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Global Warming Impact on Hunger and Sustainable Development in Sub- Saharan Africa: A Case Study of Nigeria

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Global Warming Impact on Hunger and Sustainable Development in Sub-Saharan Africa: A Case Study of Nigeria

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ABSTRACT

This research paper investigates the impact of global warming on hunger and sustainable city in Sub-Saharan Africa. Secondary Data was obtained for the study at the Center for Atmospheric Research, National Space Research and development Agency, Kogi State University, Campus, Anyigba. Descriptive statistics were employed to analyze the data. The analyzed data revealed that mean monthly Air temperature for April 2016 increased to 1.11°C warmer, surpassing the previous record set between 1951 – 1980 many staple crops could not adapt quickly to the changing weather leading to reduction in crop yield. The sub-region is shifting toward aridity which affect the rain-fed subsistence agriculture practice in the region; coastal areas are experiencing flooding as farm land are submerge in flood. The effect of the above is manifested in hunger – severe food insecurity. The Author advocates the following irrigation farming for all year farming, River Basing Development should be fully utilize genetically modify crops that are draught resistance should be develop and alternate clean energy source.

Keywords: Global Warming, Food Insecurity, Hunger, Sub-Saharan Africa, Sustainable Development.

1.2 BACKGROUND TO THE STUDY

There are different views regarding the effect of global warming on agriculture. It may show positive or negative effects on various types of crops in different regions of the world. Tropical and subtropical regions will be more affected since the average temperature in these regions is already on the higher side. A rise of 2°C may be quite harmful to crops. Soil moisture will decrease and evaporation will increase, which may drastically affect wheat and maize production.

One of the man's activities that suffer repercussion of global warming most is agriculture. Climate determines the types of agricultural land use engage in by man e.g arable farming.

Agricultural productivity has declined in Sub-Saharan Africa, for example, per capital agricultural production fell by 5percent over the last 20 years while increased by 40 percent in other developing countries (practical action 2006). At independent most sub-Saharan African countries were self sufficient in food. In less than 40 years, the sub-continent went from being a net exporter of basic staple to reliance on import and food aids Plaut(2006).

In 2004 the cost of cereal imported by sub-Saharan African excluding South Africa amounted to \$4.4billion by 2020. Africa is projected to import more than 34 tons yearly at a cost of \$8.5billion(African Fertilizer Summit 2006).

Poor nutrition causes nearly half (45 percent) of death I children under age five-3.1 million children each year.

One in four of the world's children suffer stunted growth, In developing countries the proportion can rise to one in three. 66 million primary school age children attend classes hungry across the developing world, with 23 million in Africa alone.

Purpose of the Study

The main purpose of this study is to determine the impact of global warming on Hunger, Food insecurity and environmental Sustainability.

To determine critical climate logical variable that account for variation in crop yield in Sub-Saharan Africa.

To proffer a policy framework that will help in combating the impact of global warming on Hunger, Food insecurity and environmental sustainability.

2.0 CONCEPTUAL FRAMEWORK

Global warming describes the current rise in the average temperature of earth's air and ocean. It is an increase in the average temperature $0.74 \pm 0.18^{\circ}\text{C}$ ($1.33 \pm 0.32^{\circ}\text{F}$) between the start and the end of 20th century (NASA 2010).

Global warming is the term used to describe a gradual increase in the average temperature of the earth's atmosphere and its oceans a change that is believed to be permanently changing the earth's climate. The increase volumes of carbon dioxide and other green house gases released by the burning of fossils fuels, land clearing, agriculture and other human activities are believed to be the primary source of the global warming that has occurred over the past 50 years. Scientist from the inter-governmental panel on climate carrying out global warming research have recently predicted that average global temperature could increase between 1.4 and 5.8°C by the year 2100. Changing resulting from global warming may include rising sea level due to melting of the polar ice caps, as well as an increase in occurrence and severity of storms and other severe weather events. Evidence have been suggested that draughts have been occurring more frequently because of global warming, the rises expected to become more frequent and intense in Africa, southern Europe, the middle east, most of the Americans, Australia and south east Asia. Their impact are aggravates because of increase in water demands, population growth, urban expansion and environmental protection efforts in many areas. Draughts result's in crop failures and loses of pasture for grazing livestock's which are as a result of effects of global warming.

