

Climate Change, Disaster Risk Management And The Urban Poor In Port Harcourt Metropolis.

Eyenghe Tari, Ibama Brown, Wocha Chikagbum

ABSTRACT: The need to adapt to climate change will be a fundamental driver of developing countries. The impacts are global in outlook but the mitigation policies and plans to cut down greenhouse gases emission and other elements are more local in actions. This study is carried out to evaluate and ascertain the risks of climate change on the urban poor in Port Harcourt city. However, from our findings, it shows various possible sectors that the impacts will be severe. These areas include environment, health, food insecurity, air and water pollution, flooding and ecosystem distortion; and the urban poor are most vulnerable. Also, most vulnerable areas in the city were identified which include Diobu, D/Line, Port Harcourt Township, New GRAs and most parts of Obio/Akpor local government areas in the city. Most of the residents in these areas suffer flooding because of increasing rainfall. The temperature of the city has increased and the ecological system is distorted around the coastal areas. The study also proffers possible appropriate policies and plans that should be adopted by policy makers and urban planners to mitigate and/or ameliorate the impacts of climate change on the poor of Port Harcourt city.

Key words: air and water quality, Climate change, ecosystem distortion, environmental impact, health and food insecurity,

INTRODUCTION

In the recent years, scientists noticed that the average temperature of the earth was increasing and looked for causes for the change. This change was initially thought to be caused by natural phenomenon alone, but recently was suspected to be more of human activities (Enger et al, 2006). With man trying to search for resources to better his living standard so he impacted on the earth. These activities of man have emitted some poisonous elements such as carbons (CO₂, CO), sulphur, methane, nitrous oxide, chloroflouro-carbons (CFCs) etc, to the earth resulting to climate change and global warming. These impacts are feared generally if the trend continued it will be difficult to cope with in the future, if urgent and appropriate measures are not considered or taken (Ogboi, 2012). The climate change has emerged to be the greatest environmental threat facing the world today, both to the government and the populace. Thus, from 1850 to date it had been recorded that five warmest earth temperatures had been recorded in human history. These warmest years are 1995, 1998, 2001, 2002 and 2003 (Houghton, 2005 cit. Ogboi, 2012).

The impacts of the temperature rise has recorded heavy ice melting in the Arctic region and the Alps, sea level rise, heavy storms and rainfall, flooding, drought, desert encroachment, heavy snowfall, increase heat waves, hurricanes, cyclones, typhoons, and tsunamis in recent times. These natural and human induce activities have impacted on several natural and human activities including ecology, agriculture, food security, health, water resources industrial production and urbanization (Ogboi, 2012). And these impacts are predicted to affect more of the poor in the society who are mostly vulnerable; these are women, children, and the aged in the society. With the world population reaching 7 billion and these populations are found more in the developing economies in the world, the poorest population are in these countries (PRB, 2011). However, with the natural rise of population and migration of people to the urban areas it is estimated that by 2025 about 5 billion people to be living in the urban centres resulting to inadequacy and inefficiency of urban resources and governance (Enger et al, 2006). Nigeria's population which is amongst the highest in the world and the highest in Africa is estimated to be 162 million in 2011 (PRB, 2011). And her economy is a developing economy; her urban population is growing in an unprecedented rate. From the Nigerian National Urban Development Policy (NUDP) 2006 report state that more than half of Nigerian population will be living in urban areas with about 5.8% growth rate per annum. If this happens, the rate of vulnerability of climate change will be acute in the urban centres. Cities in Nigeria such as Lagos, Kano, Kaduna, Ibadan and Port Harcourt have the highest population growth and equally urban poor. Port Harcourt city which has the highest population in the Niger Delta region of the South-South geopolitical zone in Nigeria is have environmental challenges such as flooding due to heavy rainfall, intensive heat wave as a result of high temperature, ecological problems, health and social problems. This paper is to investigate the disaster risk and policies implications as regards to climate change to the populace, and government preparedness to the environmental threats and more concern to the residents especially the poor living in the city.

