCCC. PAN-LCD is articulated on the seven following objectives:

- Rational land use;
- Promotion and implementation of catchment's slopes development practices;
- Promotion of irrigation and drainage;
- Mainstreaming of the land degradation control techniques within the other poverty reduction strategies and sustainable development activities;
- Promotion of good governance;
- Capacity building;
- Promotion of awareness raising, training and public information campaigns.

The options and the priority measures of adaptation suggested by NAPA include the strategic axes of the PAN-LCD, especially the protection of natural resources and production in rural areas.

II.3.4. Burundi NAPA Goals, Objectives and Strategies

Adaptation to climate change is defined as the overall measures of autonomous development and the technical, political, economic, legislative and other measures that make it possible to minimize the adverse impacts of climate change. In this process of development, the objective is to produce and implement priority actions that are urgent and immediate and that contribute to the country efforts of adaptation to the adverse effects of climate change.

Since Burundi is among the poorest countries in the world with very limited capacities of adaptation, it is confronted with problems of adaptation to climate change. It is in this context that NAPA intervenes in national capacity building in order to identify and implement the priority actions of adaptation of the main vulnerable socio-economic sectors.

The projects registered under NAPA should be clear and simple projects that can benefit from the support of interested donors. Considering the complex interactions between climate and environmental processes, the projects should be well integrated in the country development strategies and profit from a sufficient synergy with the various international conventions.

For this, Burundi NAPA defined three main objectives, i.e. to:

- Identify a series of national action plans of adaptation displaying priority activities to be undertaken to deal with the Burundi urgent and immediate needs and concerns for purposes of adaptation to the adverse effects resulting from climate change.
- Develop measures of adaptation according to the national situation.
- Human and institutional capacity building as regards climate change.

II.3.5. Burundi NAPA Barriers to Activities Implementation

Barriers could occur in the implementation of NAPA activities. Financially speaking, Burundi might have difficulties in mobilising financial resources necessary to implement the suggested priority actions. Regarding the institutional aspect, the poor institutional capacity to implement NAPA activities could also represent a barrier to implementation. All these barriers should be solved before expecting a positive impact from the priority adaptation projects.

III. INVENTORY OF PRINCIPAL ADAPTATION NEEDS

Climate change has generated a number of needs as regards adaptation in the various vulnerable sectors. This is why strategies of response were suggested by affected population. Besides, additional strategies should be considered for the future.

III.1. PAST AND CURRENT PRACTICES OF ADAPTATION

Practices of adaptation to the adverse effects of climate variations always existed in the history of Burundi. Vis-à-vis famine, the population moves towards areas less affected by the extreme events (dryness, invasion of locusts, etc.) where they can find some food. In these areas, the displaced people offer their services in the form of labour and receive in turn foodstuffs. Once the situation returns to normal, they return to their original places.

A traditional form of adaptation for the Burundian farmers is that they could adapt the succession of crops to the farming seasons, especially vis-à-vis the threats of diseases and plant pests. Crops most sensitive to fungic diseases are grown during the seasons with low rainfall, or even during dry seasons, whereas the crops resistant to diseases and plant pests are grown during seasons with heavy rain.

In certain areas like Kirimiro, farmers have already adapted their agricultural calendar to the rhythm of seasons: crops with long vegetative cycle are planted at the beginning of the rains, to be harvested at the end of the rains. Short cycle crops are planted in March - February to be also harvested at the end of the rains. There are of course enormous losses as per the total annual production, but these losses are preferred compared to those that could result from rotten harvests. These practices are particularly carried out by farmers with very large farms.

However, some farmers grow crops that relay bean, such as cowpea, pigeon pea and groundnut, especially in the areas of Mosso and Imbo, to supplement the protein-leguminous plants whose production is in continuous reduction. In the same way, the growing of soybean, sunflower and the market gardening is becoming more and more significant.

Burundians have adopted a system of conservation of genetic resources, i.e. the conservation in the form of ears or dry seeds to constitute grains in the attics. This conservation is also done by repetitive transplanting or propagation by cuttings for some dryness resistant plants.

In the sector of livestock, during the crises of dryness, the stockbreeders prefer moving their herds along the rivers where they can find better fodder, or directly take refuge in other internal or external areas where they could find natural pastures. In such crises of dryness, stockbreeders also adopt the solution of selling on the hoof or by slaughtering their animals even at lower price. They thus prefer to get smaller livestock like sheep or goats, which are less affected by the periods of dryness because they are able to diversify their sources of food (herbaceous and aerial pastures, etc).

Since the most remote times, Burundians have adopted traditional methods of conservation of the natural forest ecosystems. This is a Burundian habit that consisted in respecting in a quasi religious way certain ecosystems and/or elements of biodiversity, both animal and plant biodiversity. In the Burundian tradition, cutting of trees in the Kibira forest was particularly banned. This high altitude forest was regarded as a “Symbol of Alliance between the Sky and the Earth”. Only the King was allowed to perform hunting activities in the Kibira forest. The traditional conservation also concerned certain thickets considered as sacred. These were fragments of forests prohibited to exploitation and bearing the name of “Intatemwa” literally “what one should not cut”, or “Ikidasha” literally “what one should not burn”.

Forest protection by these firewalls is part of the methods introduced a long time before by the colonial government. Currently, this aspect of conservation tends to disappear because of the increasingly pressing needs of the population.

As regards forestry, Burundians know, in a traditional way, how to safeguard certain local species by incorporating them in the fields due to their agro-forestry role, like *Erythrina abyssinica*, *Ficus div. sp.*, *Cordia africana*, *Albizia will gummifera*, etc. Several trees, whose growing was controlled, were used long time ago in the growing of sacred woodlots. These were the trees related to the practice of “Kubandwa” (ceremony of praying God though *Kiranga*). Three trees, i.e. *Erythrina abyssinica*, *Ficus div. sp.* and *Chenopodium ugandae* constitute the main species in the sacred woodlot known as “Igitabo”. Several similar sites are still visible in the country.

As regards energy, interesting experiments were undertaken in the field of the exploitation of new and renewable energies in Burundi. This is particularly the case with the solar energy whose photovoltaic installed equipment amount to nearly 75 KW. This equipment is used for lighting, power supply of the telecommunication material, refrigeration and water pumping. Biogas facilities were also installed in several localities of the country for lighting of houses, as well as wind energy for water pumping.

III.2. Relevant Solutions of Adaptation

Options are proposed for adaptation to periods of rainfall deficit coupled with the subsequent dryness, and others concern the adaptation to periods of precipitations above the normal, but much of the actions are valid in both situations.

Table 3 (in appendix) shows the options suggested by reviewed sectors and sub-sectors. From this table, a regrouping of options made it possible to draw up the 14 following options:

1. Reinforce the management of existing protected areas and include in protected areas the natural ecosystems identified as being threatened and vulnerable;
2. Safeguard existing woodlots and reforest the stripped areas;
3. Install mechanisms to control erosion in sensitive areas;
4. Control the river dynamics of watercourses and torrents in Mumurwa, including the city of Bujumbura;
5. Popularise short cycle and dryness resistant food crops;
6. Popularise rainwater harvesting techniques for agricultural or domestic use;
7. Identify and popularise improved techniques for use of wood and new renewable energies;
8. Increase the number of hydropower micro stations;
9. Establish and protect strategic buffer zones in Lake Tanganyika floodplain and around the lakes of Bugesera;
10. Identify and popularise the breeding of species adapted to local climate conditions;
11. Popularise zero-grazing techniques;
12. Identify and popularise dryness resistant forest species;
13. Train and inform the decision makers and other partners, including the local communities on the methods of adaptation to climate variability;
14. Improve seasonal early warning climate forecasts.

IV. CRITERIA FOR SELECTING PRIORITY ACTIVITIES

IV.1. SELECTION OF ANALYTICAL METHOD

In selecting the analytical method, it was necessary to take into account the following considerations:

- The method should allow and promote discussions with various stakeholders;
- The method should be able to be used with limited data;
- The method should allow transparency of the results obtained.

The consultation engaged in the country through regional workshops and meetings of all stakeholders made it possible to determine a whole set of criteria based on country specificities.

To determine the ranking criteria, several methods were examined: Cost-Benefit Analysis (CBA), Cost-Effectiveness Analysis (CEA) and Multi-Criteria Analysis (MCA). Following the lack of quantitative information, the MCA which combines the CBA and the CEA was used. This method allows the use of variables and non-monetary indicators. The choice of this methodology also arises from the need to consider the scarcity of financial resources of the country; these resources should be used with the maximum effectiveness as they constitute a factor of mobilisation of external resources.

IV.2. Selection of Screening Criteria

Hierarchisation of the options of adaptation can be done only by suitably selected criteria. A taskforce of experts was appointed to determine the criteria to be considered in the ranking of the options and actions identified for adaptation to the adverse effects of climate change.

This taskforce was composed of the national consultants having made sectoral studies on NAPA and officials from the Ministry for Land Management, Tourism and Environment, the Ministry for Energy and Mines, the Ministry for Agriculture and Livestock, the Ministry for Public Health, the Ministry for Development and Reconstruction Planning. This consultation was organized by NAPA Project from 21 -25 March 2006.

In the search for screening criteria, it was suggested to consider the objectives and priority axes of the Government as regards development, the concerns related to climate change and the cost of the actions or options suggested.

Based on all these considerations, the criteria for selecting the priority options of adaptation are such that priority will be given to an option which, once implemented, will be able to sustain a salubrious environment, make it possible for the ecosystems to play their part of hydrology and climate regulation, reduce poverty especially among women, increase production and economy of the country. Also, considering the low incomes of the population, the precariousness of the country economy and the requirements of the donors as regards limitation of financial resources, a low-cost option will have priority to an expensive option.

The criteria, in the MCA approach, are therefore differentiated in two groups, i.e.:

- **Cost:** this is primarily the monetary cost. This criterion, which translates a disadvantage, represents the taking into account of the scarcity of Burundi resources. This is actually a constraint impossible to remove given the precariousness of the country's finances.
- **Effectiveness:** it is analysed as an advantage or benefit in its dimensions of improved environmental conditions and contribution to sustainable development. This group imposes the decomposition of the criteria translating the effectiveness into the 2 following sub-groups:

Climate-sensitive criteria:

- Sustainable environmental management;
- Aptitude of adaptation;
- Prevention of climate risks.

Government objectives

- Fight against poverty;
- Food security;
- Women empowerment;
- Economic growth.

Considering the fact that these criteria do not have the same importance, it was decided to initially allot a weighting to each of the three categories of criteria (Table 4).

Table 4: Weightings distributed according to categories

Categories of criteria	Weightings
Government objectives	30
Cost	20
Sensitivity to climate	50
Total	100

Thus, the criteria and their weight as illustrated in Table 5 were retained to be used in the identification of the final priority options. This table shows absolute weightings and the relative weightings allotted to each criterion.

Table 5: Criteria of selecting the priority options and related weighting

Criteria	Absolute weighting	Relative weighting
Sustainable environmental management	25	0.25
Cost	20	0.20
Aptitude of adaptation	15	0.15
Fight against poverty	14	0.14
Food security	10	0.10
Prevention of climate risks	10	0.10
Women empowerment	4	0.04
-Economic growth.	2	0.02
Total	100	1.00

IV.3. Assessing Priority Options

The fourteen above-selected options of adaptation to climate change were analysed by comparing every option against the criteria. The method of calculation applied during this exercise of prioritisation of the options was as follows:

- Initially, it was necessary to determine a scale that will make it possible to compare the options against the criterion considered. For all the criteria translating benefit, the selected scale is 1-10 where 1 is the minimal score and 10 is the maximum score. For the criterion “Cost” translating expenditure, it was necessary to allot the actual values of the option in thousands U.S. dollars. Here, the options are compared one against each other by taking each criterion separately. This is how Table 6 was produced.

- In the second step, to compare simultaneously the options based on all the criteria, it was necessary to operate a standardisation of the scales. One had to express the values of the criteria in the same measuring unit on a common scale. The following formulas allow this standardisation:

- Formula translating the ascending values for the benefit (benefits):
$$\frac{(C-m)}{(M-m)}$$

- Formula translating the decreasing values for the costs (disadvantages):
$$\frac{(M-C)}{(M-m)}$$

Where C = value considered (corresponds to the value allotted to the option compared to a criterion)

M = maximum value (corresponds to the great value allotted to an unspecified option of the column)

m = minimal value (corresponds to the small value allotted to an unspecified option of the column)

These formulas made it possible to design Table 7.