In recent months, heavy rains led to a series of flooding that consequently triggered landslides in the Philippines causing death and destructions. These were captured by international media. The frightening images were a reminder of the vulnerability of people and place to global warming related disasters.

It is predicted that increase in the world's average temperature will lead to drastic changes in rainfall pattern, with significant increases and more frequent flooding in some areas. Sea-level rise put in risk some of the world's most densely populated areas. The UNPFA (2007) estimate that low elevation coastal zones i.e areas less than 10 meters above sea levels currently account for only 2% of the world's land area but 13% of its urban population within Nigeria, flooding is a common occurrence in cities especially at the height of the rainy season even in cities which are located far from the coast. The green house gas emissions from human activities are driving global warming.

The world's average surface temperature is projected to rise over the 21st century and is likely to surpass 3 degree with some area of the world expected to warm and most vulnerable people are being affected the most.

Climate change is a global challenge that does not respect national borders. Emissions anywhere affect people everywhere from 1880 to 2012 average global temperature increase by 0.85°C IPCC (2016).

Oceans have warmed, the amounts of snow and ice have diminishes and sea level has risen. From 1901 to 2010, the global average sea level rose by 19cm as ocean expanded due to warmers and ice melted. The arctic's sea ice extent has shrunk in every successive decade since 1979 with 1.07 million km^2 of ice loss every decade.

Given current concentrations and on-going emissions of green house gases, it is likely that by the end of this century the increase in global temperature will exceed 1.5°C compared to 1850 to 1900 for all but one scenario. The world's oceans will warm and ice melt will continue.

Average sea level rise is predicted as 24-30cm by 2065 and 40-63cm by 2100. Most aspects of climate change will persist for many centuries even emissions of carbon dioxide (CO_2) have increased by almost 150 percent since 1990. Emission grew more quickly between 2000 and 2010 than in each of the three previous decades.

One of man's activities that suffer repercussion of climatic change most is agriculture. Climate determines the types of agricultural land use engaged in by man e.g arable farming, plantation agriculture, livestock grazing, fishery e.t.c. in arable farming for instance, climatic change may bring about the following among others

- a. Regional shift in cropping pattern
- b. Determines the size and configuration of farm land
- c. Determines the type, status and magnitude of crop pest and diseases.

For example, regional shift in livestock grazing currently experienced in Niger Republic has a lot of bearing with a shift in climate towards severe aridity. Also, animal pests and diseases are climatically controlled. Changes of the marine ecosystem on a global scale are less documented but it is evident that artificial pollutants have involved deep seas. These changes represent a threat to agricultural resources.

3.0 SUSTAINABLE DEVELOPMENT

The fundamental objective of ecocity development is to ensure sustainability of the urban system sustainable development has been defined as, "any process of urban development consistent with an international development pattern that improves the quality of life of all the world's citizens in a sustainable manner (Roberts et al 2009) ecocities seeks to ensure sustainability of the total environment (physical, economic and social) sustainable cities are cities where socio-economic interests are brought together in harmony with environment and energy concerns in order to ensure continuity in change (*Nijkamp and Perrels cited in Robert's et al 2009-13*) .

A sustainable agenda would entail policy and design measures that ensures an ecological balance between human activities land-use, consumption of services such as energy and water, waste management and the natural environment of the city for instance, it has been shown that more compact cities use less energy and sharing measures in building materials, improve energy efficiency such measures are expected to lead to a reduction in CO_2 emissions and reduction in energy cost.