- *Ibama Brown is currently a Lecturer in the Department of Urban and Regional Planning in the Rivers State University of Science and Technology, Port Harcourt, PH+2348035519084. E-mail: ibabrown@yahoo.com*
- *Eyenghe Tari is currently a research assistant in the Department of Urban and Regional Planning in the Rivers State University of Science and Technology, Port Harcourt, PH +2348055136552 Email: t.eyenghe@gmail.com*
- *Wocha Chikagbum is currently a Lecturer in the Department of Urban and Regional Planning in the Rivers State Polytechnic, Bori. PH+2348036751450 Email: chikagbum.eric@gmail.com*

PROBLEM STATEMENT

The rapid urbanization process in Nigerian cities is overwhelming in term of population and spatial area. Almost the entire cities in Nigeria are facing the challenges of urbanization which ranges from physical, environmental, economic and social. Port Harcourt city which is the industrial hub of the Niger Delta region is also saddled with these urbanization challenges. The key factors to these emerging challenges are said to be lack of urban planning and political will by politicians to allocate human and capital resources to achieve sustainable development. Port Harcourt as the headquarters of the oil and gas exploration and production in Nigeria, the activity has contributed to the emission of lethal pollutants to the environment which has caused health, environmental and socio-economic problems. Today the city temperature has increased drastically resulting to high level of heat wave. The intensity of the heat is felt by every resident which complaints are recorded in different quarters. Also, flooding is recorded in many parts of the city, even in areas that are planned for example the New GRAs, D/Line and the Port Harcourt Township areas are always flooding because of heavy rainfall. Lack and inadequate drainage systems within the city to drain storm water and domestic waste water are sighted to be the problem. The emission of toxic liquids and gases by companies operating within and the periphery of the city have affected the water aquifer which is the major source of water supply to the residents of the city. The atmospheric condition has change over the years. This has made breathing to be difficult and the health standards are falling with sicknesses and diseases affecting large part of the population. These problems are emanating from the consequences of climate change and global warming through the emission of greenhouse gas and elements to the environment of the city. This research will examine why the persistence of the problem since Nigeria is part of the Intergovernmental Panel on Climate Change (IPCC) 2001 treaty. What has made the government reluctant to cut down the emission of the greenhouse gases and elements on Nigerian environment and it consequent implications, if urgent and appropriate steps are not taken to protect humans and the ecology of the city of Port Harcourt it will be disastrous on the environment.

THE STUDY AREA

Port Harcourt city is located within the subequatorial south region of South-South Nigeria and has a cosmopolitan population with people from diverse nationality, tribes and ethnic groups. The indigenous tribe and ethnic groups comprise of the Ikwerres and the Okrikas but more of the Ikwerres in the geographical and spatial area covered. The both ethnic groups have strong identity with the ancestral belief. This has made them to have strong cultural values. The massive influx of people from other regions within the state, country and outside the territory of Nigeria have made the population to be cosmopolitan in characteristics. These movements have greatly influenced the culture and beliefs of the indigenous ethnic groups. Today Christianity is the most prominent religion in the city based on the early interaction of the Christian missionaries. There are other religions such as Islam and the old existing African religion (traditionalists). However, the Greater Port Harcourt city region have expanded and stretched to cover the entirety of

Port Harcourt City Council and Obio/Akpor LGAs. Other LGAs which parts of the lands falls within the city includes Eleme, Oyigbo, Okrika, Ogu/Bolo, Ikwerre, Emuoha LGAs. These has made the city physical area to be large and growing to be a metropolitan centre in the Niger Delta region. The population of the city in 1991 from National Population Commission (NPC) was estimated to be about 440,399 populations with 2.8% growth rate per annum. But today the city population is estimated to be about 1.9 million and Nigerian urban centres are growing by 5.8% growth rate per annum (NUDP, 2006). This is as a result of natural population increase and large migration to the city because of agglomeration of business activities such as gas, oil, and other industrial activities (both trade and manufacturing). The region experiences heavy rainfall for eight to nine months of the year between April to November. The highest rainfalls are July and September with the average mean yearly is 2,300mm. The highest temperature is normally is between the months of January to May each year while the lowest in the year are between June and July. The variation in temperature begins in January which is about 32°C (90°F) and the lowest is about 26°C (78.8°F) in July but the average mean yearly is 30°C (86°F). The relative humidity is comparatively uniform over the entire state because of the proximity to the Atlantic Ocean and is between 80% - 100%. This has influenced moderate climate and humid air over the entire delta region. There are two wind conditions in the state namely; Southwest Monsoon Wind (Atlantic Ocean) and Northeast Trade Wind (Sahara Desert) winds. The both winds brings precipitation (rainy season) and harmattan (dry-hot season), (Port Harcourt Master Plan, 1975). Port Harcourt city environmental area is uniquely complex in ecological biodiversity. The topography of this area is of the low-plain and uniquely sitting on wetlands and swamps susceptible to seasonal flooding. The soil types found within the city area are sandy, loamy, clay and peat soils. The upper layer of the soil is mainly soft mud with thickness of up to 6m (20ft) having high content of organic materials, which makes development expensive. Some of the areas are Borikiri, Marine Base, Eagle Island, Old GRA and the New GRAs areas. Though depends on the parent materials which the soils are formed, (Port Harcourt Master Plan, 1975). It vegetation are typical to variance of the tropical rain forest and wetlands which are influenced by the type of soil in the region. The main difference lies in the hydrological sequence of their habitats. The freshwater swamp forest is subject to longer period of inundation than the moist lowland forest.

