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Research Paper

Evaluation of the Effects of Climate Change on the Inhabitants of the Niger Delta Region

Odigwe, M. Atubi A.O and Efe, S. I.
Department of Geography and Regional Planning,
Faculty of the Social Sciences, Delta State University, Abraka, Nigeria
P.M.B 1, Abraka, Delta State, Nigeria.

ABSTRACT
The study investigates the evaluation of the effects of climate change on the inhabitants of the Niger Delta Region. This is to decide the human characteristic and natural reasons for climate change in the Niger Delta Region, and to looked at climate change effects in the Niger Delta region and adaptation strategies adopted in the Niger Delta region. The study used the ex-post facto and survey research design. The research used the yearly precipitation and temperature data from 1925 – 2018 from the Climate Research Unit library (CRU) Ts 4.03 with the assistance of Google earth. The grid points of 5^o x 5^o gridded high-resolution stations was utilized. The study administered 398 questionnaires using the 5-points Likert scale question. In testing the hypotheses ANOVA and regression analyses were utilized. The study observed that what triggered climate change in the Niger Delta region were caused primarily predicted by increase in population, deforestation, gas flaring, volcanic eruption, astronomical causes, bush burning, change in earth's environment, variation in solar output, and industrialization. On the other hand, 79% of what triggered climate change in the Niger Region depicts wrong urban design and human errors as a factor. Furthermore, the study indicates that the effects of climate change in the Niger Delta region were primarily predicted by disruption of cable network and television reception, rise in sea level, acid rain, policing military operations, tourism/recreation, power outage, building, death, flooding, bad roads, agricultural/food security, increased temperature, prevalence of disease, conflict, security, economics, displacements, and drought, while the remaining 21% of the effects of climate change in the Niger Delta region depicting wrong planning and human errors as a factor.
KEYWORDS: *Evaluation, variability, effects, climate change, inhabitants*

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I. INTRODUCTION

Climate is viewed as the statistical depiction in the area of the mean and inconstancy pertinent to amounts, for example, precipitation and temperature throughout some stretch of time going from months to thousands or millions of years (Intergovernmental Panel on Climate Change [IPCC], 2014). In this regard, the IPCC (2014) defined climate change as direct or indirect activities of man on the earth surface which modifies the configuration of the global atmosphere. Adedeji et al. (2014) averred that climate change is among the major obstacles faced by man in recent time and also contribute substantial stress to humanities and to the environment, with threats in food production owing to shift in weather patterns, expansion in the danger of disastrous flooding owing to rising in sea levels, and with great impacts which is worldwide in scope and phenomenal in scale. They stated further that without intense action now, adjusting to these effects later on will be more troublesome and costly.

Various researches carried on the effects of climate change in Africa established that by year 2050, closed to 75 million 250 thousand individuals are anticipated to be exposed to increased water stress because of climate change (IPCC, 2007). IPCC further stated that, agricultural activities, including food access, in numerous African nations and districts is projected to be seriously undermined by climate irregularity and change, and regions reasonable for farming, the seasons dimension for planting of crops, and yield potential, especially along the edges of semi-arid and arid-area territories, are expected to diminish. This would facilitate unfavourably influence on food security and intensify lack of healthy sustenance in the continent. In certain nations, yields from rain fed farming could be decreased by up to 50% by 2020 (IPCC, 2007). IPCC (2014) documented the cause of 95% of climate change, and its impact such as sea level rise, flooding and coastal

erosion to human activities. Therefore, there appears to be a wide-ranging consent in the literature that climate is changing due to the burning of fossil fuels and changes in land use. Many studies have identified the Niger Delta region as highly vulnerable to impacts of climate change, stemming from sea level rise, increased precipitation, and intensive industrial activities from oil exploration (Federal Ministry of Environment, 2014; Akeh & Mshelia, 2016; Duru & Emetumah, 2016; Abdulkadir et al., 2017; Agumagu & Agumagu, 2018; Matemilola, 2019). He further stated that coastal erosion and flooding are the most pervasive problems, which have caused the movement of numerous people from their original ancestral land or settlement to a new location in some regions of the Niger Delta.

