MINISTRY OF ENVIRONMENT AND SUSTAINABLE DEVELOPMENT

GENERAL SECRETARIAT

PERMANENT SECRETARIAT OF THE NATIONAL COUNCIL FOR ENVIRONMENT

BURKINA FASO

Unity - Progress- Justice

Rice field, source from GES

herd of bovine zebu, source from GES

SECOND NATIONAL COMMUNICATION OF BURKINA FASO ON CLIMATE CHANGE

September 2014

Table of contents

List of tables

List of schemes

List of maps

List of photos

Acronyms and Abbreviations

AEP	:	Supply in Drinkable Water
AMMA	:	Multidisciplinary Analysis of the African Monsoon
CC	:	Climate Change
CCNUCC	:	Main Convention of the United Nations on Climate Change
CES	:	Conservation of Waters and Soils
CFA	:	(Franc) Communauté Financière d'Afrique
CFC	:	Chloro-Fluoro-Carbonates
CIMAC	:	Inter-ministerial Committee for the Implementation of Actions of the Convention
CNI	:	Initial National Communication (or First Communication)
CO_2	:	Carbon dioxyde
COP	:	Conference of Parties
COVNM	:	Non Methane Volatile Organic Components
CSLP	:	Strategic Framework to Fight Poverty
DGPSA	:	General Directorate of Productions and Agriculture Statistics
DGPSE	:	General Directorate of Productions and Livestock Statistics
DGRE	:	General Directorate of Water Resources
DRRA	:	Regional Directorate of Animal Resources
ECOPAS	:	Protected Ecosystems in Sudanese-Sahel Africa. Regional program park W (Benin, Burkina and Niger)
ENEC	:	National survey on the quantity of livestock
FAO	:	Food and Agriculture Organization
GES	:	Greenhouse Gas
GIEC	:	Inter-Governmental Group of Experts on the Evolution of Climate
GIRE	:	Integrated Management of Water Resources
GR2M	:	Agricultural Engineering 2 parameters, Monthly
GRN	:	Management of Natural Resources
INERA	:	Institute of Environment and Agricultural Research
LBC	:	Low-consumption Lamp
LEAP	:	Long Lange Energy Alternatives Planning Systems
MAHRH	:	Ministry of Agriculture, Hydraulics and Water Resources
MARP	:	Accelerated Method of Proactive Research
MCG	:	Mechanisms of General Circulation
MCR	:	Mechanisms of Regional Circulation
MDP	:	Mechanism for a Clean Development
MECV	:	Ministry of Environment and Quality of Life
MOB	:	Project Management of Bagré
MRA	:	Ministry of Animal Resources
NPKBS	:	Nitrogen-Phosphorus-Potassium-Boron-Sulfur
OMM	:	World Meteorological Organization
ONEA	:	National Company of Water and Sanitation
ONG	:	Non-Governmental Organization
PAGIRE	:	Action Program for the Integrated Management of Water Resources
PAN/LCD	:	National Action Program to Fight Desertification

PANA	:	National Action Program for the Adjustment to Climate Change
PANE	:	National Action Plan for Environment
PDIS	:	Integrated Development Plan of the Samendeni valley
PIB	:	Gross Domestic Product
RGPH	:	General Census of Persons and Housing
SAAGA	:	Acronym of RAIN in the Mooré, the national language
SIG	:	Geographic Informations Systems
SN-SOSUCO	:	National Company – Sugar Company in the department of Comoé
SOFITEX	:	Textile Fibers Company of Burkina
SONABEL	:	National Company of Electricity of Burkina
SONABEL	:	National Company of Electricity of Burkina
SOPAL	:	Liquor Production Company
SP/CONAGESE	:	National Secretariat of the National Council for the Management of Environment
SP/CONEDD	:	Permanent Secretariat of the National Council for Environment and Sustainable Development
SRP	:	Strategies for the Reduction of Poverty
UNESCO	:	United Nations Educational, Scientific, and Cultural Organization
VAHYNE	:	Analysis of the Hydrological Variability and Impacts on Water Resources of the Hydrological Variability and Impacts on Water Resources
WBM	:	Water Balance Template

Foreword

The second national communication of Burkina Faso is subsequent to the one submitted in November 2001, at the Main Convention of the United Nations on Climate Change, which has also been referred to as initial communication. The process of that communication started since 2006, but all types of difficulties delayed its finalization.

I would kindly like to mention here that beyond these difficulties, all the competent stakeholders and institutions in the field of climate change in Burkina Faso, have considered the finalization of this report as a major challenge. After multiple efforts and privations, we have been able to finalize this document which fully informs the international community on climate change in our country.

This second communication therefore enables Burkina Faso to meet its commitments towards that convention it has signed and ratified. This convention presents, in compliance with the commitments made, the emissions of Greenhouse Gas (GES), the strategies of adjustment undertaken to face the impacts of climate change, and the actions taken to mitigate the emissions of Greenhouse Gas.

The Ministry in Charge of Environment who managed he coordination of that national communication, would hereby like to thank all the State stakeholders, the public sector and the private sector for their mobilization and their determination all throughout the elaboration process of this report.

The Ministry would also like to express all his gratitude to the Fund of Global Environment (FEM) which funded the project and the United Nations Program for Development (PNUD) which has been the execution agency.

Le Ministre de l'Environnement et du Développement Durable

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Analytical summary

NATIONAL CONTEXT

Burkina Faso is a landlocked country in West Africa, located between 9°20’ and 15°05’ of North latitude, 5°20’ of West latitude and 2°03’in East longitude; the land area of Burkina Faso is 274 000 Km^2. The climate is like the Sudanese type. The rainfall, which is very variable and irregular, decreases from the south-west towards the North. The temperature is also very variable according to the seasons of the year, with strong diurnal amplitudes. The hydrographical network of Burkina Faso is rather dense but not crossable.
Its population has been estimated to 14 017 262 inhabitants, with an average density of 51,8 inhabitants per km^2, according to the General Population Census in 2006.

At the socio-ecological level, five regions characterize Burkina Faso, and have an impact on the country’s economy: the Sahel, the East, the Centre, the West and the South West. The agricultural sector and the tertiary sector are the main sectors of activities for the economy of Burkina Faso.

Agriculture represents 60 % of the total exports. Despite the fact that is occupies more than 80 % of the population that activity is still lagging behind and largely depends on rainfall. The letter of Agriculture Development Policy adopted by the country should enable to overcome some difficulties faced by the populations through food safety, an improvement of income, a diversification of the farming population and a better conservation of natural resources.

The business sector is the favorite field of informal activities, therefore difficult to control. It occupies an important part of the uneducated population therefore limiting its growth and prosperity. The exports products are not varied and mostly include cotton, food crops and other products such as cereals and tubers, groundnuts, shea butter, sesame, fruits and vegetables and livestock products.

The other activities of the tertiary sector (farming, forestry), the secondary sector (industry and mines), and the tertiary sector (transports) is not weak and less organized. That situation is aggravated by poor health coverage and a low school enrollment rate; this explains the position of Burkina Faso among poor countries.

On the climate level, the temperatures are very high from March until September. The gradual disappearance of vegetation for various reasons (obtaining croplands, energetic and well-being needs, rudimentary farming practices) do not encourage a sustainable exploitation of natural resources. The degradation of the canopy increases the fragility of the soil and facilitates the appearance of a surface crust which prevents the humidification of the soil and therefore prevents the new growth of woody or herbaceous vegetation.

The important human factors are rather characterized by a very irregular demographic density, with an average growth rate of 2,38 %. Both an important internal migration (to underutilized areas), and external (to neighboring countries) is well-known. This is a major concern considering the fact that it leads to a gradual degradation of fragile ecosystems and causes the departure of strong individuals towards foreign countries.

The national situation in terms of medical care, nutritional status, illiteracy and creation of employment is a major concern and ranks the country among the less developed. The primary sector mainly dominates the national economy. Unfortunately, this sector is traditional and occupies less than a third of arable lands with very few competitive cash crops on the international market to generate a financial safety margin.

THE INVENTORY OF EMISSIONS SOURCES AND ABSORTION WELLS OF GREENHOUSE GAS IN BURKINA FASO

The set up of greenhouse gas inventories related to energy sectors, industrial processes, solvents, agriculture, and the utilization of soils, forestry and wastes. This requires enormous data which were not always available, therefore requiring the use of extrapolation and approximation to enable its implementation.

1994 has been selected as a baseline to collect information and calculations, on the basis of technical recommendations linked to the type of inventory, taking into consideration the economic environment and the availability of the data. The results here below indicate the situation of emissions and absorption of greenhouse gas in Burkina Faso.

✓ **The energy sector**

The energy sector is one of the most implicated domains in the inventories surveys due to the releases from combustion of combustible fossils. In 2007 in Burkina Faso, the emissions of this sector have been very significant with a contribution of 1300,5 Gg of carbon dioxide. Transports is the most polluting sub-sector with 776,4 Gg.
The energetic industries and manufacturing industries are ranked second and third in terms of sub-sectors being a source of pollution.
To that we need to add other trace gases (N_2O, CO, MNVOC, NO_X, CH_4) also emitted during the incomplete combustion of fuels.

✓ **The sector of industrial processes**

The emissions of CO_2 in the sector of industrial processes have a tendency to rise, however with a considerable reduction of the total emissions of CO_2 in the sector during 2001 and 2002. That reduction of emissions is the reason why the production of cement was stopped in the country. The total emissions of CO_2 in the sector of industrial processes indicated 304 Gg in 2007. Between 1999 and 2007, these emissions doubled because they indicated 143 Gg in 1999. Generally speaking, the categories of industrial processes contributing to the formation of CO_2 in Burkina Faso are minerals and metal production.

✓ **The agricultural sector**

The evaluation of greenhouse gas in the sector of agriculture involves the farming and livestock activities. There are essentially six (6) categories of source: the enteric fermentation, the manure management, the rice cultivation, agricultural soils, the burning of savannah and agricultural residues burnt in the fields.
The total emissions of GG of the Agricultural sector in en equivalent CO_2 indicated 19 142 Gg in 2007, indicating an increase of 42 % compared to 1999. For each of these years from 1999 to 2007, the most part of greenhouse gas emissions in the agricultural sector come from the categories of enteric fermentation and agricultural soils, contributing to more than 90% of

the total of the emissions. The other gases emitted in the form of trace, such as nitrous oxides and nitrogen oxides come from burning practices.

- ✓ **The sector of the utilization of lands and forestry**

The emissions of greenhouse gas from the Lands Use sector, changes in land use and forestry (ATCATF) are mainly made of carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). This sector also emits other gases such as NOx and CO.

The main categories impacting the emissions and sequestrations of GG in the ATCATF sector are as follows: the changes of forests and other wooded fields and stocks of biomass (sequestration) and the conversion of forests and grasslands (emissions). Considering the total gross emissions of GG in all the sectors, the contribution of the ATCATF sector decreased from 10% in 1999 to 7% in 2007. Concerning the sequestration of GG by the ATCATF sector en 2007, the power of gross sequestration in Burkina Faso indicates 2 047 Gg against 239 Gg in 1999 thanks to the efforts made by the country through various programs of reforestation and protection. The ATCATF sector is net sequester in CO_2, because in 2007, the net emissions of CO_2 by this sector are negative (-502 Gg).

- ✓ **The waste sector**

The emissions of Gg in the waste sector mainly come from solid wastes dropped on the ground and water treatments. The total of GG emissions in the waste sector has increased by 71 % between 1999 and 2007. Methane is the most important gas in emissions of GG for the waste sector. It represented 96 % of the emissions in the sector in 2007. The rest is due to N_2O.

VULNERABILITY OF THE MAIN ECONOMIC SECTORS AND ACTIONS FOR MITIGATION

In the context of this national communication, the sectors of agriculture and water resources have been selected for the analysis of the vulnerability and adaptation, which will be preceded by that of the current climate context and its possible evolution by horizon 2050. The following units of exposure have been analyzed:

- Maize and cattle in the sector of agriculture;
- The dams of Bagré, Kompienga, Ziga and Sanmandeni in the sector of water resources.

The baseline situation has been established by analyzing the two factors of climate mostly influencing the units of exposure selected in the sub-region: the rainfall, which the natural tendency is likely to decrease by 2050, and the temperature, which tendency is likely to rise within the same time horizon.
In the sector of agriculture, the maize unit is characterized by an increase in planting areas, increasing from 185.000 ha to 381.000 ha between 2000 and 2008. The yields during the same period are very variable, increasing from 1,04T/ha in 2007 to 1,78T/ha the previous year, with a weak average of 1,44T/ha. Concerning the cattle unit, there is a slight increase in the number, leading to foresee by 2013, an average density in the East region of 33,05 UBT/km^2 and the water demands representing 16,74 million cubic meters. By 2025, the

density will be close to 43, 51 UBT/km^2 and water needs will represent 22, 04 million cubic meters.

Concerning the sector of water resources, the results collected from the implementation of the GR2M model have been deemed as presenting the best performances on all the basins selected. These results deemed good and satisfactory enabled to select the GR2M model afterwards for the evaluation of the impacts of climate change by time horizons 2025 and 2050.
With regard to that baseline situation concerning the units selected, a number of perspectives have been made to appraise what will happen in the context of climate change.

The situation with climate change varies from one unit to the other, and also according to the scenarios studied:

- Concerning the maize unit, even if the rainfall increases by +5, 6% in 2025, the survey area would only cover 32% of cereals needs in the country. This rate drops to 23,5% in 2050. This indicates that we need to find measures of adaptation;
- Concerning the cattle unit, as well as meat and milk, out of the three scenarios envisaged, we note that if scenario 1 should occur again, this would cause important losses for the country in terms of exportation revenues, and for the cattle-meat- and milk stakeholders. Furthermore, an important number of non-professionals breeders could give up this activity.

Concerning the sector of water resources, a certain number of impacts affect the runoffs, the filling of dams, their hydrological balance, the production of hydro-electricity, irrigation and the fish production at the level of all the units of exposure.

Faced with these factual realities, measures and strategies of adaptations have been recommended to enable the country to fight the dangerous consequences of climate change. For all of these sectors, these measures and strategies are institutional and technical.
Concerning the maize unit, these measures and strategies envisaged include:

- The institutional measures;
- The techniques of collection and conservation of water in the plot (the zaï, the djengo, the half pipe, the stone bunds and grass strips) ;
- The irrigation techniques;
- The reinforcement of the utilization of organic and mineral fertilizers;
- The popularization of improved varieties of maize;

Concerning the cattle unit, the measures essentially aim at:

- Reinforcing the fight against infectious and parasitic diseases in extensive livestock
- Reinforcing the epidemiologic monitoring of priority diseases;
- Improving the genetic potential of cattle mainly by the introduction of new efficient genes;
- Set up a system of early warning on the risks of fodder and water crisis;
- Set up an operational system for the management of cattle food crisis.

Concerning the water resources, they essentially consist in:

- The creation of a favorable political and institutional framework;
- The development and management of water resources;
- The monitoring and assessment of water resources;
- The capacity building;
- The promotion of periodical fishing, to improve the productivity and production of water;
- The increase of irrigation efficiency for the irrigation schemes.

One of the other important measures to undertake concerning the management of climate change is the mitigation of greenhouse gas. For this survey, the analysis of mitigation of the emissions involved two sectors: the sector of energy and the sector of agriculture. The survey only involved these sectors due to the difficulties linked to the availabilities of data, and the complexity with regard to the utilization of planning/setting up tools of the scenarios. The concept was to identify a number of unscheduled mitigation actions in the plans and sector-based programs of Energy and Agriculture and recommend them as an option of mitigation.

The emissions avoided by the implementation of these options have been evaluated. The costs pertinent to the options selected have been evaluated.

In terms of national strategy for the implementation of that Convention in Burkina Faso, the actions of mitigation are not an absolute priority for the country, or elsewhere for most developing countries. However, the country undertakes measures and policies with regard to commitments and/or efforts to reduce emissions of polluting gases to meet the commitments it subscribed to towards the international community.

INTRODUCTORY

Faced with the risks of the global climate (rising temperatures, rising sea levels and increased occurrence of extreme climate events, etc.), the General Assembly of the United Nations created in 1990, the Inter-governmental Negotiation Committee (CIN) in charge of the elaboration of a Draft Convention on climate change.

The project of Convention was therefore elaborated was adopted on 9th May 1992, at the United Nations Headquarters, in New York. The Convention was signed by the representatives of 154 countries including Burkina Faso in June 1992, during the Earth Summit in Rio de Janeiro. On September 3rd 1993, the parliament of Burkina Faso ratified that convention which subsequently was applicable by March 21th 1994.

Articles 4 and 12 of the Draft Convention of the United Nations on Climate Change (CCNUCC), stipulate that each Party must communicate at the Conference of the Parties, the information relevant to its anthropogenic emissions by sources and absorption by sinks, of any greenhouse gas (GG) not controlled by Montreal Protocol (inventories of GG). The compliance of this specification is subject to the presentation of a National Communication which must also include the actions aimed at mitigating or facilitate an appropriate adaptation t these climate change, and all other information deemed useful to meet the full objective of the Convention.

Burkina Faso has elaborated this national communication in compliance with the directives of the CCNUCC included in the decision 17/CP 8 adopted during the eighth session of the Conference of the Parties. It documents the situation of climate change in the country; it also completes and updates some data already reported to the international community during the first Communication of 2001.

In compliance with the pertinent directives, this national communication has been broken down as follows:

- An introductory on the current national context on the physical and socio-economic levels;
- The national inventory of Greenhouse gas including an analysis of the trends over the period 1999 to 2007 ;
- An analysis of vulnerability and the adaptation of the economic sectors of agriculture and water resources in 2000 as the baseline year;
- A suggestion concerning the measures of mitigation enabling to reduce the emissions of GG GES ;
- Suggestions for the measures to adopt to meet the obligations of the Convention mainly in the fields of research and systematic observations of the climate system, the set up of adequate technologies and their transfer, the sensitization of the public, information and training
- Weaknesses of the country in this type of exercise, from a comparative analysis of the two national communications.

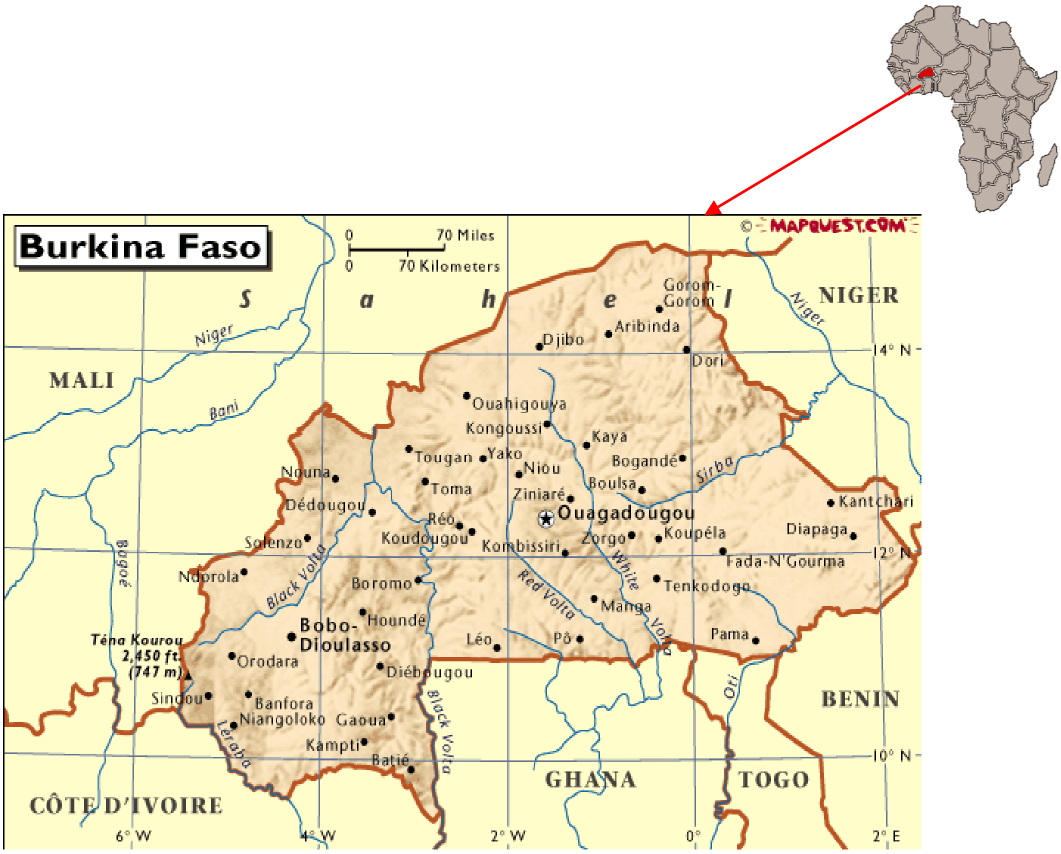
The elaboration of the national communication also gives the opportunity to reaffirm the vision of the country concerning the global struggle against climate change.

I NATIONAL CONTEXT

1.1. Physical framework

1.1.1. Geographical situation

Burkina Faso is a landlocked country at the heart of West Africa, located between 9°20' and 15°05' of North latitude, 5°20' of West longitude and 2°03'of East longitude. The country spreads over an area of 274 000 km². It is limited at the north and West by Mali, at the East by Niger, at the South by Côte-d'Ivoire, Ghana, Togo and Benin (map 1). The geographical position of Burkina gives the country its biophysical characteristics.



Map 1 : Situation of Burkina Faso

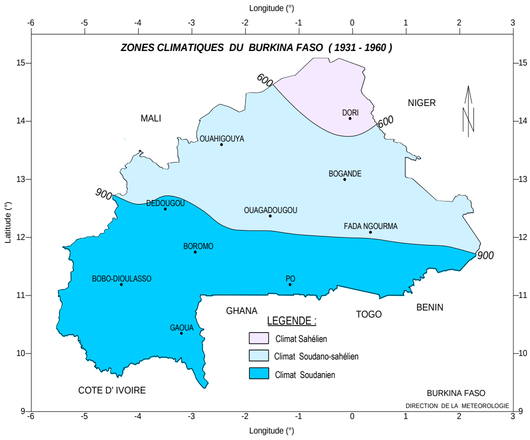
1.1.2 Geomorphology

On the geomorphologic level, over 80 % of the country relies on a wide monotonous plain surface, with an average altitude between 250 and 300 m. Sandstone areas in the West and North West, are dominated by relict mounds: on the West side, these mounds are 700 meter high, which is the case for the ''Piton of Bérégadougou ''(717 m) dominating the plain of Banfora and Mount Ténakourou (749 m), the highest peak of the country; in the South-West, they are indicated by the ''chain of the Gobnangou'' (500 m) at the Benin border.

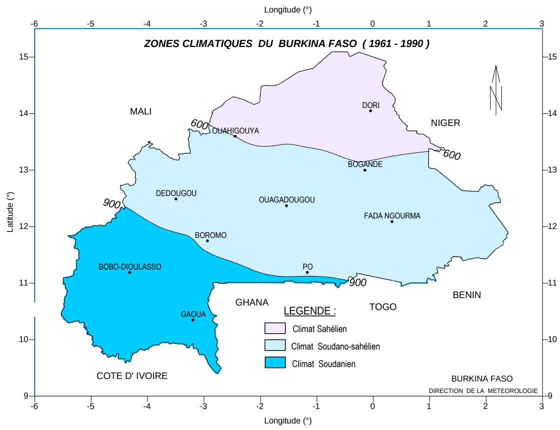
1.1.3 The climate

Three typical eco-climate areas subdivide Burkina Faso: the Sahel area in the North, the north-Sudanese area in the center and the south-Sudanese area in the South-West. The limits of these subdivisions migrated toward the South under the influence of the modifications of the climate as indicated in maps 2. The characteristics of each area are summarized in Diagram 1. The most significant climate factor is the rainfall (Diagram 1) which decreases from North to South and is subject to seasonal and inter-annual variations resulting in droughts or heavy floods some years at a higher an increasing frequency.

The very severe droughts in 1972-74 and 1983-84 have strongly affected the country with their consequences of disasters: decimated herds, bad harvests, famine, displaced populations, etc. this major natural calamities enabled to sensitize the national public and international opinion on the climate impacts and the great vulnerability of the populations of Burkina Faso in particular, and the populations of the Sahel in general.



a)



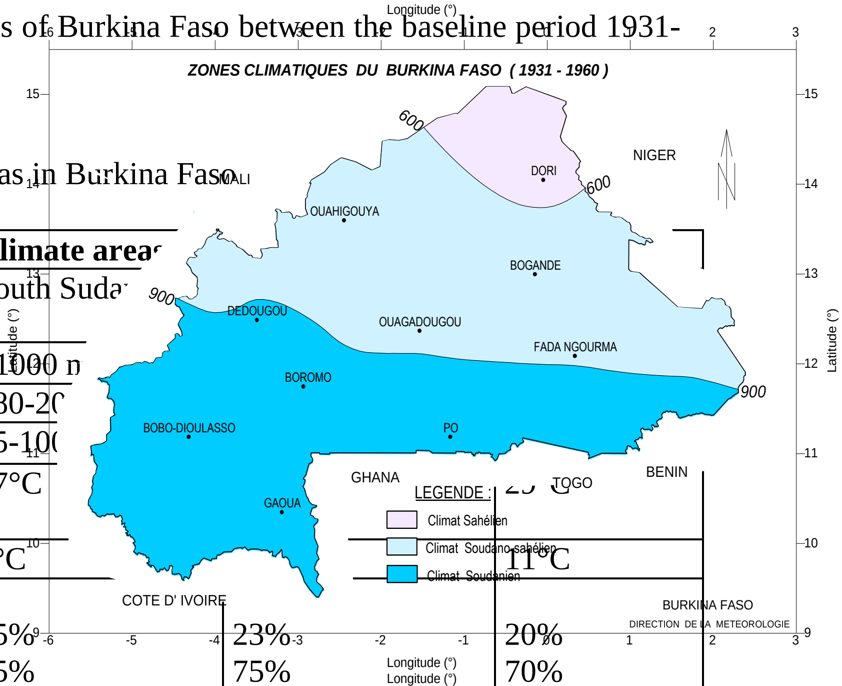
b)

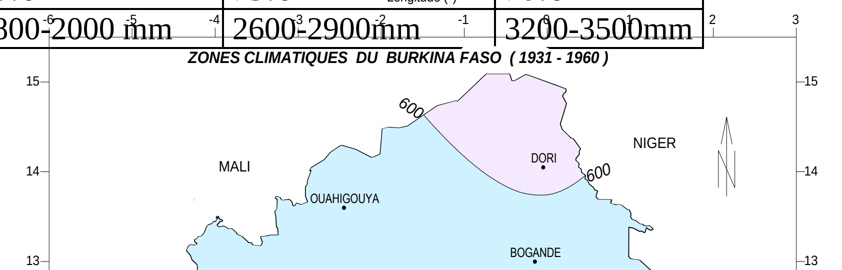
Source: Directorate of meteorology of Burkina Faso

Map 2: Evolution of the eco-climate areas of Burkina Faso between the baseline period 1931-1960 (a)- and 1961-1990 (b).

Diagram 1: Characteristics of climate areas in Burkina Faso

Characteristics of the climate areas	Climate areas South Suda[illegible]	[illegible]	[illegible]
Annual rainfall	>1000 m[illegible]	[illegible]	[illegible]
Duration of the rainy seasons	180-20[illegible]	[illegible]	[illegible]
Number of rainy days	85-10[illegible]	[illegible]	[illegible]
Average annual temperature annuelle	27°C	[illegible]	[illegible]
Seasonal amplitude	5°C	[illegible]	11°C
Humidity of the air Dry season Moist season	 25% 85%	 23% 75%	 20% 70%
Annual evaporation (bac class A)	1800-2000 mm	2600-2900mm	3200-3500mm

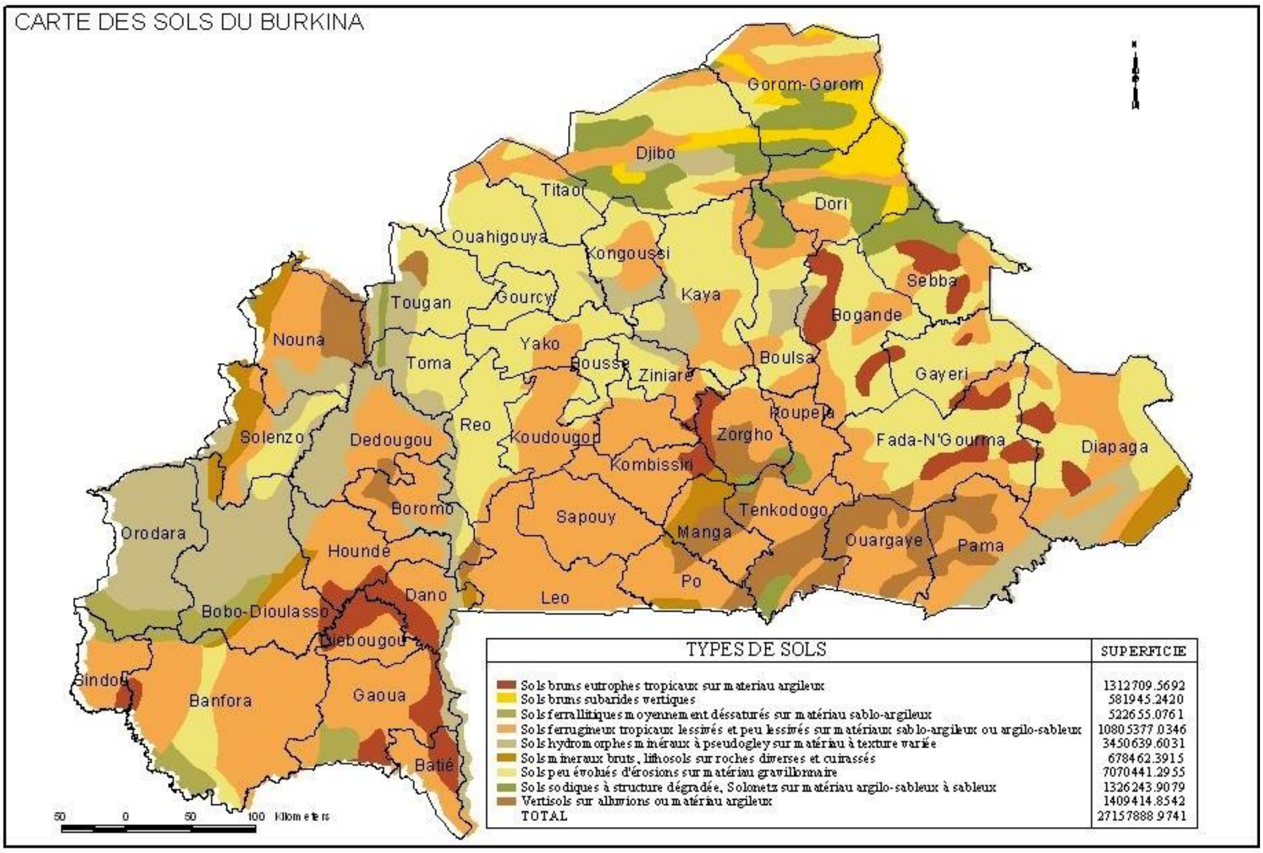




Source: Directorate of meteorology of Burkina Faso

1.1.4 The soils

According to the level of evolution, there are nine types of soils as Map 3 here below indicates.



Source: National Company of soils 2003

Map 3 : Map of the soils in Burkina Faso

The most dominant soils are as follows:

- Leached tropical ferruginous soils and lightly leached 39.78%;
- Slightly eroded soils on gravelly materials 26.03%;
- Hydromorphic pseudogley mineral soils 12.70%.

In general, the situation of soils in Burkina is rather unstable. The soils have a poor level of fertility (poor in nutrients and organic component) with a limited water reserve. Most of these soils are characterized by their great structural fragility causing them to be easily degradable under crops.

1.1.5 The hydrographic network

There is not much rainfall in the country and it is slightly rough; however the hydrographical network of Burkina Faso benefits from a dense capacity with 3 international rivers (the Niger, the Volta and the Comoé province) which are all subdivided into 17 national sub-rivers.

1.1.6 The vegetation

The important factor for the natural canopy is rainfall. According to the annual rainfall there are three types of vegetation in Burkina Faso from North to South. They are broken down as follows:

- Annual grasses on slopes and ridges with shrubs in the shallows at the level of the average annual rainfall of 200-400 mm;
- Trees and especially shrubs everywhere, sustainable grass in the lowlands at the level of the 400-800 mm area of annual rainfall;
- Trees, shrubs and mainly shrubs everywhere and perennial grass everywhere, forests in the lowlands in the area of 800-1200 mm annual rainfall.

The current vegetation indicates 1.407 species (PEDD, 2003) broken down as follows:

- 28 species of superior mushrooms;
- 191 species of algae;
- 185 species of herbaceous aquatic flora and subservient to wetlands;
- 627 species of terrestrial herbaceous plants;
- 376 species of woody plants.

In Burkina, there are two hydro-geographic domains subdivided into sectors and districts on the basis of the trilogy climate-flora-vegetation (Guinko, 1985). It is the Sahel and Sudanese which borders are situated at approximately on the 13th North parallel.
The overall vegetation of the Sahel domain is dominated by multi-aspects steppes (grass, shrubs and trees). The main species are: *Acacia raddiana, Grewia tenax, Maerua crassifolia, Hyphaene thebaica (doum palm tree), Acacia laeta, Bauhinia rufescens, Pterocarpus lucens, Combretum glutinosum, Acacia macrostachya, Acacia senegal, Euphorbia balsamifera, etc*

The Sudanese domain is the extension area of savannahs. The vegetation in the farming landscapes is dominated by protected species such as *Vitellaria paradoxa* (shear nut), *Parkia biglobosa* (néré), *Tamarindus indica* (tamarin tree), *Adansonia digitata* (baobab tree), etc. there are also, near the households, “ sacred woods ” protected by customary practices testifying the existence of a vegetation made of open forests. Further down South there are forests which are the less disturbed due to the weak density of the population. There are many Guinean species such as *Antiaris africana, Chlorophora excelsa, Dialium guineense, Acacia polyacantha subsp. campylacantha, Acacia sieberiana, Anogeissus leiocarpus, Daniella oliveri, Diospyros mespiliformis, Khaya senegalensis, Isoberlinia doka* and *Isoberlinia dalzielii*. But there are often species such as *Burkea africana, Vitellaria paradoxa* subsp. *parkii, Lophira lanceolata, Monotes kerstingii, Parkia biglobosa*, etc.

