Republic of Benin
Ministry of Environnement, Habitation and Urbanism
Department of Environement

FIRST NATIONAL COMMUNICATION OF THE REPUBLIC OF BENIN TO THE FRAMEWORK CONVENTION ON CLIMATE CHANGE

EXECUTIVE SUMMARY

Consultants for Green House Gas inventories, mitigation and vulnerability :

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CHAPTER I : NATIONAL SITUATION

Located in west Africa, with a surface area of 112622 Km^2, the territory of Benin is made up of a narrow stretch of land sprawling at right-angle down to the coast of the gulf of Guinea. It is bounded on the North by Burkina Faso and the Republic of Niger on the East

by the Federal Republic of Nigeria and on the West by the Republic of Togo. With coastline of 124 km, it extends approximately 672 km from the North to the South and reaches 324 km where it is the widest.

1-1 - Physical Features

Benin has a less strongly market relief, the only mountainous region being the North.

The climate is hot and wet, with the mean annual rainfall ranging from about 700 mm (North) to 1500 mm (South-East) and the average air temperature of about 27°C. Most certainly, geographical elements such as the stretching of the territory in latitude, the existence of the Atacora mountain and the orientation of the coastline bring about a slight difference in the climate pattern.

The country is watered by a lot of rivers belonging to two great basins : river Niger basin and the coastal basin.

The vegetal cover is less diversified and the soil profile is composed of four main types of soil.

1.2 - Population and Economy

Benin's population was estimated at 5.8 million inhabitants in 1998 with an annual growth rate which remains stagnated at 2.8 %. Family is both a unit of production and social integration.

In terms of Sustainable Human Development, there is still a lot to be done as regards current indicators, despite the huge efforts undertaken.

The sector of agriculture plays an important part and more than 65% of the population are still engaged in farm activities (INSAE, 1998).

Economy growth which was negative before 1991 has increased during the decade and reached 6.1% in 2001 according to figures provided by West African Economic and Monetary Union.

1.3 - Democratization

The new institutional order introduced through the historical Conference of the Active Forces of nation held in February 1990, the materialization of which is in progress, has made of Benin an easier destination and hoisted it at the vanguard of "new democracies". Benin has got the experience of peaceful, fair and transparent elections.

CHAPTER II : GREENHOUSE GAS INVENTORY

The inventory carried out as part of this national communication is based on 1995 data.

The methodology used is the one approved by the Intergovernmental Panel on Climate Change (IPCC)

II.1.1 - Synthesis of Greenhouse Gases Inventory in Benin in 1995

Figures 1 and 2 show the contribution of each sector as well as that of each gas to the total amount of Greenhouse Gas emissions in terms of CO_2 Equivalent.

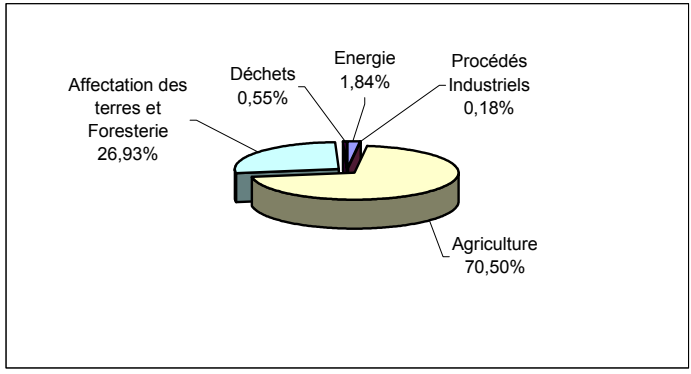

Figure 1 : Contribution of each sector to the total emissions of greenhouse gas in terms of CO_2-Equivalent