LITERATURE REVIEW

CLIMATE CHANGE: GLOBAL OVERVIEW

Thus, over 3.4 billion people i.e more than half of the world population live in areas which are at risk and/or prone to disasters (World Bank, 2005). These disasters are associated with major natural and human induced hazards such as droughts, floods, hurricanes, earthquakes, volcanoes, landslides, mudslides, cyclones, tsunamis, typhoons, etc which are attributed to climate change activities. Climate change is defined as the systematically significant variation in the mean state of the climate or in its variability, persisting for an extended period of time typically for decades or longer (IPCC, 2001). United Nations, 1993 in

Article 1 defined climate change as the attribution of direct and indirect of human activities that alter the composition of the global atmosphere and which are in addition to natural climate variability observed over comparable time period. The accumulating evidence of increasing earth temperature resulting to global warming have projection of long term effect, and growing public and political administration determination to address its causes led during the 1990s to two high-level international conferences and treaty proposals (Fellmann, et al, 2005). The first 'Earth Summit', which was held in Rio de Janeiro, Brazil in June, 1992. The Framework Convention on Climate Change was signed by 166 countries calling the industrialized countries to try cut down the emission of greenhouse gases and elements at 1990 levels by the year 2000 as a necessary first step to prevent disruption world agriculture and natural ecosystems. The small Island countries fearing possible obliteration with rising sea level proposed even more stringent reductions by the industrialized economies. United States and EU countries agreed to the overall proposals and start setting emission cutting timetable but developing countries like China and others did not bound to précised target because the argued it will slow down their economic growth. The second step was in December, 1997 the 'Kyoto Protocol' in Japan for Climate Change Summit was staged for binding treaty arrangement made earlier in Rio de Janeiro, Brazil since the all countries have recognized that climate change is a major global concern that requires collective actions because of the earth environmental challenges in depletion of resources, ecological imbalances and natural disasters. In this Summit the countries of the world came with different interest and bargaining positions. The European Union (EU) countries proposed that all industrialized countries should reduce the emission of CO₂ and other heat trapping gases to 85% of their own 1990 levels within 12 years. The United State proposed not more lower than 1990 levels and not until sometime 2008 – 2012 and the developing countries demand that industrialized countries collectively achieve 35% emission reduction by 2020. The Kyoto treaty a total of 160 nations agreed to the treaty on the limiting of CO₂ and other greenhouse gases. Initially the protocol covers only 3 greenhouse gases: carbon dioxide, methane and nitrous oxide, but additional 3 compounds were to be added namely: hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride (Enger et al, 2006). In 2001 Climate Change Action Plan was developed as a follow up of the Kyoto Protocol for some continental treaties and national programmes. The EU countries to reduce emission by 8% within 15 years, United States by 7%, Japan and Canada by 6%.

CAUSES OF CLIMATE CHANGE

Climate change as a global phenomenon is caused by many factors associated mostly by human induced activities. This occurs when several gases in the atmosphere are transparent to ultraviolet and visible light but absorb infrared radiation. These gases allow sunlight to penetrate the atmosphere and absorbed by the Earth's surface. This sunlight energy is reradiated as infrared radiation (heat), which is absorbed by the greenhouse gases in the atmosphere. When these gases are trapped at the atmosphere with the depletion of the ozone layer, the sunlight reflects back to the earth to cause global warming

