

Impacts of Climate Change on Crop Production in Rivers State, Nigeria

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Abstract: Climate change impact on crop production is a global issue that is contributing to food insecurity, crop farmers in Rivers State are finding it difficult to meet the food demand of the teeming population in the state due to climate change impact. This paper x-rays the impacts of climate change impact on crop production in the state, these include low productivity, loss of biodiversity, breed of conflict or communal crisis, causes displacement of farming communities amongst others. However, to meet up the food demand and also sustenance of rural economy which is dependent on farming, different climate change mitigation and adaptation measures were suggested as way forward for crop farmers in the state.

Keywords: Climate change, adaptation, mitigation and impact.

I. INTRODUCTION

The world has so far suffered and experienced rapid climate changes in terms of different environmental problems such as floods, erosions, tsunamis and earthquakes. These environmental problems influence the production of healthy, safe and affordable food, fibre, and fuel. These environmental problems constitute threat and to global ecological systems which is known as climate change. Climate change refers to changes beyond the average atmospheric condition that are caused both by natural factors such as the orbit of earth's revolution, volcanic activities and crustal movements and by artificial factors such as the increase in the concentration of greenhouse gases and aerosol. The aftermath of climate change is been felt today in all facet of human livelihood, most especially those livelihoods that depend on land and water, which agriculture is one of them. Agriculture both contributes to and is a victim of climate change, the use of chemical fertilizers, pesticides, and animal wastes in agricultural activities accounts for about 30% of all greenhouse gas emissions. This rate will undoubtedly continue to climb because to the rising global population's increased food need, as well as the increased demand for dairy and meat products and the intensification of agricultural processes. Agricultural processes contribute to multiple climate pollutants (greenhouse gases which include nitrous oxide (N₂O), carbon dioxide (CO₂) and methane (CH₄), which causes climate change and global warming and significant impact on the sustainability of food production.

Humans have a basic need for food, and maintaining a good diet is important for maintaining our welfare. To fulfil our growing demand for food, a sophisticated and increasingly globalized manufacturing and transportation system emerged.

Our food is produced, stored, processed, packaged, delivered, prepared, and served before it reaches our plates. Food supply emits greenhouse gases into the atmosphere at every stage. Methane and nitrous oxide, two potent greenhouse gases, are released in substantial amounts by agriculture in particular following the application of urea and lime; a tiny quantity of CO₂ emissions is produced directly from agricultural production, but these sources account for a very small percentage of global CO₂ emissions. Vermeulen et al (2012), observed that energy-use CO₂ from either agricultural operation (such as tractor fuel) or embedded in inputs (such as the manufacture and transportation of fertilizer) can also be included as food system emissions. In the IPCC (Intergovernmental Panel on Climate Change) accounting framework, these emissions are classified as energy or transport emissions.

However, the implications of the changing climate on agricultural productivity are widespread and are anticipated to pose a future threat to food security. Global food security relies on both sufficient food production and food access. Food security can be attained when everyone, at all times, has physical and economic access to enough food that is wholesome, safe, and meets their dietary needs and food preferences for an active and healthy life. Today food security globally is truncated by food access, many people all over the world lack access to food due to food insecurity occasioned by poor crop production due to climate change.

In Rivers State, agriculture is among the traditional occupation of the people, they engage in farming, fishing, fruit gathering, and so on. Fishing is well known occupation of the coastal communities (riverine areas) while crop farming is the occupation of the upland communities.

crop production is directly linked to a major determinant of food production, it is crucial to understand and quantify the response of major land base food sources crops like cassava, cucumber, okro, yam, water yam and maize to rapid changes in environmental conditions to feed the ever-increasing population of the State and the World at large.

Climate change is the most serious environmental threat to the fight against hunger, malnutrition, disease and poverty in Africa, mainly through its impact on agricultural productivity. According to Udulor cited in Ezechinnah (2019), global interest on climate change and the predicament of the environment,

especially in the face of prevailing mass poverty, disease, malnutrition, hunger, population growth, unemployment and pollution of air, land and water has made it compelling for most countries of the world to embrace possible adaptive strategies as a precondition for environmental quality. Climate change which refers to the average increase in global temperature, has become a megatrend that will lead to significant global changes in the future. Concerning its impacts, the United Nations' Intergovernmental Panel on Climate Change (IPCC) presented considerable scientific evidences in its fourth report on climate change (2007) and they have become clearly recognized worldwide. In addition, people have become more aware of the fact that global warming cannot be avoided due to the continued increase in greenhouse gas emissions and the changes in the climate system.

