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Climate change: Some meteorological indicators and the perception of farmers in Yenagoa Metropolis, Bayelsa state, Nigeria

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Abstract: ***Due to urbanization and industrialization, the natural environment has been severely degraded, thereby posing a challenge to its sustainability. Climate change has affected biodiversity as well. This study assessed the perception of local farmers in Yenagoa metropolis, Bayelsa state, Nigeria on climate change. Also meteorological indicators such as temperature, relative humidity and wind speed were measured. Results showed that about 76%, 66% and 76% of respondents indicated that temperature precipitation and flooding events have respectively increased in the recent times. The meteorological analysis showed that temperature ranged from 24 – 35 ºC, relative humidity ranged from 69.2 – 86.9%and wind speed ranged from 0.3 – 1.3m/s in the month of August, 2014. About 83%, 73% and 56% agreed that vegetation cover aid in stabilizing the atmospheric temperature, soil against natural hazard such as erosion and flooding, and carbon sequestration respectively. About 65% of the respondents engage in crop rotation as a means of adapting to the effects of climate change.***

Keywords: Agriculture, Bayelsa state, Climate change, Farmers perception.

1. Introduction

Environmental dilapidation is a threat to the environment and its biotic composition. Several environmental problems are caused by natural and anthropogenic activities. Some of the natural extreme environmental effects are tropical cyclones (including hurricanes and typhoons), earthquake, floods, droughts and heavy precipitation [1]. Most natural disasters are triggered by anthropogenic activities. In the other hand, anthropogenic activities are hazard resulting from the activities of man on the environment. The major pollutants or contaminants of the environment are industrial wastes including liquid, solid and gaseous emissions. Gaseous contaminants are pollutants gases such as oxides of carbon, nitrogen and sulphur, hydrogen sulphide, ammonia, volatile organic compounds etc. In practices, gaseous emissions are released during the combustion of fuels such as diesel (automotive gas oil), gasoline (premium motor spirit), household kerosene, aviation fuel and biomass. In Nigeria, gas flaring is common practice in the Niger Delta region (Akwa Ibom, Abia, Rivers, Edo, Imo, Ondo, Bayelsa, Cross River and Delta), the Nigeria oil and gas production province. Abdulkareem et al. [2] reported that Nigeria flare about 75% of the total gas produced, being the highest among the organization of petroleum exporting countries. Fossil fuels have been diversely used in several sectors of the economy including transportation, telecommunication, electrification (using generators powered by fossil fuels), manufacturing etc. In addition,some industrial wastes such as cassava and oil palm processing wastes could be degraded via the activities of microorganisms to release methane and carbon dioxide, which are the principal greenhouse gases. Recently, Ohimain and Izah [3] reported that several tonnes of palm oil mill effluents (POME) produced in Nigeria, could contribute to greenhouse gases especially carbon dioxide and methane. In a developing nation like Nigeria, with a population of about 170 million, the effects of increased greenhouses gas emissions and the attendant climate change could be high.

Increased carbon dioxide emissions have been attributed to the combustion of non-renewable fuels particularly petroleum. Ali-Elredaisy [4] stated that carbon dioxide released into the environment could lead to long term and short term effects. These may include rising in atmospheric temperature, irregular rainfall (precipitation) which could result to high relative humidity, changes in the breeding pattern of several biodiversity in their respective habitats, changes in ecosystem purification (i.e. air and water purification), pollination potentials of plants by pollinators, food production, and nutrient cycles (carbon, hydrological, nitrogen cycles).It could also lead to extinction of some biological diversity that could not withstanding high temperatures. It could lead to behavioral changes including fruiting time of plant species. Enete and Amusa [5] stated that climate change is the most serious environmental menace to the fight against hunger, malnutrition, disease and poverty. Climate change affects agricultural productivity. Also, due to rising sea levels, climate change has caused destruction of infrastructure in many countries through coastal flooding. Staudinger et al. [6] have stated that sea level rise could lead to loss of habitats, which could affects several species population. In the recent times, ambient temperature change has been increasing reaching 0.6 ˚C from 0.3 ˚C within the nineteenth century. Ali- Elredaisy[4] projected that the global atmospheric temperature rise could reach 1.5 – 4.5˚C by 2030.

