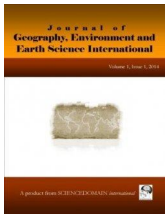

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Kyoto Protocol and the Challenges of Implementation in Nigeria

B. C. Anwadike[1*]

[1]Department of Biology, College of Education, Warri, Nigeria.

Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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ABSTRACT

This review paper focuses on the objectives of the Kyoto Protocol and the challenges of compliance and implementation in Nigeria Historically the Kyoto Protocol is an amendment of the agreement on the United Nations Framework Convention on Climate Change (UNFCCC) signed in the Japanese City of Kyoto in Dec. 1997. It was signed and ratified by 55 industrialized nations of the world before it came into force in Feb. 2005 to reduce the level of greenhouse gas (GHG) emission implicated in global warming to a safe and tolerable limit. Presently a total of 191 countries of the world have signed the treaty with only 55 industrialized nations ratifying it making the implementation of the treaty obligatory on them. The primary GHG that the treaty addressed to reduce their emission levels are CO_2, CH_4, N_2O, SF_6, Hydro fluorocarbon and Per fluorocarbon. The treaty set specific emission reduction targets for each industrialized nation for compliance. This paper relies on secondary GHG emission data in Nigeria for the review. Nigeria is a signatory to the treaty but is yet to ratify it. Some of the sources of the gases in Nigeria include natural gas and fossil fuel combustion, bush burning, gas flaring, fairly used refrigerators and air conditioners, overpopulation, forest fire etc. Challenges facing the implementation of the treaty in Nigeria includes; overdependence on fossil fuel and natural gas as the major foreign exchange earner, absence of reliable data on GHG, emission, absence of sound and sustainable environmental policies and programs, over lapping policies among environmental agencies of government etc .Greenhouse gases build up in Nigeria is on the rise especially CO_2 above the pristine value causing a rise in the

**Corresponding author: E-mail: anbenj@yahoo.com;*

atmospheric temperature overtime. The effects include desertification, loss of ecosystem and biodiversity, flooding etc. Thus there is the need to mitigate some of the anthropogenic activities that increases the level of GHG in the atmosphere that is in compliance with the provisions of the conventions and treaties on the environment Nigeria needs to ratify the protocol because the benefits outweighs the cost and the revenue loss fear that is anticipated from overdependence on crude oil can be allayed by the diversification of the economy to environmentally friendly ventures such as the development of solar, nuclear, hydro power sources and the exploitation of solid minerals.

Keywords: Greenhouse gas; protocol; convention; anthropogenic activites

1. INTRODUCTION

One of most intriguing and widely discussed issues of global concern in the world today is climate change which presumably ranks second only to population explosion. The world today is considered to be a global village such that actions and reactions which generate greenhouse gases from natural and anthropogenic sources are many a time globally felt. This is mainly because certain global emission of GHG into the environment resulting from combustion of natural gas and fossil release CO_2 and other greenhouse gases into the air and water that can cause adverse effects. These media are in a state of flux and their effects can be felt on the other side of the globe because these "global commons" lack natural frontiers to check their movements. While almost every country in the world has signed the Kyoto Protocol, the signature alone is symbolic or a token of support. Ratification carries legal obligation and effectively becomes a contractual arrangement and agreement.

Many atmospheric processes taking place on the earth's surface precisely biochemical activities depend on the exchange of heat originating from solar radiation. The absorbed heat warms the atmosphere, evaporate, and warm the surface of the earth alongside a host of other effects. Solar energy is a short wave radiation and on reaching the earth's surface is partially reflected, absorbed and re – radiated back to space as terrestrial or long wave radiation. It is known that atmospheric gases such as CO_2, O_2 and water vapor re –emit the absorbed short wave radiation back to the earth's surface as the long wave infra –red radiation. Greenhouse gases (GHG) are gases that absorb and emit radiation within the thermal infra red range. Atmospheric concentration of CO_2 from the industrial period (1750 to 2017) increased from 280ppm to 406ppm representing about 40% increment of the gas (NASA [1]). Carbon dioxide concentration in the atmosphere has increased remarkably in spite of carbon sinks and originates largely from combustion of fossil fuel and natural gas, forest fires, deforestation etc The effect of this is an increase in the earth's surface temperature above the pristine value that can cause global warming leading to ecosystem and biodiversity loss (Mora [2]).

