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1.0 INTRODUCTON

The evidence of Rainfall and Temperature trend is recognized by today's world as one of the important environmental problems that affect humanity.It refers to a serious and continuous change in weather pattern, largely attributed to the emission of greenhouse gases such as carbon dioxide, methane, nitrous oxide and water vapor by humans, mainly produced from thetransport, agriculture, manufacturing and energy sectors of the economy.

Recent changes in climate have led to warmer temperatures, heavy rainfall, drought, and floods etc. (AkinsanolaandOgunjobi, 2014).Therefore, the knowledge of climate variability over the periodof instrumental records and beyond on differenttemporal and spatial scale is important tounderstand the nature of different climate systems andtheir impact on the environment and society (Oguntunde*et al*. 2012).

Climate variability is the variations of the normalstate and other statistics of the climate on all temporal and spatial scales beyond that of individual weatherevents. Variability may result from natural internal processes within the climate system (internal variability)or from anthropogenic external forces (external variability) (IPCC 2001, 2005). The global climate has changed rapidly with theglobal mean temperature increasing by 0.7^{O}C within thelast century (IPCC 2007). However, the rates of changeare significantly different among regions (IPCC 2007).This is primarily due to the varied types of land surfaces with different surface albedo, evapotranspiration andcarbon cycle affecting the climate in different ways.

1.1 BACKGROUND TO STUDY

The Niger Delta is a very sensitive area housing several ecosystems or local biomes. This has made it particularly vulnerable to little changes in environmental conditions, weather variability inclusive. Apart from the generalized effects of climate variability, there are certain impacts that are either unique to or more pronounced in the region. Some of these are discussed below.

1.1.1 Coastal Erosion and Flooding

The Niger Delta region is a coastal environment in which Warri is a major city with high rate of petroleum exploration activities. Increased flooding and aggravated erosional activities have been reported in the coastal regions and these have been linked with global warming by the IPCC. According to the IPCC (1990), working with records over the last 100 years, have shown that a strong correlation exist between greenhouse gases emission and climate change and between global temperature and sea level rise. Global temperature is expected to rise by between 0.2^{O}C to 0.5^{O}C per decade. The rise in temperature is expected to cause thermal expansion of sea and melting of polar ice. These will cause the sea level to rise for about 3-10 cm per decade during the next century. In some places, especially in Forcados, some oil wells have been lost to the ocean due to erosion. Apart from coastal erosion, flash flood in general has impacted negatively the livelihood of many communities within the Warri environ as a result of excessive rainfall. Flood and erosion remove top soil, destroy roads, affect fresh water resources and threaten lives and properties. Many people have been rendered homeless by floods and several roads have been made impassable.

1.1.2 Change in Rainfall Pattern

Meteorological data have shown that rainfall pattern in Nigeria has changed in the past decades. Oladipo (1995) reported that the decline in rainfall in Nigeria started at the beginning of the 1960s when a decade of

relatively wet years ended. According to him, the persistence of below-mean rainfall in the last two decades in Nigeria is an indication of an abrupt change in climate. The Niger Delta lie predominantly in the tropics having two seasons – the wet and dry seasons. The wet season occur from May to September, while the dry season begins in October and ends in April.Food security has been defined as the ability of people to grow and obtain food. The agricultural sector in Nigeria is highly sensitive to rainfall pattern. It has been predicted that climate variability orchange will pose serious threat to food security. Climate change creates uncertainty in the rainfall pattern (timing and amount) and affects agricultural activities.

Agriculture in the Niger Delta is highly dependent on rain and irrigation is seldom practiced. The changes in the rainfall pattern have greatly affected the agriculture in the region. 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 till the months of June/July (the peak of the rainy season), when rain fall more or less continually. The periodic rainfall pattern before the peak in June enables farmers to cultivate various crops. Because of the change in rainfall pattern, farmers who plant after the first or second rain in run into huge loss when the rains are delayed beyond the usual due to climatic changes. The crops are scotched causing huge economic loss. Before this time farmers can predict the rain and they know precisely when to plant their crops. The crops after they are planted are watered periodically by rain before the peak of the rainfall in June. The amount of rainfall within the period before the peak is necessary for the optimum performance of many crops most especially the maize which is widely consumed in every part of Nigeria. (Etiosa and Mathew 2007.)

