

# Causes and Consequences of Climate Change in Port Harcourt and its Environs

Rivers State, Nigeria

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## ABSTRACT

Man, in the process of meeting his basic needs, has engaged in several unsustainable practices which are currently negatively affecting and changing the climate. The impact of human activities on the climate, therefore, has raised serious concerns and consequences that cannot be generally disregarded. It is therefore the aim of this paper to saliently look at the causes and consequences of climate change in Port Harcourt and its environs. From key informants, in-depth interviews, and personal observations, it was gathered that the human activities that are causing climate change in Port Harcourt manifest mostly from the following sources: rapid population growth, physical land use (residential, commercial, industrial, institutional, etc.) development (brown revolution) and areal expansion; continuous deforestation; huge municipal, clinical, and industrial waste generation and inappropriate management systems; pipeline vandalism and oil bunkering activities/artisanal refinery operations leading to oil spills on both land and sea; and legal and illegal gas flaring from proximate locations, causing land, sea, and water pollution. The consequences of climate change, as found in the study area, are increased urban heat waves, unpredictable weather conditions, flooding (mostly from excessive rainfall), loss of biodiversity, and increased medical attention.

## I. INTRODUCTION

Man generally depends on his environment for living, playing and working and so, man's life is shaped by his environment. The state of man's environment will definitely have either positive or negative impact on him. From shifting weather patterns that threaten food production, to rising sea levels that increase the risk of catastrophic flooding, the impacts of climate

change are global in scope and unprecedented in scale (Adedeji, 2014).

Climate change which according to the United Nations (2021) refers to long-term shifts in temperatures and weather patterns is presently a major topical issue of our time that is impacting human lives and health in a variety of ways. In 2012, more than 32 million people were forced to flee their homes due to natural disasters, mostly resulting from extreme weather events attributed to climate change (Aulakh, 2013). Unprecedented flooding, heat waves and wildfires as a result of the release of excess earth greenhouse gases have caused damages to multiple of billion dollar investments in rural, urban and their natural environmental sensitive areas with such areas undergoing rapid shifts in response to changing temperatures and precipitation patterns (Wolff, 2014, National Academy of Sciences, 2020). Human lives and the essential ingredients of good health (clean air, safe drinking water, nutritious food supply, and safe shelter) which are directly linked to the climate are grossly and adversely affected by these distortions of the climate which though there are natural agitation forces but without gainsaying on the long-term trend are mostly caused by human activities on the earth surface (Reidmiller, Avery, Easterling, Kunkel, Lewis, Maycock, and Stewart, 2017; Hayhoe, Wuebbles, Easterling, Fahey, Doherty, Kossin, and Wehner, 2018).

It is projected that "between 2030 and 2050, climate change is expected to cause approximately 250,000 additional deaths per year, from malnutrition, malaria, diarrhoea and heat stress alone. The direct damage cost to health is estimated to be between USD 2-4 billion per year by 2030" (UN, 2021). The UN, (2021) further declares that areas with weak health infrastructure which most apparently is the developing countries

will be the least able to cope without assistance to prepare and respond. This energetic statement and a legally binding international treaty on climate change -the Paris Agreement (Agreement, 2015) adopted by 196 Parties at the United Nations Framework Convention on Climate Change (UNFCCC) Conference of the Parties (COP) 21 in Paris, on 12 December 2015 and entered into force on 4 November 2016 has spurred different countries, different states governments to taking rapid response to the changing temperatures and precipitation patterns which is posing an intrinsic challenge not only on rural and urban communities and its residents but also on global health.

Presently, Nigeria's climate has been changing with evidence in frequent extreme weather conditions, temperature increases, unpredictable rainfall, rise in sea level, flooding especially in coastal areas, drought, desertification, land degradation and general loss of biodiversity of both fresh and salt water environment and resources (Haider, 2019). Port Harcourt municipality in Nigeria is not free from these evidences as climate change is impacting seriously on her entire ecosystems (physical infrastructure, transport systems, water and energy supply and the provision of ecosystems goods and services). Greenwalt, Dede, Johnson, Nosa, Precious and Summers, (2021) stated that Port Harcourt, Nigeria, as with many cities in Africa, is already experiencing impacts from climate change while also facing development challenges and compounding vulnerabilities.