1.1.7 The wildlife

Burkina has a rather rich biological diversity. There are 2.394 animal species (CONAGESE, 1999) divided as follows:

- 1.515 species of insects;
- 198 species of aquatic fauna;
- 665 species of wildlife;

- 16 species of domestic animals.

This wealth of the wildlife is linked to a large extent to the geographical position of the country which gives it a range of extended inhabitants forming a transition between the Sahel steppe and the Sudanese-Guinean forests meadows savannahs. However, that biodiversity is becoming increasingly poorer. Some species are rare, mainly the species from the Sahel threatened by drought and the destruction of their habitat. Some species such as the manatee or the giraffe have unfortunately recently disappeared. Other species are only periodically reported on the national territory. This mainly includes Sahel species making short halts from Mali or Niger such as ostriches (reported many times in 1990 around the Christine drilling) or the Oryx gazelles (seen for the last time in Burkina Faso in 1986). Other species on the other hand, are very abundant Burkina Faso. This is the case of elephants which are, beyond doubt, the most important population in the West African sub-region, but also antelopes, hartebeests and warthogs, etc.

1.2 Socio-economic context

1.2.1 The population

The data collected from the overall census of population and habitat (RGPH) in 1975, 1985, 1996 and 2006, and the priority survey conducted in 1994, enable to describe the demographic profile of Burkina Faso. The population in the country increased from 10 312 609 inhabitants in 1996 to 14 017 262 in 2006.

1.2.1.1. Division of the population

The division of the population indicates inequalities according to the regions. The temporary findings of the RGPH in 2006 indicate that the Centre region which is hosting the administrative capital of the country de 2006 capital has 11,1% of the national population. Then comes the ‘’Buckle of Mouhoun’’ and ‘’High Basins’’ departments with 10,5 and 10,3% of the total population. The less populated regions are as follows: the Cascades with 3,8% of the population, the South-West (4,6%) and the Centre-South (4,7%).

There is a reinforcement of urbanization in Burkina Faso which increased from 12,70 % when the RGPH was conducted in 1985, to 16,50 % during the RGPH conducted in 1996. The rate of urbanization indicated 20% in 2006.
Women represented approximately 51,67 % of the total population in 206 against 51,8 % in 1996. During the census conducted in 2006, the masculinity report indicated 94 men for 100 women in the country (INSD, 2007).

The population of Burkina Faso is essentially young. According to the findings of the QUIBB 2005 survey, 45,3% of the population is under 15 years old. The average age of the population is estimated to be 21,8 years old and 50% of that population is 16 years old for he most part. The social burden of potentially active people is high and indicates a high dependency ratio of 96%.

1.2.1.2. Movements of the population

a) Natural movement

The births and fertility rates indicated 48‰ and 213‰ in 1996. The synthetic index of fertility indicated 6,9 children per woman. The gross mortality rate and the rates of infant and mother mortality indicated 15‰, 115‰ and 207‰ in 1996.

b) Migratory movement

Migration is very old phenomenon in Burkina Faso. A number of these movements are indicated below:

- Internal migrations

These include the displaced populations inside the country from one region to the other. There are two types of internal migrations: the rural exodus and rural migrations.

- *The rural exodus*

The main reasons for rural exodus are socio-economic reasons: the search for remunerated employment in town, and also the rural way of life which no longer convenient for youngsters. These uncontrolled migrations result in an overfishing and deforestation in major cities such as Ouagadougou, Bobo-Dioulasso and Koudougou, etc.; and many issues of urbanization.

- *The rural migrations*

Rural migrations involve individual or groups departures, whether they are spontaneous or organized. These migrations usually leave from infertile or overcrowded regions, toward more fertile and under-exploited regions, with the intent to stay remain there temporarily (for the duration of the rainy season) or permanently. Temporary migrations toward gold mining areas are common frequently.

The Northern regions, the Centre North and the Central Mainland are the main households of rural migrants' departures. The regions of the High Basins, the East, the Boucle of Mouhoun and the region of the Cascades, with a significantly positive migration, are the final destinations of these migrants.

- International migrations

Burkina Faso is characterized by a tradition of important immigration towards coastal countries, and mainly Côte-d'Ivoire, Ghana and Gabon. During the colonial period, the country was considered as a tank of manpower for coastal country. The international migrants are predominantly young, and men outnumber women (SP/CONAGESE, 2001).

1.2.2. The living conditions

1.2.2.1. Poverty

The findings of the three main surveys conducted by the government in 1994, 1998 and 2003 describe a worsening incidence of poverty in Burkina Faso. On the basis of an absolute threshold of poverty estimated at 82.672 F CFA in 2003 against 72.690 FCFA per adult and per year in 1998, the proportion of poor people increased from 45,3% to 46,4% between the two periods, thus indicating an aggravation of 1,1 point (MED, 2004). Compared with 1994, poverty generally increased by 2 points, the incidence of poverty indicated 44,5% in 1994 for a threshold of 41.099 FCFA per adult on an annual basis.

1.2.2.2. The Human Development Index (IDH)

According to the Global Report on Human Development, the HDI indicated 0,37 in 2005, ranking Burkina Faso 176th over 177 countries ranked. This ranking is broken down as follows: life expectancy at birth (51,4 years old) ; adults literacy rate (23,6%) ; gross enrollment rate all levels included (29,3%) ; per capita income (1.213 $US). This indicator, which reflects the poor level of general development of the country, poorly increased rising from 0,313 in 1995 to 0,330 in 2001 and to 0,37 in 2005. The situation of poverty, involving nearly half of the population, explains the low level of human development in the country.

1.2.2.3. Health

The health situation in the country is characterized by common and specific mortality rates which are usually high. The common mortality rate, estimated at 15,2 ‰ is essentially explained by the high child mortality, infant and maternal rates. The rate of prevalence to HIV/AIDS indicated a significant decline since 1997. It dropped from 7,17% in 1997 to 4,8% in 2001 and 2,01% in 2005. (DEP/Health, 2006). The high mortality is predominantly due to illnesses, the weak health and vaccine coverage and malnutrition.

Most diseases are due to water; the most common one are: schistosomiasis widespread in humid regions (areas of stagnant water with vegetation), river blindness spread by the black fly and linked to running water and malaria, which has indicated a resurgence over the past years due to the increase of the population and the progressive resistance to parasites to drugs.

Diarrheal diseases, lung or heart diseases remain important issues of human health. There are diseases with important epidemic potential such as measles, meningitis, and yellow fever and to a lesser extent cholera, etc. these epidemics result in considerable mortalities according to the years. In 2005, 9.625 of meningitis have been detected (with a mortality rate of 20,72%), 1.077 case of measles and 2.292 cases of tuberculosis.

The health and vaccine coverage is weak in Burkina Faso. Passive health coverage is 10.079 inhabitants per CSPS and 186.681 inhabitants per CM or CMA in 2005. In 2005, 77,05% of health facilities complied with the minimum standard in terms of health workers[1]. The average theoretical radius indicated 8,19 km in 2005. The satisfaction in terms of health services has been evaluated at 77,2% for the entire country.

Regarding the nutritional situation, approximately 51,3% and 46,1% of the entire population have experienced retarded growth and a underweight problems (INSD, 2005).

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[1] A health facility, or more precisely a CSPS, responds to the standard in terms of staff if if there is at least one certified nurse or a licensed nurse, a mid-wife or auxiliary mid-wife, a travelling health worker or a laborer (DEP/MS, 2006).

1.2.2.4. Education

The gross primary school enrollment rate indicated 60,3% at national level including 55% for girls and 66,1% for boys during the academic year 2005/2006 (DEP/MEBA, 2007). The net enrollment rate indicates 47,7% at national level (thus 43,2% for girls and 52% for boys).

Illiteracy has a much stronger impact on women compared to men. The rural environment is also disadvantaged compared with the urban environment in terms of literacy (16,9% against 61,7%). Except for the regions of the Centre and the High Basins (surely because they host the two biggest cities in the country), the proportion of people who have no level of instruction in the various region indicated 70%. 59% of the urban population is literate against 14,5% in the rural areas. According to the gender, 16,6% of women are literate against nearly double concerning men.

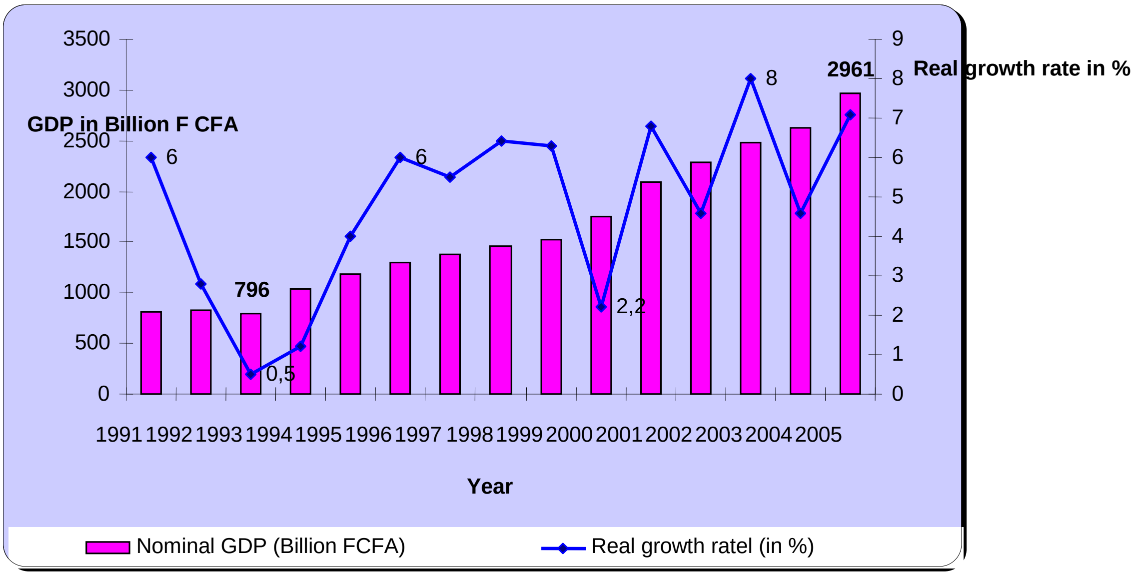
The gross rate of secondary enrollment is weak and approximately indicated 19% en 2005. At this level also, the discrimination according to the gender exist even if it occurs at a lesser.
The superior enrollment is exclusively urban with a weak rate of 3,8% in 2005.

1.2.3. Evolution of economic indexes

On one side, this paragraph evaluates the macro-economic situation through the economic activity and inflation and on the other side the economic sectors in Burkina Faso. It links the economic performances in the country with the biophysical data.

1.2.3.1. The economic activity

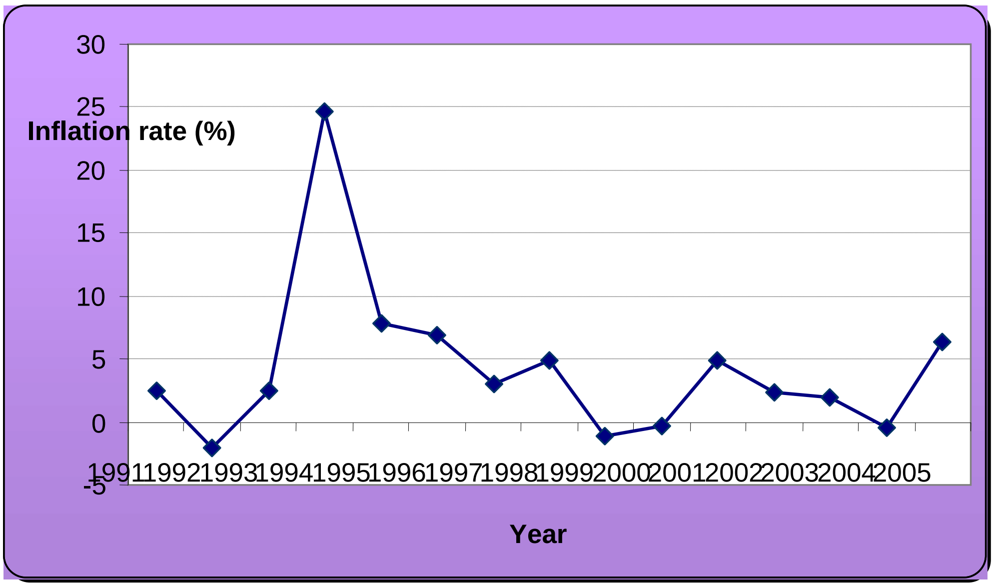
From 1991 to 2005, Burkina Faso recorded appreciable macro-economic performances. The 1990 decade started with a decrease of growth which reached its lowest level in 1993 with a growth rate of 0,5%. In the beginning of 1995, there has been a resurgence of the growth which maintained itself above 6% per year, to a superior level of the national growth indicating 2,4%. In 2000, there was a rate of 2,2% resulting from the severe drop of the cereals production and other external chocks (rise of the petrol products prices). In 2001, Burkina Faso recorded another growth rate resulting from a good cotton and crops campaigns. The good performances of the economy are linked to the situation of the farming campaign which depends on climate conditions. Diagram 1 indicates the evolution of the nominal GDP and the real growth rate.



Source of data: INSD, 2006a, 2006b.
Diagram1 : Evolution of the nominal GDP and the real growth rate.

1.2.3.2. Inflation

During the period 1991-2005, Burkina Faso was able to maintain a one-digit level of inflation except in 1994 where the prices skyrocketed further to the devaluation of the F CFA. Inflation has been rapidly controlled after the devaluation. It dropped to 7,8% in 1995 and 6,9% in 1996. The inflation issues are impacted by the climate factors. Diagram 2 indicates the annual evolution of inflation.



Source of data: INSD, 2006a, 2006b.
Diagram 2 : Evolution of the annual inflation rate in Burkina Faso de 1991 à 2005

1.2.4. The agricultural sector

Agriculture is a key sector of the economy in the country. This sector is broken down into two sub-sectors; the crops and animal productions.

1.2.4.1. The crops productions

The sub-sector of agriculture contributes to nearly 25% of the GDP of Burkina Faso. Agriculture is practically exclusively extensive and essentially practiced in family farms of 3 to 6 ha maximum.

The arable surfaces are estimated at 10 millions hectares (thus approximately 30% of the total surface of the country). Only 3,5 to 4,0 millions hectares (thus 13% of the total surface of the country and the third of arable lands) are cultivated every year.
The main crops are summarized in Table 2 here below.

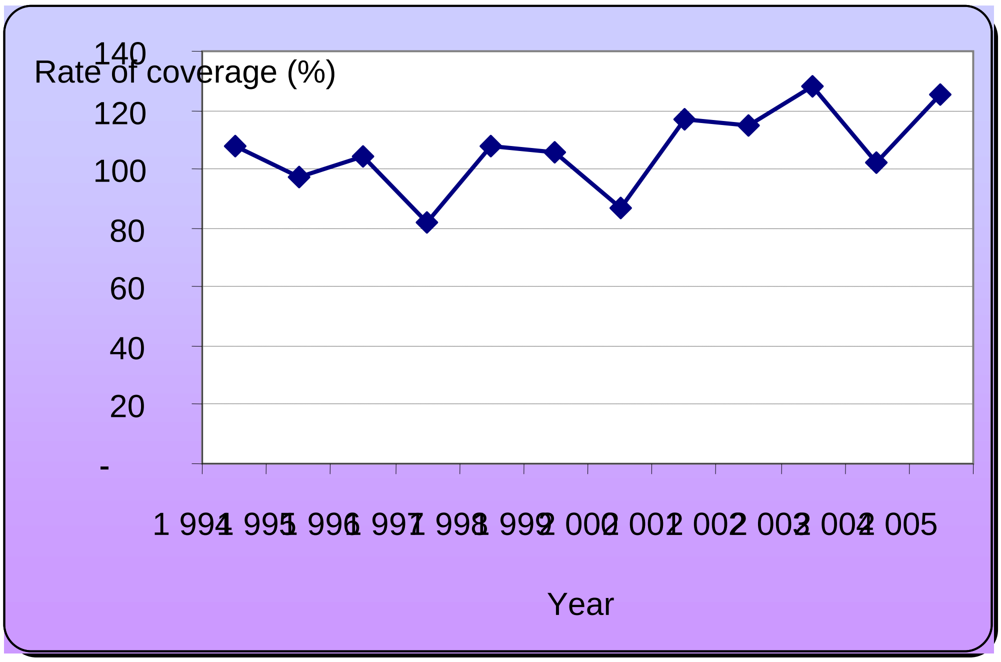
Table 2 : Surfaces, yields and crops productions in Burkina (2005/06)

Crops	Surface (ha)	Yields (t/ha)	Yields (tons)
- Cereals	3.237.581		3.649.533
- Millet	1.309.710	0,913	1.196.253
- Sorghum	1.422.272	1,092	1.552.911
- Maize	442.497	1,806	799.052
- Rice	52.563	1,779	93.516
- Fonio	10.539	0,740	7.801
Other crops	112.061		575.060
- Cowpea	64.154	0,693	44.471
- Voandzou	36.976	1,114	41.210
- Yams	2.433	7,530	18.322
- Potatoes	8.498	8,333	70.815
Cash crops	948.558		968.359
- Cotton	621.748	1,146	712.707
- Groundnuts	274.603	0,803	220.525
- Sesame	46.294	0,541	25.060
- Soya	5.913	1,702	10.067
Total	4.298.200		

Source of data: DGPSA/MAHRH, 2007

The sub-sector of crops productions is dominated by the rainfall system. Only approximately 24.000 ha of lands are irrigated for an irrigable potential of 233.500 ha including 130.000 ha in partial control of water and an additional 30.000 ha in total control of the water (MAHRH, 2004). The crops irrigated include rice, sugar cane and vegetable crops. Gardening is practiced in irrigated areas in small individual gardens mainly in urban and suburban areas. Over the last years, the culture of irrigated maize is promoted (during the dry season) through the small irrigation and the emergence of new stakeholders whose objectives are to sell their products since they are mostly oriented towards agro-business. Les superficies des cultures maraîchères sont passées de 4.632 ha en 2001/02 à 8.879 ha en 2004/05. The vegetable production indicated 166.147 tons in 2004/05.

The vegetable productions can hardly satisfy the nutritional needs of the country and guarantee food safety. The cereals balances (diagram 3) indicate that the national production covered the needs of the population during 9 years out of 12 between 1995 and 2005. The regions which are mostly dependent of the cereals deficit are the Centre, the Central Mainland, the North and the Sahel.



Source: DGPSA/ MAHRH
Diagram 3 : Evolution of cereals balances from 1994 to 2005

This sub-sector of the Burkina agriculture is faced with many constraints. Those linked to the biophysical factors are broken down as follows:

- The insufficiency, the irregularity and the high variation of scarcity of rainfall over as time goes by;
- The degradation of natural resources and the decrease of the soils' fertility;
- The fact that the country is landlocked and the consequences concerning the level of internal and external transportation costs;
- The lack of water control;
- The strong demographic pressures on agricultural lands and high cultural intensity;
- The rural exodus resulting in the fact that many valid individuals go away.

1.2.4.2. Breeding

Breeding plays an important role in the economic and social life of Burkina Faso. It contributes to approximately 10% in the GDP. The breeding products are the second source of income after cotton. It provides the country with approximately 19% of exports revenues (average in 1994-98). The value of exports increased from approximately 6,9 billion FCFA in 1994 to nearly 15 billion FCFA in 1998. It also contributes to food safety by enabling rural populations to face the climate hazards and the irregularities of farming productions. The meat consumption in Burkina Faso is estimated at 9,3 kg/inhabitant/year. (PAPISE, 2000).

Approximately 6% of the active population practices breeding as a main activity. Most of the breeders live in the rural areas (92%) against 8% in the urban areas. (DGPSE, 2006).
Burkina has an important and diversified quantity of cattle. Table 3 compares the figures of the second national survey on the number of cattle (ENEC II) conducted in 2003 with the estimations of 2005. The annual growth rates are estimated at 2% for cattle and pigs, 3% for sheep, goats and poultry.

Table 3 : Evolution of the number of cattle in Burkina Faso

Year	**1 989**	**2 003**	**2 005**
Cattle	3.860.000	7.311.544	7.606.887
Sheep	4.900.000	6.702.640	7.110.788
Goats	6.370.000	10.035.687	10.646.811
Pigs	496.000	1.886.851	1.963.039
Donkeys	403.000	914.543	951.447
Equines	22.000	36.067	36.757
Camels	12.000	14.811	15.401
Poultry	16.515.000	31.940.068	32.358.775

Source: DGPSE, 2005, ENEC I (1989), ENEC II (2003)

The breeding activity is characterized by the coexistence of two systems of exploitation: the traditional systems and the improved systems.

- **Traditional systems or extensive breeding:** these are the predominant systems of exploitation. Usually extensive, whether they are the local or migrating type, these systems are well adapted to the seasonal or inter-annual variability of pastoral resources. However, they experience the consequences of the climate hazards (drought) and those of the restriction of the pastoral environment further to the extension of the crop areas and as a consequence, the high risk of conflicts among breeders and the other users of natural resources.

- **Systems of improved breeding:** the improved exploitation systems, which are more extensive, mainly occur in the urban or semi-urban areas. They include milk production, cattle, sheep, and pork and poultry breeding, cattle-fattening, sheep, pigs and poultry.

The breeding activity in Burkina Faso id characterized by its weak productivity: the average weight of the carcasses is 113 kg for, 9 kg for cattle and 8 kg for goats. The milk production is en average 110 liters per lactation of 180 days and per cow (DGPSE, 2006). These performances still remain below the potentials and possibilities of improvement.
The development of the breeding sector faces various constraints among which land insecurity, essentially characterized by a progression of the farming areas, thus limiting the access of herds to pastoral resources (pastures and water), the difficulties in terms of food and water for the cattle linked to climate hazards, the health problems with the prevalence of major destabilizing impacts on the economic aspect.

1.2.4.3. Forestry

In Burkina Faso, the forestry sector remains a key sector of development considering its roles in terms of preservation of the ecological balance, food safety, production, and support to production (fertilization of soils, control of the water regime, etc...), economy and health of populations.

The sub-sector of forests produces fire wood, lumber wood and timber service which businesses provide income to the populations involved in the sector. Many forest products such as shear nuts are exported and bring a relatively important part of the trade balance of the country. Concerning the wildlife, there is a genuine professionalization through the owners of hunting areas which develop the travel agencies, tourisms agencies and the hotels. In terms of fisheries, traditional fishing is becoming very important with the construction of large dams and the organization of sale of fresh and or/transformed fish.

The management of forestry resources creates employments. For the entire forestry sector, the profits could reach 12,960 billion FCFA in 2015 without mentioning the export value of the other main forestry products which would reach 3,382 billion FCFA at the same period. In addition to these financial contributions, we must add the non-monetary value of the forestry sector to the development of agriculture, breeding and to the preservation of the major ecological balances of the country. (SP/CONEDD, 2004).

1.2.5. The sector of water resources

1.2.5.1 Surface waters

Burkina Faso has 4 watershed national basins (carte 4) broken down as follows:

- The Comoe water shed basin with an area of 17.590 km^2 and representing 7% of the national territory;
- The Mouhoun water shed basin covering an area of 91.036 km^2, or 33% of the territory. It is the largest basin with sustainable water such as the Mouhoun and the Kou ;
- The Nakanbé wate shed basin covering 81.932 km^2, or 30% of the territory. This basin has many water outlets such as Bagré, Kompienga, Ziga and Toécé ;
- The Niger water shed basin with an area of 83.442 km^2, thus 30% of the national territory.

(Source : Programme GIRE, 2004)
Map 4 : Situation of the big national hydrographical basins of Burkina Faso.

The water resources of Burkina are very variable and subject to climate hazards. According to the report (GIRE, 2001) pertaining to the situation of water resources in Burkina and the context of their management, the annual contribution of the 4 national basins approximately amount to **7,5 billion m^3** including **2,66 billion m^3** held on an approximate area of **100.000 ha** made of dams, natural lakes and water points (table 4). The potential total of surface water in Burkina is estimated at **8,6 billion de m^3** (GIRE, 2001).

Table 4 : Potential of surface water of the national basins.

Water shed basin	**Area (km²)**	**Rainfall (in billion m^3)**	**Annual contributions (in billion m^3)**	**Volume conserved (in billion m^3)**
Comoé	17.590	19,0	1,55	0,08
Mouhoun	91.036	74,5	2,64	0,29
Nakanbé	81.932	62,3	2,44	2,20
Niger	83.442	51,1	0,86	0,10
Total Burkina Faso	**274.000**	**206,9**	**7,5**	**2,66**

Source : GIRE, 2001

1.2.5.2. Ground waters

The ground waters reserves are estimated for the entire country at **402 billion m^3**, varying from 268 to 534 billion m^3. The volume of renewable useful water volume infiltrated is estimated at 32,4 milliards m^3 (table 5). The total annual useful potential renewable is therefore **41 billion m^3** in an average year, or 8,6 billion m^3 for surface waters and 32,4 billion m^3 for infiltrated waters (GIRE, 2001). Although the ground waters are mainly exploited for the needs of populations in terms of consumption water mainly in urban and suburban areas, the public is not aware of it. We can mention a few recent surveys conducted by Dakouré (2003) on the sedimentary basin of Taoudéni, and Sandwidi (2007) concerning ground waters of the Kompienga basin, and the deep aquifers of the Gondo plain (Sawadogo, 2009).

Table 5 : Potential in ground water and infiltration of the national watershed basins.

Water shed basin	**Area (km²)**	**Rainfall (in billion m^3)**	**Total reserve (in billion m^3)**	**Useful water infiltrated (in billion m^3)**
Comoé	17.590	19,0	88	2,53
Mouhoun	91.036	74,5	175	12,4
Nakanbé	81.932	62,3	80	8,4
Niger	83.442	51,1	59	9,1
Total Burkina Faso	**274.000**	**206,9**	**402**	**32,4**

Source: GIRE, 2001

1.2.5.3. Availabilities and water demands

Throughout the past 50 years, the availabilities of water drastically dropped further to the decrease of rainfall. The demands are drastically increasing. They are estimated at approximately **2,596 billion m^3**, and represents 10, 2% of the usable water resources in average year (table 6) and up to 52,5% during the very dry year (GIRE, 2001). This means that Burkina Faso is in a situation of high water stress according to the index of insufficiency as defined by UNESCO and the OMM which is 1000 m^3/ha/year.

Table 6: Usable water resources and the water demands.

Water shed Basin	**Usable water resources in an average year (in billion m^3)**	**Water demand (drinking and non-drinking water demands) (in billion m^3)**
Comoé	0,8	0,208
Mouhoun	1,74	0,191
Nakanbé	1,66	2,144
Niger	0,73	0,053
Total Burkina Faso	**4,94**	**2,596**

Source: GIRE, 2001

The water demands are divided as follows: **505 billion m^3 (or 19%)** for consumption demands and **2,091 million m^3 (or 81%)** for hydra electrical demands. The drinking demands are broken down into domestic demands (**20, 58%**), demands for irrigations (**63, 96%**), demands for breeding (**14, 26%**), industrial demands (**1,19%**) and mining demands (**0,07%**).

1.2.5.4. Quality of waters

Concerning the quality of waters, the insufficient and inaccurate data do not enable to provide exact figures for the whole country (GIRE, 2001). Nevertheless we can say that surface waters are usually of good physic-chemical quality (pH, salinity, major ions solution) however without being drinkable. These waters are increasingly loaded with solid suspensions (MES), resulting from the erosion of soils.

Regarding ground waters, they are usually drinkable but in certain cases (urban aquifers for instance), they can contain many toxic components (nitrates, heavy metals, etc.…). The preliminary findings of a survey in process (Guissou, 2009) enabled to show that only 4 drillings analyzed over 20 comply with the standards of components in arsenic recommended by the World Health Organization (OMS) adopted by Burkina Faso.

1.2.6 The energy sector

The energy sector is very important in the political economy of Burkina Faso. The main energies used in Burkina Faso are broken down as follows:

- **Traditional energies:** they have represented 84% of the final energy consumption in Burkina Faso in 2003. The traditional energies are essentially wood and charcoal.

- **Oil products**: they indicated 14% of the final consumption in Burkina in 2003. All these products are imported. These imports are evaluated at 340.500 metric tons for consumption of 328.900 metric tons in 2003. The importations occur through the harbors of Togo, Ghana, Benin and Côte d'Ivoire. The monopoly of oil products is under the responsibility of the National Company of Petroleum Products (SONABHY).

- **Electricity**: it only represents 2% of the final consumption of Burkina Faso. The production and distribution of electricity are essentially guaranteed by the National Company of Electricity in Burkina (SO.NA.B.EL), which production was 495,2 gWh in 2003. The sales indicated 419,2 gWh, increasing from 43, 2% between 1998 and 2003. The rate of coverage is 12 % for approximately 250.000 subscribers over the same period.

1.2.7 Transports

The sub-sector of transports plays an important role in the economy of Burkina Faso. It guarantees the exchanges of agricultural, industrial and business products. It is considered as a strategic position due to the geographical position of the country making it a compulsory area for Sahelians (Niger and Mali) for their access to the sea. There are three types of transports in Burkina Faso: road transports, railway transports and air transports.

The road network, although it is insufficient, grew during these past ten years to cover the main needs of the country. The road network identified in Burkina Faso is 61.500 km including 15.272 km classified. This network is broken down into 6.697 km of national roads, 3.581 km of regional roads, 4.994 km of departmental roads and 46.095 km of rural roads. Aside from the administrative classification, the network is divided according to technical standards. Thus, over the 15.272 km of classified roads, approximately 1.992 km of roads is paved and the rest is dirt roads.

Road transport remains dominated by activities in the private sector concerning the transportation of goods and persons. The bad condition of vehicles, the massive use of two-wheel vehicles and the bad conditions of roads result in the main source of air pollution of this sub-sector essentially in the big urban centers.

The railway network links Ouagadougou to Abidjan on a distance of 1145 km including 617 in the territory of Burkina Faso. The railway transport is guaranteed since 1995, by the International Company of African Railway Transport (SITARAIL) created since the privatization of the Abidjan-Niger railway Rail. SITARAIL mainly focuses in the transport of freight. In 1998, the company transported 57% of the goods imported to Burkina Faso and 34% of exportations goods. It guaranteed the transport of 65% of oil products towards Burkina Faso. However the crisis in Ivory Coast resulted in a stop of railway transportation in 2002 then slowly resumed a year later. The railway transport is running slow and is waiting for a normalization of the socio-political situation in Côte-d'Ivoire.

Air transport is not very well developed and essentially based on passengers' transport towards foreign destinations. Only two airports are functional: the international airports of Ouagadougou and Bobo-Dioulasso.

1.2.8 Industries and mines

There are not many manufacturing industries. These are usually agro-processing and textile factories being the essential aspect of the sector. Furthermore, an important variety of industrial unit sis oriented towards mechanic activities, chemistry, civil engineering and public works, leather processing, etc.

The industrial sector is strongly faced with the competition of foreign products which quality if often better. In addition to that, there are many other obstacles hindering the development of the industry such as the fact that Burkina is a landlocked country, the high cost of factors and means of production (energy and imported products), the narrowness of the domestic market, the weak profitability of exploitation of mining resources and the lack of diversification of the production.

Burkina has huge mining potential. However, the mining industry is only beginning. Except for gold resources, mining resources are limited and difficult to value due to the distance from the sea and the lack of transport infrastructures (manganese and clinker of Tambao, phosphates in the region of Fada N'Gourma).

Artisanal mining involves 200 sites across the country, and involves 100.000 to 200.000 persons. It produced 16 tons of gold between 1986 and 2003 and injected 80 billion CFA in the country's economy over the same period.

1.2.9. Business and services

The main activity of the private sector in Burkina Faso includes micro, small and mid-size businesses, essentially based in Ouagadougou and Bobo-Dioulasso. A large majority of companies (80 %) work in the informal sector. The number of official companies indicated 5.075 against 482[2] for big businesses in 2009. The informal sector is mainly occupied by women and men with a weak level of education or illiterate.