- In the third step, it was necessary to identify weighted scores. For each option, one will obtain the weighted score by multiplying its standardised value by the weight of the corresponding criterion. The summation of the weighted scores was done line by line. The most advantageous option will be therefore that with the best weighted sum. This weighting operation led to the results of Table 8. Ranking of the options is made by comparing the sums obtained (Table 9).

Table 6: Allocation of scores by option

Criteria		Sustainable environmental management	Cost	Aptitude to adaptation	Struggle against poverty	Food security	Prevention of climate risks	Woman empowerment	Economic growth	Total
Scale		1 - 10	(x1000 US \$)	1-10	1-10	1-10	1-10	1-10	1-10	
1	Enhance the management of existing protected areas and transform into protected areas the natural ecosystems identified as threatened or vulnerable	8	200	6	4	3	7	4	5	
2	Safeguard existing woodlots and reforest stripped areas	7	400	7	5	3	7	2	6	
3	Set up mechanisms to control erosion in sensitive areas	7	600	7	4	6	7	2	5	
4	Control river dynamics of watercourses and torrents in Mumirwa, including the city of Bujumbura	7	2000	7	4	3	8	2	5	
5	Popularise short cycle and dryness resistant food crops	3	200	5	7	8	4	6	7	
6	Popularise rainwater harvesting techniques for agricultural or domestic use	6	1000	8	5	6	6	5	6	
7	Identify and popularise improved techniques of use of wood and renewable new energies	6	700	6	4	2	6	6	5	
8	Increase hydropower micro stations	4	500	5	5	1	4	2	6	
9	Establish and protect strategic buffer zones in Lake Tanganyika floodplains and around the lakes of Bugesera	7	200	6	4	3	6	4	5	
10	Identify and popularise the breeding of species adapted to local climate conditions	3	200	5	6	6	3	3	5	
11	Popularise zero grazing techniques	4	100	5	7	7	3	5	6	
12	Identify and popularise dryness resistant forest species	6	100	6	5	2	6	2	5	
13	Train and inform the decision makers and other actors, including local communities, on methods of adaptation to climate variability	5	500	5	3	3	5	5	7	
14	Improve seasonal early warning climate forecasts	7	500	7	6	6	8	2	4	

Table 7: Standardisation of scores

Criteria		Sustainable environmental management	Cost	Aptitude to adaptation	Struggle against poverty	Food security	Prevention of climate risks	Woman empowerment	Economic growth	Total
1	Reinforce the management of existing protected areas and transform into protected areas the natural ecosystems identified as threatened or vulnerable	1	0.95	0.5	0.25	0.29	0.8	0.5	0.33	4.62
2	Preserve existing woodlots and reforest stripped areas	0.8	0.84	0.75	0.5	0.29	0.8	0	2	5.98
3	Set up mechanisms to control erosion in sensitive areas	0.8	0.74	0.75	0.25	0.71	0.8	0	1	5.05
4	Control river dynamics of watercourses and torrents in Mumirwa, including the city of Bujumbura	0.8	0	0.75	0.25	0.29	1	0	1	4.09
5	Popularise short cycle and dryness resistant food crops	0	0.95	0.25	1	1	0.2	1	3	7.4
6	Popularise rainwater harvesting techniques for agricultural or domestic use	0.6	0.53	1	0.5	0.71	0.6	0.75	2	6.69
7	Identify and popularise improved techniques of use of wood and renewable new energies	0.6	0.68	0.5	0.25	0.14	0.6	1	1	4.78
8	Multiply hydropower micro stations	0.2	0.79	0.25	0.5	0	0.2	0	2	3.94
9	Establish and protect strategic buffer zones in Lake Tanganyika floodplains and around the lakes of Bugesera	0.8	0.95	0.5	0.25	0.29	0.6	0.5	1	4.88
10	Identify and popularise the breeding of species adapted to local climate conditions	0	0.95	0.25	0.75	0.71	0	0.25	1	3.91
11	Popularise zero grazing techniques	0.2	1	0.25	1	0.86	0	0.75	2	6.06
12	Identify and popularise dryness resistant forest species	0.6	1	0.5	0.5	0.14	0.6	0	1	4.34
13	Train and inform the decision makers and other actors, including local communities, on methods of adaptation to climate variability	0.4	0.79	0.25	0	0.29	0.4	0.75	3	5.88
14	Improve seasonal early warning climate forecasts	0.8	0.79	0.75	0.75	0.71	1	0	0	4.8

Table 8: Allocation of weighted scores compared to criteria

Criteria		Sustainable environmental management	Cost	Aptitude to adaptation	Struggle against poverty	Food security	Prevention of climate risks	Woman empowerment	Economic growth	Total
Absolute weighting		25	20	15	14	10	10	4	2	100
Relative weighting		0.25	0.20	0.15	0.14	0.10	0.10	0.04	0.02	1.00
1	Enhance the management of existing protected areas and transform into protected areas the natural ecosystems identified as threatened or vulnerable	0.25	0.19	0.08	0.04	0.03	0.08	0.02	0.01	0.68
2	Safeguard existing woodlots and reforest stripped areas	0.2	0.17	0.11	0.07	0.03	0.08	0	0.04	0.70
3	Set up mechanisms to control erosion in sensitive areas	0.2	0.15	0.11	0.04	0.07	0.08	0	0.02	0.67
4	Control river dynamics of watercourses and torrents in Mumirwa, including the city of Bujumbura	0.2	0	0.11	0.04	0.03	0.1	0	0.02	0.50
5	Popularise short cycle and dryness resistant food crops	0	0.19	0.04	0.14	0.1	0.02	0.04	0.06	0.59
6	Popularise rainwater harvesting techniques for agricultural or domestic use	0.15	0.11	0.15	0.07	0.07	0.06	0.03	0.04	0.68
7	Identify and popularise improved techniques of use of wood and renewable new energies	0.15	0.14	0.08	0.04	0.01	0.06	0.04	0.02	0.53
8	Multiply hydropower micro stations	0.05	0.16	0.04	0.07	0	0.02	0	0.04	0.38
9	Establish and protect strategic buffer zones in Lake Tanganyika floodplains and around the lakes of Bugesera	0.2	0.19	0.08	0.04	0.03	0.06	0.02	0.02	0.63
10	Identify and popularise the breeding of species adapted to local climate conditions	0	0.19	0.04	0.11	0.07	0	0.01	0.02	0.43
11	Popularise zero grazing techniques	0.05	0.2	0.04	0.14	0.09	0	0.03	0.04	0.58
12	Identify and popularise dryness resistant forest species	0.15	0.2	0.08	0.07	0.01	0.06	0	0.02	0.59
13	Train and inform the decision makers and other actors, including local communities, on methods of adaptation to climate variability	0.1	0.16	0.04	0	0.03	0.04	0.03	0.06	0.45
14	Improve seasonal early warning climate forecasts	0.2	0.16	0.11	0.11	0.07	0.1	0	0.07	0.75

Table 9: Ranking of options compared to the scores obtained

Ranking by priority	Score	Ranking
Improve seasonal early warning climate forecasts	0.75	1
Safeguard existing woodlots and reforest stripped areas	0.70	2
Enhance the management of existing protected areas and transform into protected areas the natural ecosystems identified as threatened or vulnerable	0.68	3
Popularise rainwater harvesting techniques for agricultural or domestic use	0.68	4
Set up mechanisms to control erosion in sensitive areas	0.67	5
Establish and protect strategic buffer zones in Lake Tanganyika floodplains and around the lakes of Bugesera	0.63	6
Identify and popularise dryness resistant forest species	0.59	7
Popularise short cycle and dryness resistant food crops	0.59	8
Popularise zero grazing techniques	0.58	9
Identify and popularise improved techniques of use of wood and renewable new energies	0.53	10
Control river dynamics of watercourses and torrents in Mumirwa, including the city of Bujumbura	0.50	11
Train and inform the decision makers and other actors, including local communities, on methods of adaptation to climate variability	0.45	12
Identify and popularise the breeding of species adapted to local climate conditions	0.43	13
Increase hydropower micro stations	0.38	14

V. PRIORITY PROJECTS

Based on the similarity existing between some priority options, we made a regrouping exercise that made it possible to define the type of important projects of adaptations to climate change (Table 10).

Table 10: List of Priority Projects

Rank	Name of Project	Options Selected	Cost ('000 US\$)
1	Improvement of seasonal early warning climate forecasts	- Improve the seasonal early warning climate forecasts	500
2	Rehabilitation of degraded areas	- Safeguard existing woodlots and reforest stripped areas - Identify and popularise dryness resistant forest species	500
3	Safeguarding of the natural environments	- Enhance the management of existing protected areas and transform into protected areas the natural ecosystems identified as threatened or vulnerable.	200
4	Rainwater Valorisation	- Popularise the rainwater harvesting techniques for agricultural or domestic use	1000
5	Erosion control in the region of Mumirwa	- Set up erosion control mechanisms in sensitive areas	600
6	Protection of buffer zones in Lake Tanganyika floodplain and around the lakes of Bugesera	- Establish and protect strategic buffer zones in Lake Tanganyika floodplain and around the lakes of Bugesera	200
7	Popularisation of short cycle and dryness resistant food crops	- Popularise short cycle and dryness resistant food crops	294
8	Zero grazing technique	- Popularise zero grazing techniques - Identify and popularise the breeding of species adapted to local climate conditions	300
9	Capacity building to promote energy-wood saving techniques	- Identify and popularise improved techniques of use of wood and renewable new energies	700
10	Stabilisation of river dynamics of watercourses and torrents in Mumirwa, including the city of Bujumbura	- Control the river dynamics of watercourses and torrents in Mumirwa, including the city of Bujumbura	2000
11	Education on climate change adaptation	- Train and inform decision makers and other actors, including local communities, on the methods of adaptation to climate variability	500
12	Increase hydropower micro stations	- Increase hydropower micro stations	500

PROJECT 1

1. Title: Support Climate Forecasts for Early Warning

2. Rationale

Burundi is an agricultural country, with an agriculture system that extremely depends on seasonal weather conditions. The farming peasant of Burundi, who was accustomed to the regularity of seasons, is now disorientated by the climate variability and climate change. However, the National Weather Service that was to provide information on climate was weakened by the socio-economic crisis that the country went through recently. The service is no longer able to provide good information on the behaviour of farming seasons. Good seasonal climate information would make it possible for the farmers to better adapt to the adverse effects of climate change. Climate forecasts thus constitute a high priority action for better adaptation.

3. Description

Global objective

The global objective of the project is to build the human and technical capacities of the National Weather Service in order to establish reliable seasonal climate forecasts.

Specific objectives

- Improved weather forecasts;
- Valorisation of information relating to climate forecasts in key economic sectors.

Activities

Specific objective 1: *Improved weather forecasts;*

- Enhance in priority the technical equipment receiving data and other regional products;
- Enhance meteorological and hydrological observation networks;
- Enhance national capacities to analyse and interpret meteorological situations with a strong probability of occurring;
- Conduct advanced training courses for the executives in specialised centres.

Specific objective 2: *Valorisation of information relating to climate forecasts in key economic sectors*

- Create a weather media service to disseminate information to the wider public;
- Assist the services of the Ministry for Agriculture to integrate the climate seasonal forecasts into the technological packages of supervising the rural agricultural world;

Short-term outputs

- A functional system of regional weather data collecting and data processing;
- Meteorological and hydrological observation networks rehabilitated and modernised;
- A functional early warning system;
- A system of national partnership involving the users, the private sector and the providers of information on the seasonal forecasts put in place;
- Training of technical staff and experts;
- Set up a national early warning system for the follow-up, and adaptation to climate change.

Long term outputs

- Increased agricultural production;
- Population well adapted to the adverse effects of climate change.

4. Implementation

Project implementation and institutional arrangements

The project will be carried out under the responsibility of the Burundi Geographical Institute (IGEBU) in the Ministry for Land Management, Tourism and Environment. The project headquarters will be in Gitega where the IGEBU head office is built. IGEBU is the national project implementation agent.

Monitoring and evaluation

The national Project Steering Committee will be composed by representatives of the various ministries using climate information and representatives of the farmers. Evaluation will be made on biannual basis by a tripartite commission: Government + UNDP + Donors representatives.

Risks or constraints

- Data relevancy in the field require the involvement of a big number of participants difficult to monitor on a regular basis;
- Lack of support by donors.