Studies have showed that other urban environments, such as Warri, are also at risk from the combination of climate change impacts and rapid urban expansion into floodwater storage zones. In recent years, the frequency and magnitude of floodwater retaining ponds on urban streets has increased with greater urban development into lowland and marshlands within the city. Although notable researches have been carried out in the region on climate change which include, Onwuemele (2015) that studied the Livelihood responses to Climate Change in the Niger-Delta region, the outcomes revealed that closed to 80% of the households have gone into non-farming activities as a means of livelihood that have negative impacts on food security. Ajayi (2014) analysed the responsiveness of climate change in the region. The analysis indicated that level of their awareness is low but improving. It was found, however, that the mass media has great impacts to play in climate change awareness in the region. The outcomes also revealed that the people of the region had long been involved in some homegrown and incipient adaptive approaches to climate change for years. Ajayi (2015) examined the effects of Climate Change on production of cassava in the region. The results of analysis showed that high effects of climate change include high susceptibility to pests and diseases; inadequate water supply/drought for nutrient circulation; cassava leaves discoloration; cassava roots discoloration; cassava roots reduction and restricted growth of cassava plants though washing away of top soil nutrients owing to erosion; cassava roots maturing late; soil nutrients are destroyed owing to high temperature; reduced quantity and strength of starch from cassava roots and water content of cassava roots were reduced, "moderate" effects; increased weed population and reduced dry matter of cassava roots were of "low" effects. Their result also indicates that the determinants of cassava profitability were farm size, farmers' knowledge in cultivation of cassava, farmers' knowledge of climate change adaptation strategies, various ways of managing strategies of climate change adopted, cost of labour and inputs materials.

Hassan et al. (2020) studied the possible effects of climate change in the Niger Delta region. The outcomes from the climate change scenarios foresee an expansion in precipitation across every single future period and under both emission situations, with the most noteworthy predictable increase during the last thirty years of the century. Under the RCP8.5 outflow situation, the precipitation at Port Harcourt and Yenegoa stations is anticipated to increase by 2.47% and 2.62% while the precipitation at Warri station is anticipated to increase by 1.39% around the century.

Climate Change impacts on the inhabitants of the Niger Delta Region

Human activities have exacerbated climate change with its attendant impacts on farming activities in different parts of the region. Marine fisheries and other resources, crop production and forest resources and efficiency may not be saved from the impacts of whims and caprice in climatic elements. Climate change additionally influences livelihood susceptibility (Bryceson et al., 2002; Ekins et al., 2003; Cochrane, 2006; Reed et al., 2013). Seaside regions have already experienced sea level increment of almost one foot in the past five decades, with forecasts indicating that the increment could be as high as three feet within the next nine decades (Duru & Emetumah, 2016). This will increase the incidence and strength of flooding by incoming rivers and/or the sea; and lead to widespread erosion and disarticulation of coastal wetlands (Federal Ministry of Environment, 2014; Agumagu & Agumagu, 2018; Akeh & Mshelia, 2016; Abdulkadir et al., 2017). Hydrological modelling revealed that a 1.5-foot sea level rise would immerse about 11,000 square miles of coastal land (Sayne, 2011).

A sea level rise of 1m could result in loss of about three-quarters of the land area of the Niger Delta (Olapido, 2010; Federal Ministry of Environment, 2014). It has also been estimated that a rise in sea level by up to 59cm by 2100 will result in the submersion of several Nigerian coastal states (Haider, 2019). This includes parts of Lagos and other smaller towns along the coast (Ebele & Emodi, 2016). This will disrupt the life and activities of residents and wreak immense havoc on the ecological balance (Ebele & Emodi, 2016). Sea level rise, excessive rainfall concentration, erosion and flooding of farmland will also reduce agricultural production in the region (Anabaraonye et al., 2019; Amobi & Onyishi, 2015; Building Nigeria's Response to Climate Change Project [BNRCC], 2011). Flooding of the River Niger, for example, has washed away significant amounts of farmlands (Nkechi et al., 2016).

Sea level rise and extreme weather will also affect Nigeria's coastal and marine areas (BNRCC, 2011). Severe storms will threaten fishing vessels and crew, affecting fish farmers on board (Ebele & Emodi, 2016). The suitability of inland fisheries is additionally compromised by increased saltiness and attenuation of lakes

and rivers (Ebele and Emodi, 2016). Onwuemele (2015) surveys livelihood responses of individuals to climate change. The outcomes demonstrated that over 80% of the households have differentiated their occupations into the non-farm area with attendant negative implications on food security.