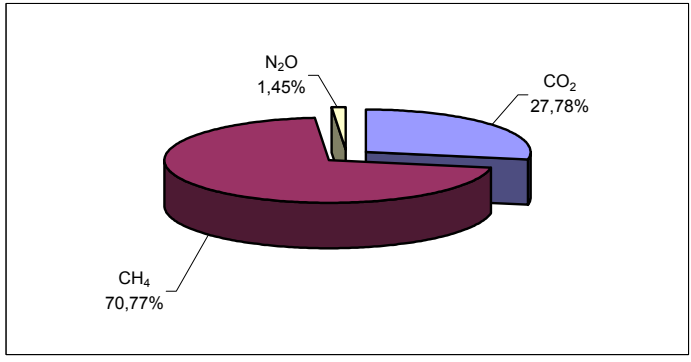

Figure 2 : Contribution of each gas to the total emissions of greenhouse gas in terms of CO_2-Equivalent

II.2 - Comments

The major sources of greenhouse gas emissions in terms of CO2 Equivalent are the sector of Agriculture (70%) and that of Land-Use Change and Forestry (26.93%).

The high contribution of the Agriculture sector is essentially attributable to methane emissions. As regards the sector of Land-Use Change and Forestry, it mostly results from carbon dioxide emissions.

On the whole, greenhouse gas emissions in Benin are estimated at 54 155.65 Gg of CO_2. These emissions are less than carbon absorption estimated at 62 108.16 Gg of CO_2 in 1995.

CHAPTER III : STRATEGIES FOR THE MITIGATION OF GREENHOUSE GASES EMISSIONS

Republic of Benin is a non-Annex I Party to the United Nations Framework Convention on Climate Change (UNFCCC) and is not a net emitter of greenhouse gases. However, it develops strategies for greenhouse gas emissions reduction.

Based on the results of greenhouse gas emissions inventories developed in 1995 and the development objectives of the country, strategies formulated have covered the Energy sector for which mitigation studies have been carried out. Two sub-sectors have been mainly targeted in order to reduce emissions in this sector. The sub-sector of residence and transport are included for the simple reason that they are respectively the largest consumers of traditional energy and conventional energy.

In the sub-sector of transport, options for reduction in greenhouse gas are based on the strict monitoring of imported vehicle fleet, the promotion and development of public transport.

In the sub-sector of residence, measures conducted are related to the extension of fuelwood and gas-powered stoves through the introduction of a program of assistance for the acquisition of improved hotbed and stoves by the populations.

CHAPTER IV : VULNERABILITY & ADAPTATION

Benin is caracterised by a sub – equatorial climate from the latitude of Save and tropical humid to dry climate from Save to Malanville. The climate are recently marqued with decrease of rainfalls and strength spatio-temporel variabilities. It is in this context that the scenario of climate change are elaborated, focus on temperature and rainfall dynamics toward 2100.

The simulations done on MAGICC SCENGEN +1°C to +2,5°C of temperature rise toward 2100.The simulations of Penman-Monteith evapotranspiration model predict an increase between 6 and 19,5% of water losses due to evaporation.

This warming should increase the length of dry period from one to two month according to the station. This situation may be damageable for agricultural and all the socio – economical processes related to the primary sector.

IV.1 - Vulnerability of lakeside ecosystems

Two ecosystems have been studied : Nokoué and Ahémé lakes

IV.1.1 - Formulating Scenarios of the trend

Various scenarios have been used for the study of vulnerability of Lakes Nokoué and Ahémé. The first scenario, an analogical one, draws on data of past periods. It has enabled to determine from a systemic analysis, the vulnerability of target element in the light of trends known at social, economic and environmental level.

The study of impacts has been conducted using the methodology of the IPCC. Temporal horizons considered are 2025, 2050. The second scenario, the climatic and regional one as well as

that of the acceleration of sea-level rise corresponding to the IS92a scenario of the IPCC, have also been used to carry out the study.