Project duration: 3 years

5. Financial resources

Activities	Cost (US\$)
- Enhance in priority the technical equipment receiving data and other regional products	150,000
- Enhance meteorological and hydrological observation networks	100,000
- Enhance national capacities to analyse and interpret meteorological situations with a strong probability of occurring;	150,000
- Conduct advanced training courses for the executives in specialised centres.	50,000
- Create a weather media service to disseminate information to the wider public.	20,000
- Assist the services of the Ministry for Agriculture to integrate the climate seasonal forecasts into the technological packages of supervising the rural agricultural world.	30,000
TOTAL	500,000

PROJECT 2

1. Title: Rehabilitation of Degraded Areas

2. Rationale

With the foreseen climate change in the next decades, in much degraded areas, the very rigorous and long dryness will not be able to allow the regeneration or evolution of the vegetation. In the areas with clear forests and savannas, climate change will support the installation of rock deserts. In the Rusizi floodplain, on dune soils, there will be gradual installation of sandy desert and naked soils surmounted by multiple epigeal termites' nests the other non-dune places.

In Bugesera, which is the most arid area of the country, climate change will substantially reduce the xerophilous thickets, and the lawns will be degraded into stripped beaches covered by ferruginous concretions sprinkled with numerous termites' nests.

At the level of the subalpine stage mountain forests, starting from 2500 m of altitude, the subalpine vegetation primarily made up of Ericaceae should disappear and make room to rocky soil. The existing forest resources are also very much exposed to the adverse effects of climate change. The insufficiency of activities to manage national woodlots worsens their degradation.

Currently, it is in these much degraded zones that we have intensified erosion from flooding rains in plains and valleys, which are the source of pollution of lakes and rivers.

To stop the amplification of desertification under the effect of climate change, it will be necessary to reforest the already naked zones with adapted species. Moreover, sustainable management of forest resources constitutes a very effective way to reduce their vulnerability vis-à-vis climate variability and climate change.

3. Description

Global objective

The global objective of the project is the restoration of the vegetable cover of degraded areas.

Specific objectives

- Reconstitution of highly degraded areas with species adapted to the terrestrial ecosystems;
- Restoration of existing woodlots;

Activities:

Objective 1: *Reconstitution of highly degraded areas with species adapted to the terrestrial ecosystems*

- Reforest the degraded zones of the subalpine stage of the Congo-Nile watershed;
- Create zones of plantations in the degraded zones of the thickets of Murehe, and mountain chains of Ruyigi and Cankuzo;
- Identify and popularise dryness resistant forest species.

Objective 2: *Restoration of existing woodlots*

- Quantify the current stock of the principal resources and assess their possible future evolution vis-à-vis their reproductiveness and the effectiveness of the protecting measures;
- Replant the zones of destroyed woodlots;
- Work out plans to manage existing woodlots.

Short-term outputs

- Reconstitution of the biomass at the level of the subalpine stage of the Congo-Nile watershed;
- Bands of plantations installed around the thickets of Murehe and mountain chains of Ruyigi and Cankuzo;
- Possible future evolution of the principal specified forest resources indicated;
- Exploitable resources identified and frequency of exploitation determined taking into account the reproduction time span;
- Plans of adapted wood management availed.

Long-term outputs

- Reconstitutions of hydrological and weather regulation systems
- Population well adapted to the adverse effects of climate change
- Increased agricultural production

4. Implementation

Project implementation and institutional arrangements

The Forestry Department, which is the institution responsible for afforestation, is the national project implementing agency. Project coordination will be conducted by a National Coordinator. This project includes several sectors and this is why several institutions will be involved in the implementation. The Forestry Department will have to collaborate with the INECN, which is in charge of the natural ecosystems. A planning team will have to include representatives of all stakeholders. A Steering Committee will be put in place that will include representatives of the NAPA Committee, the National Environment Commission, the Coordination Body members for biodiversity-related activities, as well as the representatives of the institutions in charge of biodiversity.

Monitoring and evaluation

The Project National Coordinator, jointly with the National Director shall, every 3 months submit to the donors an activity progress report. Tripartite reviews will be organised each year to review the progress achieved by the project and will bring together representatives of donors, the government of Burundi and the implementing agency. Field visits of evaluation will be organized on request by the three partners concerned. A final report presenting the work completed, the results obtained and problems encountered will also be submitted for approval to the donor 3 months before the end of the project.

Risks and assumptions

- Compounded poverty leading the population to clear natural milieus.
- Absence of funds to achieve the set of activities envisaged.

Project duration: 3 years

5. Financial resources

Specific objectives	Activities	Cost (US\$)
<i>Reconstitution of the highly degraded areas with species adapted to the terrestrial ecosystems</i>	- Reforest the degraded zones of the subalpine stage of the Congo-Nile watershed	100,000
	- Create zones of plantations in the degraded areas of the thickets of Murehe, and the mountain chains of Ruyigi and Cankuzo	150,000
<i>Preservation of existing woodlots</i>	- Quantify the current stock of the principal resources and assess their possible future evolution vis-à-vis their reproductiveness and the effectiveness of the protection measures	50,000
	- Replant the areas of destroyed woodlots	150,000
	- Work out plans to manage existing woodlots.	50,000
Total		500,000

PROJECT 3

1. Project Title: Safeguarding the most Vulnerable Natural Environments

2. Rationale

In Burundi, the inventory of the terrestrial ecosystems situation shows that the current climate conditions compounded by anthropic actions prevent the ecosystems from blossoming and playing their ecological role. With the climate change likely to happen in the next decades, the ecosystems might undergo substantial degradation.

Regarding the other ecosystems like the afro-mountain stage forests, the clear forests, the xerophilous savannas and thickets, in spite of the gradual evolution envisaged following the conditions of moisture, the long and rigorous dry season will have adverse consequences on the vegetations, though already adapted to the arid or very arid milieus. In fact, all these ecosystems are targeted by farming clear-cutting, repetitive bush fires and overgrazing that split them up and destroy them completely. The dryness will thus come to stop or slow down their regeneration.

The disappearance and the disturbance of the terrestrial ecosystems will obviously involve intensified rainy erosion on steep slopes. This will logically result into intense losses of soils due to erosion and flooding in plains and valleys. The rivers will be finally disturbed and water opacity will reach its high maximum, thus contributing to the pollution in Lake Tanganyika. This situation, certainly disastrous, should not last long. With the disappearance of the regulator, precipitations will have to also rarefy in favour of dry periods that are much more alarming.

To stop these consequences induced by climate change, it will be necessary to stop the disturbance of the vegetation by reinforcing the conservation of terrestrial ecosystems in protected areas and control all the other vulnerable ecosystems.

3. Description

Global objective

The objective of the project is the delimitation of all the Burundi protected areas to avoid their clearing through limits encroaching. The other aim of the project is to protect the natural environments that are not yet protected to allow the evolutionary process of savannas and clear forests and the thickets. The global objective is thus stated as follows: "Improved ecological conditions of the terrestrial ecosystems through effective protection".

Specific objectives

- Enhance the conservation of protected areas
- Control the ecosystems of the vulnerable milieus.

Activities:

Objective 1: - Enhance the conservation of protected areas;

- Conduct a study of the most vulnerable natural resources in the Kibira National Park and Rusizi Natural Reserve ;
- Avail alternatives to substitute the natural resources of the Kibira National Park and Rusizi Natural Reserve;

Objectives 2: - Control the ecosystems of the vulnerable milieus

- Create new areas to be protected, including the savannas and clear forests of Kumoso and Buyogoma and the xerophilous thickets of Murehe;
- Train the local communities for their empowerment with regard to the management of new areas established as community protected areas.

The project will strive to halt the degradation of the terrestrial ecosystems. The mountain rain forest being preserved in the system of protected areas, essential measures will aim at strengthening monitoring system.

The sclerophyllous forest and the xerophilous thickets of the Rusizi floodplain being located in a very vulnerable area in Burundi, measures to be envisaged concern the adoption of measures to monitor land clearing and the anarchistic distribution of lands.

Clear forests being under-represented in the Burundi protected areas, required essential measures will be the identification of new areas to be protected especially in the depression of Kumoso.

Regarding the xerophilous thickets of Bugesera, required measures will consist of protecting all the hills in Murehe.

With regard to eastern savannas, it is advisable to control the peaks of Ruyigi, Cankuzo and Kumoso. In the Burundi eastern region, it will be necessary to set up community protected areas designed as protected milieus under the sole supervision of local communities. This will make it possible to stop bush fires.

Short-term outputs

- Local communities involved in conservation of the Kibira National Park and Rusizi Natural Reserve ;
- Alternative activities compatible with the protection measures put in place.
- Vulnerable milieus set up into community management protected of areas.

Long-term outputs

- Water and climate regulation systems reconstituted through the reduction of floods and attenuation of dryness;
- Population well adapted to the adverse effects of climate change;
- Increase in the agricultural production.

4. Implementation

Project implementation and institutional arrangements

This project results from the consensus of various actors since it encompasses various actions identified based on local and national studies and approved by all the population during national and regional consultation workshops.

Thus, under the responsibility of INECN, the involved actors include all the institutions responsible for ecosystems, the local population and local governments, the nongovernmental organisations, etc.

INECN, which is the institution responsible for preserving the biodiversity, is the national project implementing agency. The coordination of project activities will be made by a National Coordinator. This project includes several sectors, and this is why several institutions will be involved in the implementation. A planning team will include representatives from all the stakeholders. A Steering

Committee will be set up and will include representatives from NAPA Committee, the National Environment Commission, members of the biodiversity- related activities coordinating body and representatives of the institutions in charge of biodiversity.

Monitoring and evaluation

Every 3 months, the National Project Coordinator, jointly with the National Director submit to the donor, an activity progress report. Tripartite reviews will be organised each year to examine the progress achieved by the project and will bring together representatives from the donor, the Government of Burundi and the Executing Agency. Field visits of evaluation will be organised on request by three partners concerned. A final report presenting the work completed, the results obtained and the problems encountered will also be presented to the donor for approval 3 months before the end of the project.

Risks and constraints

- Compounded poverty leading the population to clear the natural milieus
- Absence of funds to carry out the activities envisaged

5. Financial resources

Specific objectives	Activities	Cost (US\$)
Enhanced conservation of protected areas	- Conduct a study on the most vulnerable natural resources of the Kibira National Park and Rusizi Natural Reserve	100,000
	- Avail alternatives to the natural resources of the Kibira National Park and Rusizi Natural Reserve.	50,000
<i>Sub-total</i>		150,000
Control the ecosystems of the vulnerable milieus	- Create new areas to be protected including the savannas and clear forests of Kumoso and Buyogoma and the xerophilous thickets of Murehe	30,000
	- Train local communities for their empowerment with regard to the management of new areas set up as community protected areas	20,000
<i>Sub-total</i>		50,000
Total		200,000

PROJECT 4

1. Project Title: Rainwater Valorisation

2. Rationale

In Burundi, the economy of the country is based on rain-fed agriculture. Agriculture contributes for approximately 50% of the GDP, provides more than 90% of employment, and ensures 95% of the foodstuffs and more than 80% of the foreign income.

The agricultural sector thus depends largely on the seasonal climate conditions, which are not controllable by the farmer. Climate seasonal variability generally consists of the late beginning or early end of the rainy season, or even an interruption of precipitations during several weeks in the middle of the season.

These irregularities disorientate the farmer in their usual agricultural calendar, surprise and destroy the crops in full vegetative phase, resulting in a catastrophic fall in the agricultural outputs.

Some areas of the country, especially the North-East, are regularly struck by famine as a result of dryness prevailing at periods of the year when it should normally have rained.

However, Burundi has sufficient water resources if we consider the annual precipitations. Even in the least sprinkled areas, annual precipitations are approximately 800 - 1000 mm per annum. These resources are not used in an optimal way to meet the needs of the country. Irrigation is still embryonic; marshes and lower valleys are not protected from floods, and the population always relies on direct precipitations to sprinkle their crops.

To remedy these adverse impacts of climate variability and climate change on the population's feeding and the economy in general, action should be undertaken to collect and store rainwater during the wet periods, and use it in a programme of arable land irrigation. This water would also be useful for the livestock.

These installations on hills will make it possible to maintain sufficient moisture in the terrestrial environments during the dry periods, and to protect marshes and lower valleys against floods during periods of heavy precipitations.

Moreover, considering the scarcity of water sources in this North-Eastern part of the country, it is most urgent to conceive photovoltaic systems. Technically speaking, the storage would be hydraulic in order to avoid the electrochemical storage that constitutes the most failing component of the photovoltaic systems. Considering the dispersion of rural settlements, this activity will have to be a community endeavour through a provision of modular installations with a system of distribution by fountains. In the region of Bugesera, one will have to pump water from the lakes, thus involving the use of essential blocks of purification.

