Impacts of Climate Change in Central African Republic

Soulé Baoro Serge K.G*, Song Shaoxian, Edo Ekata Emmanuel Maidou Herve and Tola Kogadou Igor

School of Resources and Environmental Engineering, Wuhan University of Technology, 122 Luoshi Road, Wuhan, 430070 China

Abstract: The purpose of this paper is to provide an overview of the Climate Change (CC) in the Central African Republic (CAR). Many researches on strategies to fight CC and reduce Green House Gas (GHGs) emissions have been conducted. However, implementation poses a serious problem at different levels including political, economic and socio-environmental. CC is seen as one of the greatest challenges of the 21st century. The CAR, like other countries of the world, has ratified the Kyoto Protocol on 1st January 2008, which aims to reduce the GHGs emissions responsible for CC. Almost all sectors (Energy, Agriculture, Forest, Health, Transport, Economy...) are affected by CC. GHGs are abundant in the Earth's atmosphere. In the absence of efficient meteorological equipment and stations to save accurate data, the CAR and even Africa in general is considered a "black hole" of climate information which must be used by the Intergovernmental Panel-evolution of Climate change (IPCC) to evaluate effects of CC on the continent. Despite its low level of GHGs emissions, the CAR reaffirms its adherence to the principle of collective responsibility. Pursuant to 1CP / 19 (Further advancing the Durban Platform) by these ambitious measures to meet this challenge. Thus, in the CAR, political, military and economic constraints are obstacles to the implementation of strategies to fight CC. Given its low level of development, 80% of rural population, forests and lands of the CAR are the most affected by CC; These impacts in all sectors are very difficult to assess due to the lack of reliable data, of its very weak economy and the multiple armed conflicts that do not make the collection and updating of data easy, almost half of the territory 14 prefectures on 16 have been occupied by armed groups.

Keywords: Emissions, Green House Gas, Kyoto Protocol, Durban platform and IPCC.

1. INTRODUCTION

Climate Change is a major threat to growth and sustainable development in Africa, as well as to the achievement of the Millennium Development Goals. Africa is particularly vulnerable to CC because of its excessive dependence on rain-fed agriculture, which is further worsted by poverty and lack of capacity. Human activity is the main cause of global warming [1]. The production and massive consumption of fossil fuels, the release of methane and deforestation favor the increase of GHGs, causing a rise in temperature. CC is often the cause of natural disasters. The main impacts on the forest in CAR are deforestation and forest degradation, poaching, uncontrolled use of biological resources, lack of national inventory of biological resources and taxonomic reference center, uncontrolled introduction of invasive alien species, loss of agricultural biodiversity, lack of an early warning system for bushfires, forest fires and armed conflict [2].

The anthropogenic Green House Gas is central to the Climate Change phenomenon, increasing their concentration in the atmosphere is one of the factors behind the recent global warming. However, the Intergovernmental Panel on the Evolution of Climate (IPCC) through its Work Group III is indeed focused on aspects of both scientific, technological and socio-economic mitigation measures (until 2030), to reduce emissions GHGs [3].

Climate Change affects public health in many different ways. There are direct and indirect impacts, as well as those that occur immediately and those that occur over a longer period of time. We estimate that 150 000 deaths worldwide were caused by CC in 2000. According to a new WHO study, this is projected to increase to 250 000 deaths per year worldwide by 2040 [4]. This estimate would have actually been higher if we had not factored in the reduction of child mortality expected in future years. Extreme weather events are already among the top CC impacts that affect public health. In addition, mortality related to heat waves and flooding is expected to increase, in particular in Europe. And changes in the distribution of vector-borne diseases such as cholera and malaria in Africa will also increase and will affect human health [4].

The Central African Republic has prepared and submitted its Initial Communication (IC) in 2003 following its ratification of the Framework Convention of United Nations on Climate Change (UNFCCC) in 1996. The Second National Communication was developed with the same objective in mind, to provide information on CC territory and their management. Since the interpretation of CC phenomena is often a reflection of the availability of meteorological data, the inadequacy of these data does not reveal a true national climate trend [5].

