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NATIONAL ADAPTATION PROGRAMMES OF ACTION
TO CLIMATE CHANGE

NAPA-RWANDA

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Foreword

The Republic of Rwanda has finished its report on National Adaptation Programmes of Action to climate change "NAPA" in conformity with the guidelines prepared by the Least Developed Countries Groups of Experts (LEG) and adopted by the November 2001 Assembly of the Conference of Parties to the United Nations Framework Convention on Climate Change (Decision 28/CP7). Being a country with an economy essentially based on rain-fed agriculture, it is with no doubt vulnerable to negative effects of climate change. With a rate of 60% of the population below poverty line, its adaptive capacity to impacts related to extreme meteorological phenomena is very low.

Having in mind scientific predictions that climate change shall have a serious effect on Least Developed Countries (LDC), the Rwanda NAP A report constitutes a decisive step in its search to respond to immediate and urgent needs for adaptation to negative effects of this change. It therefore offers integration opportunities of measures and strategies of adaptation to climate change in the document for Economic Development and Poverty Reduction Strategy (EDPRS) under preparation. This comes to complete and correct loopholes discovered during the preparation and implementation of Poverty Reduction Strategy Paper (PRSP I).

This NAPA document shall guide political decision makers and national planners on priorities in vulnerable economic sectors as well as strategies and priority actions of adaptation to climate change which were identified according to retained criteria during workshops and seminars of stakeholders organized for this purpose.

From the ranking of priority actions, the project profiles were developed with an urgent character requiring funds to immediately respond to needs caused by the impacts of climate variability in our country. We take this opportunity to request national authorities responsible for ordinary and development budgets as well as our bilateral and multilateral development partners, to attract more attention to NAP A projects of high priority to vulnerable communities due to cyclic climate hazards.

The Government of Rwanda strongly thanks the Global Environment Facility (GEF) and the United' Nations Environmental Programme (UNEP) for their financial and technical support during NAP A exercise and other ongoing projects related to environment. The one week consultancy carried out by the International Expert provided by UNEP Adaptation Programme to climate change to help in the NAP A project coordination has been profitable for the development of a portfolio of high priority projects and the finalization of this report.

Our sincere thanks equally go to all partners of public and private sectors who participated in different consultation meetings on the evaluation of vulnerability, identification and priority choice of potential activities for adaptation to climate change in different sectoral domains. Their participation has allowed the coordination of NAP A, in collaboration with the NAP A team and National Committee for Climate Change (NCCC), to achieve the project objective.

The Minister of State
in charge of Lands and Environment
HAJABAKIGA Patricia

Summary

The NAPA Rwanda report is the result of a process of study, concertation and consultation carried out by NAPA national team from January 2005 to July 2006. This team comprises:

- NAPA national project coordinator,
- UNFCCC Focal Point and Director within Rwanda Environment Management Authority (REMA),
- Environment programmes representative in the Ministry of Lands, Environment, Forestry, Water and Mines (MINITERE),
- Environment Focal Point in the development planning unit / Ministry of Finance and Economic Planning (MINECOFIN), and
- The Director of Lands and Environment in the Prime Minister's office.

The work process not only involved sectors represented in this team and national experts, but also a considerable number of actors, regional and local partners namely local communities as well as women and youth associations.

Following directives of LEG – NAPA experts, the exercise aimed at evaluating current vulnerabilities to climate change according to the eight steps of NAPA guide in consideration of socioeconomic aspects and land use that exarcerbe these vulnerabilities, to identify most vulnerable population groups, regions and sectors, determine priority adaptation options, select urgent and immediate project activities to be implemented as well as defining their profiles.

Results of this process focused on identification of high vulnerabilities to climate change of the population and sectors of agriculture, water resources and energy due to mutual influences and cumulative impacts of:

- High degradation of arable land due to erosion, following torrential regime of rains in Northern regions (Gisenyi, Ruhengeri and Byumba), Centre/West (Gitarama, Kibuye, Gikongoro) and floods in their downhill slope;
- Desertification trend in agro-bioclimate regions of the East and South-East;
- The lowering of level of lakes and water flows due to pluviometric deficit and prolonged droughts; and
- Degradation of forests.

This situation is translated into high vulnerability of high proportion of Rwanda population to climate change because it essentially lives on biophysical support and its modes of existence highly depend on services that are directly offered by ecosystems, not only for food but also for energy. These services are currently more and more sharpened and altered by climate change and anthropogenic action.

The strategy for adequate response to this situation reached by NAPA Rwanda is articulated on six (6)-priority adaptation options to climate change which include:

- An Integrated Water Resource Management – IWRM;
- Setting up an information systems to early warning of hydro-agro meteorological system and rapid intervention mechanisms;
- Promotion of non agricultural income generating activities;
- Promotion of intensive agro-pastoral activities;
- Introduction of species resisting to environmental conditions;
- Development of firewood alternative sources of energy.

From these priority options, 7 high priority projects, hence urgent and immediate, have been selected and their profiles developed. These projects are prepared and identified by direct responses and cross-cutting positive impacts they target once implemented to improve the adaptation capacity of the populations and vulnerable sectors due to climate change and contribute to reinforce the resilience of highly fragilised ecosystems. They are centered on:

1. Land conservation and protection against erosion and floods at the level of Districts of vulnerable regions to climate change;

2. Establish the mastering hydro meteorological information and early warning systems to control extreme phenomena due to climate change: - Installation and rehabilitation of hydrological and meteorological stations;

3. Development of irrigated areas by gravity water systems from perennial streams and rivers in often vulnerable zones to prolonged droughts;

4. Support Districts of vulnerable regions to climate change in planning and implementing measures and techniques related to conservation and water harvesting and intensive agriculture, and promoting existing and new resistant varieties of crops adapted to different bioclimatic soil.

5. Increase adaptive capacity of grouped habitat "Imidugudu" located in vulnerable regions to climate change by the improvement of drinking water, sanitation and alternative energy services, and the promotion of non agricultural jobs.

6. Increase food and medicine modes of distribution to respond to extreme climate change and sensitize to stocking and conservation of agriculture products;

7. Preparation and implementation of woody combustible substitution national strategy to combat the deforestation and erosion as well.

These projects are to be launched starting from 2007. There is also need to consider with great importance the aspect of necessary *disconnection* of energy production of wood as an urgent strategy for Rwanda, which is in the urgent global "national" adaptation efforts to climate change. Also, the stabilization of populations around grouped habitat giving access to basic services and gradual and restabilized reconversion of the population towards agricultural or non agricultural related employments, participates to increase the adaptation capacity of the population to climate change, climate variability and extremes.

It is certain that in this phase of the country's development, success in the implementation of these projects and achieving assigned objectives is not possible unless relevant measures are taken to support these urgent and immediate projects which include:

- Increase coordination process and intersectoral concertation;
- Reinforcement of organizational capacities and human resources at national, Provincial and District levels; and
- Urgent access to funding these projects.

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[3] **Source : Data from the Meteorological Service/MININFRA**

GLOSSARY

ARAMET	Land Development Support Research Association
ARDI	Rwanda Association for the Promotion of Integrated Development
ATEDEC	Technical Action for Community Development
AVODI	Association of Volunteers for Integrated Development
CBD	Convention on Biodiversity
CCD	Convention to Combat Desertification
CDF	Common Development Fund
CEPGL	Economic Community of Great Lakes Countries
COFORWA	Compagnons Fontainiers Rwandais
EDPRS	Economic Development & Poverty Reduction Strategy
ELECTROGAZ	Etablissement de Production, de Transport et de Distribution d'Electricité, d'Eau et de Gaz
ENSO	El Nino/Southern Oscillation index
FAO	United Nations Food and Agriculture Organization
FEWS-NET	Famine Early Warning System-Network
GDP/PIB	Gross Domestic Product
GEF	Global Environment Facility
HIMO	Haute Intensité de Main d'œuvre
IPCC	Intergovernmental Panel on Climate Change
LDC/PMA	Least Developed Countries
LEG	Least Developed Countries Expert Group
MCA	Multicriteria Analysis
MEA	Multilateral Environment Agreement
MINAGRI	Ministry of Agriculture and Animal Resources
MINALOC	Ministry of Local Administration, Community Development and Social Affairs
MINECOFIN	Ministry of Finance and Economic Planning
MINICOM	Ministry of Commerce, Investment Promotion, Tourism and Cooperatives
MININFRA	Ministry of Infrastructure
MINISANTE	Ministry of Health
MINITERE	Ministry of Lands, Environment, Forests, Water and Mines
NAPA/PANA	National Adaptation Programmes of Action to Climate Change
NBI	Nile Basin Initiative
NCCC	National Commitee on Climate Change
NGO	Non Government Organisation
NUR/UNR	National University of Rwanda
ORTPN	Office Rwandais du Tourisme et des Parcs Nationaux
PASAR	Projet d'Appui à la Sécurité Alimentaire au Rwanda
PDRCIU	Projet de Développement des Ressources Communautaires et des Infrastructures de l'Umutara
PND	Politique Nationale de Décentralisation
PNV	Parc National des Volcans
PPPMER	Projet pour la Promotion de Petites et Moyennes Entreprises au Rwanda
PRIMATURE	Prime Minister's Office
PRSP	Poverty Reduction Strategic Paper
RDO	Rwanda Development Organization
REMA	Rwanda Environment Management Agency
RWARRI	Rwanda Rural Rehabilitation Initiative

SINELAC	Société Internationale de l'Energie des Grands Lacs
UN	United Nations
UNFCCC	United Nations Convention Framework on Climate Change
UNDP	United Nations Development Programme
UNEP/PNUE	United Nations Environmental Programme
USAID	United States Agency for International Development
WEF/FEM	World Environment Fund
WFP/PAM	World Food Programme
WHO	World Health Organization
WMO	World Meteorological Organization
ZCIT	Zone de Convergeance Inter-Tropicale

INTRODUCTION

Aware that Least Developed Countries (LDC) lack necessary means to face the problems linked to climate change, the Decision 28 of the 7th Conference of Parties (28/CP.7) to UNFCCC has established guidelines for the preparation and implementation of National Adaptation Programmes of Action (NAPA). The NAPA has the aim of helping the LDC define adaptation priority activities to climate change in order to obtain funds from GEF or other donors for their implementation.

Rwanda, a Party to UNFCCC, received in July 2005 an LDC grant for the preparation of NAPA which will be used as a simplified and direct channel of communication for expressing its urgent and immediate adaptation needs to climate change.

UNEP, the GEF Agency for the implementation of NAPA project in Rwanda, has provided technical advice to the project coordination and facilitated the participation of three people from the national NAPA team in the workshops organized at OUAGADOUGOU and DAR ES SALAAM in 2003 and 2004 respectively. The intervention of UNEP consultant in July 2006 centered on the finalization of 7 projects and their profiles.

OBJECTIVES AND STRUCTURE OF THE REPORT

The NAPA Rwanda team carried out a concertation and consultation study, in the framework of the following objectives:

- To evaluate the present vulnerabilities to climate change according to eight guiding steps of NAPA considering the socio-economic aspects and land use that exacerbate these vulnerabilities;
- To identify the most vulnerable groups of population, regions and sectors;
- To determine priority adaptation options;
- To select urgent and immediate activities and projects to be implemented;
- To define their profiles.

Chapter one of this report introduces the framework and preparation method of NAPA–Rwanda.

Chapter 2 presents a brief description of present socio-economic and environmental context with an indication on adaptation actions to existing climate change. These actions are followed by concepts from the global change, sensitivity, vulnerability and adaptation to climate change.

In chapter 3, climate change in Rwanda is presented under the form of variability of observed precipitations and temperatures.

Chapter 4, constituting the central nucleus of the report, presents impacts and effects observed on the environmental and socio-economic systems, resources exposed to climate risks and the matrix of sensitivity of these resources and human groups.

In chapter 5, we find current vulnerabilities to climate change, the variability of the climate and extreme phenomena by regions and sectors.

After dealing with the national priorities, the urgent and immediate needs to climate change are identified in chapter 6 by a selection of priority adaptation options through multicriteria analysis.

The characteristics and generic logical frameworks of priority options are developed in chapter 7.

The selection of NAPA priority projects (hence urgent and immediate) and the preparation of their profile are respectively indicated in chapter 7 and 8. The detailed development with operation plan of some of them or their sub-projects is in annex 2.

1. FRAMEWORK AND METHOD OF PREPARATION OF NAPA-RWANDA

In order to achieve the objectives described above, the NAPA process in Rwanda has been carried out according to the directives from LEG in the following phases:

Phase 1 – Creation of a pluridisciplinary team:

For the preparation of the National Adaptation Programmes of Action in Rwanda, the NAPA national team has been established and is responsible for the coordination of all the activities of NAPA within the National Committee on Climate Change. This team includes:

- The National Coordinator of NAPA project,
- The National Focal Point of the Convention (UNFCCC) and Director from Rwanda Environment Management Authority (REMA),
- The Representative of Environment Programmes in the Ministry of Lands, Environment, Forests, Water and Mines (MINITERE),
- The Representative-Focal Point of Environment Programmes at the Development Planning Unit/Ministry of Finance and Economic Planning (MINECOFIN), and
- The Director of Lands and Environment in the Prime Minister's office.

Phase 2, 3 and 4: Evaluation of vulnerability to climate change

A report/summary document prepared by six national consultants in July 2005 constituted a documentary review on past and present studies on the vulnerability and adaptation measures to climate change in Rwanda. This has made it possible to identify the major causes of vulnerability of the sectors to climate change through consulted sectoral studies, identify the most exposed regions and sectors and to formulate guidelines and recommendations related to adaptation measures to be taken.

A second concerted evaluation of vulnerability to the present variations of the climate and to extreme meteorological phenomena with the identification of regions and sectors where climate change increase the associated risks has been realized by the members of the team with the participation of many sectoral representatives from concerned ministries.

Public consultations carried out in all provinces of Rwanda during the fourth term of the year 2005, have made it possible to realize an overall summary of vulnerabilities for eight strategic sectors as well as the traditional and modern adaptation activities to climate change.

The results of evaluation of vulnerabilities obtained during each of the four phases of NAPA, and from consultations with partners, namely the local communities including the associations of women and youths, have been validated in the month of October 2006 by the National Committee on Climate Change (NCCC) in which the public and private sectors, as well as the civil society were represented.

Phase 5, 6, 7 and 8 – Formulation of potential adaptation activities:

Sectoral studies on vulnerability conducted by national consultants, with reference to the Poverty Reduction Strategy Paper - PRSP I and the Initial National Communication related to the

UNFCCC and public consultations made it possible to produce a first list of potential options which were the subject of a multicriteria analysis (MCA). The MCA has been considered by the National NAPA team as the most appropriate and most rapid for evaluating the adaptation options, because it has made it possible to use more selected criteria including the monetary/quantified values and the qualitative parameters. This phase was realized in a 4 day workshop in order to formulate and select activities and develop the proposal first forms for NAPA projects.

According to LEG directives, the discussed potential options have been evaluated according to national orientations, namely the national poverty reduction strategy, the sectoral strategies and the Multilateral Environment Agreements.

From 40 options initially identified in 6 key sectors identified as the most vulnerable, the selection process has made it possible to produce a second list of 20 options taking into account the need to realize integrated projects and which are crosscutting to these sectors. The NAPA team has again applied multicriteria analysis and identified priority adaptation options which match adequately the most urgent and immediate needs of the poorest local communities, and therefore, the most vulnerable from the socio-economic and climate point of view. These proposed priority adaptation options are those which fit in the local dynamics or which lie within the national development programmes. Finally, 7 project proposals and their profiles have been prepared.

2. CURRENT SOCIO-ECONOMIC AND ENVIRONMENTAL CONTEXT AND RETAINED CONCEPTS

Socio-economic indicators and those of sustainable development policy including poverty reduction strategy presently implemented in Rwanda constitute contextual framework of the retained concepts for the realization of NAPA.

2.1 Current socio-economic and environmental context

The key elements of the present national context to retain refer to:

1. **A very mountainous country of 26.338 km^2**, a population of 8.128.533 inhabitants of whom almost 17 % live in urban areas. The population growth rate is at 3.1%. There is a high average density of 328 inhabitants per km^2. In volcanic areas of Ruhengeri and Gisenyi, it can reach 600 inhabitants/km^2.

2. **The rural settlement is much dispersed** and encroaches often on productive agricultural lands. The population living below poverty line is estimated at 60%, of which 66% live in rural areas. About 43% of the population are in a situation of extreme poverty.

3. **High density population zones are currently characterised by overexploitation of lands and a vegetal cover severely altered.** Erosion and landslides processes are advanced. This situation explains the present migratory dynamic of people from the most densely populated provinces in the North (Ruhengeri, Gisenyi, Byumba) and the South (Butare, Gitarama) towards the least populated provinces especially in the East (Umutara, Kibungo) and South East (Kigali Ngali) in search of a new land for agriculture and livestock (ref. 3rd general population census in 2002). These migrating populations are already economically vulnerable and this vulnerability is increased by the high risk of drought and desertification of the zone that receives them.