### The Problem Statement

Although, climate change and its consequences have become one of the greatest threats facing mankind today, it is sadly true that the exploitations and exploratory activities of man himself are the major causes of this increasing effect on the climate and earth's temperature thereby making the livable environment unhealthy and unlivable.

In the face of the present global realities of climate change, extreme weather conditions, temperature increases, unpredictable rainfall, flooding after rains etc are uninterruptedly evident in Port Harcourt urban and peri-urban systems. This has severely impacted the entire ecosystems (physical infrastructure, transport systems, water and energy supply and the provision of ecosystems goods and services). It is on this note that this paper is poised to investigate the actual causes of this rapid change in climate and its impact on urban,

peri-urban and rural livelihoods of Port Harcourt and its environs.

## II. BACKGROUND INFORMATION ABOUT THE STUDY AREA

Port Harcourt the capital city of Rivers State also called the Garden City of Nigeria, it lies along the Bonny River and is situated in the Niger Delta Region. Port Harcourt was established on the very edge of the West African swamp in 1912 by the British Colonial organisation of Nigeria next to the farmlands called Obomotu, close to the bluffs of Igwuocha of the Diobu-Ikwerre town. Port Harcourt was some time ago called Igwuocha and was renamed by Frederick Lugard, the Governor General of Nigeria after Lewis Vernon Harcourt the Secretary of State for the Colonies on eighteenth August 1913 (Mmom and Nwagwu, 2013). Port Harcourt is one of Nigeria's quickest developing urban areas. The normal yearly development rate of Port Harcourt between of 1963 and 2010 has been estimated to be 5.2%. The development of Port Harcourt is attached to the social and financial history of the nation. The city is the oil capital of Nigeria, since it has the greater part of the country's multi-national oil and gas, two refineries, petroleum-related administration organisations, and in addition a quick extending business sub-area (Wokekoro and Owei, 2006; Johnbull & Ikiriko, 2021; Johnbull & Nwokaeze, 2021).

Port Harcourt City Local Government area feature a tropical wet climate with lengthy and heavy rainy seasons and very short dry seasons like her counterpart, Obio/Akpor Local Government Area (World Weather Information Service, 2017). The harmattan in the Local Government Area is mostly pronounced from the months of December to January; and the area experiences heaviest precipitation during the months of June to September with an average rainfall of 367mm of rain yearly (World Weather Information Service, 2018). December is the driest month with a mean rainfall of 20 mm, mean temperatures are typically between 25°C and 28°C and relative humidity is between 75% and 78% (World Weather Information Service, 2018).

## III. REVIEW OF RELATED LITERATURES

### 3.1 Theoretical Framework

Climate change is increasing air and water temperatures, altering precipitation patterns, intensifying many natural disturbances, affecting species distribution and survival, and changing ocean chemistry, among other impacts. These

environmental changes are occurring concurrently with other pressures such as pollution, conversion of natural ecosystems to other land uses, transport and introduction of non-native species, and exploitation of natural resources. Together, these stressors threaten the contributions that species make to ecosystem functioning and the ability of ecosystems to sustain the many benefits known as ecosystem services that society has come to rely on. (EPA, 2016).

The rapidity of the changes that are now being observed has raised many questions about ecosystem vulnerability, what future ecosystems will look like, and their long-term ability to sustain the same (or similar) services they provide today. In response to these concerns, researchers are working to improve understanding of the effects of climate change and how ecosystems respond to them, as well as to identify opportunities to manage ecosystems so that they can persist in the face of climate change (Dias, 2016).

Scientists have made major advances in the observations, theory, and modeling of Earth's climate system, and these advances have enabled them to project future climate change with increasing confidence. Nevertheless, several major issues make it impossible to give precise estimates of how global or regional temperature trends will evolve decade by decade into the future. Firstly, we cannot predict how much CO<sub>2</sub> human activities will emit, as this depends on factors such as how the global economy develops and how society's production and consumption of energy changes in the coming decades. Secondly, with current understanding of the complexities of how climate feedbacks operate, there is a range of possible outcomes, even for a particular scenario of CO<sub>2</sub> emissions. Finally, over timescales of a decade or so, natural variability can modulate the effects of an underlying trend in temperature. Taken together, all model projections indicate that Earth will continue to warm considerably more over the next few decades to centuries. If there were no technological or policy changes to reduce emission trends from their current trajectory, then further globally averaged warming of 2.6 to 4.8 °C (4.7 to 8.6 °F) in addition to that which has already occurred would be expected during the 21st century. Projecting what those ranges will mean for the climate experienced at any particular location is a challenging scientific problem, but estimates are continuing to improve as regional and local-scale models advance. (EPA, 2017)

### 3.2 Concepts of Climate Change

The UNFCCC, (1992) defines climate change as “a change in climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable periods of time”.