In coastal eco-zones, windstorms and extreme rainfall, rising sea levels and floods can cause injuries, drowning, death, severe physical and mental trauma, particularly for citizens who live along major river deltas, on islands and on low-lying coastal areas (Abdulkadir et al., 2017; Amanchukwu et al., 2015). Flooding, stagnant water, ground water pollution and increased precipitation intensity increased builds flare-ups of water-borne illnesses and different sicknesses like malaria and hepatitis usually suffered in Southern Nigeria (Ebele & Emodi, 2016; Osuafor & Nnorom, 2014; BNRCC, 2011). Drinking water can be contaminated from sewage, industrial and chemical waste through the process of heavy rainfall events, which can lead to the outbreak of infections (Ebele & Emodi, 2016; BNRCC, 2011). In parts of Southern Nigeria, for example, flooding from sea level rise has contaminated freshwater aquifers, rivers, and stock-watering points. This has increased salinity in these bodies of water and polluted them with sediment and sewage (Sayne, 2011).

The Niger Delta region had faced some challenges due to the negative effects of climate change in the region, for instance there are issues of flooding year in year out, which have caused a lot of havoc on the inhabitants of the region, ranging from loss of farm lands, loss of buildings to floods, people in coastal areas have also lost their building as a results of submerging of the area due to sea level rise, loss of lives due to flooding and heavy erosion as in the case of Agbor Delta State where two boys from the same parents were carried away by erosion into the Orogodo river in 2019 (Ochei, 30th June, 2019). There are issues of road destruction due to the work of erosion in the region as you can see in the East-West road from Benin to Port Harcourt. Also, there are issues of loss of academic session in region closed to coastal area state like Bayelsa every year their primary and secondary schools stay at home due to the issues of flooding in the state to avoid casualties, and normal academic session resume after the cessation of the flooding have dried off. However, there is dearth on quantitative researches on the effects of climate change on the inhabitants of the Niger Delta region. Most studies carried out in the region are qualitative in nature, literature based. For instance, Etuonovbe (2008) studied the sustaining Coastal Management/Adaptation of Climatic Change and Sea Level Rise in the Niger Delta, but no data collected. Akinro et al., (2008) examined changing climate and degradation of the environment in the region, no data collected for analyses and Uyigue (2009) analyzed the changing climate of the region, no data was collected for the study.

Conceptual Framework

This study is based on the concept of vulnerability. The concept of vulnerability has been widely used along with adaptation and resilience concepts by policy makers and social scientist (Turner, 2016; Yenneti et al., 2016). The IPCC (2014) expressed vulnerability to "encompasses an assortment of ideas and components including affectability or vulnerability to damage and absence of ability to adapt constantly" Beroyer-Eitner (2016) characterized vulnerability as how much a framework, subsystem, or framework segment is probably going to encounter hurt because of exposure to a risk, either an annoyance or a pressure/stressor.

Moreover, Dumenu and Obeng (2016) characterized vulnerability as how much a framework is helpless to or incapable to adapt to antagonistic impacts of climate change, including environment inconstancy and limits consequently exposure, affectability and versatile limit assume a critical part all the while. Thusly, Turner (2016) and Yenneti et al. (2016) traced the origin of vulnerability to ensuring food security by making food available to individuals and groups of people to reduce poverty. Also, it is being described as a means to avoid destruction through reduced exposure of people to climate hazards. Dumenu & Obeng (2016) and Yenneti et al. (2016) classified vulnerability into two features: physical and social vulnerability. The physical vulnerability expresses exposure and state of natural hazards while social vulnerability is about system capacity and the use of social economic factors. Moreover, Yenneti et al. (2016) noted, the greater contributions of social vulnerability to climate change research than physical vulnerability.

Therefore, Dumenu and Obeng (2016) defined the concept of social vulnerability to climate change "as the intent in which a structure is vulnerable to the negative impacts of climate change owning to interplay of social, economic and demographic factors". Furthermore, Yenneti et al. (2016) posited social vulnerability in a different framework that combined exposure, sensitivity and adaptive capacity. Exposure is referred as the level at which a system is exposed to the influence of climate variations while sensitivity is the extent to which a system is either affected harmfully or usefully.

In the context of climate change, vulnerability can be characterized as how much a framework is vulnerable to, or unfit to adapt to, unfriendly impacts of climate change, including variability in climate parameters and extremes. Vulnerability is an element of the magnitude, character, and percentage of variation in climate to which a framework is exposed, is compassion, and its adaptive capability (IPCC, 2007). It is dictated by the resilience of a framework over stress. Vulnerability discussed the increase scientific investigation comprehension of climate delicate frameworks under changing climatic conditions, to focus on research endeavours to especially vulnerable areas of the regions and economy and to create adaptation techniques

(Braun and Aheuer, 2011). Vulnerability is likewise named biophysical and socio-economical vulnerability (Brooks, 2003).

