

Environmental Implications of Climate Change on the Coastal Areas of the Niger Delta

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Abstract- This paper presents the environmental implications of climate change on the coastal areas of the Niger delta located in the southern part of Nigeria. It gives a general overview of global climate change and predicts its consequences and examines how it has made the coastal areas of the Niger delta vulnerable to natural disasters such as flooding and others. The build-up of greenhouse gases in the atmosphere has led to an enhancement of the natural [greenhouse effect](#). It is however deduced that human-induced enhancement of the greenhouse effect is of concern because ongoing emissions of greenhouse gases have the potential to warm the planet to levels that have never been experienced in the history of human civilization. Such climate change could have far-reaching and/or unpredictable environmental, social, and economic consequences. The Global warming has the tendency of establishing favorable atmospheric conditions for disease carrying vectors and making it possible for these organisms to spread diseases that are realized more harmful to beings.

Index Terms- Climate, climate change, environmental implications of climate change, coastal areas of Niger delta

I. INTRODUCTION

Climate is the average weather conditions of a place or region including typical weather patterns, the frequency and intensity of storms, cold spells and hot weather. Weather on its part is the daily fluctuating state of the atmosphere around us, characterized by the temperature, wind, precipitation (rainfall), clouds and other weather elements. The type of climate found in the southern part of Nigeria is the tropical monsoon climate which is influenced by the monsoons originating from the South Atlantic Ocean brought about by the warm moist maritime tropical air mass.

Climate Change according to the Intergovernmental Panel on Climate Change (IPCC), means any change in climate over time, whether due to natural variability or as a result of intense human activities in the environment. In 1988, the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) in Villach created the IPCC to bring together leading scientists and other experts involved in the study of climate change, its effect and the necessary responses. The panel (IPCC) has done an assessment of climate for the past 1,000 years in relation to the present and provides estimates of its projected future evolution and their uncertainties. The IPCC in its

report released in 2007 linked the primary cause of global warming to human activities.

Climate change is a long-term shift in weather conditions identified by changes in temperature, precipitation, winds, and other indicators. Climate change is largely due to anthropogenic activities of man and it poses an existential threat to our nations and way of life. The major activities of man that brings about climate change are gas flaring, industrial emissions and deforestation. It should be noted that if the environmental laws in Nigeria could be implemented especially the laws on gas flaring and deforestation, carbon emissions into the atmosphere would be minimal and this would in turn have little effect on the climate.

Having reviewed the global position of climate change and its predictable consequences, it is now safe to examine specifically how vulnerable the Niger delta is, with regard to flooding in the coastal areas. Some of the factors that render the Niger delta prone to flooding as identified are soil type, vegetation depletion or overgrazing and climatic factors like rainfall. Annual rainfall in the Niger delta varies from 2000 to 5000 mm. The delta has such high rainfall levels because it is so near to the Atlantic Ocean which is the source of the moisture. Bonny town found in the coastal area of the Niger delta in southern Nigeria for instance receives well over 4000mm (157.5in) of rainfall annually. Others are Forcados (4870mm); Calabar (3070mm); Warri (2730mm); Port Harcourt (2400mm); etc.

II. FACTORS RESPONSIBLE FOR CHANGE IN CLIMATE

Climate change can involve both changes in average conditions and changes in variability, including for example, extreme events. The earth's climate is naturally variable on all time scales. However, its long-term state and average temperature are regulated by the balance between incoming and outgoing energy, which determines the Earth's energy balance. Any factor that causes a sustained change to the amount of incoming energy or the amount of outgoing energy can lead to climate change. As these factors are external to the climate system, they are referred to as 'climate forcers', invoking the idea that they force or push the climate towards a new long-term state, either warmer or cooler depending on the cause of change. Different factors operate on different time scales, and not all of those factors that have been responsible for changes in earth's climate in the distant past are relevant to contemporary climate change.

Factors that cause climate change can be divided into two categories - those related to natural processes and those related to human activities. In addition to natural causes of climate change, changes internal to the climate system, such as variations in ocean currents or atmospheric circulation, can also influence the climate for short periods of time. This natural internal climate variability is superimposed on the long-term forced climate change.