One of the salient but outstanding births of the industrial revolution is the emissions of greenhouse gases from fossil fuel combustion, deforestation, agricultural and aquaculture practices which unarguably have induced global warming and climate change. Observed and anticipated changes in the climate include higher temperatures, changes in rainfall patterns, changes in the frequency and distribution of weather events such as droughts, storms, floods and heat waves, sea level rise and consequent impacts on human and natural systems. Many scientists argue that the impacts of climate change will be devastating for natural and human systems, and that climate change poses an existential threat to human civilization. However, action to respond to climate change has been slow. Climate change draws attention to the relationship between science and society, challenges global governance institutions, and triggers new social movements. Engagement with climate change by social scientists is prompting conceptual renewal in areas such as social practice theory, and transition and transformation studies.

### 3.3 Causes and Consequences of Climate Change

Climate change has the potential to affect all natural systems thereby becoming a threat to human development and survival socially, politically and economically. Anthropogenic activities such as burning of coal, oil and natural gas, as well as deforestation and various agricultural and industrial practices, are altering the composition of the atmosphere and contributing to climate change. These human activities have led to increased atmospheric concentrations of a number of green house gases. (EPA, 2016)

The Intergovernmental Panel on Climate Change (IPCC) has conducted about four assessments to date. These assessments show that warming of climate system is unequivocal. The fourth assessment report stated that continued GHG emissions would reduce many changes in the global climate system during the 21<sup>st</sup> century that would very likely be larger than those observed during the 20<sup>th</sup> century (Pachuari, 2009). The study further stated that delayed emission reductions significantly constrain the opportunities to achieve lower stabilization levels and increase the risk of more severe climate change impacts. Africa has

also been identified as being especially vulnerable because of low adaptive capacity and projected climate change impacts.

Climate change in Nigeria affects rainfall, pattern, emergence of diseases and pest, crop and animal production, fisheries, biodiversity, frequency and regularity of floods, human health (gas flaring) and artisanal refining of petroleum products. It has been suggested that climate change could potentially contribute to increased incidences of flooding. This being the case, the city of Port Harcourt would seem to be especially at risk with serious consequences for property, livelihoods and the environment. (Agbola and Olurin, 2003).

These challenges have stirred the Rivers State government to declare special day in a month as environmental sanitation day. On environmental sanitation days, markets are closed, traffic is banned before 10.00 a.m and people are enforced to stay at home and clean their immediate environment. Sanitation regulators, refuse handlers, health officers, special duty officers and special task force are only allowed to work out of their vicinity. The government is serious at it that special areas are delineated with containers and brick walls for appropriate refuse dumps which are spectrally located at road and street corner and off the highways.

#### IV. METHODOLOGY

This study belongs to qualitative research and adopted the use of a descriptive phenomenological approach to gather relevant data. Key informants, in-depth interviews and personal observation were employed to gather data. Data were collected from permanent secretaries of responsive Rivers State government ministries (Transport, Water resources, environment), Directors of research and statistics in the three line ministries, RIWAMA, leaders of Nigerian Environmental Society, Nigerian Waste Management association, NESREA, and academicians (Climatologist and meteorologist).

#### V. RESULTS OF THE STUDY

##### 5.1 The Causes of Climate Change in the Study Area

Causes of climate change are both natural and anthropogenic (human-induced). Majorly, human activities that are causing climate change in Port Harcourt manifest mostly from the following sources viz-a-viz rapid population growth, every day physical landuse (residential, commercial, industrial, institutional etc) development (brown revolution) and areal expansion which of course leads to continuous deforestation; huge municipal,

clinical and industrial waste generation and inappropriate management system, pipe line vandalism and oil bunkering activities/artisanal refineries operations leading to oil spills on both land and sea, and legal and illegal gas flaring from proximate locations causing both land, sea and water pollution (See Plate 1).