Biophysical vulnerability is a term utilized by climate change researchers while economical vulnerability is utilized by friendly researchers (Brooks, 2003). The first includes event of danger or harm brought about by the framework because of activity of risk upon the framework while the subsequent one is autonomous of harm and it is the inherent present status of the framework or communities. With regards to flood, vulnerability is the degree to which a framework is vulnerable to flood because of exposure, a discomposure, related to its capacity (or powerlessness) to adapt (Balica, et al., 2013). This shows that one needs to manage an inconsistency while estimating vulnerability as it is hard to characterize it accurately (Birkmann, 2005).

Studies has showed that people are made vulnerable in a numerous and is a million-dollar question (Bankoff et al., 2004). Vulnerability causes poverty. As per Yamin et al. (2005) "the present poverty is the previous unaddressed vulnerability". Concerning individuals, vulnerability can be evaluated as the attributes and circumstance of an individual or groups that impact their ability to adapt to, oppose and recuperate from the effect of a natural disaster (Wrachien et al., 2011). There are numerous investigations on vulnerability evaluation of natural disasters particularly somewhat recently in which numerous extreme cataclysmic events, like Indonesian and Japanese tidal wave and typhoons in USA and Australia, have been reported (Kim and Choi, 2013). These catastrophic events have prompted impressive loss of lives and remarkable socioeconomic costs (Khailani and Perera, 2013).

Study Area

The region called Niger Delta falls inside the equatorial rain forest area of Nigeria. The region spanning over 20,000 square kilometres hosts about 25% of the Nigerian population. Around 2,370 square kilometres of the Niger Delta territory comprise of streams, creeks, estuaries and swamps. The delta, with mangrove wetlands spreading over around 1900 square kilometres has the biggest mangrove wetlands in Africa. The region ecosystem is profoundly different and accommodate varieties of species and amphibian vegetation and human life. Economic activities of the people in the region include fishing, farming and trading. The rural population commonly fish or practice subsistence agriculture, and supplement their diet and income with a wide variety of forest products.

Researches all over the globe had attributed climate change to anthropogenic or human activities, these activities in the Niger Delta region, is exacerbated by gas flaring as you can see all over the region, oil spillage is another major factor which is caused either naturally or human interference known as illegal oil bunkering by the people in the region and oil expatriates, and degradation of ecological surrounding owing to the obliteration of natural habitants of the region due to oil and gas exploration and exploitation which started in Oloibiri in the present day Bayelsa state on January 15, 1956, where the first commercial oil was discovered by Shell Darcy.