Table 2 : Scenarios of the Acceleration of Sea-level rise

	2050	2100
Basis assumption	07 cm	20 cm
Mean assumption	20 cm	49 cm
Extreme assumption	39 cm	59 cm

The last scenario is based on an increase in temperature. The mean temperature values for the 1961 –1990 period have been introduced into MAGGIC SCENGEN and have enabled to determine the future temperatures and to have an idea on future climate profile.

IV.1.2 - Results and Interpretation

Without climate changes, we realize that biophysical implements are already inducing some forms of degradation of the lakes considered.

Anthropogenic activity through notably fishing methods leads mainly to the accumulation of muddy deposits, the reduction in depth.

Figure 3 outlines the scenario of changes in the lakes considered.

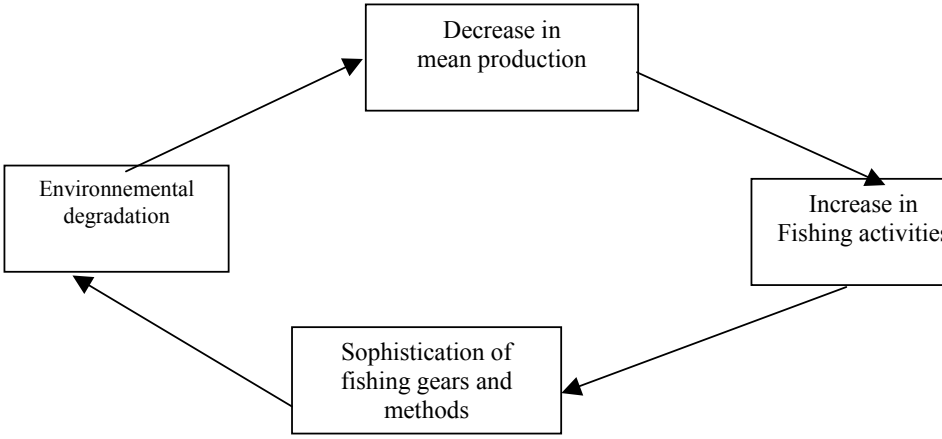

Figure : Interactions of Human-induced Activities and Lake Production

Within the prospect of a future climate showing temperature characteristics, released from MAGGIC SCENGEN model and within the context of a sharp marine transgression as a result of a sea-level rise, the two lakes remain vulnerable.

In the context of an increase in air temperature which would imply that of water, living environment of fishery resources, a decrease in the content of dissolved oxygen is expected.

Further distribution of species would result from it, given the fact that the availability of oxygen will seriously be affected. Risks of anoxia or hypoxia for water species are potential.

The sea-level rise we are representing on the basis of above-mentioned scenarios would bring about :

- High salinization of rivers ;
- Acceleration of calcareous deposit on the surface of branches making difficult the adherence of périphyton ;
- Reduction in the fauna with the appearance of new species ;
- Disappearance of mangrove followed by the destruction of natural spawning grounds ;
- Ecological change in the flora.

Furthermore, the combined effects of increase in temperatures and sea-level rise would bring about a change in the trophic network, a loss in biodiversity (death of some species) and would slow down the growth of species that would adapt . Moreover, the productivity of such ecosystems will be affected.

IV.1.3 - Autonomous Adjustment and Adaptation Strategies

The migration of some species is likely to occur, considering past trends. On the contrary, the appearance of new fish species could be recorded.

Among the convenient strategies for adaptation, it is proposed to:

- Dredge and restock sand from the lakes so as to offer disturbed species, new ecological in depth adaptative conditions ;
- Introduce new euryhalite species ;

- Improve the production of lakes through the protection of water courses (by removing the "acadjas", in compliance with statutes and regulations);
- Promote aquaculture ;
- Convert populations to other profit-making activities such as animal rearing and agriculture ;
- Reforest banks of preclude water courses from silting-up and sanding-up;
- Sensitize and inform the neighbouring populations ;
- Construct regulating dams to control the distribution of discharges between the lakes and the sea.