which change the atmospheric conditions of the earth. The ozone layer shield the earth from excessive sunlight, it's approximately 15 to 35 kilometres (9-21 miles) from the earth surface (Enger, et al, 2006). These greenhouse gases such as CO, CO₂, CFC, NO₄ has are harmful gases that has contributed to the depletion of the ozone layer causing global warming and acid rainfall. All these have caused climate change that has become global environmental challenge by countries, governments and individuals. The effects of climate change have caused several environmental and health concerns in different region of the earth. Africa is greatly affected with the challenges of climate change being the most vulnerable region and population to this threat. The continent facing problems such as drought, flooding, food security, coastal surge, desert encroachment and other health risks are not far from effects of climate change and global warming. Nigeria, the most populous country in Africa is most vulnerable to this effect mentioned above. Thus, having these types of conditions prevailing and experienced in the environment of Nigeria, there is need for the governments, corporate organizations and the citizenry to show concern on how to reduce these impacts. There are various contributors to climate change in Nigeria environment. These contributors are from human activities ranging from industrial land use, agricultural, bush burning, oil and gas processing, natural, and municipal wastes (Magbagbeola, 1999 cited in Ologunorisa, 2011). Niger Delta region in Nigeria where there are so many industrial activities are facing great environmental and health challenges attributed to climate change and global warming. With oil and gas exploration, production and distribution going on in the environment has resulted to the emission of greenhouse gases such as carbons, carbon dioxide, sulphur, nitrous oxide, methane, chlorofluorocarbons, crude spills, etc to the atmosphere and environment. Port Harcourt city which is the economic hub of the Niger Delta region is not an exception to this emission problem, where the oil and gas products from the region are used for the distribution to other parts of the country and world. There are many substances being emitted to the environment and there is possibility that there will be high environmental risk and health implications to the inhabitants, wildlife, plants, other living organisms and manmade materials. Although, it is recorded in Niger Delta Regional Development Master Plan, 2006 that oil spills pose a severe threat to the sustainability of biodiversity resources particularly fishes and marine/aquatic wildlife. That in 2000 over 5400 oil spills occurs in different oil fields in the region which amount to about 2.4 million barrels of crude oil into the sea and coastal areas in the region. Although the Nigeria government is said to remain committed to ending gas flaring and discharge of crude and wastes from oil and gas activities to the environment in 2008 (NDRDMP, 2006). This activity is believed to be a major contributor to air and water pollution, and acid rain in the region.

CLIMATE CHANGE AND URBAN POOR

Over the world every urban area is faced with peculiar problems ranging from housing, food and nutrition shortages, unemployment, health services, traffic and transportation, inadequate infrastructural provision, water and sanitation, municipal waste management, gender

inequality, environmental and slum problems, social problems, security and good governance problems. Though, most of the urban challenges are seen and experienced in emerging cities which have large population living below the poverty line. The urban poor are the most vulnerable segment in every urban society. The effects of climate change on the urban poor are numerous; the risks are high with respect to housing, food security, basic sanitation, waste management and slum development. According to World Food Programme (WFP, 2009), that the impact of climate change on hunger has evolved significantly over the last 15 years. Their studies concluded that there is notable decline in crop yields of wheat, rice and maize caused by increased heat and water stress would be greater in developing countries and these are the staple foods in Africa, East Asia and Latin America. This would increase food prices consequently further cause food insecurity especially in urban areas where the urban poor are concentrated. Hence, with the constant impacts of climate change on urban environment, there is threat to available freshwater supply and quality. The urban poor especially in developing countries cannot afford portable and safe drinking water for domestic use as a result of pollution of the water resources within their reach. Industrial and domestic wastes are dumped and discharged into water bodies thereby causing incursion and health risks to the population. Also, high level pollutants from acid rain, chlorofluorocarbons, aerosols, CO, sulphur and CO₂ impairs water quality making it unsafe for domestic use. The hydrological cycle is being altered and depleted from constant abuse and pollution from human activities. The housing challenges are high in developing countries. Thus, with the constant demand for housing are increasing. In urban areas where land is expensive has pushed the urban poor to marginal and unsuitable land to meet their housing demands. Lands that are prone to environmental hazards such as erosion, flooding, landslides and other effects that are contributed and/or triggered by climate change and greenhouse effects becomes the home for the urban poor because they are cheap and easily accessible by these most vulnerable populations in urban centres. This development results in the development of slums, squalid and squatter settlements in urban centres. These sections of the urban environment with such development are often deprived and neglected from urban infrastructure and social services thereby increasing the socio-economic disparity and inequality in the urban environment. These continue to proliferate urban poverty in every section of the urban environment.