The economic importance of forest resources such as vegetation includes timber, medicine, food etc. The Nigeria vegetation cover in the southern region is basically rainforest. The rainforest hold different vegetation strata including farm plots, home gardens, bush fallows and riparian forests. The rainforest also contain obligate wetland plants (i.e. *Saccharum officinarum*, *Aspilia africana*), facultative wetland plants (i.e. *Musa paradisiaca*, *Panicum maximum*), facultative upland plants (such as *Manihot esculenta*, *Thaumatococcus danieli*), and obligate upland plants such as *Chromolaenaodorata*, *Capsicum annuum*. The vegetation cover in the region includes Phanerophytes (woody plants), Megaphanerophytes (trees exceeding 30 meters in height), Meso-phanerophytes (mostly tall trees with height in the range of 8 – 30 meters), Microphanerophytes (trees and shrubs whose height ranged from 2 – 8meters), Nanophanerophytes (vegetation whose height is below 2 meters they are mainly shrubs) and vines (vegetation that could creep).

In the coastal regions of Nigeria, the effects of climate change which have led to multiple flooding events are quite high. Bayelsa state, which is located in central Niger Delta region, has experienced several flooding episodes. In addition, the water level in the state is quite high. The people of the region are mainly farmers (i.e. fish farming and plant cultivation), civil servants and business men. The state is fast developing due to urbanization and migration.

Agriculture is the main source of food to humanity resulting from the consumption and of plants and animals. In the recent times, there is a slow but evident interference of climate change with agricultural processes. Studies on the assessment of how the indigenous people perceive the impacts of climate change on agriculture are scares in literature. Therefore, this study is aimed at determining the perception of indigenous farmers towards climate change in Yenagoa, Bayelsa state, Nigeria.

2. Materials and methods

A field gathering exercise was carried out in Yenagoa metropolis in the month of August 2014 using qualitative and quantitative techniques. Structured questionnaires were used to obtain primary data on socio-economics of the respondents and their perception of ecological and biological systems in relation to climate change. For the purpose of triangulation, direct observation was also done. In all, a total of 100 questionnaires were administered, while the 80%that was retrieved was analyzed and used for the study.

Also, the current relative humidity, atmospheric temperature, wind speed of the study area was measured in four different period of the day i.e. 08:00, 11:00, 14:00 and 17:00 hours for a period of four weeks in the month of August 2014 using pocket meteorological station, Kestrel (model: 4500 NV, manufactured by Nielsen-Kellerman CO, Boothywn, USA). All the data gathered were analyzed using qualitative and quantitative data analysis techniques. Microsoft Excel program (2013) was used to compute the descriptive statistics (proportion) and graph plotting.

3. Results and Discussion

3.1. Socio-economic characteristics of the respondents

Among the 80 questionnaires retrieved, 55% were from males while the rest 45% were from females. Their educational attainment is as follows; 1.3%, 5.0%, 21.3%, 26.3, and 46.3% had below first leaving school certificate, first leaving school certificate, senior school certificate, diploma and first degree and above respectively. Also, 27.5%, 43.8%, 25%, 2.5% and 1.3% fall within the age bracket of 21 – 30, 31 -40, 41-50, 51 - 60 and >60 years respectively. Their level of education could influence their perception toward climate change indicators in their locality.

3.2. Perception of Local People on Climate Change and Its Impacts

Climate change has been a major challenge affecting humanity in recent years. Based on the socioeconomic characteristics of the respondents, they could be described as being knowledgeable on climate change adaptation and the importance of basic meteorological indicators such as temperature, precipitation, relative humidity.

Temperature

About 76.2% of the respondents indicated that temperature have been rising in the recent years, while 15.0% opined that there have been no change in temperature and 8.8% don't know whether there is change in temperature (Figure 1a).Temperature measurements during a short break in between the raining season period (called August break) showed that temperature ranged from 24.0 -26.3ºC (8:00 hours), 25.0 – 28.0ºC (11:00 hours), 27.0 – 35.2ºC (14:00 hours) and 25.0 – 29.8 ºC (17:00 hours) (Figure 1b). Temperature is a major indicator pertinent to climate change. Increase in temperature has been a major concern affecting the world. The increase in the temperature opined by the respondents is an indication that they are aware of the effects of temperature on the society especially with regard to the environment. Similarly, based on Figure 1b, the temperature is usually optimum around 14.00 hours closely followed by 17.00 hours and least at 8.00hours. The increase in the atmospheric temperature could result to species and population shifts and/or changes in phenology, which could alter biotic interactions [6].