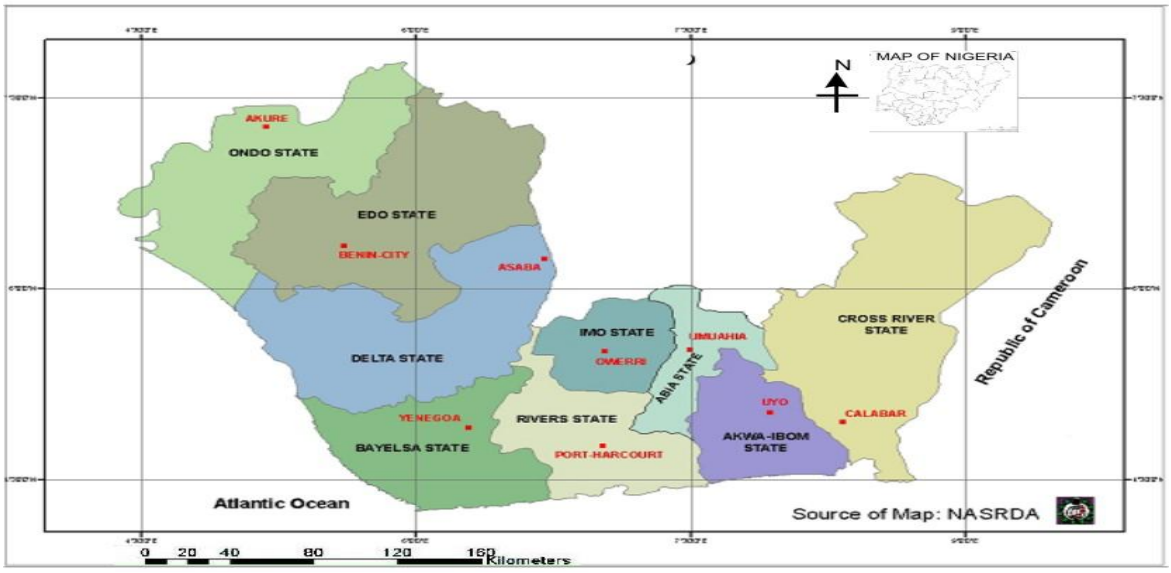

Fig. 1: The Niger Delta Region of Nigeria

Source: National Space Research and Development Agency (2021)

II. MATERIALS AND METHODS

The research adopted ex-post facto and survey research design, the ex-post facto design involved the collection of rainfall and temperature data for the period of ninety-four years from archive of the Climate Research Unit (CRU) University of East Anglia, while the survey research design involved the collection of climate change data from the region using the questionnaires. In order to collect rainfall and temperature data, the grid points of 5 ox 5o gridded high-resolution CRU Ts 4.03 stations was utilized. While, the questionnaire was administered to the residents of the various states that made up the Niger Delta Region. The population of the Niger Delta region is 42,637086 million and the Taro Yamane online calculator was used to determine the sample size of 400 at www.classgist.com. The 400-questionnaire distributed to the respondents, three hundred and ninety-eight (398) questionnaire was retrieved and used for the study. Measuring the effects of climate change on the inhabitants of the Niger Delta, the 5-points Likert scale questions was utilized. There are seven (7) survey questions with sixty (60) items having 5-point Likert rating scale ranging from Undecided (1), Disagree (2), Strongly Disagree (3), Agree (4), and Strongly Agree (5). The following researchers had used the five-point Likert scale in studies of climate change within and outside Nigeria (Farauta et al., 2011; Ochieng & Koske, 2013; Ogunsola et al., 2018; Adedamola, 2019; Akrofi et al., 2019). In testing the hypotheses, ANOVA and regression analyses were utilised. The following researchers in the field of climate change have utilised ANOVA and regression model in their various studies within the Niger Delta Region and outside the region (Tunde et al., 2013; Adedamola, 2019; Olubanjo & Alade, 2018; Igwenagu, 2014; Floyd et al., 2016).

III. RESULTS AND DISCUSSIONS

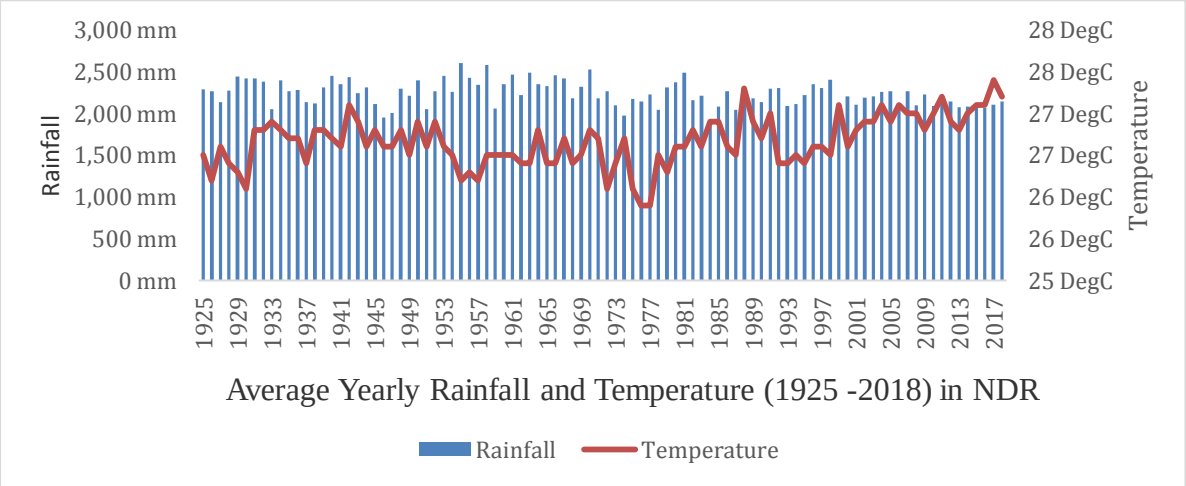

Fig. 2: Average Yearly Rainfall and Temperature (1925 -2018) in the Niger Delta Region