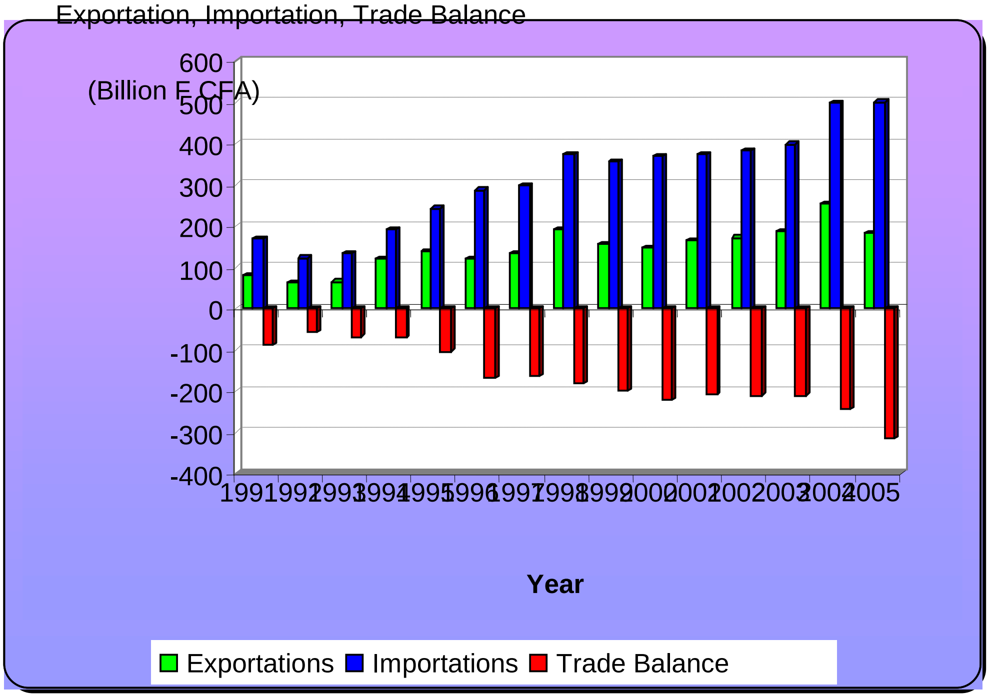
The contribution of the private sector in the composition of the GDP is limited by various handicaps including: (i) the poor level of human capital development, with less than 0,45

[2]According to the classification of companies by the General Directorate of the Tax Department (DGI) based on the sector and turnover taxes.

years of education in average for the workforce; (ii) the poor level of equipment on the territory and the main physical factors of the capital; (iii) the poor access to appropriate infrastructures and reasonable costs enabling it to be competitive.
Burkina Faso mainly exports farming products including cotton, animals, fruits and vegetables, handicrafts, etc.

Beside agricultural products, the country exports gold. After three consecutive years (1991-1993) of decrease in exportations, there was a rise in 1994, with two peaks in 1998 and2004 (table 4). This revival of exportations could be justified by the devaluation of the F CFA in 1994. Basically, the rise in exportations results from the increase of the cotton production.

Concerning importations, they are essentially made of products of equipment occupying the first rank of foreign exchange, oil products and food products (rice and wheat.). There has been a decrease between 1991 and 1992. By 1994, there has been an increase of importations in terms of value, with an exportation ration over importation inferior to 0, 5 in 1996 (table 4).



Source of data: INSD, 2006a, 2006b.

Table 4 : Exportations, importations and Trade balance of Burkina Faso

1.3 Institutional framework and national policies

Burkina Faso ratified the CCNUCC and the Kyoto protocol in September 1993 and March 2005. To this day, it has elaborated several documents of policies and strategies concerning climate change with regard to some specifications of these protocols. Among others, these include:

- The National Strategy of implementation of the Convention on Climate Change adopted in November 2001 ;
- The National Program of Adaptation to climate change (PANA) in 2007.

In terms of organizations in charge of climate change, there is the Permanent Secretariat of the National Council for the Management of Environment (SP/CONAGESE) within the Ministry in charge of environment which will be transformed in SP/CONEDD with more important missions.

In 1995, Burkina set up the inter-ministerial committee for the Implementation of Actions for the Draft Convention of the United Nations on Climate Change (CIMAC). This committee was fully involved in the elaboration of the First National Communication on Climate Change. The CIMAC stopped functioning due to a lack of funding. Since then, no organization of coordination has been created to replace it. Beyond any doubt this was certainly the reason why this national communication launched since 2007 was negatively impacted.

II. NATIONAL INVENTORY OF GREENHOUSE GASES

The inventory of greenhouse gases conducted by the INSD in the framework of the survey: « *Emission in the air in Burkina Faso of Substances pertaining to the increase of gas effect* ». It covers the five pertinent sectors hereafter: energy, industrial processes, agriculture, and the utilization of lands, the change in lands and forestry allotment and wastes. The data on the use of solvents are not available. Therefore they have not been included in this national inventory.

2.1 Overall methodology

The national inventory of greenhouse gas addressed the following main components: le carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). The other gases estimated are carbon monoxide (CO), carbon monoxide (NO_x), and non-methane volatile organic compounds (COVNM). The figures concerning the rest of gases are not significant due to a lack or insufficiency of data regarding the activity.

The methodology described in the « Reviewed guidelines of the GIEC (1996) », have been used.

The data used at national level result from several administrative sources. They have been obtained by surveys or during censuses. On the international level, the data come from databases provided by the FAO, the World Bank and the UNFCCC.

At national level, there is no specific emission factor in the country. We have used the factors by default suggested by the GIEC. The experts' opinions we requested mainly involve the sector of Agriculture and the change of lands allocation. These factors address the fraction of nitrogen in animal wastes, and the average growth rate per tree. A number of coefficients come from the department of agricultural research of Burkina Faso.

The method of level 1 (*tiers 1*) has been used due to the lack of detailed data and specific factors of emission.

Emissions = data of activities x factor of emission
The key sources categories are identified through a predefined threshold of cumulative emissions. The key sources categories are those which, one added by decreasing over of importance, amount to over 95 % of the total level.

2.2 Greenhouse gas emitted in the energy sector

The data used to assess the emissions come from the National Company of Oil products of Burkina (SONABHY), the National Company of Electricity of Burkina (SONABEL), and the General Directorate of Energy (DGE) through an energetic balance. The data relevant to oil products importations are corrected by factors which include the uncontrolled cross-border trade (importations and exportations).

The evaluation in the variation of oil products variation being difficult to establish, we suppose that in the inventory and in the long term, all the available quantities of oil products

are consumed. The data obtained after he treatment are considered as the quantities of oil products used in the country for a given year.
The estimations of CO_2 emissions in the energy sector are conducted by using the method of reference and the sector-based reference.

A number of factors of emissions are provided by intervals in the GIEC guidelines. When is the case, it has been used by the center of the interval for the estimation. However, concerning the category of transports and by including the average age of vehicles in Burkina Faso, the coefficient of maximum emission has been selected.

Seules les émissions liées à la combustion de combustibles fossiles sont prises en compte. Les émissions fugitives de combustibles sont nulles au Burkina Faso. Cela est dû au fait qu'il n'y a ni d'activités d'extraction de charbon, ni d'activités liées à la filière du pétrole et du gaz naturel dans le pays. Au Burkina Faso, il n'existe pas d'activités de transport et de stockage du CO_2. The emissions related to that category are therefore not neglected.

The emissions of Gg in the energy sector essentially come from the original thermal electricity production, the use of oil products in transports, the manufacturing industries, households and businesses.

2.2.1 Emissions of Gg in the energy sector in equivalent CO_2

Table 5 provides the evolution of Gg emissions in equivalent CO_2 in the categories of the energy sector from 1999 to 2007.

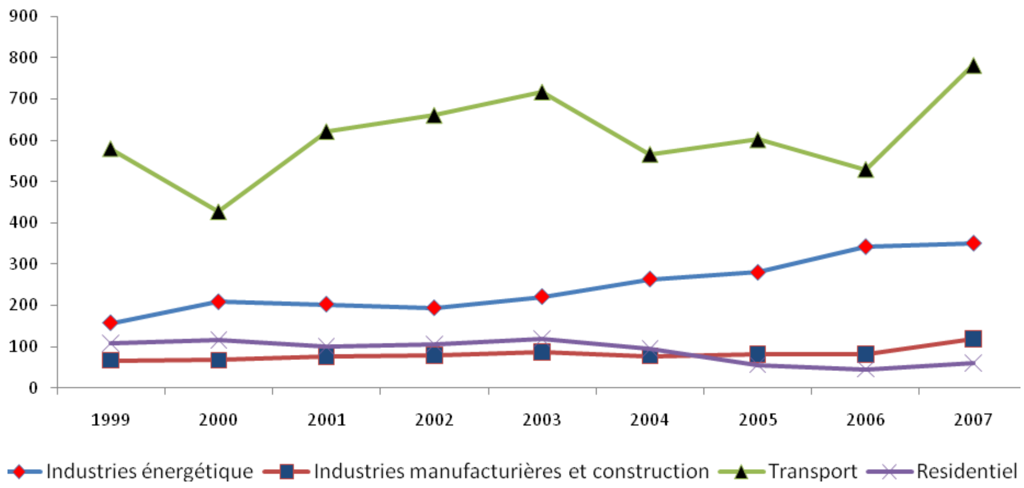


Table 5 : Evolution of emissions in the categories of the energy sector from 1999 to 2007 in Gg

All emissions of Gg in the energy sector contribute to 6 % in the total emissions of all sectors.

These emissions are essentially dependent from the three categories; transports, the energetic industry, the manufacturing industry and construction. These have recorded an overall rising trend since 1999. The decrease noticed in 2000 is due to the slow activities of urban transports by the company X9 and the slow business activities of the railway company.

In 2007, transports emitted 782 Gg of GG, in variation of 35 % compared to 1999. The emissions in the categories of energetic industries have more than doubled since 1999. The emissions of Greenhouse Gas in the transports category (road, air and railway) represent more than half of the total emissions in the energy sector since s 1999.

2.2.2 Emissions of CO_2 in the energy sector

CO_2 is practically the only gas contributing to the emissions of GG in the energy sector. It represents more than 99 % of emissions in the sector. Concerning CH_4 and N_2O, there are traces in the emissions of the sector. The variations of emissions of CO_2 follow those of all GG (table 6).

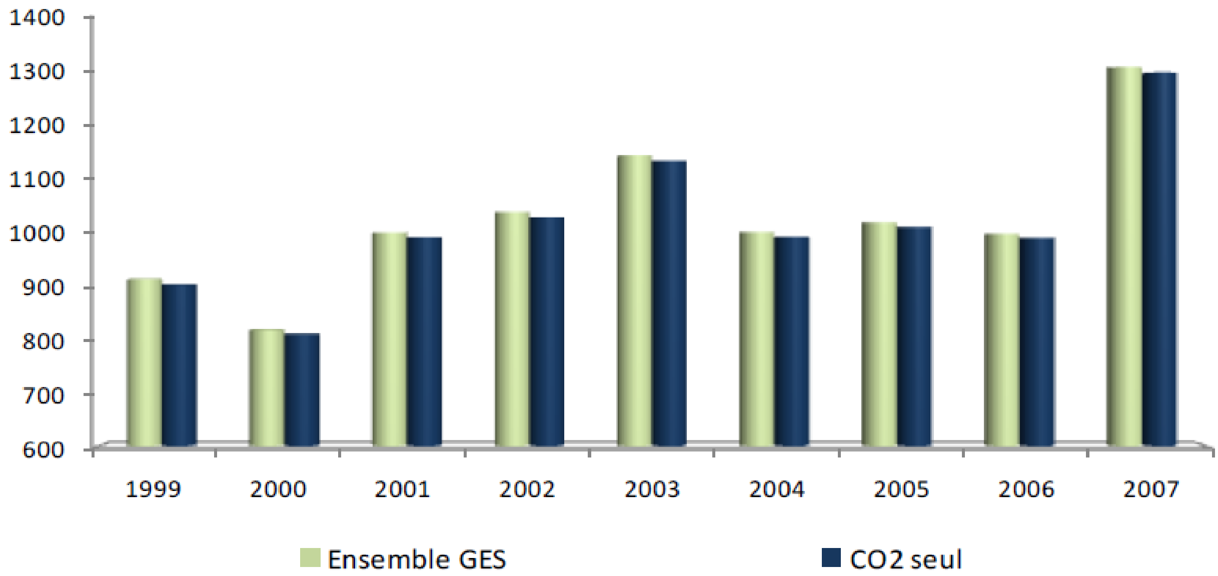


Table 6: Comparative evolution of CO2 emissions, and other GG in the energy sector from 1999 to 2007 in Gg.

Emissions vary from approximately from 900 Gg in 1999 to nearly 1300 Gg in 2007. Every year, they are mostly dominated by CO_2. It is important to pint out that in the same period, the 4-wheels vehicles were four times higher (327%). This resulted in an increase of the oil consumption in the category of transports (INSD, 2010).

The categories of transports, energy industries and manufacturing industries and constructions industries are those which contribute to over 95 % of emissions of CO_2 in the energy sector. These categories are therefore identified as key sources (table 7).

Tableau 7 : Identification of key sources categories of CO_2 in the energy sector in 2007.

Category	**CO_2 emitted (Gg)**	**Percentages**	**Cumulated percentages**	
Transport	776,4	59,7	59,7	**Catégories sources clés**
Energy industries	349,2	26,9	86,6	
Manufacturing and construction industries	117,9	9,1	95,6	
Résidentiel	57,0	4,4	100,0	
Total Energy	**1300,5**	**100,0**		

SOURCE : INSD/IGES 2010

2.3 Greenhouse gas emitted in the sector of industrial processes

Concerning the estimations of the industrial processes sector, the data used are mainly drawn from national figures and statistics on productions. This data are collected every year by the INSD to elaborate the national figures and the index for the industrial production. Burkina Faso is not very industrialized and the data is often individual. This results in difficulties concerning the treatment and availability of information considering the risk to violate the statistical secret.
The estimations of Greenhouse gas conducted only address CO_2. For that sector the emissions of previous gases (NO_x, CO, COVNM and SO_2) have been evaluated.

2.3.1 Emissions of CO_2 in the sector of industrial processes

The total emissions of CO_2 in the sector of industrial processes indicate 304 Gg in 2007. Between 1999 and 2007, these emissions doubled because the figures indicate 143 Gg in 1999. This increase is due to that of the category of minerals and the category of steel production. Table 7 indicates the evolutions of CO_2 emissions in the sector of industrial processes.

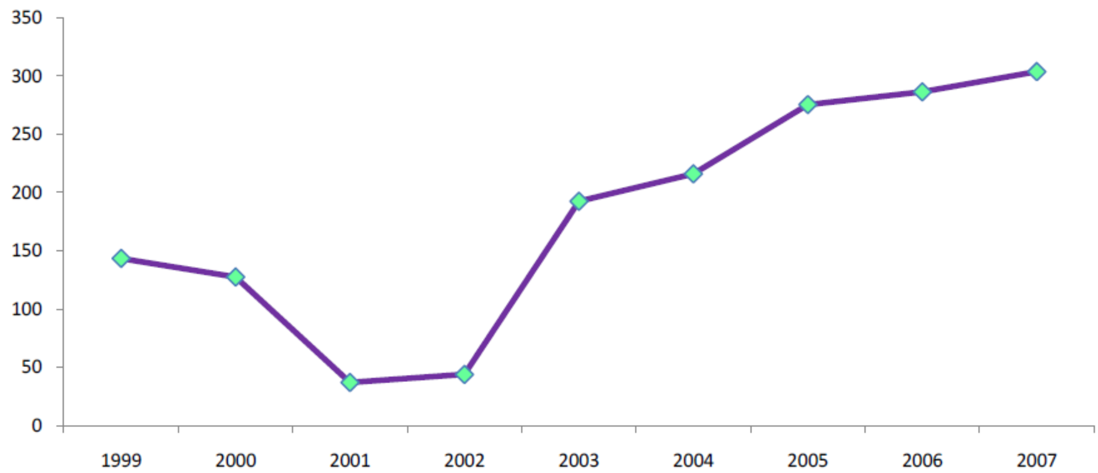


Figure 7 : Evolution of CO_2 emissions in the sector of industrial processes (in Gg)

The emissions of CO_2 in the sector of industrial processes have a tendency to rise. However, the total emissions of CO_2 in the sector are considerably reduced during the years 2001 and 2002. That reduction of emissions results from the fact that the cement production in the country stopped. Table 8 provides an illustration of that general trend concerning the emissions of CO_2 highly dominated by the category of minerals.

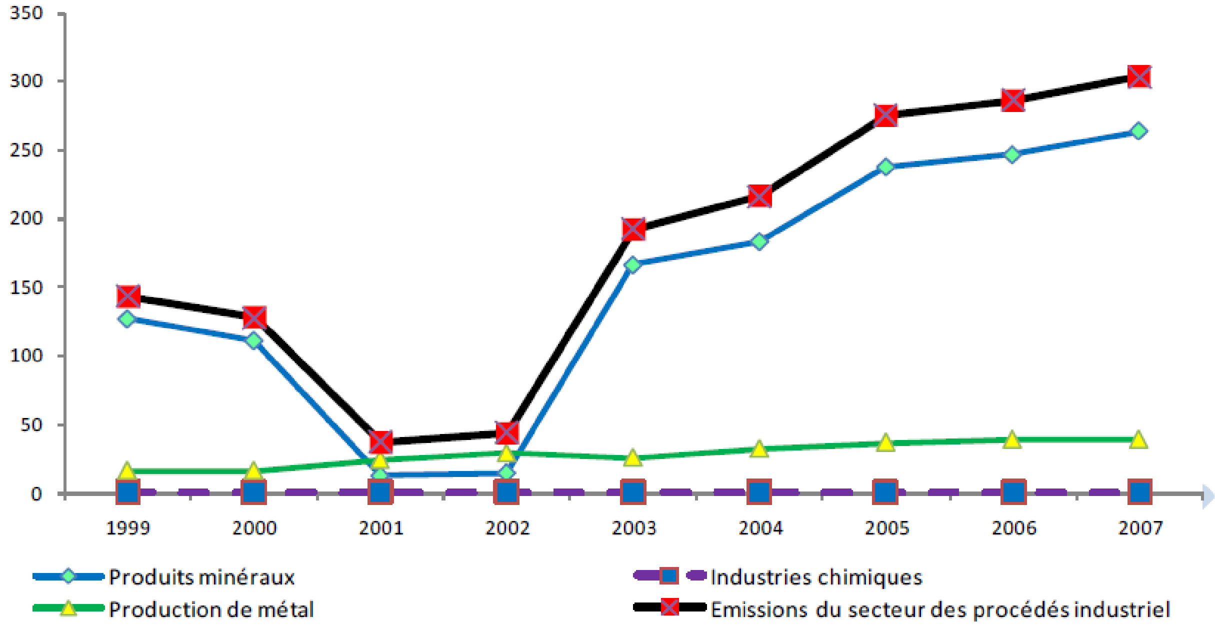


Table 8 : Comparative evolution of CO_2 emissions in the sector and categories from 1999 to 2007

The emissions of CO2 in the sector of industrial processes represent 19 % of all emissions of CO_2 emitted by all sectors. The evolution of emissions follows that of the category of minerals.

Basically, the categories of industrial processes which contribute to the formation of CO_2 in Burkina Faso are minerals and the steel production. Over the period 1999-2007, the categories of minerals contributed in average, to three quarters of the emissions of CO_2, over approximately one fourth for the category of metal production. The chemical industries have a weak contribution in the formation of Greenhouse gas (only 0,4%) over the period in question.

The emissions of CO_2 in the category of minerals indicate 264 Gg in 2007. They are twice as much compared with those in 1999. The sub-category of cement production is the reason for that evolution.

The emissions of CO_2 in the category of the steel production indicate 39 Gg in 2007, therefore increasing of 143 % compared to 1999. The sub-category of aluminum production is entirely the reason for those emissions.

The sub-categories of the cement production (category of minerals) and the sub category of aluminum production (category of the steel production) are important sub categories in the emissions of CO_2 in the sector of industrial processes. They contribute to 84 % and 13 % in the emissions of CO_2 in the sector (table 8). They are identified as key sub-categories of CO_2 in the sector of industrial processes since they contribute to 97 % of the total emissions.

Table 8 : Production of CO_2 by the sub categories in the industrial processes

Sub category	CO_2 (Gg)	Frequency (%)	Cumulated frequencies (%)	
Cement production	255,23	84,0	84,0	**Key sub categories**
Aluminum production	38,88	12,8	96,8	
Utilization of cement and dolomite	6,12	2,0	98,8	
Lime production	2,90	1,0	99,8	
Ammonia production	0,71	0,2	100,0	
Total	**303,84**	**100,0**		

SOURCE : INSD/IGES 2010

2.3.2 Emission of other gases by the sector of industrial processes

Additionally to CO_2, the other previous gases which emissions have been evaluated are mainly emitted during the activities of industrial production. In 2007, the sector of industrial processes emitted 52 tons of NO_x. These emissions only come from the category of metal production. These figures doubled compared to 1999. Table 9 provides the emissions of gases in the sector of industrial processes.

Table 9 : Emissions of other gases in the sector if industrial processes from 1999 à 2007

Gas	1999	2000	2001	2002	2003	2004	2005	2006	2007
NO_x (tons)	21,50	21,50	32,25	38,70	34,40	43,00	49,45	52,25	52,25
CO (1000 tons)	1,35	1,35	2,03	2,43	2,16	2,70	3,11	3,28	3,28
COVNM (1000 tons)	70,46	86,78	76,54	77,49	68,53	68,46	68,72	70,24	70,24
SO_2 (1000 tons)	0,21	0,20	0,21	0,26	0,32	0,39	0,49	0,49	0,50

SOURCE : INSD/IGES 2010

The emissions of CO indicate 3284 tons in 2007 increasing by 142 % compared to 1999. These emissions are 99% due to the category of the category of metal production.
The emissions of COVNM essentially come from the category of minerals. They indicated 70 Gg in 2007 and have not changed compared to 1999. On the other hand, they decreased by 19 % compared to 2000 where they reached their maximum level (87 Gg).
The emissions of SO_2 indicated 0,5 Gg in 2007 essentially coming from the category of metal production (70 %). These emissions are rising by 140 % compared to 1999.

2.4 Greenhouse gases in the sector of agriculture

The data concerning the productions and areas cultivated were provided by the Permanent Agricultural Survey (EPA) conducted every year, and the data concerning the General Census of Agriculture (RGA) conducted by the General Directorate of the Promotion of Rural Economy (DGPER). Those pertaining to the use of fertilizers were provided by the database of the World Bank, processed and reviewed by the EPA data. The data concerning the animal species were provided by the National Survey on the Quantity of Cattle (ENEC II) conducted by the General Directorate of Previsions and Cattle Statistics (DGPSE) in 2003.
The emissions of the various gases essentially come from six (6) categories:

- The enteric fermentation,

- The manure management,
- The culture of rice,
- The farming soils,
- The controlled burning of savannahs,
- The farming residues burnt in the fields.

The enteric fermentation essentially releases methane (CH_4), manure liberates methane (CH_4) in anaerobic conditions. The burning of savannahs produces carbon dioxide emissions (CO_2) but these emissions are supposed to be totally reabsorbed by vegetation. However, the fires of savannahs also produce other gases such as methane, carbon monoxide, nitrous oxide and nitrogen oxide. The burning of farming residues in the fields is a usual phenomenon in Burkina Faso. The residues burnt produce important emissions of carbon monoxide, nitrous oxide, methane and nitrogen oxide. The farming soils emit in a certain measure nitrous oxide resulting from the use of fertilizers in Burkina Faso.

2.4.1 Emissions of Greenhouse gases in equivalent CO2

The total emissions of GG in equivalent CO_2 in the sector of Agriculture indicated 19.142 Gg in 2007, increasing by 42 % compared to 1999.

The sector of Agriculture contributed to 88 % of the national total of GG emissions in 2007. The category of enteric fermentation is the category which causes the most emissions of GG (nearly half for every year). The category of farming soils is ranked second in terms of contribution (slightly above 40%). This is justified by the fact that the essential part of methane in the sector is emitted by the enteric fermentation, and a considerable amount of nitrous oxide is emitted by farming soils (table 10). The other categories do not contribute much to the emissions (less than 10 %). The category of manure management contributes to approximately 6 % in the emissions of the sector. Concerning the categories of rice, the burning of savannahs and farming residues, their contribution is approximately 2 %.

Table 10 : Percentages ands cumulative percentages of the various categories

Categories	**Percentages**	**Cumulative percentages (%)**
Enteric fermentation	49,72	49,72
Farming soils	42,83	92,55
Manure management	6,25	98,80
Farming residues burnt in the fields	0,96	99,76
Rice	0,21	99,97
Controlled burning of savannahs	0,03	100,00

SOURCE : INSD/IGES 2010

The structure of contributions of the various categories of GG emissions in the sector of Agriculture is stable from one year to another.

For each of these years from 1999 to 2007, the essential part of greenhouse gas emissions result from the categories of enteric fermentation and farming soils which contribute to over 90% of total emissions. These two categories contributed to 82 % of the national total emissions of GG emissions in 2007.

The emissions of GG in the sector of Agriculture are broken down into almost equal proportions of CH_4 and N_2O in 2007. The balance of emissions and absorptions is deemed nil in this sector. However, by taking into consideration the emissions not evaluated by their PRG, the quantity of CH_4 emitted (442 Gg) largely exceeds those of N_2O (29 Gg).

2.4.2 Emissions of CH_4 in the sector of agriculture

The quantity of CH_4 emitted in 1999, is 315 Gg. That emission increased to 442 Gg in 2007, therefore indicating an increase of nearly 40 % since 1999. Methane is the main gas emitted by the category of enteric fermentation (more than 90%). This is justified by the fact methane essentially results from digestive process of ruminants. The other categories (manure management, rice, the burning of savannahs and farming residues in the fields) poorly contribute (less than 10%) to the emissions of CH_4 in the sector.

Cattle are the species emitting the more CH_4 by enteric fermentation. In 2007, they contributed to 73% of the CH_4 emissions for the category of enteric fermentation (table 9).

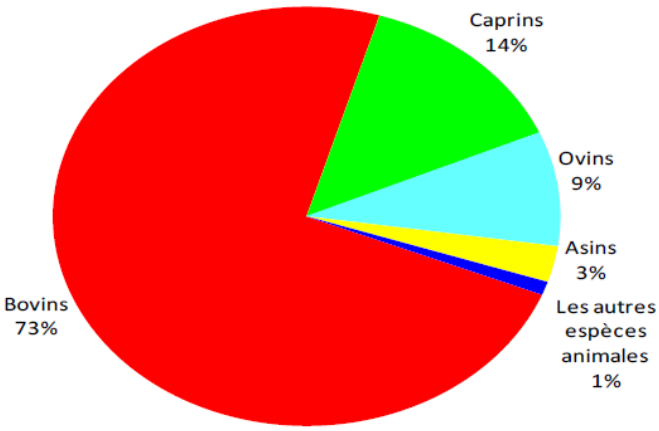


Table 9: Contribution of animal species in the emissions of CH_4 by enteric fermentation in 2007

The manure management contributed to 5 % in the emissions of CH_4 in 2007. Cattle and pigs are the species contributing the most to these emissions (42 % and 27).

The key categories sources of CH_4 in the sector of Agriculture are enteric fermentation, manure management and farming residues burned on the fields. In the category of enteric fermentation, the sub categories such as cattle, goats, sheep and donkeys are the most important. In the category of manure management, only the cattle are a key source category (table 11).

Table 11 : Key categories and sub categories of CH_4 in Agriculture

Category	**Sub category**	**Emission of CH_4 (in Gg)**	**Percentages**	**Cumulative percentages**
Enteric fermentation	Cattle	304,22	68,8	68,8
	Goats	57,14	12,9	81,7
	Sheep	36,65	8,3	90,0
	Donkeys	11,56	2,6	92,6

Manure management	Cattle	8,78	2,0	94,6
Farming residues burnt in the fields	Farming residues burnt in the fields	5,73	1,3	95,9

SOURCE : INSD/IGES 2010

2.4.3 Emissions of N_2O in the sector of agriculture

In 1999, the quantity of N_2O emitted in the sector of Agriculture was 20 Gg. This emission indicated 28 Gg in 2007, thus indicating an increase of nearly 43 %.
The emissions of nitrous oxide by the sector of Agriculture represent nearly all the emissions of N_2O of all sectors. The contribution of the category of farming soils in the emissions of N_2O in the sector of Agriculture decreased from 94 % in 1999 to 91 % in 2007. The category of manure management represented 8% of the emissions in 2007, against 6 % in 1999. The other categories contribute much less (approximately 1%) in the emissions of N_2O in the sector (figure 10).

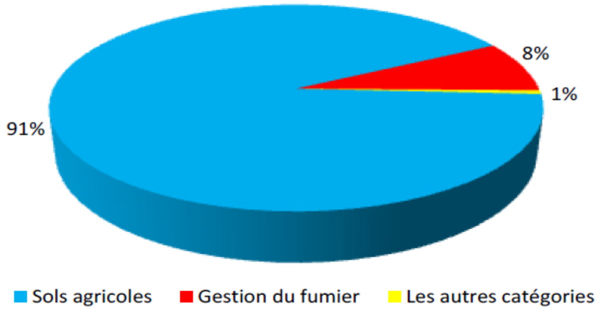


Table 10: Contribution of categories in emissions of N_2O in the sector of Agriculture in 2007

The categories of farming soils and manure management are key sources of N_2O in the sector of agriculture.

2.4.4 Emissions of other gases in the sector of agriculture

The sector of Agriculture also releases nitrogen oxide (NO_x) and carbon monoxide (CO).
Nitrogen oxides are all nearly emitted by the category of farming residues burnt on the fields. This category contributes to nearly 97% in the emission of this gas. The emissions of NO_x indicated 6,0 Gg in 2007, increasing by 39% compared to 1999. The emissions of CO in 2007 indicated 126 Gg, increasing by 35% compared to 1999. The category of residues burned in the field contributes to 95% in these emissions.

2.5 Emissions of GG in the sector of the Allotment of Lands, Changes in the Allotments of Lands and Forestry (ATCATF)

The emissions of greenhouse gases from the Allotment of Lands, changes in the allotment of lands and forestry (ATCATF) are essentially made of carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). This sector also releases other gases such as NO_x and CO.

The main categories impacting the emissions and sequestration of GG in the ATCATF sector are as follows:

- The changes of forests and other wooded lands and biomass stocks (sequestration) ;
- The conversion of forests and grasslands (emissions).

Te net emissions of CO_2 represent are the difference between the gross emissions of CO_2 and the gross sequestrations of CO_2.

The data mainly come from the database concerning the occupation of lands (BDOT) from 1992 and 2002 of the Geographical Institute of Burkina (IGB). The forests areas selected are those made of woodland, gallery forest, the savannah and wooded steppes provided they comply with the criteria of « forest » selected at international level. Concerning the trees out of the forest, their estimation is conducted by applying the average number of trees per unit of surface with a canopy type, to the total area of that type of canopy in the country. The average number of trees per unit of surface is obtained by a light survey combined with photos. The data pertaining to the use of energy wood result from surveys conducted in households, and include the wood used in the manufacturing process of charcoal. The data pertaining to handicraft wood and household wood are estimated by data provided by the national accounting department and data collection in companies.

2.5.1 Emissions of GG in equivalent CO_2

The gross emissions of greenhouse gases resulting from the ATCATF sector indicated 1.562 Gg in 2007, decreasing by 7 % compared to 1999 due to the increase in the proportion of households using gas bottles as the main source of cooking, which reduces the use of wood and charcoal and the adoption of improved stoves which save these sources of energy. Regarding the category conversion of forests and prairies it is the only category that releases Greenhouse gases in this sector. Therefore it is the key source category of the sector.

If we include all the gross emissions of greenhouse gases in all the sectors, the contribution of the ATCATF sector decreases from 10% in 1999 to 7% in 2007 (table 11). The decrease of that portion is due to the impacts of the reduction of these gross emissions of GG of the ATCATF sector (-7 %) and the increase of the total gross emissions in all the sectors (+38%).

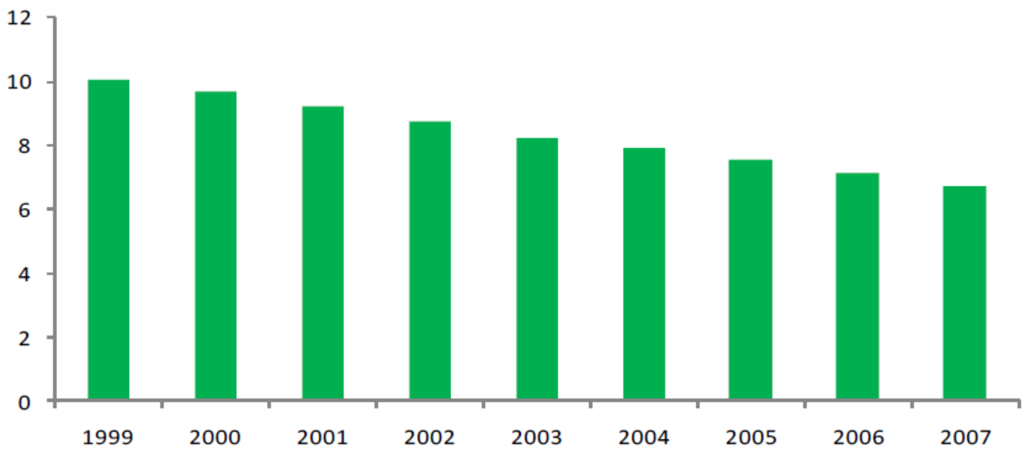


Table 11: Evolution of the proportion of the ATCATF sector in all the gross emissions (%)

The emissions of GG in the sector are mainly broken down into CO_2. in 2007 for instance, the gross emissions of greenhouse gas in the ATCATF sector were made of 99 % CO_2, less than 1% of CH_4, and traces of N_2O.

2.5.2 Sequestration of greenhouse gas by the ATCATF sector

In 2007, the power of gross sequestration in Burkina Faso indicated 2.047 Gg against 239 Gg in 1999. The increase of this power of sequestration is due to the results of the reforestation campaigns conducted by the country for a long time to fight desertification. For instance, from 1999 to 2007 the number of trees planted has tripled (table 12). In addition to that, we must also add the efforts of sensitization for the reduction of logging, the protection and management of forests and the use or the improvement of firewood.