Food security is complex sustainable development issue, linked to health through malnutrition, but also to sustainable economic development, environment and trade. There is a great deal of debate around food security with some arguing that;

- There is enough food in the world to feed everyone adequately, the problem is distribution.
- Future food need can or cannot be met by current level of production
- Globalization may or may not lead to the persistent food insecurity and poverty in rural community.

Issues such as whether household get enough food, how it is distributed within the household and whether that food fulfils the nutrients needs of all members of the household shows their food security is clearly linked to sustainable development.

Food Security

Food security is tied to Agriculture. At the level of the household, food security implies that every member of the household at all times has sufficient food for a healthy and active life. In this content it is not just a matter of quantity of food but also quality; especially ensuring that all the food groups are represented to ensure a balanced dietary intake. The food should also be obtained in ways that are socially acceptable. This excludes scavenging begging, stealing or dependence on emergency supplies. At the macro level food security is centered on economic access. That is, the people have the economic means to acquire sufficient food of suitable quality to meet their need for healthy living (Danbatta, Penni and Iko 2007).

Food production in Nigeria is dominated by small holdings, most of whom are subsistent, (fig.1) this means they grow for their own consumption and put on the market only what is surplus to their needs or when they have a pressing financial need.

Food availability per capital in Sub-Saharan Africa has declined by 3 percent since 1990. This compares with per capital increases of more than 30 percent in Asia and 20 percent in Latin America. Ariyo (2007) international academy council IAC (2004) showed that almost 200 million Africans were undernourished at the dawn of millennium compared to 133 million in 1980. Malnourished children in Africa now stand at 33 million most of whom are found in sub-Saharan Africa. Agricultural productivity has declined in sub-Saharan Africa, for example per capital agricultural production fell by 5 percentage over the last 20 years while increased by 40 percent in other developing countries (Practical Action 2006). At independent most sub-Saharan African countries were self sufficient in food. In less than 40 years the sub-continent went from being a net exporter of basic staples to reliance on import and food aids Plaut (2006). In 2004 the cost of cereal imported by sub-Saharan Africa excluding south Africa amounted to \$4.4 billion, by 2020 sub-Sahara Africa is projected to import more than 34 tones yearly at a cost of \$8.5 billion (Africa Fertilizer Submit 2006).

4.1 CAUSES OF FOOD SECURITY

Population growth has been at an alarming rate, increasing 3.5% annually altering food consumption to a great height.

Pest, diseases and weeds infection continue to reduce the gain of food and livestock production on the field and at storage.

Heavy dependency on rain fed agriculture leading to production of most crops once every year as opposed to irrigated land which will produce two cropping a year furthermore, environmental degradation, explosion of savanna zone and draught contributed greatly to food insecurity.

4.2 Implication of Food Insecurity

Food insecurity, especially unavailability and un-affordability has serious ripple effects on national security and stability. Such ripple effects as severally noted (FAO) 1998; Iwagu (2008)

- Mass poverty and starvation
- Diminished work performance
- Depletion of human capital arising from poor nutrition, low immunity to diseases which ultimately leads to untimely death.
- High import bills leading to balance of payment deficits.
- Mass protest/riot and political instability as currently witnessed in Egypt, Ethiopia, Nigeria, Sudan, Senegal, Mali e.t.c.

5.0 RESEARCH METHODOLOGY

The research made use of Secondary data obtained from The Center for Atmospheric Research (CAR) National Space Research and Development Agency Kogi State University, Anyigba.

The data include Rainfall and Temperature data between the year 2010-2015. Descriptive statistics was employed in analyzing the Data to show rainfall and temperature variability.

5.1 The Study Area

Nigeria is located between latitude 4°N and 14°N of the equator and between longitude 3°E and 15°E of the Greenwich Meridian. Nigeria is bounded in the North by Niger Republic at the south by Atlantic Ocean, in the east by Cameroon Republic and at the West by Benin Republic.

She became independent in 1960 from British colonial master, as at independent the country had three regions namely: North, East and West. The Northern region had it headquarters in Kaduna, East in Enugu and West in Ibadan. For administrative conveniences and regional development planning, these three regions has grew over time to thirty six states.