The population of Port Harcourt municipality is continuously on the increase with growth rate now 6.5% totaling about two million, nine hundred and twelve thousand, nine hundred and sixty (2912960). This whooping population coupled with the status of Port Harcourt as headquarter of the Oil Rich Rivers State has encouraged continuous drift of people into the city. Without doubt, this has placed demand for the different urban landuses and significant social, economic and physical infrastructure (utilities and facilities).

The high population of Port Harcourt is also attended with increased automobile usage, generators, different types of operational engines and electric utility plants. The use of aerosols, insecticides, pesticides and herbicides through urban and peri-urban agriculture is also on the increase and without control and these definitely are finding their way into the atmosphere thus enforcing depleting the layers which are supposed to support and sustain mans environment.

Although, the use of open dumps does not conform to the increasing public awareness of environmental issues, including the present focus on sustainability and global climate change, In Port Harcourt, the practice of open waste dump as the major means of waste disposal is still in vogue. Municipal, clinical and industrial solid wastes are all transported to the open dump sites. Waste in these sites are uncovered, hardly compacted, without control of waste placement, No application of cover soil, or minimal cover (often associated only with forming access roads), invitation to treat for vermin, dogs, birds and other vectors often present, poor leachate management and without provision for generated gas management. It is evident by researchers physical observation that waste seen on open landfills in Port Harcourt encompasses metals/ aluminum, textiles, paper, paper board, medical waste, dry cell battery, food waste, water proof bags, disposable diapers, computer accessories, electrical wires and consoles, bulbs, bottles, wood, plastics etc. While metal/aluminum, plastics and bottles are selected from the dump by waste scavengers, the biodegradable wastes are allowed to decompose. But again, it is also identified that Port Harcourt waste dumps are put on fire periodically, especially



during sunny weather. Metals such as lead, zinc, cadmium, arsenic and mercury are part of the municipal waste stream and when burned, become part of the gases and particles that leaves the combustion chamber or end up as part of the ash residue. In either case, they contaminate the environment as there was no adequate control mechanism to remove prior to combustion or after

the combustion. The waste from these open landfills burns with their soot and the wind sends the characteristic offensive smell to the closer residential neighbourhoods. Of course, residents will inhale it into their lungs as it evaporates into the atmosphere. Plates 1, 2 and 3 show the unsustainable manner of waste dumping, collection and evacuation of waste in the study area.



Plate 1: Waste collection center at Eastern-by-Pass, Port Harcourt



Plate 2: A waste Dump Site at Bundu, Port Harcourt



Plate 3: Waste collection methods along Industry Road, Port Harcourt

Vandalizing of oil pipe lines and oil bunkering activities/artisanal refineries operations occur in proximate locations of Port Harcourt municipality. Most of these operations lead to oil spills on both land and sea, and legal and illegal gas flaring which causes both land, sea and water pollution. Liquid pollutants evaporate into the atmosphere, reach condensation point; some infiltrates the ozone layer while others fall back as rain but in this case, acid rain.

On the 21<sup>st</sup> of February, 2017, a specialist and consultant surgeon by name Dr. Furo Green of the Braithwaite Memorial Specialist Hospital, Port Harcourt raised an alarm in an interview with Niger Delta Vigilante (NDV) of the presence of black soot and decried its impact saying that six million Rivers people were at the risk of cancer over the hydrocarbon (Vanguardngr.com, 2017). The black soot is blamed as a fall out of an illegal but thriving oil bunkering business in the Niger Delta region which is called Kpo-fire. This is supported by Goodnews and Wordu, (2019) who stated that Kpo-fire is the operation of artisanal refineries which rely on oil theft. Kpo-fire is simply a local oil process of heating the crude in fabricated oven to extract petroleum products while the residual is released into the environment not minding the

implication on the ecosystem (Vanguardngr.com, 2021). (See Plate 4). The Rivers State government in response to curb that anomaly has set up Joint Military Taskforce (JTF) to monitor the activities of these operators, arrest and destroy the illegal refineries which virtually are in all waterfront areas of Port Harcourt. The taskforce operation technique is to set these refineries on fire because the business is scattered everywhere. It is noted that almost every day, artisanal refineries are set on fire (Maduawuchi, 2021). Burning these illegal refineries and the products is not also the best way to solve the problem as such activity increases air pollution and its negative impacts contributing to the change in climate.