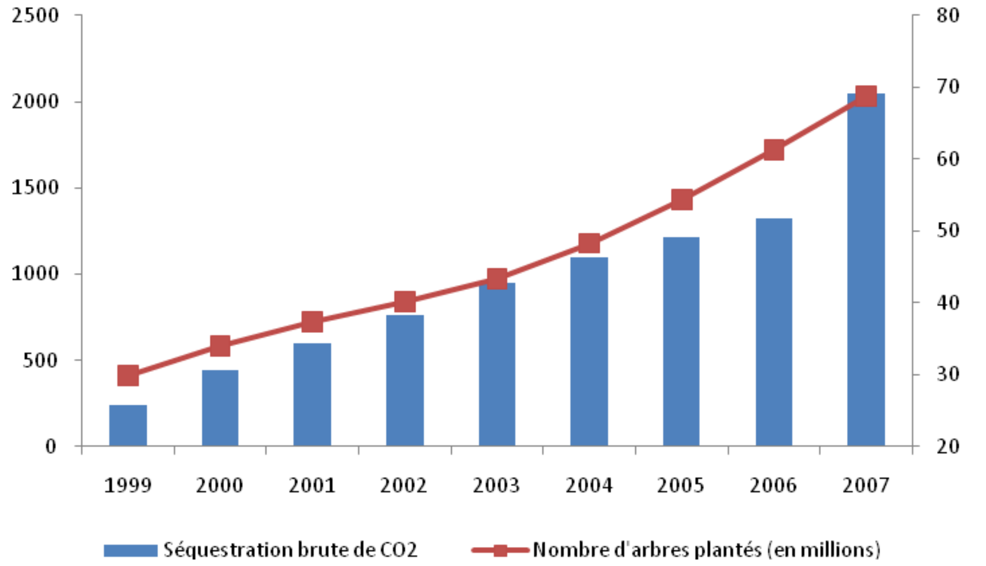


Table 12: Comparative evolution of CO_2 sequestrations (in Gg) and trees plantings (in million)

In the ATCATF sector, only the category of changes in forests and wooded lands and biomass stocks contribute to the sequestration of de CO_2. It is the only key wells category of the sector.

2.5.3 Net emissions of CO_2 in the ATCATF sector

In 2007, the net emissions of CO_2 by the ATCATF were negative (-502 Gg). This sector therefore net sequester in CO_2. These net emissions have been continuously decreasing since 1999, when they used to be 1.430 Gg. The trend to the reduction of net emissions of CO_2 by the ATCATF sector results from the increase of the gross sequestration of CO_2 by the sector, and the reduction of gross emissions of CO_2 of this sector. Table 13 indicates the net emissions of CO_2 by the ATCATF sector.

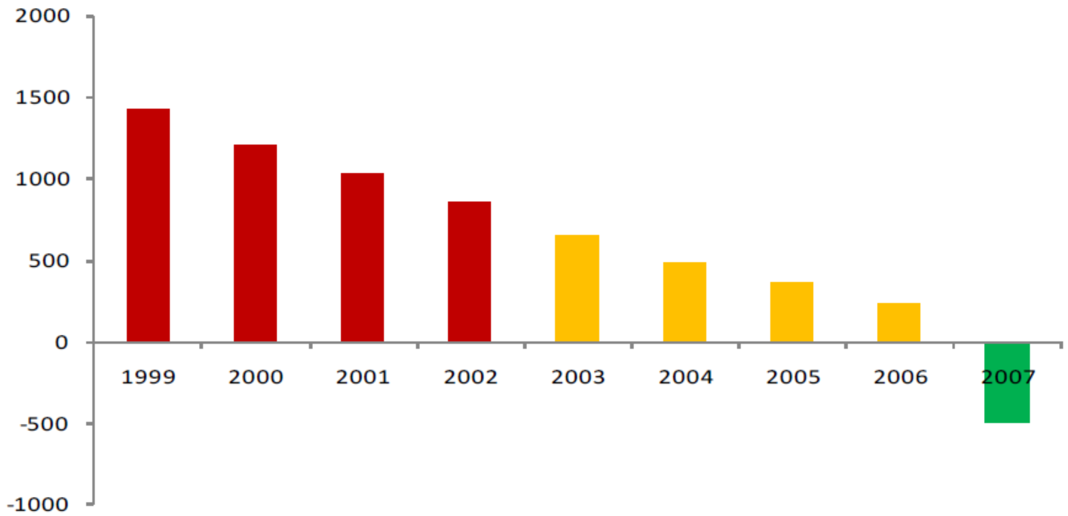


Table 13: Evolution of net emissions of CO_2 by the ATCATF sector

In 2007, the ATCATF sector is becoming an absorption sink and enables to sequestrate nearly a third of all net emissions of CO_2 In all the sectors.

The emissions of CH_4 in 2007 coming from the ATCATF sector indicated 0,721Gg, thus decreasing by 7% compared to 1999. The proportion of emissions of CH_4 in the ATCATF sector is very weak compared to the total national emissions of CH_4 (less than 1%). The emissions of N_2O from the ATCATF sector are traces f gases. These emissions have a very slight proportion compared to the emissions of greenhouses gases in the sector of forestry and also very slight compared to the emissions of N_2O in all the sectors.

Concerning the other previous gases, the ATCATF sector is source of 1% of the total emissions of NO_x and 3% regarding that of CO taken for all the sectors.

2.6 Wastes sector

The emissions of greenhouse gas in the waste sector essentially come from solid wastes dropped on the ground et water treatments.

The data concerning the activity of the waste sector are available in Town halls, combined with the generation of wastes per capita. The data concerning the urban populations come from censuses of the population and housing from 1996 and 2006 (RGPH 1996 and RGPH 2006), and demographic perspectives. The perspectives of the population are conducted through the use of components[1]. The calculation also uses that data provided by surveys conducted on the life conditions of households, particularly the percentage of the population whose wastes are sent to the dump. The information concerning the consumption of proteins also comes from surveys conducted regarding the life conditions of households (EP1994, EP1998, EBCVM2003, QUIBB2005, and QUIBB2007).

2.6.1 Emissions of GG GES in equivalent CO2

The total emissions of GG, in the sector of wastes, increased by 71 % between 1999 and 2007. Table 14 provides an illustration. This is justified by the increase of emissions in the

[1] Method of components

category of solid wastes dropped on the ground (53 points), supported by that of the category concerning the management of used waters (18 points). These emissions of greenhouse gas increased from 48 kg in 1999 to 64 kg in 2007.

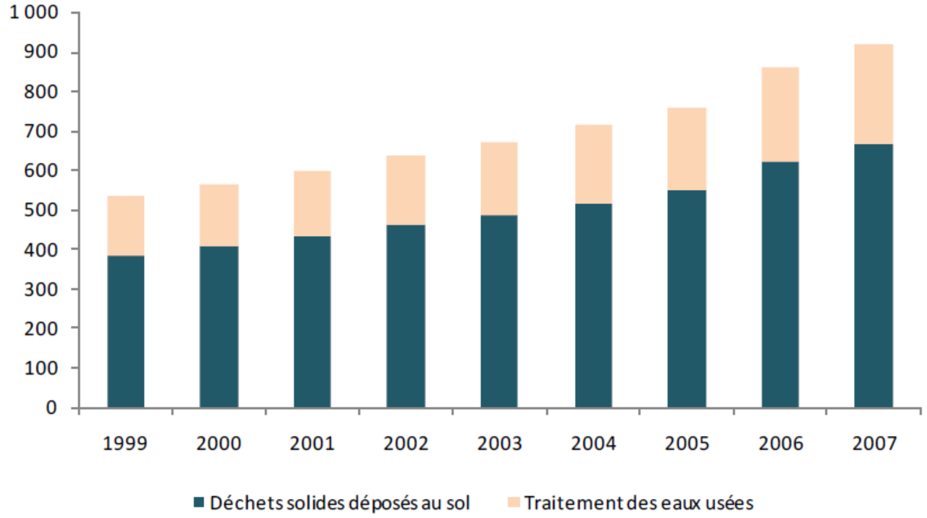


Table 14: Evolution of Greenhouse gas in the sector of waste from 1999 to 2007

In 2007, the emissions of greenhouse gas caused by the category of solid wastes dropped on the ground indicated 667 Gg, therefore on the rise by 72 % compared to 1999. The emissions from the category of used waters indicated 245 Gg in 2007, therefore increasing by 66 % par compared to 1999.
Methane is the predominant gas concerning the emissions of Greenhouse gases for the wastes sector. It was 96 % of the emissions in the sector in 2007. The rest is due to N_2O.

2.6.2 Emissions of CH_4 in the waste sector
The total emissions of CH_4 increased by 3 % starting from 22 Gg in 1999 to reach 38 Gg in 2007. This increase is justified by the increase of emissions in the category of solid wastes (56 points) supported by the category concerning the management of used waters management (17 points).
The category of solid wastes contributes to 76% in the emissions of CH_4 in the sector, and the category of used waters to 24% (table 15). The two categories are thus key categories sources in the emission of CH_4 in the sector.

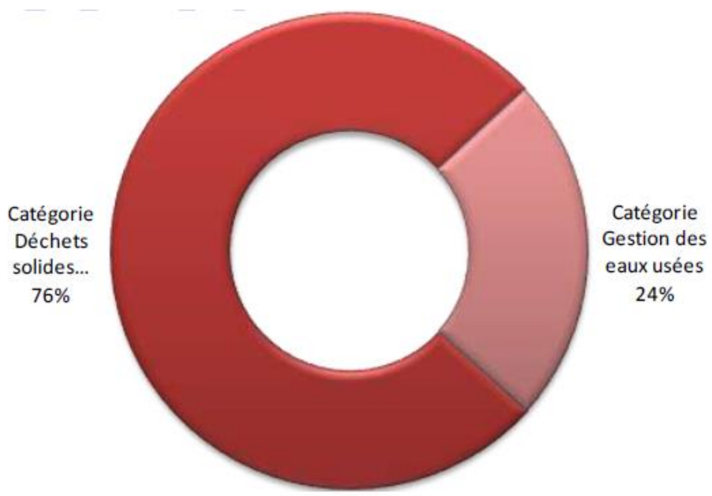


Table 15: Contribution of the categories to the emissions of CH_4 in the wastes sector in 2007

2.6.3 Emissions of N_2O in the wastes sector

The emissions of N_2O from the wastes sector indicated 157 tons in 2007. These emissions have been continuously increasing since 1999, but they only represent 0,5 % of the total national emissions of N_2O.

The category of used waters management is the only one releasing N_2O in the sector of wastes. It is therefore the only key source category for N_2O in the sector.

2.7 National emissions of Greenhouses gas in equivalent CO_2

In 2007 the total emissions of Greenhouse gas (GES) in Burkina Faso expressed in terms of CO_2 equivalent indicated 21.700 (Gg). Table 16 provides the levels of emissions of Greenhouse gases in Burkina between 1999 and 2007.

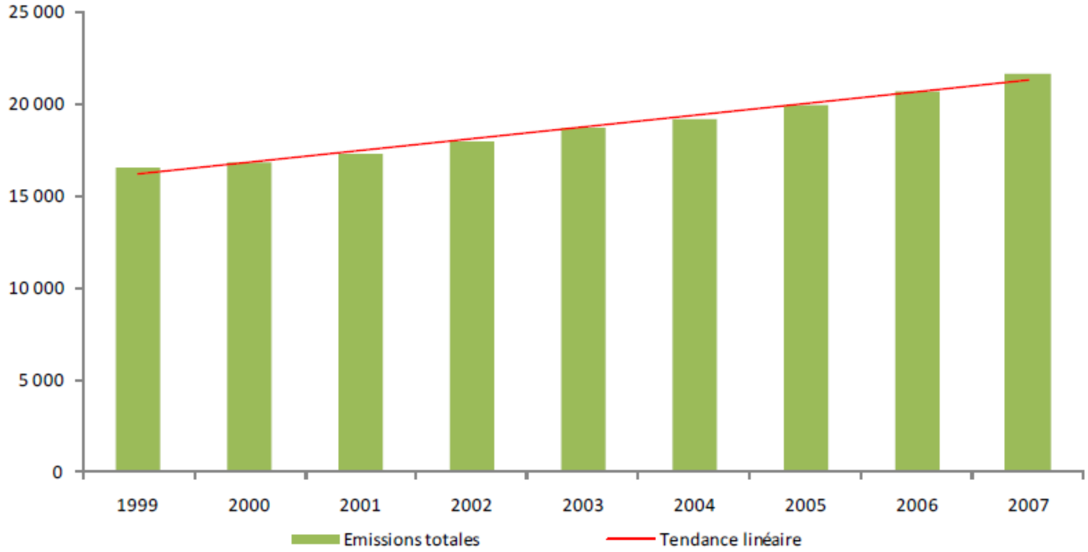


Table 16: Evolution of greenhouse gas emissions in Burkina Faso in equivalent CO_2 (Gg)

Compared with the population of the country, the total emissions of greenhouse gas per inhabitant indicated 1.522 kg in 2007, thus increasing by 2 % compared to 1999.

The emissions of Greenhouse gas increased by 31 % compared to 1999. This increase is justified by the growth of emissions in the agriculture sector (34 points) combined with the decrease of emissions in the sector of forestry (-8 points). Table 17 provides the contribution of the various sectors to the total emissions of greenhouse gas between 1999 and 2007.

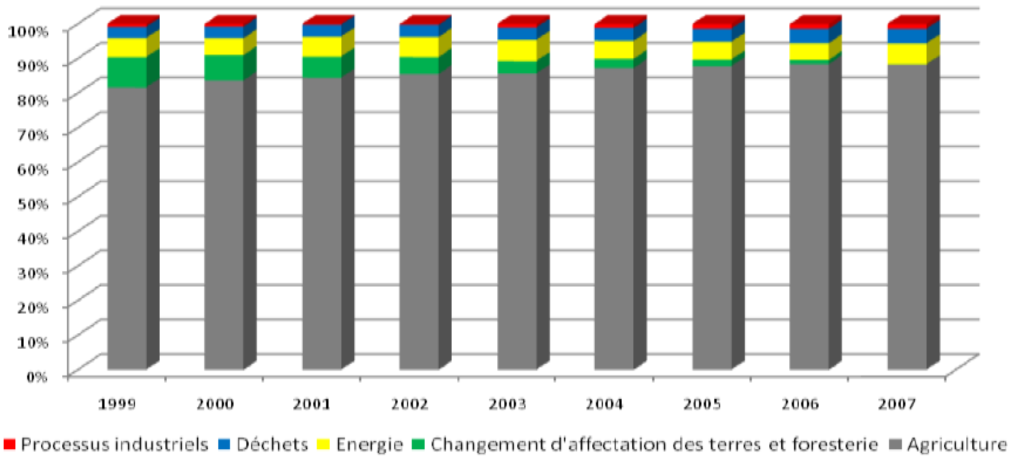


Table 17: Contribution of the sectors in the total emissions of Greenhouse gas from 1999 to 2007

Methane constitutes 51% of all Greenhouse gas emissions, nitrous oxide 42% and carbon dioxide 7% (table 18). The emissions of CO_2 are more important in absolute quantity. However, when measuring each gas by its power of overall warming potential (PRG), methane and nitrous oxide are the most important.

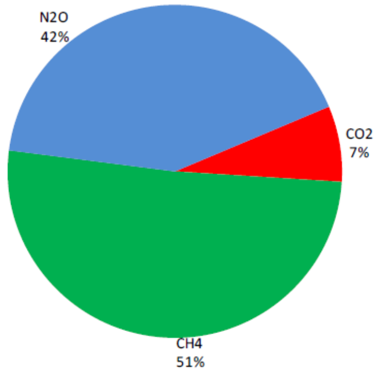


Table 18: Contribution of gas to the total emissions of greenhouse gas in 2007 (Measured by their PRG)

Table 12 provides a summary of the key sources sub categories of Greenhouse gas in 2007.

Table 12 : Key source sub categories of Greenhouse gas in 2007

Category	Sub category	Main gas emitted	Greenhouse gas emissions (Gg)	Percentages	Cumulative percentages
Farming soils	Farming soils	N_2O	8198	37,8	37,8
Enteric fermentation	Cattle	CH_4	6997	32,3	70,1
Enteric fermentation	Sheep	CH_4	1314	6,1	76,2
Enteric fermentation	Goats	CH_4	843	3,9	80,0
Transport	Road transport	CO_2	716	3,3	83,4
Solid wastes	Solid wastes dumped on the ground	CH_4	667	3,1	86,4
Manure management	Storage on dry fields	CH_4	665	3,1	89,5
Energetic industries	Industries énergétiques	CO_2	350	1,6	91,1
Enteric fermentation	Donkeys	CH_4	266	1,2	92,3
Minerals	Production of cement	CO_2	255	1,2	93,5
Management of used waters	Households and businesses used water	CH_4	253	1,2	94,7
Manure management	Cattle	CH_4	202	0,9	95,6

SOURCE: INSD/IGES 2010

III VULNERABILITY AND ADAPTATION OF THE MAIN ECONOMIC SECTORS TO CLIMATE CHANGE

The vulnerability of a given system to the variability and climate change is usually seen as the result of three components:

- The *exposure* of the system and the units composing it. In other words how is the system or the unit exposed to the risk linked to climate;
- The *sensibility* which can be defined, according to the GIEC, as the degree to which the system is affected, whether positively or negatively by the chocks connected to the climate;
- The *capacity of adaptation* which, according to the GIEC, is the ability of the system to withstand the adverse effects of he climate, and even elaborate strategies to survive.

In the framework of this national communication, the sectors of agriculture and water resources have been selected for the analysis which will be preceded by that of the current climate context and its possible evolution by 2050.

3.1 The climate

3.1.1 Methodology of survey concerning the vulnerability of the climate

There is now a great number of global templates (all based on the general circulation) used to elaborate the scenarios of climate change to the scale of the planet. But basically, they are not very effective on the Sahel area and we often obtain contradictory results. For instance, for the same scenario A1B the CNRM-CM3 GCM schedules for 2050, a certain improvement of the rainfall while the CSIRO-MK3 GCM foresees the complete a overall drying of the Sahel area of West Africa.

Subsequently, with regard to the poor effectiveness of the global templates applied in the Sahel region, and in the absence of a regional template approved for Burkina Faso, the method referred to as ‘’disturbances method’’ has been used to generate the values to use for the evaluations of the impacts linked to vulnerability and climate change. It is broken down as follows:

Future climate = baseline climate + disturbance caused by climate change
Practically speaking, the method is to apply to the historical series over the period of reference, disturbances representing climate change.
The baseline climate situation has been established on the normal 1961-1990. However, comparisons have been made with a more recent period 1971-2000.

In order to implement the method of disturbances, we specify the following:

- The climate reference, which is presented her by the normal 1961 – 1990.
- The disturbances caused by climatic change, which are included in that survey of the extrapolations of given trends by the last GIEC report published in 2007.

3.1.1.1 Basic climate situation

The focus is placed on the two main parameters of the climate which have a stronger impact, directly or indirectly, on the two economic sectors selected: rainfall and temperature.

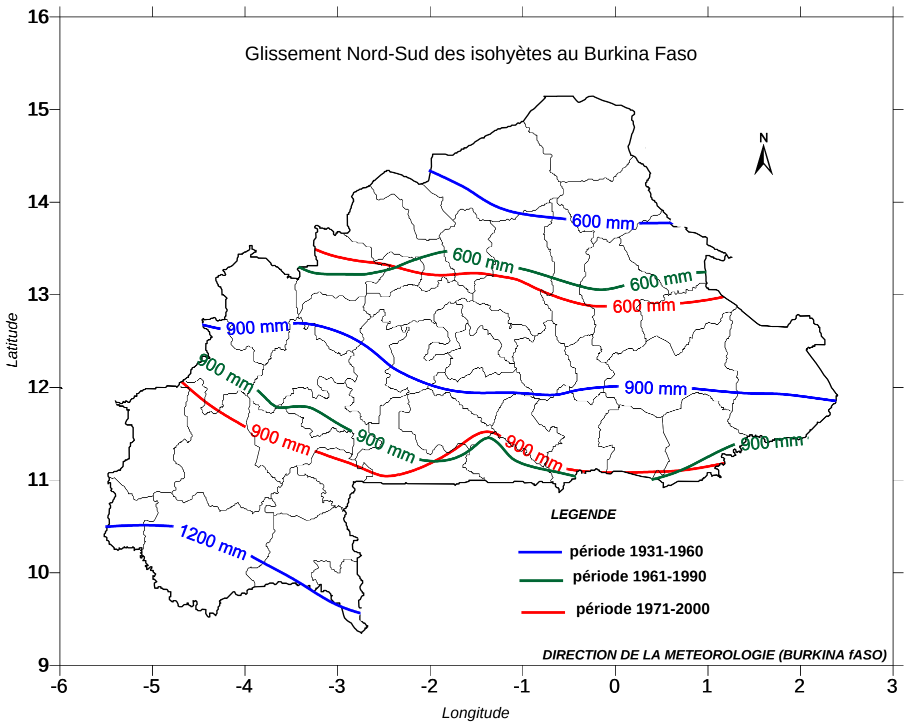
a) Characterizations of the variability and climate change on the rainfall

The analysis of the historical data of rainfall indicates an overall situation of movements of isohyets toward the south. During the period 1931-1960, Burkina Faso could record an annual rainfall superior than 1.200 mm in its South-West region, as indicates that isohyets on Map n°5 5.

The post 1960 period has been characterized by a significant decrease of the rainfall. We notice the absence of isohyets 1.200 mm over the periods 1961-1990 and 1971-2000. The lack of rainfall noticed is much more important between the periods 1931-1960 and 1961-1990 (Map n° 6). It thus confirms the impact of two droughts recorded in Burkina Faso over the period 1972- 1990.

Concerning the period 1971-2000, the annual accumulation of the rainfall varies between 290mm in the North and 1170 mm in the South.

The spectacular movement of isohyets is the tangible characterization of the variability and climate change over the whole country.



(Source: Directorate of Meteorology)

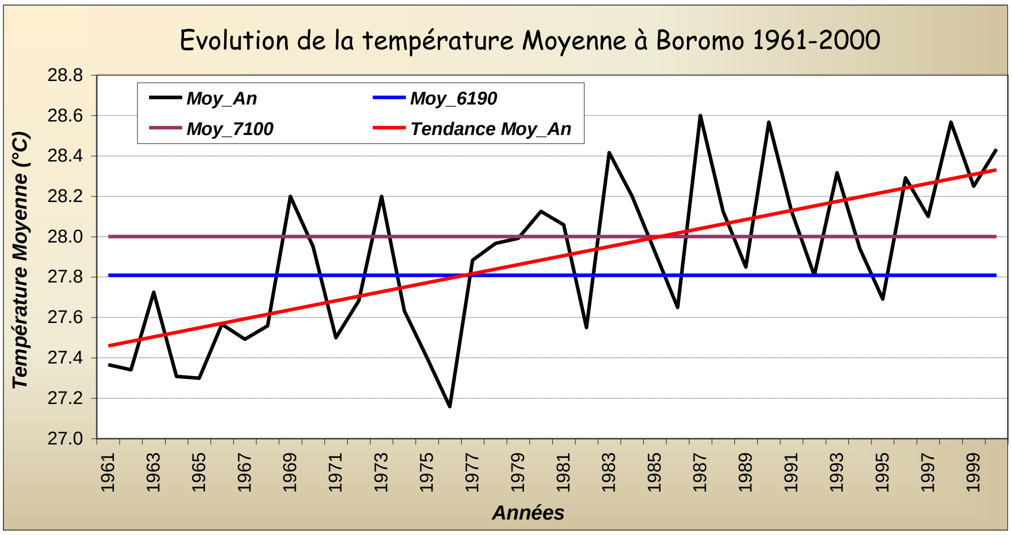
Carte 5 : Migration of isohyets from 1931 to 2000

The number of rainy days of the period 1961-1990 varies between 31 and 91 with an average of 58 days and a standard gap of 13 days. In average, there is n significant change in the number of rainy days over the period 1971-2000, compared with the baseline period 1961-1990.

b) Characterization of the variability and climate change on temperatures

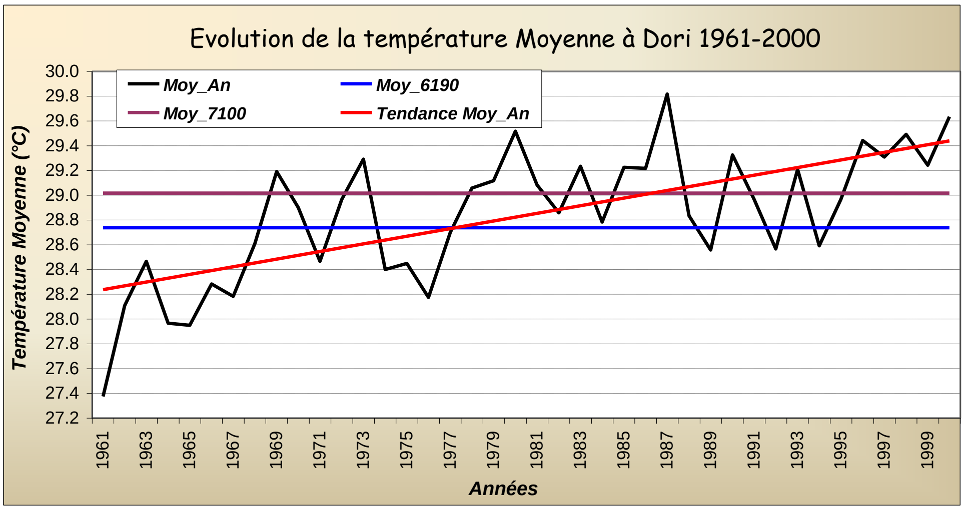
The maximum temperature varied in average between 32,8 °C in Bobo-Dioulasso and 36,6 °C in Dori for the baseline period 1961-1990 and between 33,0°C (Bobo-Dioulasso) and 36,6 °C (Dori) over the period 1971-2000. Dori and Ouahigaya (in the Sahel area) have been hot areas while Bobo-Dioulasso, Gaoua and Niangoloko (Sudanese area) recorded the lowest average maximum temperatures. Concerning the average minimum temperature, it varied between 20°C and 22°C usually over the two periods (1961-1990 and 1971-2000).

In example, tables 19 and 20 provide the evolution of the average temperature in Boromo (Sudanese area) and Dori in the Sahel region.



Source : *Direction de la Météorologie*

Table 19: Evolution of the average temperature in Boromo, period 1960 - 2000



Source : *Direction de la Météorologie*

Table 20: Evolution of the average temperature in Dori, période 1960 - 2000

The average annual temperature increased by at least 0,5°C over the period 1961-2008 on all the synoptic stations in the country. The national average temperature of 27,5°C in 1961 increased to 28,5°C in 2008.
The annual average temperature in 2000 varied between 23,8°C and 30,8°C concerning the minimum temperature is between 26,1°C and 35,7°C for the maximum temperature. Compared to the average temperatures in 1961-1990, the minimum monthly temperature increased throughout 2000 except in February. These high temperatures vary between 0,4°C and 3,6°C. Concerning the average temperature, it dropped throughout 2000 except in January, April and September (table 21).

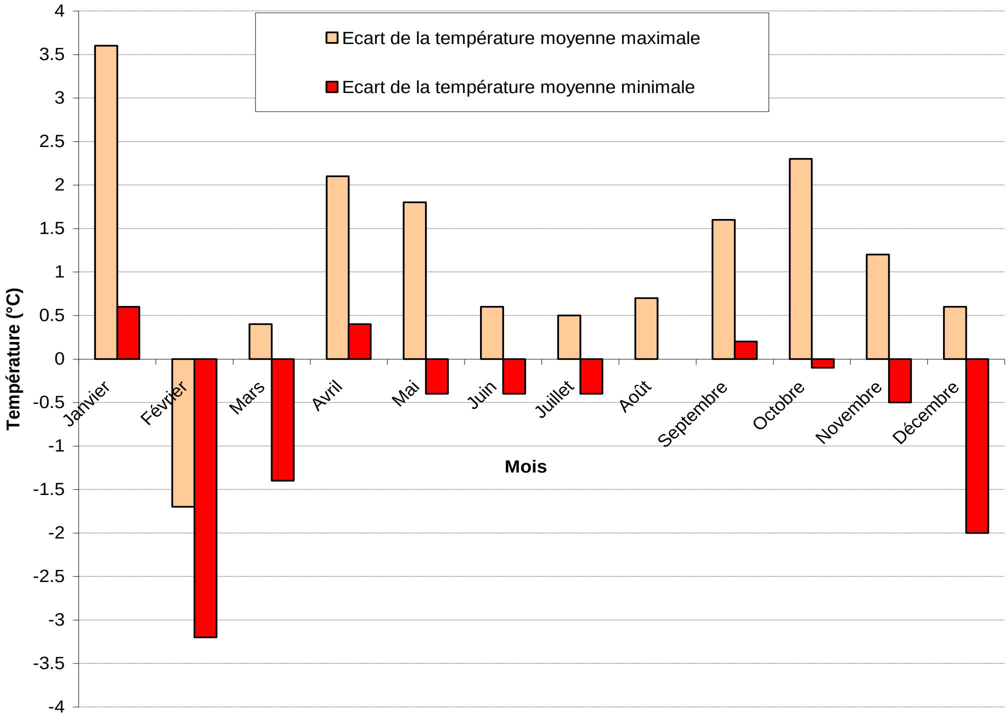
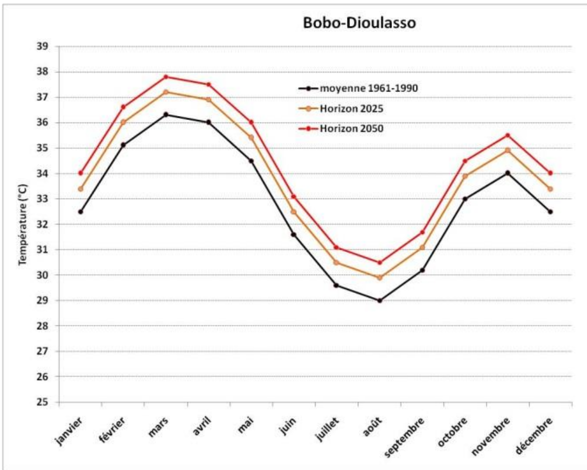


Table 21: Monthly gaps of the minimum and maximum in 2000 (compared with the period 1961-1990).

3.1.2.1 Possible evolutions of the climate by 2025 and 2050

a) Perspective of the evolution of the temperature

The perspective for the whole territory indicate an increase in the maximum and minimum temperatures of 0,9°C by 2025 and 1,5°C by 2050 (table 22). That increase in temperature follows the current inter-season variation: the months of February, March, April and May being much hotter; while June, July, August and September are crops periods, therefore remain the least hot months.
The trends are similar with minimum temperatures.



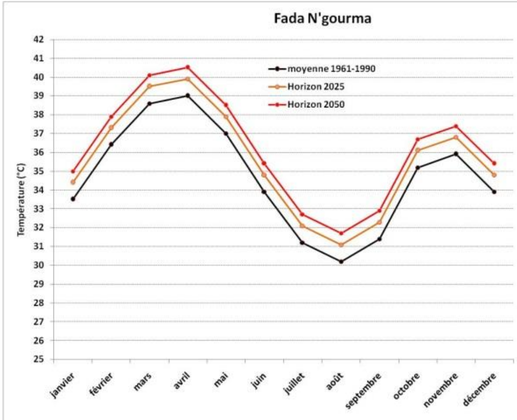
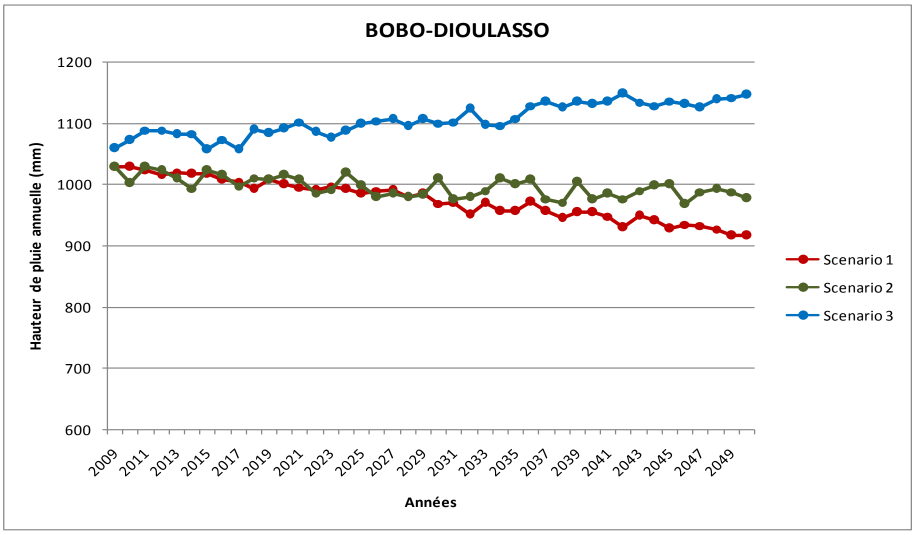


Table 22: Possible evolutions of maximum and minimum temperatures in two synoptic stations of Burkina Faso.

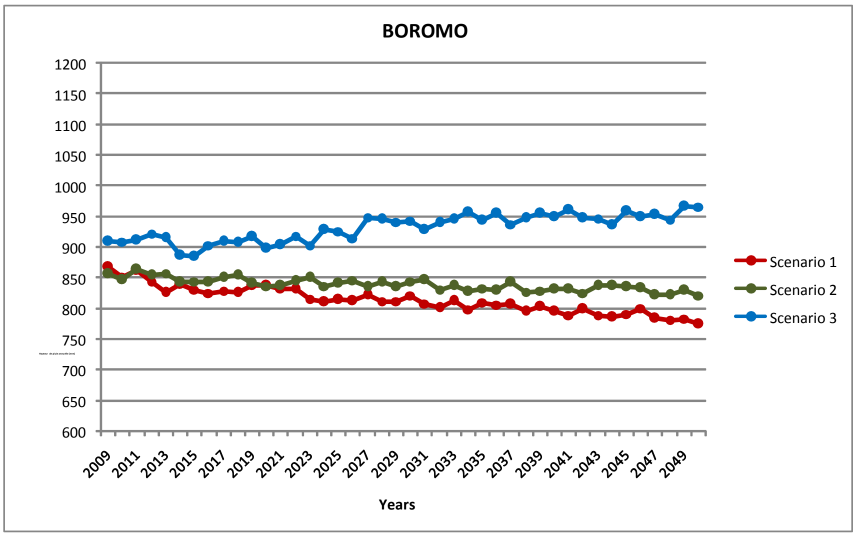
b) ***Perspective concerning the evolution of the rainfall***

according to the potential trends provided in the GIEC elaborated in 2007, the rainfall could record a decrease of -6,4% in 2025 and -11% by 2050 in the event of maximum tress, or an increase in the same proportions for the favorable situation. Between the two extreme situations, we have integrated an transitional situation which would be a moderate type of -3,2% in 2025, and -6,5% in 2050.