METHODOLOGY

In order to obtain relevant information/data on the impacts of climate change and disaster risks the study adopted various data collection, handling and analytical methods. The study employed both primary and secondary data collection. But for more relevance the study mostly relied on secondary data because much study on climate change and urban poor has not been carried out in Port Harcourt region due to the complexity of the issue. The primary sources of that were used are based on direct physical observation of natural and anthropogenic activities in the Port Harcourt region that have changed natural phenomena through photographs and the like.

DISCUSSION OF FINDINGS

Environmental Degradation

According to Huq, 2009 Nigeria is amongst the most vulnerable countries to climate change in Africa. Port Harcourt region is not an exception to this problem and is faced with constant environmental challenges. From studies that were carried out in this region shows high level of environmental degradation. These facts are seen especially around the waterfronts of the city where the most vulnerable populace are residing and they are the urban poor. With constant bash of the river currents on the banks of the rivers and creeks that crisscrossed the city, there is evidence of river surge on the banks of these water bodies washing away the banks into the rivers and creeks. This action is attributed to the high level of discharge of greenhouse elements-carbons and sulphur that causes climate change (heavy and acid rainfall, high intensity of sun, increase of sea level, see Table 1 show the level of increased of GHGs from pre-industrial era to 2005) on the environment by multinational companies involved in oil and gas exploration and exploitation within and surrounding regions of Port Harcourt. However, with the inadequacy of housing provision and basic urban infrastructure and services, the ever increasing urban population of Port Harcourt extends its settlements to disaster prone areas that are within low lying terrains (swamps and marshy) building shelter with substandard building materials that cannot withstand environmental and natural forces. The urban poor who invades these area does not have the financial resources to pay for the required technology to build houses in such areas. Places that such development are seen in the city include Marine Base, Prison, Abuja, Ibadan, Okrika, Elechi Beach, Afikpo through Timber, Ndoki, Abonnema Wharf, Njemanze waterfronts, etc. Living in such areas, residents are prone to health challenges such diseases and sicknesses because of contamination to their food and domestic water supplies. Though, the government through her urban renewal programme is demolishing these waterfronts in the city. Waterfronts such as Njemanze and Abonnema Wharf have been demolished and paid compensation to land owners. This will help reduce risks amongst residents of these waterfronts. The challenges to this urban renewal programme by the government are that there are no proper studies that were carried out, so that the affected people can participate in decisions of their future. We anticipate more proliferation of squatter and slum development in other parts of the city if proper strategy is not applied in the ongoing exercise. The government has not need to prepare herself to handle the problems that will come from movement of people from one place to other. This issue mostly concerns the urban poor in the city who find it difficult to adjust to such movements.

Table 1: Change in Anthropogenic Greenhouse Gases over the Years

Gas	Pre-industrial Level	1988 Level	Increase Since 1750	2005 Level	Radioactive Forcing (w/m ²)
Carbon (iv) oxide CO ₂	280 ppm	387 ppm	107 ppm	399 ppm	1.46
Methane	700 ppb	1745ppb	1045 ppb	1774 ppb	0.48
Nitrous Oxide	270 ppb	314 ppb	44 ppm	319 ppm	0.15
CFC ⁻ 12	0	533 ppt	-	-	0.17

Source: IPCC Radioactive Forcing Report 1994, IPCC TAR (2001), IPCC (2007)