*Address correspondence to this author at the School of Resources and Environmental Engineering, Wuhan University of Technology, 122 Luoshi Road, Wuhan, 430070 China; Tel/Fax: 027-87166203;
E-mail: soulegil@yahoo.fr; ssx851215@whut.edu.cn; edoekata@gmail.com; herve-maida@yahoo.fr; tolakogadou@hotmail.com

E-ISSN: 2311-8741/17

First, assessing CC in the CAR deserves some clarification: with 744 meteorological stations in Africa compared with only 10 in the CAR (and 3,800 in metropolitan France), three-quarters of which are out of service or declared not conform to international standards by the World Meteorological Organization (WMO), the CAR is one of the regions of the world least monitored by climate experts and therefore one of the least well-known. WMO had recently recognized that in the absence of reliable tools for observation and analysis, Africa was a veritable "black hole" in information (Climate in Africa..., 2009). In its 1998 report, the IPCC also acknowledged this difficulty by pointing out that in the complexity of atmospheric dynamics on the African continent, questions about the value of observation scales Retained in time and space. We know, for example, that recently in the CAR the farmer and the breeder began to feel a disturbance in the agricultural calendar due to an increase in temperatures or a decrease in average annual rainfall in the Sub-Saharan region. However, there is no exact meaning for the farmer and the breeder in the semi-arid zones. Seasonal averages must be taken into account because the increase in dry season temperatures means less impact on fields and pastures that are already dry and less used than when sowing, harvesting or grazing [6].

(December–March). The Central African population is estimated at about 5 million with a demographic growth of about 2.5% / year. It is mostly rural (62.1%), female (50.2%) and young (49.4% are aged under 18). The country is sparsely and unevenly occupied by people. The territorial average density is 7.2 inhabitants per km². Decades of military-political crises have wiped out the development premises. The last conflict of 2012 to 2013 generalized insecurity destroys the productive and dismantles the administrative apparatus. From south to north, biological diversity is organized into four (4) major phytogeographic zones, each with a specific fauna: Congo-Guinean zone of dense humid forest; Sudan-Guinean zone housing the semi-humid forests, clear and dry; Mid-Sudanese and Sudano-Sahelian composed of different types of savannas and steppes. (Table **1**)

Table 1: Ecological Areas and phytogeographic Central Africa Republic

Environmental Field	Vegetation	Area (km2)	Observations
Congo-Guinean	Moist forests - Southeast - Southwest Savannah peril-forest	10,000 37,500 56,400	Production forest
Sudan-Guinean Mid-Sudanese	Savannah woodlands and tree semi-moist forests and forest galleries	(290,000 + 170,000) 460.000	All the central part, eastern and western Central African Republic, more than 2/3 of the territory
Sudano-Sahelian	Shrubby savannah, savannah grassland steppes on cuirasses	58,000	Far East country
Total Area		621900	

Source: Boulvert, Y. 1986.

2. MATERIALS AND METHODS

2.1. Presentation of the Central Africa Republic

Central African Republic is located in the heart of Africa, with 623,000 km2. The country extends from 14° 30 ' to 27° 30' east longitude and 2° 20 ' to 27° 30' north latitude. With 2 seasons: Raining season is 8 months (April–November) and Dry season 4 months

3. CHARACTERISTICS OF CLIMATE CHANGE IN CENTRAL AFRICA REPUBLIC

3.1. Climatology of the CAR

Temperatures and rainfall in CAR vary considerably. Rainfall is abundant in the south-west and south-east parts, especially in the forest areas. They tend to decrease and become more variable towards the north in the Sahelian zone towards Chad.

We can calculate the variance and the standard deviation from the following formulas:

The variance $(S)^2, S^2 = \sum_{i=0}^{n} \left(T - \bar{T}\right)^2 / n - 2$

The standard deviation $(S), S = \sqrt{S^2}$

The observed climatological data taken into account are: rainfall, Air temperatures (minimum, mean and

maximum), wind and relative humidity. For the temperature, the equation base is: $\bar{T} = (Tx + Tn)/2$,

$\bar{T}$: Mean temperature = $(Tx + Tn)/2$.

Tx: Monthly average of daily maximum temperatures.

Tn: Monthly average of minimum daily temperatures.

3.2. Forest

The statistical data collected from Project to Support the Realization of the Planning Plan on forestry potential reflect the pressure due to socio-economic activities. This Deforestation is visible on maps of the south-west Central prepared through Satellite images taken respectively in 2003 and 2008.

3.3. Agriculture

Of the 150 000 km² or 1.5 million hectares of agricultural land, only 7 000 km² are cultivated each year. The pastoral area of 160 000 km² is far from being fully utilized. Agriculture is concentrated in the south-west Forest zone in the tropical rain due to reduced rainfall in the north-east and central Savannah areas. Less than 5% of the area is occupied by family farms and 1.7 hectares per household of 5 people on average. Food crops represent 75% of cultivated areas and are often self-consumed.

3.4. Biodiversity

The main threats to biodiversity in the CAR are related to human activities. They are responsible for the continual reduction of biological resources. These threats are due to widespread poverty throughout the CAR territory and political and military conflicts that has weaken existing management systems.

3.5. Greenhouse Gas Emission

The results of inventories of GHGs emissions in CAR from 2003 to 2010 reference period of the Second National Communication of the country developed under the UNFCCC. These inventories have identified key areas that are vulnerable: the Energy sector, the Industrial Processes sector, the agriculture sector, the sector changing land use forestry and waste sector [7].