Fig 1: Map of Nigeria Showing the 36 States and the F.C.T

Source: Ministry of Environment 2016

The common system of Agricultural practice in Nigeria is subsistence Agriculture. Fig.2.

Fig 2; Rice farming

Source: Author's field work 2016

This means they grow crops for their own consumption and offer for sales what is surplus. Food crops like wheat, millet, rice and maize are commonly grown in the Northern part of the country while roots and tuber crops like yam and cassava are mostly produce in the Southern Part of the country.

There are two types of season in Nigeria these are: Dry season and Rainy Season. The Raining season occurred between March and November while the dry season occurs between November and February . Those

farmers involved in commercial cash crop productions lack overall co-ordination with regards to species or qualities, each farmer grows what he happens to like sometimes on a small holding of less than 5 hectares. Fig3.

Fig 3: Sugar cane plantation
Source: Author's field work 2016

METHODOLOGY

The research made use of secondary data obtained from the Centre for Atmospheric Research (CAR) National Space Research and Development Agency Kogi State University, Anyigba.

The data include rainfall, air temperature and soil moisture data between the year 2011 – 2015. Descriptive statistics was employed in analyzing the data.

DATA ANALYSIS AND DISCUSSION

Table 1; Mean Monthly Rainfall (MM) 2011-2015

Monthly Rainfall(mm)	2011	2012	2013	2014	2015
JANUARY	0.11	0	0.004	0.0002	0.14
FEBUARY	0.004	0.0009	-0.5	0.0003	0.004
MARCH	0.0017	0.5	0.002	0.007	0.004
APRIL	0.0014	0.0052	0.07	0.02	0.003
MAY	0.007	0.01	0.06	0.019	0.011
JUNE	0.004	0.007	0.01	0.016	0.0069
JULY	0.0051	0.01	0.07	0.019	0.06
AUGUST	0.012	0.01	0.011	0.3	0.15
SEPTEMBER	0.0082	0.01	0.036	0.437	0.08
OCTOMBER	0.0082	0.05	0.018	0.5	0.42
NOVEMBER	0.003	0.003	0.0027	0.053	0.12
DECEMBER	0		0.002	0.52	0.36
AVERAGE	0.013717	0.0551	-0.01786	0.157625	0.113242

Source: Centre for Atmospheric Research (CAR) – NATIONAL SPACE RESEARCH AND DEVELOPMENT AGENCY (NASRDA) KOGI STATE UNIVERSITY CAMPUS 2016

Table 1: above revealed the rainfall regime 2011 – 2015 monthly rainfall and mean annual rainfall between 2011 – 2015. The onset of raining season of the climatic zone studied which is tropical continental climate suppose to be April / May however it has drifted to June. The month of August that is expected to be dry which is known as August – break experiences rainfall.

The implications of the above on food security is grave in the area of cultivation of cereal crops such as maize and tubers. It has also affected the cropping season.

Secondly in the area of pest and disease, the August break which is meant for drying of grain crops during the early harvest suffer post harvest lost due to rainfall in that period. Pest like stem borers and Tuta absoluta have destroyed hundreds of hectares of maize and tomatoes farm in Northern Nigeria due to climatic hazard occasioned by global warming.

Table 2.1; Annual Rainfal (MM) 2011-2015

Years	Rainfall(mm)
2011	0.013
2012	0.1
2013	-0.02
2014	0.16
2015	0.11

SOURCE: Centre for Atmospheric Research (CAR) – NATIONAL
SPACE RESEARCH AND DEVELOPMENT AGENCY (NASRDA)
KOGI STATE UNIVERSITY CAMPUS 2016

Scale: let 1cm represent 0.02 unit in y axis.