Fig 2 indicates that there had been fluctuation in the climate of the Niger Delta region, with evidence from the rainfall and temperature above, which indicates yearly fluctuation from 1925 – 2018. From Fig. 2, the year with highest average annual rainfall was 1955, which recorded an amount of 2600.7mm with a corresponding temperature of 26.2^{o}C. In the same vein, the lowest average annual rainfall occurred in 1984 with 1854mm, and a corresponding temperature amount of 26.9^{o}C. On the temperature records, the highest average annual temperature was recorded in 2017 with an amount of 27.4^{o}C with a corresponding rainfall amount of 2103.9mm. While, the lowest average temperature of 25.9^{o}C was recorded in 1976 – 1977 with a corresponding rainfall amount of 2140.1mm and 2226.7mm respectively.

Fig. 2, also depicts that there is reduction in the rainfall pattern in the Niger Delta region, and increased in the temperature of the region. The results of the study are in tandem with the work of Olapido (2010), BNRCC (2011), Enete (2014), Federal Ministry of Environment (2014) and Akande et al. (2017). The study established that there is an increase of 746.7mm in rainfall amount from 1925 – 2018 and a rise of 1.5^{o}C in temperature from 1925 – 2018.

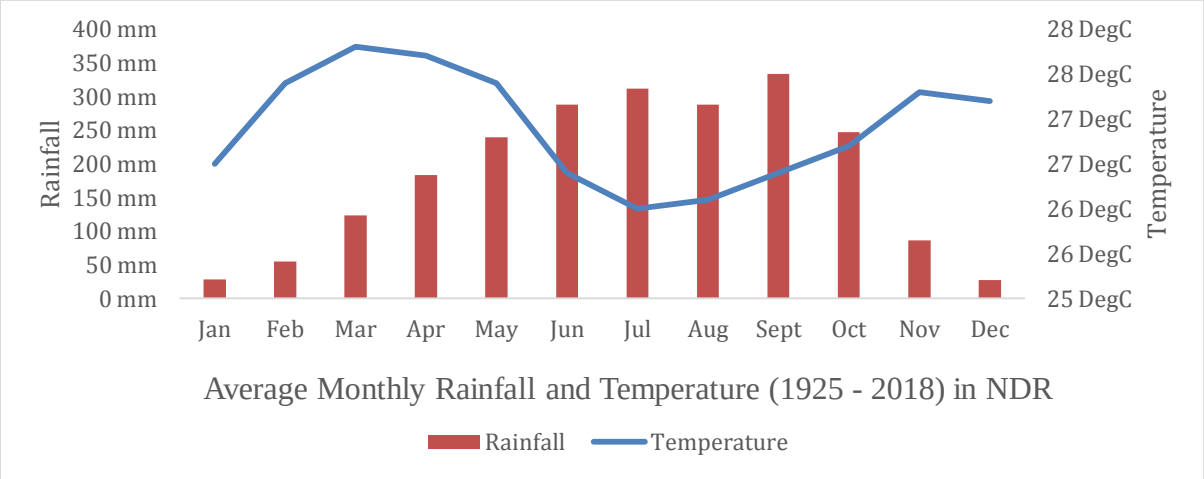

Fig. 3: Average Monthly Rainfall and Temperature in the Niger Delta Region

From Fig. 3 it was observed, that there is gradual increase in rainfall from January -September in the Niger Delta Region, with a double rainfall maximum in the month of July (311.6mm) with a corresponding low amount of temperature (26^{o}C) and September (333.5mm) with a corresponding high temperature of 26.4^{o}C. therefore, a gradual reduction in the amount of rainfall from October (246.5mm) to December (27.2mm) with a corresponding high temperature of 26.7^{o}C and 27.4^{o}C respectively. The study showed that rainfall increases with corresponding decrease in temperature in the Niger Delta Region (See Fig. 3).

Table 1: Decadal Variation in Rainfall and Temperature in the Niger Delta Region (1925 – 2018)

	Rainfall (mm)	Temperature (^{o}C)	Level of Change	
1925 – 1954	2263.913	26.7		
1955 – 1984	2285.96	26.5	-22.05	-0.2
1985 – 2018	2173.571	26.9	112.39	-0.4

Source: Authors Computation (2021)

Table 1, shows that from 1925 – 1954, 1955 – 1984 and 1985 – 2018 had average rainfall of 2263.913mm, 2285.96mm and 2173.571mm individually in all the three (3) climatic normal. Table 1 displayed the level of change or variation in rainfall in the Niger Delta region, with a change of -22.05mm and 112.39mm respectively. Table 1 also indicates that from 1925 – 1954, 1955 – 1984 and 1985 – 2018 had an average temperature of 26.7^{o}C, 26.5^{o}C and 26.9^{o}C apiece in the three (3) climatic normal. Table 1, on the other hand, displayed the level of change or variation in temperature in the Niger Delta region, with a change of -0.2^{o}C and -0.4^{o}C apiece.