The basic formula for estimating the amount of GHGs emissions can always be expressed as;

Multiplication of AD (Activity Data) by EF (Emission Factor).

As follows: Emission = AD (Activity Data)* EF (Emission Factor);

E = Emission of Green House Gas,

AD = Activity data describes the extent of human activity leading to emissions or removals of GHGs occurring over a specified period of time and over a specified area,

EF = Emission factors are coefficients that quantify the emissions or removals of a gas per unit of activity data. (Table **2**)

- Final elaboration of two national communications;
- Participation in the conferences of the parts;
- Elaboration of the documents of strategies, of fight against the CC;
- Approval of certain legislative and regulatory texts environmental such as the Environment Code;
- Permanent inventory of GHGs and monitoring - assessment of their absorption by the wells of carbon;
- Technology transfer and capacity building of institutions at the practical and technological processes;
- Insufficient scientific research or studies on the impact of CC on the environment, the economy and society;
- Development of Education and Communication Information programs for the general public by stakeholders in relation to the realities of the country [9].

The methodology consists in characterizing all the impacts in key areas, in order to evaluate the socio-economic and environmental effects.

4. RESULTS AND DISCUSSIONS

4.1. Characteristics of Climate Change in Central Africa Republic

Climate change refers to slow variations in climatic characteristics at a given location, over time: warming or cooling. Its manifestation in the CAR by a large variation in climate, a decrease in rainfall that changes

Table 2: Summary of Environmental Impacts Associated with Climate Risks in CAR

Poor Rainfall distribution	Loss of biodiversity	Lower yields Reconversion of workers Declining purchasing power Rural exodus
Drought	Land Degradation Loss of biodiversity Surface Water Loss Loss of crops and falling Productions Fires and fields products Stripping soil	Lower crop yields Livestock deaths Revenue Decline Rural exodus Famine Diseases Change in eating habits Disruption of agricultural calendars and crop development
Floods	Flooding of crop areas Rots plants Rots plants tubers, roots (cassava, taro, yam) and plantain Erosion and loss of farmland Loss of biodiversity Flood; flooding and leaching arable fields High humidity and soil Disruption calendars crop and vegetative cycles	Waterborne diseases Displacement of populations Lives lost Moving the crops on little areas Fertile Development of certain vectors pathogenic cultures Loss or decline pickings product
Water erosion and wind turbine	Destruction of infrastructure (Roads, bridges and other amenities)	Displacement of populations Lives lost Decline of the national economy
Extreme temperatures	Loss of biodiversity	Resurgence of diseases
Strong winds	Land Degradation Loss of biodiversity	Famine, Fire Human pressures on land Litigation and social conflicts
Shifting seasons	Loss of biodiversity	High production cost Revenue Decline Declining purchasing power Rural exodus Famine (extension of the period of welding) Seasonal migrations of workers Agricultural Change cropping patterns Bushfires Fires reserves and zones Cultures
Fire forest	Loss of agricultural biodiversity Land degradation	Reduction or loss of food reserves
Subsidence soil	Deterioration in the quality of land Loss of soil fertility	Decrease of available resources for Inhabitants Severe repercussions on food Population
Increased heat in the dry season in terms of duration and intensity	Decrease of production of caterpillars and fungi Decrease of fish production Morbidity of animals, upsurge of bush fires, upsurge of diseases such as malaria and typhoid	Planting caterpillar species tree around housing areas, Promoting small-scale farming techniques, Raising awareness about the harmful effects of bush fires, Promoting pharmacopoeia exchange circles

the agricultural calendar with a very severe drought, Natural disasters (floods, landslides, bush fires, disappearance of certain water courses, drying of wells...)

Green House Gases are gaseous components that absorb the infrared radiation emitted by the earth's surface and contribute to the Green House effect. The increase in their concentration in the Earth's atmosphere is one of the factors responsible for the impact of the recent global warming. In the CAR, this is manifested by a heat wave over those last two decades attributed to GHGs, which is a global phenomenon, whose reduction depends on the collective will of the planet.

4.2. Climatology of the Central Africa Republic

The lack of meteorological data does not allow genuine national trend of climate. However, the IPCC forecasts for sub region Central Africa, applied to the CAR are favorable to higher rainfall in the range of 3% to 15% and temperature of 0.1 to 0.3°C per decade. This trend would induce a steady increase of 1 to 3°C