Concerns have been shown about the possible change in West Africa climate to global warming have been of concern to scientist in the sub-region. (Bridges and Smithson [3]) Fasehun et al. [4] analyzed the monthly average temperature data (for a period of 40 years) and rainfall (70 years) in some areas in Nigeria and obtained a general mean increase in minimum temperature of 3°C per decade. This rate of change showed latitudinal variations with the highest of 6°C per decade occurring at the figures of the Saharan region and 2°C per decade at the coast (Adeyefa and Oowu [5]; Badejo [6]). The result equally showed a marked downward trend in rainfall amount, the number of rainfall days and lengths of planting season. Similar result and trends were observed by Adejuwon et al. [7] and Janowiak [8].

There are many sources of atmospheric Pollutants in Nigeria the main source being fossil fuel combustion. Fossil fuel combustion contributes more than 95% of emission of sulphur and nitrogen oxides in highly industrialized cities. Savanna burning, agriculture, land use changes and biomass fuel contribute about 90% of sulphur emission and 55% of nitrogen oxides in rural communities Obioh et al. [9]).

The main greenhouse (GHG) gases which are not the major constituents of air include water vapor, carbon dioxide (CO_2) methane (CH_4), nitrous oxide (N_2O) and in recent time's chlorofluorocarbons (CFC) and per fluorocarbons. The actual amount of global warming contributed by each greenhouse gas is the difference between the total incoming solar

radiation reaching the earth's surface and the radiation emitted back into space [10].

Nigeria is a signatory to the Kyoto Protocol but is not .under obligation to implement the provisions since she did not ratify it. With the notable sources of GHG that are not limited from trans-boundary movement, Nigeria may find herself entangled in an imminent severe climatic change as it is presently evident. Such effects are seen from the forest of the Northern part of the old Western and Eastern regions in the South that have been replaced by savanna vegetation and this has led to decrease in the amount of rainfall in those areas and decline in soil fertility. There are reports that Ozone in the atmosphere is being depleted by (CFC) leading to the leakage of UV-B radiation especially at the Antarctic region. In the equatorial region however, the Ozone level has remained static at about [5]. Changes in global climate results from doubling of the green house gases in the atmosphere and this will affect many meteorological variables alongside the rise in temperature (WMO [11]; World Bank [12,13]; IEA [14]).

The focus of this paper is to evaluate the implication of Nigerian being a mere signatory to the Kyoto Protocol without ratifying it considering the fact that the principal source of pollution in fossil fuel which is the main foreign exchange earner of her economy. Secondly to examine the attitude of the governmental agencies charged with the responsibility to ensuring that some of the greenhouse gases are reduced in compliance with the protocol.

2. HISTORY OF KYOTO PROTOCOL

The Kyoto Protocol was adopted in Kyoto, Japan on 11 December, 1997 and entered into force on 16th February, 2005 after ratification by the 55 industrialized nations (Kyoto Protocol, [15], [16]). The detailed rule for the implementation of the protocol was adopted in Marrakesh in 2001 and is called the "Marrakesh Acocrda". Under the Treaty, countries must meet their targets primarily through national measures, however, the Kyoto Protocol offers them an additional means meeting their targets by any of the three based mechanism.

1. Emission trading-known as the carbon market
2. Clean Development Mechanism (CDM)
3. Joint implementation

As at September, 2011, 191 states have signed the protocol with 55 industrialized nations ratifying the protocol to make it an effective legal document on the countries with the exception of the United States of America and Australia while Canada withdrew its membership. Afghanistan, Andorra and South Sudan did not sign the agreement. The Kyoto Protocol is a protocol and amendment of the United Nations Framework Convention on Climate Change (UNFCCC) (UNFCCC [17] and IPCC, [18] aimed at fighting global warming result from the uncontrolled emission of GHG by the industrialized nations of the world. This is an environmental treaty with the goal of achieving the stabilization of the greenhouse gases concentration in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system Grubb [19] and Figueres [20].