4. **The economy of Rwanda is mainly agricultural.** In 2002, the agriculture sector accounted for 43% of GDP and sustains almost 90% of the population. The agricultural use depends almost exclusively on the quality of the rainy season, which makes the country particularly vulnerable to the climate change. The increased frequency of drought periods, floods, landslides and erosion presently observed considerably decreases the country's food availability.

5. **A critical situation presently prevails in Rwanda in terms of energy production and satisfaction of national needs.** In terms of energy evaluation, the biomass constitutes wood combustible and vegetal residue cover nearly 94% of the national energy needs. Presently it represents the main source of energy for households, industries and craft industries. The big pressure on firewood for energy needs does not favor the implementation of the strategy and the policy for the protection of environment. The support of fuel products account for 5%, which are almost exclusively used for transport, while electrical energy, accounts for 1%.

   One of the objectives of Rwanda Vision 2020 aims at the reduction of the rate of use of wood in the national energy production from 94% to 60% and an increase of the rate of protection against erosion from 20% to 80% by the year 2010. Additionally, the PRSP objective of ensuring a growth energy consumption rate of nearly 10% per

year, and a rural electrification rate of 30% giving electricity access to 35% of the population in 2020 is pursued.

It is time now to resolve this difficult equation in terms of optimum strategy, which will allow the urgent disconnection of energy production from biomass, but in a perspective of sustainable development.

- For example, in the present conditions of climate change combined with anthropogenic factors (agriculture and drainage of swamps or deforestation and overuse of river basins), more of **pluviometric deficits** than **strong torrential rains** are considered to be the main factors of existing hydroelectricity risks upstream of existing or planned hydroelectric production units.

The alternative production of energy, which is currently under discussion, is on the use of methane gas from Lake Kivu, developing hydroelectricity, using peat, photovoltaic solar energy, biogas, using improved stoves/ovens and the production of fuel from biomass. A strategy for a diversified approach of using alternative energies adapted to each environment and based on an efficient intersectoral concertation will make it gradually possible to achieve the objectives mentioned above in a perspective of sustainable development.

Also, the proper use and mastering the adoption of the mode of regrouped habitat envisaged in Vision 2020 according to a rational environment management and better land use – *95% of Rwandan population will be settled in serviced towns and villages (imidugudu)* – will greatly contribute to the effort of managing energy demand and appropriate supply.

6. **The present weak capacity of observation, description and evaluation** of climate/ hydrometeorological stimuli at national, regional and local levels and their impact on ecological, social and economic systems does not allow for the production of sufficient data and information for the concerned sectors of users. This important level of uncertainty and non-availability of hydro meteorological data makes planning very difficult in Rwanda now. The reinforcement of the systems of supervision, evaluation and early warning system of drought and desertification remain insufficient.

7. **The changes in the** land use **and vegetal cover**, become through their interaction with the climate, ecological process, biogeochemical cycles, biodiversity and human activities in that context of reduced space and pressure on environment, a fundamental element as well as climate change. They must therefore be considered in the process of adaptation to global change in Rwanda.

8. **The Government of Rwanda in 2000 promulgated the National Decentralization Policy (NDP)**. One of the main objectives of the reform is to give more autonomy and resources to the District in order to ensure more political and economic capacity of the citizens and local institutions. Presently, the number of Provinces has been reduced to 5 including Kigali City and number of Districts to 30. This is in line with institutionalisation of good governance with a view to identify and implement development priorities, improve life conditions of local communities and particulary fight against poverty. The participative process is now put in place with an effort to mobilizing all national leaders and development partners.

Moreover, national sectoral policies and strategies with their implementation in synergy of the multiple Conventions including the United Nations Convention to Combat Desertification with the United Nations Framework Convention on Climate Change, the United Nations Convention on Biological Diversity, the RAMSAR Convention on Humid Zones show clearly a firm commitment to good environment management and fight against land degradation and desertification.

9. **The existing adaptation actions to climate change in Rwanda** refer to:

- ***The policy of managing disasters*** initiated by the Prime Minister's Office in January 2003 following the natural catastrophes and recent extreme events of climate change: prolonged floods and droughts and their effects of famine, loss of human and animal lives and reduction of food production. A fund for emergency aid is proposed to that purpose.

  The overall aim of the national policy on disaster management is to put in place systems, structures, programmes, necessary resources and capacities in order to reduce the risks of catastrophes and therefore find solutions to the threats of catastrophes in Rwanda in order to save human lives, limit loss of goods, economy and environment to ensure sustainable development.

  A National Plan for Disaster Management and Emergency Plans will be prepared for different situations and types of catastrophes. Among the priorities considered in relation to climate change, we can mention:

  - Establishment of criteria for secure settlements in the areas exposed to meteorological hazards and its respect;
  - Development and implementation of a programme of early warning system for drought and food security in order to protect the population exposed to food insecurity and maintain food supply and the capacity of the population to acquire food;
  - Establishment of criteria for looking after the displaced population after a catastrophe;
  - Institutionalization of the functions of catastrophe management at all levels;
  - Preparation of a continuous programme of mobilizing public action using available media.

  Prevention programmes will be initiated in order to establish effective intervention mechanisms to catastrophes whenever they occur. These prevention programmes cover the following important components: early warning systems, evaluation of risks, plans, resource mobilization, information management, emergency intervention mechanisms, training, public sensitization and regular review of plans and programmes.

  The intervention and recovery after a catastrophe will be covered by emergency plans, which activate procedures established during planning of catastrophe prevention.

- ***Irrigated agriculture*** has been adopted by the Ministry of Agriculture and Animal Resources (MINAGRI) for the agro-climate region of Bugesera seriously and regularly affected by the famine following the prolonged and cyclical droughts.

- ***The cultivation of rice in swamps and shallow areas*** has been chosen as priority cultivation by MINAGRI because of agricultural techniques used for the retention of water and the capacity of conserving the harvested product.

- ***Giving at least one cow of improved race "Frisian" per household*** in the agricultural regions of the South and East of the country hit by famine. The delivery of the first part of cows of Frisian race has already began with a gift of 500 heads of cattle to the population of the disaster region of Bugesera in the South-east of the country in the framework of a programme put in place in February 2006 by the Ministry of Agriculture and Animal Resources (MINAGRI).

- ***Annual programmes of reforestation and fight against erosion.***
  During the week before the "Tree Day" in November each year and during the celebration of World Days of various Conventions in matters of environment, there is a large campaign of reforestation and fight against erosion throughout the country.

- **On-going project of adaptation to climate change in Rwanda** (among those financed by GEF and the climate change project in MSP in which Rwanda participates): **UNEP/GEF Pilot Project on reducing the vulnerability of the energy sector to the impacts of climate change in Rwanda.**
  UNEP in collaboration with GEF has initiated a project on integration of vulnerability and adaptation to climate change and implementation for sustainable development in the Eastern and Southern Africa including Rwanda. The aim of this project is to reduce the vulnerability of communities to the impacts of climate change by improving their well being and protecting their environment.

2.2 Retained concepts

Following the example of other LDCs, the settlement of environmental problems in Rwanda arising from climate change and the variability of climate necessitates more than elsewhere the integration of social and economic dimensions in the process of analysis and evaluation for the most appropriate adaptation. This necessary integration is justified by the fact that the objective difficulty of actually isolating vulnerabilities and exclusively attribute them to climate or any given impact of climate change. In addition, the significative uncertainties as regards the potential impacts of climate change on ecological and social systems as well as the present difficulties inherent to their evaluation, especially on local level, require an approach that is more or less integrated, geared towards adaptation process for sustainable development of the country.

2.2.1 Global change concept

In the present national context described above, the notion "global change" can be used to mean the human and material factors, which influence the environment in Rwanda. It makes it possible to apprehend the phenomena in interdisciplinary and holistic way. This global change is clearly seen mainly around climate change, a change in the distribution and land use and vegetal cover (a process of desertification) and a change in the net balance of carbon. The NAPA work focuses on climate change, despite the difficulty to isolate it in the vulnerability analysis and assessment, but also evaluating the choice of adaptation measures to climate change in an identified country among LDCs.

2.2.2 Sensibility, vulnerability and adaptation to climate change

Sensibility

We shall consider that the climate variations of the last decade in Rwanda came to add to the major socio-ecological disruptions taking place, such as deforestation, desertification, overuse of land and natural resources, a rural settlement which is very scattered and a high level of poverty. In this case, sensitivity represents the degree at which the present ecological, socio and economic systems are affected by the climate stimuli, of varied intensities and frequencies.

Vulnerability

The present strong dependency on natural resources in Rwanda makes economic activities directly dependent on climate conditions. In addition, because of overuse of natural resources, the ecosystems are more and more fragilised. These only two factors explain the vulnerability of Rwanda in a context of climate insecurity. Here, the vulnerability is similar to degree from which the ecological, social and economic systems are susceptible to be affected by disastrous effects of climate change, according to its sensitivity and capacity to face, therefore to adapt.

We should consider that vulnerability, depending among others on the state and level of the country's infrastructure, economy, institutions and the social capital, can be generated by climate causes but also by a multitude of processes and natural and anthropogenic factors. If that general context of vulnerability and the subjacent causes are not taken into account, the magnitude of risks, the extent of social and environmental problems and the emergencies linked to natural disasters and climate change risk to be underestimated.

The analysis of vulnerability in NAPA-Rwanda has simultaneously tackled biophysical vulnerability, which can be measured in relation to the extension of the periods of vegetation growth, the duration and frequency of dry and rainy periods, risks of floods, erosion and risks of drought, and social vulnerability, which can be measured by the level of education, income, poverty and diversification of the means of existence. Knowing that the environmental damage costs (DC) expressed under the form of economic losses are not yet evaluated in Rwanda, caution has been exercised in relation to the notion of vulnerability which could be qualified as critical from the economic point of view, only if elements presenting a known economic value are threatened. The qualitative approach in the evaluation of vulnerabilities has made it possible to identify a larger range of the vulnerabilities of areas, populations and sectors, even those that are not directly linked to climate but which actually hamper development.

The retained approach in the framework of NAPA – Rwanda consisted of an evaluation of the past and present vulnerability with the aim of building the country's adaptation capacity to climate change by the choice of urgent and immediate adaptation measures, at the national and local level.

Adaptation to the climate change

According to the Third Assessment Report - IPCC 2001, **the adaptation to climate change** means the adjustments of human and natural systems in response to present or expected stimuli and their effects which reduce the damages or exploit the opportunities favourable to

development. On the other hand, the reduction is the effort to avoid or mitigate the climate change.

The degree of adaptation is determined by the existence of measures of adaptation to present or future impacts. These measures are believed to reduce the damages or exploit the opportunities favourable to development. In the framework of NAPA – Rwanda, the attention is focused on the impacts and present vulnerability, by taking into account the historical and present events of situations and extreme climate stress experienced in several regions of Rwanda.

The adaptation capacity enables the aptitudes of a human or natural system to implement planned adaptation measures (IPCC-2001). The adaptation capacity adds to a spontaneous or autonomous adaptation, which is often revival and does not constitute a planned response. An example of the adaptation capacity: An adaptation capacity region is elevated in relation to the risks of floods if that region has the political will, the freedom, the resources and knowledge of constructing walls or polders against floods in prevention of more frequent and extreme events.

In Rwanda, with the present weak adaptation capacity to the climate change due to a high level of poverty, drought and recurrent floods, strong dependence vis-à-vis the non irrigated agriculture, a serious energy crisis which hinders human development, building adaptation capacity necessitates the integration of adaptation measures to the climate change in the global strategies of sustainable development.

This principle is strongly applied in the choice of immediate and urgent adaptation measures identified in the framework of NAPA, by the analysis of coherence and synergies with the sectoral policies and strategies of the country.

3. The climate change in Rwanda

In Rwanda, degradation of environment and ecosystems is a phenomenon caused by both the anthropogenic activities and climate disturbances. Thus, the floods of 1997 and the drought in the year 2000 respectively associated to the episodes El Nino and La Nina are clear examples. In addition, the intensity and frequency of climate hazards and their harmful effects are emphasized by the topographical structure proper to Rwandan territory, a country particularly characterized by a very accidented relief and consequently very sensitive to erosion and land slides.

3.1 Geographical and climate profile of Rwanda

In Rwanda, the equatorial climate is deeply modified by the relief at a varied altitude (900 m in south-west, 1500 to 2000 m in the south and the center of the country, 1800 to 3000 m in the highlands of the north and the west and 3000 to 4507 m in the regions of Congo-Nile Crest and the chain of volcanoes.

The observed average of 1961 to 1990 show that rains like temperatures are moderate; this is in fact the result of a combination of a certain number of factors whose explanation is in the general and regional atmospheric circulation. These factors are among others: Inter-Tropical Convergence Zone (ITCZ), subtropical anticyclones, tropical cyclones, monsoons, east waves as well as the tile connections such as the temperatures of the surface of the oceans (SST) and the episodes El Nino/Southern Oscillation (ENSO)[4].

The principal factor that controls the rainy seasons in Rwanda is the ITCZ[2]. Low pressures, the maximum of humidity and the convergence of winds characterize this one. It crosses Rwanda twice a year and determines two rainy periods: from mid-September to mid-December and from March to May. The ITCZ is at its turn controlled by the position and intensity of subtropical anticyclones such as Mascareignes, Saint Helen, Açores and the Arabian Dorsal.

During the season from mid-September to December, the dominating winds are from the Northeast and humidity comes from masses humidified by the Indian Ocean and Lake Victoria. The dry season that follows (mid-December to end February is characterized by the penetration in East Africa by masses of dry and cold airs from the Arabian Dorsal. However, the moderating effect of Lake Victoria and the diversity of the Rwandans relief maintain some rainfalls in our country.

During the season from March to May, Rwanda is influenced by a front situated between the dry winds from Southeast and from Southwest, which carry the humidity from the South Atlantic passing through the Congolese Basin.

Lastly, during the dry season from June to mid-September, the air masses of winds from South–East which arrive in Rwanda are dried of the continental air crossing of Tanzania and present a divergence in the low layers. These conditions are unfavorable to precipitations.

[4] **R. Okoola, synoptic systems affecting eastern Africa, 1999 ; Marcel Leroux, meteorology and climate of tropical Africa, 2001.**

[2] **Kinyamateka n°1611, November 2002**

3.2 Climate variability and extreme - historical trends and current situation

3.2.1 Interannual variability and abnomalities of rainfall

Unfortunately from 1990, meteorological data were only observed at Kigali Airport station; it is therefore not possible to make comparisons with recent years. To the contrary, since the correlation coefficient between rainfalls data at the Kigali station and those of other stations is sufficiently huge, and the surface of Rwanda, which is not vast, we can study climate change using the only available Kigali station.

Standardized abnomalities of total annual rainfalls have been analyzed on Kigali station. Pluviometric excesses and deficits have been considered for values of standardized abnomalities close or higher than +1 and close or less than –1. It means differences between observations and their averages are more than standard deviation (δ) or inferior to the negative value of standard deviation (-δ) (**Fig.1**).

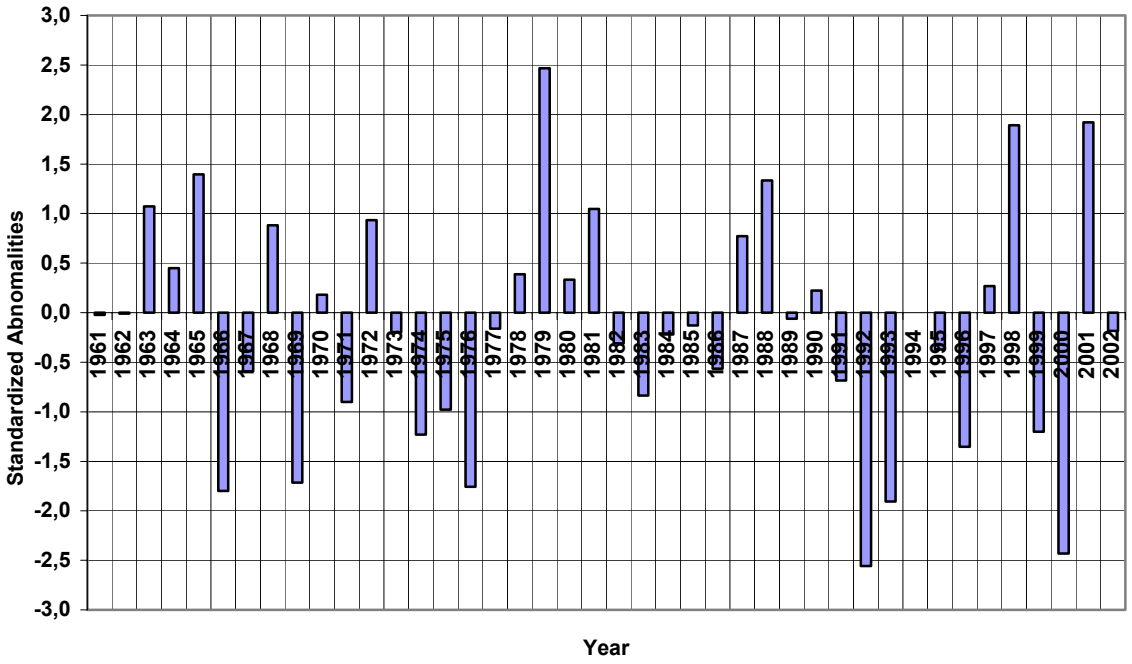

Fig.1 - Standardized abnomalities of pluviometry at Kigali (1961-2002)

The analysis of rainfalls variability registered from 1961 to 2002 shows that:

- The period between 1991 and 2000 has been the driest since 1961. In fact, Kigali station was marked by a pluviometric deficit during five years (1992, 1993, 1996, 1999 and 2000) out of which two were very remarkable (1992 et 2000).