Table 3: Meteorological Data

Areas	Stations	Temperature			Pluviometry		Humidity
		Maximum	Average	Minimum	Average(mm)	Day Number	
Guinean	Bangui	31.6	26	20.4	1555.4	130	77%
Forestry	Berberati	30.3	24.6	18.9	1571	128	79%
-	Bangassou	32	25.9	19.8	1721.2	125	77%
-	Obo	31.4	25.1	18.8	1412.8	100	70%
Sudano	Bambari	32.3	26.15	20	1541.7	128	75%
Ubanguian	Bria	31.9	25.15	18.4	1558.8	122	74%
Sudano	Bouar	29.5	24.1	18.7	1571.8	141	68%
Guinean	Bossangoa	32.9	26.1	19.3	1560.9	122	69%
Sudano	Ndélé	33.1	26.75	20.4	1356.1	110	63%
Sahelian	Birao	34.8	26.55	18.3	876.6	72	57%
Total		**319.8**	**25.64**	**193**	**1472.63**	**1178**	**709%**

and 5% to 10% of rainfall during the XXI Century. In CAR, the environmental impacts are identified in the various regions namely, extreme temperatures, drought, bush fires, floods, water erosion, winds, soil subsidence and the seasonal shift. Table **3** summarizes the main environmental impacts associated with climate risks identified in the CAR.

4.3. Synthesis of Temperature Variation in CAR

These risks can be avoided if we have effective weather forecasts. The climate determines the two seasons. It is under the influence of two anticyclones. The Libyan anticyclone leads the harmattan, dry and hot wind blowing north-east to south-west: it's the dry season. The St. Helena anticyclone brings the monsoon fresh wind and which blows from the south-west to the north-east: it is the rainy season. The average temperature is 25.64°C, it is between 25°C and 26°C with a relative humidity varies from 79% to 77% between Berberati and Bangui and 57% Birao. According to the meteorological reference stations, there are five (5) major climatic zones and ten (10) meteorological stations. Rainfall increases from north to south, from tropical to equatorial climate, which is normal. The progression in the extreme north is not very marked: 876.6 and 1571 mm for Berberati in the extreme south [10].

Where the mean is known, the variance and the standard deviation is calculated by:

$$\overline{T} = 26^{\circ}C; The\ Variance\left(S^2\right), S^2 = \sum_{i=0}^{n}\left(T-\overline{T}\right)^2 / 2 .$$

$$The\ Standard\ deviation(S), S = \sqrt{S^2} ,$$

With $\overline{T}$ = 26°C; so, S² = 41,91 be S = 6,5 and 26 – 6,5 < 26 < 26 + 6,5

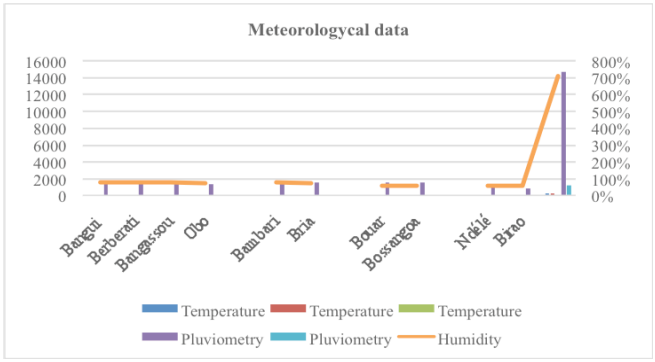

Figure 1: Graphical Representation of the Meteorological data of CAR.

4.4. Impact on the Forest

Forests cover nearly half of the CAR more than 28.3 Million ha: it has dense forest, semi-deciduous, or mosaic of forest and savannah. The moist forests, semi-wet, dry and gallery forests cover about one third this area is 9.2 Million hectares, savannas (wooded to the center, shrubby to the North) representing two thirds, about 19 Million ha. CAR has two forest massifs:

- The forest in the south west of an area of 3.8 Million hectares of forest production.
- The south east of approximately 1.6 Million hectares of conservation forest roughly 5.4 million hectares of forest.

Table 4: Total Forest Area and Percentage of Production Forests in the Congo Basin

Countries	Total Forest Area (Millions of ha)	Production Forests	
		(Millions of ha)	(% of Total)
Democratic Republic of Congo	108.3	98	83
Congo	22.3	13	58
Gabon	22.1	17	77
Cameroon	19.6	12	61
Central Africa Republic	6.3	3.5	56
Equatorial Guinea	1.5	1.5	79
Total	180.1	145	414

Source: CBFP, 2006.

- This is not negligible for CAR, one important country in reducing GHGs worldwide and in the Congo Basin that is the second lung of the world's oxygen through its role in the kidnapping Carbon (C) [11]. Although does not have the largest forest area as shown in table **4**.

Table **5** shows that the Democratic Republic of Congo (DRC) alone contains 60% of the forests of the Congo Basin and 83% of this forest constitutes the forest of exploitation. In addition, the Congo Basin offers considerable potential for economic and ecological development. In terms of biodiversity, it is undoubtedly the richest area in Africa. It has among others, huge carbon stock. Moreover, with the Congo River and its tributaries, the basin contains an important reserve of fresh water [12].