Under the protocol, 34 countries committed themselves to a reduction of four green house gases (GHG), carbon dioxide, methane, nitrous oxide, sulphurhexafluoride, hydro-fluorocarbon and perflourocarbon produced by them and all member countries. Countries including the U.S. collectively agreed to reduce their greenhouse gas emission by 5.2% on average for the period 2008-2012. This reduction is relative to their annual emission in a base year usually 1990 and owing to the fact that the U.S. refused to ratify the treaty (US National Research Council [21]), Kyoto countries fell from 5.2% to 4.2% below the base year (UNEP [22]).

Emission units do not include emissions by international aviation, shipping but are in addition to industrial gases. The highest 10 emitters are China (7%), U.S.A (16%), European Union (11%), Indonesia ((6%), India (5%), Russia (15%), Brazil (14%), Japan (3%) Canada (2%), Mexico (2%). The percentage figure represents the percentage of global emission. The major objective was to reduce worldwide green house gas emission to 5.2% below 1990 levels between 2008 and 2012 (Levy and Bradley [23]; Michael and Stephen [24], EEA [25]).

While almost every country in the world has signed the Kyoto Protocol, the signature alone is symbolic or a token of support. Ratification carries legal obligation and effectively becomes a contractual arrangement (Kyoto Protocol, [26]).

Emission units do not include emission by international aviation and shipping but are addition to industrial gases chlorofluorocarbon (CFC) which is dealt with in the Montreal

Protocol (1987) of Ozone Depleting Substance (ODS).

3. GLOBAL WARMING AND GREEN HOUSE GASES

The view that human activities are largely responsible for most of the observed increase in global mean temperature since the mid 20th century is an accurate reflection of arrant scientific thinking and this is expected to continue in the 21st century. The Intergovernmental Panel on Climatic Change (IPCC, [18]) has produced a range of projections of what the future increase in temperature might be. The IPCC projections which is expected to increase between 1.1 and 6.4°C

Greenhouse gases in the atmosphere can emit thermal infrared radiation effect. The main greenhouse gases in the atmosphere are water vapor carbon dioxide, methane, nitrous oxide and ozone. Without them the earth's surface temperature will be 33°C on average.

Carbon dioxide level in the atmosphere has increased from 280 ppm to 390 ppm from the industrial revolution period. The burning of biomass fuel for such sector/activities has increased its concentration in the atmosphere in spite of the carbon sink. Human or anthropogenic activities such as deforestation, bush burning increase the levels and its concentration in the atmosphere varies slightly with atmospheric levels being regulated by the Carbon Cycle. Atmospheric life time or residency time is 30-95 years Kyoto Protocol [27].

Water vapor is the gas phase of water produced from the evaporation or boiling of liquid water and are removed by condensation. Water exists in the atmosphere as cloud and water vapor. The level or concentration in the atmosphere varies from trace in the desert to about 4% over the oceans. It is the most potent greenhouse gas owing to the presence of the hydroxyl (OH) group in the atmosphere. The water vapor in the atmosphere is depleted through precipitation and replenished by evaporation from large water bodies such as oceans, seas etc. Although the most potent GHG but has the lowest residency time of 9 to 10 days (Kyoto Protocol [26]).

Methane (CH_4) is the main component of natural gas it is a potent GHG and the concentration in the earth's atmosphere as in 1998 was 1745 ppb and has risen in 2008 to l800 ppb. Naturally occurring methane is produced by the biological process called "methanogenesis" which is a process some microorganism use as energy source. Methanogenesis is a form of anaerobic respiration used by microbes that live in landfills, in the gut of ruminant and rice paddies. The level in the atmosphere is regulated by its reaction with hydroxyl radials from water vapor while human activities aggravate it. The atmospheric life span is 10 years and it is removed by conversion into carbon dioxide and water.

Nitrous oxide (N_20) otherwise known as "laughing gas" or "sweet air", is a colorless, non-inflammable gas with sweet odor and taste. It is used in surgery and dentistry as analgesic and anesthetic. It is known to react with ozone causing its depletion. It has 298 times more impact per unit weight than CO_2. This gas is emitted by bacterial in soils and oceans with agricultural nitrogen fertilizers being a notable source. Industrial sources make up about 20% of the total source.