FIG 4: Line Graph Showing Rainfall Variability from 2011-2015

The line graph in fig 4 above showed the rainfall variability from 2011 – 2015. Rainfall pattern is no longer stable even in the same climatic zone. The year 2013 recorded the least amount of rainfall while 2014 recorded the highest amount of rainfall, which reduce drastically in 2015. the above rainfall pattern have a dare consequences on rain-fed agriculture system which inturn affect food security in sub-Saharan Africa countries.

Table 3: Monthly Air Temperature (0C) 2011-2015

Monthly Air temperature 0C	2011	2012	2013	2014	2015
JANUARY	25.4	25.9	27	-40	25.8
FEBUARY	27.8	27.3	27.8	-40	28.73
MARCH	28.65	28.8	28	-39.9	27.71
APRIL	27.15	27.13	26	-39.9	27.8
MAY	26.3	25.6	25.7	-0.75	25
JUNE	25.1	24.6	23.4	25.3	26.33
JULY	24.4	24	18.4	24.1	23.81
AUGUST	24	23.4	10.93	23.51	22.11
SEPTEMBER	24.2	24	-10.02	24.04	24.51
OCTOBER	24.64	24.6	-39.91	25.12	26.121
NOVEMBER	25.4	25.95	-39.95	25.62	25.47
DECEMBER	25.1	25.6	-39.98	25.44	27.12
AVERAGE	25.67833	25.57333	4.780833	1.048333	25.87592

Source: Centre for Atmospheric Research (CAR) – NATIONAL SPACE RESEARCH AND DEVELOPMENT AGENCY (NASRDA) KOGI STATE UNIVERSITY CAMPUS 2016.

Table 3 showed mean monthly Air temperature from 2011 – 2015 from that record, February 2015 recorded the hottest month to have broken the previous mean record for February ever recorded by 0.93°C above the 1951 – 1980 mean for that month. The latest figure released by National Aeronautics and Space Administration (NASA) show the global temperature of land and sea was 1.11°C warmer in April 2016 than the average temperature for April during 1951 – 1980.

It all but assures that 2016 will be the hottest year on record and probably by the largest margin ever.

The new record broke the previous one by 0.24°C which was set in 2010 at 0.87°C above the baseline average for April. That record itself broke one set three years earlier at 0.75°C above the baseline average for April.

The recent figures put the recent goal agreed in Paris of just 1.5°C warming in doubt. There is inertial in the system. It's putting intense pressure on 2°C.

Table 3.1 Annual Air Temperature (0C) 2011-2015

Years	Air temperature(0C)
2011	28
2012	25.5
2013	4.7
2014	1.05
2015	26

Source: Centre for Atmospheric Research (CAR) – NATIONAL SPACE RESEARCH AND DEVELOPMENT AGENCY (NASRDA) KOGI STATE UNIVERSITY CAMPUS 2016

To put this into perspective, for each 1 degree of temperature increase, grain yields decline by about 5 percent. Maize, wheat and other major crops have experienced significant yield reduction of 40 mega tones per years in sub -

Saharan African due to warmer climate. Many staple food in the region, cannot adapt quickly enough to changing weather resulting in lower yield. Fish – a key source of protein for billions – have not only been depleted by industrial harvesting but are migrating as oceans warm and coral reefs die.

Table 4: Monthly Soil Moisture (VW) 2011-2015

Monthly Soil moisture(VW)	2011	2012	2013	2014	2015
JANUARY	0.07	0.07	0.1	968	969.13
FEBUARY	0.1	0.12	0.1	967	966.1
MARCH	0.08	0.1	0.11	966.7	966.7
APRIL	0.07	0.1	0.12	967	967.7
MAY	0.09	0.1	0.36	969.1	961
JUNE	0.1	0.12	0.13	969	951.1
JULY	0.11	0.12	0.14	968	962
AUGUST	0.12	0.14	0.121	971	967
SEPTEMBER	0.13	0.2	0.16	970.55	961
OCTOBER	0.12	0.15	0.13	969	911.1
NOVEMBER	0.1	0.1	0.01	968.3	912.2
DECEMBER	0.07	0.07	0.07	968.5	923.1
AVERAGE	0.096667	0.115833	0.12925	968.5125	951.5108