The level of oil spill in the study area is cumbersome. A time series analysis (2007-2020) is presented to show the quantity of oil spilled into the ecosystem. This is shown on Table 1. The table shows that a total of 1,033,010.747 barrels of oil were spilled into the environment from 2007-2020. A total of 91,132.58 barrels were recovered while a total of 962,326.64 barrels were lost into the environment. The data indicates that more oil barrels were lost into the environment than the ones recovered. The barrels of oil lost into the environment pollute the environment and thus calls

for environmental cleaning up. This is also a major area of challenge as the methods of clean up (ex-situ and in-situ) adopted mostly in this part of the world are filled with deception. Most often, contaminated soil, ground water, surface water and

particulates remains not mediated. A major stakeholder declares that what most of the time is aired in the news is bullshit. A visit to the contaminated site will show strong visibility of the contaminants-He said.

**Table 1: Time Series Analysis of Oil Spill in Rivers State**

S/No	Year	No of Spill	Quantity Spilled (barrels)	Quantity Recovered (barrels)	Net volume lost to the Environment (barrels)
1	2007	241	600,511.02	42,416.83	558,094.19
2	2008	151	40,209.00	1,644.80	38,564.20
3	2009	187	11,876.60	1,719.30	10,157.30
4	2010	155	12,905.00	552.00	12,358.00
5	2011	129	31,866.00	25,757.00	25,757.00
6	2012	208	9,172.00	1,955.00	7,207.00
7	2013	228	5,956.00	2,153.00	3,803.00
8	2014	166	14,150.35	2,785.96	12,057.80
9	2015	258	108,367.01	2,785.96	105,912.05
10	2016	378	51,187.90	1,476.70	49,711.20
11	2017	453	8,105.32	2,937.08	6,632.11
12	2018	495	35,123.71	2,335.93	32,787.78
13	2019	417	63,677.17	3,110.02	60,568.15
14	2020	158	39,903.667	1,183,807	38,716.860
<b>Total</b>		3,626	1,033,010.747	91,132.58	962,326.64

Source: Rivers State Ministry of Environment, 2020



Plate 4: Gas Flaring at Botem-Tai, Rivers State



Gas from Burning of Kpofire Station

Source: Researcher's Field Survey, 2021

## 5.2 Consequences of Climate Change on the study area

There are several consequences of climate change on Port Harcourt residents and their environment.

### Increased Urban Heat Waves

Port Harcourt municipality in order to meet the demands of its teeming population without mincing facts is expanding into the peri-urban communities. This definitely means consistent deforestation in favour of physical development. The trees and grasses which are

supposed to support natural cleansing and removal of human-caused emissions of the greenhouse gases from the atmosphere are destroyed in the process. Currently, there is no implementation of any kind of tree and grass planting policy running in the city. Most of the trees that make the city to be known and called garden city have been cut down without replanting. The city has already transformed to be a brown field. Even the forest soils which are supposed to sequester vast reservoirs of carbon are compacted and built upon. The compacted and hardcore surfaces absorb direct heat from the sun and then distribute it through the chains of road networks, fences and buildings. The outcome is what is experienced in Port Harcourt as heat waves. From in-depth interviews, it was extracted that the city of Port Harcourt is currently very hot especially at night.

Weather is simply the state of the atmosphere with respect to wind, temperature, cloudiness, moisture, pressure, etc. In the study locality, it has currently become difficult to predict the weather. It will be raining heavily in the Elelenwo but will be totally dry in Rumueme. This variation has made it difficult for urban residents to plan their movement and also for urban and peri-urban agric farmers to predict the weather for planting seasons. Meteorological data have shown that rainfall pattern in Port Harcourt has changed in

the past decades with the persistence of below-mean rainfall in the last two decades. This is an indication of an abrupt change in climate.

#### **Flooding Majorly From Excessive Rainfall**

Flood has the potential of paralyzing economic activities in towns and cities of the world. Climate change triggers unpredicted rainfall which in turn is giving birth to flooding, especially flash flooding has been noted as a major problem in the study area. Major roads and low line area buildings are flooded causing hardship to residents and motorists respectively (see plate 5). One common consequence of flooding is increase in cost of transportation. Commercial drivers, to make up for the distance they drive to avoid a flooded road, usually increase their cost of transportation putting the burden on their passengers. This in turn will lead to the general increase in the cost of goods and services.