The use of mechanical pumps in these regions could be considered, but experience in similar places shows that it is necessary to provide a lot of physical efforts causing considerable fatigue to children and women.

In the absence of the adduction by gravity, the use of photovoltaic solar energy to pump drinking water constitutes the best indicated and adapted solution at the environmental level compared to the pumping by diesel/gasoline motor-driven pumps that increase greenhouse gases emissions.

The activities should start in the regions the most affected by climate variability, i.e. in the area of Bugesera and more particularly in the provinces of Kirundo (Bugabira, Busoni, Kirundo, Ntega, Gitobe) and Muyinga (Bwambarangwe).

3. Project description

Global objective

The global objective of the project is to improve food security and the public health of the target population through irrigated agricultural production and clean water conveyance.

Specific objectives:

- Understand water harvesting and storage techniques;
- Understand hill irrigation techniques;
- Installation of pilot units of demonstration of these new techniques in the various communes of Bugesera;
- Avail drinking water in sufficient quantity for the benefit of the population living in the region of Bugesera.

Activities

The project will consist of achieving the following activities:

- Train A1 or A0 technicians by some 3-month training courses abroad (in Africa) for specialisation in the rainwater harvesting /storage and hill irrigation techniques ;
- Train A2 technicians locally (2 per commune, 12 for Bugesera) in rainwater harvesting /storage and hill irrigation techniques;
- Set up at least one pilot installation of rainwater harvesting and hill irrigation in each of the 6 communes of Bugesera;
- Facilitate similar installations in targeted farmers/stockbreeders;
- Install one clean water conveyance system by photovoltaic pumping in the area of Bugesera.

Outputs

In the short run

- Technicians trained and population made aware of the techniques of rainwater using for crop irrigation;
- Units of demonstration of these new techniques put in place;
- Farmers/ stockbreeders adopt the new techniques of agricultural production;
- Availability of drinking water in sufficient quantity;
- Improved human health.

In the long run

- Complementary agricultural production in the present /potential project areas, including periods of deficit precipitations;
- Protection of the lower valleys soils against floods during the periods of heavy precipitations.

The ultimate output is food self-sufficiency and sustainable land management through better control of water needed for agricultural production

4. Implementation

Institutional arrangements

The project will be implemented in the Ministry for Agriculture and Livestock. The National Project Implementation Agency will be the Directorate-General of Mobilisation for Developmental Self-Promotion and Agricultural Extension Service via the DPAEs of Kirundo and Muyinga that will second high officials to the project. A collaborative framework will be established between the Department of Agricultural Engineering and Protection of Land Heritage and the Burundi Geographical Institute (IGEBU) under the Ministry for Land Management, Tourism and Environment (MINATTE), as well as the Directorate-General of Rural Hydraulics and Energies.

Risks and barriers

The risk is for the trained technicians to leave for other jobs in Burundi or elsewhere as this often occurs.

The plots the most favourable for pilot installations probably belong to one or more private owners. This has an advantage if the owner agrees, but that could take some time before convincing them all.

Monitoring and evaluation

A National Project Steering Committee will be composed of representatives from the Ministry for Agriculture, the Ministry for Land Management, Tourism and Environment, the Ministry for Energy and Mines, as well as representatives from the Ministry for Interior.

Evaluation will be made on annual basis by a tripartite commission Government/ UNDP/ Donor representative(s).

Project duration: 4 years

5. Financial resources

Activities	Cost (\$ US)
- Train A1 or A0 technicians by some 3-month training courses abroad (in Africa) for specialisation in the rainwater harvesting /storage and hill irrigation techniques	100,000
- Train A2 technicians locally (2 per commune, 12 for Bugesera) in rainwater harvesting / storage and hill irrigation techniques	50,000
- Set up at least one pilot installation of rainwater harvesting and hill irrigation in each of the 6 communes of Bugesera	400,000
- Facilitate similar installations in targeted farmers/stockbreeders	250,000
- Install one clean water conveyance system by photovoltaic pumping in the area of Bugesera	200,000
Total	1,000,000

PROJECT 5

1. Project Title: Erosion Control in the Area of Mumirwa

2. Rationale

The region of Mumirwa experiences the problem of erosion in a way acuter than elsewhere. The steep relief, the overpopulation of the area (approx. 400 inhabitants/km²), the brittleness of soils and the overexploitation of lands offer favourable conditions to rain erosion.

In all the provinces of Mumirwa area, erosion is felt by the population as being the principal factor of the fall in soil fertility, and consequently of the fall in crop productivity. In this primarily agricultural and strongly populated area, the economic survival of the population is related to the preservation of soil productivity capacity.

In this region, any land subjected to precipitations undergoes the phenomenon of erosion, i.e. a degradation of the relief, a modification of the chemical composition of the soil and its structure and loss of the outer soil surface that is wiped off by run-off waters. The loss of the outer soil surface impoverishes the farmed lands, making it less fertile and less productive.

Erosion control and soil fertility restoration are urgent needs that require adequate circumscribing both in its form (manifestation) and its content (causes) in order to propose strategies adapted to the real land situation.

Methods recommended in the region of Mumirwa should take into account the steep slopes, the tendency of soils to massive landslide, the land exiguity, the demographic pressure and the availability of vegetable material.

3. Description

Global objective

The global objective is the installation of anti-erosion mechanisms and the introduction of suitable farming practices.

Specific objectives

Installation of biological devices;
Introduction of anti-erosion practices.

Activities

Objective 1: *Installation of biological devices*

The biological devices relate to the afforestation and the herbaceous or shrubby hedges laid out in contour lines. The following actions are recommended:

- Set up herbaceous and shrubby quickset hedges

The herbaceous quickset hedges consist of graminaceous of which the most known and tested are: *Pennisetum.sp*; *Tripsacum.sp* and *Setaria*. They are installed on equidistant contour lines of 10 m x 20 m according to slopes, and are planted into double hedges of 40 cm x 40cm on a 40 cm wide strip for *Pennisetum* and *Tripsacum*, and 20 cm x 20 cm on a 20 cm strip for *Setaria*. However, according to

the size of the property, the dimensions, the number of lines, the thickness of the band, upstream addition of a line of agro-forestry shrubs (*Leuceana*, *Calliandra*...) is possible.

Three main leguminous species are disseminated in Burundi, i.e. *Leuceanadiversifolia*, *Leuceanaleucocephala* and *Calliandra calothyrsus*. They are laid out in contour lines: 30cm between the roots and 10 - 20 m between the curves according to the slope. Their adequately developed root system makes it possible to fix the unstable grounds and the slopes.

- Produce and disseminate agro-forestry species

Agro-forestry consists of associating the crops to non-adverse shrubby species that protect and improve the soil. The species most used in the province are: *Grevillea* sp., *Cedrella* sp., and shrubs like *Leuceana* sp. and *Calliandr* sp. often used on contour lines. These trees are laid out in fields on 10 or 20 m between the roots. They are appropriate in the protection of banks and ravines.

Objective 2: *Introduce soil-protecting farming practices*

- Popularise suitable farming practices

The above-mentioned biological devices must be accompanied and supplemented by farming practices favourable to erosion-control. The principal recommended practices are: ploughing in contour lines on lands with gentle slope and gradual terraces, cultivate in hillocks and balks, application of fertiliser and green manure, recourse to fallows where it is still possible.

- Popularise anti-erosion physical devices

The physical devices are: ditches, radical terraces and stone alignments. The use of these devices varies from one locality to another. In steep slope areas with sensitive soils where the problem of plot exiguity is real, anti-erosive ditches are not recommended on hillsides. They can be used on hilltops or lands with moderate slope. The alignment of the stones extracted from the fields must be made in the horizontal direction to halt rain water run-off.

Outputs

- *In the short run*

- Increase in fertility and productivity of the arable lands;
- Conservation of water and soils;
- Increase in population's income;
- Control erosion;
- Produce vegetable materials in farming areas.

- *In the long run*

- Land protection in the Imbo plain against flooding during periods of heavy rains;
- Food self-sufficiency and sustainable land management through better water control for agricultural production.

4. Implementation

- *Institutional arrangements:*

The project will be implemented under the Ministry for Land Management, Tourism and Environment. This ministry will collaborate with the Ministry for Public Works and Equipment that includes the urban development services.

Risks and barriers:

- Non-allowance of an adequate budget;
- Inadequate extension service;
- The high cost of development works;
- Resistance by owners of the spaces concerned.

Monitoring and evaluation

- A monitoring and evaluation committee would be set up in collaboration with the donor and the ministry in charge.
- An external team will be responsible for the project evaluation and auditing.

5. Financial resources

Activities	Cost (US\$)
- Set up herbaceous and shrubby quickset hedges	200,000
- Produce and disseminate agro-forestry species	200,000
- Popularise suitable farming practices	50,000
- Popularise anti-erosion physical devices	150,000
Total	600,000

PROJECT 6

1. Project Title: Protection of the Buffer Zones in Lake Tanganyika Floodplain and around the Lakes of Bugesera

2. Rationale

The water level in Lake Tanganyika fluctuates by approximately 1 meter per annum, and 3-4 metres if the inter-annual variations are considered. The level of Lake Tanganyika varied between 772 - 777 m of altitude since 1929 (year of first statements available) to date, according to the variability of precipitations in the catchment's area. The peripheral area whose altitude is located between these two levels simply constitutes the floodplain.

During the periods of rainfall deficit at the regional level, the level of the lake is lowest, and this area is particularly threatened by the riparian population who tend to adapt it to agricultural and habitat needs, with immediate impact on the erosion of the banks and the destruction of the littoral ecosystems of Lake Tanganyika.

Similarly, in the North-Eastern part of Burundi, the marshy and lake complex of Bugesera is threatened by dryness or disappearance because of the extension of agriculture, the overgrazing and extractions by the riparian population, which are intensified during the periods of rainfall deficit in the region. These periods of dryness, which were already very noticeable during the last 5 years, should develop with the foreseen climate change.

It is known that these marshes and these lakes keep their water only thanks to the existence of intact marshy stoppers between the river and secondary valleys, that a drainage of the marshes causes the lowering of the underground waters, and that the disordered various material extraction (peat, plants, etc) causes permeability of the natural stoppers that retain water from the lakes.

In addition, the riparian population needs the resources resulting from the marshy and lake complex for their water supply and irrigation.

This project proposes to help managing the floodplain around Lake Tanganyika, more particularly in the surroundings of Bujumbura, Rumonge and Nyanza-Lac where it is widest, as well as the marshy and Lake Complex of Bugesera, according to sustainable standards of management of the resources that take account of the fluctuations of water levels related to the cyclic fluctuations of precipitations.

3. Project description

Global objective

The global project objective is to maintain the hydrological and ecological functions of the floodplain around Lake Tanganyika and the marshes of Bugesera.

Specific objectives

To successfully fulfil the objective of maintaining the marshes and a sufficient level of lakes, including during the driest periods, actions are required in the field of awareness raising, technical aspects, and the regulatory aspect. The objectives thus laid down are as follows:

- Establishment of strategic buffer zones in the floodplain of Lake Tanganyika and around the lakes of Bugesera;
- Set up agreed regulations regarding buffer zone management.

Activities

- Establishment of strategic buffer zones in the floodplain of Lake Tanganyika and around the lakes of Bugesera

- Delineate physically the marshy buffer zones and other zones to be strictly protected and restore the significant zones already encroached;
- Undertake baseline studies regarding the contours lines and physical and biological characteristics of the floodplains of Lake Tanganyika and the Northern lakes.

- Set up agreed regulations regarding buffer zone management

- Inform and raise awareness of the riparian population on the need to protect part of the hydrological complex in order to allow the harnessing of other parts in the long term;
- Set up regulations and a monitoring system for agriculture and livestock practices, and for the harnessing of certain resources in authorized zones.

Outputs

- In the short run

- Riparian population of Lake Tanganyika and the marshes of Bugesera made aware of sustainable harnessing of the water resources;
- Buffer zones of the lakes and marshes not disturbed;
- Public domain space identified and delineated;
- Waters in the lakes and marshes of Bugesera maintained on a high level.

- In the long run

- Hydrological and biological role achieved by the lakes and marshes;
- Increased biodiversity and living resources (fish);
- Change of way of living of the population through higher incomes;
- Reasonable methods of agriculture, rearing, and extractions of various resources internalised and practiced.