For instance, table 23 provides the potential evolution of annual rainfall for the two synoptic stations of the country. The two scenarios of water stress remain practically identical. Scenario 03 which indicates a rainfall of 11% is evident, but on both sites, the inter-annual variation is very high.



a) Bobo-Dioulasso



b) Boromo

Table 23: Comparaison of cumulative rainfalls provided by the three scenarios for the period 2009 to 2050 in Bobo-Dioulasso (a) and Boromo (b)

3.2. Vulnerability in the sector of agriculture

3.2.1. Selection of exposition units

Table 12 provides the matrix of evaluation of the units identifies. Here are a few observations:

- The sensibility to the variability of climate change has been appreciated by the judgment of experts;
- The contribution to the GDP has been evaluated according to the importance of each unit;
- The number of the population involved has also been evaluated by the judgment of experts. The evaluation of the population affected has been conducted in terms of percentage of the total population. The conversion has been conducted according to the following baseline (1-20%=1 ; 21-40%=2 ; 41-60%=3 ; 61-80%=4 et 81-100%=5) ;
- The sector-based interdependence provides the importance of the unit in the other sectors such as industry, and craftsmanship, etc ;
- The availability of data has been evaluated only on the basis of the experience of the experts in charge of the survey.

Further to the analysis, the ranking is indicated here below in table 12.
The cattle, maize, cotton and rice units occupying the first place in terms ranking out of the seventeen products analyzed, should be selected in priority for that analysis.
Concerning this communication the priority has been given to cattle and maize according to the availability of the data.

Table 13 : Individual information sheet concerning the selection of units of exposition

Unit of exposition	**Level of sensibility VCC**	**Contribution to the GDP**	**Percentage of population affected**	**Level of interdependence**	**Availability of data**	**Total**	**Ranking**
Cattle	3,68	4,39	3,55	4,05	3	18,67	1
Maize	4,15	3,63	3,63	3,16	3,5	18,07	2
Cotton	3,21	3,89	2,68	4	3,5	17,28	3
Rice	4,05	3	2,79	3,5	3,5	16,84	4
Sheep	2,75	3,81	3,33	3,26	3	16,15	5
Sorghum	2,47	2,47	4,26	3,13	3,00	15,33	6
Chicken	2,11	3,33	4,05	3,21	2	14,70	7
Cowpea	1,8	2,81	3,22	2,6	3	13,43	8
Goats	2,28	2,84	3,05	2,8	2	12,97	9
Millet	2,05	2,60	2,63	3,50	2,00	12,78	10
Groundnuts	2,79	2,63	1,66	2,59	3	12,67	11
Guinea-fowls	2,83	2,63	2,84	2,3	1	11,60	12
Sesame	2,33	1,94	1,21	1,5	3	9,98	13
Roots and tubers	2,26	1,69	1,58	2,07	2	9,60	14
Soy	2,27	1,7	1,1	1,25	3	9,32	15
Okra	2,42	1,23	1,89	1,35	1	7,89	16
Fonio	1,8	1,08	1,09	1,18	2	7,15	17

Source : SP/CONEDD-DCN

3.2.2. Methodology of exposure units

3.2.2.1 The type of DSSAT simulation

In the case of maize, several types have been especially developed.
We chose the CERES-Maize integrated type in the DSSAT which appears sufficiently operational for our findings (SP/CONEDD, 2010).

3.2.2.2 Experimental method

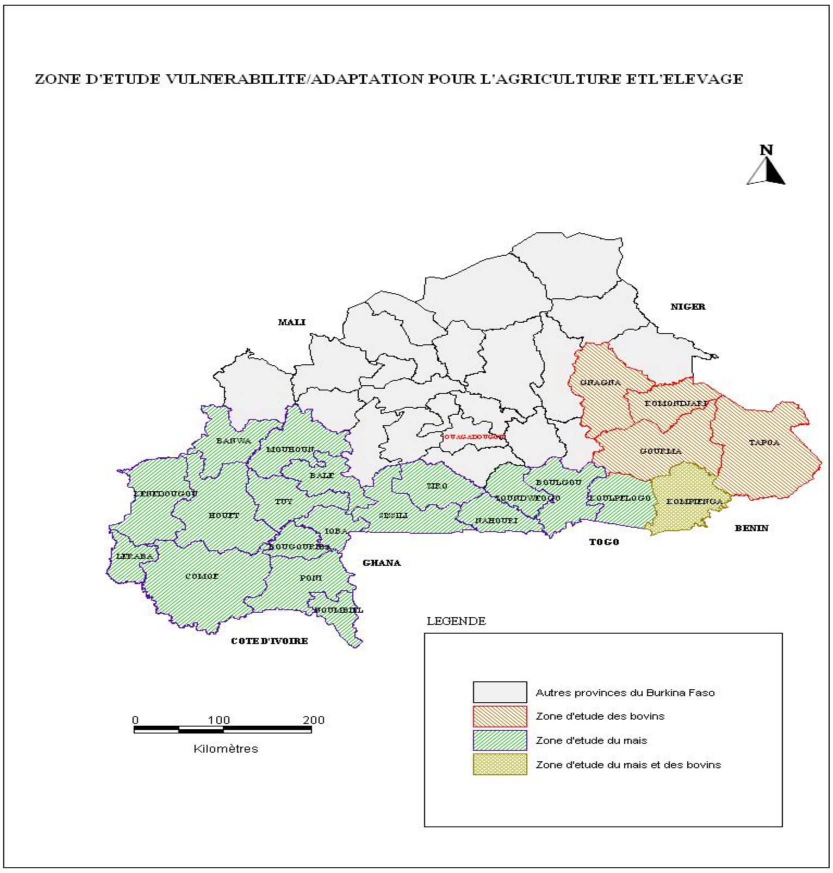
Concerning the breeding sector, the survey used the empirical method solely based on the extrapolation of statistical data of the years selected, with the Excel software. Some adjustments have been conducted by the judgments of experts.

3.2.3. Studies areas

The insufficiency of means does not allow a nationwide coverage. Hence the necessity to select an area to conduct the study for each of the products.

So, the maize unit , it has been decided to choose the areas ranging from very favorable to favorable for the success of this crop (Dembélé et al. 2006).The production statistics of the period 2000-2006 (DGPSA, 2007) have also been taken into account.

The cattle unit, the choice was guided by the number of animals. Therefore the eastern farming region ranks third (831 233 heads of cattle) after the Sahel zone.
(1.502.534 heads) and the high-Basins (1.214.034 heads) according to 2006 statistics. However we opted to carried out the study in the Eastern zone for the following key reasons: i) It is a favorite zone for animal transhumance from the Sahel region or even the Western part of Niger. Because of this , the number of animals living there at certain periods of the year, should be sharply higher than the official figure released;ii) This part of the country hosts the biggest number of (11.000km^2) classified forests and other reserves where grazing is forbidden. The pastoral pressure should increase in the coming years.
The map 6 shows the areas where the two exposition studies will be conducted.



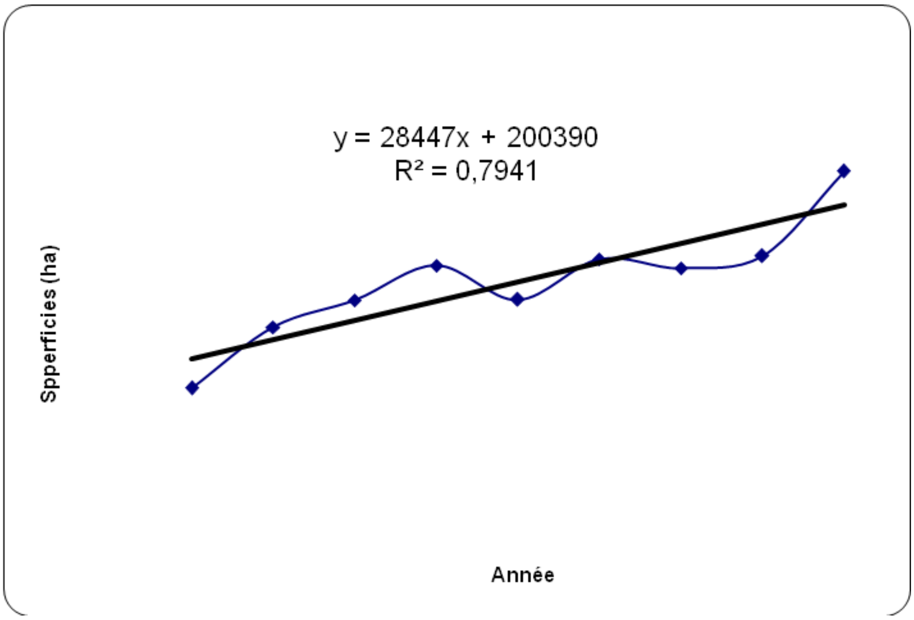
Source : SP/CONEDD-DCN
Map 6 : Study area of the vulnerability /Adaptation of both cattle and maize .

3.2.4. Baseline situation of the exposition units

3.2.4.1. Maize baseline situation

a) State of production

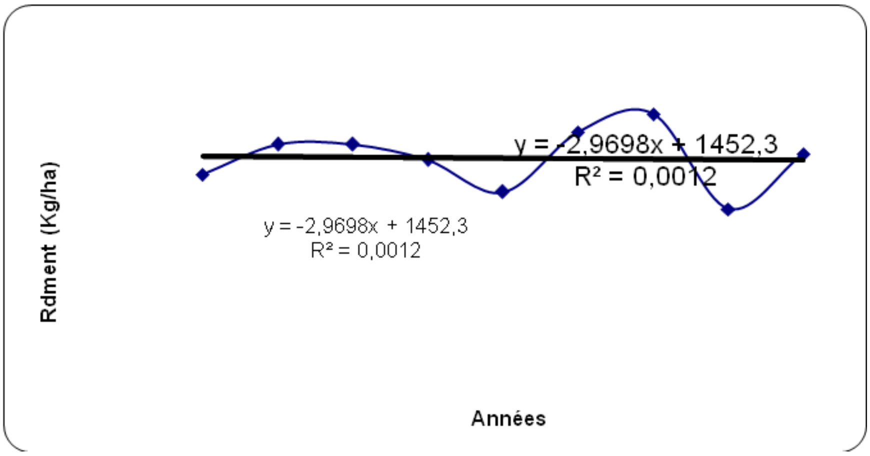
Within the study zone, from 2000 to 2008, the sown maize areas have experienced a steady increase going from 185.000 ha to 381.000 ha. This trend which started since then should continue at the detriment of the other dry cereals and mainly sorghum and millet (figure 24).



Source : DGPSA

Figure 24: Evolution of the total areas sown with maize between 2000 and 2008

The yields recorded during the same period vary ranging from 1,04T/ha in 2007 to 1,78T/ha the previous year (figure 25). The mean is estimated to 1,44T/ha which is very low regarding the yield potential of the varieties developed by INERA or those introduced which generally exceed the 5,0T/ha.

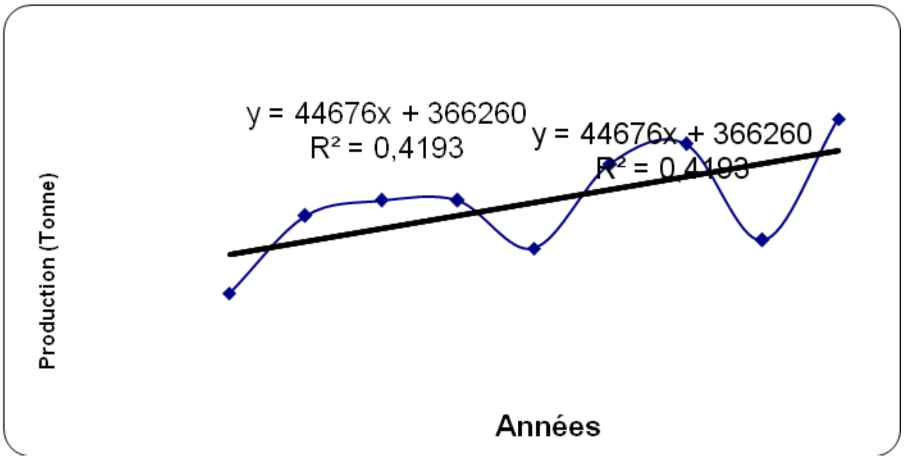


Source : DGPSA

Figure 25: Evolution of the maize means yields between 2000 and 2008

The trend of the graphic translates a yield ceiling which is rather a concern. The importance downward trend noted in 2007 could be explained by a distribution over the space and time of rains which are not favorable to maize.

Likewise the yields, the total productions also vary and range from 276.202 tons in 2000 to 792.977 tons in 2008 (figure 26). The upward trend shows more an increase of areas dedicated to this crop than an improvement however indispensable to productivity.



Source : DGPSA

Figure 26: Evolution of the total production of maize between 2000 and 2008

It should also be noted that the maize production becomes important in dry season thanks to the small scale village irrigation which has been developed in some parts of the area of study.

b) Maize unit vulnerability

The vulnerability of this economic sector which is of high importance for Burkina Faso, is mainly due to the climate hazards, the continuing degradation of natural resources, the weak diversification of crops, the persistent use of archaic farming equipment as well as the low used of farming inputs and new technologies. In addition to this, it should be noted the limited level of mobilization of production factors(lands, water, capital, labor) because of the weakness of public and private investments, but also the weakness in the organizing the institutional framework in order to really strengthen the capacity of all the stakeholders of the sector.

Maize is a water consuming crop, its vulnerability to variability and climate change will; depend mainly on but not exclusively to rainfall.

3.2.4.2. Cattle baseline situation

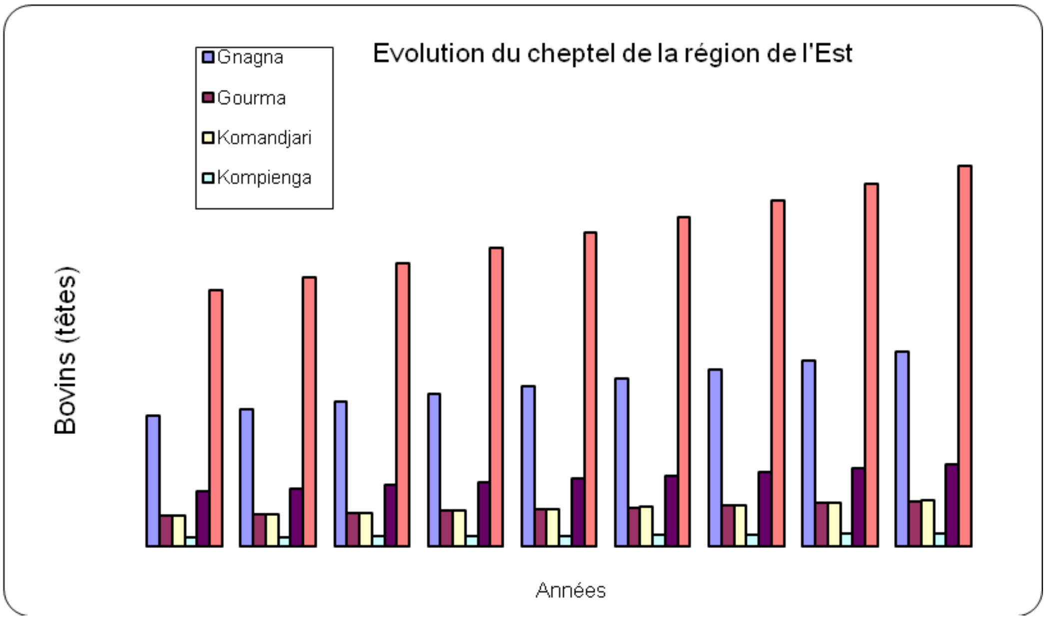
a) The production state

Based on the outputs of the two national surveys carried out in the livestock sector in Burkina Faso respectively in 1988 and in 2003, the technical services of the Ministry in charge of animal resources have estimated the increase mean rate by 5% at the national level for cattle. (MRA, 2006).

(Source : MRA, 2001)
Photo 1 : A herd of Zebus

We applied this mean rate of 5% to the 2003 statistics, to extrapolate the different values of the other years. The figure 27 below provides an evolution of the livestock in the Eastern region of the country.

<u>N. B:</u> The national increase rate is 2% and the one used in the vulnerability study is that one of the eastern region which is estimated to 5%. For the scenarii, the most optimistic considers the highest one noted in Burkina Faso to be from the Sahel (8%) and the pessimistic one considers an increase rate lower than the national mean (1%).



(Source : 2003 MIRA data)

Figure 27: Evolution of the number cattle in the Eastern region between 2000 and 2008

Following the current production conditions, the continuation of the number of livestock evolution will increase the pressure on natural ressources, meaning pasture and water resources. By 2013 the regional livestock mean density should reach 33, 05 UBT/km^2 and the water needs estimated to 16, 74 millions cubic meter. By 2025, the density will be closer to 43, 51 UBT/km^2 and water needs estimated to 22, 04 millions cubic meter.

b) Cattle unit vulnerability

Likewise the maize unit, cattle rearing strictly depends on climate hazards. Indeed, rainfall deficit leads to an insufficient production of biomass and a poor filling up of water reservoirs. The death of thousands of heads of cattle as soon as a drought occurs (like in 1972-73 then in 1991-1992) shows how vulnerable this sector is.

In the face of the negative effects generated by climate variability and change, the agro-cattle raisers have been adopting strategies and trying to feed their animals mainly in dry season, but the solution is far from being satisfying.

3.2.4.3. Impacts for maize unit by 2050

a)Without climate change forecasts

- Maize production and areas planned

The issue consists of carrying out a prospective analysis to see how the whole maize industry will evolves if there is no more change in the climate, which means otherwise that the adequate mitigation measures are applied not only in the country , in the African region but also throughout the world.

We can assume that if the climate is under control, the current production statistics will continue to progress according to their respective trend. A parameter as the annual areas sown with cereals should continue to go upward on an annual mean of 2, 3%.

The situation will be similar to what is drawn in the table 14 by 2015 and 2050.

Table 14 :Forecasts according to the maize production empirical method by 2000, 2025 and 2050

Years	**Areas (ha)**	**Productions (Tons)**
2000	185.000	276.202
2025	996734	6.028.247
2050	1.718.109	9.774.322

Source : SP/CONEDD-DCN

The current extreme yields variability does not help to extrapolate them in an appropriate manner. That is why we used the yields simulated under optimal cropping conditions with the DSSAT to estimate the productions. We can, indeed assume that the combined effort from research and agricultural extension will bring about an important increase of the yields, notably through the systematic use of organo-mineral fertilizer and improved seeds which are adapted to any maize farm.

- Relative maize weight 2025 and in 2050

With the plausible productions of 6 millions tons in 2025 then about 10 millions tons in 2050, maize will become without any doubt the first cereal of the country since spaces commonly used for sorghum are used for this crop.

On the basis of the 190kg/capita/year used to assess the country cereal needs, we have estimated the values presented in the table 15 below.

Table 15 : forecast of the relative maize weight in the country cereal needs in 2015 and 2050 .

Years	areas (HA)	Productions (T)	Country Population (inhabitants)	Cereals needs (T)	Coverage rate (%)
2000	185.000	276.202	14.017.262	2.663.279	10,37
2025	996.734	6.028.247	24.790.936	4.710.277	127,98
2050	1.718.109	9.774.322	51.906.936	9.862.317	99,11

Source : SP/CONEDD-DCN

The Table 15 helps to appreciate the evolution of the maize unit by the years 2015 and 2050 in a context where there is no climate change. We can therefore note that the maize production in the area of study which covers only 10.37% of the country cereals needs in 2000, allows to generate, alone a surplus of nearly 30% in 2015.If we assume that the surplus will be marketed according to the mean constant prices already considered for the period 1984-2008, an overall turnover of 133 billion of FCFA (266 millions de dollars US) and a margin profit of 23 billion FCFA for the farmers (46 millions de dollars US).

But By the year 2050, the maize production in the area of study will cover 99% of the total cereals needs of the country.

We can therefore conclude that, if the climate variability and change are under controlled in Burkina Faso, maize cropping will experience an important take off. But it should be recalled that the analysis is built on an empirical approach which it some limitations.

b) Forecasts taking into account climate change

- Plausible impacts of climate change on maize yields

Maize being a type C_4 type crop, an increase in the CO_2 concentration in the atmosphere, should not have any important impact on the productivity. We have taken into account the likelihood increase factor of CO2 concentration in the simulations with DSSAT.dans les simulations avec DSSAT.

The figures 28 and 29 show that for the same rainfalls assumptions the yields computed by the software follows a same trend but present some important differences whether we apply or not organo-minneral fertiliser formula developed by the scientific research and popularized by the farmers supervision services. The outputs of the figure 31 serve, somewhat, to confirm the DSSAT model validation, because the yields simulated can be compared with those released in the official farming statistics.

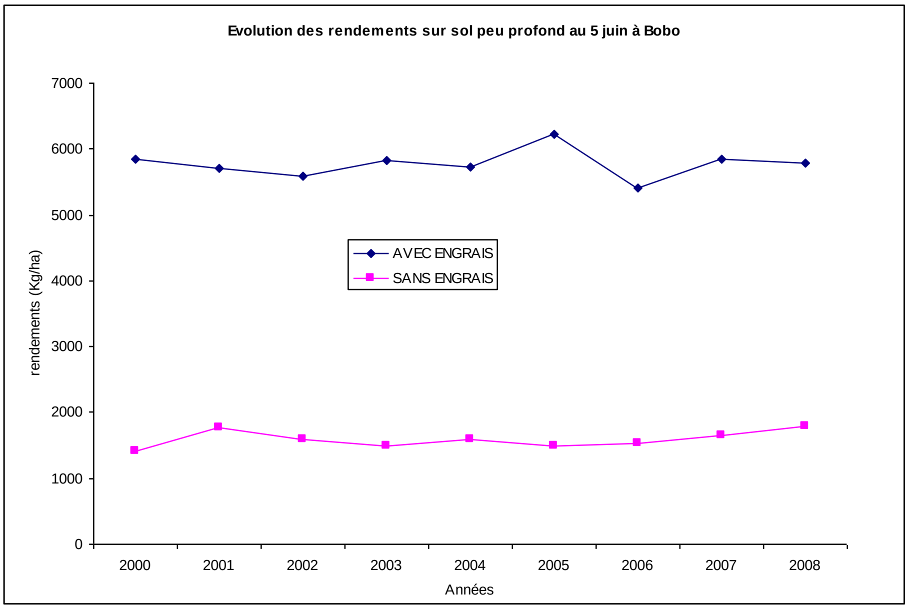


Figure 28: Evolution of the yields simulated for a maize cropped on June 05 on a shallow soil in Bobo-Dioulasso

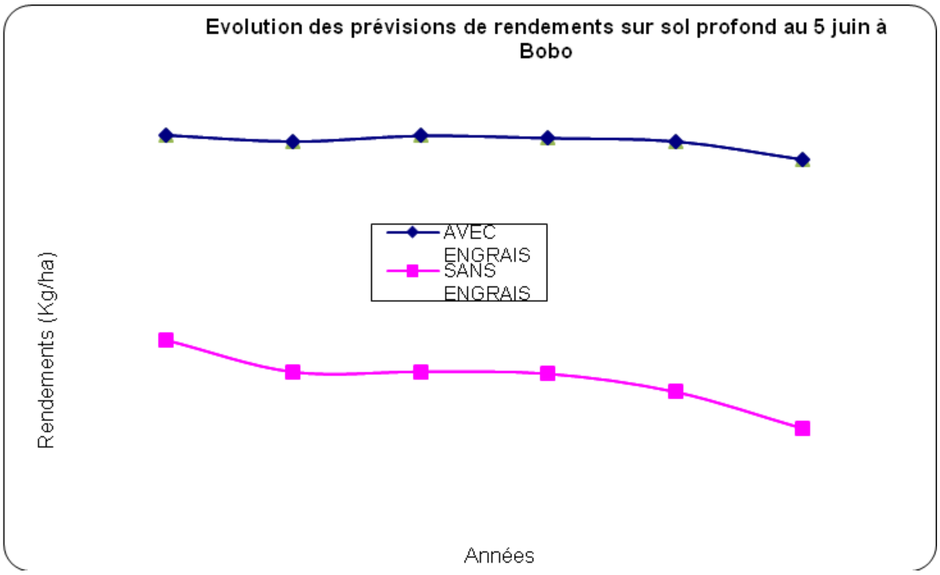


Figure 29: forecasts of likelihood yields of maize cropped on June 05 on a shallow soil in Bobo-Dioulasso

The expected productions have been estimated based on the plausible yields got. The figure 30 below present some values from which we can expect, from the two extreme cases (scenario 1 and scenario 3) compared to the production values extrapolated by the empirical method.

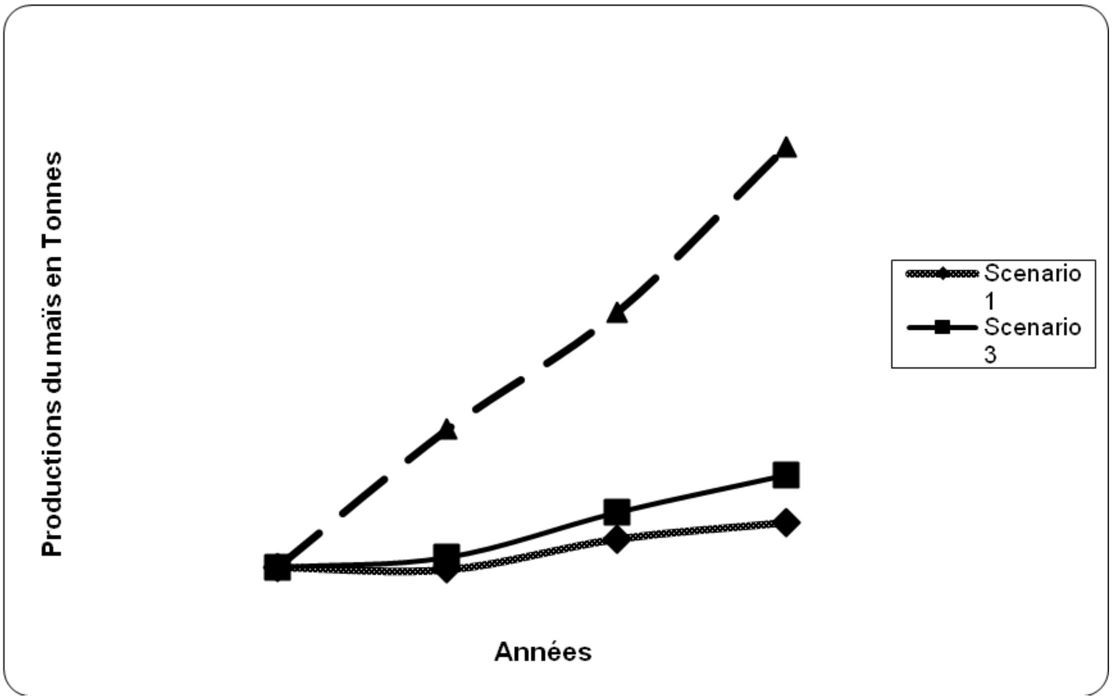


Figure 30: Plausible maize productions in the area of study with and without any climate change.

Even in an assumption where with have an increase of rainfalls by +5, 6% in 2025, the study area, will only cover 32% of the country cereals needs. This rate falls to 23, 5% in 2050 some adaptation measures should therefore be suggested.

- ***Socio economic Analysis of the plausible impacts of the climate variability and change on maize production.***

The table 16 below compares the expected productions according to the scenarios against the country cereals needs estimates.

Table 16 : Comparison of the plausible productions according to the scenarios of the country cereals needs estimates.

Years	Country Population (inhabitants)	Cereals needs (T)	Total productions under no climate change conditions Productions (Tons)	Total Productions in tons under climate change conditions (scenario1)	Total Productions in tons under climate change conditions (scenario3)
2000	14.017.262	2.663.279	276.202	276.202	276.202
2025	24.790.936	4.710.277	6.028.247	914.248	1.516.204
2050	51.906.936	9.862.317	9.774.322	1.288.603	2.365.175

Source : SP/CONEDD-DCN

An analysis carried out on the basis of the country total cereals coverage rate with the sole maize production, brings out by 2015, respectively some rates of 19,41% and 32,19% for the scenario 1 and 3,which is a notable downward trend when we compare with the situation without climate change where a surplus of 30% is expected. For the year 2050, this trend will worsen more because the coverage rate will respectively go for the scenario 1 and 3 to 13, 07% and 23, 98%.

This downward trend in the production according to the scenario 1,represents a turnover loss for the maize industry of 516,51 and 857 billions of FCFA that is 1,033 and 1,714 billions U$, respectively for the 2025 and 2050. The loss incurred for the scenario 2 is estimated to to 455,71 and 748,32 billions FCFA that is 0,914 and 1,496 billions U$ respectively for 2025 and 2050.
However it is important to note that the coverage rates at the level of the two scenarios remain higher than that one of the baseline situation-year 2000), that is 10, 37%. We can conclude that in spite of everything, the maize production will continue for sure to play an important role in the cereals assessments by 2025 and 2050.

3.2.4.4. Impacts for cattle units

a) Forecasts without climate change
If we assume being in a context where there is no climate change, the conditions will be met for ensure a continuing progress in the number of livestock. The figure 31 provides a plausible evolution of the cattle in the region. We have considered an increase rate of 5% which is the mean rate estimated with the data from the two livestock related surveys carried out nationwide.

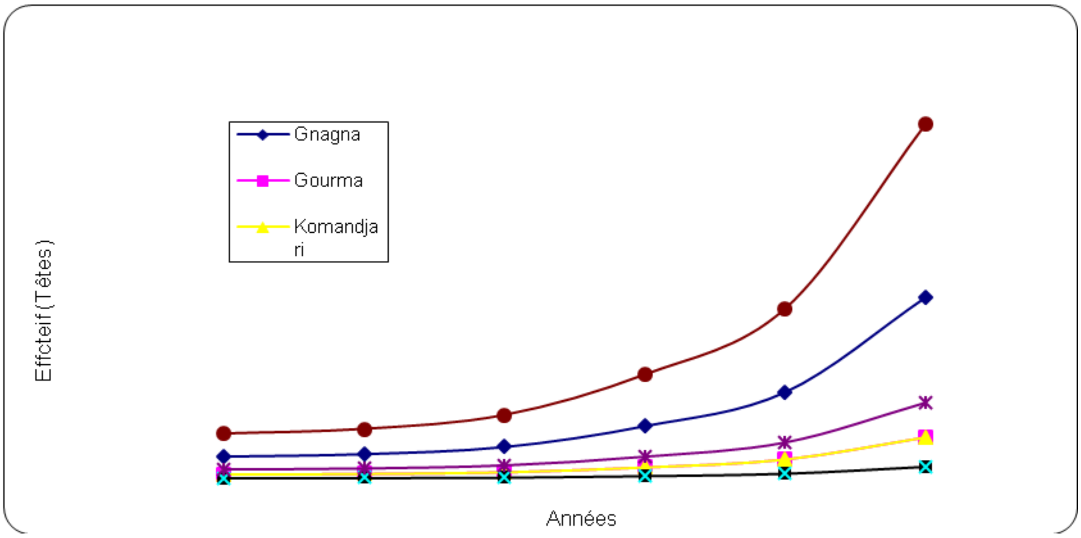


Figure 31: Plausible Evolution of the number of cattle(total and per province) without climate change .

b) Impacts with climate change
- Impacts on the number of livestock

When taking into account the three climate scenarios, we came up with the following assumptions : i) in the event of a maximum climate stress, the fodder resources ,source of the cattle feed will be extremely limited and with the increase of temperatures, the increase rate will also be taken to a minimum ; ii) the intermediary assumption will be marked by a rate of 2% and the rainfall increase by 11% could lead to a maximum increase rate of 8% currently recorded for the Sahel Zone(ENEC II).
The figure 32 provides then the plausible evolution of the livestock number according to the assumptions considered.

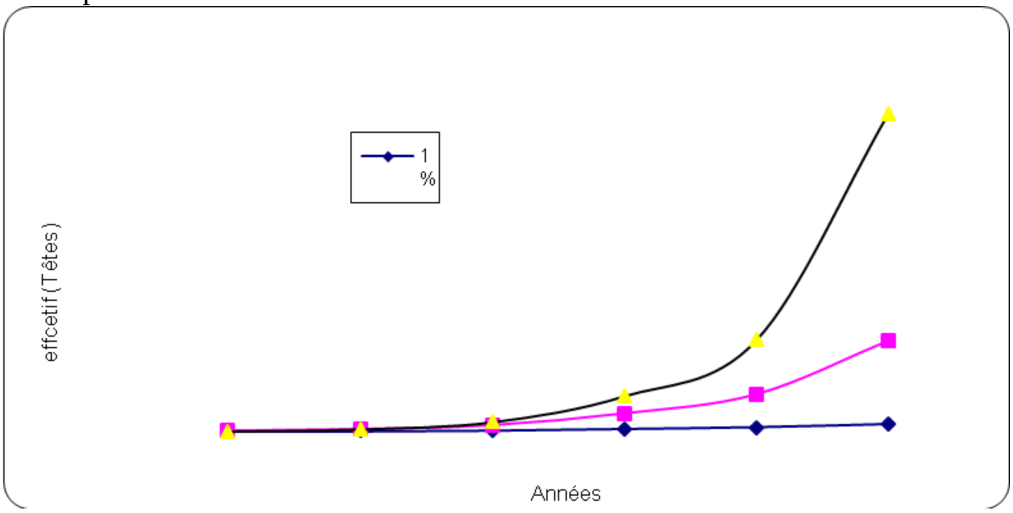


Figure 32: Plausible Evolution of the total number of cattle in the Eastern region in a context of climate change.