Over flown drainages and septic tanks as a result of flooding pollutes the environment and thus make residents vulnerable to different kinds of water-related disease such as malaria, dysentery, cholera, and diarrhea. Trauma resulting from the problem of flooding can lead to non-pathogenic diseases such as hypertension and diabetes. In some other instances, some areas are cut from other parts of the community.



Plate 5: Flooding at Afam Street, Port Harcourt.

Researcher's Field Survey, 2021

#### **Loss of Biodiversity**

The international body that provides regular assessments of the state of climate science, its present and future impacts, and possible pathways for mitigation- Intergovernmental Panel

on Climate Change, (2018) warned that biodiversity, which includes species, ecosystems, and their functions and productivity, is at risk from climate change. It further stated that Two degrees Celsius of warming above pre-industrial



temperatures would risk “shifts of species to higher latitudes, damage to ecosystems (e.g., coral reefs, and mangroves, sea grass and other wetland ecosystems), loss of fisheries productivity (at low latitudes), and changes to ocean chemistry (e.g., acidification, hypoxia and dead zones).” There is massive loss of biodiversity in Port Harcourt and its environs which is attributable to the triggers of climate change. Loss of biodiversity in the study area is leading to food insecurity and hunger. This is evident to food scarcity, increased food prices,

scarcity of seafood due to decrease in catch or the catching of polluted fish and other seafood resources like crustaceans –shrimps, lobsters, crabs, crawfish; shellfish-mussels, oysters, clams and food storage and spoilage) and finally, health issues (disease burden increase, with measles and chicken pox cited specifically, rashes, dehydration, respiratory issues, cancer, and eye conditions). Plate 6 &7 are showing the level of loss of biodiversity from oil spilled sites in the study area.

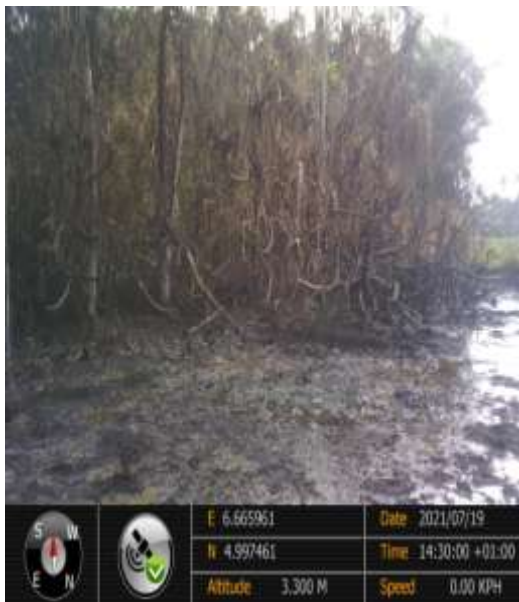


Plate 6: Oil Spilled Site at Abonnema Wharf to Elechi Beach Water Front (Illegal refinery), Port Harcourt



Plate 7: Oil Spilled Site (Kpofire) Elechi Beach Water Side, Port Harcourt

### Increased Medical Attention

A change in climate definitely will transcend to affect man and his environment. There is no way that such change will not affect residents’ health since these changes are not positive but rather negative. A rise in temperature causing the discussed heat waves causes heat rashes and other skin diseases. Flooding causes outbreak of water borne diseases. Burning of waste especially medical and industrial waste will definitely affect residents adversely. This list will be inexhaustible. Medical attention cannot be compromised by urban residents in the face of climate change.

### Recommendation for the Rivers State Government

1. Reinstate the city garden city concept by encouraging flowers and trees planting (a

carbon storage and sequestration program) with incentives

2. Building plan approval agencies to effect 10% green area in every single plot landuse development
3. Open up the actual storm water canals to aid speedy flow of water after rain
4. Implement effective waste management practices such as waste-to-wealth, waste-buy-and –sell programmes
5. Discourage pipeline vandalizing and oil theft activities by making massive recruitment exercise and school-to-work programmes.

### VI. CONCLUSION

This study has shown that Port Harcourt Municipality is faced with myriads of environmental problems caused by climate change. And that the said climate change was caused



majorly by mans activities on his environment. Some of the causes and consequences as it applies to Port Harcourt metropolis have been discussed. To avert the ongoing trend of negative impacts, it is evident that humans have major role to play in creating a positive climate change.

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