4. Implementation

- Institutional arrangements

The project will be implemented within the Ministry for Land Management, Tourism and Environment (MINATTE). Technical management will be ensured by the Department of Agricultural Engineering and Land heritage Protection. Collaboration with the Ministry for Agriculture and Livestock via the local DPAE, the INECN, and the administrative authorities (Governors, communal administrators) will be formalised.

- Risks and barriers

One should expect strong resistance of the owners (or supposed such) of the lands that will be concerned by the project. Even if the law on public domain spaces has been in existence for a long time, it is not obvious that the law was internalised by the population, including the local authorities. Specific arrangements will have to be found each time locally.

The population, generally poor and living on a day to day basis, understands with difficulty the concept of long term management. Even after long awareness campaigns, there will always be popular resistance vis-à-vis the necessity of law enforcement. Only a firm and constraining law will be enforced. High level political support will be necessary.

The marsh of Bugesera makes frontier to Rwanda. Diplomatic action will be needed from the highest authorities at the national level, to obtain the cooperation of Rwanda for a common objective.

- Monitoring and evaluation

Project monitoring and evaluation will have to be carried out by a permanent joint team made up of technicians and the administrative officials indicated by the Ministry responsible for the environment and regional planning.

An institutional mechanism will have to be set up so that law enforcement is permanent.

- *Project duration: 3 years*

5. Financial resources

Specific objectives	Activities	Cost (\$ US)
- <i>Establishment of strategic buffer zones in the floodplain of Lake Tanganyika and around the lakes of Bugesera</i>	- Undertake baseline studies regarding the contour lines and physical and biological characteristics of the floodplains of Lake Tanganyika and the Northern lakes.	40,000
	- Delineate physically the marshy buffer zones and other zones to be protected and restore the significant zones already encroached	100,000
- <i>Set up agreed regulations regarding buffer zone management</i>	- Inform and raise awareness of riparian population on the need to protect part of the hydrological complex in order to allow the harnessing of other parts in the long term;	30,000
	- Set up regulations and a monitoring system for agriculture and livestock practices, and for the harnessing of certain resources in authorized zones.	30,000
Total		200,000

PROJECT 7

1. Title: Popularisation of Short Cycle and/or Dryness Resistant Food Crops

2. Rationale

The economy of Burundi is based for more than 90% on the traditional self-subsistence agriculture. The majority of the population draws their income from the sale of agricultural produce, which represents approximately 50% of the GDP and provides more than 90% of employment in the rural area. Feeding is thus based on food productions of local origin.

For a few years now, one has observed the late return of the rains that go even beyond October, and early drying up at the end of April. On top of this, intermittent and overdrawn periods of rains during the growth and the development of the seedlings are occurring. Combined with the weak fertility of soils, the result is the fall of productions and the brittleness of food security in the country. Ultimately, consequences are absolute critical and repetitive situations of emergency food aid in many areas of the country.

With the aim of rectifying this worrying situation of rain scarcity and disturbance of the ecological agro-systems, it is urgent to develop and disseminate varieties of food crops resistant to dryness and adapted to the weak soil fertility while popularising the corresponding plant packages. These include sweet potato, corn, sorghum and corn. The support would be firstly directed towards the northern regions and other most affected regions.

3. Project description

Global objective

The global objective is to increase the agricultural production in order to contribute to improved food security by the development and the popularisation of the varieties of dryness-resistant food crops in all the provinces of the country affected by climate change.

Specific objectives

- Development and dissemination of dryness-resistant varieties
- Development and dissemination of varieties resisting to soil acidity
- Development and popularisation of appropriate technological packages
- Training of farmers/associations on seed production techniques
- Production and availing of grains in seedling centres.

Activities

- Dissemination of dryness-resistant varieties

The project will support research programmes to disseminate the short cycle varieties that resist to dryness periods. The actions will be limited to the last confirmative stage of the varieties in the regions of their adaptation.

- Dissemination of varieties resistant to soil acidity

One will develop varieties tolerating soil acidity and the periods of rainfall deficit.

- Development and popularisation of appropriate technological packages

The farming techniques will be updated for each crop and availed to the farmers. They will be popularised in the form of the phytotechnic forms with supporting illustrations.

- Training of farmers/associations of seed producers

Preferably, the training will be given to pilot units of demonstration of these farming techniques that will be identified by the communal supervisors. Monitoring will be ensured at each hill of census by an agricultural extension worker. Preliminary trainings (1 per province) of the extension workers will be provided by the specialised and multidisciplinary trainers.

- Production and availing of seeds of the adapted varieties

Pre-base seeds of varieties tolerant to dryness and to weak fertility of soils will be produced in the ISABU seedling centres. They will be made available in public seedling centres and some groupings qualified in the production of basic and commercial seeds in the target provinces. They will be primarily distributed to the most vulnerable families.

Outputs

In the short run

- Diversification of varieties performing in weak rainfall and poor soil fertility
- Adoption and control of farming techniques by farmers
- Increased agricultural production and reduced famine
- Improved human health
- Increase in population's income as a result of sales and use of the productive surplus in the potential over-harvesting regions.

In the long run

- Increase the production of food crops
- Regular provisioning of the surplus in the regions of strong consumption
- Ensured food self-sufficiency
- Promotion of the production directed towards the economy of the market.

4. Implementation

- Institutional arrangements

The project will be implemented under the Ministry for Agriculture and Livestock. It will be carried out by ISABU as regards the development of performing varieties and the production of pre-base seeds. ISABU will work in collaboration with the Ministry for Land Management, Tourism and Environment, the Department of Seeds and Plants Promotion (DPSP) and the DPAEs as regards the production of basic seeds and the groupings of the producers of commercial seeds under DPAEs supervision.

- Risks and barriers

- Most of the crops subjected to extension are not part of food habits of the population ;
- Irregularity of budget releasing according to instalments corresponding to the farming timing.

- Monitoring and evaluation

The National Steering Committee will be composed of representatives from ISABU, the MINAGRIE office, the Directorate-General for Forests, Tourism and Environment, DPSP, DPAEs and a representative of farmers by target province.

- Duration: 3 years

5. Financial resources

Total cost of the project: USD 294,000

ACTIVITIES	Cost (US\$)
Production of seeds of the varieties adapted to climate change	250,000
Dissemination of varieties resisting dryness	5,000
Dissemination of varieties tolerant to soil acidity	5,000
Development and popularisation of appropriate phytotechnic forms	4,000
Training of technicians and the groupings producing seeds	30,000
TOTAL	294,000

PROJECT 8

1. Project Title: Zero-Grazing Cattle Breeding

2. Rationale

The cattle-breeding sector will be affected by climate change. The extreme climate phenomena (cases of prolonged dryness, floods) will modify the limits of the pastoral vegetation, the quality and quantity of fodder, the duration of the season of vegetable growth, animal productivity and the quality of water.

In case of prolonged dryness, the pastures are not renewed and become rare. This decreases the dairy and meat output and makes the domestic animals skeletal. The deficit of the pastures and the crops farming of cattle foodstuffs leads the stockbreeders to migrate towards the favourable regions with all the risks of all sorts of diseases that one can meet due to promiscuity.

Burundi agricultural development and particularly the economic advancement of several farms will pass by systems of production that mainstream agriculture, cattle-breeding and forestry activities so as to protect and improve the edaphic capital and diversify the incomes.

3. Description

Global objective

The global objective is to improve and increase the agro-sylvo-pastoral production and to protect the environment.

Specific objectives

- Popularisation of zero-grazing breeding techniques;
- Promotion of the breeding of species adapted to the local climate conditions.

Activities

- Train the population on agro-sylvo-pastoral mainstreaming methods;
- Support the population in the construction of cattle sheds, installation of fodder fields, plantation of trees, shrubs and graminaceous fodder.
- Identify and import breeding species (bovines, goats and the porcine of performing breed) adapted to local climate conditions;
- Distribute animals to the pilot households (1 000 households).

Outputs

- In the short run

- Increase in the fertility and the productivity of arable lands;
- Increase in the dairy production;
- Conservation of waters and soils;
- Increase in the income of the population;
- Reduced bush fires.

- Long term potential effects

- Forest regeneration

4. Implementation

- Institutional arrangements:

Localisation: nationwide

Stakeholder: Ministry for Agriculture and Livestock

- Risks and barriers:

- Absence of effective commitment by the political decision makers and the government as regard NAPA prioritisation;
- Non-allocation of adequate budget;
- Insecurity;
- Inadequate extension services.

- Monitoring and evaluation:

Install a Steering Committee, a Project Coordinator and M&E Officer.

5 Financial resources

Activities	Cost (US\$)
- Train the population on agro-sylvo-pastoral mainstreaming methods	80,000
- Support the population in the construction of cattle sheds, installation of fodder fields, plantation of trees, shrubs and graminaceous fodder	100,000
- Identify and import breeding species (bovine, goats and porcine of performing breed) adapted to local climate conditions and distribute them to pilot households (500 households)	120,000
Total	300,000

PROJECT 9

1. Title: Capacity Building to Promote Energy-Wood Saving Techniques

2. Rationale

The Burundian rural area is home to 96% of the population and uses only wood as a source of energy. Demand is very important and increases at the rate of the population growth while the offer does not evolve at the same pace. On the contrary, it decreases.

The Burundian domestic energy sector is dominated by the traditional sources of energy, including the wood-energy used in households and peat used in the army. More than 88% is consumed by the rural households for cooking, heating and lighting.

In the urban environment, the use of wood-energy is rather focused almost exclusively on charcoal, used mainly for food cooking.

Charcoal is obtained by the traditional carbonization with an output of about 10% whereas it could be raised to 20% through training and the dissemination of improved techniques of carbonization supported by the use of improved stoves. The reduction in the quantities of wood consumed will have as a consequence the preservation of the trees on roots. Stoves in use have only an energetic efficiency of 15% whereas there are some stoves with an energetic efficiency of 15%, thus being able to generate a saving of 130%.

In addition to Bujumbura City, the project will cover the provinces of Bubanza, Cibitoke and Bujumbura-Rural.

3. Project objectives

Global objective

Increase in the surfaces covered by forests.

Specific objectives

The project aims at an increase in the forestry cover and an improvement of the forest stock management for the sustainable supply of wood-energy through:

- Forestation of the highly vulnerable natural environments;
- Training on improved stove construction and use techniques and increase their dissemination;
- Training on the improved methods of carbonization and their dissemination.

Activities

- Create new woodlots;
- Create individual woodlots;
- Introduce improved stoves into the households;
- Popularise improved methods of carbonization.

4. Outputs

In the short run

- Environmental protection by afforestation and rationalization of the use of wood through the use of the culinary stoves;

- Capacity building in rational management of forest plantations;
- 300 hectares are reforested and protected by fire walls;
- 200 hectares are rehabilitated in the wooded perimeter of Mageyo in the commune of Mubimbi, province of Bujumbura Rural;
- Agro-forestry trees are distributed to the population;
- New prototypes of wood stoves and charcoal stoves are introduced into the project area;
- Households have a wood stove in their households, especially in the 3 provinces;
- 6 technicians are trained on the techniques of carbonization;
- 120 charcoal men are trained;
- Meetings of dissemination of stoves are organised and the charcoal saving stove is adopted in the city of BUJUMBURA;
- Performing techniques of carbonization and manufacturing of improved stoves are increased and understood by trained users;
- Stove users are made aware of improved stoves and households have adopted their use;
- Seedlings are set up in individual farms on about 50 ha;
- An experience-sharing visit on the improved methods of carbonization and improved stoves is accomplished by a national officer and 2 stove users and one charcoal man.

In the long run

Contribute to the reduction of extreme poverty and hunger by reducing expenditures relating to the acquisition of wood-energy.

5. Implementation and institutional arrangements

In their development programme covering the period 2006-2010, the Government of Burundi indicated in their priorities the fight against poverty, the preservation of the environment, and the diversification of sources of alternative energies.

The project will be carried out within the framework of the national afforestation through the Ministry for Land Management, Tourism and Environment. The project will be carried out by the staff of the Forestry Department working in the provinces concerned by the project, and the project will be provided with an office space in BUJUMBURA. A National Director will be appointed by the MINATTE to monitor the implementation of the project.

6. Risks and barriers

The project implementation can be blocked by the insufficiency of qualified human resources, the low level of the effective participation of actors and the late financing of the project.