- We also notice two pronounced pluviometric excesses (1998, 2001). Similar pluviometric excess was observed in 1979.

- Like the example of the years 1981, 1988, 1998, and 2001 as well as 1976, 1992, 1993 and 2000, we have registered a progressive difference of excessive and deficiting rains in comparison to the (1961-1990) average, which was more accentuated.

We note the influence of El Nino/Southern Oscillation (ENSO) on seasonal rainfalls[6]**.** In "Generation and application of climate information products and services for disaster preparedness and sustainable development in Rwanda", a study on ENSO influence on rainfalls has been realized. Conclusions deriving from it show us the following:

- El Nino years were characterized by a pluviometry which tends to be excessive. However, some years of El Nino registered pluviometric deficits. These years are also associated to the lateness of the start of rainy seasons and some years are characterized by significant frequency of short droughts (dry spells).

- During rainy seasons, the years, which immediately followed the El Nino phenomenon, registered deficitory rainfalls marked by a significant frequency of drought short periods.

The analysis of number of days of rainy seasons (**Fig. 2**) shows a progressive tendency of short rainy seasons. In particular, the period of 2 seasons for cultivation it means March-April-May (MAM) and September-October-November-December (SOND) faced a significant drop of 1989 to1993 and consequently, a diminution of agricultural production. Hence, adaptation of farmers to this change was to meet premature farming or non-pluvial agricultural practice.

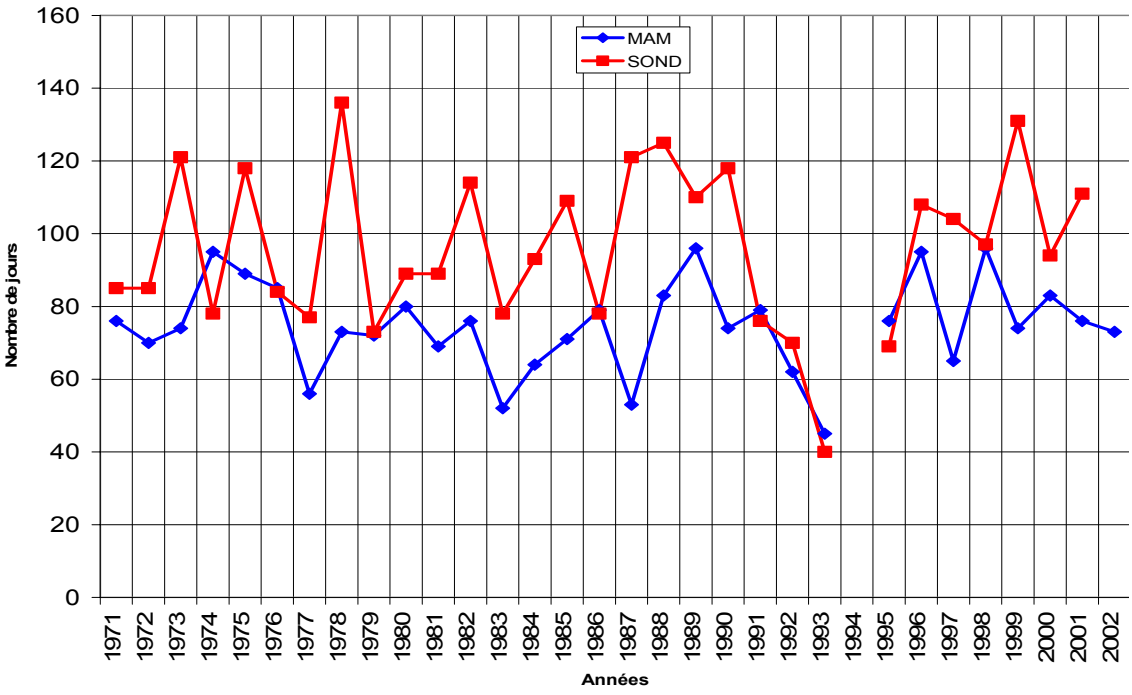

Fig. 2 – Length (days) of rainy seasons at Kigali station (1971-2002)

[6] **Generation and Application of Climate information /Meteorological service/MININFRA, 2004**

3.2.2 Variability and abnormalities of temperatures

Interannual variability of minimal and maximal temperatures at Kigali station was observed. The figure 3 illustrates standardized abnomalities of absolute annual maximal temperatures registered at Kigali station from 1971 to 2005.

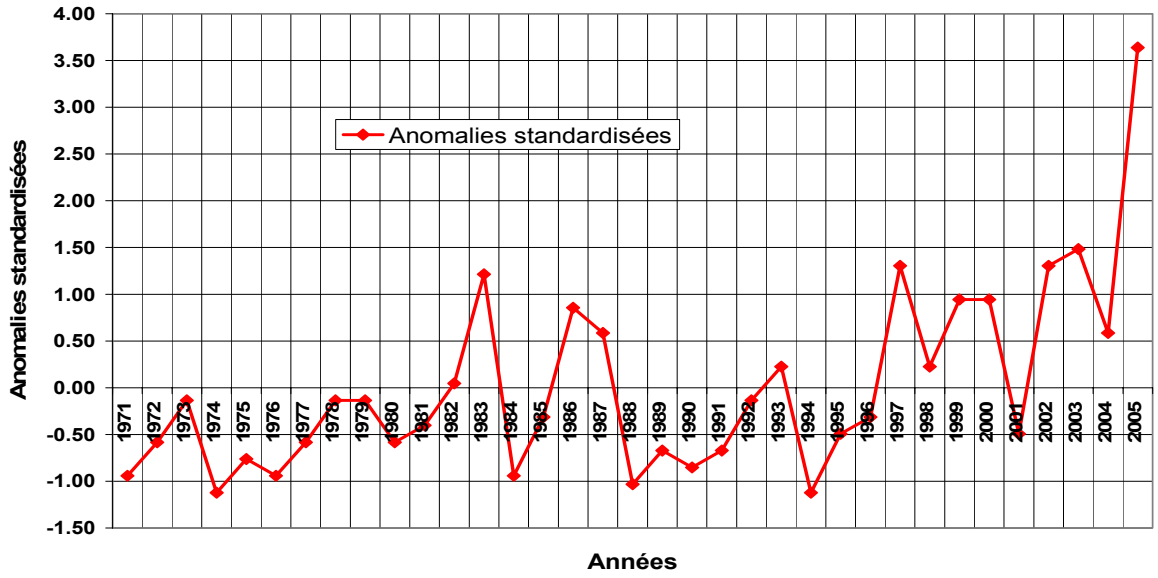

Fig. 3 - Variation of standardized abnormalities of absolute annual maximum temperature at Kigali (Period: 1971-2005)[7]

The variability of air temperature measured at Kigali meteorological station was these last years marked by high values specifically in 1983, 1986, 1997, 1999, 2000, 2002, 2003 and 2005 (Table 1).

Table 1 – Absolute annual maximum temperature (Station Kigali, 1983 – 2005)

Date	10/02/83	28/08/86	24/09/97	06/02/99	06/02/00	08/09/02	07/02/03	22/02/05
Absolute maximum	32,7 °C	32,3°C	32,8°C	32,4°C	32,4°C	32,8°C	33,0°C	35,4°C

The average value of absolute maximum annual temperature is 31,3°C for a difference type of 1,1°C.

Figures 4 and 5 below show standardized abnormalities variation of annual average maximum temperature and annual average minimum at Kigali respectively (Period: 1971-2002)[8].

[7] **Source : Data from Meteorological Service/MININFRA**

[8] **Source : Data from Meteorological service/MININFRA**

Analysis of maximum temperature shows us the same progressive tendency of increase in the temperature from the years 1990's.

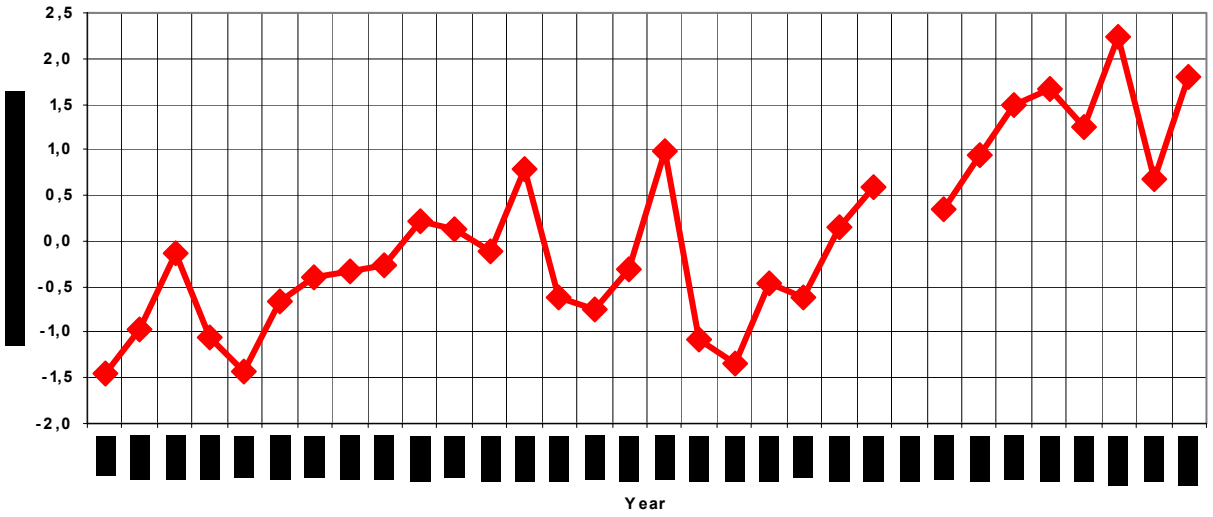

Fig. 4 – Variation of standardized abnormalities of annual average maximum temperature at Kigali (Period: 1971-2002)[9]

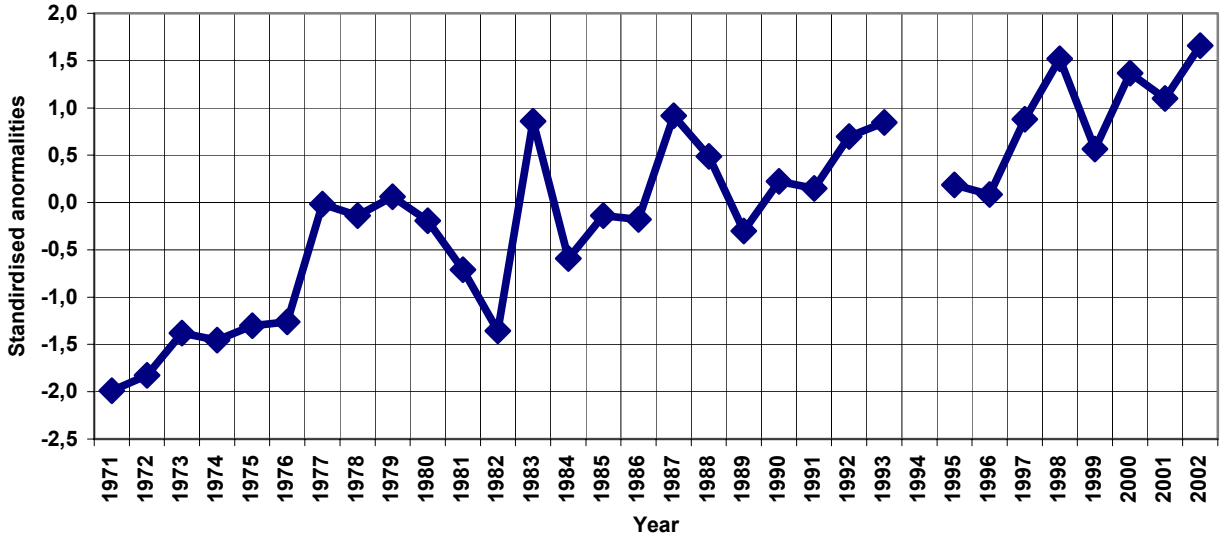

Fig. 5 - Variation of standardized abnormalities of annual average minimum temperature at Kigali (Period: 1971-2002) [10]

3.2.3 Variability of Lake Kivu level

Information on the viability of lake levels in Rwanda has been searched as an indicator of response (of reaction) to climate change. The latter disturb and affect hydrological regimes and hence lake supply. The only obtained data leads to Lake Kivu levels observed from 1940

[9] **Source : Data from Meteorological service/MININFRA**

[10] **Source : Data from Meteorological service/MININFRA**

to 2004, of which the below extract of average monthly levels from 1980 to 2004 measured at outlet.

The strong variation observed from 1993 is to be considered in relation to relative stability of previous years average monthly levels. Even though there is need to take into account effects of turbined volumes for electrical production, these strong variations cannot uniquely refer to it. Indeed, the discovered increase of levels twice during the two consecutive years from 1996 to 1998 and 2000 to 2002 seems to have little link with energy production, which cannot vary considerably. To the contrary it corresponds to positive values of standardized abnormalities of the pluviometry, hence to pluviometric excesses observed during the same period (fig.1).

The almost regular cycle of two years of strong variations of average monthly levels, apart from the variation from 1993 to 1994, is considerable. The weak level of the lake (fig.6) observed from 1993 and maintained until 1996 corresponds to short durations of two rainy seasons (fig.2) as well as pluviometric deficits realized at the same period and corresponding to negative values of standardized abnormalities of pluviometry (fig.1).

If we refer to variations of standardized abnormalities of annual average minimum and maximum temperatures (fig.4 and 5), these strong variations of such an important lake appear during the period of progressive tendency of increase in temperature observed from the 1990's. These first observations deserve to be analyzed and precised with other hydro meteorological representative stations.

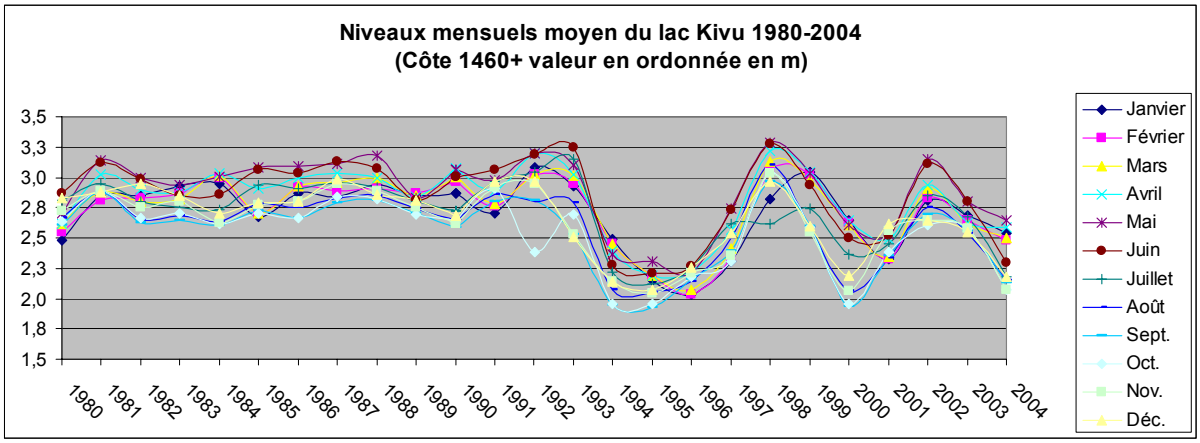

Fig. 6 – Average monthly levels of Lake Kivu 1980 – 2004

The tendency to the low level of Lake Kivu is one example among other disturbances of hydrological regimes of rivers, water flows and lakes of Rwanda. The two hydro electrical stations of Ntaruka and Mukungwa of nominal capacity of 24 MW, installed at Lake Burera and Ruhondo outlets actually produce 7 MW. Another example is the drinking water deficit of 30.000 m^3 per day that Kigali City faces following the low intake flow from Yanze River. Faced with this problem, it is very urgent to adopt national strategies of integrated watershed management so as to increase the infiltration capacity of rain water for aquiferous layer recharge.

