SITUATION IN REPUBLIC OF BENIN WITH REGARD TO GREENHOUSE GAS EMISSIONS MITIGATION

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ABSTRACT
Republic of BENIN is a non-Annex I Party to the United Nations Framework Convention on Climate Change. On the basis of national greenhouse gases (GHG) inventory developed in 2001 for the base year 1995, the country is not a net emitter of GHG but a sink. The Land Use Change and Forestry sector is entirely responsible for this characteristic.
However, some strategies are being developed to mitigate GHG emissions. These strategies cover mainly energy sector and fit with the general policy of the country in the field of energy and environment. This policy is related to the rational management of national energy resources and the promotion of clean environment. The priority sub-sectors are transport and residence.
According to projections, the following quantitative outputs are expected: from 2002 to 2007, emissions reduction is estimated at 575Gg CO_2 equivalent and removals at 6,600Gg CO_2; from 2008 to 2012, emissions reduction is estimated at 1,205Gg CO_2 equivalent and removals at 17,600Gg CO_2.

1.0 INTRODUCTION

Within the framework of the implementation of the United Nations Framework Convention on Climate Change (UNFCCC), Benin elaborated its inventory of greenhouse gases as part of its Initial National Communication on Climate Change. The inventory has been developed in 2001 for the base year 1995 and covered all sectors: Energy, Industrial Processes, Agriculture, Land Use and Forestry, Waste.
Benin, as least developed Country and non-Annex I Party to the UNFCCC, has no GHG reduction commitment under the Kyoto Protocol. However, some emissions mitigation policies and measures are being implemented. This paper describes efforts undertaken in the view of protecting and enhancing sinks, reducing emissions from land transport and residence and improving energy efficiency in residence.

2.0 STATUS OF EMISSIONS AND REMOVALS OF GREENHOUSE GASES IN BENIN

The use of the emission and removal estimation methodology from the Revised 1996 IPCC Guidelines (IPCC, 1997) has enabled to develop GHG inventory for 1995. The resulting estimate of total emissions and removals is shown in table 1.

Table 1: GHG emissions and removals of Benin in 1995 (Gg)

Sectors/subsectors	Removals	Emissions					
	CO_2	CO_2	CH_4	N_2O	CO	NOx	NMVOC
Energy	-	694.89	12.00	0.16	243.25	8.54	28.07
Transport	-	397.07	0.08	0.003	29.07	3.88	5.48
Residence	-	201.79	9.93	0.13	178.48	3.17	18.82
Other subsectors	-	96.03	1.99	0.027	35.7	1.49	3.77
Ind. Proc.*	-	96.43	-	-	-	-	0.16
Agriculture	-		1789.14	1.96	2270.66	42.01	-
LUCF**	62108.16	14242.75	14.81	0.10	129.61	3.68	-
Waste	-	11.02	9.10	0.30	1.63	0.03	-
Total	62108.16	15739,98	1837,05	2,68	2888,4	62,8	56,3

* Industrial Processes

** Land Use Change and Forestry (LUCF)

Source: National Communication of Benin on Climate Change.(2001)

The main gases emitted during this year are methane (CH_4), carbon dioxide (CO_2) and carbon monoxide (CO). Total emission of (GHG) in 1995 in Benin is estimated at 54155.65Gg CO_2 equivalent using global warming potential 1, 21, 310 respectively for CO_2, CH_4 and N_2O and removal at 62108.16Gg. The country is then globally a sink and the LUCF sector is entirely responsible for this status. Despite this, some measures are undertaken in some key sub-sectors to reduce emissions.

3.0 STRATEGIES DEVELOPED TO MITIGATE GHG EMISSIONS

The strategies fit with the general policy of rational management of energy resources and promotion of clean environment of the country. They cover energy sector and the considered sub-sectors are transport and residence for the simple reason that the latter are respectively the main conventional and traditional energy-consuming.

3.1 RESIDENCE

The most important energy source used by household in Benin for food cooking is biomass composed of wood and wood charcoal. In 1998, the share of each energy source for domestic consumption is as follow: biomass: 90%, kerosene: 9% and electricity: 1%. The consumption of biomass as fuel by households is estimated at 0.42 millions tonnes/year (FAO, 1996) and is more and more increasing. The result of this is that forests areas decrease gradually notably in the southern and centre parts of the country in particular around the main cities while emissions increase. This sector contributes to 45% of the total emissions from energy (see Table 1).

In this context, the following policies and measures are being implemented.

3.1.1 MAIN MEASURES AND POLICIES

- Public awareness, through organisations of fora on climate change and Sustainable Development and necessity to reduce energy and biomass consumption;
- Mitigation of emissions from energy use by household in substituting improved hotbed of wood and wood charcoal for traditional hotbed using the same fuel. The yield of improved hotbed using wood is about 20% versus 10% for traditional hotbed and the yield of improved hotbed using wood charcoal is around 35% versus 20% for traditional hotbed;
- Improvement of yield for the current method of production of wood charcoal, using modern processes;
- Progressive substitution of household cooking gas for wood and charcoal; gas for household cooking is now subsidized by the government.
- Promotion of reforestation activities and rational use of biomass through plantation of local species such as *Khaya senegalensis*, *Parkia biglobosa*, *Chlorophora exelsa*.

3.1.2 ESTIMATING ENVIRONMENT BENEFITS

The quantitative outputs expected from these measures are as follow:
- Reduction of 50% of wood and wood charcoal consumption from 2002 to 2012 in urban areas;
- Increase in forest areas of 300,000 hectares from 2002 to 2012.