Source: Centre for Atmospheric Research (CAR) – NATIONAL SPACE RESEARCH AND DEVELOPMENT AGENCY (NASRDA) KOGI STATE UNIVERSITY CAMPUS 2016

Table 4 revealed the amount of soil moisture in volume/weight. There is a drastic increase in mean annual soil moisture in volume/weight starting from 2013 – 2015. This could be largely attributed to increase in the amount of mean annual rainfall. The implications of the above is that each crop in each zone required certain amount of soil moisture that is why they are grown along certain belt. However, situation that arise leading to increase in the soil moisture content of the zone invariable affect crop yield pest and diseases and food security.

Table 4.1: Annual Soil Moisture (VM) 2011-2015

Years	Soil moisture(VW)
2011	0.096
2012	0.12
2013	0.12
2014	0.916
2015	0.95

Source: Centre for Atmospheric Research (CAR) – NATIONAL SPACE RESEARCH AND DEVELOPMENT AGENCY (NASRDA) KOGI STATE UNIVERSITY CAMPUS 2016

Fig 6: Line Graph Showing Soil Moisture Variability from Year 2011-2015

The above line graph shows an increase in the mean annual soil moisture (VW) due to the changing weather.

SURMMARY TABLE; RAINFALL, AIR TEMPERATURE AND SOIL MOISTURE

Years	2011	2012	2013	2014	2015
Air temperature	25.68	25.6	4.8	1.05	26
soil moisture	0.097	0.115	0.129	0.968	0.95
Rainfall	0.0137	0.06	-0.02	0.16	0.113

SOURCE: Centre for Atmospheric Research (CAR) – NATIONAL SPACE RESEARCH AND DEVELOPMENT AGENCY (NASRDA) KOGI STATE UNIVERSITY CAMPUS 2016

CONCLUSION

The impact of global warming on food security and sustainable development as revealed by findings in this paper include the rise in mean month Air temperature for the month of April by 1.11°C surpassing the base line record in 1951 – 1980, many staple crops could no longer adapt to changing weather resulting in low yield.

Severe draughts are witness in the other part of Northern Nigeria, Niger, Mauritania, Gambia, Burkina Faso, Sudan. These areas are drifting to aridity due to global warming.

The outbreak of crop pest and disease such as stem borers and Tuta Absoluta that destroyed hundreds of hectares of maize and tomatoes farm in Northern Nigeria is attributed to warming claim. The Coasta area of Nigeria witnessed severe flooding as farmland are ravaged and submerged by flooding (fig 4)

Areas in the hinterland such as Jigawa, Niger, Lokoja, Makurdi also witness severe flooding (fig 5.) due to rise in sea level occasioned by global warming.

Source: Author's field work 2016

Fig 5: Makurdi Flooding

RECOMMENDATION

The following recommendations were put forward toward achieving food security in the sub-region. Nigerian farmers should be encouraged to increase the area of irrigated land to compliment rain-fed agriculture. While government provides irrigation facilities at subsidize price. This will ensure that crops are produced both during rainy and dry season.

- Hybrid crops that are drought resistant should be developed.
- There is need to protect and conserve the environment for sustainable food security. These methods include legislation against bush burning, Afforestation and sustainable farming practice, reducing gas flaring.
- The water Basin Development Authorities should be revitalized to increase food production in order to meet the local demand. The Lake Chad Water Basin Authority which comprises country like Nigeria, Niger, Chad and Cameroon should be developed and well founded for the purpose of irrigation agriculture, fishing, ecological preservation in achieving sustainable development.
- The use of clean alternative energy sources such as: solar, wind, hydro energy and converting waste to energy.
- China and United State of America, the highest contributor of green house gases should come up with policy framework to assist African developing countries on adaptive and mitigating measure toward global warming and climate change.

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