The rain forest extends south of the country on two main sets: the forest of south-east (Bangassou Forest) and that of the south-west. The rain forest is made, inter alia, of:

- Meliaceae: Entandrophragma angolensis (Trama) Entandrophragma cylindricum (Sapelli);
- Sapotacées: Autranella congolensis (mukulungu);
- Sterculiaceae: Triplochiton scleroxylon (Ayous);
- Moraceae: Chlorophora excelsa (Iroko); Semi-deciduous dense forest prevails. It is rich in commercial species such as Sapelli (Entandrophragma cylindricum), Sipo (useful E.), Ayous (Triplochiton scleroxylon) and Limba (Terminalia superba). There are also other giant trees as mukulungu (Autranella congolensis), tali (Erythrophleum ivoirenses), mahogany (Kaya grandifolia) or azobé (Lophira alata) and in the extreme southwest of pure stands of Limbali (Gilbertiodendron dewevrei) that go up to 200 m3 per hectare. The rain forest is geographically divided into two blocks: the forest in the south-west which covers an area of 3.8 Mha operated under management and the forest of Bangassou, an area of 1.6 million ha in south-east CAR [13].

4.5. Impact on the Agriculture

Rising temperatures and changes in precipitation patterns have direct effects on crop yield and indirect effects due to changes in water availability for irrigation. For some time now, many farmers in Central Africa have regretted that Climate change are causing a decline in agricultural production. The lack of recent

Table 5: Types of Natural Formations in the Southwest (ha)

Types of Training Forest South Massif where	Years	
	2003	2008
Primary forests	1 270 558	1 243 801
Secondary forests	1 689 956	1 611 465
Tertiary forest	253142	327547
Savannas and other	685 480	716 323
Total	3 899 136	3 899 136

Source: PARPAF.

Table 6: Evolution of Food Production in CAR (1000 Tons)

Products \ Years	2003	2004	2005	2006	2007	2008	2009	2010
Peanuts	139.5	145.4	146.1	157.9	164.1	170.2	172.8	176.4
Cassava	565.6	566.9	572.0	595.0	601.8	619.7	632,7	646.0
Millet and sorghum	55.0	56.9	59.0	59.2	59.8	61.2	61.9	63.2
Corn	125.0	131.0	131.0	141.1	146.7	150.9	151.0	154.2
Paddy rice	31.9	34.1	34.1	37.6	39.1	40.0	40.9	41.7
Sesame	44.5	46.2	46.2	48.1	48.5	49.8	50.9	51.9
Squashes	29.1	30.4	30.4	31.6	31.9	32.7	33.4	34.1

Source: SDRASA 2011.

Table 7: Evolution of Livestock Production in CAR (1000 Heads)

Livestock \ Years	2003	2004	2005	2006	2007	2008	2009	2010	2011
Cattle	3347	3425	3501	3582	3663	3723	3807	4083	4182
Sheep	259	272	286	301	317	351	369	369	386
Goats	3087	3264	3450	3680	3890	4347	4599	5555	5744
Pigs	771	805	840	877	915	997	1041	996	103
Poultry	4769	4972	5183	5402	5631	5869	6117	6118	6335

Source: SDRASA 2011.

data in CAR is explained by the crisis that began in 2012, in which all villages are emptied of these populations in search of the security [14].

4.6. Impact on the Biodiversity

According to Mc Neely (1990), biological diversity encompasses all species of plants, animals and microorganisms and the ecosystems and ecological processes of which they are one of the elements, a general term that refers to the degree of natural variety including both the number and frequency of ecosystems, species and genes in a given set. (Table **8**)

In all, 45.89% of protected areas in the CAR are represented by national les parks, 44.21% by wildlife reserves, 2.48% of the presidential fleet, 5.94% of special reserve 1.25% of total reserve and 0.2% by the biosphere reserve. To date, 46 forest reserves covering an area of 635,062 ha, require management program [15].

Table 8: Dimensions and Number of Protected Areas in CAR by IUCN Class

Type Protected Areas	IUCN Class	Number	Total Area (ha)
Wilderness	I	1	86000
National Park	II	5	3188700
Special reserves	IV	2	316815
Wildlife Reserves	IV	5	2440000
Biosphere reserves	I and IV	2	14600
Hunting area farmed out	VI	47	7931800
ZICGC (11 created and in operation)	VI	11	3332100
Total		73	17310015

Protected Areas in CAR.