Project duration: 2 years

7. Financial resources

Activities	Cost (in US\$)
- Create new woodlots	80,000
- Create individual micro-woodlots	40,000
- Introduce improved stoves into households	40,000
- Popularise improved methods of carbonization	40,000
Total	200,000

PROJECT 10

1. Title: Stabilisation of River Dynamics of River Courses in Mumirwa and Imbo

2. Rationale

The Imbo lowlands receive many torrents flowing from the Congo-Nile watershed and Mumirwa, which are heavily sprinkled and steeply sloping. All these zones are very sensitive to lateral and vertical erosion along the axes of drainage, in particular during the periods of strong precipitations. Very disastrous situations of erosion characterized by landslip and deposits of the alluvia and colluviums in the lowlands are constantly observed and are likely to be accentuated following strong precipitations due to climate change.

The urban zones, in particular the town of Bujumbura that is crossed by 4 of these torrents, are particularly affected by this destroying type of erosion.

It is absolutely necessary to reduce or even remove this type of erosion to preserve both public and private infrastructure located in the vicinity of these axes of drainage.

The relatively weak slope in the plain of Imbo requires to drain rain water and to channel the rivers and torrents in order to protect the infrastructure (urban bridges, roads, buildings and other equipment) and to ensure viable sanitation.

3. Project description

Objectives

The global objective of this project is to protect the landscapes and the public and private infrastructure, located along the axes of drainage in Mumirwa and the Imbo lowlands, which are threatened by erosion during the periods of heavy precipitations. Ultimately, it is a question of ensuring the socio-economic wellbeing of the population concerned, through the development of a physical environment adapted to the changing climate conditions.

The specific objective of the project is the protection of the vital infrastructure of Bujumbura city located along the axes of the torrents by the stabilization of the river dynamics of river courses.

Activities

- Enhance meteorological and hydrological observation networks;
- Conduct a detailed study of the river dynamics of the river courses selected, in connection with the conditions of precipitations;
- Establishment of a town planning and development master plan of the lowlands taking into account the risks related to the inter-annual fluctuations of precipitations;
- Establish plans for the correction and stabilization of the rivers in question and the protection of the infrastructure in place;
- Carry out work of correction and stabilization on these rivers, starting with those that cross the town of Bujumbura;
- Work out a legislation on public safety in the case of disaster;
- Map out the zones at risk and propose land use standards in these zones or their basins slopes.

Outputs

In the short run

- IGEBU data processing collection system and communication system improved;
- Maps of the zones at risk and the zones of priority intervention done;
- River courses stabilised;
- Attenuated erosion;
- Urban infrastructure protected.

In the long run

Landscapes and natural ecosystems of the Imbo eroded or flooded lowlands, including those around Lake Tanganyika, preserved.

4. Implementation

Institutional arrangements

The project will depend on the Ministry for Land Management, Tourism and Environment. The ministry will collaborate with the Public Works and Equipment Ministry that includes the urban development services. Implementation would be entrusted with private companies, under the supervision of top managing executives from the above-mentioned ministries.

Risks and barriers

The high cost of the development works;
Resistance by the owners or supposed such of spaces concerned

Monitoring and evaluation

A Monitoring Committee will be set up in consultation between the donor and the ministry responsible. An external team will be responsible for project evaluation and audit.

Project duration: 3 years

5. Financial resources

Activities	Cost (US\$)
Enhance meteorological and hydrological observation networks	80,000
Conduct a detailed study on river dynamics of the river courses selected, in connection with the conditions of precipitations	40,000
Establish a town planning and development master plan of the lowlands taking into account the risks related to inter-annual fluctuations of precipitations	30,000
Establish plans for the correction and the stabilization of the rivers in question and the protection of the infrastructure in place	20,000
Carry out work of correction and stabilizations on these rivers, starting with those that cross the town of Bujumbura	1,775,000
Work out a legislation on public safety in case of disaster	30,000
Map out the zones at risk and propose land use standards in these zones or the basin slopes	25,000
Total	2,030,000

PROJECT 11

1. Title: Education to Climate Change Adaptation

2. Rationale

In Burundi, the impact of the variability and climate change will be the lengthening of the dry season leading to increased frequency and intensity of uncontrolled fires.

In the majority of the regions of the country, the effects are already felt where bush fires and deforestation have increased in an alarming way in recent years. It is estimated that more than 30 000 ha were destroyed following cases of arson and massive deforestation.

Consequently, education and awareness of the population on the dangers of bush fires and deforestation are essential and urgent actions to be undertaken so that the forestation efforts already undertaken in the country are not opposed.

In Burundi, climate change in the past decades caused by increased temperature and heavy rainfall showed that, overall, the terrestrial ecosystems will be able to resist and follow their normal evolution. However, it was noted that the anthropic actions in particular the close-clearing cuts in farming, the overgrazing, the bush fires, and the anarchistic exploitation of living resources will constitute a dead end in the evolution of the vegetation, under the effect of the dryness induced by climate change. It was also noted that the length of the dryness will be able to worsen the bush fires and thus amplify the degradation of the ecosystems.

These anthropic actions are however related to the way of life of the population. The local communities destroy the ecosystems to ensure their survival. The ecosystems are notably regarded as arable lands and pastoral zones. These are survival issues that make that the problems of ecosystem protection in general and environmental protection in particular are not apprehended in the same way. Certain actions undertaken to stop the famine induced in particular by dryness or floods are not meant to preserve the environment, and very often, do not target the adaptation of the population to adverse effects of climate variability. Solutions often considered like the drainage of marshes in the event of dryness, the clearing of forests in the event of land degradation often compromise the protection measures owing to the fact that the majority of the weakened ecosystems are protected and others fall within the State's domain. Regulations to preserve these ecosystems, though incomplete, exist but are not enforced.

The political decision makers must understand the adverse effects of climate change and take reasoned measures that are crucial in case of dryness and flood.

3. Description

Global objective

The global objective of the project is education and public awareness on the adverse effects of climate change, bush fires and deforestation so that the population is made aware and is worried about these environmental problems and participates in research of solutions and improved systems of adaptation.

Specific objectives

- Awareness of decision makers and other partners, including the local communities, about the adverse effects of the climate change.
- Fight against bush fires in all the natural areas of Burundi.

Activities:

- Training courses of the communal environmental extension workers on climate change;
- Public awareness campaigns of the rural population on the dangers of bush fires and deforestation;
- Work out a national action plan of fighting against bush fires;
- Radio and TV broadcasts on the adverse effects of climate change, the dangers of bush fires and deforestation;
- Produce and multiply tools of awareness and information such as folders, posters, etc in connection with the climate change issue;
- Set up a plan of prevention, preparation and response to emergencies and disasters;
- Meetings to raise awareness of population target groups on the adverse effects of climate change and the effective methods of adaptation, with regard to the natural resources and public health.

Short-term outputs

- The population is informed and made aware of the benefits of forest protection against fires and deforestation;
- Communal environmental extension workers are created and trained;
- Representatives of the population on hills are trained on the methods of bush fire monitoring and control;
- Radio and TV broadcasts on the adverse effects of climate change, the dangers of the bush fires and deforestation are produced;
- Powerful awareness tools for adaptation to climate change are available;
- An action plan of fighting against bush fires taking account of the regional specificities submitted to all stakeholders;
- Bush fire village groupings are put in place.

Long-term outputs

- Bush fires have decreased significantly;
- Deforestation has strongly regressed;
- Hydrological and climate regulation systems are reconstituted;
- Population well adapted to the adverse effects of climate change;
- Increase in the agricultural production.

4. Implementation

Implementation and institutional arrangements

INECN, the institution responsible for environmental education, is the national implementing agency of the project. Coordination of project activities will be made by a National Coordinator. This project will deal with several sectors, and for this reason, several institutions will be involved in the implementation. INECN will collaborate with the department in charge of woodlots. The planning team will include representatives from all stakeholders. A Steering Committee will be made up and will include representatives from the NAPA Committee and the National Environment Commission, members of the biodiversity-related activities coordinating body and representatives from institutions responsible for biodiversity.

This project is the consensus of various actors since it contains the various actions identified based on studies at national and local level and approved by all the population during national and regional workshops. Thus, under the responsibility of the institution responsible for environmental education,

the involved actors will be all the institutions responsible for ecosystems and woodlots, the population and the local governments, the nongovernmental organisations, etc

Monitoring and evaluation

Every three months, the Project National Coordinator, jointly with the National Director will submit to the donor an activity progress report. Tripartite reviews will be organized each year to examine the progress achieved by the project and will bring together representatives from the donor, the Government of Burundi and the Implementing Agency. Field visits will be organised on request by the three partners concerned. A final report presenting the work completed, the results obtained and the problems encountered will be also presented for approval to the donor, 3 months before the end of the project.

Risks and assumptions

The project does not present any major risk expect the absence of funding for the realisation of all planned activities.

Project duration: 3 years

5. Financial resources

Activities	Cost (US\$)
- Training courses of the communal environmental extension workers on climate change	45,000
- Public awareness campaigns of the rural population on the dangers of bush fires and deforestation	45,000
- Work out a national action plan to fight against bush fires	100,000
- Radio and TV broadcasts on the adverse effects of climate change, the dangers of bush fires and deforestation	30,000
- Produce and multiply tools of awareness and information such as folders, posters, etc in connection with the climate change issue	50,000
- Set up a plan of prevention, preparation and response to emergencies and disasters	60,000
- Meetings to raise awareness of population target groups on the adverse effects of climate change and the effective methods of adaptation, with regard to the natural resources and public health	170,000
Total	500,000

PROJECT 12

1. Title: Promotion of Hydropower Micro Stations

2. Rationale

Burundi faces today an increasing energy deficit following the fall in the levels of dams consecutively to the reduction of precipitations and prolonged dryness. The country must mobilise investments to construct new hydropower stations and diversify its sources electric power supply.

On the other hand, Burundi has a dense hydrological network, whose majority of river courses flow from rather important depressed areas that would allow the installation of exploitable micro power stations, including during the dry season.

These small-size infrastructures are more easily within the range of donors whose vocation is the promotion of the living conditions of the rural population. Wood is the only energy resource for this population.

Without electricity, possibilities of production and improvement of the well-being of the population are inaccessible.

3. Project description

Global objective

Promote the development of economic activities and to reduce of poverty, more particularly outside large cities, within an environmentally-friendly framework.

Specific objective

Increase in the rate of electricity supply at the national level through multiplication of micro power stations, starting with regions most underprivileged in energy resources.

Activities

- Carry out studies and updates to identify all the potentialities of hydro-power production.
- Promote, through micro-grants and loans, hydropower micro stations on sites selected according to their relevance for the saving of wood and other climate-dependant natural resources.

Outputs

In the short run

The national potentialities of hydropower production are updated.
The national capacity of power production is increased and decentralised.

In the long run

The economic and human benefits of the use of electricity are extended to the small urban centres and rural areas.

4. Implementation

Institutional arrangements

A team coordinated by the Ministry for Energy and Mines will be responsible for the execution of the project. The team will define the procedures for the studies and the realisation of infrastructures entrusted with private companies.

Risks and barriers

- Lower flows of rivers during the periods of rainfall deficit.
- Delay in the mobilisation of financial resources.
- Difficulties of payment by the communities connected to the power supply network.

Monitoring and evaluation

A team of civil managing officials be set up in agreement with the donor. The donor will also set up his own project M&E team, which will work in collaboration with the team of the Ministry for Energy and Mines.

Project duration: 3 years

5. Financial resources

Activities	Cost (US\$)
Carry out studies and updates to identify all the potentialities of power production	100,000
Promote, through micro-grants and loans, hydropower micro stations on sites selected according to their relevance for the saving of wood and other climate-dependant natural resources	400,000
Total	500,000

VI. NAPA PREPARATION PROCESS

NAPA preparation process was participatory both at national and local level. Its objective was to produce concrete proposals of adaptation to climate change that take into account the concerns of the local population in connection with the issues of development and environmental protection, and of the national and sectoral governmental policies.

VI.1. Government input

The contribution of the Government dealt mainly with the:

- Installation of the Project Steering Committee
- Installation of the National Coordination Unit;
- Allocation of office space and vehicle of transport to the National Coordination;
- Providing of the support staff.

VI.2. Consultative process

National Consultation

The NAPA process was founded on assets, including the knowledge available in various documents of sectoral policies and plans. The national consultation was done according to a participatory and multidisciplinary approach and was characterised by meetings of dialogue with all the actors concerned with climate change and the setting up of a number of working groups. The participatory consultations that took account of the gender issue dealt with state institutions, NGOs and private institutions as well as local communities.

Initially, it was necessary to set up Project Steering Committee whose members came from all the sectors concerned with climate change, and in which all the decisions are taken, including the validation and adoption of various documents.