Green house effect

The earth's climate is greatly affected by green house effect. This is a phenomenon whereby the temperature of the earth's surface is gradually increased. This happens when the concentration of carbon (iv) oxide (CO₂) released into the atmosphere from the burning of fossil fuels rises and thus makes the atmosphere to become transparent to short wave radiation from the sun and opaque to long wave radiation (or heat), which is trapped near the earth's surface. Apart from carbon (iv) oxide, other green house gases or causes of green house effect are: chlorofluorocarbons (CFCs) used in large scale in refrigeration and air-conditioning industries, as well as aerosol sprays and foams; nitrous oxide (N₂O) released from nitrogenous fertilizers, deforestation and biomass burning; and methane (CH₄) from rice fields, cattle, landfills and fossil fuel production.

In addition to climate change, green house effect also exposes the earth's surface to ultra-violet radiation which is highly injurious to the human and biological life; reduces rainfall and therefore leads to a decrease in the availability of irrigation water, hydroelectric power generation and water for industrial uses; causes a rise in sea level due to melting ice and subsequently flooding and loss of farmlands; reduces agricultural production of crops such as corn, wheat etc.

Solar output

Majority of the energy that causes the climate of the surface of the earth to change comes from the sun. The strength of the sun or solar energy output absorbed by the atmosphere is constantly changing and this have an impact on the climate of the earth. Changes in solar irradiance have contributed to climate change over the past century.

Earth's orbit

The orbit of the earth round the sun is elliptical (not circular) and as such at some particular times the earth maintains an approximately constant distance away from the sun, but at other times when the ellipse is more pronounced, the earth either moves closer to the sun moves further away from it as it navigates around its orbit. When the earth moves closer to the sun, our climate becomes warmer and then colder when it moves away from the sun. Hence the orbit of the earth round the sun results to a change in climate

Orientation of the earth's axis

The earth is known to rotate around an axis (an imaginary line connecting the north and south poles) that is tilted at an angle. When this angle changes by either increasing or decreasing it causes the seasons to change (summer for instance becomes warmer and winters become colder).

Human activities

Respected scientific organizations such as the National Academy of Science, the Intergovernmental Panel on Climate Change (IPCC) and World Meteorological Association (WMO) have all identified climate change as an urgent threat caused by humans that must be addressed. Human activities such as the burning of fossil fuels and the conversion of land for forestry and agriculture have the greatest impact on the atmosphere than any other single human activity. Since the beginning of the Industrial Revolution, these human influences on the climate system have increased substantially. In addition to other environmental impacts, these activities change the land surface and emit various substances to the atmosphere. These in turn can influence both the amount of incoming energy and the amount of outgoing energy and can have both warming and cooling effects on the climate. The dominant product of fossil fuel combustion is carbon dioxide, a greenhouse gas. The overall effect of human activities since the Industrial Revolution has been a warming effect, driven primarily by emissions of carbon dioxide and enhanced by emissions of other greenhouse gases.

The build-up of greenhouse gases in the atmosphere has led to an enhancement of the natural [greenhouse effect](#). It is this human-induced enhancement of the greenhouse effect that is of concern because ongoing emissions of greenhouse gases have the potential to warm the planet to levels that have never been experienced in the history of human civilization. Such climate change could have far-reaching and/or unpredictable environmental, social, and economic consequences.

Deforestation

The earth is protected by forests by helping to absorb the massive amounts of carbon dioxide (CO₂) which is the most abundant type of pollution that causes climate change. Forests are currently being destroyed at an alarming rate through logging and clearing of land for agricultural and livestock uses. These activities releases huge amounts of carbon dioxide and other harmful greenhouse gases into the atmosphere, and also reduces the region's ability to absorb carbon pollution.

Other factors

Carbon dioxide is the main cause of human-induced climate change. It has been emitted in vast quantities from the burning of fossil fuels and it is a very long-lived gas, which means it continues to affect the climate system during its long residence time in the atmosphere. However, fossil fuel combustion, industrial processes, agriculture, and forestry-related activities emit other substances that also contribute to climate change. Some, such as nitrous oxide, are long-lived greenhouse gases like carbon dioxide, and so contribute to long-term climate change. Other substances have shorter atmospheric lifetimes because they are removed fairly quickly from the atmosphere. Therefore, their effect on the climate system is similarly short-lived. Together, these short-lived climate forcers are responsible for a significant amount of current climate forcing from anthropogenic substances. Some short-lived climate forcers have a climate warming effect (positive climate forcers) while others have a cooling effect (negative climate forcers).