Flooding

Urban flooding is prevalent in Port Harcourt city. Hence, rapid urbanisation in the city has further increased flooding challenges. Lack of proper and adequate drainage systems to channel storm water and domestic wastes water to natural drainage channels has made reoccurrence of flooding in the city in recent years. Lack of urban planning through preparation of street layouts, subdivision plans, zoning plans and regulations, and development control mechanisms are attributed to cause of most the city's flooding challenges. Developers most time develop along natural drainage channels resulting storm water and wastes water to force itself to empty spaces within the environment increasing runoff that causes flooding in different parts of the city. Areas such as Diobu, D/Line, GRA Phases 2, 3, and 4, the Port Harcourt Township are all faced with flooding challenges because it has nowhere that wastes water can be easily channelled to. The worst area in Port Harcourt is the Obio/Akpor axes where no form of urban planning was carried out by the urban and physical planning agencies in the city. In most of these areas is being inhabited by the urban poor who are most vulnerable to the flooding problems. Most of their living conditions are that of squatters, squalor and slums which are prone to flooding. Recently, the government of Rivers State is embarking on urban restructuring through the Ministry of Urban Development and Physical Planning. The Ministry is currently demolishing structures along natural drainage lines within the city as to enhance the free flow of storm and domestic wastes water. To support this effort the government also setup a Flood and Erosion Control Committee to come up with Flood Master Plan for the city of Port Harcourt. The government have started removing debris and silts from these natural drainage lines (creeks and rivers) and constructing levees to prevent these drains to overflow its banks to reduce flooding problems in the city. The major roads within the city have their drains expanded to collect the volume of storm water to natural drains e.g Ikwerre, NTA/Mgbouba, Ada-George, Stadium road, Elekahia road, Azikiwe/Station road, Old Aba road, Okporo road, Rumuola, Creek, Olu-Obasanjo Bypass Roads are reconstructed to mitigate some of the flooding challenges in their various neighbourhoods.

FOOD INSECURITY AND LIVELIHOOD THREATS

Food and livelihood threats are increasing in the world due to climate change activities. According to WFP, 2009 that there is a general conclusion that climate change is likely to reduce global food potential and that the risk of hunger will increase in the most marginalized economies; this will effect crop yields and change of food production, prices and number of people at risk of hunger. This concern is coming up when the world is fighting to reduce the outlook of poverty in our societies especially the developing economies. Port Harcourt city is not an exception to these threats. Thus, when agricultural lands and other means of livelihood within and around the city are polluted through emissions of carbons and sulphurs from human activities these would result to food supply shortages and eliminate people sources of livelihoods (see Table 2). The foods listed in the table; rice and maize are some of the staple food items in the Niger Delta region which are at threat as a result of regular CO₂ contamination from fertilization and other climate change elements. Most of the poor in the city are within the informal sector. Their primary occupation is farming and fishing; their produce endangered, because crude oil and its associated elements are discharged to lands used for farming and water bodies used for fishing. The quantity and quality of their products are reduced in this instance thereby reducing the food supply to the inhabitants of the city. The most vulnerable people are the urban poor who live below poverty line (i.e. less than 1 dollar/day). With the subsequent increase in food prices due to shortage of food supply, the prevalent increased of the poor in the city cannot cope with the situation forcing them to look for alternative means of livelihood and occupation. When unemployment increases other social problems may arise from this situation such as prostitution, crime, violence, drug peddling, child abuse, and other form of socio-economic vices.

Table 2: Projected World Price of Selected Crops Products (US\$/mt)

Food	2000	2050				
		No. Climate Change	NCAR No. CF	CSIRO No. CF	NCAR CF Effect (%)	CSIRO CF Effect (%)
Rice	190	305	419	414	-17.14	-16.36
Wheat	113	132	263	267	-10.39	-11.37
Maize	95	95	158	162	-11.41	-13.50

Source: World Food Programme (WFP), 2009

Note: Prices are 2000 US\$. The last two columns report the % difference between the price in 2050 with and without the CO₂ fertilization effects. For example the NCAR GCM, assuming CO₂ fertilization is effective in the field, results in a 17.41% decline in the world rice price in 2050 compared with the no CO₂ (CF) price.

AIR AND WATER QUALITY

Roughly, one-third of the solar energy that reaches the top of earth's atmosphere is reflected directly back to space (Ogboi, 2012). The carbons, sulphurs and other elements emitted to the environment pollutes the ecosystem thereby endangering humans, plants and animals. The amount of

CO₂, CH₄ and N₂O that are emitted around Port Harcourt environment are enormous that impairs the air quality (see Table 3 & 4). With emissions sources that are common such as the refinery, petrochemical and flow stations, plants within and at the periphery of the city contribute to air pollution. Other major sources of such fumes are from vehicles and power generating plants which increases the effects. However, with the increase in purchase of vehicles and power generating plants due to irregular public power supply has further exacerbated air pollution in the city. The Rivers-Bayelsa States region emits the highest level of these gases from the table below. Water supply is another common problem in Port Harcourt city. The sources of water for domestic use are not potable. Most residents get water for domestic use through untreated boreholes, wells and rain. These sources of water are not treated, which exposes the users to health problems such as diarrhoea, typhoid-fever, dysentery, etc. Hence, the users are mostly urban poor who cannot provide their own treated water for domestic use. The proliferation of boreholes close to the coastal areas of the city can cause salt water intrusion as water from the ocean can easily seep to the underground water source. With constant emission from industries and manufacturing outfits the rain water is highly polluted with sulphur and hydrocarbons contents exposing the residents

to high level of risks. There is need for the government to re-evaluate the public water supply system in the city by replacing the old water mains that runs across PH Township, Diobu, D/Line, Old and parts of New GRAs areas to other parts of the city especially the Obio/Akpor Local Government Areas for safe portable water supply to residents, since most of them cannot afford safe portable water for domestic use.