- Impacts on livestock systems

Most likely, and even if the conditions in the area worsen, traditional resettlement will continue. But considering the natural resources to distribute are becoming scarce, there is no doubt that conflicts will increase (mainly between farmers and breeders). The migrants could come sooner while the rainy season is not totally over.

Regarding the second type of extensive system (letting the herd fed itself in the fields, usually in the outskirts of villages in landscaped paths or not), this aspect should naturally develop toward a semi-intensive system if the breeders want to continue the livestock activity.

- Impacts on the water needs

In order to have an idea on the water needs for cattle by 2025 and 2050, we used the current figure indicating 30litres/day/animal (PROSPERE) and assessed the needs based on the potential quantity of livestock expected.

Table 17 here below provides the expected potential values.

In 2050 according to scenario 1 (reduction of rainfall by -11% with a growth rate of 1%) we will need 1,5 Mm^3 of water only for the livestock in the region. This need increases to 25,5Mm^3 if we include an increase of the rainfall by +11% corresponding to a growth rate of 8%.

As we will see in the following paragraph with scenario 1, Burkina Faso could have a serious water shortage in 2050. It could potentially be impossible to have enough water for the livestock.

Table 17 : Assessment of the upcoming water needs for the livestock in the East* Region

Years	Number of livestock according to the growth rate of 8%	Water needs in Mm3	Number of livestock according to the growth rate of 5%	Besoins en eau en Mm^3	Number of livestock according to the growth rate of 1%	Water needs in Mm^3
2000 (baseline)	783.069	0,8	783.069	0,8	783.069	0,8
2025	**3.395.673**	**3,7**	**2.103.488**	**2,3**	**1.065.571**	**1,2**
2050	**23.255.183**	**25,5**	**7.123.158**	**7,8**	**1.366.522**	**1,5**

Source : SP/CONEDD-DCN

1. The number of livestock in the survey area for 2000 (baseline year) is 783.069.

- Impacts on the availability of fodder

With regard to scenario 1, the availability of fodder will be limited.

In contrast, regarding scenario 3 there should be an increasing availability of fodder. In the conditions scheduled in this scenario, Claussen et al. (2003) reports, per decade, a potential increase of the vegetation by approximately 10% of the total surface of the Sahara, and this essentially occurs by the impact of the increase of concentrations in CO_2.

- Impacts on the meat production

Table 18 here below provides an assessment of what could be the beef production in the survey area based on the various scenarios.

Table 18 : Potential productions (in tons) of beef in the East region based on the scenarios

Meat production /scénario (T)	**2000**	**2025**	**2050**
Scenario1 (1%)	8.614	11.721	15.032
Scenario2 (without CC to 2%)	8.614	23.138	78.355
Scenario3 (8%)	8.614	37.352	255.807

Source : SP/CONEDD-DCN

With regard to scenario 3, there is a significant increase in the meat production. Therefore, the meat production in 2025 and 2050 could be 4,3 times and 29,6 times more significant than the baseline year (2000). Therefore, the production in 2050 for the same scenario could be 3,2 times more significant than scenario2 (without climate change) for the same year.

In contrast, scenario 1 could result in a significant decrease of the meat production by the relevant years. The meat production based on scenario1 would only indicate 19,18% of the situation of scenario2 (without climate change) in 2050 against 50,7% in 2025. Scenario 1 therefore indicates harmful impacts on the nutrition and health of populations mainly in urban areas where the consumption of meat is the major source of essential proteins.

- Impacts on the milk production

Table 19 below provides the estimations regarding the cow milk production in the survey area.

Table 19: Possible productions (in liters) of fresh cow milk based on the scenarios in the East region.

Milk production /scenario (L)	**2000**	**2025**	**2050**
Scenario1 (1%)	17.227.518	23.442.562	30.063.484
Scenario2 (without CC at 2%)	17.227.518	46.276.736	156.709.476
Scenario3 (8%)	17.227.518	74.704.806	511.614.026

Source : SP/CONEDD-DCN

The same trends of progression recorded for the meat production remain valid for milk. The reduction recorded in the milk production with regard to scenario 1 would particularly impact the health of babies and the youngest population, considering the fact that milk is a essential component of their foodstuff.

In conclusion, regarding meat and milk, in scenario1 happens, this could result in significant exports losses for the country, and also for the stakeholders of the livestock-meat and milk

sector. One of the other consequences related to the first one is that a significant number of non-professional farmers could abandon that activity.
Furthermore, there could also be an increase in the importations of milk and meat which could worsen the deficit of the trade balance of the country.

3.2.5 The measures of adaptation in the sector of agriculture

3.2.5.1 Institutional measures

Since the period of the Regional Organisms of Development (ORD) founded by the State in the early 60's until now, Burkina Faso still did not find the pertinent institutional framework to boost the development of its agriculture. Worse than that, the regional directorates in charge of agriculture do not have the staff or means to be operational. The few agents there are becoming old due to the fact that recruitments are decreasing down. The situation is practically identical in research centers and agricultural training. It would be urgent to appraise the policy of research and agricultural popularization, in terms of real capacity building.
Another action would be to encourage farmers and the other stakeholders involved (mainly insurance companies) to promote climate insurance based on a predefined climate index which includes factors such as rainfall, temperature, sunshine or result from a combination of several climate parameters. The State should create a suitable framework for the emergence of that new type of insurance.

3.2.5.2. Technical measures

a) The techniques of collection and conservation of water on the plot
With regard to the negative impacts of climate change on agriculture and natural resources, the populations developed strategies of adaptation to maintain, and even to increase agricultural production. These strategies are either internal, or they are introduced in the community by coaching organizations in the rural areas. These techniques are mostly well-known in the mid-Northern part of the country.

As part of the adaptation strategy developed we need to point out the techniques of collection and conservation of water such as the zaï or the djengo (Photos 3 and 4) and the half-moon (Photo 5). To reduce the run off and the erosion of the soil, several techniques such as stone bunds (Photo 6) and grass strips (Photo 7) have been developed.


Zai

Djengo

Photo2 : zaï technique Photo 3: djengo technique

Photo 4 **: half moon technique**

Photo 5: bunds of stones

Photo 6: grass strip

The zaï technique (Photo 2) consists in making little hole of a few inches wide, in the bare and compacted soil where even grass cannot grow any longer, and add a handful of manure or compost with approximately 600 g per hole. Planting is carried out in the holes of the zai after the first rains. The djengo (Photo 3) is exclusively conducted on sandy soils where it is impossible to produce zaï in the beginning of the rainy season. Most of the time there is no organic component.

Concerning the half-moon technique (Photo 4), the holes look like a half-moon. These techniques enable the retention and conservation of rain water for the crops and improve the fertility of soils.

The stone bunds (Photo 5) and grass strips (Photo 6) are techniques of adaptation enabling to reduce the phenomenon of run off and erosion, and reducing the degradation of farming soils.

All these techniques combined with the tillage techniques, mainly the partitioned logs which proved to be very effective on maize, (Somé, 1989; Nicou and al, 1990), should be widely popularized.

b) Irrigation techniques

Irrigation (supplement in the wet season, or total in the dry season) seems essential in the future for agriculture in dry or semi-dry areas, where temperatures are high and the evaporation is important. Burkina Faso is very much aware of that fact and has focused on the development of small irrigation with rather spectacular results contributing to the improvement of food safety in the country. That initiative should continue and be intensified (Photo 7).

Photo 7 : Culture of maize under irrigation during the dry season

c) Reinforce the utilization of organic and mineral fertilizers

A few years ago, the government had launched a campaign to popularize the production of organic fertilizers through the promotion of compost pits. This initiative should continue but at the same time, the State should review its policy concerning the availability of mineral fertilizers for farmers.

d) The popularization of improved varieties of maize

The efforts of agricultural research which has set up several varieties of improved maize adapted to the current context in the sector are strategies of adaptation for the farmers. Table

20 here below indicates the non-exhaustive list of the varieties of maize and their potential yields.

Tableau 20 : Potential yields of improved varieties made by INERA and made available to farmers

Varieties	Yields	Observatories
FBC 6 SR-22 SR-21 (hybrid) FBH-33 (hybrid) IRAT-81	5,6 T/ha 5,1 T/ha 4,2 T/ha 7,5 T/ha 5 T/ha	Cycle of 105 to 110 days
MAKA KEJ	3,5T/ha 3,0 T/ha	Cycle of 90 days

Source : INERA

In addition to the varieties developed by the agricultural research, several other varieties in the sub region can be introduced.
The introduction of new crops such as hybrids, or plants adapted to higher heats and significant droughts need to be considered because scientific research must be in advance to meet the upcoming challenges.

e) Scientific actions specific to livestock

These actions will essentially aim at:

1. Reinforcing the fight against infectious and parasitic diseases in the extensive livestock;
2. Reinforcing the epidemic monitoring of priority diseases;
3. Improving the genetic potential of cattle mainly by bringing new and more efficient genes;
4. Setting up an early system warning concerning the risks of fodder and water ;

1. Setting up an operational management system livestock food crisis

3.3 Vulnerability and adaptation in the sector of water resources

3.3.1. Identification of exposure units

With regard to this data and information collected on the field and desk research, a matrix of assessment of vulnerability has been developed. In contrast with the sector of agriculture, we have applied a simple component regardless of the criteria and a simple component without including the criteria and a weighed component by stressing on the importance of the criteria. The rating scale used is broken down as follows:
***1** : very weak ; **2** : weak ; **3** : average ; **4** : high ; **5** : very high.*
Initially schedule to be applied at national scale, the matrix of assessment indicates that, whatever the situation may be, the water shed basin of the **Nakanbé** is the most vulnerable, followed by the water shed basin of the **Mouhoun**, the **Comoé** and **Niger.**

The second step of the identification process is to look always, following the same method, exposure subunits to assess their vulnerability. The subunits used are summarized in Table 21.

Table 21: Subunits used to measure vulnerability at the level of drainage basins

Basins	**Sub-units**	**Main Functions**
Nakanbé	Bagré Dam	Hydroelectricity, irrigation, fish farming, tourism
	Kompienga Dam	Hydroelectricity and fish farming
	Ziga Dam	Drinking water supply (DWS) for Ouagadougou, and fish farming
Mouhoun	Sourou Dam	Irrigation and fish farming
	Samendeni Dam	Hydroelectricity, irrigation and fish farming
Comoé	Moussodougou Dam	SN-SOSUCO irrigation and market gardening DWS for Banfora
Niger	Yakouta Dam	Drinking water supply (DWS) for Dori, fish farming and market gardening

Source: SP/CONEDD-DCN

It emerges from the evaluation the following orders of ranking, with and without weighting of criteria (Table 22).

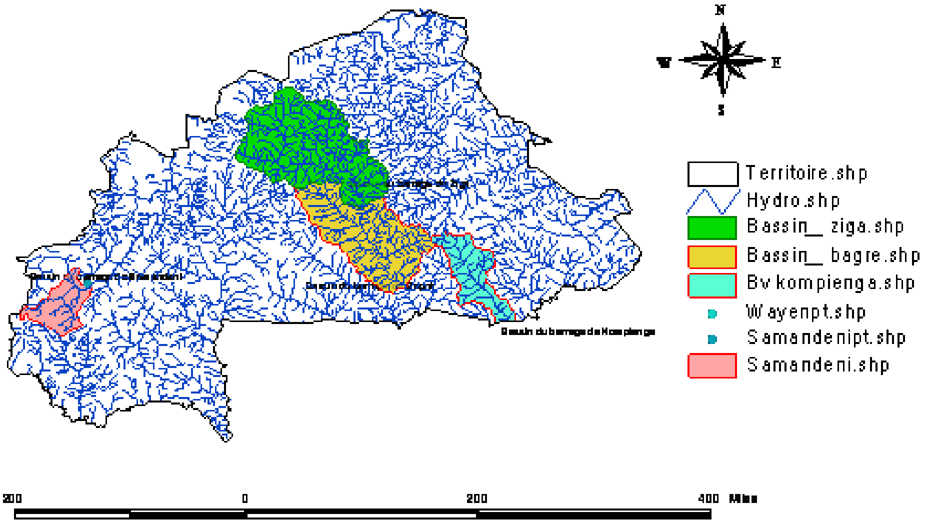
Table 22: Summary of the results of the subunits vulnerability assessment (dams) with and without weighting of criteria.

Rank (without weighting)	**Subunits**	**Rank (with weighting)**	**Subunits**
1st	Bagré Dam	**1st**	Bagré Dam
2nd	Ziga Dam	**2nd**	Ziga Dam
3rd	Kompienga Dam	**3rd**	Kompienga Dam
4th	Samendeni Dam	**4th**	Moussodougou Dam
5th	Moussodougou Dam	**5th**	Samendeni Dam
6th	Sourou Dam	**6th**	Sourou Dam
7th	Yakouta Dam	**7th**	Yakouta Dam

Source: SP/CONEDD-DCN

Note that both options provide essentially the same results, except for a permutation of the fourth and fifth ranks.

For the remainder of the study, we use the four (4) first subunits the most vulnerable that are the dams of Bagré, Ziga, Kompienga and Samendeni. We preferred Samendeni to Moussodougou due to the lack of access to data. Map 7 locates the subunits selected.



Map 7: Distribution of sites selected as exposure subunits.

3.3.2 Analysis Methodology

The establishment of baseline information was made in the same manner as in agriculture. The assessment of impacts was made through the hydrologic modeling. After analyzing the results of the implementation of the three (3) GR2M, and WBM2 WBM6 models, it appears that the GR2M model has the best performance on all basins with Nash values greater than or equal to 67% in calibration and validation.

However, there is a tendency to underestimate the flood peaks and overestimate, in some cases, dry weather flows. This lack of performance on large floods is due to the excessive size of the "ground" reservoir, playing the role of production function (Diello, 2007). Despite these shortcomings, the results provided by the GR2M model are good and satisfactory. It will be subsequently used for assessing the impacts of climate change at 2025 and 2050 time horizons.

3.3.3. Baseline situation exposure subunits

3.3.3.1. The reservoir of Bagré

Data on the flows are presented in Table 23 and Figure 33. The flood hydrograph in 2000 is bimodal with a first peak low in June and a significant peak in August. The first peak is the result of contributions from areas close the outlet due to the first rains of May and June. The flow remains intermittent and focused on the rainy season. August alone accounts for 42% of annual flows.

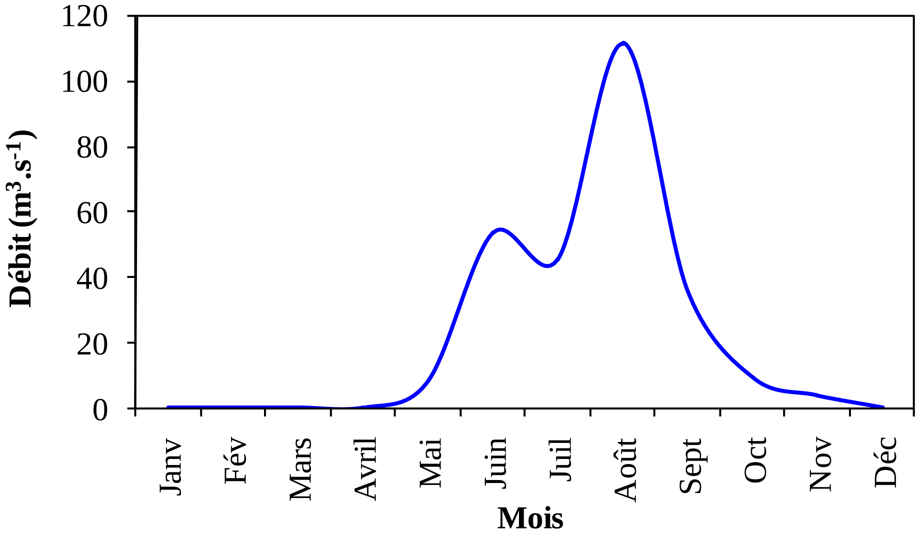


Figure 33: Seasonal variation of monthly average flows in 2000 at the Bagré station. Source: SONABEL

The module of the year 2000 is 22.3m^3/s. The total annual flow is 709 million m^3. It should be noted that the year 2000 was particularly dry on the basin of Bagré Dam.

Photo 8: View of the Nakanbé River downstream from the Bagré dam

Table 23: Monthly Flows (m^3/s) in 2000 at the Bagré station.

Jan.	Feb	Mar	April	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec.	Annual
0,0	0,0	0,0	0,0	8,1	53,7	45,4	111,5	35,8	9,1	3,9	0,0	**22,3**

Source: SONABEL

The various water supplies, losses and uses of the reservoir of Bagré in 2000 are shown in Table 24.

Table 24: Data on water resources at Bagré in 2000.

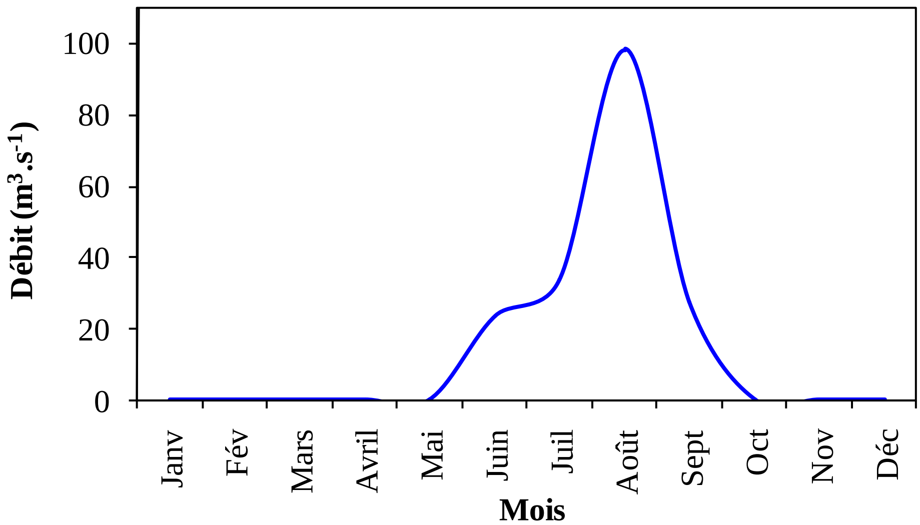
	Jan	Feb	Mar	April	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
Volume turbiné (Mm^3) Turbine volume	97,7	82,6	88,4	123,3	112,0	129,3	102,5	45,1	55,7	48,6	31,3	2,5	**919,0**

(Mm3)													
Volume of supplies (Mm^3)	0,0	0,0	0,0	0,0	21,7	139,3	121,5	298,5	92,8	24,5	10,4	0,0	**708,7**
Volume evaporated (Mm^3)	42,8	50,0	38,8	61,0	43,7	29,8	18,0	19,5	29,0	36,6	34,1	20,4	**423,4**
Volume for irrigation (Mm^3)	1,8	1,8	2,4	2,2	1,5	1,9	1,1	1,2	1,2	2,3	1,9	1,1	**2,5**
Volume let out (Mm^3)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	**0,0**
Volume of rain (Mm^3)	0,0	0,0	0,0	8,5	85,2	235,2	105,4	298,0	164,9	47,8	0,0	0,0	**945,0**

Source: SONABEL

3.3.3.2. The reservoir of Kompienga

The data of flows in 2000 are presented in Table 24 and Figure 34. We find seasonality in the variations in the course of the season with a single-mode distribution corresponding to a peak of 98.2 m^3/s in the month of August. This month alone accounts for 54% in the annual



report.
Figure 34: Seasonal variation of monthly average flows in 2000 at the Kompienga station.
Source: SONABEL

The average annual flow is 15.2 m^3/s, with an annual volume of 485 million m^3 let out.
The various water supplies, losses and uses of the reservoir are shown in Table 25.

Table 25: Data on water resources for the Kompienga Dam in 2000

	Jan	Feb	Mar	April	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
TurbinedVolume (hm3)	70,4	68,5	93,7	61,3	97,4	71,0	55,2	37,0	43,2	45,7	38,6	13,1	**695,0**
Volume of supplies (hm3)	0,0	0,0	0,0	0,0	0,0	61,5	89,6	262,9	71,2	0,0	0,0	0,0	**485,2**
Volume evaporated (hm3)	26,3	35,8	39,0	34,5	26,1	17,8	13,7	11,7	13,5	19,3	27,3	21,8	**286,7**
Volume of rain (hm3)	0,0	0,0	0,0	8,2	56,3	153,8	104,0	212,7	163,0	12,9	0,0	0,0	**710,9**

Source: SONABEL

Filling volumes remain well below the maximum volume of the reservoir (normal volume) with a maximum degree of filling of 64% at the beginning of year (January) probably due to good rainfall in previous years (1998 and 1999). This rate drops to a minimum of 36% in June and July, before rising to 48% in September. At the end of 2000, the filling rate is only 40%.

3.3.3.3. The reservoir of Ziga

The year 2000 is the year of impoundment of the Ziga dam. Hydrological data are therefore incomplete. The hydrological characteristics of the reference station (Wayen station) are presented in Table 26. The flow is concentrated in the months of July, August and September, which represent 93% of annual contributions. These annual supplies amounted to 654 million m^3 (Mm^3) for the year 2000 at an annual average rate of 20.5 m^3/s.

The maximum filling rate is reached in September 2000 with a value of 35%. At year end, the dam is 24% full. The operation of the dam for supplying the city of Ouagadougou in water really began in 2004.

Table 26: Monthly Flows (m^3/s) in 2000 at the Wayen station.

Jan	Feb	Mar	April	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
0,0	0,0	0,0	0,0	1,1	3,6	88,3	89,1	50,8	13,0	0,0	0,0	**20,5**

Source: DGRE

3.3.3.4. The case of Samendeni

Hydrological data from Samendeni station are presented in Table 27. The flow remains constant throughout the year with a low water period from December to May and a flood period from June to November. The maximum rate of flow is reached in August (94.2 m^3/s). The lowest dry weather flows occur in March and April (0.7m^3/s).
The mean annual flow in 2000 is 20.5m^3/s corresponding to an annual volume of 651 Mm^3 let out.

Table 27: Monthly Flows (m^3/s) in 2000 at the Samendeni station.

Jan	Feb	Mar	April	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
3,2	1,5	0,7	0,7	2,2	13,8	18,4	94,2	56,3	36,6	11,9	5,9	**20,5**

Source : *DGRE*

3.3.4. Analysis and evaluation of impacts on water resources

The analysis of impacts on water resources focused on the flows, the dam filling, the water balance, hydroelectricity production, irrigation and fish production.

3.3.4.1. The Bagré Dam

Figure 35 shows the results of simulations on flows. In general, the evolution of annual flows shows a downward trend in flows. Compared to the base year 2000, we can see that the flows in 2025 and 2050 remain more important regardless of the type of scenario.

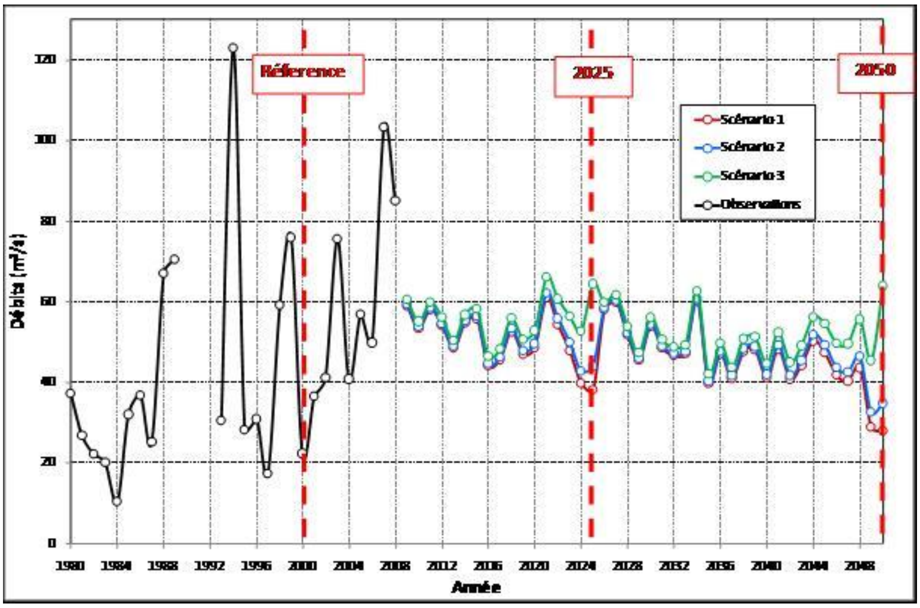


Figure 35: Evolution of annual flows for the three (3) climate change scenarios on the basin of Bagré.

The analysis of monthly flow shows the following observations:
- Regardless of the type of scenario, the monthly flows are still higher in 2025 and 2050 than in 2000;
- For each type of scenario, peak flows are higher in 2025 than in 2050;
- A shift of the occurrence of flow peaks in 2025.

Indeed, we note that in 2025, for each scenario, flow peaks occur later in September, while in 2000 and 2050, they occur in August.
The analysis of conditions for filling the Bagré Dam at the horizons of 2025 and 2050 is based only on water supplies from the watershed; water uses and losses are not considered. This allows seeing if the water supplies from the watershed permit to fill the dam in 2025 and 2050.
The following results were noted:

- In 2025, the dam fills only for scenarios S2 and S3. It fails to fill for S1. The filling rates at year-end are respectively 95%, 105% and 143% for S1, S2 and S3. Note that the filling occurs earlier (in early September) for S3, while it occurs later (mid-October) for S2;
- In 2050, the dam fills up only for the S3 scenario. The filling rates at year-end are 76%, 89% and 142% respectively for S1, S2 and S3.

For the water balance of the dam, we conducted an assessment on an annual time step on the Bagré Dam in 2025 and 2050 for the three scenarios S1, S2 and S3.

It may be noted that compared to 2000, when the balance was negative (inventory change of -413.2 mm^3), the years 2025 and 2050 indicate positive balances for the three scenarios on the reservoir of Bagré. The negative balance in 2000 is due to low water supplies from the watershed to the dam due to the nature of this particularly dry year. For both 2025 and 2050, the S1 scenario indicates the lower balance sheets reaching 69.2 mm^3 in 2050. The S3 scenario in 2025 indicates the highest balance sheet (235.5 mm^3). This water balance will therefore be used for the assessment of impacts on hydroelectricity production and irrigation.

For the hydro-electricity production from the turbine water volumes resulting from the water balance, we can determine the hydro-electric production. This is the annual producible as the actual production depends on demand. There is a general decline in production compared to the base year 2000. In 2025, the declines are respectively -33%, -19% and -10% compared to 2000 for scenarios S1, S2 and S3. In 2050, these declines reach -74%, -56% and -26% for the same scenarios S1, S2 and S3 respectively.
In terms of electricity production, sales value is estimated on the basis of the cost per KWh by SONABEL which is 120 FCFA (about 24 cents US).
Table 28 provides an economic assessment of climate change impacts on hydroelectricity production in Bagré.

Table 28**:** Economic evaluation of impacts on hydroelectricity production in Bagré

Scenario	**Energy produced in MWh (1)**	**Sales Value in CFA francs (2)**	**Gaps in CFA francs (3)**
2000	47.966	5.755.920.000	0
2025_S1	32.063	3.847.560.000	-1.908.360.000
2025_S2	39.064	4.687.680.000	-1.068.240.000
2025_S3	42.940	5.152.800.000	-603.120.000
2050_S1	12.615	1.513.800.000	-4.242.120.000
2050_S2	20.983	2.517.960.000	-3.237.960.000
2050_S3	35.635	4.276.200.000	-1.479.720.000

Source: SP/CONEDD-DCN

A data analysis of Table 28 shows that the S1 scenario will result in losses on revenues in 2025 as in 2050 compared to the base year 2000, respectively of the order of 1.908 and 4.242 billion CFA francs (about 3.816 and 8.484 billion US dollars). Thus scenarios S2 and S3 respectively constitute the average scenario and the low scenario with a significant decrease of the effect caused by climate change.

In terms of irrigation and based on an annual water demand of 20,000 m^3/year in the perimeter of Bagré (source MOB), we determined the irrigable areas. Compared to the base year 2000, the areas increased significantly, especially in 2025. Indeed, in 2025, the areas of 2000 are multiplied by 5.15; 6.28 and 6.90 respectively for the S1, S2 and S3 scenarios. In 2050 on the other hand, the multiplicative factors are more than 2.03; 3.37 and 5.73 respectively for the same scenarios. This is explained by the fact that the development of the Bagré valley is achieved gradually according to the national agricultural policy and funding opportunities.

Regarding fish production, patterns resulting from climate change go up and down. To estimate the gains and losses of production, a price of 1,400 CFA francs per kilogram (US $ 2.8) was used and includes a producer price of around 500 CFA francs (US $ 1) per kilogram for fishermen, and a consumer price (market price) of about 900 FCFA (US $ 1.8) per kilogram. The assessment allows retaining the following results:

- In 2025, only the S1 scenario suggests a decline in production of 43.4 million CFA francs (US $ 86.8 million) compared to the base year 2000. We notice on the other hand a larger increase in production for the S3 scenario, that is 896 million CFA francs (US $ 1.79 million);
- In 2050, only the S3 scenario generates an increase in production of approximately 883.4 million CFA francs (US $ 1.76 million) compared to the base year 2000. The value of the loss of the largest production is recorded at the level of S1, with 406 million FCFA (US $ 81.2 million), which represents a shortfall of about 144,980,000 CFA francs (about US $ 290,000) for the 500 fishermen and 261.01 million CFA francs (about US $ 522 million) (for the about twenty wholesalers registered at Bagré Lake).

3.3.4.2. The Kompienga Dam

Compared to observations in recent years (1994-2008) where there has been a normalization phase of flows, or even a slight tendency to increase, the flow projections show a general downward trend whatever the scenario (Figure 36).

Compared to the base year 2000, we observe:

- In 2025, a decrease in flow of 15% and 7% for scenarios S1 and S2 and a 21% increase for the S3 scenario. In all three scenarios, the maximum range of variation of the flows is -15% and +21%;
- In 2050, a decrease for the three scenarios (62% for S1, 53% for S2 and 17% for S3). Flows in 2050 will thus undergo a maximum variation between -62% and -17%.

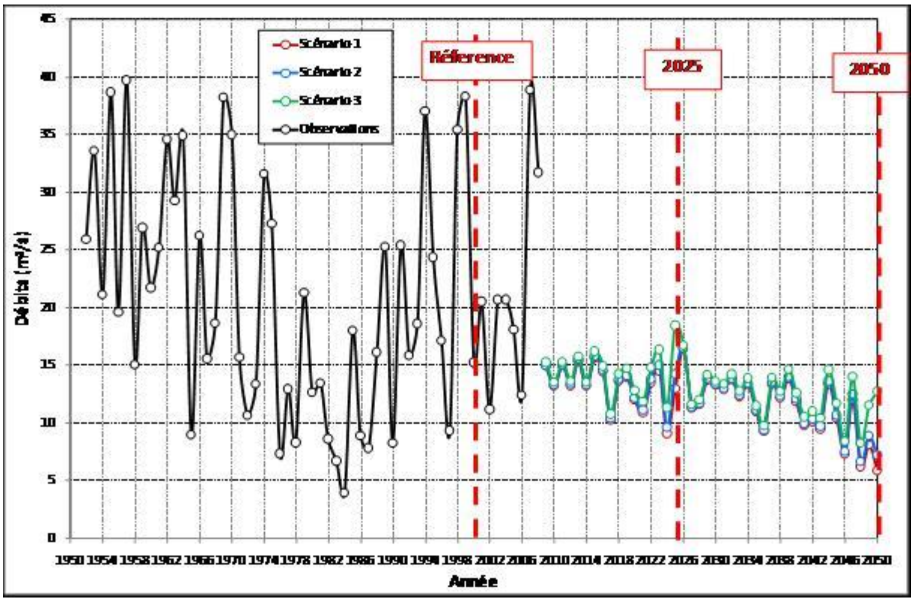


Figure 36: Evolution of annual flows for the three (3) climate change scenarios on the basin of Kompienga.

The simulation results of the monthly flows of the Kompienga River make the following observations:

- In 2025, there was a delayed occurrence of flood peaks (in late August - early September) and prolonged low water flow (until November). There was also a decrease in peak flows for scenarios S1 and S2 compared to 2000. These decreases are 31% and 25% respectively for S1 and S2. Scenario S3 has a flow peak similar to the 2000 rate;

  - In 2050, the monthly rates are sharply lower. Flow peaks experience decreases of 70%, 64% and 40% compared to 2000 for scenarios S1, S2 and S3 respectively. These flow peaks occur in the same month (August) as in 2000. The beginnings and ends of flow are also comparable to those of 2000.

We evaluated the different components of the water balance on the water reservoir of Kompienga. The results show that in 2000, the balance was in deficit of -347.1 Mm^3; which allowed drawing from the initial stock by turbining up to 695.0 Mm3. In 2025 and 2050, we do not know the original stocks in the dam.

Thus on the basis of a maximalist assumption that all water supplies are used (essentially turbine) and lost by evaporation, the inventory change becomes null, that is to say that if one starts with a minimal volume of 200 million m^3 (as assumed for the analysis of the dam filling) at the beginning of year 2025 and 2050, it remains the same volume of 200 million m^3 at the end of the year.

We note that, given the increase in temperature in 2025 and 2050, the volumes evaporated undergo increases relative to the base year 2000. These increases are of 45% in 2025 and reach 93% in 2050. This constitutes a significant loss of water to the Kompienga Dam and a low availability of water for hydroelectric production.

Hydroelectricity production is determined from the turbine volumes from the water balance of the reservoir. As already pointed out, there is a drastic decrease in energy production compared to 2000. In 2025, decreases are of 79%, 72% and 51% for scenarios S1, S2 and S3 respectively. In 2050, production is zero in the case of scenarios S1 and S2, and very low (3.224 MWh) for the S3 scenario, or decrease of 93% compared to 2000. The consequences of this situation in 2050 will be disastrous for socio-economic sectors in the country.