Table 2: Perceived Reason for Changing Climate in the Niger Delta Region

Items	Mean
Increased temperature	3.2
Increased precipitation	4.1
Flooding	4.2
Diseases and pest outbreak	3.9

Source: Authors Computation (2021) Criterion = 3.01

Table 2, shows the mean scores on the responses from the residents of the Niger Delta region on the awareness of changing climate. The mean score of 3.01 signifies that the respondents strongly agree to the items while the mean score below 3.01 signifies that respondents strongly disagree with the item as stated. From Table 2, the result shows that the respondents strongly agree. Specifically, the result shows that there is an increase in precipitation, temperature, flooding, and disease and pest outbreak in the Niger Delta region due to changing climate.

Table 3: Perceived Causes of Climate Change in the Niger Delta Region

Causes of climate change	Options	Mean
Natural causes	Volcanic eruption	2.3
	Variations in solar output	3.3
	Changes in Earth's environment	4.0
	Astronomical causes	2.6

Human activities	Industrialisation	4.3
	Gas flaring	3.9
	Bush burning	4.7
	Deforestation	3.6
	Increasing Population	3.7

Source: Authors Computation (2021) Criterion = 3.01

Table 3, shows the mean scores on the responses from respondents on the causes of climate change in the Niger Delta region. From Table 3, the result shows that seven of the nine items listed received strongly agree, while two items received strongly disagree. Specifically, respondents disagree that volcanic eruption and astronomical causes do not contribute much to the causes of climate change in the region. The respondents agree that the remaining seven items contribute highly to the Niger Delta climate change causes

Table 4: Effect of climate change in the Niger Delta Region

Impacts	Mean
Increased temperature	3.8
Increased precipitation	3.3
Flooding	3.9
Rise in sea level	4.2
Acid rain	3.6
Drought	4.0
Coastal Erosion	4.0
Agricultural/food security	3.9
Commercial	3.7
Economic	3.7
Tourism/recreation	3.6
Building	4.0
Prevalence of diseases	4.0
Conflict and security	3.9
Policing and military operations	3.7
Transportation	3.7
Bad roads all over the region	3.7
Death	3.7
Displacement of people after heavy rainfall	4.0
Incessant power outage	4.4
Disruption of cable network and television reception	3.4

Source: Authors Computation (2021) Criterion = 3.01

From Table 4, the result shows that all the items listed received strongly agree. In the same vein, the respondents agreed that climate change have negative effects on all the items mentioned above.

Table 5: Mostly Affected Other Aspect by Climate Change in the Niger Delta Region

Other Areas Affected	Mean
Increased temperature	3.3
Increased precipitation	3.9
Flooding	3.4
Rise in sea level	4.2
Acid rain	2.9
Drought	2.4
Coastal Erosion	4.0
Agricultural/food security	3.9
Commercial Activities	3.7
Economic Activities	3.7
Tourism/Recreation Activities	3.6
Building	2.4
Prevalence of diseases	4.0
Conflict and security	3.9
Policing and military operations	3.7
Transportation	3.7
Bad roads all over the region	3.6
Death	3.7
Displacement of people after heavy rainfall	4.0
Incessant power outage	3.9
Disruption of cable network and television reception	3.4

Source: Authors Computation (2021) Criterion = 3.01

Table 5, shows the mean scores of respondents on the effects of climate change in the Niger Delta Region over the years. From Table 5, the result shows that eighteen of the twenty-one items listed received strongly agree, while only three items received strongly disagree. Specifically, respondents disagreed that climate change do not cause acid rain, drought and building in the Niger Delta region. However, the respondents agree that the climate change affects the breaming eighteen items listed.