Table 3: Emissions of Greenhouse Gases by Sector

S/N	Sources	Emissions in Gigagrams		
		CO ₂	CH ₄	N ₂ O
1	Households	3991.77	154.35	2.56
2	Agriculture/Forestry	0.30	672.09	2.56
3	Service	45.73	0.01	0.00
4	Industry	10689.43	33.24	0.37
5	Transportation	14558.81	4.09	0.20
6	Energy Conservation	34635.36	116.36	0.38
7	Primary Energy Conservation	34635.36	116.36	0.38
8	Natural Resources	1038.96	66.23	0.00
Total		73,312.73	1,051.04	10.72

Source: Magbagbeola, 1999 cit. Ologunorisa, 2012

Table 4: Greenhouse Gas Emissions by State in Nigeria

S/N	State	Emissions in Gigagrams				% of Nigeria Total Emission
		CO ₂	CH ₄	N ₂ O	Total Emission	
1	Abia	9.13	4.17	0.01	13.31	0.2
2	Akwa Ibom	5733.60	23.30	0.33	5766.23	10.16
3	Anambra	1277.04	53.36	0.33	1330.68	2.34
4	Bauchi-Gombe	856.72	60.53	0.39	4284.13	7.55
5	Edo-Delta	4282.89	0.71	0.53	4284.13	1.62
6	Benue	473.07	25.87	0.30	499.24	0.88
7	Borno-Yobe	609.22	126.40	0.81	736.43	1.30
8	Cross River	599.73	18.18	0.22	618.13	1.09
9	Adamawa-Taraba	456.08	78.96	0.35	535.40	0.94
10	Imo	3275.17	23.96	0.42	3299.55	5.81
11	Kaduna	1367.07	35.45	0.29	1402.81	2.47
12	Katsina	133.96	24.41	0.28	158.65	0.28
13	Kano-Jigawa	1226.13	38.29	0.66	1265.08	2.23
14	Kwara	931.04	57.77	0.21	989.02	1.74
15	Lagos	8271.68	24.65	0.56	8296.93	14.62
16	Niger	444.71	57.87	0.21	989.02	1.74
17	Ogun	1296.90	14.15	0.22	1311.27	2.31
18	Ondo-Ekiti	635.22	26.48	0.32	662.02	1.07
19	Oyo-Ogun	1848.37	40.09	0.52	1889.07	3.33
20	Plateau-Nasarawa	964.47	46.09	0.25	1010.81	1.78
21	Rivers-Bayelsa	20457.70	83.28	0.59	20541.57	36.18
22	Sokoto-Kebbi-Zamfara	634.21	95.00	0.72	729.93	1.29
	Sum of States	55,786.11	971.98	10.51	56,786.60	100.00
	Nigeria	73,312.73	1,051.04	10.72	74,374.49	

Source: Magbagbeola, 1999 cit. Ologunorisa, 2012

CONCLUSION

Climate change impacts have become a global environmental epidemic. The impacts cut across all continents, regions, societies and environment. All economic status is being affected and has further increased the disparities between and within continents and regions. Climate change is global phenomenon but requires more of local actions to reduce its impacts on the urban poor. Urban centres in developing countries, most of which developments are not properly coordinated and controlled, are highly vulnerable to the impacts of climate change. The important issue in these urban centres is better understanding of these impacts by town planners as to incorporate it into national and local environmental policies and plans. The most vulnerable people in urban centres to climate change are the poor who economically cannot cope with the challenges of climate change. The city of Port Harcourt which is facing climate change challenges especially the urban poor, are most affected because to live in an environment prone to climate change impacts. The ever increasing flaring of hydrocarbons, sulphurs and other greenhouse elements in the region further increases the impacts. The effects on environment, economy, livelihood, food, ecosystem, water and air are potent and distortion to growth and development of the Port Harcourt city region. The government of the city should articulate better climate change policies and plans in their development plan for environmental sustainability.