In a second instance, a panel of national experts was put in place (NAPA Multidisciplinary Taskforce) who conducted sectoral studies for NAPA development).

The two bodies constituted the Burundi NAPA Team.

Primary consultations and discussions between the panel of experts and the Steering Committee made it possible to identify and validate the following sectors that were reviewed:

1. Natural resources;
2. Energy ;
3. Landscapes and natural ecosystems, subdivided into the following three (3) sub-sectors:
 - Terrestrial ecosystems
 - Wet ecosystems
 - Landscapes
4. Agriculture subdivided in three (3) sub-sectors:
 - Agriculture
 - Forestry
 - Livestock
5. Health

Working methodology of the NAPA multidisciplinary team

Each group worked in its sector or sub-sector following all the steps of NAPA development up to project briefs. Thus, each sectoral document was a NAPA document for a given document. Meetings

to merge the documents were held periodically between all sectors or sub-sectors to allow the sharing of information and ideas.

The methodology adopted to carry out impact assessment coupled the following methods:

- field survey and statistical method
- analogy
- expert judgement

Capacity Building for NAPA Multidisciplinary Team

While working on their respective sectoral studies, the experts, to which a number of senior officers from the ministries involved in the sectors under review were added, benefited from a five-day training by an international consultant specialised in NAPA development processes.

Therefore, the multidisciplinary team of experts produced nine (9) sectoral reports submitted for discussion and enrichment to the regional consultation.

- Regional Consultation

The regional consultation was based on the participatory approach. The national territory was divided into four zones considered to be strategically homogeneous as regards climate change:

- South-eastern zone (Ruyigi, Cankuzo, Rutana), covering the natural regions of Buyogoma and Moso;
- Northern zone (Kirundo, Muyinga, Ngozi, Kayanza), covering approximately the natural regions of Buyenzi, Bugesera and Bweru;
- Centre and South (Gitega, Bururi, Karusi, Mwaro, Makamba) covering approximately the natural regions of Kirimiro, Bututsi and Buragane;
- Western region (Bujumbura, Cibitoke, Bubanza, Muramvya), the natural regions of Imbo, Mumirwa and Mugamba.

Four consultative workshops with stakeholders, particularly the local community, were organised in each one of these regions to identify the options and urgent needs of adaptation to the adverse impacts of climate change.

The workshops made it possible for the NAPA Multidisciplinary Team to sum up the collected information in order to consolidate the sectoral NAPA document.

Validation of NAPA sectoral reports

The NAPA sectoral reports were submitted for analysis and comment to the institutions corresponding to the sectors reviewed. The formulated recommendations and observations were integrated in the sectoral provisional reports. A 2-day national workshop was then organised to validate the NAPA sectoral reports.

-Drafting of Burundi NAPA document

Two consultants were recruited to assist the National Project Coordinator in drafting a strategy of adaptation to climate change and a National Adaptation Plan of Action. The NAPA draft document was analysed and commented on by a limited team from representatives of the sectoral ministries and the LDC team of experts before being submitted to the Project Steering Committee and the national workshop designed to validate the Burundi NAPA document.

VI. 3. Mechanism of Adoption by the Government

The final NAPA document was submitted to the Ministry for Land Management, Tourism and Environment for endorsement.

VI.4. Final NAPA Dissemination and Implementation

The NAPA document will be submitted to the various concerned sectors and donors. The Ministry for Land Management, Tourism and Environment will, every time it is necessary, organise awareness raising, monitoring and evaluation of NAPA activities will be done by an ad-hoc joint team, created jointly by activities for donors with a view to mobilise funds for NAPA implementation.

VI.5. Country Commitment and Monitoring & Evaluation

The preparation of the present document was initiated by the Government of Burundi and is part of the major policy and strategy documents adopted by the Government, including the Poverty Reduction Strategy Paper (PRSP), the Burundi Environmental National Strategy and Environmental Action Plan (SNEB/PAE). Due to the ownership by the Government of the NAPA development process, the complementarity and conformity to the present effort of adaptation to climate change and the prevention of natural disasters, the Government of Burundi was committed to the implementation of projects identified in partnership with donors.

Monitoring & evaluation (M&E) of NAPA activities will be done by a joint *ad hoc* team set up jointly by the ministry in charge and the donor(s). The project coordinators or executing agencies will provide the M&E team with progress reports, mid-term evaluation reports or final reports as recommended by the projects documents. The M&E team will submit its report highlighting the outputs, the problems and the next steps.

BIBLIOGRAPHY

1. BARARWANDIKA, A. et al. (2000)- L'étude prospective du secteur forestier au Burundi. Forestry Department (Burundi), FOSA.
2. BARARWANDIKA, A. et al.(1999) - Ressources forestières et produits forestiers au Burundi. Forestry Department (Burundi).
3. BAZZAZ, F. et SAMBROEK, W. (1997) - Changements climatiques et production agricole. FAO, Rome and POLYTECHNICA, Paris
4. BIGENDAKO. M.J et MUBAMBA,T. (2001) - Plan d'actions d'adaptation aux changements climatiques, Projet BDI/98/g32, Bujumbura/Burundi, Décembre 2001.
5. BIKWEMU, G. (1991) - Paléoenvironnements et Paléoclimats au Burundi occidental au cours des quarante derniers millénaires par l'analyse palynologique des dépôts tourbeux. Université de Liège. Thèse de Doctorat. 238 p.
6. COENEN E. J., HANEK G., KOTILAINEN P., (1993): Shoreline ranking of Lake Tanganyika based on the results of an aerial frame survey; FAO/FINNIDA Research for the Management of the Fisheries of Lake Tanganyika. GCP/RAF/271/FIN-TD/10.
7. COULTER G.W. (eds). (1991) - Lake Tanganyika and its life; British Museum (Natural History) and Oxford University Press, Oxford. 354p.
8. DGEE: Note d'information du secteur de l'Energie au Burundi, Nov. 2005.
9. DIALLO, S. (2003)- Stratégie d'intégration de l'énergie dans la réduction de la pauvreté et dans le développement durable, UNDP/Ministry for Energy and Mines, Bujumbura/Burundi, October 2003.
10. EGL (Energie des Grands Lacs) : Etat des lieux et initiatives en vue de la Relance de l'EGL, « Séminaire d'identification d'un programme d'intégration régionale en appui à la CEPGL par l'Union EUROP2ENNE », GISENYI/Rwanda, du 17 au 19 août 2005.
11. Gay, D. (1989) - Recommandation pour la gestion du Parc National de la Ruvubu. Corps de la paix, Burundi
12. GOURLET, S., (1986) – Le parc National de la Kibira au Burundi : Quelles potentialités pour quel avenir ?. Ecole Normale du Génie Rural, des eaux et des forêts (GREF).
13. HABYAREMYE, F.X ., (1995) – Etude phytocoenologique de la dorsale orientale du lac Kivu (Rwanda). Université Libre de Bruxelles, Thèse de Doctorat
14. HARIMENSHI, R. (1998) - Evaluation de l'état de fonctionnement des digesteurs et prospection de nouveaux acquéreurs d'installations à biogaz, MEM/Burundi, Bujumbura, octobre 1998.
15. IGEBU, (2001) - Evolution climatique actuelle et développement des scénarios de changements climatiques à l'horizon 2050.
16. IPCC (1997) - Introduction aux modèles simples employés dans le deuxième rapport d'évaluation du GIEC . L.D.
17. LEG/PMA : Lignes directrices pour l'établissement des programmes d'action nationaux aux fins d'adaptation. UNFCCC, July 2002.

18. MINATTE (2001) : Première Communication Nationale au Titre de la Convention cadre des nations Unies sur les Changements Climatiques, Bujumbura.
19. NSABIMANA E (2000) – Inventaires nationaux des GES, module IV – agriculture : Bujumbura
20. NSABIMANA E (2000), Salvator MWAMINIFU S, NINGANZA L et NSHIMIYE S (2001) – Etude d’analyse d’atténuation des GES , module IV – agriculture : Bujumbura
21. NTAKIMAZI, G. (1985) - Hydrobiologie du Bugesera. En particulier des lacs Cohoha sud et Rweru en vue d’une gestion qualitative de la forme piscicole. Vo. I et II, Thèse de doctorat, F.U.L. 454 p.
22. NTAKIMAZI, G. (1991) - L’évolution de la faune piscicole dans les lacs Cohoha et Rweru au cours des dix dernières années. In : Rapport de la deuxième consultation technique portant sur l’aménagement des pêcheries des lacs Cohoha et Rweru. Projet Régional PNUD/FAO pour la planification des Pêches Continentales (PPEC), RAF/87/099-TD/30/91.
23. NTAKIMAZI, G., (1995)- Le rôle des Ecotones terre / eau dans la diversité biologique et les ressources du lac Tanganyika. Projet UNESCO/MAB/DANIDA 510/BDI/40, 1991-1994, Rapport final, 84 p.
24. NTAKIMAZI G., B. NZIGIDAHERA, F. NICAYENZI, K. West, (2000) - L’état de la diversité biologique dans les milieux aquatiques et terrestres du delta de la Rusizi. Rapport de l’Etude Spéciale Biodiversité (ESBIO). Projet Lutte contre pollution et autres mesures visant à protéger la biodiversité du lac Tanganyika (RAF/92/G32).
25. NZIGIDAHERA, B. (1993) - Contribution à l’étude systématique et écologique des champignons ectomycorrhiziques de la forêt claire de Nkayamba (Rumonge, Burundi), Université du Burundi. Mémoire de fin d’étude 146 p.
26. NZIGIDAHERA, B. (2000) - Analyse de la biodiversité végétale nationale et identification des priorités pour leur conservation. PNUD-INECN, 127 p
27. OMM/PNUE, Directives techniques pour l’évaluation des incidences de l’évolution du climat et des stratégies d’adaptation, Genève/Suisse, 1995.
28. OMM/PNUE (2001) : Bilan 2001 des changements climatiques, Rapport de synthèse. Genève, 2003.
29. O’REILLY C. M., ALIN S. R., PLISNIER P. D., COHEN A.S. ,MCKEE B. A., (2003) - Climate change decrease aquatic ecosystem productivity of Lake Tanganyika, Africa. Nature, Vol.424 (766-768)
30. PLISNIER P. D. (2000) - Recent climate and limnological changes in Lake Tanganyika. Verh. Internat. Verein. Limnol. 27 (1 – 4)
31. PLISNIER P. D. (2004) - Probable impact of global warming and ENSO on Lake Tanganyika. Bull. Séanc. Acad. R. Sci. Outre-Mer 50 (2004-2), 185-196.
32. PNUD/PNUE/UNITAR, Programmes d’Actions Nationaux d’Adaptation – PANA, Une sélection d’exemple et d’exercices tirés des ateliers régionaux de préparation au PANA, UNFCCC/LEG, July 2004.
33. PNUE (1998) : Manuel des méthodes d’évaluation des impacts des changements climatiques et des stratégies d’adaptation. October, 1998.

34. PLISNIER, P. D. (1997) - Climate, Limnology and fisheries changes of Lake Tanganyika; FAO/FINNIDA Research for the Management of the Fisheries of Lake Tanganyika. GCP/RAF/271/FIN-TD.72 (En) : 39p.
35. REFES, Bilan diagnostic de la pauvreté au Burundi entre 1998 et 2002. October 2005.
36. REPUBLIQUE DU BURUNDI (2001) : Première Communication Nationale au titre de la Convention Cadre des Nations Unies sur les Changements Climatiques. August 2001.
37. RUZIMA, S. (1998) - Protection de l'Environnement, rapport du séminaire sur le Développement Humain Durable (DHD), Bujumbura
38. SINARINZI, E. (2001) - Evolution climatique actuelle et développement des scénarios des changements climatiques à l'horizon 2050, Mai 2001.
39. SINARINZI E. et SHIRAMANGA M., (2001) - Situation climatologique actuelle et développement des scénarios de changement climatiques à l'horizon 2050, dans « Etude de vulnérabilité et adaptation aux changements climatiques du Burundi », Bujumbura/Burundi.
40. SUNZU-NTIGAMBIRIZWA, S. (2001) - Etude de vulnérabilité et adaptation aux changements climatiques - Secteur de l'énergie
41. THOMAS J.P., BROERSMA K, KABORE D, GNAGNA CISSE A : Sélection et hiérarchisation des options, Atelier PANA. Ouagadougou, 28-31 October 2003.
42. - VERBURG P., B. KAKOGOZO, L. MAKASSA, S. MUHOZA, and J . M. TUMBA, (1998)- Hydrodynamics of Lake Tanganyika: 1993-1996; Synopsis and interannual comparisons; FAO/FINNIDA Research for the Management of the Fisheries of Lake Tanganyika. GCP/RAF/271/FIN-TD.87 (En) : 52p.
43. VERBURG P., HECKY R. & KLING H., (2003) - Ecological consequences of a century of warming in Lake Tanganyika
44. UNEP/Energy, Changing Climates: The Role of Renewable Energy in a Carbon-Constrained World, REN21, Pre-Publication Draft, December 2005.
45. VICE- PRESIDENCE DE LA REPUBLIQUE DU BURUNDI : Cadre stratégique intérimaire de lutte contre la pauvreté au Burundi, 2003.