Table 6: Adaptation Strategies Adopted in the Niger Delta Region over the years

Items	Mean
awareness campaigns about climate change and its effects	4.6
community mobilization/involvement	4.5
improved research on climate change adaptation	2.7
Capacity building and institutional strengthening	2.3
collaboration of different sectors to ensure effective response	2.8
integration of climate change into resource management	2.6
economic incentives and financial mechanisms	2.8
Policy – including new/revised legislation, bills, Acts of Parliament, etc.	2.3
reinforce or heighten existing coastal protection infrastructure	2.5
technical flood protection	4.5
natural retention of flood water	3.1
restriction of settlement/building development in risk areas	3.2
improving insurance schemes against flood damage	2.8
improving forecasting and information	2.1

Source: Authors Computation (2021) Criterion = 3.01

Table 6, shows the mean scores on the responses from respondents on the adaptation strategies adopted in the Niger Delta Region over the years. From Table 6, the result shows that five of the fourteen items listed received strongly agree, while nine items received strongly disagree. Specifically, respondents disagreed that the following adaptation strategies improved research on climate change adaptation, capacity building and institutional strengthening, collaboration of different sectors to ensure effective response, integration of climate change into resource management, economic incentives and financial mechanisms, policy – including new/revised legislation, bills, acts of parliament, reinforce or heighten existing coastal protection infrastructure, improving insurance schemes against flood damage and improving forecasting and information are not practice in the Niger Delta region. However, the respondents agreed that the following adaptation strategies awareness campaigns about climate change and its effects, community mobilization/involvement, natural retention of flood water, and restriction of settlement/building development in risk areas are the major adaptation strategies in the Niger Delta region.

Hypotheses Testing

Table 7: Natural and Human Causes of Climate Change in the Niger Delta region

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.764[a]	.583	.579	10.02300	.583	12.236	9	389	.013

a. Predictors: (Constant), increase_population, Deforestation, Gas_flaring, Volcanic_eruption, Astronomical_causes, Bush_burning, change_in_earth's Envr, Variation_in_solar_OP, Industrialization

Table 7, showed the prediction of the standard multiple regression result model that was statistically significant, F (9, 389) = 12.236, $p < 0.05$, and accounted for approximately 58% of the variance of the causes of climate in the Niger Delta region ($R^2 = 579$). The causes of climate change in the Niger Delta region were primarily predicted by increase in population, deforestation, gas flaring, volcanic eruption, astronomical causes, bush burning, change in earth's environment, variation in solar output, and industrialization. On the other hand, 42% of the causes of climate change in the Niger Region depicts wrong urban design and human errors as a factor.

Table 8: Effects of Climate Change in the Niger Delta Region

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.891[a]	.793	.631	15.01328	.793	14.142	17	380	.011

a. Predictors: (Constant), Disruption_of_cable_networkand_television_reception, Rise_in_sea_level, acid_rain, Policing_military_operations, tourism_recreation, power_outage, building, death, flooding, badroads, Agricultural/food_security, incresed_temperature, Prevalence_of_disease, conflict_security, economics, diplacements, drought

Table 7, showed the prediction of the standard multiple regression result model that was statically significant, F (17, 380) = 14.142, p< 0.05, and accounted for approximately 79% of the variance of the effects of climate in the Niger Delta region (R^2 = 579). The effects of climate change in the Niger Delta region were primarily predicted by disruption of cable network and television reception, rise in sea level, acid rain, policing military operations, tourism recreation, power outage, building, death, flooding, bad roads, agricultural/food security, increased temperature, prevalence of disease, conflict security, economics, displacements, and drought, while remaining 21% effects of climate change in the Niger Delta region depicting wrong planning and human errors as a factor.

IV. CONCLUSIONS

The study indicates that most adaptation strategies in the Niger Delta region are awareness campaigns about climate change and its effects, community mobilization/involvement, technical flood protection, natural retention of flood water and restriction of settlement/building development in risk areas. The study revealed that the causes of climate change in the Niger Delta region were primarily predicted by increase in population, deforestation, gas flaring, volcanic eruption, astronomical causes, bush burning, change in earth's environment, variation in solar output, and industrialization. On the other hand, 42% of the causes of climate change in the Niger Region depicts wrong urban design and human errors as a factor. Furthermore, the study shows that the effects of climate change in the Niger Delta region were primarily predicted by disruption of cable network and television reception, rise in sea level, acid rain, policing military operations, tourism recreation, power outage, building, death, flooding, bad roads, agricultural/food security, increased temperature, prevalence of diseases, conflict security, economics, displacements, and drought, while remaining 21% effects of climate change in the Niger Delta region depicting wrong planning and human errors as a factor.

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