In all, despite the combination of many causes, climate change will potentially affect ecological habitats as well as the ichthyological diversity of Lakes Nokoué and Ahémé.

IV.2 - Vulnerability of the shoreline

IV.2.1 - Methodological Approach

Natural and anthropogenic factors accounting for the current dynamics of the coastline have been identified. For the sake of grasping in detail major changes in the coastline, stereoscope has been used. Scale corrections have been made with a scanner and Winimage software, specially recommended for topographical studies.

Changes in the coastline between 1954 and 1995 have been reconstituted by elaborating a table showing the velocity of changes, on the one hand, and by drawing a sketch of changes in the coastline, on the other hand.

In the light of a climate trend simulation, estimates have been made and show an elevation of about 20 cm for the year 2030, 40 cm for 2070, and 60 to 70 cm at the end of the century.

IV.2.2 - Dynamic of the Shoreline

The littoral of Benin formerly deemed stable, has recorded a disruption of its status attributable to the construction of the port of Cotonou in 1962.

The part of the coast in the West of the Port which can be qualified as an area where the "connection of waves and gravity effects" is balanced, is subjected to erosion. On the whole, the shoreline is retreating. The mean deviation between the shoreline in 1954 and 1955 is about 50 meters all along this stretch.

Furthermore, it is advisable to note immediately that in the West part of the Port, there is a highly strong silting-up commenced before 1973, with a maximum value reaching about 300 meters. Such a strong build-up is undeniably attributable to the construction of the Port of Cotonou in 1962.

On the other hand, studies conducted in the area East of Port extending from the Siafato groyne over a distance of 8 Km in the same direction, reveal that erosion is maximal and in progress.

As a matter of fact, the littoral transit has been stopped by serial groynes, thus creating an area whereby sediments are remobilized by currents in the East of the structure. Consequently, the protection of the beach is no more ensured naturally, and erosion continues.

The maximum retreat between 1981 and 1996 shorelines is approximately 150 meters. The phenomenon could, therefore, reach the oil storage tanks located at some 3 Km from the Benin-Nigeria border which is of paramount economic importance to the Republic of Benin.

One the whole, data collected from various surveys forecast a retreat of 50 meters for 2025s, and then 100 meters by the year 2050, if no protective sea-wall is envisaged.

IV.2.3 - Impacts of the vulnerability of the shoreline

At the economic level, the phenomenon of erosion has led to the disappearance of land, and damages caused in this respect are more or less considerable depending on land tenure and pertaining activities. Coconut trees, second economic resource of Benin coastal stretch, constantly disappear as a result of the dynamic earlier invoked. Planted at an interval of 10 meters, it fall down at the rate of one row every five years with an average loss of 1 400 coconut trees every year.

Now, in addition to its economic function, this plant plays an important role in the embedding of the sandy substrate due to its highly dense rooting system and the shade it constitutes for winds.

Such functions are, however, insignificant as compared with the degradations caused by the evolution of the shoreline at the mouth of river Mono. In fact, during the storm season in 1997, 400 hectares of land were flooded, and crops damaged.

Areas such as Donatin, Tokplégbé, Marina, PK 10 only to mention a few, run the risk of disappearing from the map.

In addition, the international road linking Benin to Togo and Nigeria at some 300 meters from the beach, and the oil storage tank field located at some 3 Km from the Benin-Nigeria border, are sooner or later at risk.

As regards human beings, because of the floods that would result from the sea level rise, villagers will be compelled to abandon their settlements.

IV.2.4 - Adaptation measures

Proposed actions towards adaptation are summarized in table 4 below.