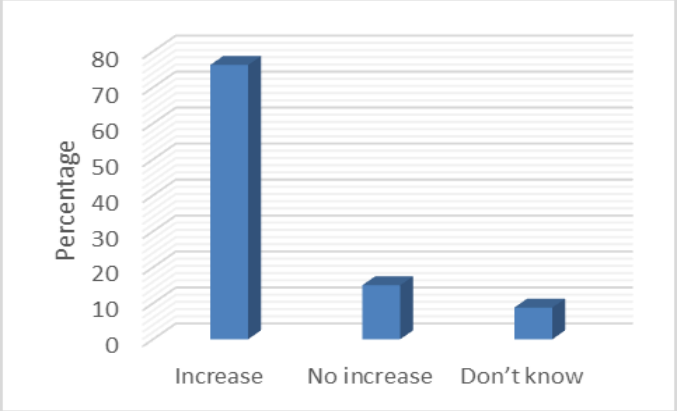

Figure 1a:Response to changes in temperature;

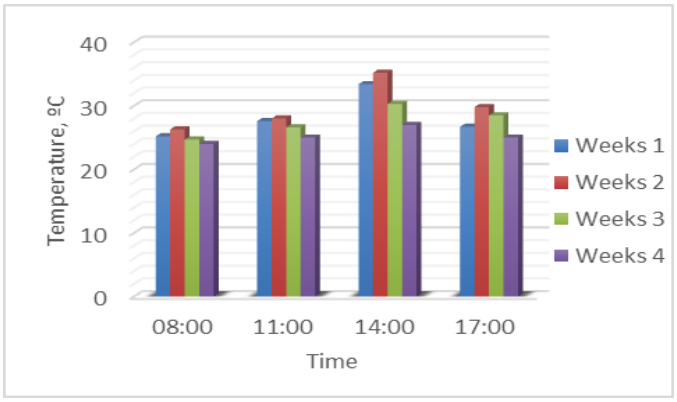

Figure 1b:Changesin temperature value during the day

Precipitation

Figure 2a showed the perception of the respondents toward precipitation. About66.3% of the respondents perceived that there is increase in rainfall, 17.5% showed that there is no increase in the rainfall, while 16.2% were undecided. The rainfall patterns in recent years have increased over time. For instance, the rainfall in February – March in the coastal region like Yenagoa in Bayelsa state were as high as rainfall of April-May. Yet, the period (February and March) have been severally reported as rainy season [7 - 9]. With regard to climate change, precipitation has led to shifting of the rainy season; decrease in winter rainfall and uncertainty of the intensity and pattern of rainfall and snow fall [10].Relative humidity of the study area rangedfrom73.1 – 85.1% (8:00 hours), 76.3 – 86.1% (11:00 hours), 69.2 – 86.9% (14:00 hours) and 76.5 – 83.1% (17:00 hours) (Figure 2b). The relative humidity is a reflection of rainfall possibilities. Due to slight break during the rainy season (August break), the relative humidity during the rainy season could also be higher than the values reported in this study. The peak of the relative humidity reported was in the morning hours i.e. 8:00 hours. The changes in the rainfall pattern could result to changes in the composition and structure of species [6].

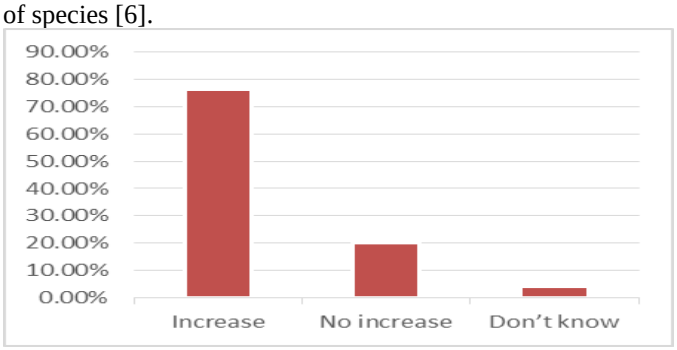

Figure 2a. The perception of the people toward change in precipitation

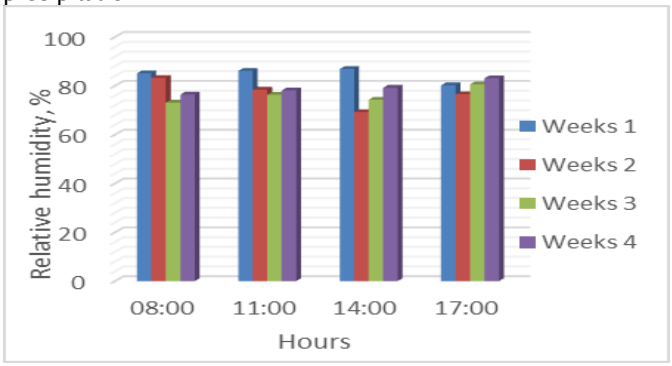

Figure **2b**: the relative humidity of the study area in the Month of August.