1.1.3 Vegetation Loss

One important feature observed in the study region is the gradual disappearance of primary forests (Etiosa and Agho 2007). This may be partly due to climate change and partly due to human activities. Uncontrolled logging, agricultural activities, acid rain, oil exploration and exploitation, urbanization and mining activities contribute to lose of vegetation. The vegetation of some part of the Niger Delta is dominated by grasses, sedges and shrubs with few scattered trees and they were mainly palm trees. In other parts, trees grow close to one another to form thick canopy over undergrowths.The Niger Delta region of Nigeria which contains one of the highest concentrations of biodiversity on the planet could experience a loss of about 40% of its inhabitable terrain in the next thirty years. As majority of the people living in the Niger Delta are farmers, the environmental and social consequences of climate change is putting livelihoods at serious risks.

1.2 STATEMENT OF THE PROBLEM

The impacts of climate change together with rising world population enact a serious threat to all vital sectors of the world economy. Recent concern about rising global temperature was justified by its negative impact in all sectors of the economy most especially water supply, ecosystems, coastal habitats, industries, health and agriculture sectors. Findings from several studies (Anuforom, 2010; BNRCC, 2011; Farauta*et al*., 2011; Odjugo, 2010; UNDP 2010) predicted a temperature rise of 1.5 0 to 2.5 0 C for Nigeria in the 21stcentury. The threat has serious negative consequences for all sectors of the economy.

The major climatic challenge prone to the Warri environment is the Flash Flooding which occur more often after an excessive rainfall in which increasing flood risk is now being recognized as the most important sectoral threat from climate change in most parts of the Delta region which has prompted public debate on the apparent increased frequency of extreme, and in particular, on perceived increase in rainfall intensities

(Oriola, 1994).

This observed challenge is creatingincreased uncertainty about future temperature andprecipitation regimes which makes investments inagriculture and other weather-dependent livelihoods inherent more risky (FAO, 2008) in study location.

Based on this background, this study attempts to ascertain the degree of variability of weather pattern in Warri, Delta State, in a bid to understanding, managing and possibly predicting the aforementioned related challenges thereby providing an empirical basis for the formulation of effective adaptation and mitigation policies.

1.3 SIGNIFICANCE OF THE STUDY

Temperature and rainfall trend detection is an important exercise that can provide an indication of the magnitude of climate or weather variability providing a clear picture of the impact in the trends of the study area and a prerequisite for developing a framework for mitigation and adaptation policies. The knowledge of temperature and rainfall trends in the study area has tremendous potential benefits some of which can be highlighted as follows:

It will bring to limelight the potential effect of climate variabilityin Warri city

It will enlightenrelevant authorities and residents on applicable adaptation measures

It will provide empiricalbasis for the formulation of effective mitigation policies

The project work will serve as an indispensable and valuable data for students, academics and future researches who might be interested in validating their findings in similar settings

1.4AIM AND OBJECTIVES

The Aim of the study is to examine the trend of rainfall and temperature in Warri, Delta State.

The objectives of the research are:

To ascertain the temperature and rainfall trend in Warri, Delta State

To discern with certainty the significant changes in temperature and rainfall trend in Warri, Delta State

To uncover the implications of observed trend and variations in temperature and rainfall trend in Warri, Delta State

1.5 STUDY AREA

1.5.1 Location and Position

The study area, Warri, has its geographical coordinates as 5°31N5°45E/5.517°N 5.750°E/5.517; 5.750 (Ekeh and Palmer 2005).Warri is a city in Delta State, Nigeria. It is an oil hub in South-South Nigeria and houses an annex of the Delta State Government House .Warri city is one of the major hubs of petroleum activities and businesses in the southern Nigeria**.** Delta state, southern Nigeriais bounded by Edo state to the north, Anambra state to the east, Rivers state to the southeast, Bayelsa state to the south, the Bight of Benin of the Atlantic Ocean to the west, and Ondo state to the northwest. On the east and south the state is bounded by the lower course and delta of the Niger River.