Global warming not only causes a change in temperature and precipitation but also increase the frequency of floods, droughts, heat waves, and the intensity of typhoons and hurricanes following the change in temperature and precipitation patterns. The impacts of climate change are also shown in various other forms throughout the world, including the rise of sea level, decrease in glaciers, northward movement of plant habitats, changes in animal habitats, rise of ocean temperature, shortened winter and early arrival of spring. Indeed, most efforts made by the Nigerian government and non-governmental organizations (NGOs) have failed woefully to address certain environmental issues that require urgent attention. This is largely so because the crusade for environmental quality is being focused more on the environmental front, such as environmental sanitation exercises, clean-up campaigns, seminars, workshops and other mundane activities which merely attack the symptoms rather than the problems. Other measures to control erosion, desertification and so on have not yielded significant success.

Floods due to heavy rains are being experienced particularly in Southern parts of Nigeria in the years 2011, 2011 and 2019 (Ezechinnah, 2019). For example, in Rivers State, the floods that occurred between July and September 2012 led to the destruction of lives and infrastructure, lots of people were displaced and hectares of farm lands were submerged. Those who were affected lived in displacement camps for about three months. Drought has led to the shrinking of Lake Chad which has also led to a reduction of land for cultivation and grazing (Fagbohun, 2010). Due to climate change, temperature is high and it is in higher temperatures that most diseases thrive as stated by (USEPA, 2014).

The agricultural sector contributes some percentage of the Nigerian Gross National Product (GNP) and majority of the rural populace are employed in this sector. The dominant role of agriculture makes it obvious that even minor climate deteriorations can cause devastating socioeconomic consequences. Sufficient food production is among the principal challenges facing many developing countries. Farmers especially in Rivers State this year 2022, are experiencing an irregular rainfall which affects the growth of agricultural products, examples are maize, okra, vegetables,

cucumber, garden eggs among others, new diseases such as molds, nematodes scabs are appearing on vegetables at an alarming rate that is difficult to classify.

As the acceleration of global warming affects not only ecological systems but also human life, it has become an important issue both nationally and internationally. Approaches to deal with the issue of global warming are divided largely into mitigation measures, focusing on reduction and absorption of greenhouse gases, the causative factors, and adaptation measures to minimize the damages by climate change. So far, the global warming issue has focused on the mitigation of greenhouse gases based on international environmental conventions such as IPCC and Kyoto Protocol. For agriculture, however, the focus has been shifted to adaptation and adaptability based on the assessment of the impacts of climate change and vulnerability to it. IPCC emphasizes that it is very important for the agricultural sector to adapt to climate change. This is because even if greenhouse gas emissions decrease, global warming will still continue for the next several decades due to its previously emitted greenhouse gases.

It takes at least five (5) to ten (10) years to assess the impacts of climate change and the vulnerability to it and prepare proper countermeasures against it. Especially, as agriculture is climate-dependent and thus susceptible to climate change, it is very urgent to prepare adaptation measures against climate change.

II. CONCEPTUAL REVIEW

Climate Change

Climate change refers to a change in the state of the climate that can be identified by changes in the average and/or the variability of its properties, example is temperature, precipitation amongst others and that persists for an extended period, typically decades or longer, (Flint, 2013). It varies from place to place depending on latitude, distance from sea, vegetation and terrain characteristics as it pertains to the presence or absence of mountains. It also varies in time from season, year to year, decade to decade and on longer time scales which extends to millions of years, (McCaffery, 2010). He further explained that climate system consists of the atmosphere (air), the hydrosphere (water bodies), the biosphere (living organism), the lithosphere (land), the cryosphere (ice and snow), and how these components of the climate system interact with one another under the influence of solar energy. Mbalisi and Nzokuru, cited in Ezechinnah, (2019), pointed out that the climate of a place depends on the following factors:

1. The amount of solar energy received by the climate system which depends on the solar output, the extent of the radiation losses in space before reaching the earth's atmosphere, the distance of the earth from the sun and the angle of tilt of the earth's axis of rotation
2. The way this energy is distributed and absorbed over the earth's surface which depends on the earth's atmospheric composition, its topography, the extent of