3.3 Natural and anthropogenic disaster

Flooding

About76.2% of the respondents opined that the level of flooding have risen, 19.9% indicated that flooding have not increased in the recent years while 3.9% are undecided (Figure 3). Flooding event affects farming practices (cultivation of crops such as yam, cassava, vegetables etc). As a result of flooding, farmers in study area cultivates crops with short life span such as vegetables, maize and cassava during the period considered to be dry season (November to March) and by the peak of rainy season (June to July) most of the crops will be harvested prior to flooding of late August and September. The variation in rainfall pattern it could affect the planting period of farmers in the study region. Due to heavy precipitation in the region, the and gradual change in the rainfall pattern, the period of flooding event may change and could take farmers unaware in years to come. Generally, Staudinger et al. (2013) stated that an increase in extreme natural events such as flooding, drought e.t.c. could lead to mortality and diseases outbreak, while changes in hydrologic regimes could lead to variation in the flow pattern of streams, which could affects population persistence and community composition.

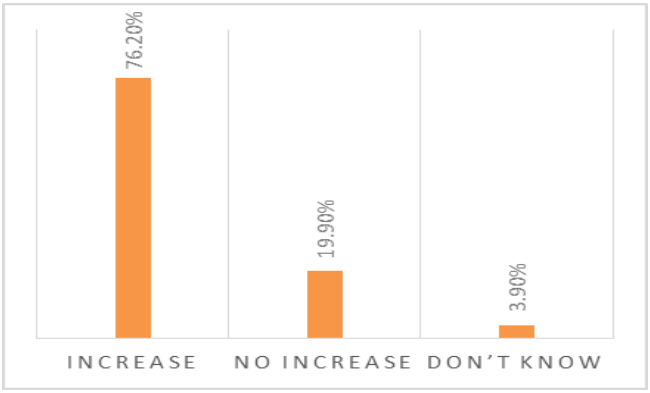

Figure 3: Perception of the people about flooding events

Other Ecological and biological impacts

Table 1 presents the perception of the respondents on climate change in relation to ecological and biological impacts. About 62.5 % of the respondents stated that soil moisture is depleting in cultivable land, 47.5% indicated that the wind pattern have changed and is getting warmer, 60.1% indicated that water resources have not changed, while 66.3% showed that there is no bush fire. About 38.8% of the respondents opined that some species of plants are at the risk of extinction in the wild, 47.5% have changed their reproduction time/duration resulting to changes in yield time, 42.6% opined that new plant diseases has not emerged, 42.5% opined that the population of invasive plants are beginning to change, 45% indicated that the vegetation cover of the forest is depleting, while another 45% indicated that there is no depletion of forest resources and 55.0% reported that medicinal herbs has not decreased in the recent years.

Wind speed during the month of August ranged from 0.3 – 0.7m/s (8:00 hours), 0.4 – 0.7m/s (11:00 hours), 0.4 – 1.2m/s (14:00 hours) and 0.3 – 1.3m/s (17:00 hours) (Figure 4). The wind speeds fell within the light air and light breeze on the Beaufort scale and are calm. About47.5% of the respondents opined that the wind patterns have changed. Vegetation that could not tolerate high temperature, rainfall, water could reduce in population or even become extinct as a result of climate change. The low response to water resource

availability could be because of the abundance of water bodies in Bayelsa State. Water for agricultural purposes is not a problem to the people in the study area due to abundance of rivers, creeks, borrow pit and high level of ground water. In most region of Yenagoa metropolis, water table is between 10 – 40 feet during the dry seas which could be 3 – 7 feet during the rainy season. Due to availability of water, resources in the region the level of bush fire is relatively low.