If atmospheric levels of short-lived climate forcers are continually replenished by ongoing emissions, these continue to exert a climate forcing. However, reducing emissions will quite quickly lead to reduced atmospheric levels of such substances. A number of short-lived climate forcers have climate warming effects and together are the most important contributors to the human enhancement of the greenhouse effect after carbon dioxide. This includes methane and tropospheric ozone; both greenhouse gases and black carbon, a small solid particle formed from the incomplete combustion of carbon-based fuels (coal, oil and wood for example).

Other short-lived climate forcers have climate cooling effects, most notably sulphate aerosols. Fossil fuel combustion emits sulphur dioxide into the atmosphere (in addition to carbon dioxide) which then combines with water vapour to form tiny droplets (aerosols) which reflect sunlight. Sulphate aerosols remain in the atmosphere for only a few days (washing out in what is referred to as acid rain), and so do not have the same long-term effect as greenhouse gases. The cooling from sulphate aerosols in the atmosphere has, however, offset some of the warming from other substances. That is, the warming we have experienced to date would have been even larger had it not been for elevated levels of sulphate aerosols in the atmosphere.

III. IMPLICATIONS OF CLIMATE CHANGE ON THE COASTAL AREAS OF THE NIGER DELTA

Global warming of coastal areas

Observations over the years has shown an increased global mean temperature, commonly referred to as global warming, and this already has significant impacts on environmental and human life. Studies by the IPCC Fourth Assessment show that most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in human greenhouse gas concentrations, which if not checked on time could cause further severe damage to the ecosystem which have already been destabilized. The greenhouse gases attack the ozone layer which now allows ultra violet rays which ordinarily would not adversely affect the earth now directly hit the earth's surface causing the ambient temperature to be astronomically high. The increase in global temperature is significantly altering the climate of the earth, resulting in more extreme and unpredictable weather as evidenced by the frequent occurrence of heat waves and record droughts followed by intense rainfalls.

Erosion of coastal areas

Some parts of the Niger Delta are usually subjected to seasonal flooding when rivers overflow their banks. Given the scientific prediction of sea level rise that would be occasioned by climate change, it means that, the lowlands of the Niger Delta shall be exposed to higher risks with increasing change in climate. This paper discusses the relationship between climate change and riverine/coastal flooding. It also gives background information and situates the vulnerable nature of the Niger Delta within the context of global atmospheric warming.

The Intergovernmental Panel on Climate Change has linked the rise in sea level to climate change. Between 1960 and 1970, a mean sea level rise of 462mm was recorded along the Nigerian coastal waters. Flooding of low-lying areas in the Niger Delta

region has been observed. Settlements in the coastal region have been uprooted by coastal erosion. In some places, especially in Forcados, some oil wells have been lost to the ocean due to erosion. The overflow arising from the rise in sea level will increase problems of floods, intrusion of sea-water into fresh water sources and ecosystems, destroying such stabilizing systems as mangroves, and affecting agriculture, fisheries and general livelihoods. Coastal vegetation, especially the mangroves, has been lost to coastal erosion. The Niger Delta could lose over 15,000 square kilometers of land by the year 2100 with a 1000mm rise in sea level. Moreover, it is predicted that Nigeria will lose a huge amount of money as a result of the sea level rise while majority of the people of the Niger Delta will be displaced due to the low level of the region.

Flooding of coastal areas

Climate change leads to flooding in the southern part of Nigeria, especially in the coastal regions of the Niger Delta. In many communities in the Niger Delta region, several houses have been abandoned by the owners due to floods resulting from heavy and brief rainfall, and many more areas in the region are vulnerable to floods. Owners of the affected houses did not anticipate the problem they now find themselves when their houses were being built. Occupants of some of the affected houses, who are unable to relocate for financial reasons, will have to cope with the situation. This makes them vulnerable to different kinds of water-related disease such as malaria, dysentery, cholera, and diarrhea. Trauma resulting from the problem can lead to non-pathogenic diseases such as hypertension and diabetes. In some other instances, some areas are cut off from other parts of the community as a result of flood.