4. NEGATIVE EFFECTS OF CLIMATE CHANGE

In Rwanda, negative effects linked with disturbances of climate system affected these two last decades different sectors and natural resources involved in socioeconomic development. In fact, a correlation exists between the increase in temperature and the humidity of the soil; the lowering of lake water levels and water flows, drying up of sources, agricultural productivity and appearance of paludism.

Recently in 1997, serious floods linked with El-Nino episode of 1997/98 destroyed a big number of agricultural plantations and ecosystems occupying shallows and swamps of Nyabarongo and Akanyaru river basins.

From 1999 to 2000, a prolonged drought seriously affected Bugesera, Umutara and Mayaga regions. Like the famous Ruzagayura famine during 1943 to 1945, such disasters are mostly provoked by climate change.

Other factors, linked to various anthropogenic activities, just like in the general atmospheric circulation, the position and intensity of tropical anticyclones and intertropical convergence zone are susceptible to provoke similar effects. It was the same case for negative effects provoked by landslides and landslips in the North (Gakenke, Cyeru, Rulindo, Butaro, and Kinihira) and the West (Nyamasheke, Karongi and Ngororero) of the country in 2001/2002.

4.1 Occurrence of extreme phenomena of drought and floods

Like other central and eastern regions of Africa, Rwanda is from the 80's confronted with either prolonged droughts episodes or serious floods. As an example, during October-December 1997, the pluviometry varying between 725 and 1240 mm, being largely above normal reference[11] pluviometry .

To the contrary, during March-April-May 2000, an important low pluviometry was registered followed by a prolonged drought which devasted these regions including Rwanda. The same scenario of irregularities of rainfalls was produced from September 2005 until February 2006 where practically the September to December farming season did not give any harvests. This provoked a famine in the eastern and southern provinces of Rwanda, which provoked an emergency intervention from the Government to the most vulnerable population of these regions (Umutara, Kibungo, Bugesera, Mayaga, and Butare).

Floods, landslides, droughts episodes constitute the major repetitive natural disasters for Rwanda associated with climate change often linked with ENSO episodes. These phenomena take birth from the Pacific far from African coastal zones, but this doesn't spare these continental regions including Rwanda under the shelf of their effects such as among others, the disturbance of pluviometric regime.

External factors linked to El Nino and La Nina episodes often influence the climate variability in Rwanda and connexed effects such as famines.

Since the year 1902, a series of big famines, following prolonged droughts episodes has been registered in Rwanda. In 1999/2000 East and South-eastern regions of the country were seriously affected by a low agricultural production associated with La Nina 1999/2000 episode. The same case was reproduced in 2005/2006. Also, an increase of frequent prolonged droughts has been experience since the 1980's.

[11] **World Meteorological Organisation, N°950, 2003).**

Table 2 - El Nino/La Nina Episodes and Famines in Rwanda

Period	El Nino /La Nina Episodes	Catastrophe	Consequence	Affected Region
1902/03	**El Nino Episode**		"Kimwaramwara" Famine	Butare
1916/1918	**La Nina**	-	"Rumanura" Famine	Generalized
1924/25	**La Nina**	-	Famine	Various regions
1943/44	**La Nina**	Drought	"Ruzagayura" Famine	Generalized
1963	**El Nino Episode**	Diluvian rain	"Rwagakoco" famine	Generalized
1982/83	**El Nino Episode**	Drought, strong heats	Low agricultural production	Generalized
1986/87	**Episode El Nino**	Strong heats	-	-
1990	**La Nina**	-	Famine	Various regions
1991/92	**El Nino Episode**	Drought	-	East
1997/98	**El Nino Episode**	Drought, high heats	-	-
1999/2000	**La Nina**	Drought, high heats	Famine	East of country especially Bugesera
2005/2006	**La Nina**	High heat and prolonged drought	Famine; water sources drying; tendency of desertification	Generalized; East and South mostly affected

Of the seven big famines:

- Three took place just before the El Nino phenomenon (e.g: Rumanura famine in 1917-1918)
- Two coincide with El Nino episode (e.g.: Rwagakoco famine in 1963)
- Two others appeared just after the event of El Nino (Ruzagayura in 1943 and the case of Bugesera in the year 2000), it means during La Nina event.

The intensity of the catastrophe registered determines the gravity of the impact on the regional and affected population groups. In some cases, these catastrophes due to the variability of the climate under the influence of El Nino or La Nina episodes were generalized to the whole country. Once such or such catastrophe affects a group of populations, different sectors involved in socioeconomic development are also affected at different degrees.

4.2 Influence of climate hazards on agricultural production

The figure 7 below illustrates the fluctuations of cereal production leguminous, tubers and roots, banana and fruits as well as vegetables from the year 2000 to 2004. After the evolution realized until 2002 in banana, tubers, fruits and vegetable production, we noticed a low production joining sensibly values achieved in 2000, particularly for tubers, roots, cereals and leguminous.

Cereal production hardly increased regardless of low production of Sorghum, which represents almost 53% of the total production of cereals. This increase is due, according to MINAGRI statistic department, to the efforts of the Ministry, which improved the production of some cereals such as rice and maize in helping the extension of cultivated areas. The leguminous production sensibly went down in 2004 due to heavy rains registered in high altitude regions, which are generally more productive.

According to the MINECOFIN's department of statistics, the low performance of food production from 2002 is the result of irregular rainfalls and a dislocation of rainy seasons which took place.

These weakening of agricultural production linked to climate hazards are to be seriously considered knowing that food needs in the country are ever growing.

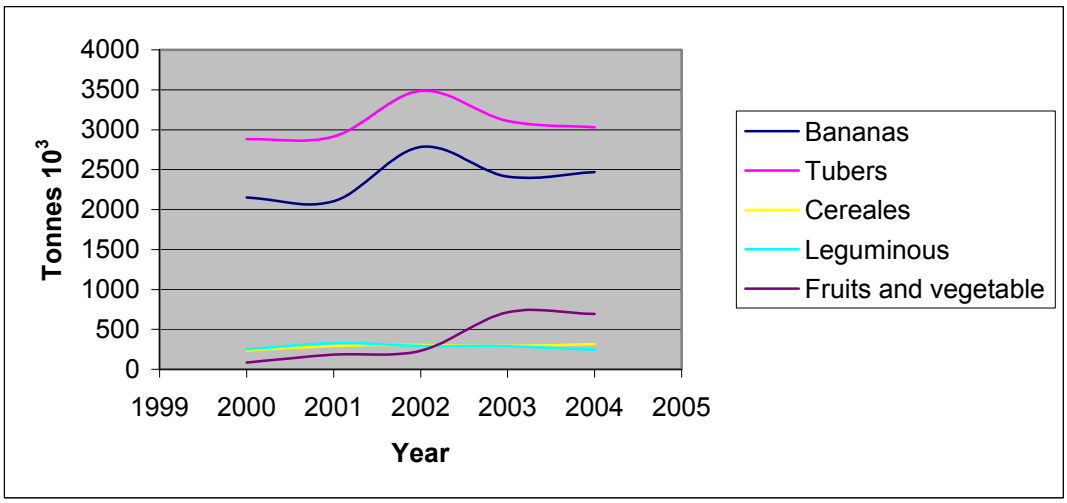

Fig. 7 - Evolution of cereal, leguminous, tubers, fruits and vegetable production during the period 2000 - 2004

4.3 Resources exposed to most current climate change

Current climate change risks to which vulnerable existence modes are exposed in Rwanda are presented in the following table 3. They are described in relation to their consequences, their length, their geographical area, and their frequency. An exponential scale of evaluation has been utilized.

Table 3 - Inventory of most current risks

N°	Risks	Wording	Impact	Loss in human lives	Length, days	Spatial area km^2	Frequency %	Tendency
1	**Prolonged seasonal drought**	Failure of harvest; lost of young seedlings; increased water demand	2	1	2	4	2	I
2	**Short period droughts in rainy seasons (dry spells)**	Critical growth of food producing crops and reduced productivity of harvests.	1	1	2	3	2	M.
3	**Recurrent droughts on 2 or 3 successive years**	Reduction in water resources and hydroelectric energy; Drying of banana plantations; Pauperization of the population especially in rural areas; Displaced populations; Food aid.	4	4	3	4	2	I
4	**Rains with high intensities of more than 50 mm/h**	Rise in the water level, floods, landslides, localized landslides; Lost of production in swamps products; Soil erosion on basin sides and expansion of river beds; Malaria cases increase.	3	2	2	3	3	M
5	**Low precipitation**	Critical growth of food producing crops and poor harvests.	3	1	3	4	3	M

Legend:

Risks*	1	2	3	4	5
Impacts	1.000 FRW P/capita	10.000 FRW P/ capita	100.000 FRW P/ capita	$1000x10^3$ FRW P/ capita	$1000x10^4$ FRW P/ capita
Lost in human lives	1 person p/event	10 persons p/event	100 persons p/event	1000 persons p/event	10000 persons p/event
Length	1 day	10 days	100 days	1000 days	
Spatial area	1 km^2	10 km^2	100 km^2	1000 km^2	10000 km^2
Frequency	1% probability = 1time/100 years	10 % = 1time/10 years	100 % 1 time/year		
Tendency indicators	I = important		M = average		N = uncertain

*Estimates are calculated on exponential scale

In the previous table, the evaluation shows that the most current risks are:

1. **Prolonged seasonal drought**, **recurrent drought on two or three successive years** as well as **low precipitations** have an important impact of spatial area of 1000 km^2, leading to a loss of 1000 lives, economic losses of 1.000.000 FRW/capita among the affected population. The occurrence tendency of these events is very important and of high frequency.

2. **Particularly intense rains coupled with short droughts (dryspells) alternating with low precipitations in rainy seasons** also presents a recurring risk with localized impacts in an area of 100 km^2, a loss of 100 human lives and economic losses of 100.000 FRW/capita among the affected populations. The occurrence tendency of these events is considered as average but of high frequency.

4.4 Sensitivity matrix of human resources and human groups

In table 4 below, the sensibility of 3 observed units representing services rendered by ecosystems, means and modes of existence is analyzed in relation to each climate risk most frequent as identified above. There is a need to consider that major socioeconomic disturbances (deforestation, desertification, overexploitation of lands and natural resources, dispersed rural habitat and high level of poverty) are already experienced in Rwanda and climate variations of the last decade in Rwanda come to complicate matters.

For this analysis, only 4 services rendered by ecosystems essentially linked to agricultural production for food subsistence needs, water resources and energy needs satisfaction is taken into consideration. Means and modes of existence are five respectively and representative of all regions of Rwanda.

The sensibility levels refer to an evaluation scale of 1 to 5. Exposition indicator measuring to risk corresponds to global vulnerability of each unit or subunit analyzed in relation to recorded most current risks taken into consideration; it is expressed in percentage.

Table 4 - Sensitivity matrix of human resources and groups in Rwanda.

	MOST FREQUENT CLIMATE RISKS				INDICATOR OF EXPOSITION %
	1. Prolonged seasonal drought	2. Short drought during rainy season (dry spells)	3. Heavy rains	4. Short rains	
SERVICES RENDERED BY ECOSYSTEMS					
Soil humidity	5	3	1	3	60
Water resources	5	2	1	4	60
Pastures	5	2	1	3	55
Timber/Firewood	2	1	2	3	40
MEANS OF EXISTENCE					
Food producing crops harvest	5	3	4	4	80
Industrial products (Coffee, tea)	5	3	2	4	70
Animals	4	2	1	3	50
Charcoal	2	1	1	1	25
Rainfed Agriculture	5	3	2	3	65
Manpower	3	1	2	1	35
MODES OF EXISTENCE					
Farmers/home plots	5	2	3	4	70
Pastoralists/ Domestic level	5	2	1	3	55
Big farmers	4	1	2	2	45
Traders/ Rural markets	4	1	3	3	55
Civil servants	3	1	2	2	40

Legend:

Sensibility scale

1	Weak
2	Relatively weak
3	Relatively high
4	High
5	Very high

Scale of exposition

≥ 70 %	Very high vulnerability
≥ 55 %	High vulnerability
≥ 25 %	Relatively high vulnerability

From this matrix, it comes out that:

1. Foods producing crops and industrial crops (tea, coffee) as means of existence have a very high degree of sensitivity especially during seasons of frequent and prolonged droughts as well as heavy or poor rains. Their vulnerability is very high. It is the same for farmers and pastoralists on domestic plots;

2. Big farmers and rural traders present as means of existence also a high degree of sensitivity to seasonal frequent and prolonged drought risk but are relatively less vulnerable due to their possibility of easy access to financial means and their know how that they have to easily adapt to climate hazards;

3. There is also a very high sensitivity for almost all services rendered by ecosystems during frequent and prolonged dry seasons and modes of rain-fed agriculture. Both have a high vulnerability.

5. EVALUATION OF VULNERABILITY

After identifying most frequent risks which are mainly droughts and heavy rains and high sensitivities to services rendered by ecosystems, means and modes of existence is now below localize most vulnerable regions and sectors.

5.1 Regions most exposed to deficits and pluviometric excesses[12]

Bioclimate region mostly exposed to pluviometric deficits **(Fig.8)** have been determined from information on dates of beginning and ends of rainy seasons and from the analysis of short droughts (dry spells) data during March to May and September to December seasons. These regions are characterized by frequent droughts and they are extended on:

- North-East (Umutara);
- East (Kibungo);
- South East (Bugesera and Mayaga regions).

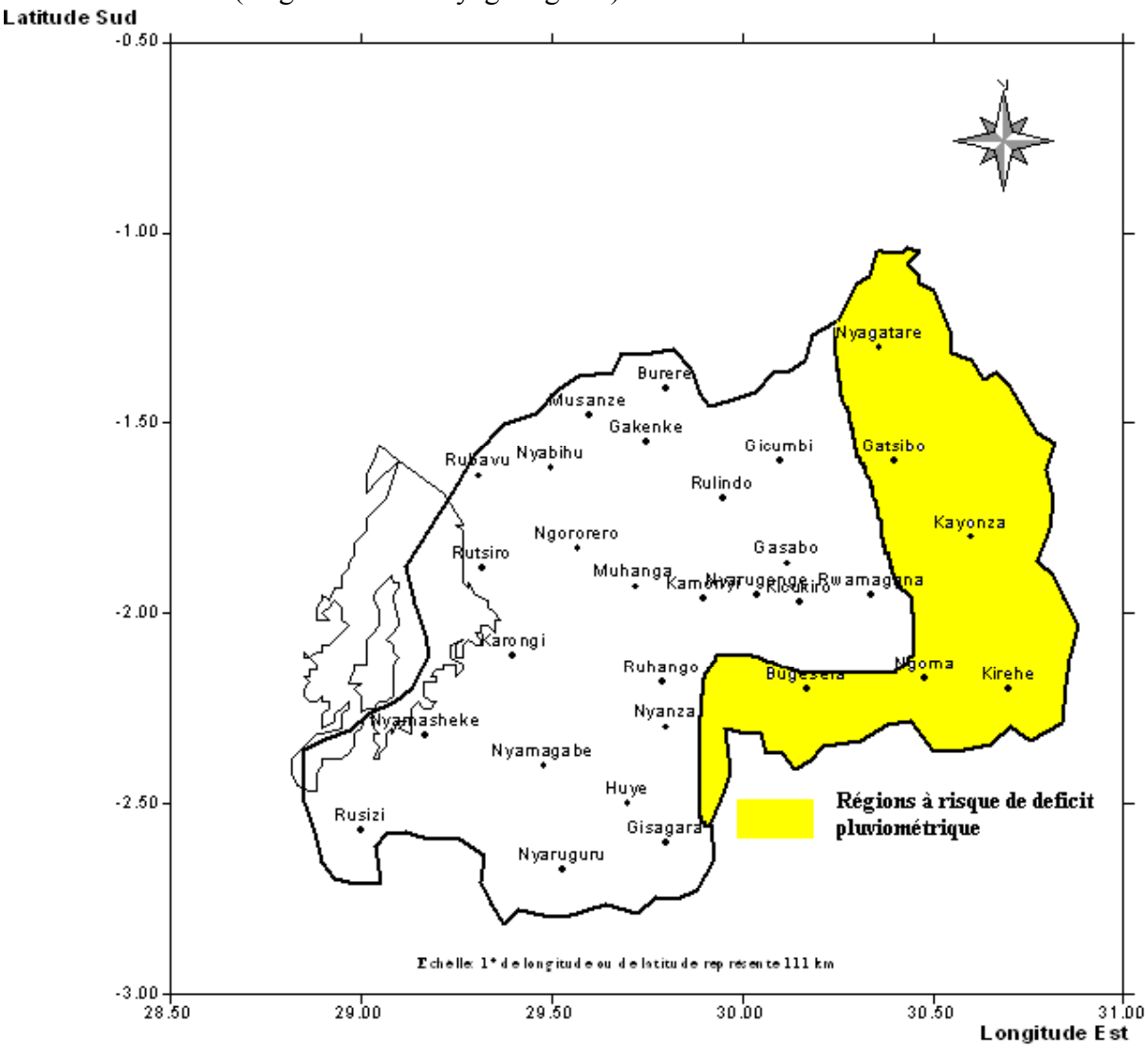

Fig. 8 – Map representing regions with risks of pluviometric deficit and threatened by frequent droughts[13]

[12] Meteorology Service/MININFRA, 2004

[13] **Source: Data from Meteorological service /MININFRA**

Bioclimate regions most exposed to pluviometric excesses **(Fig.9)** were identified from the analysis of the frequency of precipitations above 50 mm per day. These regions are very vulnerable to negative effects caused by heavy rains. They are particularly exposed to destructive erosion, considerable soil degradation, landslides and landslips. Low altitude zones or least accidental are not spared. They are extended to:

- A big part of northern regions (Ex Provinces of Gisenyi, Ruhengeri and Byumba) and the Southwest region (Ex-Provinces of Gikongoro and Butare) and the western region (Ex- Provinces of Kibuye and Cyangugu);
- The north of Kigali and some parts of the center (Ndiza, Muhanga).