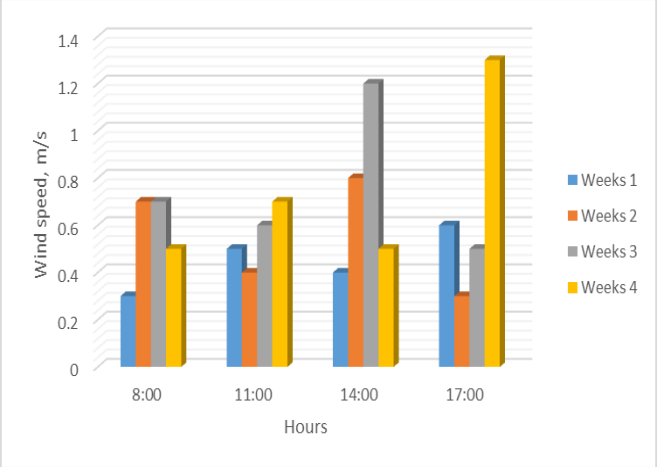

Figure 4: Wind speed of the air from the study area.

Role of the vegetation cover

Table 2 presents the perception of the respondents to the function of vegetation cover to climate change. The study showed that 82.5% agreed that the vegetation cover supports the cooling effect of the air i.e. stabilizing the atmospheric temperature, 72.5% indicated that vegetation helps in stabilizing soil, reduction of natural dangers such as erosion and 56.3% opined that the vegetation helps in sequestration of carbon, and maintenance of atmospheric carbon dioxide. About 5% do not know the role of vegetation covers in the protection of the environment from climate change. Similarly, 12.5% indicated that the atmospheric environment is the same and not changing. Vegetation through photosynthesis could sequester and store carbon, thus mitigating climate change. But in recent times, the rate of deforestation has increased due increased use of forest resources. Despite, high rate of utilization of plants species for timber purpose (lumbering), afforestation (replanting of tree) is quite low or nearly absent in the study area. Timilsina-Parajuli et al. [10] stated that vegetation covers holds about 20% carbon in their biomass especially in the tropical regions of the world. The soil hold a number of biodiversity such as microbes, habits for some animals species and source of substrate for plants species.

Adaptation in the current situation is one of the sure means by which farmers could manage climate change. About 64.8% of the respondents practice crop rotation, while 31.3% do not practice rotation and 3.9% were undecided. Crop rotation helps in regaining soil nutrients in addition to wadding off plant diseases. Farmers could also adapt to the effects of climate change on vegetation through changes in the time of planting. This have already being practiced in Yenagoa.

Table 1: perception of the people in relation to ecological and biological impacts of climate change.

Ecological and biological impacts	Yes	No	Don't known
Reduction in soil moisture	63	28	10
Change in wind pattern	48	43	10
Reduction in water resources	31	60	8.6
Increase in bush fire	10	66	23.7
Has some plant species gone on extinction in the wild in the study area	39	30	31.2
Changes in flowering and fruiting time of plants/crops	48	43	10
Different plant/crop diseases in the recent years	39	43	18.8
Changes in the population of invasive plant species	43	20	37.5
Reduction in the vegetation cover	45	45	10
Reduction in medicinal herbs	35	55	10

Table 2: The perception of the people to the function of Vegetation cover to climate change

Impacts	Yes	No	Don't known
Vegetation helps in cooling the environment to maintain the atmospheric temperature	82.5	12.5	5.0
Vegetation helps in stabilizing soil, reduction of natural dangers such as erosion	72.5	17.5	10.0
Vegetation helps in sequestration of carbon, and maintenance of atmospheric carbon dioxide	56.3	15.1	28.6

4. Conclusion

Climate change has impacted on the biotic and abiotic components of the ecosystems. The biotic composition plays essential role for the survival of humanity. The study evaluated the perception of farmers in Yenagoa metropolis on climate change issues. The study found that more than 50% of the respondents opined that temperature, precipitation, soil moisture depletion,has been on the increase while they also asserted that vegetation cover aid in stabilizing the atmospheric temperature, soil against natural hazards, and carbon sequestration. While 35 – 47.5% opined that there is change in flowering and fruiting time of crops, new crop diseases have emerged, invasive plant species have been on the increase, grass production and medicinal herbs are declining, and some plants are at the risk of extinction in the wild. Meteorological indicator analysis showed that relative humidity and temperature is high in the month of August, while the wind speed recorded is calm according to Beaufort scale. About 65% of the famers practice crop rotation as means of adapting to the effects of climate change.

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