Table 9: Overview of Greenhouse Gas Emissions by Sector

Overview of GHGs Emissions by Sector			
Sectors	**Sub-Sectors**	**Total Emissions (kt CO2 Equivalent)**	**Proportion of Total Emissions**
Energy	Combustion of coal and firewood	18 716	98,7%
	Transport		
	Industry		
	Others		
Agriculture	Manure Management	16 243	0,1 %
	Culture rice		0,3 %
	Agricultural land		61,6 %
	Enteric fermentation		13,3 %
	Combustion residues Agricultural		0,1 %
	Lights prescribed		24,8 %
Land use and Forestry (without CO_2 sequestration)	Conversion of forests into agricultural land	1 562	0,14%
	Forest industry		
Residual Materials	Spreading of solid waste	2 565	?
	Waste water		
	Land fall		
	Others		

Source: 2nd National Communication(SNC).

Table 10: Balance Sheet of GHGs Emissions for the Period from 2003 to 2010

Sectors	CO2	CH4	CO	NO2	NOX	NMVOCs
Energy	1748.73	0.32	51.51	0.01	7.85	9.57
Industrial Processes	0.81	-	-	-	-	4.98
Agriculture	-	2084.59	26075.05	8.19	297.6	-
Use change and forestry	-1766581.6	723.84	6333.6	17.6	179.76	
Waste	-	2,01	-	2.05	-	-
Totals	-1764832.1	2810.76	32460.16	27.85	485.21	14.55

Table 11: Summary of Waste Sector GHGs Emissions (Gg)

Years / Total		2003	2004	2005	2006	2007	2008	2009	2010
Total CH4	(Gg)	0.056	0.058	0.059	0.060	0.061	0.075	0.148	0.133
N2O Emission	(Gg)	0.237	0.243	0.248	0.254	0.259	0.264	0.270	0.276
Total GHG	(Gg)	0.293	0.301	0.307	0.314	0.320	0.339	0.418	0.409

4.7. Overview of Greenhouse Gas Emissions by Sector

The last official inventory of GHGs emissions for the Central Africa Republic was based on 1994 data (UNFCCC, 2002) and was published in the national communication in 2008. The GHGs emissions are presented by four of the six transmission sectors defined by the UNFCCC:

1. Energy;
2. Agriculture;
3. Land use, land use change and forestry (LULUCF);
4. Waste management.

Table 12: The Coefficients of Conversion and Factors Issuance Fuels Assessment CO_2 Emissions

Fuel	Factors Conversion (TJ / t 103)	Factors Issue (Tc / TJ)
OIL PRODUCTS		
Gasoline	44.8	18.9
Kerosene for jet fuel	44,59	19.5
Other kerosene	44.75	19.6
Gas / diesel	43.33	20.2
Oil / diesel	40.19	21.1
LPG	47.31	17.2
WOOD ENERGY		
Wood fire of	14.65	29.9
Charcoal	29.31	29.9

Source: ESMAP, 1992.

The results of inventories of GHGs emissions in CAR from 2003 to 2010 reference period of the Second National Communication of the country developed under the UNFCCC. These inventories have been identified as key areas that are vulnerable: the Energy sector, the Industrial Processes sector, the agriculture sector, the sector changing land use and forestry and waste sector. While the annual emissions of the CAR are estimated at 116,285.49 kteq-CO2 in 2010, or 26 tons CO2-eq/person represent less than 0.002% of global emissions [16]. The paper also shows a gap in wastewater treatment systems. Until now, the country does not have systems for the collection and treatment of solid waste, whether urban or rural. Given that the data are incomplete, in the near future we plan to involve municipalities in a program to reduce GHGs emissions in order to process data in the residual materials sector, particularly waste management, which is a serious problem in the country today. The concept of Climate-municipality is an innovation throughout the world and the CAR must take ownership of it. Among the regions of the world considered most vulnerable to CC, Africa appears to be one of the most vulnerable. Due to the weakness and the failure of the supervisory systems and in particular the absence or ineffectiveness of the prevention and protection policies, droughts, floods, landslides, cyclones. There are often dramatic impacts (displacement of populations and Climate refugees, epidemics, famines, etc.) [17]. (Table **12**)

The analysis of the situation of the implementation of CC reveals constraints and obstacles which are among others:

- The political instability and insecurity which hamper the normal functioning of the institutions, thus decisions-making, limit the resources particularly financial resources mobilizable at the national level and little encourage development partners to get involved in the process.
- The structure of the economy of the CAR, which has become fragile mainly based on natural resources, particularly agriculture (80% of the active population, 50% of GDP and 95% of food sources) and forests (Main Industry and energy source of the country) Which depend heavily on phenomena of variability climatic and CC.
- Poverty affecting nearly 80% of the population, particularly the rural population who's only alternative to food and income is the harvesting of natural resources, which are thus over - exploited and threatened with extinction. Increased risk of destruction of carbon sinks.
- The insufficient articulation of environmental policies between them, which marks the fact that the specific nature of CC is not taken into account in both the design of programs and their implementation by appropriate means.
- The weak legislative and legal arsenal regulating the issue of CC and their non-articulation with the other national political and economic orientations of the country.
- The scarcity of human and financial resources in the specific field, the low participation of poorly informed populations, the insufficient circulation of information and the absence of exchanges between actors in particular [18].
- Establish a directory and statistical database to better know qualitatively and quantitatively the technical and scientific potential operating in the

areas of CC. The country must develop a training or career development plan. The resource persons used must have status as consultants. Many specific areas must have specialists, especially in taxonomy, ornithology, herpetology, mammology, ichthyology...