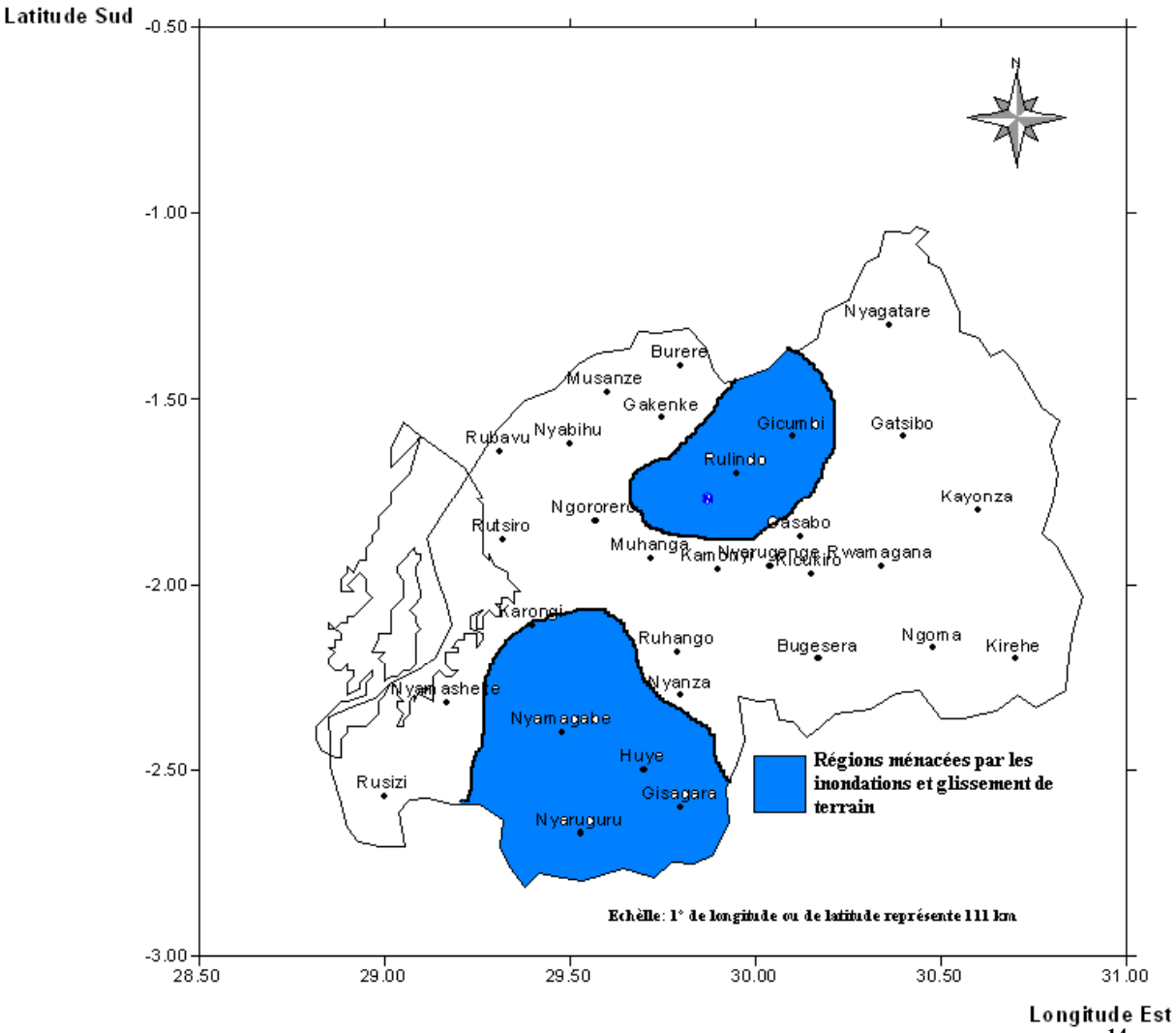

Fig. 9 – Map representing regions threatened by floods and landslides[14]

It was realized that southern and eastern regions situated along Akagera and Akanyaru valleys are more sensitive to current climate variability and future climate change if observed tendencies continue. Furthermore, these vulnerable regions receive more and more migrating population from regions with high density of population and natural resources have reached a critical level of degradation. These migrating populations are searching for new agricultural lands and pastures and already present a high economic and social vulnerability.

The table 5 below summarizes the types of physical impacts of identified vulnerable regions and affected sectors:

[14] **Source: Data from Meteorological service /MININFRA**

Table 5 – Inventory of negative effects of climate change per most vulnerable regions

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

The National Adaptation Programmes of Action "NAPA" should therefore implement projects aimed at fighting prolonged droughts risks in eastern and southern provinces and risks of intense precipitation and erosion in the northern and western provinces. These projects should in a more sustainable development perspective, better respond to the immediate and emergency character of adaptation means to climate change by integrating at once management aspects of the demand and those of the offer of the means and resources.

5.2 Current vulnerability of regions and sectors affected by climate change

On the basis of information received from provincial consultations, table 6 indicates and confirms vulnerable regions and sectors affected by prolonged droughts and torrential rains.

Table 6 - Causes of impacts, vulnerable regions and affected sectors

Climate hazards	Vulnerable regions	Consequences on most affected sectors
Increase of temperature, prolonged droughts and high evapotranspiration.	Swamp complexity of Akagera river. Akagera park, Rugezi swamp. Bioclimatic region of East and Southeast and some zones of the Central plateau (Umutara, Kibungo, Bugesera, Mayaga Gitarama) 6 hydroelectric stations, Ntaruka, Mukungwa, Gihira and Gisenyi, RUSIZI I and RUSIZI II.	**Water resources** Low river flows and disturbance of hydraulic cycle in general. Low water level of lakes and rivers; ▪ Drying up of water sources. ▪ Loss of aquatic ecosystems (hippopotamus deaths due to drying of Gabiro-Akagera valley in the Akagera National Park during la Nina 1999-2000). **Land Ecosystem and Agriculture** Decrease banana production. Cereal and leguminous production especially maize and beans growth becomes almost impossible. Favourable conditions to parasites (caterpillars on sweet potatoes and beans). Pastures without perpetual water or from irrigation become threatened and extinct. **Food security** Fluctuations in the production, risks of food insecurity and favourable conditions to famines. **Hydroelectric and wood energy** Reduction of hydroelectricity production. Limited forest resources and exposed to direct and indirect drought effects (bush fire). Low production of wood resources.

Table 6 - Causes of impacts, vulnerable regions and affected sectors (continued)

Climate hazard	Most vulnerable regions	Consequences on most affected sectors
Heavy rains, floods, frequent landslides and landslips.	Riverside regions of Akagera, Akanyaru and Nyabarongo rivers.	**Health** Proliferation of mosquitoes and diseases of water-borne origin (malaria, diarrhoea, etc). Loss of animal and human lives.
	High altitude regions of West, South-West, North, Centre and Congo Nile crater foothills (Budaha, Ndiza and Buberuka highlands). High mountainous regions, Congo Nile crater regions, valleys and shallows (peat bogs, altitude meadows); North (Cyeru, Nyamugali).	**Agriculture** Erosion becomes an important factor for low agricultural production and food insecurity. Crops destruction risks and high silting-up particularly in swamps and shallows. **Infrastructures** Destruction of anti erosive systems, destruction of economic infrastructures (roads, bridges, schools, hospitals, houses, etc.). **Economy** Reduction of production, and GDP. Reduction of rural population revenues. Increase of foodstuff cost. Movements of the population in search of food.
	6 hydroelectric stations (Ntaruka, Mukungwa, Gihira et Gisenyi, RUSIZI I and RUSIZI II).	**Hydroelectricity** Low hydroelectric production.
	Protected zones, national parks, cultivated lands, Affluents and swamps: Nyabarongo, Rugezi, Akagera and Mukungwa rivers.	**Ecosystems** Problems related to water pollution and invasion of aquatic pollutant plants (toxic products, water hyacinth…); Loss of soil fertility by leaching of arable lands; Increase of sediments on arable land at the outlets of slopes; Local risks of landslides; Risks of irreversible land leaching Soil erosion and degradation; River, lake and reservoir sedimentation.

6. IDENTIFICATION AND CLASSIFICATION OF ADAPTATION OPTIONS

Adaptation options to climate change per key sector of Rwanda economy have been identified following sectoral studies on vulnerability carried out by experts, the PRSP I, the Initial National Communication related to UNFCCC and public consultations carried out in all Provinces during the fourth term of the year 2005.

6.1 Analysis of adaptation options – NAPA-Rwanda

A first list has been prepared and comprises 40 identified options from 6 most vulnerable sectors including: Agriculture and animal husbandry, lands, water resources, forestry and health. After analysis of these potential options, a second list comprising 20 options taking into consideration the necessity to implement integrated and transversal projects within these sectors was prepared.

NAPA team formulated key adaptation options which adequately respond to most immediate and urgent needs of most poor local communities and hence, most vulnerable in socio-economic and climatic point of view. These key adaptation options proposed are the ones which integrate into local dynamics or become integrated into the national development programmes:

1) Promotion of non rain-fed agriculture;
2) Increase agricultural techniques;
3) Introduction of species resistant to drought in arid and semi arid zones;
4) Introduction of precocious varieties in arid and semi arid zones;
5) Protection of basin sides in mountainous zones;
6) Promote stocking techniques of agricultural products after harvesting;
7) Reinforce early warning and rapid intervention systems;
8) Reinforce animal husbandry in permanent stalling;
9) Promote veterinary and phytosanitary services;
10) Develop alternative sources of wood energy ;
11) Rational utilisation of wood energy;
12) Preparation and implementation of forestry development plan;
13) Preparation and implementation of land development plan;
14) Integrated water resources management (IWRM including rainwater);
15) Promotion of non agricultural activities;
16) Increase the rate access of drinking water;
17) Favour access of the public to medical insurance services;
18) Prevent and fight against vectors of water-borne diseases;
19) Integration of NAPA in policies and national development plans;
20) Facilitate accessibility to health services.

6.2 Selection of potential adaptation options and integration with national objectives of sustainable development

Options and adaptation measures to climate change identified during various consultations of NAPA process constitute very important additional information of formulated national objectives and multilateral Conventions on environment ratified by Rwanda.
Rwanda sustainable development objectives are stipulated in the documents of policies dealing with development, poverty and vulnerability such as vision 2020, decentralisation policy, documents for strategies for poverty reduction (PRSP I and EDPRS), sectoral

strategies and policies, policies and plans for the implementation of MEA(Multilateral Environment Agreement) action plans such as CBD and CCD.

The PRSP I review in February 2006 helped to integrate environment and other aspects of climate change such as drought, salt and pest in EDPRS – Economic Development and Poverty Reduction Strategy as an essential element of economic development so as to fight poverty and consolidate the welfare of Rwandans. Environmental data shall now be integrated in local development plans so as to determine impacts of action plans and their policies. The dimension of environment and environmental problems shall be considered and dealt with by these development plans.

Priority strategies and objectives underlined in these national development plans in relation to NAPA are indicated in table 19 of Annex 1.

After confrontation with national priorities and so as to maintain the process of analysis easy and manageable, taking into account **urgent and immediate needs** established in PRSP, EDPRS and other development programmes, 11 priority options have finally been retained to be submitted for multicriteria analysis. They include:

1. Promotion of non rain-fed agriculture;
2. Intensive agriculture and animal husbandry;
3. Introduction of drought resistant species;
4. Integrated water resource management;
5. Stocking and conservation of agriculture produce;
6. Information systems, early warning and rapid intervention mechanisms;
7. Development of sources of energy alternative to firewood;
8. Preparation and implementation of a national land development plan;
9. Access to health facilities and fight vectors of water-borne diseases;
10. Promotion of non agricultural activities, and
11. Preparation of a forest development plan.

6.3 Selection of NAPA immediate and urgent options

Due to financial constraints and limited capacities to be developed for a better implementation of these priority options, *specific criteria* are utilized to select and make a hierarchy of highly priority options.

The national team used criteria mostly recommended by *Least Developed Countries Expert Group* and also adapted to national context such as:

- Impact on vulnerable groups and resources,
- The contribution to sustainable development (Socio-cultural, ecological and economic),
- the synergy with MEA (Multilateral Environment Agreement),
- Risks reduction,
- Cost-efficiency (financing).

These criteria have been analyzed simultaneously in table 7 showing the measurement of each criterion in relation to its response to the vulnerability of option (advantages, risks reduction or its disadvantages, financial costs, non monetary constraints). In consideration of lack of exact data on the real values to attribute to each measure unit of criteria, the measure by scale was preferred by the technical team.

Table 7 - Evaluation of criteria for each adaptation option

N°	OPTIONS	CRITERIA				
		Impact on vulnerable groups and resources	Contribution to sustainable development (socio-cultural ecological and economic)	Synergie with MEAs	Risks reduction	Cost efficiency
	Unit	Scale from 1 to 2	Scale from 1 to 3	Scale From 1 to 10	Scale from 1 to 5	Scale from 1 to 10
1	Promotion of non rain-fed agriculture	2	2	5	3	8
2	Intensive agri-animal husbandry	2	2	7	5	6
3	Varieties resisting to drought	2	2	3	5	7
4	IWRM: Integrated water resource management	2	3	4	5	8
5	Stocking and transformation of agricultural products	1	2	4	3	8
6	Information systems of early warning and rapid intervention	2	2	10	5	6
7	Development energy sources alternative to firewood	2	2	7	4	7
8	Preparation and implementation of land development plan	1	3	5	3	5
9	Access to health facilities and fight against water-borne diseases	1	1	5	2	5
10	Promotion of non agricultural activities generating income	2	3	7	4	6
11	Preparation and implementation of forestry development plan	1	3	8	5	8

All criteria have been standardized on a scale from 0 to 1 with increasing values for advantages and decreasing values for disadvantages (costs). This has allowed to calculate average notes for all criteria and realise a first classification MCA1: Multicriteria Analysis 1 shown in table 8 below:

Tableau 8 - Standardized notes and 1st classification MCA1 of 11 options

N° Options		Standardized Option Notes/Criteria					
		All criteria are noted on a scale of 0 to 1					
		Impact on vulnerable groups and resources	Contribution to sustainable development (socio-cultural ecological and economic)	Synergy with MEA	Risks reduction	Cost efficiency	Note moyenne AMC 1 Classement 1
1	Promotion of non rain-fed agriculture	0	0.50	0.28	0.33	1	0.42 (9)
2	Intensive agro-animal husbandry	1	0.50	0.57	1	0.33	0.68 (5)
3	Varieties resisting to drought	1	0.50	0	1	0.66	0.63 (7)
4	IWRM: Integrated water resource management	1	1	0.14	1	1	0.82 (1)
5	Stocking and transformation of agricultural products	0	0.50	0.14	0.33	1	0.49 (8)
6	Information system of early warning and rapid intervention	1	0.50	1	1	0.33	0.76 (2)
7	Development of energy sources alternative to firewood	1	0.50	0.57	0.66	0.66	0.67 (6)
8	Preparation and implementation of land development plan	0	1	0.28	0.33	0	0.32 (10)
9	Access to health facilities and fight against water-borne diseases	0	0	0.28	0	0	0.05 (11)
10	Promotion of non agricultural activities of income generating schemes	1	1	0.57	0.66	0.33	0.71 (4)
11	Preparation and implementation of forestry development plan	0	1	0.71	1	1	0.74 (3)

At the preceding level, the same importance has been given to 5 criteria. In order to always search for high priority option, the technical team judged it useful to give some criteria more consideration due to their importance in relation to others. Hence the impact on groups and vulnerable resources got more than 3 marks followed by the contribution to sustainable development and reduction of risks, which got 2 marks and lastly the synergy with MEA, and efficiency cost got the last note of 1 mark only.