Ozone (0_3) otherwise called triatomic oxygen, fluorinated gases (sulphur hexafluoride, chlorofluorocarbon, hydro chlorofluorocarbon are major greenhouse gases. The CFC is used as refrigerant, fire suppression and manufacturing process. The volume of CFC is 533ppt. while the proportion of hydrochloroflourocarbon (HCFC) is 69ppt (IPCC [18]).

4. KYOTO PROTOCOL AND IMPLICATION FOR NIGERIA

Presently, Nigeria is a signatory to many global conventions protocols and treaties which are relevant to the environment. Atsegbua *et al*.[28] noted that Nigeria has only ratified thirty global environmental conventions while leaving out fifty two at the moment.

Historically, Dr. Raphael Adewoye the former Director General of the Federal Environmental Protection Agency (FEPA) on 22 April 1998 at the opening ceremony of the workshop on Global Warming and Climate Change organized by the Friends of the Environment remarked that Nigeria like most other African countries is not only vulnerable to climate change and the associated phenomena. They also bear the burden of triple vulnerabilities which are:

1. Land based vulnerability to environmental impact of climate change which is engendering desert encroachment in the

northern part of the country with phenomenal southern progression threatening the southern area lying below the Atlantic Ocean coastline.
2. Economic vulnerability of a nation largely dependent on revenue from fossil fuel.
3. Population based vulnerability of over 100 million people, a large percentage of which are resources poor rural people whose poverty burden will be further compounded by climate change and result in greater human misery and environmental refuges.

Furthermore on 3rd August, 1998, Nigerian's first national communication to the UNFCCC and the inauguration ceremony of the members of the National Committee on Climate Change (NCCC) was held in Kano city. The preparation of the National Communication was in fulfillment of the commitment of parties under articles 4 and 12 of the convention where by parties undertake and prepare and forward their national communication to the Secretariat of the UNFCCC on Climate Change (Atsegbua et al. [28]. This is to assist parties to the convention in monitoring how far each party is complying with the implementation of the convention especially in the area of greenhouse gas emission.

5. NATIONAL EMISSION OF SOME GHG IN NIGERIA

Table 1. shows the national emission for specified sectors/activities reported by Obioh et al. [9]. The breakdown for Co_2 gas shows a gross national emissions of 73,310,000 tones with combustion processes having 70,090,000 tons, 34,625,000 tons for oil and gas systems, 31,400,000 for gas flaring, 14,600,000 tons for transportation while the least of 10,700,000 coming from industrial production. Methane generation breakdown shows 143,000 tons coming from combustion processes, 115,900 tons from oil and gas system and 720 tons from gas flaring. Transportation accounted for 4,100 tons, while industrial production generated 33,200 tons, solid waste open burning was 6,600 tons and forest/savanna burning generated 118,00 tons with the least coming from fuel wood combustion with value of 30 tons. Nitrogen oxide showed a gross national emission of 7,000 tons, combustion process. (7,100 tons), forest/savanna burning (1,000 tons), industrial production (400 tons), solid waste open burning and gas flaring component had 70 and 30 tons respectively. Oxides of Nitrogen (No2) showed gross national emission of 924,860 tons with oil and gas systems having 716,700 with solid waste open burning having the least value of 1,190 tons.

Although, these records may have changed presently as official records of the present situation could not be reached.