RECOMMENDATIONS

In order to reduce the impacts of climate change and associated problems to the urban poor of Port Harcourt city, from the study there are recommendations that are appropriate to reduction and sustainability of the environment. These recommendations are as follow:

- Prepare inclusive development plans for Port Harcourt city and region that would incorporate climate change adaptation mechanisms and disaster resistant planning concepts.
- Such plans should consider the urban terrain, natural drainage system, hydrology and ecological characteristics to reflect the carrying capacities of the environment.
- Local environmental protection policies and plans should be formulated and implemented to reflect sustainability and adaptation by the populace.
- The national, state and local governments should collaborate to form a framework and synergy on gas flaring and other greenhouse emission policies and penalties, guidelines to protect and promote economic, ecological and environmental friendly actions.
- The concept of green urbanism should be adopted to create parks, green lawns, street tree planting and floral landscaping to absorb CO and CO₂ gases from industrial plants and vehicles to reduce heat wave and temperature intensity in the city.
- The government and multi-national companies should invest in climate change research so that data for urban planning can be available to promote sustainable development.

- Assess the vulnerability level of climate change to the urban poor and develop mitigation implementation procedures and guidelines.
- Strengthen sanctions to multi-national companies that pollute the environment especially agricultural lands and fishing waters to protect the livelihoods of dependence of these resources.

ACKNOWLEDGMENT

The Authors wish to sincerely acknowledge the contributions towards the success of this work of: Tpl. C.O. Ibeakuzie, Dr. V.C Obinna, Dr. (Mrs.) O.B.Owei, and Jane Emeruem.

REFERENCES

- [1] Enger E. D, B. F. Smith and A. T. Bockarie :Environmental Science: A Study of Interrelationships. Tenth Edition, New York, USA: The McGraw-Hill Companies, Inc. Pp 387-415 2006.
- [2] Fellmenn J. D., Getis A., Cretis J. and Malinowski J. C.: Human Geography: Landscapes of Human Activities, Eighth Edition, New York, USA: The McGraw-Hill Companies, Inc. Pp 483-517, 2005.
- [3] Huq S.: Learning to Live with Climate Change. <http://www.islamonline.no/serbvlet>, 2009.
- [4] Intergovernmental Panel on Climate Change (IPCC): Third Assessment Report (TAR), 2001.
- [5] Martin P., E. Alex, M. W. Rosegrant and T. Wheeler:Climate Change and Hunger: Responding to the Challenge. Rome, Italy: World Food Programme, Via C. G. Viola, 68-70. Pp 11, 55-59, 75, 2009.
- [6] National Population Commission: Census 1991 Final Report, Rivers State. Abuja, Nigeria: Federal Government Press. Pp 1-30, 1991.
- [7] Nigeria, Federal Republic of: National Urban Development Policy. Published by: Abuja, Federal Ministry of Housing, Environment and Urban Development. Pp 1-55, 2006.
- [8] Nigeria, Federal Republic of: Niger Delta Regional Development Master Plan. Port Harcourt, Nigeria: Niger Delta Development Commission, 167 Aba Road. Pp 196, 2006.
- [9] Ogboi K. C.: An Overview of Climate Change: Causes, Processes and Manifestations. Paper Presented on 14th Edition of NITP/TOPREC MCPDP, Theme: Climate Change: Challenges for Physical Planning in Nigeria. Pp 6-34, 2012.
- [10] Ologunorisa T. E.: Climate Change: Impact, Vulnerability and Adaptation in Nigeria. Paper Presented on 14th Edition of NITP/TOPREC MCPDP, Theme: Climate Change: Challenges

for Physical Planning in Nigeria. Pp 37-56, 2012.

- [11] Population Reference Bureau: 2011 World Population Data Sheet: The World at 7 Billion. Washington DC, USA: 1875 Connecticut Avenue, NW, Suite 520, 2011.
- [12] Specialist Konsult: Port Harcourt Master Plan, 1975. Port Harcourt, Rivers State: Ministry of Lands and Housing. Pp 1-35, 1975.
- [13] World Bank: Natural Disaster Hotspots: A Global Risk Analysis. New York, USA: 29 March, The World Bank, 2005