The relative part of each criterion is obtained by dividing the standardized note of each criterion by 9 (total amount of marks). Hence the weighed index of each option is obtained by adding products of the relative balance of criteria and that of the initial standardization option as shown in table 9. This has led to a second MCA 2 classification different from the first once but linked more to primordial value of the impact of options on the groups and vulnerable resources and on the contribution to sustainable development according to the consensus of the technical team.

Table 9 - Standardized notes and 2nd classification MCA 2 of 11 options

N°	OPTIONS	Standardized Option Notes / Criteria					
		All criteria	are noted on	a scale of	0 to 1		
		Impact on vulnerable groups and resources	Contribution to sustainable development (socio-cultural ecological and economic)	Synergie with MEA	Risks reduction	Cost efficiency	Average note MCA 2 (Classification 2)
	High level	3	2	1	2	1	9
	Average	0.333	0.222	0.111	0.222	0.111	1
1	Promotion of non rain-fed agriculture	0	0.50	0.28	0.33	1	0.325 (9)
2	Intensive agro-animal husbandry	1	0.50	0.57	1	0.33	0.765 (4)
3	Varieties resistant to drought	1	0.50	0	1	0.66	0.739 (5)
4	GIRE: Integrated water resource management	1	1	0.14	1	1	0.903 (1)
5	Stocking and transformation of agricultural products	0	0.50	0.14	0.33	1	0.310 (10)
6	Information system of early warning and rapid intervention	1	0.50	1	1	0.33	0.813 (2)
7	Development of energy sources alternative to firewood	1	0.50	0.57	0.66	0.66	0.726 (6)
8	Preparation and implementation of land development plan	0	1	0.28	0.33	0	0.326 (8)
9	Access to health facilities and fight against water-borne diseases	0	0	0.28	0	0	0.031 (11)
10	Promotion of non agricultural activities of income generating schemes	1	1	0.57	0.66	0.33	0.800 (3)
11	Preparation and implementation of forestry development plan	0	1	0.71	1	1	0.633 (7)

Comparing the two classifications, it appears that some options keep the same positions or successive positions, which never complicated discussions within the technical team. This lead to limit criteria to these two classifications, which are considered to guide decision makers towards final selection and in the preparation of projects profiles.

Table 10 – Comparative results of the 2 multicriteria analyses

N°	OPTIONS	Comparison MCA1	Comparison MCA2
		Note (Classification 1)	Note (Classification 2)
1	Promotion of non rain-fed agriculture.	0.42 9	0.325 (9)
2	Intensive agro-animal husbandry.	0.68 5	0.765 (4)
3	Varieties resistant to drought.	0.63 7	0.739 (5)
4	IWRM: Integrated water resource management.	0.82 1	0.903 (1)
5	Stocking and transformation of agricultural products.	0.49 8	0.310 (10)
6	Information system of early warning and rapid intervention.	0.76 2	0.813 (2)
7	Development of energy sources alternative to firewood.	0.67 6	0.726 (6)
8	Preparation and implementation of land development plan.	0.32 10	0.326 (8)
9	Access to health facilities and fight against water-borne diseases.	0.05 11	0.031 (11)
10	Promotion of non agricultural activities of income generating schemes.	0.71 4	0.800 (3)
11	Preparation and implementation of forestry development plan.	0.74 3	0.633 (7)

Hence, from these results, and considering existing interventions of the government in its duties to provide equipments and collective services and considering the local dynamics, existing national development programmes and experiences of other countries in resolving similar vulnerability problems, **6 priority options** are selected for which projects shall be prepared for funding and implementation of NAPA in Rwanda. These options are as follows:

Priority n° **1**: **Integrated water resources management (IWRM)**

- Aim: Reduce the vulnerability of ecosystems, population and sectors due to the quantitative and qualitative shortage of water resources and the damages caused by the runoff due to the climate change.

Priority n° **2**: **Set up information systems of hydro agrometeorologic early warning system and rapid intervention**

- Aim: Improve information system of hydro agro meteorological early warning system and rapid intervention and reduce the exposure of the population and sectors at risk of extreme events and climate catastrophes.

Priority n° **3**: **Promotion of income generating activities**

- Aim: Improve the adaptation capacity of rural population vulnerable to climate change through the promotion of income generating non-agricultural activities.

Priority n° **4**: **Promotion of intensive agriculture and animal husbandry**

- Aim: Improve the adaptation capacity of farmers and pastoralists to climate change through setting up agro-sylvo-pastoral systems adapted to real land vocation.

Priority n° **5**: **Introduction of varieties resisting to environmental conditions**

- Aim: Improve adaptation capacity of farmers and adapt to climate change through promotion of appropriate cultural techniques and the introduction of varieties resisting to environmental conditions.

Priority n° **6**: **Development of energy sources alternative to firewood**

- Aim: Reduce the pressure of woody combustible and hence reduce the overexploitation and degradation of forests through the promotion of energy sources alternative to firewood. This aim contributes at the same time to reducing the vulnerability to the energy crisis of the country especially the poor rural population.

7. CHARACTERISTICS AND GENERIC LOGIC FRAMEWORK OF PRIORITY OPTIONS

Table.11 below shows the characteristics of the six priority options, so as to put them in relation to target groups and their sectoral or multisectoral nature to their mainstreaming to a bigger programme, to stakeholders in charge of their execution and potential sources of funding.

Table 11 – Characteristics of the 6 priority options

Priority options	Targeted groups	Integration	Crosscutting aspects	Stakeholders	Source of funding
1. IWRM: Integrated water resource management (IWRM)	Rural communities, agro-animal husbandry, urban population	Rwanda Vision 2020 Poverty Reduction Strategy National Strategy to Combat Desertification	Multisectorial	Public sector , Private sector, NGO and Local communities	Government Donors NGO
2. Information system of early warning system and rapid intervention	Government Local population NGOs UN Agencies Institutions and researchers	Management policies for catastrophic risks	Multisectorial	National services for hydro-meteorology Central and local Gvt. NGO and UN Agencies	Gvt., OMM, UN Agencies
3. Promotion of non agricultural activities of income generating schemes	Rural communities	Poverty Reduction Strategy Rwanda Vision 2020	Multisectorial	Private sector and targeted groups (beneficiaries)	Government Donors and Private sector
4. Intensive agro-animal husbandry	Rural communities	National agriculture policies Rwanda Vision 2020	Multisectorial	Rural communities	Government Donors and ONG
5 . Promotion of varieties resisting to drought	Rural population of the arid eastern and southeast regions of the country	National agriculture policies National strategies for the fight against desertification	Multisectorial	ISAR and beneficiaries	Government and Donors
6. Development of energy sources alternative to firewood	Urban and rural population	Forestry policies Energy policies, Strategies for the biodiversity conservation	Multisectorial	Researchers Private sector NGO Local laborers	Government Private sector NGO

The determination of the generic logic framework of the six priority options according to the structure proposed by Least Developed Countries Group of Experts is realized in the following tables 12, 13,14,15,16, and 17. **For each priority option**, we come to **a serie of activities or urgent and immediate projects**. Table 18 shows a summary of these urgent and immediate projects for the adaptation to climate change.

Table 12 – Priority option 1: Integrated Water Resources Management - IWRM

	Logic of intervention	Indicator of success objectively verifiable (Sources and means of verification)
Aim	Reduce the vulnerability of ecosystems, population and sectors due to the quantitative and qualitative shortage of water resources and the damages caused by the runoff due to the climate change. .	o Number of water storage projects which increase retained volumes and increase river water flows. o Number of water protection projects for the satisfaction of drinking water needs, water for irrigation, water for industry and energy. o Number of projects for protection against erosion, landslides and floods.
Objectives	- Increase the level of lakes and rivers water flows and protection of humid zones. - Protection of basins sides. - Satisfaction of drinking water needs for rural and urban populations. - Satisfaction of water for irrigation and industry. - Reduction of land loss due to erosion.	o Hydrological reports (bulletins), observations and gauging (mesuring flows), solid gauging. o Investigation and agricultural news lines and FEWS-NET. o Investigation and public health news lines (reports on water-borne diseases).
Expected results	**Project 1.1** - Mastering hydro meteorological information and early warning systems to control extreme phenomena due to climate change: - Installation and rehabilitation of hydrological and meteorological stations so as to identify tendencies of climate change in all regions of the country. **Project 1.2** - Improve access to drinking water, to sanitation services and alternative energy to firewood. **Project 1.3** - Conservation and protection of lands against erosion and floods at districts level of vulnerable regions.	o Number of installed stations. o Number of ha. with anti erosive ditches well maintained. o Number of ha. with developed radical terraces. o Number of ha. and vulnerable reforested hills. o Increase the number of production and distribution drinking water functioning systems, electrical installations and rural and urban inhabitations with access to them.
Inputs	Hydrologist observers, meteorological engineers, hydrologists and civil engineers, agronomists, drinking water & energy, technical equipments and laboratories technicians	Budget: - Government, donors, NGO and communities. - Integration project HIMO. - UN Agencies.

Table 13 - Priority Option 2: Setting up information systems for hydro-agro-meteorological early warning system and rapid intervention mechanism

	Logic of intervention	Indicator of success objectively verifiable (Source and means of verification)
Aim	Improve information systems of hydro-agro-meteorological early warning system mechanism and rapid intervention, and reduce population and sectors exposure to the risks of extreme events and climate catastrophes.	o Set up institutions in charge of hydro-agro-meteorological information management and rapid intervention. o Set up and give real and timely hydro-agro-meteorological information to local organisations (district, provincial and national)
Objectives	In support to national service for risks and catastrophic management, set up progressively national, regional and local hydro-agro-meteorological information network of early warning and rapid intervention.	o Budget allocated to local and national institutions in charge. o Specialised reports of hydro- agro-meteo services: transmitted and received. o Reports of rapid intervention units.
Expected results	**Project 2.1** - Set up an information network for meteo-agrological early warning system and rapid intervention in agrobioclimatic regions of East (Umutara, Kibungo), Southeast (Bugesera, Mayaga), and central plateau. **Project 2.2** – Increase modes of food distribution to encounter extreme climate phenomena.	o Reduction of the number of the population affected by extreme events and climate catastrophes. o Reduction of intervention time for rescue and food supply in concerned regions. o Increase food stocks and water management at district level.
Inputs	- Specialists, engineers and technicians in the information network management, hydro-agro-meteorological early warning and rapid intervention mechanism. - Doctors and health specialists in crisis and climate catastrophes management. - Specialised staff in civil protection.	o Budget: - Government, NGO, OMM. - WHO and UN Agencies.

Table 14 – Priority option 3: Promotion of non-agricultural income generating activities

	Logic of intervention	Indicators of success objectively verifiable (Sources and means of verification)
Aim	Increase the adaptation capacity of rural population vulnerable to climate change through the promotion of non agricultural income generating activities.	Increase of annual revenue/inhabitant.
Objective	Reinforcement of professional capacities of the population. Creation of non agricultural employments. Creation of a favourable environment to non agricultural investments.	o Number of trained persons, trainers availability and training modules per activity. o Follow up reports of professional training programme. o Number of non agricultural employments created. o Number and state of basic infrastructures created (HIMO). o Financial mechanism and financial institutions established. o Training projects (PPPMER-Project for the promotion of small and medium enterprises in Rwanda, PDRCIU (Umutara community resource development and infrastructure project). o Existence of markets. o Site visits, investigations, interviews or resource persons.
Expected results	**Project 3.1** - Creation of financial and banking mechanisms favouring non agricultural investment at local level. **Project 3.2** - Professional training adapted to HIMO – roads and swamps development. **Project 3.3** - Professional training: crafts, basketry, broidery, welding, water and sanitation network. **Project 3.4** - Training in fundable mini projects study.	o Average salary/person/workday HIMO. o Number of trained. persons/category of professional activity. o Number of people trained in mini projects fundable.
Inputs	Professional trainers. Training expenses.	o Common Development Fund "CDF". o Budget: Government, NGO, UN Agencies.

Table 15 – Priority Option 4: Promotion of intense agri-pastoral activities

	Logic of intervention	Indicator of success objectively verifiable (Sources et means of verification)
Aim	Improve the adaptation capacity of farmers and pastoralists vulnerable to climate change through setting up agro-sylvo-pastoral systems adapted to real land vocations.	o Agro-pastoralists have more and more sustainable means to face climate change. o Lands are more and more protected and less degraded.
Objective	Preparation and implementation of a master plan for land allocation and utilisation according to their real vocation for more appropriate agro-sylvo-pastoral systems.	o MINAGRI follow up and reports o Respect and application of schema directives at district and provincial levels. o Reports of performance follow up for applied agro-sylvo-pastoral systems.
Expected results	**Project 4.1** - Realisation of the three pilot farms in East, South East and Central plateau agro climate zone. **Project 4.2** - Collect and stock rainwater (valley dams and others) for irrigation and drinking water for animals. **Project 4.3** - Realisation of irrigated perimeters by gravity around perpetual water flows. **Project 4.4** – Set up a veterinary dispensary network in the three relevant regions.	o The three pilot farms are operational with a budget and competent staff. o The pilot farms start demonstrating and sensitising appropriate knowledge in the implementation of agro-sylvo-pastoral systems. o The number of functional system of retained water from rain is at the increase. o Agricultural production at the level of irrigated perimeters increases o The number of vaccination interventions and animal health follow up increases. o Field visits.
Inputs	Management personnel and agro-pastoralists engineers and technicians in agronomy and animal biology. Engineers and technicians in irrigation. Veterinary and zootechnicians.	Budget: - Government, Donors, NGO and communities. - HIMO integration Project. - UN Agencies.

Table 16 – Priority option 5: Introduction of species adapted to environmental conditions

	Intervention logic	Indicators of success objectively verifiable (Sources and means of verification)
Aim	Improve adaptation capacity to climate change for farmers and foresters through promotion of adapted farming techniques and the introduction of resistant species to environmental conditions.	o Budget allocated to research for agriculture and forestry specialists. o Intersectorial concertation network is set up.
Objective	Adapt farming practices to land vocation and adapt crops with resistant species to environmental conditions.	o Follow up and MINAGRI reports. o Respect and application of directives to district and provincial levels. o Follow up reports of performance of resistant varieties chosen.
Expected results	**Project 5.1** - Action of promotion and sensitisation to farming techniques adapted to farmers. **Project 5.2** – Promotion of the introduction and reintroduction of resistant and adapted species to the environment (non GMO). **Project 5.3**- Action of promotion and sensitisation to food producing crops stocking techniques.	o Reduction of losses (in ha) of arable land. o Improvement of agriculture production. o Increase the number of ha to resistant varieties. o Number of farmers participating to sensitization campaign for food producing crops stocking techniques.
Inputs	Specialists in plant biology Engineers and technicians (agronomist). Research support.	Budget: - Government, Donors, NGO and communities. - UN Agencies.

Table 17 – Priority option 6: Development of energy alternative sources to firewood

	Logic Intervention	Indicators of success objectively verifiable (Sources and means of verification)
Aim	Reduce the pressure on woody combustible and hence reduce forests overexploitation and degradation and erosion through promotion of energy sources alternative to wood. The pursued objective aims at reducing energy crisis vulnerability of the country particularly poor rural population.	o Sustainable development and utilisation of alternative energy sources. o Reduction of wood energy in national energy programme.
Objective	- Safeguard forestry and protected areas ecosystems. - Rational exploitation of forestry resources. - Substitution of wood combustible by other sources of energy.	o National forestry inventory. o Teledetection; integral investigations on domestic life conditions (EICV/INSR). o Reports of forestry services on reconstituted areas. o Number of families utilising alternative energy sources different from wood.
Expected results	**Project 6.1** – Preparation and implementation of substitution strategy of woody combustible.	o Quantity of electrical energy produced. o Number of families using peat. o Number of installed and operational solar panels. o Number of biogas digesters constructed. o Number of families using improved stoves, briquettes using residues of solid wastes. o Areas of reconstituted forestry zones.
Inputs	- Electrical engineers and technicians. - Professional local artisans. - Training expenses, various equipments.	Budget: - Government, donors, NGO and communities. - UN Agencies.