- The challenge of adaptation to CC must be well perceived in the CAR. The executive training process needs to be planned. Put the right man in the right place. In addition, active non-governmental organization (NGO) staff must be sufficiently informed and trained in this regard. National elected officials responsible for voting texts must be interested in CC issues.
- At the institutional level, the legislative and legal arsenal regulating the issue of CC and its

The Difficulties Causing the Negative Impacts that Prevent the Implementation of the Mechanisms are:

Conventional Domain	Individual Level	Institutional Level	System Level
1. Biodiversity **2.Fight Desertification** **3. Climate Change**	- Specialist in environmental law - Specialist in Sustainable Development Strategy - Specialist in analysis, monitoring and evaluation of the environmental impact - Specialist in communication, information and environmental education - Biological security specialist - Specialists in meteorology and in climatology - Specialists in hydrology, and soil science, geology and biogeography - Specialists in weather watch Broadcasting specialist news weather and climate - Planning Specialist strategic and impact analysis	- National and local structures for management planning, monitoring and evaluation of the environment - Financing structure for cross-development and environment activities - Participation in regional partnership frameworks - Management training structure in the field of environmental management - Information Structure and of the data collect - Meteorological and Climate Observation Center - Planning, management, monitoring, evaluation and monitoring of development activities integrating CC adaptation needs - Coordination structure for actions to combat the impact of CC - The legal arsenal aimed at mitigating the impact of CC - Transfers of adequate equipment and materials for observation - Development of information, education and communication program	- National System of the Heritage Account - Technology transfer system and practical biosecurity processes - National system for monitoring, evaluating and controlling the impact of development activities - Financing system for sustainable management programs - Training system, environmental information - System of permanent inventory of GHGs for monitoring and evaluation of their absorption by their well, - Technology Transfer System and Practical Methods for the Conservation and Reinforcement of Wells and Reservoirs - Prediction and management system for calamities, including drought, floods, bushfires - Financing system for adaptation measures to CC. - Training system, information on the impact of climate change

Source: Self-Assessment of National and Global in Environmental Management Capacity Building Needs.

Priorities for the Climate Change are:

Priorities 1	**Improve Staff Skills of Technical Structures in Climate Change**
Action 1.1	Training of personnel in climate change,
Action 1.2	Ability to develop ecological awareness at the level of state institutions, civil society and NGOs.
Priorities 2	**Strengthen the Capacity of Research Institutions through Training on Climate Change**
Action 2.1	Endowment of institutions in equipment and technology transfer.
Priorities 3	**Improve Monitoring Capabilities and Systematic Observation of Climate**
Action 3.1	Strengthen National Meteorological and Climatological Services, Availability and Circulation of Environmental Information.
Action 3.2	Put in place a monitoring and control system for the exploitation of resources and an environmental services payment system.
Priorities 4	**Improve Availability and Flow of Information on Climate Change**
Action 4.1	Establishment of a monitoring mechanism for Climate Change in CAR and in the sub-region.
Action 4.2	Put a specific information and communication program on climate change.
Action 4.3	Put a sub-regional network for the exchange of meteorological information.
Priorities 5	**Strengthen Good Governance and Decentralization**
Action 5.1	Improve the overall political environment of the country and administrative efficiency through adequate reforms.
Action 5.2	Ability to design and formulate an environmental policy based on the clarification of the missions of the institutions and the coordination of actions.

Source: Self-Assessment of Capacity Building Needs (Document Completed).

articulation with the other national political and economic orientations of the country must be effective. Set up specialized structures on the subject and the mechanisms of planning, management, monitoring and evaluation [19].

- Put a sustainable development strategy fully integrating the obligations of the mechanisms (Biodiversity, Fighting Desertification, and Climate Change).

- The mobilization of financial resources not only by the Central African Government but also by other development partners including donor agencies active in CAR as well as NGOs and civil society organizations. Particular attention should be given to issues of complementarity, synergy, partnership, stakeholder involvement, absorptive capacity and especially political involvement.

- An Information Management System must be established in order to better monitor and evaluate global environmental impacts and trends at the national level.

- Institutional structures and mechanisms must be strengthened with multidisciplinary specialists (meteorologists, climatologists…) a view to integrating and implementing the provisions of the Rio Conventions in sectoral and regional development frameworks.