Indeed, in 2025, compared to 2000, the S1 scenario is one that causes a greater loss of production, with 4.422 billion CFA francs (US$ 8.844 billion) against 2.846 billion CFA francs (US$ 5.692 billion) for scenario 3.
In 2050, due to the zero level of electricity production due to drastic reduction in water availability (scenarios 1 and 2), production losses amount to an average of 5.488 billion CFA francs (about 11 million US dollars).

- Based on an average annual fish production of 60 kg/ha/year in the absence of specific biological facilities, fish production from the man-made lake has been determined:
  - In 2025, the decrease (compared to 2000) was respectively 55%, 53% and 46% for scenarios S1, S2 and S3 respectively;
- In 2050, the decline increases and is respectively 67%, 65% and 56% for scenarios S1, S2 and S3 respectively.

3.3.4.3. The Ziga Dam

In general, the trend of increasing flows recorded on the observed rates will fade in the future, and there will be a downward trend, but with high annual variability. More specifically with respect to the base year 2000, we note that:
- In 2025, the flows will undergo a decrease of 36% and 24% for scenarios S1 and S2, and an increase of 17% for the S3 scenario. The range of variation thus being -36% and +17% for all three scenarios;
- In 2050, the declines will be more pronounced with 49% for S1 and 36% for S2. The increase will be slight for S3 (23%). This gives a maximum variation range of the flows between -49% and +23%.

Figure 37 shows the evolution of annual flows for the three scenarios in Wayen.

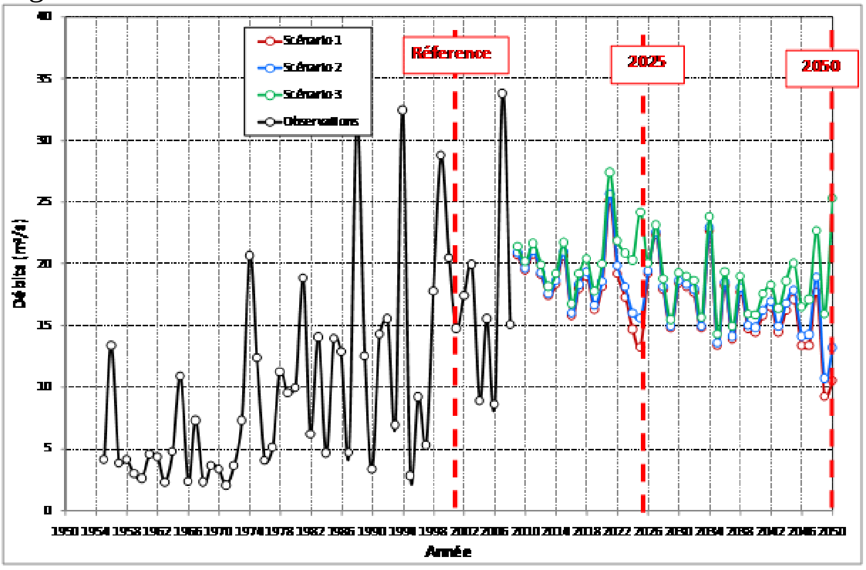


Figure 37: Evolution of annual flows for the three (3) climate change scenarios on the basin of the Ziga Dam (Wayen station).

From the water balance, we determine the volume of water available for drinking water supply for Ouagadougou. Compared to the base year 2000 we notice:
- In 2025, an increase in available volumes by 5%, 8% and 16% for climate change scenarios S1, S2 and S3 respectively;

- In 2050, we have rather declines of 14% and 10% for scenarios S1 and S2. S3 scenario indicates an increase of 4% of the volume of water available.
On the basis of available data (EIA Ziga, 1995), we projected water demand of the city of Ouagadougou considering specific fuel consumption of 100 l/per capita /day in 2025 and 150 l /per capita /day in 2050. It follows total water demand of 129.9 million m^3 in 2025 and 675.8 million m^3 in 2050.

3.3.4.4. *The Samendeni Dam*

Remember that it is a dam at the planning stage. The general trend of standardization of annual flows begun in the 1990s will be interrupted in the future with a more general decline in flows.
Compared to the base year 2000, the following observations appear:

- In 2025, flow decreases regardless of the scenario. They are of 50%, 46% and 33% for scenarios S1, S2 and S3 respectively;
- In 2050, flow decreases regardless of scenarios considered. These reductions are of 56%, 48% and 25% respectively for S1, S2 and S3.

Figure 38 shows the evolution of these flows.

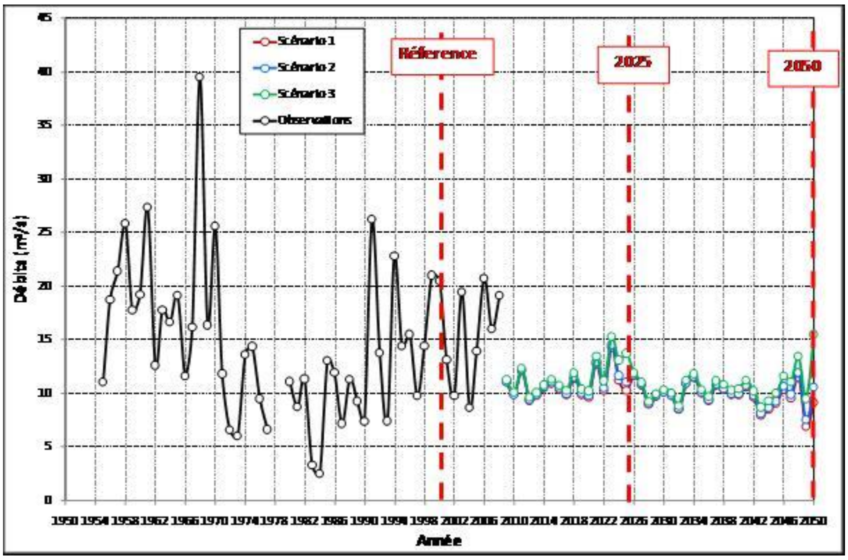


Figure 38: Evolution of annual flows for the three (3) climate change scenarios on the basin of Samendeni.

In terms of monthly flows, the results show that:
- In 2025 and 2050, there is a shift in the body of flood hydrographs compared to the year 2000 with a later occurrence of peak flows in September. The peak flow occurring in August 2000;
- In 2025, the maximum flows recorded declines of 49% for S1, 45% for S2 and 33% for S3 compared to 2000;
- In 2050, these declines are of 54% for S1, 47% for S2 and 25% for S3 still compared to 2000;
- The beginnings and ends of flow occur during the same months in 2000, although we can note lower flows at the beginning of the season for all scenarios.
Figure 39 shows the evolution of these flows.

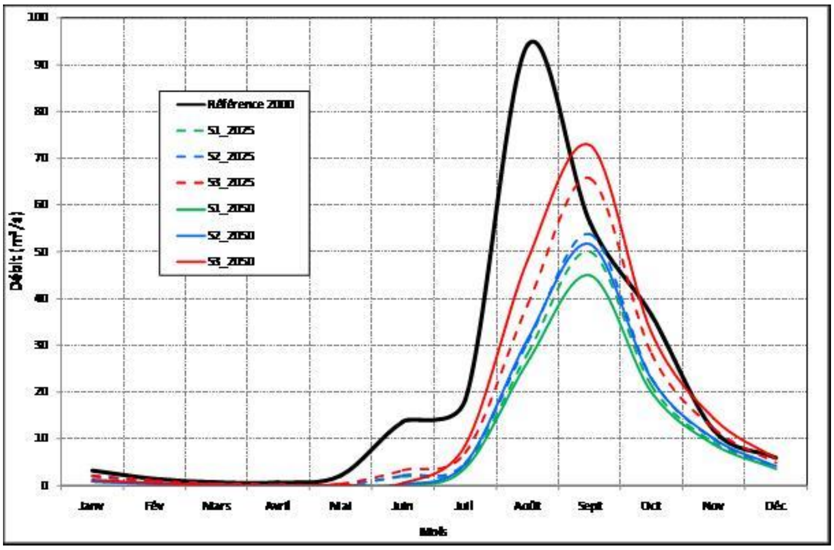


Figure 39: Evolution of the monthly flows for the three (3) climate change scenarios on the basin of Samendeni.

At the filling of the dam, with an initial volume of 50 million m^3, corresponding to the volume of dead storage of the dam, we note that the dam never fills whatever the climate change scenario considered. Indeed, the contributions of the watershed remain well below the storage capacity of the dam, even in the case of an increase in rainfall. Thus the dam seems oversized with a volume of 1.050 million m^3.

The results of the evaluation of energy production based on different climate scenarios show a significant decrease in the production potential of the dam. Indeed, compared to 2000 (fictitious dam), the production of hydroelectricity in 2025 would be divided by 11.0 for S1; 6.5 for S2 and 3.0 for S3. In 2050, hydropower generation would be even lower (divided by 14.4 for S2 and by 2.4 for S3), and even no production for the S1 scenario.

In terms of irrigation, based on the water needs of the perimeter of Samendeni of 15,850 m^3/ ha/year (BERA/STI/LI 2007), we can estimate the irrigated area with the volume of irrigation water from the water balance. The results indicate a significant decline in irrigated areas compared to 2000:

- In 2025, these declines are of 91% for S1, 85% for S2 and 65% for S3;
- In 2050, these declines increase, with 100% for S1, 93% for S2 and 58% for S3.

In the case of reduced rainfall scenarios (S1 and S2), the volume of water is not sufficient for irrigation. This will cause severe damage to the project which has, among other objectives, the development of 23,000 ha on the horizon (2025-2030).

3.3.5. Adaptation

Given the scope of the study and the diversity of the sites studied, the proposed strategies can be made general to all water resources in Burkina Faso. They consist essentially of:

- The creation of a favorable policy and institutional framework

Among the many actions and strategies implemented by political powers to reduce the vulnerability of Burkina Faso to face climate variability and climate change, we can cite among others, the development and adoption of IWRM, NAPA, NCA, the ratification of the United Nations Framework Convention on Climate Change (UNFCCC), the establishment of specialized institutions such as the CONEDD and CONASUR, and cloud seeding actions

(SAAGA program), revision of some policy documents for consideration of climate change (water policy and strategies, strategic framework to fight against poverty, etc.).

- Development and management of water resources

For the development of water resources in response to declining rainfall in the context of climate change, affecting the availability of water on all the sites studied, it is essential to increase the availability of water research and construction of other dams and catchments. It is in this sense that the thinking has already been launched in Bagré where the construction of a second dam (Nialé Dam) is projected by 2015 at about 40 km downstream from the Bagré Dam. Furthermore, it is essential to develop strategies to reduce losses of bodies of water through evaporation in response to the increase in temperature, and therefore in evaporation. At this level, recent technological innovations such as the technique of subsurface dam (for example the one of Nare built in 1997) and artificial recharge, especially in fractured basement area, are highly considered. Individual systems for the collection and storage of rainwater should be encouraged and popularized through the construction of rainwater catchment (on roofs and concessions) and reservoirs. This stored water can be used as a supplement (drinking, housework, gardening, etc.) and reduce the pressure on water resources.

To strengthen the integrated management of water resources, this strategy already underway for the establishment of the IWRM program aims to integrate all the quantitative and qualitative aspects of water, all stakeholders, policy makers and users of the water sector, all hydrological and socioeconomic conditions and water policies and all temporal and spatial scales of the water resource. This requires a concerted management of trans-boundary basins and the establishment of an autonomous management and watershed planning framework (establishment of basin agencies).

These strategies should be supported by improved water management through water mobilization (fight against leaks in dams), its routing (fight against water leakages in pipes and canals) and its use (fight against domestic waste water, improve the efficiency of irrigation). It also involves preservation of the quality of groundwater and surface water to help limit the degradation of water resources. Other measures relate to:

- Monitoring and evaluation of water resources.

This strategy aims to improve understanding of water resources, to promote scientific research, to develop a system of early warning of floods and an Information System on Water (SNIEau);

- Capacity building

This strategy requires awareness, information and communication, training and development of basic skills, equipment and technical tools, legal and administrative framework, mobilizing financing, and finally, cooperation and exchange of information;

- The promotion of fisheries management to improve productivity and production of bodies of water;

- Increasing the efficiency of irrigation perimeters

Measures for this strategy take place through a rehabilitation of irrigation canals, control of water courses and modernization of irrigation equipment. The choice of crops and cultivation techniques should also be improved and adapted.

IV MITIGATION MEASURES

Burkina Faso, like other developing countries and being a contracting stakeholder to the United Nations Framework on Climate Change, has attempted to analyze mitigation of greenhouse gases emissions.

This effort involved energy and agriculture sectors because of the difficulties related on the one hand to data availability and on the other to the complexity of the use of planning/modeling of scenario. Indeed, the lack of disaggregated data has not enabled to use tools such as LEAP for energy sector and COMAP for forestry sector. The approach consisted in identifying some mitigation actions not included in the sectoral plans or programs regarding energy and agriculture and translating them into mitigation options. The emissions avoided by the implementation of these options have been evaluated. The costs of the selected options have been assessed.

4.1. Analysis of GHG mitigation

The inventory of greenhouse gases in 2007 shows that the key sources of GHG are respectively ranked as follows: agricultural soils (37.8%), cattle enteric fermentation (32.3%), Sheep (6.1%), goats (3.9%), terrestrial transport (3.3%), solid waste (3.1%), the management of manure stored in dry lands (3.1%), energy industries (1.6%), donkeys enteric fermentation (1.2%) , cement production (1.2%), the management of domestic wastewater (1.2%) and the management of cattle enteric fermentation (0.9%). It clearly appears in this order that agriculture sector is the sector producing the most greenhouse gases. As this sector is of paramount importance, implementing restrictive mitigation measures will make the country more vulnerable to climate change.

In this regard, it is worth highlighting that the success of mitigation measures is strongly related to the positive effects they will have on productivity and economies to be conducted on production factors. Producers will not undertake any measures that do not improve the yields of their exploitations.

IGES 2007 shows that LULUCF is a net CO_2 sequester in Burkina Faso because of reforestation projects and programs carried out in the country. This is the reason why it is worth paying great attention to this sector.

Cattle breeding are mainly mobile in Burkina; this age-old practice impedes on important mitigation action aiming at improving cattle’s breeding to reduce enteric fermentation.

Considering these various reasons, two sectors have been selected for the implementation of mitigation measures: energy sector for actions aiming at controlling energy and the use of renewable energy and agriculture sector for the diversion of agricultural residues burned in farms for an energy use.

4.1.1 Energy sector

4.1.1.1 Basic scheme for mitigation

Strategies and actions plans developed in energy sector and which can be taken into account in a baseline scheme can be listed as follows.

Control of energy within administration through the Energy Management Cell charged with implementing electrical energy savings in administrative buildings.

National Strategy as regards traditional energies: this planning tool regarding energy policy in the traditional energies sub-sector is currently discussed among the main affected bodies. This strategy will contribute in reducing the pressure on ligneous resource through forestry developments in order to achieve a sustainable production of wood energy and to promote energy economies by the use of improved stoves and the search of alternative energy.

National policy regarding biofuels: being drafted this strategy is developed through the Interdepartmental Committee in charge of Coordination Development Activities of Biofuels Sectors in Burkina Faso (CICAFIB).

The National White Book (NWB): The NWB aims at bringing energy to contribute effectively to meet the Millennium Development Goals ((MDG) and to reduce poverty. Such energy options concern connecting the electrical network to renewable energies powers plants and to the development of the community or individual photovoltaic system.

While considering a basic scenario where Burkina will as usual meet the energy demand through an increase of the energy supply until (2020), end of the current planning period in energy sector, mainly by relying its strategy on oil products (fossil energies) and importing electricity. This scheme is characterized by the following points:

- increase of the population to more than 21 million in 2020 with a growth rate estimated at 2.9% ;
- access rates to electrical energy to 100% in urban areas and to 49% in rural areas in 2020;
- Technical options to energy access dominated by that of the network and that of heat-energy to 72% in 2020 with the achievement of the dam of Samendeni, for a hydro-electrical production of 16 Gwh/year and the interconnection between Bobo-Dioulasso and Ouagadougou for a power estimated at 85 MW;
- The demand in fossil energies going from 15% in 2004 to 25% in 2020 while the demand in biomass will undergo a decrease going from 85% in 2004 to 75% in 2020.
- In Burkina Faso, the access to motorization in rural areas relies on the multifunctional platform (MP). In addition, there is the establishment of supplying lighting systems in drinkable water by using MP with networks micros in the areas with populations estimated between 1,000 and 3,500 inhabitants. Meeting the MP objectives therefore requires a synergy of actions with development sectors. The program is going ahead with the vision 2020 which has set a policy of access to coherent energy services with scheduled sectoral facilities.

- Most of the platforms operate with Diesel groups supplied by fossil hydrocarbon. Establishing a short local production channel of biofuels to supply MP will enable to reduce the emissions related to this rural motorization program.

4.1.1.2 Mitigation scheme

This scheme specially concerns measures whose implementation will enable to further mitigate GHG emissions. This includes the following actions:

- **Action 1:** consolidate the actions for controlling energy through the use and replacement of current lamps by more efficient lamps by targeting households and tertiary sector. The feasibility study for developing an energy-efficient project by the use of power-saving tubes initiated by SONABEL and UNDP in 2009 has served as a reference[1]. During this study, the survey has enabled to count the kind, number of lamps and the using time for the year 2008 (table 28). These data have been proportionally extrapolated to other years to the development of consumers numbers per year.

Table 29: Mitigation options by substituting economic lamps

	Baseline scheme		Mitigation scheme			
Kind of lamp	Power demand (W)	Kind of lamp	Power demand (W)	Energy saving per lamp unity (W)	Average time use (h)	Saving/year /lamp (kWh/an/lamp)
Fluorescent tube of120 cm	45	adaptater + T5	31	14	2,35	12,0
Fluorescent tube of 60 cm	28	adaptater + T5	17	11	1,28	5,1
Incandescent lamp of 40 W	40	LFC of 15 W	15	25	1,79	16,3
Incandescent lamp of 60 W	60			45	1,46	24,0

Source: SP/CONEDD-DCN

Relying on the historical trend of the development of SONABEL consumers 'number between 1997 and 2007, the number of the upcoming consumers have been assessed. It is assumed that there will be a constant distribution of the kinds of lamps in the future and a maintenance of the time use for each kind of lamp as observed in the survey regarding the feasibility study for developing an energy-efficient project by the use of power-saving tubes initiated by SONABEL and UNDP in 2009.

[1] The feasibility study for developing an energy-efficient project by the use of power-saving fluorescent tubes UNDP-BF/SONABEL, January 2009

By 2030, 8,083,140 lamps will be established according to the following distribution: 82% of lamps T5 (31% lamps of 120cm and 52% lamps of 60cm) and 8% of fluo compact lamps.
Purchasing lamps whose cost is evaluated in accordance with the best offers of SONABEL survey market is evaluated at 29,106,363,925 FCFA corresponding to about 58 million US $. Over the period 2015-2030, (the consumer is responsible for the lamp whose lifetime is coming to an end), the accumulation of CO_2 emissions is estimated at 336Gg. The investment per ton of CO2 avoided is therefore estimated at ((172 $ tCO_2).

If the option for achieving efficient lighting has been chosen, it is therefore important to open the mitigation action opportunities on the overall equipments for energy use such as the high-quality cooling producing systems (air conditioner and refrigerator). Promoting public transport is also a solution to be explored.

- **Action 2:** Ensure every ten years, the establishment of 20 MW solar PV related to the network. The year 2015 is planned for the operationalization of the first power plant, the second being scheduled for 2026.

The produced energy has been evaluated at 26.3 GWh until 2025 and 52.6 GWh from 2026 by considering a factor using solar system to 15%. These productions allow avoiding 253.5 Gg tCO_2 from 2015 to 2030. The system investment has been evaluated at 136.4 billion FCFA (278.8 million US $)[3]. While taking into account the lifetime of each system, about (25 years), investment per ton of avoided carbon is estimated at 443.2 US $ tCO_2).

Considering these two mitigation measures has enabled to assess the development of emissions reductions of the energy production category (figure 40).

[3] Average cost of the Project in Germany and Korea (5.2 million of Euros/MW)

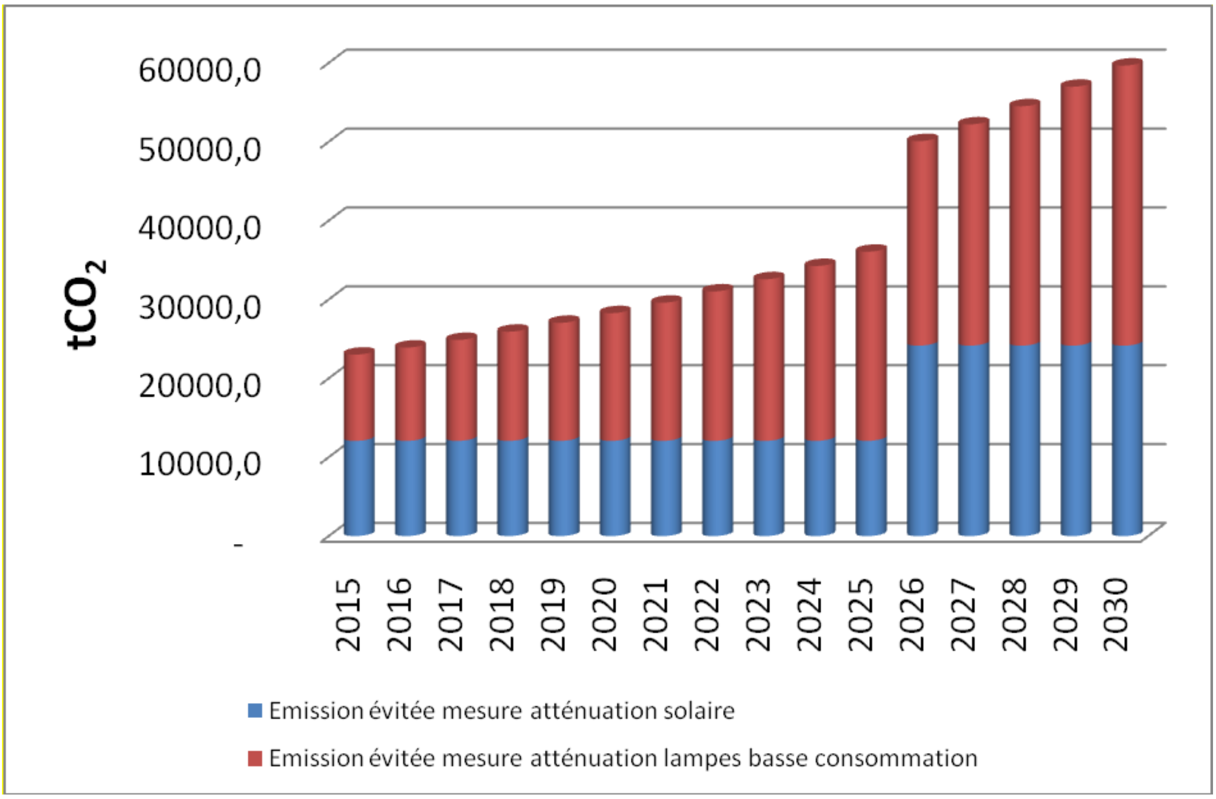


Figure 33: Evolution of emissions reductions in energy sector

4.1.2 Agriculture sector

4.1.2.1 Baseline mitigation scheme

The Rural Development Strategy (RDS) is the reference framework for the overall actions in rural sector by 2015 with the promotion of agricultural, forestry, fauna, fisheries and pastoral sectors as the development priority. In order to operationalize such national guidance and strategies, public authorities have undertaken a certain number of measures among which we can mention the development of action plans related to strategic sectors and the implementation of projects/programs for promoting the following agro-sylvo-pastoral sectors:

- The action plan of rice sector which aims to develop about 2,500 ha of low lands ;
- COTTON action plan
- The action plan of cattle/meat sector intending among others, at improving the genetic potential of local races, including enhancing the various rations to achieve the cost-effectiveness of feeding operations, and increasing the value of agricultural residues (straw from the various cereals) in animal feeding with the treatment using urea;
- The action plan of integrated management of soils fertility aiming among others at turning residues coming from harvests into organic manure;
- The action plan regarding agriculture mechanization aiming at improving equipment rates in the various areas of Burkina mainly through the development of the animal draught cultivation;

- Valorizing cow dung by producing biogas will also contribute to mitigate the GHG emissions. Indeed the project entitled “**Biogas for better life**” plans to establish more than 25, 000 biogas units in order to increase the value of the dung of 75, 000 cows stored by 2015.

4.1.2.2 Mitigation scheme

a) Mitigation options

The mitigation options in agriculture sector are among others the following:

- Improving the composition and use of the cattle’s feed in order to reduce enteric fermentation;
- Improving the management of cultivated lands and pastures and recovering soils and deteriorated lands;
- Enhancing manure management systems including composting practice;
- Reducing burning practice of harvest residues in farms.

Few years ago, the government of Burkina Faso had undertaken a dissemination campaign for the production of organic manure by promoting composting pits. This initiative should go on with the support of programs such as the program for community investment in agricultural fertility (PICOFA) and the agricultural development program of GTZ (PDA/GTZ).

As for the improvement of the management of cultivated lands and the recovery of deteriorated lands, several initiatives have been undertaken through the practices of techniques for collecting and storing water as zai, djengo or half-moon. To slow down the water streaming and soil erosion, several techniques such as stones and grass strips have been developed (cf. paragraph 3.2.5.2).

Cattle breeding are mainly mobile in Burkina. This practice impedes on a large-scale action which aims at improving cattle feed for the reduction of enteric fermentation.
Limiting burning practice of agricultural residues in farms could be a mitigation scheme likely to involve agriculture sector. Collected residues can be used to produce electrical energy.

b) Mitigation scheme choice

Given the lack of specific information about the mitigation options described as follows and the complexity of modeling their future impacts, only one action has been selected to build up the mitigation scheme of agriculture sector. This deals with reducing burning practice of harvest residues in farms. This reduction is got by collecting the waste of cotton plant stalks for gas generators combined to generators for electricity production.
The current practice on cotton culture is stockpiling of saplings and burning them on farms for phytosanitary reasons. The option to produce electricity from this waste will allow meeting the challenge of increasing electrical supply in rural areas. This option has been studied[1] and

[1] *General Directorate of Energy (DGE) ; Francophone Institute of Energy and the Environment(IEPF)*
“Feasibility Study of Integrated Electricity Production from Biomass in Burkina Faso”

is currently on trial in Pô in the prospect of establishing two units of 250 KW in Pô and Garango [2].

In the mitigation scheme, the principle for using this technology is the establishment of a capacity of 250 KW on each cotton grinning unit for the unit consumption. The additional electricity will be supplied by the local network. Burkina has 18 grinning units from which the electricity production units will be established. This is expected on the short term to reach 20[3]. To get benefit from the feedback of experience regarding Garango and Pô units, the mitigation schemes will only be established and made operational from 2015.

Substituting fossil electricity will bring about a power-saving of 900g of CO_2/kWh of the produced electricity.

The data relating to investment cost have been received from promoters from the units of Pô and Garango. Establishing 20 units will cost 12.1 billion FCFA (24.2 million US$) and will save 29.6 kt$CO_2$ per year. The table 30 presents the calculation of gazo-power plants, the emissions avoided and investments to be achieved.

[2] NOVIS-ATMOSFAIR: Steering Project for Exploiting Agricultural Residues for Rural Electrification in Burkina Faso : Electricity from Biomass gasification for Pô and Garango

[3] Minister in charge of the mission to the President of Faso, Charged with analysis and prospect « Retrospective Study on Cotton sector in Burkina Faso » October 2008.

Table 30: Productions of gazo- power plants and emissions of CO_2 avoided

Number of grinning units	Number of gasification units to be established	Unit power (kW)	Total Power	Energy produced per year GWh	Quantity of cotton stalks consumed (tons)	Avoided emissions (tons)	Investment cost (FCFA) $ US	Investment cost per ton of CO2 $US
20	20	250	5.000	32,85	27.375	29.565	24.270.000	820,9

Source: SP/CONEDD-DCN

Investment cost per ton of CO_2 avoided per year is estimated at 410,452 FCFA/tCO_2 (820.9 \$/tCO_2).

Implementing mitigation actions should cause a change in the national market likely to bring about a decrease in the equipments costs and therefore in that of the ton of CO_2 avoided.

4.2. Constraints for the implementation of mitigation schemes

4.2.1 Technical constraints

The main constraints are the difficulties for getting specific data on certain technologies that could be used within Burkina context to achieve mitigation. Despite the fact that research organizations are available to invest in the capitalization of such necessary data, it is worth noting that weaknesses or even the lack of resources do not facilitate the research initiatives in this extent. Therefore, actions aiming at implementing mitigation through mechanisms such as MDP are difficult to be developed.

4.2.2 Financial constraints

During the development of the CNI priority projects on climate change in Burkina Faso, getting the funding from the United Nations Framework Convention on Climate Change (UNFCCC) was scheduled. However, the UNFCCC was deemed to be a facilitator and not a donor which has significantly changed the initial orientation reserved to the funding issue of these projects. Searching other funding sources at the international level did not provide promising outcomes. Thus, we note the main priority projects carried out is the responsibility of the CNI’s independent planning.

The access to funding for acquiring equipments related to renewable energies is also a challenge in the environment of the proposed financial services. Indeed, the funding private institutions have generally financial products not adapted to this kind of investment whose cost-effectiveness varies over time.

4.2.3 Constraints on the institutional level

The various priority projects identified in CNI had a cross-cutting character in several domains (energy, agriculture, forestry, cattle-breeding, hydraulics, industries, etc.) and required the involvement of the stakeholders of such fields. Unfortunately, the importance of such projects has not been seized and has been “a concern” for only the Minister in charge of environment.
The priority projects should be perceived as a reference framework of the national important projects whose implementation must involve the overall affected national sectors to better consider the issues related to climate change on the global and sectoral level. SP/CONEDD will play a coordination role.

4.3 Supporting measures for the implementation of mitigation measures of DCN

For a better implementation of the second national communication of Burkina Faso about climate change in Burkina Faso, a certain number of supporting measures are deemed necessary.

4.3.1 At the institutional level

It is suggested to create a sustainable organization with a leader (SP/CONEDD) to carry out inventories. Being a state structure providing statistic data, INSD should play a major role in this organization.

The other key technical ministries such as ministries in charge of forests, agriculture, animal resources, research, finances and economy, energy, trade, have also their contributions to bring.

4.3.2 At the technical and research plan

The need to have certain parameters taking into account realities of the national context such as the factors of greenhouse gases conversion and emission of is essential. In this regard, it is worth privileging national research (CNRST, CNSF, Universities…) to bring solutions.

4.3.3 At the tax system level

As for the tax system level, a preferential taxation policy in favor of mitigation equipments or technologies should be contemplated in consultation with the ministry in charge of finances and that of commerce (FASONORM as an example).

4.3.4 At the organizational level

This deals with:

- Involving the overall concerned organizations by the issue regarding climate change to the process to be undertaken.
- Defining clearly the roles of the various stakeholders in order to avoid the competence conflicts and the repetition of the actions to be carried out;

- Creating a permanent and efficient consultation framework over the issues related to climate change.

4.3.5 At the legislative and regulatory level
This deals with proposing the necessary legislative and regulatory texts towards:

- Acquiring technologies ;
- Disseminating and awareness campaigns about climate change.

It is necessary to take into account the issues related to the normalization, enforcement of regulatory texts in connection with bush fire, lands clearing, environmental assessments and inspections, etc.

4.3.6 At the financial level

4.3.6.1 Internal funding

a) Funding from the state

Contribution from the State budget could come from:

- The national contribution of projects and programs about climate change ;
- The State contribution at the level of Conventions ;
- Tax and customs exemptions;
- Preferential tax system ;
- Grants

b) Funding from the decentralized public authorities

The decentralized public authorities will be involved in the various funding to achieve facilities for environment management within their region. Decentralized authorities could explore the funding possibility through the opportunities provided through twinning system.

c) **Funding from the private sector**

This includes establishing mechanisms likely to urge the private sector to further invest in the issues related to climate change through for examples improvement systems for industries or companies meeting certain criteria related to the consideration of the climate change dimension in their activities.

4.3.6.2 External Funding

- **Bilateral and Multilateral Cooperation**
- **Global Funds for Environment**
  - Global Environment;
  - Special Climate Change Funds;
    - Mechanism for a Proper Development.

V. RESEARCH AND SYSTEMATIC OBSERVATION OF CLIMATE CHANGE IN BURKINA FASO

5.1. National network for the systematic observation of the environment and climate

5.1.1. Weather observation network

At first, meteorological activities in Burkina Faso consisted mainly in rainfall monitoring led by the missionaries of the Catholic Church from 1902 and the colonial administration thereafter. On December 12, 1959, the Agency for the Safety of Air Navigation in Africa and Madagascar (ASECNA) was created and meteorological activities were then mainly directed towards supporting Air Navigation. It was not until 1972 that the country established a National Directorate of Meteorology by Decree No. 72-278 / PM / MTT / T / URB dated 30/12/1972. This department is under the authority of the Ministry of Transport. It falls within the Directorate General of Civil Aviation and Meteorology (Garané, 2010).