Table 18 – Summary: Urgent and immediate projects according to the 6 high priority options

Priority options	Integrated water resources management - IWRM	Set up early warning system for hydro-agro-meteorological disaster, and rapid intervention mechanisms	Promotion of non agricultural Income generating activities (*)	Intensive agropastoral promotion	Promotion of introduction species resisting to environmental conditions	Development of energy alternative to firewood
	Priority 1	**Priority 2**	**Priority 3**	**Priority 4**	**Priority 5**	**Priority 6**
Urgent and immediate projects	**Project 1.1** Mastering hydro meteo-rological information and early warning systems to control extreme phenomena due to climate change: - Installation and reha-bilitation of hydrological and meteorological stations **Project 1.2** – Increase the adaptation capacity of imidugudu villages in vulnerable regions through the improve-ment of drinking water supply services and alternative energy. **Project 1.3** - Conservation and protection of lands against erosion and floods at the level of districts and regions vulnerable to climate change.	**Project 2.1** Establishment of information, hydro-agrometeo early warning and rapid intervention network in agro-bioclimatic eastern (Umutara, Kibungo) and South-eastern(Bugesera &Mayaga) regions **Project 2.2** – Improvement of food and medical modes of distribution to face extreme climate change phenomena.	**Project 3.1** Creation of financial and banking mechanisms favouring non agricultural investment at local level. **Project 3.2** Professional training adapted to HIMO – roads and swamps development. **Project 3.3** (**) - *Professional training, craft industry, basketry broidery, welding, clean water supply network.* * *This priority option shall be considered within project 1.2* ** *This project shall be integrated to project 1.2*	**Project 4.1** - Realization of three pilot farms in agrobioclimatic zones of East, South East and Central plateau. **Project 4.2** - Aid to districts of vulnerable regions to prepare and implement measures of conservation and water storage. **Project 4.3** - Realization of irrigation in gravitated parameters from water flows in vulnerable regions.	**Project 5.1** - Sensitization and promotion action on adapted farming techniques for farmers. **Project 5.2** - Promotion of the introduction and reintroduction of species adapted and resisting to environment (non GMO). **Project 5.3** - Promotion and sensitization action on food producing crops stocking techniques.	**Project 6.1** – Preparation and implementation of national strategy for substitution of woody combustible to face climate change.

8. CHOICE OF HIGH PRIORITY PROJECTS

According to the table 8, there are some similarities of proposed projects by different priorities, therefore the projects gathering together concluded to definitive list of Rwanda NAPA projects, as following:

1. Lands conservation and protection against erosion and floods at districts level of vulnerable regions to climate change;

2. Mastering hydro meteo-rological information and early warning systems to control extreme phenomena due to climate change: - Installation and rehabilitation of hydrological and meteorological stations;

3. Development of irrigated areas by gravity water systems from perennial streams and rivers in often vulnerable zones to prolonged droughts;

4. Support Districts of vulnerable regions to climate change in planning and implementing measures and techniques related to land conservation, water harvesting and intensive agriculture, and promoting existing and new resistant varieties of crops adapted to different bioclimatic soil;

5. Increase adaptive capacity of grouped settlement "Imidugudu" located in vulnerable regions to climate change by the improvement of potable water, sanitation and alternative energy services, and the promotion of non agricultural jobs;

6. Increase food and medicine modes of distribution to respond to extreme climate change and sensitize to stocking and conservation of agriculture products;

7. Preparation and implementation of woody combustible substitution national strategy to combat the deforestation and erosion as well.

9. PROFILE DEVELOPMENT OF HIGH PRIORITY NAPA PROJECTS

The profiles of these 7 identified projects have been developed with the aim at sensitizing the policy decision-makers and potential funds and donors about their finalities to resolve the urgent and immediate needs of vulnerables communities and economic sectors to climate change.

PROJET N° 1

TITLE OF PROJECT: **Conservation and protection of lands against erosion and floods at district level in vulnerable regions**

LOCALISATION: Regions vulnerable to erosion, landslides and frequent floods

JUSTIFICATION: This project for conservation and protection of lands and infrastructures against erosion, landslides and frequent floods due to climate change affecting Northern and Western districts of the country and their infrastructures comes to reinforce and support provincial efforts to act locally.

In the current context of low agricultural productivity and food insecurity this project helps at the rehabilitation and preservation of the forestry and agricultural potentials globally participate in the protection of basins and hence in the protection of water resources.

In these regions whose current environment is degraded, this project shall help reduce the vulnerability of the population and help to maintain and restore their mode of existence and shall hence reduce their migration in search for new lands for agriculture and animal husbandry.

INTEGRATION OF PROJECT:

This project fits well in the policies, strategies, programmes and envisaged actions as described below:

Policy / National Strategy	Objective, Programme / Current planning actions or implementation
Rwanda Vision 2020	Sustainable management of natural resources (lands, water, forests, ecosystems...)
	Increase of protection against erosion rate from 20% to 80 % in 2010 and 90% in 2020
Poverty reduction strategy	Promotion of public works at high intensity of manpower (HIMO)
National land policy	Land development
National agriculture policy	Restoration of soil fertility and conservation
National forestry policy	Reforestration of non agricultural spaces
National strategy and action plan to fight desertification	Anti erosive actions
	Integrated management of basins and fight against reduction of natural water reservoirs

GLOBAL OBJECTIVE:

Reduce vulnerability of regions affected by torrential rains, erosion and floods.

SPECIFIC OBJECTIVES:

- Stabilise lands at different altitudes and riversides against erosion, landslides through appropriate techniques;
- Improve gradual restoration of vegetal cover adapted to these different altitudes;
- Protect high zones and infrastructures against floods damages through appropriate techniques.

PROJECT COMPONENTS:

1. Preparation and implementation of master plan for lands protection of agricultural zones, forestry and riversides threatened by erosion;
2. Preparation and implementation of master plan for the protection of productive lands and vulnerable infrastructures threatened by landslides and floods;
3. Follow up and evaluation.

EXPECTED RESULTS:

- Intervention measures for lands protection of agricultural and forestry zones as well as riversides vulnerable and threatened by erosion are identified, evaluated and implemented in high zones and average altitudes;
- Gradual restoration of vegetal cover is undergoing and visible;
- Intervention measures for the protection of high zones principal infrastructures of districts through appropriate techniques against damages due to floods are identified, evaluated and implemented;
- Departure of population from those zones in search of new lands is highly reduced;
- Lands loss (ha/year) by hydric erosion is reduced;
- Solid transport (in suspension matters - MES) of water flows is reduced.

BENEFICIARIES:

- Agriculturalists, pastoralists, foresters.
- Managers of water and forests resources.
- Managers of infrastructures.
- Tourism sector.
- Employment sector (HIMO).

IMPLEMENTING AGENCIES

- Project coordination.
- MINITERE, MININFRA.
- Districts, Provinces.

FOLLOW UP AND EVALUATION

- Institution: Project team, pilot and steering committees, beneficiaries and donors
- Frequency: Term and annual
- Type: Physical and financial
- Methods: Reports with performance indicators, seminars, field visits

RISKS AND BARRIERS

1. Adequation between land policy dispositions, actual land occupancy and farming practices risk to be difficult to adopt and set up adequate intervention measures;
2. Current financial and human means are reduced for the preparation of master plans and their implementations;
3. The time allocated for works risks to be short.

TIME: 5 years

PERIOD: 2007 – 2012

BUDGET: 1.450.000 $ US

PROJECT N° 2

TITLE OF PROJECT: **Mastering hydro meteorological information and early warning systems for control of climate change hazards – Installation and rehabilitation of hydrological and meteorological stations.**

LOCALISATION: Whole country

JUSTIFICATION:

Currently, meteorological and hydrological stations that numbered over a hundred in 1989 have been reduced to only one operational station at the Kigali Airport due to effects of the 1994 genocide.

As described in point 2.1 "Current socio-economic and environmental context", **the present low capacities of observation, description and evaluation** at the same time of hydro meteorological climate stimuli at national, regional, and local scales and their impacts on ecological, social and economic systems do not yet allow a production of data, and enough reliable information for concerned user sectors.

This important level of uncertainty and lack of available hydro meteorological data makes planning exercise much more difficult in Rwanda today. Lack of these data leads various sectoral services to incapacity of prevention, adaptation and resist to extreme phenomena. Reinforcement of surveillance, evaluation and early warning systems of drought and desertification remain insufficient.

In order to respond to these systematic insufficient observations, a project *"Mastering hydro meteorological information and early warning systems for control of climate change hazards – installation and rehabilitation of hydrological and meteorological stations"* is indispensable and urgent so as to identify climate change tendencies throughout the country. These tendencies will help Rwanda in the formulation of appropriate measures of adaptation to prolonged seasonal drought risks or floods due to climate change in different sectors of economic development and at the same time fulfill her commitments to the implementation of UNFCCC concerning the preparation of national communication on the basis of reliable hydro meteorological data and previsions.

PROJECT INTEGRATION:

This project is well integrated in the national policy of disaster and catastrophes management, which aims at the following actions:

- Management of natural catastrophes and evaluation of vulnerability risks by climate change;
- National plan for risks and catastrophes management;
- Development of information and early warning systems;
- Reinforcement of national competences in risks and catastrophes management;

- Integration of risks and catastrophes management in large national programme for poverty reduction, community development and environmental protection;
- Mobilization of resources, training and public awareness, and regular review of plans and programme.

Yet, the prevention and management of catastrophes due to climate change cannot be achieved unless there is reliable data collection from all regions of the country, of their analysis and hydro meteorological previsions.

OBJECTIVE :

Regularly possess historical and current hydraulic and meteorological data useful in all socio-economic sectors including the prevention of disaster and catastrophes due to climate change.

SPECIFIC OBJECTIVES :

- Possess appropriate and functional hydro meteorological services and station.
- Supply information on necessary hydro meteorological previsions to decision makers and different sectoral users so as to prepare in time the fight against dangers of extreme phenomena that may occur.

COMPONENTS:

1. Formulation and preparation of the installation and rehabilitation programme for meteorological and hydrological stations (IRPS-HM);
2. Institutional and organizational reinforcement for optimal implantation of IRPS-HM and its operations;
3. Preparation of invitation to tender documents;
4. Follow up installation and rehabilitation works;
5. Global project follow up and evaluation.

EXPECTED RESULTS:

Necessary data to the preparation of hydrological previsions and climate tendencies so as to prevent risks of drought and floods is regularly collected and representing the national situation on:

- At least 70 rehabilitated stations and 30 meteorological stations installed;
- 11 hydrological stations are rehabilitated (principal network) and 10 new hydrological stations are to be installed (secondary network).

BENEFICIARIES:

Major beneficiaries are agricultural services, water resource management services, farmers, aeronautical services, research institutions, decision makers, transport and infrastructure services, early warning system and rapid intervention at vulnerable district level.

IMPLEMENTING AGENCIES:

- National Hydro Meteorological Institute (under creation)
- Ministry of Lands, Environment, Forestry, Water and Mines (in charge of climate change project)
- Ministry of Infrastructure
- Ministry of Agriculture and Animal Resources
- Research institutions and agricultural projects
- Decentralized administrative structures (province and districts) for disaster and catastrophes management

FOLLOW UP AND EVALUATION:

Institutions: project coordination, pilot and steering committee, donors (LCDF, OMM, etc);
Frequency: term and annual
Types: physical and financial
Methods:

- Report on activity development with performance indicators;
- Half way review seminars;
- Field visits.

RISKS AND BARRIERS

1. Poor financial capacity, poor material and human resources for current hydrological and meteorological services to carry out the project follow up;
2. Lack of sectoral concertation during the preparation of the programme for installation and rehabilitation of hydro meteorological stations;
3. For hydrological stations: the large volume of related works linked to the restoration and consolidation of riversides can generate major costs;
4. Weak current surveillance means for repair and maintenance of stations.

TIME: 4 years

PERIOD: 2007 – 2011

BUDGET: 1.900.000 $ US

PROJET N° 3

TITLE OF PROJECT: **Realisation of round irrigation perimeters from water flows in vulnerable regions.**

LOCALISATION: Vulnerable regions of East and South East

JUSTIFICATION:

Agro bio climatic regions of the East and South East of the country (Umutara, Kibungo, Bugesera, Mayaga) have been identified as vulnerable from many aspects particularly in relation to frequent droughts, which affect poor population. The realisation of irrigated perimeter project shall contribute to the improvement of adaptation capacity of agro-pastoralists to climate change through the set up of non-pluvial practices.
This project concerns some continuous water flows from which their waters may be exploited by simple methods to irrigate some plots favourable and productive in vulnerable regions of the East and South East.
The introduction of simple and sustainable methods of irrigation in gravity shall create some resilience among rural population in harmony with their environment. This shall help regroup the population in irrigation cooperatives from continuing water flows and encourage Imidugudu.

PROJECT INTEGRATION: (Policy, strategy, ongoing programme)

Policy / National strategy	Objective, Programme / Ongoing planning action or implementation
Rwanda Vision 2020	Sustainable management of water resources
	Modernization of agriculture
Poverty reduction strategy	Promotion of public works of high manpower intensity (HIMO)
National land policy	Technological improvement of agricultural sector
National agriculture policy	Irrigation especially in arid zones
National strategy and action plan to fight desertification	Management of natural resources
National strategy and action plan for the conservation of biodiversity	Conservation and rational and sustainable utilisation of agro ecosystems and biodiversity

GLOBAL OBJECTIVE:

Favour initiative of small farmers and pastoralists to practice agriculture and animal husbandry different from rain-fed practice in small-adapted plots for irrigation by gravity systems.

SPECIFIC OBJECTIVES:

- Identify and improve the potentiality of micro-plots of productive lands downstream perpetual water flow

- Favour and introduce simple and resolving irrigation practices

PROJECT COMPONENTS:

1. Carry out a pedological study of identified areas downstream favourable to irrigation in gravity systems
2. Feasibility study for three pilot plots to be irrigated using simple and sustainable methods has been done
3. Realisation of irrigation and development of the three plots (irrigation – drainage)
4. Follow up and evaluation of the project

EXPECTED RESULTS:

- Identified areas are irrigated properly and are productive
- Beneficiary population are less vulnerable to climate change in those zones exposed to frequent droughts
- Grouped habitat and the creation of irrigation cooperatives are stimulated.

BENEFICIARIES :

Farmers and pastoralists at the level areas located downstream perpetual rivers.

IMPLEMENTING AGENCIES

- Project coordination,
- MINITERE,
- MININFRA,
- Concerned districts,
- REMA,

FOLLOW UP AND EVALUATION

- Institution: Project coordination, pilot and steering committees, beneficiaries and donors
- Frequency: Term and annual
- Type: Physical and Financial
- Methods: Report with performance indicators, seminars, field visit

RISKS AND BARRIERS

1. Attribution of favourable plots is complicated
2. Gravity irrigation through simple methods provokes important loss of water
3. Water flows in question gets reduced with time
4. Conflicts of utilisation appear with hydro electrical micro central projects

TIME: 4 years
PERIOD: 2007-2011
BUDGET: 750.000 $US

PROJET N° 4

TITLE OF PROJECT: **Assistance to districts of vulnerable regions to plan and implement conservation measures and water storage**

LOCALISATION: Vulnerable regions of East, South East and some zones of the central plateau

JUSTIFICATION:

Agro bio climatic regions of the East, South East of the country and certain zones of the central plateau (Umutara, Kibungo, Bugesera, Mayaga, Gitarama) have been identified as vulnerable on many aspects especially in relation to events of frequent droughts affecting poor population.

This project aims at reinforcing district capacities to implement conservation measures and water storage to satisfy irrigation and animal husbandry needs. Districts of these regions shall help to find adequate solutions for rainwater conservation through valleys dams and other adequate systems.

Some zones are producers of superficial water flows and important run-off during rainy seasons and face regular and frequent floods. They could be subject to hydraulic and hydro geological study so as to direct water from those zones so as to stock it in convenient superficial sites or recharge the sheets and utilise them during dry seasons.

At the level of habitat, collecting pluvial water individually or collectively means could also be exploited and reduces the pressure of some rare water points for drinking water use. Through these practices, conflicts of drinking water use, irrigation and water for animals could be reduced in these zones.

PROJECT INTEGRATION:

This planning project is meant for implementation of measures of storage and water conservation in districts of vulnerable regions and responds to objectives and programmes of national policies and strategies. Details on links existing between programmes and this project are developed in the table below:

Policy / National strategy	**Objective, Programme / Undertaken planning or for Implementation**
Rwanda Vision 2020	Sustainable management of water management
	Modernisation of agriculture
Poverty reduction strategy	Promotion of public works at high manpower intensity (HIMO)
National land policy	Irrigation, especially in zones of aridity tendency
National agriculture policy	Restoration of fertility and conservation of soil
	Realization of valley dams
National strategy and action plan to fight desertification	Realisation of rain water storage for agro pastoral activities

GLOBAL OBJECTIVE:

Increase the capacity of the population living in vulnerable regions of East, South East and some zones in central plateau to cope with climate change.

SPECIFIC OBJECTIVES :

- Increase rain water storage capacity and floods in vulnerable districts for irrigation and animal husbandry during dry seasons;
- Reduce the pressure on water points meant for drinking water;
- Reduce conflicts of drinking water utilization in these regions.

PROJECT COMPONENTS:

1. Carry out a hydraulic and hydro geologic study in the central part of Eastern province which gets frequent floods;
2. Analysis of storage of superficial water capacity or the recharge of sheets;
3. Choice and realization of water storage pilot plan;
4. Rehabilitation of existing water points for drinking water and put in place protection areas in East and South East regions;
5. Implementation of protection regulation of these water points.