Table 3 : Envisaged solutions

Actions	Benefits	Constraints
Construction of groynes	Stabilisers of beaches, they interfere with the littoral transit which happens to be countered, deflected and compelled to deposit part of its load ; Their role is, therefore, to trap flowing sediments.	Rather substantial cost of 500 million CFA.F per groyne.
Building of protective sea-walls brought closer together	Protect buildings and roads of communication build too close to the ocean against the damping forces of the waves.	Need for periodical upkeep
Construction of breakwaters	Lower the reflecting power of waves ; Create a levigation trough between them and the coastline, therefore, allowing alluvial deposits.	They can only be implemented in coastal areas whose tidal levels are low.
Sand sucking	Adjustment of the grain dray, the loading point and the littoral retreat.	Cost (1.5 million CFA.F) per linear meter of coastline.

Source : Findings of survey, PCNCC-B, 2001

On the whole, current trends and future projections made, with regard to the coastline of Benin, do not predict any bright prospects both at the economic and human level.

In consequence, significant financial efforts should be made and a general mobilization of the population would enable to combat the harmful effects of the current trends and the consequences of climate change.

IV.3 - Vulnerability of Agriculture

Already depending on climate variability, agriculture like all other sectors in Benin, is exposed to climate change.

The economy of Benin essentially rests on agriculture in which 60% of the active population are engaged. Contributing for 40% to GDP, it accounts for 80% of exports and still constitutes the major backbone of the growth of national economy owing to a growing rate of 8% for this sector.

IV.3.1 - Vulnerability of Agricultural productions

Under conditions of agricultural practice and the use of current species and varieties, outcomes of researches show that the agriculture of Benin remains vulnerable.

In fact, the yield level remains below the potential of cultivated varieties in the case of the reference scenario.

The levels of estimated yields on the basis of "CROP-MODEL" output considerably decrease as compared with those of the reference period. A comparative analysis shows a fall in harvesting in the order of 3 to 18% as against the current period, all crops inclusive.

Table 4 : Estimation of average yields (Kg/ha) per crop and for the main agricultural regions of Benin in 2025

Regions / Crops	Donga	Borgou	Plateau	Zou / Collines
Cassava	7443.1	5602.0	6557.8	6602.9
Beans	393.2	366.0	459.3	392.8
Sorghum	663.7	677.8	*	546.4
Cotton	830.2	1070.6	662.3	774.6
Maize	766.7	767.0	660.1	700.9
Rice	1182.0	1367.4	1746.2	1883.7
Groundnut	725.8	788.5	560.3	629.2

* crop not planted in the region
Source : Results of study, PCNCC-B, 2001

Such as a situation is attributable to an under-elevation of the major agricultural and climate indexes which directly influence yields. At this juncture,it is the case of humidity index, the decrease of which means a fall in the climate-induced water uptake as a result of the pejoration of the potential evapotranspiration and a shortage of the relevant rainfall.

IV-3.2 Modern Strategies for Adaptation

The table below shows some possible options among so many others as part of an adaptation of agriculture to the predicted climate change

Table 5 : Proposed strategies for adaptation per targeted crop

Targeted crops	Constraints identified resulting from climate change	Strategies envisaged	Constraints	Recommendations
Maize Sorghum	Disruption of the ecology; Reduction of the rainfall period	Selection of adapted varieties; Irrigation	Rather long duration of researches	Involve farmers in research activities; Sensitize and train farmers
Cotton Cassava	Shortage of rainfalls	Selection of tolerant varieties Construction of water tanks; Hydro-agricultural installations	Rather long duration of researches Cost	Draw on experiments of Mali Work with farmers; Train farmers.

Source : Results of study, PCNCC-B, 2001

To conclude, climate change is a serious threat to the economy of Benin in the sense that it projects negative impacts on our agriculture.

It is, therefore, advisable to implement the proposed measures of adaptation to mitigate the simulated negative effects.