- Institutionalize and implement a comprehensive program of training, retraining and public awareness on the best understanding and application of IPCC good practices for achieving sustainable outcomes of relevance to global environmental management.

In summary, the most important requirement in terms of capacity building is to strengthen the capacity of the institutions and, in particular, to strengthen the technical capacities so that they can carry out their mandates [20].

CONCLUSION

The Central African Republic accepts all the mechanisms aimed at effectively contributing to the reduction of GHGs without hindering its economic, social and environmental development. But it is unfortunate that the country is having difficulty implementing these mechanisms. In terms of commitments on CC and GHGs emissions, the CAR is very poorly equipped politically, economically and socio-environmentally. To meet the challenge of sustainable management of natural resources, the impact of resource degradation inherent in human activities and the changes imposed by CC. Human capital is very small in the face of repeated political and military crises, lack of training and capacity building, or less regular refresher training. The readjustment of the political arsenal of national measures and provisions on treaty texts does not follow. The lack of a program and financial and technical resources are not likely to be a dynamic sector, where interventions are usually random and inconsistent. Faced with these constraints, the government and the institutions involved must work resolutely to overcome its shortcomings.

ACKNOWLEDGEMENTS

The author wishes to thank all the experts of the institutions gathered within the technical coordination REDD+, Ministries of Environment, Ecology and Sustainable Development (MEESD), Water, Forest, Hunting and Fishing (MWFHF) Of the CAR for consultations and all papers made available, I congratulate my colleagues for their encouragement and all my gratitude to those who have contributed to the realization of this manuscript.

REFERENCES

[1] Mbalamona EA. Impact des changements climatiques sur l'agriculture et l'environnement dans le bassin du Congo. Chez *7ème Conférence Africaine sur la Population.* Johannesburg Afrique du Sud 2015.

[2] Michel B. L'étude prospective du secteur forestier en Afrique République centrafricaine. Rome, Italie 2001.

[3] Hourcade JC. Mieux comprendre le climat. DICOM-DGEC-CITIZEN/BRO/13188-octobre, Suede 2013-2014.

[4] Menne B. Climate change and human health. *Article Published 30 Jun 2015. Last modified 16 Dec 2016.*

[5] d. l. e. d. DD. Ministère de l'Environnement. Deuxieme Communication Nationale de la Republique Centrafricaine. BANGUI-CAR, 2013.

[6] Taabni AFeM. L'Afrique face aux changements climatiques, Bordeaux, France: Presses universitaires de Bordeaux 2012.

[7] Werf Vd. Les Cles du Climat et son Evolution (Mieux comprendre le GIEC). Le site du GIEC : www.ipcc.ch, Paris, France 2009.

[8] FAO, Troisieme Atelier Regional FAO sur les Statistiques pour les Émissions de Gaz a Effet de Serre, Casablanca, Maroc 2014.

[9] FC and PEDL Ministere Des Eaux. Programme D'Action National D'Adaptation (PANA), Bangui, CAR 2008.

[10] FRDJ-PCYB Pierre. Agroclimatologie du Centrafrique, PARIS,FRANCE: Éditions de l'ORSTOM 1988.

[11] Lanly J. Inventaire Forestier en Republique Centrafricaine, Bangui, CAR 1966.

[12] Locatelli B. Les synergies entre adaptation et atténuation en quelques mots:Adaptation et atténuation, Bassin du Congo, Central Africa 2011.

[13] Borie TL–J, Aménagement Forestier en Centrafrique, Bangui, CAR 2005.

[14] O.d.N.U.p.l.e.l. (FAO). Estimations des émissions de gaz à effet de serre en agriculture, Rome, Italie 2015.

[15] M.D.L.E.D.L'ECOLOGIE. 4ème RAPPORT NATIONAL à la Convention sur la Diversité Biologique. Bangui-RCA- 2010.

[16] I.P.o.C.C. (IPCC). 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Geneva,Switzerland 2013.

[17] Canada E. Analyse des NAMA (Nationally appropriate mitigation action) potentielles, Bangui-Central African Republic 2012.

[18] P.0.A.: P.2.C.N. République Centrafricaine. Autoévaluation des besoins en Renforcement des Capacités de Gestion de l'Environnement National et Mondial. Bangui-RCA 2008.

[19] d.l.e.d.D.D. Ministère de l'Environnement.Contribution Prévue Déterminée au niveau National de la République Centrafricaine -CPDN, Bangui, CAR 2015.

[20] S.A. and N.S. DJIGO. Evaluation Thematique des Contraintes en Matieres de Priorisation des Capacites dans le Cadre de la Convention des Nations Unies sur les Changements Climatiques, Bangui, CAR 2008.

Received on 24-10-2017 Accepted on 16-11-2017 Published on 28-12-2017

DOI: https://doi.org/10.12974/2311-8741.2017.05.02.3