Change in the pattern of rainfall

Meteorological data have shown that rainfall pattern in Nigeria has changed in the past decades. The decline in rainfall in Nigeria started at the beginning of the 1960s when a decade of relatively wet years ended. The persistent decline in the last two decades in Nigeria is an indication of an abrupt change in climate. Moreover, there is change in the timing of rainfall and farmers can no longer predict the rain and know precisely when to plant their crops. This is already having an impact on food security, especially in the Niger Delta where rain-fed agriculture is practiced. Farmers in the region begin cultivation at the end of the dry season, when the rain begins to fall. They plant their crops after the first or second rain in the month of March, and sometime in April. After the first rain, the rain falls periodically until the months of June/July (the peak of the rainy season). The amount of rainfall within the period before the peak is needed for the optimum performance of many crops. Because of the change in rainfall pattern, farmers who plant after the first or second rain run into huge losses when the rains are delayed beyond the usual due to climatic changes. The crops are scorched causing huge economic loss.

Outbreak of diseases and famine

Global warming has the tendency of establishing favorable atmospheric conditions for disease carrying vectors and making it possible for these organisms to spread diseases. What this means is that in developing countries, this will lead to higher

incidences of disease outbreak while the developed countries where diseases have been controlled would spend more money keeping out these disease bearing insects. Some species of fish and vegetation can no longer be found in some Niger Delta communities as there is massive migration of fishes while their structures suffer adverse degradation within few years of erecting them.

Change of habitat

Climatic change also affects the flora and fauna in the Niger delta by changing their life cycles and causing increased migration to more conducive areas for the organisms.

Acid rain

Another effect of climate change in the coastal areas of the Niger delta is acid rain. This result when sulphur (iv) oxide (SO_2) released into the atmosphere through the burning of fossil fuels gets oxidized to sulphur trioxide (SO_3) by a process known as photochemical oxidation. The SO_3 formed further combines gradually with atmospheric water to form tetraoxosulphate (vi) acid (H_2SO_4) which falls back as rain (acid droplets). Acid rain has the potential of virtually destroying everything it comes in contact with and has also has the tendency of polluting groundwater through seepage. It results in the death of fishes prevents their eggs from fertilizing and producing more fishes; it reduces the fertility of the soil and crop yield; it is responsible for the dissolution of metals (such as mercury, lead in the earth's crust) which then enters into the body fishes and later on humans; and also lead to the damage of monuments and buildings.

IV. COPING WITH CLIMATE CHANGE IN THE COASTAL AREAS OF THE NIGER DELTA

Source of livelihood

Many people in the Niger delta whose source of livelihood once depended on natural sectors such as farming and fishing had to change their means of livelihood. Because of the degradation of their environment, they can no longer engage in farming and fishing. For this reason, many are now traders, dealing on different kind of goods. Few persons work in the civil service, still fewer ones are employed by the multinational oil companies operating in the area. Many engage in multiple activities in other to increase their income. Change in means of livelihood has led to the rate of rural-urban migration; it has also affected the workforce in the rural communities and subsequently affecting agricultural production.

Floods

To cope with the persistent flooding in the region, the use of pedestrian bridge has been developed locally so that the affected areas can have access to other parts of the community to enable them carry out their daily activities. The pedestrian bridge are made of wood, in some other cases they are constructed with earth materials such as sand, pieces of broken building blocks or granite stones. The bridges are constructed on community efforts and initiative, usually after waiting for the government for a long time without results. The bridges constructed with wood have one disadvantage; wood is biodegradable and thus have short life

span. Those constructed by heaping sand are soon eroded by water.

Rainfall pattern

Because of the uncertainties in predicting the rain, farmers now delay their time of planting. After the first or second rain, they watch the rain for some time to ensure that the rain fall regularly enough before planting. They do this to prevent their crops from being killed when rain is delayed. Another way farmers in the region are overcoming this problem is by the use of fast-maturing varieties. Fast-maturing varieties of maize with high yields have been introduced and are being used by farmers. The risk involved in this strategy is that local species are being displaced by these species, though some farmers still cultivate the local ones. In future, new species may completely displace local species; this may lead to the extinction of local ones. It is important that the right mechanisms are put in place to protect local species from extinction.

V. CONCLUSION

When we refer to climate change in the coastal areas of the Niger delta, the first thing that comes to mind is gas flaring, the next is deforestation, which is massively going on in the area covered by this paper. The reason is because the factors mentioned above contribute enormously to the carbon levels in the atmosphere. Deforestation in particular poses a lot of danger in the sense that the forest acts as a carbon sink, when the forest is destroyed; the carbon in there is released into the atmosphere. Deforestation and gas flaring are the major contributors to carbon emissions in the coastal areas of the Niger delta.

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