CHAPTER V : NATIONAL EFFORTS TOWARDS THE PREVENTION OF CLIMATE CHANGE

Since Benin has gained independence on 1st August 1960, many statutes and regulations have been adopted with a view to a streamlined protection and management of natural resources. On this ground, mention can, inter alia, be made of the following statutes and regulations: Decree n° 82-435 dated 30 December 1982 relating to the ban on bush fire and slash-and-burn cultivation in the republic of Benin, Decree n° 86-516 dated 15th December 1986 relating to the definition of responsability in the management of coastal areas, Law n° 98-030 dated 12th February 1999 relating to an outline law on Environment in Benin and to the establishment of a National Committee on Pollution Control (National Committee for Environment).

This list includes Decree n° 92-17 dated 28th July 1992 establishing and setting forth the prerogatives of the Ministry of Environment, Housing and Town Planning.

V.I - National Plans And Studies on Sustainable Development

In the wake of the Rio de Janeiro Earth Summit held in 1992, Benin has become aware of the stakes linked to development, environment and has introduced a number of enacting terms for sustainable development.

In the 1998-2002 National Policy Guidance, a high priority is given to poverty alleviation in order to strengthen economic growth.

As regards environmental concerns, the Policy Guidance has identified deforestation, soil degradation due to farming system and

the type of inputs utilized for the extension of cotton crop, coastal erosion related to sea level rise, and development of harbour structures, urban pollution attributable to the poor management of household and industrial waste as key sectors where efficient actions should be taken from now on.

The National Agenda 21 adopted on 22nd January 1997 by the Government outlines the guidelines and conditions to achieve a sustainable development. It is an instrument which enable the integration of national environmental concerns into development programs and plans. The findings of National Studies on the "2025 Benin Longs-Term Prospects" specifically call on a streamlined and sound management of both natural and human resources.

In other respects, Benin has elaborated for over five years the Policy and National Strategy for Regional Development. The main objective of this policy through a strategy put in place for regional development is to provide the urban and rural population with a level of welfare and capabilities enabling them to handle their socio-economical development through a better enhancement of their local potentialities while proceeding to a sustainable preservation of their resources.

For a few years back, the Agreement on sustainable development between Benin and the Netherlands has been signed. The Benin Center for Sustainable Development (CBDD) is the management body of the afore-mentioned Beninese-Dutch Agreement on Sustainable Development, the purpose of which is to promote the welfare of the society of Benin on the whole.

The Environmental Action Plan constitutes the index of national mobilization for a sustainable development.

In addition, the establishment of National Commission on Sustainable Development (CNDD) and ABE (Benin Environment

Agency) which is statutorily responsible for the development for Impact Studies on Environment (EIE) both at the level of policies and strategies, and at the level of projects, is instrumental in the will of Benin Government to prevent any change in the environmental area.

Apart from implemental or on-going programs and projects in the field of Environment, Benin recommends for funding a number of projects and programs in various sectors of the economic and social life, as shown in the table below.

Title	Global Objective	Expected Results
Mitigation Projects		
Projects of Greenhouse Gas Mitigation	Reduce greenhouse gas emissions through the promotion of improved hot beds using fuelwood, kerosene or gas-powered stoves; Improve the living conditions of the populations.	Emissions of greenhouse gases attributable to households are reduced at a lower cost.
Mitigation of Greenhouse Gases through the fostering of public transport	Reduce greenhouse gas emissions through the promotion of public transport; Improve the living conditions of the populations.	Reduction of greenhouse gas emissions due to the subsector of transportation.
Adaptation Projects		
Pilot project: Benin coastal protection	Reforest the coastal areas and experiment the artificial technique of beaches filling.	The shoreline is protected; Coastal erosion is countered.

Study of the hydrological functioning of low grounds in the Sudanese zones of North-Benin	Improvement of knowledge on the hydraulic and hydrological functioning of low grounds with a view to their development and the assessment of trends in the water balance of crops and a better knowledge of farming techniques required for agricultural management in the Atacora Province	The hydrological behavior and functioning of low grounds are known; The hydrodynamic functioning of the soil is determined; The potentialities of low grounds and the agronomical constraints linked to water management are identified.