3.1.2.1 SCENARIOS AND METHODOLOGY

The simple following assumptions have been considered to estimate emissions reduction and removals.
- Only reforestation and substitution of improved hotbed for traditional hotbed have been taking into account;
- Effects of improvement of wood charcoal production processes on reduction of emissions are not considered at the present stage;
- Use of improved hotbed of wood enables a 50% cut in consumption of wood as its yield is twice the one of traditional hotbed;
- Use of improved hotbed of wood charcoal enables a 43% cut in consumption of wood charcoal (yield of improved hotbed is 35% versus 20% for the traditional one);
- Only 15,000 households in urban area are concerned in 2002, with an increase annual rate of 41,4%. Half of households use improved hotbed for wood and the remaining half use improved hotbed for charcoal wood;
- The following IPCC factors have been used. Emission factor for wood and charcoal wood: 29.9 kg C/GJ; oxidation factor: 0.9; net calorific values (NCV): 17 GJ/metric ton for wood and 29 GJ/metric ton for wood charcoal;
- with regard to carbon removal due to reforestation, it’s considered a static accumulation of 8 metric tons of dry matter/hectare/year and a carbon proportion of 0.5 in dry matter. It’s also assumed a progressive reforestation of 30,000 ha/year, without exploitation during the considered period.

Reduction of CO_2 emissions are computed as follow:

CO_2 emissions reduction in Gg due to the use of improved wood hotbed = P_w x number of households x D_w x 365 x NCV_w x EF x OX x 44/12 x 10^{-9}

CO_2 emissions reduction in Gg due to the use of improved wood charcoal hotbed = P_c x number of households x D_c x 365 x NCV_c x EF x OX x 44/12 x 10^{-9}

Where:
P_w and P_c are respectively percentages cut in consumption of wood and wood charcoal; P_w = 50% and P_c = 43%.
D_w and D_c are respectively daily consumption of wood and wood charcoal;
D_w = 9 kg/household/day and D_c = 2 kg/household/day.
NCV_w and NCV_c are respectively net calorific values for wood and wood charcoal
EF and OX are respectively emission and oxidation factors

Sequestration of CO_2 = A x R x 0.5 x 44/12
Where:
A = area of reforestation (ha)
R = average accumulation rate of dry matter (8 metric tons/ha/year).

3.1.2.2 RESULTS

Table 2: Estimation of CO_2 benefit from measures.

	2002 - 2007	2008 - 2012
Emissions reduction ($GgCO_2$)	575	1,205
Sequestration due to reforestation ($GgCO_2$)	6,600	17,600
Total CO_2 benefit	7,175	18,805

Non-CO_2 GHG have not been computed yet.

3.2 LAND TRANSPORT

Land transport has been identified as key source and constitutes a major concern to the government. The country has recorded, these last fifteen years, a meaningful increase of its automotive park, in particular cars and motorbikes through notably the upsurge in second-hand vehicles coming mainly from Europe. The age of these cars, average of age 15 years, and the appearance of the two-wheeled vehicles transport mode as well as the poor maintenance of motors and the kind of fuel used are for the most part responsible of the air pollution due to transport. This sector is the main oil-consuming from the energy dashboard and contributes to 40% of emissions from energy according to the national GHG inventories (see Table 1).
The volume of different pollutants emitted in the main cities of Benin is more and more increasing and this situation is among the main causes of the frequency of several respiratory affections and other uneasiness identified by

the specialists of health. A specific analysis of information from hospitals shows that air pollution in Cotonou, economic capital of Benin, is responsible for respiratory affections. The frequency of these affections varied from 4.29% in 1994 to 6.37% in 1999 (Tractebel Report, 2000).
The cost of these affections in Cotonou has been valued at a total of about US$ 923,077 per year and has been reached around 1.2 % of the Gross Domestic Product of the whole country. It is therefore very important to take adequate measures in order to limit the deterioration in the air quality in urban area.

3.2.1 MAIN MEASURES AND POLICIES

All taken measures and ongoing policies in this sector to reduce GHG and other pollutants have objectives to reduce medium-term and to control noxious emissions.
- The Ministry of Environment has initiated since March 2000, periodic processes of technique control in the main goal to identify vehicles, motorcycles and mopeds badly kept or badly controlled whose motors give out pollutants in quantity that contribute to deterioration in air quality.
Processes of regulating permit to reduce emissions mainly CO on this side of the norm fixed at 2% in BENIN.
- Every last Saturday of the month is set "Day for a healthy Environment" by the Ministry in charge of the environment and some environmental problems are tackled in a convenient way: pickup of garbage, draining of gutter, regulation of vehicles motors, etc.
- The Ministry of Environment has taken rules and regulations in the view of taxing polluting vehicles and the implementation of these measures has started since November 2001.
- To promote public transport, imported vehicles (buses, …) destined for this mode of transport are duty-free (exempted from customs taxes).
- Another measure aiming at regulating second-hand vehicle import is taken and impose that the age of this category of vehicle should not go beyond 10 years.

4.0 CONCLUSION AND RECOMMENDATIONS

Although further studies are needed to complete estimation of CO_2 benefit, these measures are examples of initiatives undertaken in a non-Annex I Party to the UNFCCC like Benin to produce benefits on climate change politics.
These initiatives require to be formalized within the framework of the Kyoto Protocol in particular its mechanisms. In this connection, there is a need for capacity building to strengthen technical and institutional capacities to develop and implement Clean Development Mechanism projects for the country.

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