6. CHALLENGES FACING THE IMPLEMENTATION OF THE CONVENTION IN NIGERIA

Overtime, Nigeria appears oblivious of the consequences from the non-challant attitude to GHG emission in the country. Governmental policies have been very inconsistent towards alleviating the emission of the GHG as certain disasters would have occurred before the nation wakes to realities. The Nigerian borders are still very much porous to the importation of certain goods such as fairly used fridges and air conditioners that have been disposed off by the originating countries. These equipments use CFC as coolant that is implicated as a GHG which can accumulate in the atmosphere and contribute to global warming. The importation of fairly used vehicles and other automobiles considered to be a major pollutant generator from the originating countries find their way to the country through unscrupulous businessmen and women in connivance with corrupt import regulatory agencies officials aggravate this situation. The level of carbon dioxide in the atmosphere is gradually increasing above the bench mark value that can aggravate global warming because of the over dependence on fossil fuel and natural gas as source of electricity to homes and offices. In this period of epileptic power supply from the national grid, people provide their own electricity by means of fossil fuel combustion that generates CO_2 which is one of the GHG implicated in global warming. According to the World Trade Organization in 2015 which stated that fuel constituted 79.3% of Nigeria's export in 2014. Crude oil and natural gas are major foreign exchange earners in Nigeria and its overdependence on them with a monolithic economy without the obvious realization that it is no longer sustainable because of the dwindling earnings that has affected even other oil producing countries. The pressure to diversify the economy is very high on the Nigerian Government because she failed to plan in times of excess earnings from crude oil export as the operation of the economy is riddled by both public and private corruption. For long even the major agency responsible for the crude

Table 1. National emission for specific sector/activities

s/n		Tones							
	Sector/activities	**$S0_2$**	**$N0_x$**	**CO**	**PM**	**CH_4**	**N_2O**	**PB**	**CO_2**
1	Combustion process	67,300	35,900	5,900,000	1,441,000	143,000	7,100	2,464,000	20,090
2.	(i) Oil And Gas System total	18,900	716,700	291,800	2,300	115,900	380	0	34,652,000
	(ii) Gas Flaring component	300	40,200	65,100	60	720	30	0	34,400,000
3	Transportation	11,600	80,900	103,300	817,200	4,100	200	2,500	14,600,000
4	Industrial production	13,400	16,500	15,600	1,054,000	33,200	400	60	10,700,000
5	Solid waste open process	1970	1,190	65,600	7,790	6,600	70	0.39	nd
6.	Biomass burning process								
	(i) forest/savanna burning	26,500	18,100	2,064,000	1,306,000	118,100	1,000	1,000	0(e)
	(ii) fuel wood	500	30,000	3,257,000	108,800	30	nd	10	0(e)
	(iii) charcoal	200	1,800	94,900	4,700	nd	nd	20	0(e)
7.	Gross national emissions (all air pollution sources)	86,900	924,860	6,121,500	22,335,000	1,165,000	7,000	2,464,800	73,310,000
8.	Netherlands (for comparison)	201,00	576,000	930,000	139,700	$Na^{(0)}$	na	na	159,000,000

Source: Obioh et al. [9]

oil and natural gas (Nigerian National Petroleum Company) does not have a reliable data on the earnings and volume of exports from the terminals to other countries. Consistently there are accusations of corruption in the operations of the sector hence the clarion call on the government to deregulate it. Economy diversification to other solid minerals has become a common slogan for successive governments but falls short of implementation with no obvious development plan which is the hallmark of modern economies of the world. Climate change is caused by the rise in the levels of GHG in the atmosphere leading to elevated temperature above the safe pristine value. Nigeria today is experiencing an adverse climatic change resulting in persistent flooding, droughts, out of seasons wet and dry seasons, drying up of wetlands causing ecosystem oversimplification. The effect is the scarcity of water to support irrigation and hydro electricity generation. The agricultural sector in Nigeria contributes significantly to the Gross Domestic Product (GDP) and employs a lot of persons in the rural areas. The Kyoto Protocol ratification remains a nightmare to Nigeria because of the inherent fear of sacrificing the short term economic developments on the altar of long term impact of ecological consideration of climate change. It is sad to say that Nigeria's Development Plans do not take into cognizance the threat of climate change resulting from the usage of its main export earner which is crude oil. However it can be said that presently due consideration will be given to economy diversification because of the falling price of crude oil in the world markets and the proposals by many major trading partners to embrace other cleaner technologies by outright ban on the use of gasoline engines. This is enough information to economies whose main stay is crude oil to use their earnings to diversify their economies including Nigeria. Although Nigeria is not the cause of the climate change and global warming but the adverse effect on the country are obvious such as the prevalent seasonal flooding, desert encroachment in the Northern part of the country and the riverine areas that depend on fishing for their livelihoods are destroyed from rising flood water.