EXPECTED RESULTS:

- A greater proportion of superficial water flows in zones of frequent floods is retained and conveniently stored to satisfy irrigation and animal needs;
- Irrigation and animal husbandry cooperatives through stalling are created;
- Water points (wells and borings) essentially satisfy drinking water needs and are protected;
- Conflicts of safe water utilization are reduced.

BENEFICIARIES:

Small farmers and pastoralists in dry vulnerable zones

IMPLEMENTING AGENCIES:

- Project coordination,
- MINITERE,
- MININFRA,
- Districts,
- REMA.

FOLLOW UP AND EVALUATION

- Institution: Project coordination, pilot and steering committees, beneficiaries and donors.
- Frequency: Term and annual.
- Type: Physical and financial.
- Methods: Reports with performance indicators, seminars, field visits.

RISKS AND BARRIERS

1. Hydrological and hydro geological study may not get concrete results and storage sites for surface water or sheets recharging may not exist;
2. Appropriate lands for irrigation are not near storage sites and transport and water pumping may be required and necessary;
3. Risks associated with water-borne transmitted diseases may increase due to bad utilisation of storage water;
4. Low coordination and intersectoral concertation capacity at district level may prolong details of its realisation.

TIME: 4 years

PERIOD: 2007 - 2011

BUDGET: 560.000 $US

PROJECT N° 5

TITLE OF PROJECT: **Increase the capacity of adaptation of villages "Imidugudu" in vulnerable regions through improvement of drinking water and sanitation and alternative energy services and promotion of non-agricultural activities.**

LOCALISATION: Vulnerable regions of the East, South East, North and West

JUSTIFICATION:

Prolonged and recurrent droughts on 2 or 3 consecutive years often hit the East and South Eastern regions. On the other hand, Northern and Western regions are particularly exposed to devastating erosion, considerable lands degradation and landslides. In both cases, resulting risks are impoverishment and people migrations in search of new lands for agriculture and animal husbandry, either in protected areas or marginal lands. These migrant populations already present a high level of social and economic vulnerability.

The current effort in the realization of regrouped habitat "Imidugudu" is supposed to answer a triple strategy: Reduce the scattering of rural habitat and pressure on productive lands, improve life conditions of the population through health services, education, access to drinking water, energy supply as well as reducing the pressure on forests and marginal lands.

This effort should be followed and supported by improving life conditions of Imidugudu villages particularly those already installed in vulnerable regions by increasing access to drinking water, sanitation and electricity supply using alternative energy. Furthermore, this effort shall stimulate the regrouping of the population in rural areas due to advantages they find.

To the contrary, in some villages around dense forests and swamps of Akagera national park, Birunga and Nyungwe currently subjected to strict measures of conservation and protection, some families are obliged to leave their agricultural exploitations without getting any other pieces of land due to the exiguity of agricultural lands on the entire territory.

In the integrated project framework, complementary dynamics shall be useful in the promotion of activities (agric-pastoral, crafts industry or HIMO) and non-agricultural employment so as to cater for domestic needs and lead to a gradual and balanced reconversion of activities.

PROJECT INTEGRATION:

This project perfectly finds its integration in national policies, strategies and programme as described below:

Policy / National strategy	Objective, Programme / Ongoing action or implementation
National land policy	National development and application of regrouped habitat policy
Rwanda Vision 2020	National land development and basic infrastructure development
	Sustainable water resources management
	Reduction of the percentage of the use wood energy in the national energy programme from 94% to 60% in 2010 and 50% in the year 2020
	Reduction of the percentage of the population involved in the primary sector of agriculture from 90% to less than 50% in the year 2020
Poverty reduction strategy	Development of socio-economic infrastructures (water, energy, fight against erosion) Promotion of activities (agro-pastoral, craft industry or HIMO)
National energy policy	Strategy to promote alternative energy

GLOBAL OBJECTIVE:

Stimulate regrouped rural habitat through improved basic services in Imidugudu villages in vulnerable zones and reduce exposure of rural population to climate change.

SPECIFIC OBJECTIVES:

- Increase access to drinking water and waste water sanitation in Imidugudu villages of vulnerable zones;
- Supply electricity through utilization of alternative energies so as to reduce deforestation of vulnerable zones and the rate of wood energy utilization in the national energy programme;
- Reinforce professional capacities of the population and creation of agricultural and non agricultural employments;
- Creation of a favorable environment to non-agricultural investments.

PROJECT COMPONENTS:

1. Identification of Imidugudu villages in zones vulnerable to climate change;
2. Preparation of a drinking water supply, sanitation and alternative energy project in this villages;
3. Preparation of an invitation to tender document for the execution of project in three Imidugudu villages pilot project;
4. Follow up of activities in the three pilot villages;
5. Training and sensitization of the population on the economic use of water and energy;
6. Reinforcement of land preservation capacities, fight against erosion and of irrigation;
7. Promotion of activities for support and professional training;
8. Global follow up and evaluation of project.

EXPECTED RESULTS:

- Services of drinking water, sanitation and alternative energy are operational and well maintained in the three villages Imidugudu pilot project and the acquired experience kept;
- The village population increases due to the coming of new families;
- Participating people possess the needed professional competence in different sectors of agricultural and non agricultural and non agricultural activities and have employments;
- The increase of income of the beneficiaries is realised.

BENEFICIARIES:

- Population of villages Imidugudu from the East, South East, North and Western regions.

IMPLEMENTING AGENCIES

- Project coordination
- MINITERE,
- MININFRA,
- ELECTROGAZ,
- Districts of vulnerable zones,
- RWARRI,
- MINICOM,
- CDF,
- REMA,
- Micro finance institutions.

FOLLOW UP AND EVALUATION

- Institution: Project coordination, pilot and steering committees, concerned districts, beneficiaries and donors.
- Frequency: Term and annual.
- Type: Physical and Financial.
- Methods: Reports with performance indicators, seminars, field visits.

RISKS AND BARRIERS

1. Weak capacity of coordination for concerned services in the optional choice of technical solutions and project planning for drinking water installations, sanitation and alternative energy for each village;
2. Reception capacity and extension of each village is difficult to evaluate;
3. Weak capacity of follow up during the execution of works at the level of the three pilot villages;
4. At village level, keeping trained staff for the managing of installations difficult;
5. Interest of weak people for the training and reinforcement of professional capacities;
6. Difficult access to product market and sale of services.

TIME: 4 years
PERIOD: 2007 – 2011
BUDGET: 1.650.000 $ US

PROJET N° 6

TITLE OF PROJECT: **Increase modes of food distribution and health support to face extreme climate phenomena**

LOCALISATION: Vulnerable regions of East, South East, North and West

JUSTIFICATION:

The implementation of projects meant to reduce vulnerability and increase the capacity of population adaptation to climate change (including climate variability and extremes) require some time to reach results, hence the need to start them and their emergency to start immediately.

However, uncertainty in the evolution of climate phenomena through their probability of occurrence such as droughts and floods added to the very precarious situation of these rural population vulnerable regions requires a strong attention for the organization of rescue and food products in particular during climate catastrophes.

This project is meant to support national and provincial efforts to increase the modes and means of food distribution and health support during these catastrophes. This project in itself should be considered as a complimentary component at the same time to activities of national risks and catastrophe management service and of the project to be eventually undertaken and which shall concern the implementation of information system and hydro-agro-meteorological alert and rapid intervention.

PROJET INTEGRATION:

This project is part of the programme planned by risks and catastrophe management policy as well as in the poverty reduction strategy. The link existing between this project and this programme are detailed below:

Policy / National strategy	Objective, Programme / Undergoing actions of planning or implementation
Risks and catastrophe management policy	Risks and catastrophe management national plan
	Development of information and early warning systems
	Integrated management of basins and fight against reduction of natural water reservoirs
Poverty reduction strategy	Identification of major problems facing the community

GLOBAL OBJECTIVE:

Increase Rwanda's capacity to fight effects on the population from catastrophes due to climate change including climate variability and extremes.

SPECIFIC OBJECTIVES:

- Increase national, provincial and district organizational capacity to manage food and medical stocks and manage crisis due to famine for health support;
- Increase national, provincial and district capacity to define and implement best means and modes of food products and medicine distribution in the regions affected by climate catastrophes.

PROJECT COMPONENTS:

1. Analyze the current organizational management of food and medical stocks at national, provincial and district levels;
2. Analyze the quality and quantity of current food and medical stocks at different levels;
3. Formulation and implementation of recommendations for the choice of the best organizational means and modes of food products and medicines in the identified vulnerable regions.

EXPECTED RESULTS:

- Analysis of organizational capacity in the management of food and medical stocks is carried out and recommendations implemented up to the level of districts recognized as vulnerable;
- The implementation of recommendations also centers on communication means, transport and frigorific installations and stocking;
- Intervention plan is set up and regularly tested.

BENEFICIARIES:

Poor and destitute population in vulnerable regions affected by climate catastrophes.

IMPLEMENTING AGENCIES

- Project coordination,
- MINICOM,
- MINITERE,
- MININFRA,
- Districts, Provinces,
- Decentralized administrative structures (provinces and districts) for risks and Catastrophe management,
- REMA.

FOLLOW UP AND EVALUATION

- Institution: Project team, pilot and steering committee, donors
- Frequency: Term and annual
- Type: Physical and financial
- Methods: Reports with performance indicators, seminars, field visits

RISKS AND BARRIERS

1. The management of recommendations organizational means and management up to the level of vulnerable districts risks to be rejected among other priorities of the country;
2. Lack of financial and human means for installation and frigorific infrastructures and stocking;
3. Lack of means for acquisition and maintenance of communication and transport of food products and medicine.

TIME: 2 years

PERIOD: 2007 - 2009

BUDGET : 850.000 $ US

PROJET N° 7

TITLE OF PROJECT: **Preparation and implementation of woody combustible substitution national strategy to combat the deforestation and put a brake on erosion due to climate change.**

LOCALISATION: Whole country

JUSTIFICATION:

In Rwanda, wood energy utilization goes up to 94% of urban and rural families and this rate keep growing due to lack of alternative energies. Apart from domestic needs, forests are overexploited so as to satisfy the growing demand of schools, prisons, industrial and unskilled establishments.
This phenomenon which has a negative impact on ecological equilibrium of the country in general and some terrestrial and forestry ecosystems (Bugesera, PNA, Gishwati, Nyungwe, Mukura, PNV) in particular and private forests has provoked such phenomena as erosion, reduction of lake levels, water flows, as well as their consequences on the production of hydro electrical energy.
Implementation of a project of woody combustible becomes indispensable to break the overexploitation of wood leading to economic and serious ecological crisis, consequence of deforestation and land degradation, which facilitate erosion and floods during torrential rains.

PROJET INTEGRATION:

Policies, strategies and national programmes underway insist on the necessity to reduce wood energy consumption through utilization of other new and renewable energies in order to protect and conserve terrestrial ecosystems and fresh water against drought risks, erosion and floods. This project is part of energy sector development programmes, but also increases the adaptation capacity to climate change of the Rwandan population. The following table shows the integration of this project in different development programmes.

Policy / National strategy	Objective, Programme / Ongoing planning action or implementation
Rwanda Vision 2020	Sustainable natural resource management
	Reduction of the rate of wood energy utilization in national energy programme from 94% to 60% in 2010 and 50% in 2020
Poverty reduction strategy	Ensure a growing rate of energy consumption near 10% per year and rural electrification rate of 30% leading to 35% of the population in 2015.
	Promotion of public works at high manpower intensity (HIMO)
Energy national policy	Strategies to reduce wood and charcoal consumption
	Strategies to promote alternative energy resources in substitution of wood (solar, Aeolian, methane gas, peat, biogas…)
National strategy and action plan to fight desertification	Reafforestation and rehabilitation of damaged forestry spaces
National strategy and action plan for biodiversity conservation	-Protection and management of protected areas and terrestrial and humid ecosystems; -Conservation and rational utilization and sustainable ecosystems and biodiversity

OBJECTIVE:

The global objective is to reduce the pressure on forests done by rural and urban communities using wood energy.

SPECIFIC OBJECTIVES:

- Supply other sources of alternative energies instead of firewood and charcoal;
- Sensitize the public on the utilization of alternative energies to safeguard the forestry cover.

COMPONENTS:

1. Formulation of the strategy for woody combustible in Rwanda;
2. Development and set up of financial support to investment;
3. Reinforce national capacities in the management of the installation of alternative energy production;
4. Promotion of integrated approach of wood combustible substitution;
5. Achievement of four pilot projects for wood combustible substitution;
6. Preparation of application for tender document;
7. Follow up and evaluation of four pilot projects results;
8. Global project follow up and evaluation.

EXPECTED RESULTS:

- Vision 2020 objectives and those of PRSP I are being achieved;
- The number of families and establishments using alternative energies is growing;
- Economic losses due to lack of energy are reduced;
- Forestry areas are better protected and under gradual recovery;
- Erosion phenomena due to deforestation are reduced.

BENEFICIARIES :

- Rural and urban households.
- Industrial establishments, schools, prisons
- Forest ecosystems

IMPLEMENTING AGENCIES:

Ministries and parastatals: MINITERE, MININFRA, MININTER, ELECTROGAZ, REMA;
Research institutes: KIST, IRST,
Private sector: Individuals and professional associations,
Decentralized structures: Districts and Sectors.

FOLLOW UP AND EVALUATION:

Institutions:
- Project coordination,
- Concertation and steering committee,
- Donors (LDCF, GEF, NGO, etc..).

Frequency: monthly, term, semester and annual follow up.
Type: Physical and financial.
Methods: performance test, field visit and seminars.

RISKS AND BARRIERS

1. Low capacity of human and financial resources for the preparation and implementation of a sustainable strategy as early as possible;
2. Risks of focalising the effort only on hydroelectricity energy considering the availability and relative mastering of technology and not adapting mixed solutions;
3. Resistance to change of mentality.

TIME: 4 years
PERIOD: 2007 – 2011
BUDGET: 950.000 $US

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Annexes

ANNEX 1

Table 19– National objectives for sustainable development and other Multilateral Agreements on Environment (MEA)

Policy	National objectives	Transversal domaines
Vision 2020	Environment protection and sustainable development of natural resources (water, forests, ecosystem) through: - Reduction of wood energy utilisation in national energy programme from 94% to 60% in the year 2010 and 50% in 2020; - Increase in the rate of soil erosion protection from 20% to 80% here 2010 and at 90% in 2020; - Reduction of the percentage of the population in primary sector of agriculture from 90% to less than 50%; - Reduction rate of diseases linked with environmental degradation at 60%. National and basic infrastructure development; Modernisation of agriculture.	Environment protection and sustainable management of natural resources Science and technology including ICT
Poverty reduction strategy	Priority reinforcement of agricultural transformation, Development of socio-economic infrastructures (transport water, energy, development of swamps, health and fight on anti erosive…); Intensification and regionalisation of crops; Promotion of public works with high manpower intensity (HIMO); Reforestation programme; Identification of major problems facing the community.	Development of socio-economic infrastructure
Land national policy	National development and application of the policy of regrouped habitat “Imidugudu”; Set up a land geographical centre; Professionalisation and technological development of agricultural sector; Irrigation especially in zones with aridity tendency; Protection and development of swamps; Studies of environmental impact as a prerequisite to agricultural development;	National development Irrigated agriculture

Policy	National objectives	Transversal domains
National agriculture policy	Restoration of fertility and soil conservation; Introduction to crop varieties adapted to climate change; Development of swamps with dams to retain water for irrigation; Animal husbandry per stabulation modes; Industrial transformation and conservation of agricultural products.	Soil conservation
National forestry policy	Agro forestry; Reforestation of non agricultural spaces; Adaptation to climate change.	Reafforestation programmes
Energy policy	Strategies to reduce wood consumption and use of charcoal; Strategies to promote wood substitution energy resources (methane gas, peat, biogas…); Strategies for promotion and extension of rural electrification; Study of environmental impact of lake Kivu methane gas and peat.	Environment protection Alternatives energy to wood
National strategy and action plan for the conservation of biodiversity	Protection and management of protected areas and humid and terrestrial ecosystems; Rational and sustainable utilisation and conservation of agro systems and biodiversity; Promotion of modern techniques (sectors: agriculture, animal husbandry, renewable energy…)	Sustainable management of ecosystems and natural resources
National strategy and action plan to fight against desertification	Anti erosive fight and natural resource management reforestation and rehabilitation of damaged forestry spaces; Integrated management of basins, rain water reservoirs for agro pastoral activities; Fight against reduction of natural water reservoirs.	
Risks and catastrophe management policy	Management of natural catastrophes and evaluation climate change vulnerability risks; National plan for evaluation of risks and catastrophes; Development of alert integrated information systems; Reinforcement of national capacities in risks and catastrophe management; Integration of risks and catastrophe management in big national programmes of poverty reduction, community development and environment protection; Resource mobilisation, training and sensitisation of the public and regular review of plans and programmes.	Integration of aspects of climate change in national development policies and programmes; Training and sensitisation of the public

ANNEXE 2

Detailed profiles of priority projects for the adaptation to climate change