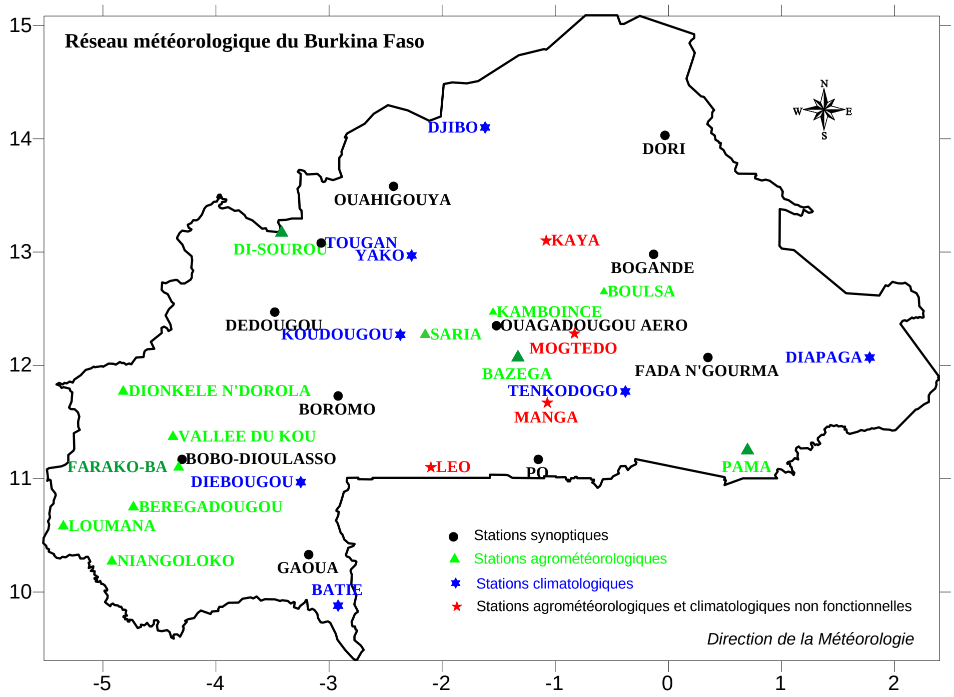
The Department of Meteorology is responsible for:

• The management of the meteorological observations network (strengthening, monitoring, maintenance …);

• The collection, processing and archival storage of meteorological and climatological data;

• The development and dissemination of weather, agro meteorological and climatological information and products to support the various sectors of socio-economic activities in the country (civil aviation, agriculture, livestock, forestry, health, education, environment, energy, construction and public works, etc.).

To fulfil its duties, the Department of Meteorology relies on a network of observation and measuring stations (Map 8)



Source: Department of Meteorology

Map 8: Network weather observation Burkina Faso

The network includes:
- 10 synoptic stations,
- 09 functional climatological stations,
- 03 non-functional climatological stations,
- 20 agro-meteorological stations.

The basic piezometric network comprises fifty four (54) observation sites and one hundred and nineteen (119) measure points.

In addition we note:
- ***A hundred and thirty (130) rainfall stations***
- ***A radiosonde station*** and a receiving device for satellite imagery and analysis products including: A MSG Station, a MDD, a PDUS and a SADIS located in Ouagadougou at ASECNA;
- ***Two weather radars*** based in Ouagadougou and Bobo-Dioulasso, which were acquired by the SAAGA Program.

The factors that are weaknesses for the meteorology of Burkina Faso concern the observations and measurements network, the national data and products processing, management and dissemination system and human resources. Indeed, the low density of measurements network makes it difficult to characterize the inter- and intra-seasonal variability of rainfall which is very significant in the Sahel but also prevents a close monitoring of convective phenomena.

5.1.2. Water resources observation networks

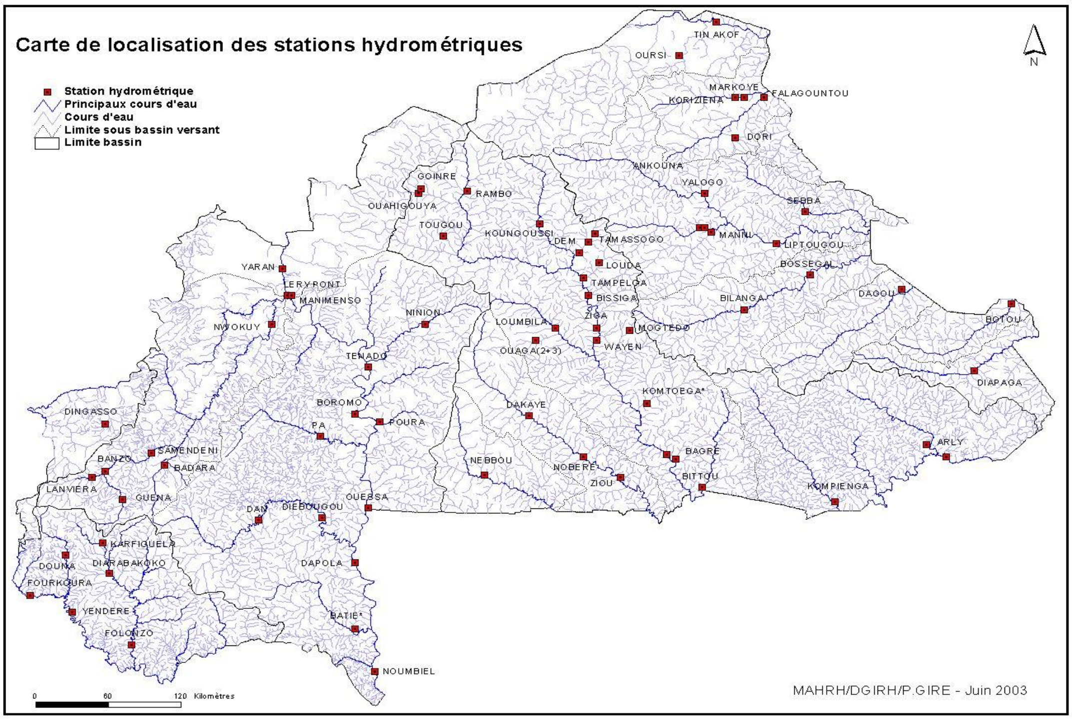
Knowledge of the water resource and its uses (works, quantities used, pollution, consequence on the resource and the environment, risks, and so on) is the basis for rational water management and planning.

In Burkina Faso, the first systematic measurements on rivers date from 1952. The monitoring and measures on water resources have been entrusted to the Directorate General of Water Resources (DGRE) of the Ministry of Agriculture, Water and fishery Resources. This structure responsibities include:

- National Water Policy;
- GIRE and AEP sectoral policies and water resources mobilization through the construction of dams.

The current hydrometric network includes 94 stations on rivers, dams, lakes and natural ponds. The observations focus on changes in the water level and rate of flows of the river. The map 9 below shows the location and distribution of measuring stations.

The basic piezometric network comprises 54 observation sites with 119 measurement points.



Source: MAHRH / DGRE 2003
Map 9: Hydrometric measurements network of Burkina Faso

5.2. Institutional arrangements and major research programs on climate change

5.2.1. Institutional arrangements

5.2.1.1 CNRST

The National Centre for Scientific and Technological Research (CNRST) ensure the coordination and monitoring of all scientific research conducted in Burkina Faso, by both national and foreign structures operating on the territory of Burkina Faso.

It originates from the Black African Fundamental Institute (IFAN) created in France during the colonial period and which branch in Upper Volta was installed in 1950. The structure has become the Voltaic Centre for Scientific Research (CVRS) in 1965 and later the National Centre for Scientific and Technological Research (CNRST) since 1978. It is currently a public building with a scientific, cultural and technical purpose (EPSCT) under the Ministry of Secondary and Higher Education and Scientific Research (MESSRS).

The tasks assigned to CNRST include among others:

- ✓ helping define, develop and implement the national policy as regards scientific and technological research;
- ✓ developing, implementing and monitoring scientific and technological research programs;
- ✓ disseminating scientific and technical information;
- ✓ participating in the scientific training of staff;
- ✓ exploiting the research conclusions and promoting their use by the public.

To effectively achieve its mission, CNRST has developed several core services including the National Development Agency for research conclusions use (ANVAR) and the National Forum of Scientific Research and Technological Innovation (FRSIT) which is organized once every two years. Operational research institutes are:

- ✓ Environment and Agricultural Research Institute (INERA);
- ✓ Applied Science and Technology Research Institute (IRSAT);
- ✓ Health Sciences Research Institute (ICES);
- ✓ Institute of Societies Science (INSS).

All these institutes running several research programs in laboratories and specialized units tackle, to various degrees, aspects related to climate change, particularly in the area of adaptation to its adverse effects.

5.2.1.2 Universities

a) The University of Ouagadougou was founded in 1974 with only 374 students. It now has more than 30,000. Called second-generation university, it started its academic activities by means of Schools and Institutes. Since the reform in 2000, it operates on the basis of research and training units (UFR) and has a legal status of public institution with a Scientific, Cultural and Technical vocation (EPSCT).
Among the objectives of the reform can be noted, among others, the need to:

- open the temple of knowledge to its environment, Burkina society;

better guide academic research towards finding solutions to the development issues for the well-being of the people in all areas;

- Intensify the development of new information and communication technologies (Internet, computers, and distance learning...).

To meet the growing demand of students, the state has created a second university in Ouagadougou (Ouaga 2 University).

b) The Polytechnic University of Bobo-Dioulasso (UPB) was established in September 19, 1995, by Decree No. 95-340 / PRES / MESSRS as Polytechnic University Centre of Bobo-Dioulasso (CUPB). On May 16, 1997, the adoption of Decree No. 97-254 / PRES / PM / MESSRS turned the CUPB into the Polytechnic University of Bobo-Dioulasso (UPB). The creation of the UPB was led by a policy of decentralization of higher education in Burkina Faso.
The Polytechnic University of Bobo-Dioulasso is a public institution with a scientific, cultural and technical vocation (EPSCT), responsible for higher education and scientific research. It is a national university whose mission is the development and transmission of knowledge for the training of men and women with a view to meet the needs of the Nation. To achieve that goal, the UPB has the following objectives:

- ✓ train executives in all areas in general and vocational courses in particular;
- ✓ conduct scientific research and disseminate results;
- ✓ raise the technical, scientific and cultural level of the students for an opening on the labour market and production sectors;
- ✓ grant degrees and diplomas;
- ✓ develop skills in all sectors of the country.

c) The University of Koudougou opened in the 2005/2006 academic year. It joined the Ecole Normale Supérieure de Koudougou (ENSK) whose mission is the academic and pedagogical training of secondary school teachers and the retraining of basic education actors.

The University of Koudougou (UK) has five training and research units (UFR), two schools and one institute.

Several universities as well as research and higher education centers currently exist in the country among which:

d) The private higher education universities and centers
Universities created by the National Council of Catholic Education (University of St. Thomas Aquinas in Ouagadougou, the academic units of Bobo-Dioulasso and Kaya, local campuses of the West African Catholic University (UCAO); the University Libre de Bruxelles (ULB), and so on.
Burkina Faso thus has a great potential for training and research facilities that can be successfully used in the field of climate change.

5.2.1.3 Structures depositary of relevant data for IGES

The other structures are mostly used as depositary sites of relevant data for the assessment of greenhouse gas.
They include:

State institutions

- The National Council for the Environment and Sustainable Development (CONEDD);
- The Bagré Project Management (MOB);
- The Sourou Valley Development Authority (AMVS);
- The National Centre for Scientific and Technological Research (CNRST);
- The Environment and Agricultural Research Institute (INERA);
- The Applied Science and Technology Research Institute (IRSAT);
- The Direction of Meteorology (DM);
- The University of Ouagadougou (OU);
- The Polytechnic University of Bobo-Dioulasso (UPB)
- The National Bureau of Soils (BUNASOLS);
- The National Institute of Statistics and Demography (NISD)
- The General Directorate of Promotion and Rural Economy (DGPER) / Agricultural Statistics Forecasting Department (DPSA)
- The Animal Statistics Service (SSA);
- The Geographical Institute of Burkina (IGB)
- The Directorate of Inputs and Agricultural Machinery (DIMA)
- The Directorate of Plant Protection and Packaging (DPVC);
- The General Directorate of Water (DGRE);
- The General Directorate of Agricultural Water (DGHA);
- The General Directorate of Nature Conservation.
- The National Meteorology (Ministry of Transport)

Private institutions, mixed economy and projects

- The Fibers and Textiles Company of Burkina (SOFITEX);
- The National Union of Cotton Producers of Burkina (UNPC-B);

- The National Union of Agricultural and Market Gardening Cooperatives of Burkina (UCOBAM);
- The New Sugar Company of Comoé (SN-SOSUCO);
- The National Office for Water and Sanitation (ONEA);
- The Burkinabe Leather Company (SBC);
- The Refrigerated Slaughterhouse of Ouagadougou (AFO);
- The National Land Management Programme (PNGT);
- The SAPHYTO;
- The Agro-Pastoral and Industrial Company of BURKINA (FIR / B);
- The Agricultural and Chemical Products Trade Company (SOCOPAC).

Regional or international institutions
- Research Institute for Development (IRD);
- Centre for International Cooperation in Agronomic Research for Development (CIRAD);
- The representation of FAO;
- The International Union for Conservation of Nature (IUCN);
- The International Institute for Water and Environment (2IE former EIER);
- The Center for Research on Water Supply and Sanitation (CREPA);

In almost all cases, paper and digital media are the support used in the archiving system. The data consultation is usually done on the spot.
Unfortunately, there is no formal framework for communication between the different actors on the assessment issue of greenhouse gas emissions.

5.3. Analysis of the limitations of the research and systematic climate change observation

Several factors are limiting the research and systematic observation of climate change. Among these factors, can be cited:

• The low density of the measurement network, which makes the characterization of the inter and intra seasonal variability of rainfall difficult, but also the high cost of the networks management and maintenance, observations and monitoring;
• The lack of qualified staff especially in the areas of database management, statistics and computer programming;
• the slow recovery of data: the Directorate of Meteorology can only receive data in real time from 10 synoptic stations, which is insufficient for an operational analysis of the agro-meteorological situation in the country and characterization of floods;
• The insufficiency of human resources.

VI. EDUCATION, TRAINING AND AWARENESS OF PEOPLE ON CLIMATE CHANGE

6.1. Climate change in the curricula of education and formal training

The curriculum incorporating aspects related to climate change, mainly concerns:

- Climatology;
- Bioclimatology (water-soil-plant-atmosphere relations and techniques to improve the crops water balance);
- Dynamic climatology and climatic geomorphology;
- Water Projects in response to CC;
- Droughts, climate change projections and future of pastoralism.

6.2. Effort to raise public awareness of climate change

The COP15 of Copenhagen really appears as a major turning point in public awareness about CC, which had hitherto been the domain of a few specialists. Many were not aware that a global meeting is regularly held to discuss issues that affect all humanity. This fact can be explained by various constraints among which:

i. The lack of national expertise in the various technical areas of climate change. At this level, the Department for the Environment (focal point international conventions post Rio) is itself inadequately equipped. In addition, it appears that State officials lack the will, availability or simply interest in engaging in such great issues;
ii. The not yet effective involvement of government departments other than the one in charge of the Environment in the management of climate change-related issues.

iii. The lack of national mechanisms for a minimum financing of the management of this type of issues, for example through the CC National Committee, and the lack of financial means to implement capacity building measures.

6.3. Need for capacity building

Given the importance of the different sectors of the national economy and their sensitivity to climate change, we can identify seven (07) priority areas of activities to be considered for priority actions to strengthen national capacities and transfer technology; these are:
- Agriculture (including livestock);
- Water resources;
- Forestry;
- Energy;
- Health;
- Data collection and management;
- Policies, strategies, programs and projects.

These areas have, however, been retained in the initial communication.

It is worth noting that several initiatives were undertaken or are taking place in the country as regards capacity building in the field of climate change.
Without being exhaustive:

- **UNDP / GEF RAF02-G31 project "Capacity Building for Improving the Quality of greenhouse gas emissions assessment in Francophone West and Central Africa.**" The project has trained several national experts in the field of greenhouse gas emissions assessment in 14 African countries including Burkina Faso. It also helped develop a manual of procedures for national GES inventories;

- **The National Partnership Program for Sustainable Land Management (CPP)** whose objective is "to sustainably improve the productivity of rural resources through the use of an integrated and holistic approach allowing Burkina Faso to achieve its millennium development goals related to the reversal of the current trends of its environmental resources loss. "

- **Projects / programs related to climate change in the forestry sector, among other projects:**

- Integrated Rural Development (IRDP)
- National reforestation (PRN);
- Forest management (SNFP);
- Management of rural areas (PNGT);
- Sustainable management of traditional energy sources;
- Fire management in rural areas.

- **The National Action Plan for Adaptation Development Process (PANA**). This activity has gathered several national experts who were trained, especially in the field of vulnerability and adaptation to climate change;
- **The implementation of PANA** is done through three (3) projects aimed at:

- Capacity building for adaptation and reducing vulnerability to climate change in the agro-forestry-pastoral ***(PANA-BKF-UNDP-FEM Project***) field;

- Capacity building of technical services, local authorities of regions and those of towns and villages, elected officials, policy makers and technical and financial partners on climate change for human security in Burkina Faso (PANA-BKF-UNDP-DANIDA Project);

- Achieving a better suitable process for municipal, regional and national developments in Burkina Faso by incorporating risks and opportunities related to Climate Change ***(PANA-BKF-UNDP-DANIDA project***).

- **The Poverty-Environment-Initiative (IPE) project of Burkina Faso** supported by the UNDP and the UNEP for the integration of environmental issues in the planning and budgeting with a view to support the achievement of the MDGs;

- **The National Capacity Building Self-Assessment project (NCSA)** about the priorities of capacity building for a better management of the global environment including the implementation of the three Rio conventions in addition to POPS and water.

VII STRENGTHS AND WEAKNESSES OF THE NATIONAL COMMUNICATION PROCESS AND RECOMMENDATIONS

7.1 Elements of analysis of the two communications in the country

Since the first national communication, a project of capacity building funded by the Kingdom of Denmark has helped to contribute to the implementation of NAPA through activities of sensitizations on environmental challenges as well as the adverse effects of climate change and the operational and managerial activities of capacity building of the structures (devolved, decentralized, populations, services, decision-makers, elected representatives). To do this:

- (8) regional training workshops involving 13 regions of Burkina Faso on the implications of climate change for key sectors of the economy in each region, gathering the Governors, the High Commissioner, Mayors, counselors, officers and directors of the regional and provincial technical services were organized for 480 people;
- (168,810) people have been sensitized on climate change through the mass media;
- A network of journalists and communicators from the Circle of Information in Climate Change (CIC) is functional with its 20 local offices. This network has sensitized 45,000 people;
- A network of parliamentarians in climate change has been established;
- A coalition of civil society on climate change was also born;
- An awareness workshop was organized to the attention of all the Mayors of Burkina Faso on the prevention and management of disasters in a changing climate;
- (5) teaching aids of awareness and training developed among which 995 simplified NAPA and 2085 other teaching aids distributed;
- 7500 simplified documents of NAPA, translated into national languages (Fulfulde, Dioula, Mooré and Tamasheq) were multiplied for the populations.

In addition, Burkina Faso organized in 2009, the Global Forum on Sustainable Development with as theme: "Climate Change, what opportunities for sustainable development?" Two thousand (2000) participants representing the major countries of the world, heads of state, world leader personalities, the various organs of the United Nations, representatives of regional organizations, sub-regional and international NGOs, Business and Society civil, Centers and Research Institutes or training, special guests took part in the forum of Ouagadougou.
This forum of Ouagadougou in its objectives, on the one hand contributed to the consolidation of the African common position for the COP 15 and COP / MOP 5 held in December 2009 in Copenhagen, and on the other hand, to a greater awareness of stakeholders at all levels on the issue of climate change.

In addition, Burkina Faso has been involved on 1st September 2009, in exceptional floods which have caused loss of life and many damage estimated at over 70 billion francs CFA. This extreme climatic event more challenged decision makers and raised awareness of the suffering people.

Despite these efforts to raise awareness about climate change, much remains to be done in the field to reach the optimum level of awareness and receipt of documents such as this national communication on climate change.

7.2 Analysis of some specific aspects

7.2.1 The availability and reliability of activity data for GHG inventory

For the INC, the basic data on the GHG emission sources, particularly in the sectors of consumption of electricity, hydrocarbon, or the production of solid waste, were available. Quantitative data were generally known, but not necessarily kept and systematically less managed. However it is not the case for biomass consumption.
In the area of industrial Processes, it suits to note a significant evolution in the national industrial fabric between the reference year of the INC (1994) and the one of the SNA. All industrial units in the country were classified as food-processing industries and declared non-producing of GHG. The evolution, both from the point of view of the number of industrial units and in the diversity of the processes that they use necessitated to take into account the emissions related to this sector in the SNA.

In the forestry sector, such as the use of biomass and changes in land use and agricultural sector, reliable data are not always available on a national scale on the evolutions in the area and quantities involved. Reliable data undoubtedly exist at local scales but their discontinuity in space and even in time does not permit the relevant national extrapolations. Unfortunately, the lack of means failed to put in place arrangements for the collection and storage of data, observation devices capable of generating standards more adapted to the conditions of the Sahel in general and Burkina in particular. Thus, in the SNA, the configuration is the same as regards the availability and reliability of data in the different sectors.

7.2.2 The reliability of methods and tools for data analysis

An overall deficiency in the INC, concerns uncertainties related to GHG emission factors used by the group of national experts to estimate these emissions lack of features data or relevant to the semi-arid region that owns Burkina Faso. The latter had to content themselves with the default factors provided by the Intergovernmental Panel on Climate Change (IPCC). For the SNA, these difficulties remain that is why the method of estimating emissions called Tier1 (level 1) has been used again for all the categories and subcategories of different sectors. The problems mentioned above (lack of data to evaluate specific emission factors) were not allowed to use higher methods. Moreover, the lack of training of those responsible for collecting data on the use of recommended guidelines and best practices and the lack of a basic network for the systematic collection and storage of data failed to make a quantitative assessment of the uncertainties on the activity data in both the INC and the SNA.

7.2.3 Inventory results

In the INC, the agricultural sector is by far the most responsible for GHG emissions for the year 1994 (4708.4 Gg CO2 equivalent). It is followed far behind by the energy sector (902 Gg CO2 equivalent), the waste sector (352.01 Gg CO2 equivalent). Change in the area of land use and forestry is an important system of GHG sequestering, 1388.7 Gg CO2 equivalent emissions. In the SNA, the trends are the same with levels increase over 1994 variables across sectors. The agriculture sector accounts for the largest portion of the total GHG emissions. In 2007, agriculture alone contributes to 88% (19,096 Gg CO_2 equivalent) of the total emissions, energy accounts for 6% (1.302 Gg CO_2 equivalent), waste to 4% (868 Gg CO_2 equivalent) and industrial processes only 1% (217 Gg CO_2 equivalent). This area was not included in the INC due to the structure of industries of Burkina Faso, dominated by the sub-sector of food-processing industry. The power of GHG sequestration by the LULUCF is almost equivalent to the emissions from the sector but has decreased significantly compared to the INC.

The main GHG considered in the two communications are: CO_2, N_2O and CH_4. INC for which the considered year is 1994, the methane production is dominated by the agricultural sector 94% of the total CH_4 emissions. This is followed by the sectors of waste and change in land use and forestry. Change in the area of land use and forestry ranks first in CO_2 emissions. This is followed by the energy sector. However, forest formations are devices or system capable of sequestering CO_2. Nitrous oxide emissions are low in all sectors. Agriculture is ranked first (nearly 79%) followed by the waste sector (21%). For the SNA, we observe the same trends in all except the carbon dioxide where industrial processes are taken into account henceforth. CO_2 is emitted mainly by the LULUCF (1562 Gg in gross emissions), the energy sector (1,300 Gg) and the industrial processes sector (304 Gg) in 2007.

Agriculture is the sector which emits the most of CH_4 (442 Gg or 92%) far ahead of the waste (38 Gg or 8%) for the year 2007. The agriculture sector is almost the only issue the N_2O in Burkina Faso. This sector is responsible for 99% of emissions of this gas in 2007.

7.3 Recommendations

7.3.1 Making the most visible climate change dimension in AGSSD

One of the major issues in the formulation of the second communication should be the integration of climate change dimension in the policies and strategies of development of the country, especially in the Accelerated Growth Strategy and Sustainable Development (AGSSD).
Efforts have been made in this direction in the latest version of AGSSD and it is hoped that it is effective in the implementation of the latter.

7.3.2 Use of the strategic environmental assessment tool

The Strategic Environmental Assessment as a tool for policy analysis and national development strategies is still poorly known in Burkina Faso. The consistency of national policies and development strategies and the integration of environmental considerations such as climate change, natural resource management (NRM), the conservation of biodiversity and the fight against desertification in frames development planning go through this type of strategic analysis.

7.3.3 Strengthen the synergy between international conventions

The search for synergy in the implementation of conventions called RIO1 appears as a major issue in the next national communication. Almost all actions to fight against desertification and the conservation of biological diversity have obvious attenuators effects on GHG emissions or the effects of absorption or sequestration of these gases.

Beyond the conventions called Rio convention, in accordance with the conclusions of the last conference of the CONEDD, this synergy of implementation should be extended to all international conventions and protocols related to the environment which Burkina Faso has subscribed; this in order to enhance the effectiveness and impact of public and private action.

7.3.4 Mobilize specific expertise

The experience of the formulation of the first national communication revealed the complex nature of the work. She especially highlighted the unavailability or difficulties in mobilizing data in the relevant sectors, as well as the lack of adequacy of the tools of analysis with the local ecological and socioeconomic conditions, as well as the difficulties of control by the local experts, models of calculation or forecast implemented for the cause needs. This experience should be utilized to mobilize in time and, if necessary, train, retrain or recruit the necessary expertise to conduct studies under the second national communication. Unfortunately this was not possible. It should therefore register these actions for the next national communication.

In this direction, it would be suitable for a first step to involve experts from different ministerial departments in a participatory approach to the mobilization and a first shaping of basic data, depending on the format desired for the next national communication.

7.3.5 Improve the level of uncertainty in the estimation of GHG emissions

In view of the observation made in section 4.2 on the reliability of methods and tools for data analysis and the assessment made by the stakeholders themselves to the implementation of the INC, improving uncertainties which characterizes the coefficients of GHG emission due to their adaptation to the local ecological and socio-economic conditions, is an issue that not only exceeds the scale of a single country of the size of Burkina Faso but also involves taking more active and coordinated universities and research centers in the sub-region. This was not made for this second communication and remains a fundamental measure to improve levels of uncertainty in the estimation of GHG.

7.3.6 Strengthen relevant «environmental accounting »

The economic models that provide the basis for strategic planning in developing countries like Burkina are still largely ignorant of environmental issues such as natural resource management, the fight against desertification and the conservation of biological diversity. They are better with respect to more abstract concepts such as vulnerability and adaptability to climate change.

The need to develop, to the attention of executives statistics, taxes, customs, finance and financial backers, an "environmental accounting" to provide quantitative data that can facilitate consideration of environmental issues in plans and strategies of economy development is more than a necessity.

In this sense, and regarding for example the forestry sector, it seems necessary on the one hand to refine national biophysical parameters used for the COMAP model, those employees and take from the model is not from conditions semi-arid, and on the other hand to increase the assessment surveys of socioeconomic parameters (costs, benefits) measures for the protection, management and reforestation.

7.3.7 Develop a strategy of communication on climate change

This is to make the scope of the understanding of the economy players, concerns about climate change and, in particular, which affects the vulnerability and adaptation of the major economic activities. Each economic player in major economic sectors, those the most vulnerable to climate change in particular, has the right to be adequately informed of the links between its activities and these climate issues, as it is his duty to know how it contributes to possible climate changes. Stakeholder consultation showed that the concepts of climate change, greenhouse or vulnerability of an economic sector are fully accessible to all economic players, provided that it is presented in terms of its scope. Therefore it seems appropriate to develop a strategy of communication adapted to various groups of economic players, so that from the individual awareness, it born behavior and consumption patterns compatible with the challenges of climate change.

7.3.8 Adjust the national legislation to climate change issues

The Law on Environmental Code adopted by Burkina Faso in 1997 does not specifically pinpoints issues related to climate change. However the Kyoto Protocol from the Framework Convention on Climate Change has just come into force and offers, particularly through the clean development mechanism (CDM) and the "carbon market" opportunities for the private sector and States to make investments in partnership with other economic players in the North. It seems; therefore, appropriate to adjust the national legislation and regulations in order to create adequate trust conditions for potential investors.

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Annex
Sheets of priority projects

PROJECT-01

Project title :
Capacity building of institutions and professional organizations on climate change.

Beneficiary country : Burkina Faso

Project justification :

The implementation of measures and strategies to adapt to climate change effects is essential in view of the extreme vulnerability of which are subject human beings and systems of production that support them.

So to make realistic forecasts and assess the effects of climate change presupposes the acquisition of tools and scientific knowledge.

It is at this level that the control of modeling as a tool of stimulation and prediction proves highly useful for different stakeholders.
Capacity building in this area will then allow technicians to operate within a framework of planning, including a small margin of error in the future

Expected outcomes :

Capacity building of technicians from sectors of agriculture, water resource, forestry and national meteorology, energy, transportation is provided on :

- Modeling related to climate change;
- Inventory and mitigation of greenhouse gas emissions;
- Model adapted to local context and/ or regional are available;
  Information and awareness about climate change;
- Set up of funding applications – Technical training.

Stakeholders :

- Ministry of the Environment and Water
- Ministry of Secondary and Higher Education and Scientific Research (CNRST, Universities)
- Ministry of Agriculture
- Ministry of Finances
- Ministry of Transports (national weather Service)
- Interdepartmental Committee for the implementation of the actions of the Convention on Climate Change (CIPAC).

Project Cost : The budget for this project is estimated at 50 million Francs CFA

Structure/Agency of Coordination : SP/CONEDD Tel. : (226) 50 31 24 64 ;
Fax : (226) 50 31 64 91 ; E-mail : sp-connedd@fasonet.bf

PROJECT-02

Project title : Production of pure vegetable oil with Jatropha curcas (Jatropha)
Beneficiary country : Burkina Faso
Project justification: The Production in rural areas collides with the lack of energy resources for the motorization and the electrification. This deficiency is a major concern for the authorities of Burkina who have implemented an outreach program of multifunctional platforms for reducing poverty. The platforms are presented to fully supply from imported diesel. Jatropha production to extract for use in short circuit is an alternative that could boost local development. The agricultural machinery in rural areas could be driven by this local resource.
Expected outcomes : - Establishment of extraction unit, treatment, storage and mixing of the oil; - Establishment of marketing channels.
Planned activities : - Feasibility study for the determination of producible (seeds), the supply, the calculation of costs, social and environmental implications scheme; - Establishment of rural units of production, processing and storage. - Implementation of the marketing channel.
Stakeholders : **Institutional actors** - Ministries in charge of Agriculture, Environment, Energy, Trade, Finances, Etc. **Actors of Research and Development** - 2IE, IRSAT, Universities **Actors of Distribution** - Private actors **Other Actors (Consumer)** - Multifunctional platforms, Industries, Rural Electrification.
Project Cost : 800 000 000 FCFA
Structure/Agency of Coordination: SP/CONEDD Tell. : (226) 50 31 24 64 ; Fax : (226) 50 31 64 91 ; E-mail : sp-connedd@fasonet.bf

PROJECT-03

Project title : Installation of generators gas groups on the sites of cotton production
Beneficiary country : Burkina Faso
Project justification: Cotton is the main source of currency for Burkina Faso. Its production occupies a large part of the population. Three cotton companies (SOFITEX, FASOCOTON and SOCOMA) are responsible for ginning and trading of cotton. Most of the ginning units are installed in rural areas where sometimes the grid is not available. The on-site power generation is often provided by generators of capacity up to 1500 kVA supplied. These groups are supplied with fully imported hydrocarbon into Burkina Faso. Installation of Generator gas group would provide added value to cotton production through the promotion of cotton stalks which are burned until that on the field for phytosanitary issues. This would also limit the outflow of foreign exchange from the state for the import of petroleum products whose consumption contributes to the production of GHG.
Expected outcomes : - 20 generating gas units are installed in the ginning units - A rural market of cotton stalks is established for marketing. - The costs of electricity production in rural areas are reduced - GHG emissions in the sector of energy and agricultural are reduced.
Planned activities : - Feasibility study for the determination of producible, the supply, design, social and environmental implications scheme; - Organization of the production chain / biomass harvesting - Recruitment of management structures and operating power plants - Development of sites and installation of systems
Stakeholders : **Institutional actors** - Ministries in charge of Agriculture, Environment, Energy, Trade, Finances, Etc. - Customary societies **Actors of Research and Development** - IRSAT, **Actors of Distribution** - Private operators of electricity sector **Other actors (Consumers)** - Rural municipalities
Project Cost : 15 000 000 000 FCFA
Structure/Agency of Coordination : SP/CONEDD Tel. : (226) 50 31 24 64 ; Fax : (226) 50 31 64 91 ; E-mail : sp-connedd@fasonet.bf

Appendix: contribution to the development of the second National Communication of Burkina Faso on Climate Change

The publication of the second communication of Burkina Faso on climate change under the United Nations Framework Convention on Climate Change (UNFCCC) is the result of a joint effort involving the key players listed below.

Coordination team

- Mamadou HONADIA, Permanent Secretary of CONEDD
- Bobodo Blaise SAWADOGO, Point focal UNFCCC and Coordinator of DCN at SP/CONEDD
- Peter HANSEN, Responsible for Climate Change at UNDP, Ouagadougou

Finalization of the second communication Document on the Climate Change

- Mamadou KHOUMA, International Consultant,
- Oumar SANOGO, National Consultant,
- Léopold SOME, National Consultant.

Study of vulnerability/adaptation of agricultural sector

- Leopold SOME, National Consultant

Study of vulnerability/adaptation of Water Resource sector

- Harouna KARAMBIRI, National Consultant

Modeling for vulnerability/adaptation studies

- Mathieu BADOLO, National Consultant,
- Moussa WANGO, National Consultant.

Economy aspects for vulnerability/adaptation studies

- Denis TOE, National Consultant

Studies on Mitigation

- Mohamed OUEDRAOGO, National Consultant

Inventory of greenhouse gases

- National Institute of Statistics and Demography (NISD) with the support of the Swedish Cooperation

Biophysical and socio-economic study

- Mathieu OUEDRAOGO, National Consultant.