Delta State currently has twenty-five local government areas. They are: Aniocha North, Aniocha South, Bomadi, Burutu, Ethiope East, Ethiope West, IkaNorthEast, Ika South, Isoko North, Isoko South, Ndokwa East, Ndokwa West Okpe, Oshimili North Oshimili South, Patani, Sapele, Udu, Ughelli North, Ughelli South, Ukwani, Uvwie, Warri North, Warri South and Warri SouthWest.

1.5.2 Population

It is a commercial capital city of Delta State, with a population of over 311,970 people according to the

national population census figures for 2006. The city is one of cosmopolitan cities in southern Nigeria comprising originally of Urhobo, Itsekiri and Ijaw people.

1.5.3 Climate

The climatic condition of Warri region experiences moderate rainfall and moderate humidity for most part of the year. The climate is equatorial and is marked by two distinct seasons: the dry season and the rainy season. The dry season lasts from about November to April and is significantly marked by the cool "harmattan" dusty haze from the north-east winds. The rainy season spans May to October with a brief dry spell in August, but it frequently rains even in the dry season. The area is characterized by tropical equatorial climate with mean annual temperature of 32.8 °C and annual rainfall amount of 2673.8 mm. There are high temperatures of 20 °C and 29.6 °C. The natural vegetation is of rainforest with swamp forest in some areas. The forest is rich in timber trees, palm trees, as well as fruit trees.

1.5.4 Geology

Warri in Delta State is a part of the Niger Delta Structural Basin in which three major sedimentary cycles have occurred since the early Cretaceous. The subsurface stratigraphic units associated with the cycles are, the Benin, the Agbada and the Akata Formations (Kogbe, 1976). The surface rock throughout the state consists of the OgwashiUku formation. The Benin formation is about 1800m and consists of loose and unconsolidated sands.There is little hydrocarbon associated with it. The underlying Agbada Formation which consists of sandstone and shales is, however, rich in hydrocarbons. It is up to 3000m and is underlain by the Akata Formation. The OgwashiAsaba Formation that underlies the northeast consists of an alternation of lignite seams and clay.

1.5.5 Relief

Warri is a region built up by the sedimentation of the Niger Delta and consists of the delta in various stages of development. Four major physiographic units are identifiable with in it. First, the freshwater swamp which is the most active area. It is located close to the River Niger, where annual flooding and deposition occurs up to 45 km from the river's course.

Second, the man grove swamp area described as an intermediate delta stage. It is much lower and a great proportion of it is brackish, having been invaded by the sea since large amounts of freshwater have ceased flowing into it. Third, the upland and swamp, which is also called the coastal plain.

It lies between the flood plain and Benin lowlands. The swamps are more restricted to broad drainage channels created when this area was an active delta. Fourth and finally, the upland Niger valley, which is a narrow strip above the delta and relatively flood free.

1.5.6 Ecological Problems

The environmental setting of Warri, Delta State has very serious ecological problems such as erosion and flooding. Coastal and creek erosion affect the coastal areas, resulting in loss of farm and residential land, and in some cases whole village such as Ogulaha and Ugborodo (Ibe,1988).

Flood is a widespread phenomenon in the state. In the coastal area, the numerous rivers and creeks flood their banks creating social and economic problems. Flash floods and flood pondages are the major features of the drylands, especially in the urban centre of Warri, Sapele and Ughelli.

In recent times, oil exploitation and gas flaring have further aggravated the ecological problems, causing very serious environmental pollution. The consequences include the destruction of aquatic life and vegetation and reduction in soil productivity.

1.5.7 Socio-Economic Activities

Warri is the economic heartbeat of Delta State, being the divisional headquarter for ShellPetroleum Development Co-operations (SPDC), also a swamp location for exploration andproduction of oil for SPDC. Other oil companies as well as oil servicing companies are alsosituated in the town.Major industries in the area are oil mining, oil servicing, petro- chemicals and sculptural and bronze making establishments.

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