APPENDICES

APPENDIX 1: NAPA LIST OF EXPERTS AND CONTRIBUTORS

Project Coordination Team:

Mr. NDERAGAKURA Ferdinand, Environmentalist, Project Coordinator.
 E-mail: fnderagakura@yahoo.fr / panaburundi@cbinf.com
 Tel.: (257) 241693

Ms. KANKINDI Christiane, Economist, Project Administrative and Financial Assistant.
 E-mail: kandichris@yahoo.fr

Table 1: Project Steering Committee:

N°	Name and Forename	Function	Address
1	Innocent DUDU Director-General, IGEBU	President	igebu@cbinf.com Tel.: 229424/0402625
2	KABURA Marie Rose, General – General for Forests, Tourism and the Environment	Vice-president	Tel.: 254256/938502 Fax 228902
3	NTUNGUKA Charles Director-General for Agricultural Planning, MINAGRIE	Member	241801/928188 ntucharl@yahoo.fr
4	BARAMPANZE Pierre Director for Energy	Member	223888/743843 barampanzepier@yahoo.fr
5	NZIGIDAHERA Benoit Responsible for CHM of CDB- INECN	Member	234304/235963/827077/
6	NSABIMANA Stany, Dean, Faculty of Geography, U.B.	Member	225228/853508 snsabim@yahoo.fr
7	NITUNGA Rose, In charge of the Environmental Programme, UNDP	Member	301177/605057 rose.nitunga@undp.org
8	Director for Programming, MINIPLAN	Member	225394
9	Environmental Advisor, MINATTE	Member	224979
10	KARIKURUBU Godeliève Representative from AFB	Member	226378/226057/937853
11	Director for Hygiene, MINISANTE	Member	211621
12	NGENZEBUHORO Emmanuela Project National Director	Secretary	241368/856809 manuniba@yahoo.fr

Table 2: NAPA Formulation Experts

Sector	Name	Address
Water resources	SINARINZI Evariste	IGEBU Tel.: 402085 (B)/402113 (H)/959259 Email: evaristesinarinzi@yahoo.com
Energy	SUNZU NTIGAMBIRIZWA Salvator	EGL, Ministry for Energy and Mines; Tel.: 225504 (B) 234751 (H)/732 789
	BARAMPANZE Pierre	Energy Directorate, Ministry for Energy and Mines Tel.: 223888/226975
Natural landscapes and ecosystems:		
Terrestrial ecosystems sub-sector of the	NZIGIDAMERA Benoit	Researcher at the INECN, Department of the Environment Tel.: 234304/827077 Email: nzigidamerbenoit@yahoo.fr
Wet ecosystems sub-sector	NTAKIMAZI Gaspard	University of Burundi 224557 (H)/213601 (B)/930942 Email: ntakimazi@yahoo.com
Landscapes sub-sector	NSABIMANA Stany	University of Burundi 225228 (B)/231168/853508 Email: snsabim@yahoo.fr
Agriculture:		
Agriculture sub-sector	RUSUKU Gerard	Director for Research, University of Burundi Tel.: (257) 224357/224873/937135 Email: grusuku@yahoo.fr
Livestock sub-sector	NSABIMANA Edmond	M&E Directorate-General, Ministry for Agriculture and Livestock Tel.: 222229/963051
Forestry sub-sector	NIYONGABO Richard	University of Burundi Tel.: 224357 (B)/857502
Health	KAVUYIMBO Venant	Director for Health Promotion, Hygiene and Sanitation, Ministry for Public Health Tel.: 211621 (B)/234905 (H)/921631 Email: kavuyimbo@yahoo.fr
	BUYOYA François Xavier	Public Health Department, University of Burundi Tel.: 223377/976217

NAPA International Contributors

Name	Role
MALOU Raymond	Facilitator, Training Workshop for NAPA Process National Experts
KUENZI Erwin	NAPA Document Commentator, LEG Member

APPENDIX 2:

Table 3: Options of adaptation identified by sector/sub-sector

Sector/sub-sector	Options
Water resources	<ol style="list-style-type: none"> 1. Water control for agricultural production 2. Installation of a technical body to coordinate the water sector 3. Catchments development for groundwater conservation 4. Safeguarding of forest formations and afforestation 5. Evaluation of water resources availability 6. Improve the techniques of installation of marshes and irrigation 7. Installation of a national water data bank 8. Improvement of seasonal early warning climate forecasts 9. Education and awareness of the population to water protection 10. Prevention and treatment of polluted water 11. Construction of contour lines to control erosion 12. Human capacity building for water resource management 13. Increase in the rate of access to drinking water and hydropower energy
Energy	<ol style="list-style-type: none"> 1. Promotion of hydropower micro stations 2. Development of an energy-saving programme 3. Updating of the national power master plan 4. Promotion of new and renewable energies 5. Forestation of catchments 6. Management of existing forests 7. Seek and dissemination of species adapted to the dryness 8. Promotion of improved techniques to use wood and by-products 9. Promotion of alternative sources of energy to wood and its by-products 10. Set up a national wood-energy programme 11. Promote the pressed brick technology 12. Exploitation of bagasse to produce electricity
Terrestrial Ecosystems	<ol style="list-style-type: none"> 1. Enhance the conservation of protected areas 2. Fight against bush fires in all the natural environments of Burundi 3. Control savannas and clear forests of the depression of Kumoso, all the wooded hills of Murehe and the peaks of the Ruyigi region 4. Reconstitute the highly degraded areas with adapted species 5. Raise awareness and inform decision makers and other partners, including local communities, on the adverse effects of climate change 6. Undertake a study for the rational use of fires in the National Park of Ruvubu
Forestry	<ol style="list-style-type: none"> 1. Reforest the stripped mountainous massifs 2. Make a forest inventory 3. Seek local and exotic forest species resistant to dryness and to diseases 4. Rehabilitate existing forest resources 5. Work out forest management and installation plans 6. Educate and raise awareness of population on the dangers of bush fires and deforestation 7. Enhance the forest and agro-forestry seed centre 8. Human capacity building on sustainable management of forestry resources and agro-forestry
Wet ecosystems	<ol style="list-style-type: none"> 1. Delineate marshy limits and the buffer zones downstream from the lakes of Bugesera and promote strict protection or restoration where the

	<p>activities are already started</p> <ol style="list-style-type: none"> 2. Promote the protective management of living resources in the marshes and the floodplain of the Rusizi delta 3. Carry out integral installation and integrated management of the littoral floodplain of Lake Tanganyika 4. Delineate and protect a strip of natural vegetation of at least 50 m in strategic zones around the marshy complex and lakes of Bugesera 5. Protect the lake against all the factors worsening water turbidity and sedimentation
--	---

Table 3: Options of adaptation per sector and under sector (continuation)

Sector/sub-sector	Options
Landscapes and infrastructure	<ol style="list-style-type: none"> 1. Reforest the higher zones (Mumirwa and Congo-Nile watershed) 2. Protect lands against water erosion on steep slopes 3. Rationally develop catchments in the Mirwa steep slopes 4. Control river dynamics (river courses and torrents) 5. Fight against the floods in the low lands (city of Bujumbura and the rest of the plain) 6. Channel the run-off waters through the city of Bujumbura 7. Build small dams on steep slopes to attenuate floods 8. Make drainage channels through the low lands in the event of flood
Agriculture	<ol style="list-style-type: none"> 1. Integrated management of water resources: <ul style="list-style-type: none"> • Training in basic techniques and water management • Development and construction of dams in lower valleys • Development of average altitude marshes to grow irrigated rice and food crops • Inexpensive irrigation of fields by building dams on the rivers in the plain of Ruzizi • Popularisation and promotion of rainwater harvesting from house roofs for agricultural use (field irrigation) or domestic use • Irrigation without mosquitoes: promotion of duck breeding in water pits • Integral development of catchments 2. Promotion of bridging crops resistant to long dryness: <ul style="list-style-type: none"> • Training of agricultural assistants on climate change • Promotion of sweet potatoes • Promotion of cassava • Promotion of banana 3. Promotion of fast-growing crops species: <ul style="list-style-type: none"> • Promotion of amaranths • Promotion of radishes 4. Identification of the associations of crops most appropriate to the various agro-ecological regions of Burundi 5. Identification of agricultural timings appropriate to the various agro-ecological regions of Burundi 6. Growing of edible mushrooms: pleurotus
Livestock	<ol style="list-style-type: none"> 1. Restock the livestock victim of climate variability and climate change 2. Research on local and exotic animal species resistant to climate change 3. Promote zero-grazing breeding 4. Foster agro-sylvo-pastoral mainstreaming

	<ol style="list-style-type: none"> 5. Promote the techniques of conservation of food and the fodder banks (ensilage and tedding) 6. Promote livestock food processing and conservation techniques 7. Monitor the evolution of cattle diseases 8. Empower stockbreeders in the management of pastoral water points
Health	<ol style="list-style-type: none"> 1. Promotion of basic hygiene and sanitation with access to drinking water 2. Communication for the change of behaviour 3. Accessibility to treatment in the event of climate change-related disasters 4. Installation of a prevention and early warning system 5. Promotion of insecticide-treated mosquito nets (ITNs) 6. Intra-domiciliary insecticide-treatment in the event of epidemics due to climate change

Table 4: List of priority projects identified by sector
(Details in sectoral NAPA Documents)

Sector/sub-sector	Project Title	Cost ('000 US\$)
Water resources	Enhance water control national capacity for food production	1 Million
	National capacity building in the evaluation of available and exploitable water resources	1 Million
	Improvement of seasonal early warning climate forecasts	0.2 Million
	Development of catchments for water and land conservation	5 Million
	Forestation of catchments to contribute to Burundi eco-climate system restoration	8 Million
	Drinking water supply by photovoltaic solar energy	1,555,200
	Flood and risings prevention programme	500,000
Energy	Reforestation and management of existing forests	8 Million
	Traditional energy sustainable management programme (Promotion energy-wood saving techniques)	0.15 Million
	Promotion of new and renewable energies (solar, photovoltaic and biogas in the centres of public interest and households in the rural area)	600,000
	Enhance electric power output	3,1 Million
Terrestrial ecosystems	Education to climate change adaptation	200,000
	Natural environment preservation	350,000
	Rehabilitation of degraded areas	500,000
Forestry	Forestation of Burundi stripped massifs and catchments	3 Million
	Forestation and rational use of wood - energy	200,000
	Education and awareness raising of the population on the dangers of bush fires and deforestation	500,000
	National forest inventory	500,000
Wet ecosystems	Protection/restoration of the marshy limits and buffer zones downstream from the lakes of Bugesera	1 Million
	Protective management of living resources in the marshes and the floodplain of the Rusizi delta	1,3 Million
	Development and integrated management of littoral floodplain of Lake Tanganyika	1,9 Million
Landscapes	Protect catchments against erosion and reforest the stripped zones of Mumirwa and the Congo-Nile watershed	1,5 Million
	Integrated management of water resources in Bugesera (Bugabira, Busoni, Kirundo)	1,2 Million
	Control the dynamics of rivers and torrents in Burundi western catchments (plains and slopes)	1,2 Million
	Channel surface water through the city of Bujumbura (rainwater and rivers)	1,1 Million
Agriculture	Growing of edible mushrooms: Pleurotis	750,000
	Development of mean altitude marshes to grow irrigated rice and food crops	55 Million
	Promotion of banana	500,000
Livestock	Agro-sylvo-pastoral mainstreaming	1,3 Million
	Development of large catchments	5 Million
Health	Community support to the management of the installed sources	180,000
	Promotion of SANPLAT flooring tile (improved latrine)	200,000
	Promotion of insecticide-treated mosquito nets (ITNs)	150,000
	Prevention, early warning and response	300,000
	Education to change of behaviours	150,000