The challenges are further compounded by the absence of environmental education of the populace especially the rural dwellers who do much bush burning in farm sites preparation and the use of biomass fuel for domestic purposes.

In spite of the heavy presence of governmental agencies at the borders, these supposedly restricted goods find their way into the country which equally increases their cost thereby increasing the vulnerability of the environment to GHG that cause global warming. Institutional corruption and conflict in the operations of the Nigerian Customs Service and failure of environmental agencies such as the Nigeria Oil Spill Detection Response Agency (NOSDRA), Nigeria Environmental Standards Regulation Agency (NESREA), Department of Petroleum Resources (DPR) in regulating the level of institutions generating them. Meanwhile Nigeria is still at a cross road concerning the ratification of the treaty because of economic consideration which may be akin to the attitude of America, Canada and Australia that made them to withdraw although both circumstances are different. The inherent and palpable fear of the Nigerian Government is that complying with policies that will reduce fossil fuel consumption will adversely hurt the economy as it is the eighth largest oil supplier in the world and the ninth largest deposits of gas. The fear is obvious because of large scale and unchecked corruption in the system with no implementable plan to diversify the proceeds to other viable economic ventures. Gas flaring that contributes significantly to CO2 levels in the atmosphere is still widely practiced in Nigeria because of the apparent lack of technology to manage it. A study by the World Bank in 2007 said that Nigeria accounts for approximately one – sixth of the world wide gas flaring that releases about 400 million tons of CO2. This problem is further bedeviled by the lack of adequate data to help us in taking vital decision on the issue. Fossil fuel which is a major source of $C0_2$ is the main foreign exchange earner of the country making her to be entangled in the web of promoting economic benefits above ecological benefits. Thus the question is, can we risk desert encroachment in the north and marine transgression in the south and argue for economy depending on fuel? Our refusal to ratify the convention can be seen by other members as act of sabotage and will there be any political and economic implication on the nation by the other member nations?. Ratification of the Kyutu Protocol by Nigeria and other OPEC countries with a monolithic economy will grossly reduce their incomes and this will spell doom for their economies. Nigeria should ratify the protocol and by extension the Paris Agreement because the overdependence on oil is no longer sustainable as evidenced by the negative economic impact on OPEC member states. Thus

the challenges posed by the decreasing foreign exchange earnings from oil can be mitigated by the implementation of the age long diversification of the economy to solid minerals exploitation since the country has enough of them. Furthermore there can be investments of the huge revenues from the sales of fossil fuel on the development of nuclear, hydro, solar and other GHG free power sources as well.

In summary, considering the above circumstance of the nation overdependence on fossil fuel, its poor power supply that makes many industries and domestic users of power generators utilizing such fuel, government policies, cross purpose functioning of agencies charged with the responsibility of limiting the GHG emissions in Nigeria, even if the government decides to ratify it, obvious loopholes for its supposedly success still abounds. Therefore, it is very likely to fail in the Nigerian environment which is an attitude that the government can hardly regulate and control. However, all perceived fears against the ratification of the protocol by the Nigerian Government can be allayed by using the earned revenues over the years to diversify the economy because overdependence on crude oil is no longer sustainable.

7. CONCLUSIONS AND RECOMMENDATIONS

It can be recommended that it is not too late to have an attitudinal change both on the part of the government and its citizen to do all within their powers to overcome the negative attitude, and put the necessary policies in place so as to ratify the convention. Governmental agencies in charge of the environment should be strengthened with policies and programs aimed at GHG reduction and there should be strict enforcement of the laws on the emission of the gases to comply with regulatory standards. Diversification of the economy through the investment of the huge earnings from crude oil should go beyond theoretical considerations as time is no longer on her side because the dwindling price of the commodity is enough information of an impending economic doom. Other environmentally friendly alternative sources of energy such as nuclear, solar and hydro should be given due consideration and implementation .Massive re a forestation and forestation programs should be done by creating more forest reserves since they act as sinks to sequester carbon from carbon dioxide, bush burning, overgrazing and other forms of land degradation should be avoided

COMPETING INTERESTS

Author has declared that no competing interests exist.

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