ice and snow cover and the distribution of continents and oceans and

3. The nature of the interaction between the components which make up the global climate system.

The problems of rapid increase in population, climate change and pressure on resources are major constraints to adequate agricultural production. Among the three, climate change is the most pressing challenges that the world faces today. Climate change is a defining phenomenon of the century. Given current atmospheric concentrations of Greenhouse Gases (GHGs), the world is already committed to significant warming. This is a serious challenge, given the wide range of expected climate impacts on natural systems, as well as on human societies, as assessed in the most recent report of the Intergovernmental Panel on Climate Change. The concept of climate change has become an important environmental, social and economic issue. It is also referred to as any significant change in measures of climate (such as temperature, precipitation, or wind) lasting for an extended period (decades or longer). IPCC, (2007). Climate change is an observed change in the climatic elements of a country or region from 30 years upward which has been statistically proven. It is an unprecedented challenge every nation is facing and its impacts over the past decades are tending towards global warming indicating that an urgent action needs to be taken towards preparedness and adaptation (Lefort et al., (2015). Climate change threatens to undermine the progress that has been achieved to date, especially in the agricultural sector.

Crop production is carried out through the selection of crops suitable for the climate of a specific area or region and application of proper farming methods. Therefore, agriculture is a climate dependent bio-industry with notable characteristics. Climate change disturbs the agricultural ecosystem, resulting in the change in agricultural climatic elements such as temperature, precipitation, and sunlight, while further influencing the arable, livestock, and hydrology sectors. The impacts of climate change on the arable and livestock sector are made

known by biological changes including the change of flowering and harvesting seasons, quality

change, and shift of areas suitable for cultivation. Most local farmers are aware that the stress on their local environment and livelihoods has increased and low capacity for adaptation is a serious issue. Adaptation generally is primarily tailored towards agricultural productions principally through irrigation and planting crop resistant species. Poverty, more than any other factor, determines vulnerability to climate change and limits adaptive capacity.

Rivers State like many other states in Nigeria largely lacks the infrastructure necessary to respond adequately to climate change. Emohua, Ahoada West, Ogba Egbema Local Government Areas are among the twenty-three (23) Local Government Areas of Rivers State whose dwellers are predominantly farmers and are suffering from the drastic negative effects of climate change. Agriculture is one of the

most significant economic sectors in Nigeria, but it is also one of the most sensitive to climate change. This is due to its significance in maintaining livelihoods, creating jobs, and reducing poverty. Additionally, it assures the supply of food and fuel and promotes economic growth. Despite the fact that the country heavily depends on the oil industry for its budgetary revenues, the majority of the population in the study area engages in subsistence agriculture. The majority of households in Rivers State still rely heavily on agriculture, which also represents a sizable portion of Nigeria's economy. It is impossible to overstate the importance of the agricultural sector to Nigeria's economy because it drives the production of food, contributes to the GDP, creates jobs, provides raw materials for agro-allied industries, and generates foreign income. Because of their reliance on rain-fed agriculture, high levels of poverty, low levels of human and physical capital, poor infrastructure, pollution from oil companies, and lack of technology, Rivers State, which is located in the Niger Delta region of Nigeria, is particularly vulnerable to climate change (IPCC, 2007). The last two decades' worth of rainfall exhibits positive and negative anomalies that line up with the wet/flood years noted in Nigeria. Low returns on agricultural investments as a result of these changes in crop output have an impact on food security. Human life, health, and wellbeing depend on food. Since these two crops provide almost 40% of the food consumed in this region, it is crucial to investigate how climate change may affect them (Nwaiwu et al., 2014).

Crop production takes a significant aspect of agricultural production and exports in Nigeria. Generally, there are many factors influencing crop production and these include soil, relief, climate and diseases among others. In relation to climate, rainfall is one of the dominant controlling variables in tropical agriculture since it supplies soil moisture for crops. Nigeria's wide range of climate variation allows it to produce a wide variety of food and cash crops (Tunde et al., 2011). In Nigeria, the climate is a valuable resource for crop production, especially in the rainforest region where farmers heavily rely on rain for agriculture. According to studies, climate change adversely affects agriculture in Africa (McCarthy et al., 2001; Onyeneke, 2010), and adaptation is one of the policy options for lessening the adverse effects of climate change (Adger et al., 2011). The climatic changes have affected the crop productivity level and agricultural harvests by the farmers in these Local Government Areas.

Climate Change and Crop Production

Climate change affects the agricultural ecosystem, giving rise to blights and pests and causing population movement and change in biodiversity. Land-based food sources are drastically affected by climate change, crops need suitable soil, water, sunlight, and heat to grow. Warmer air temperatures have already affected the length of the growing season. Changes in temperatures and growing seasons also affect the proliferation and the spreading of some species, such as insects, invasive weeds, or diseases, all of which might in turn affect crop yields. Climate change affects the hydrology including underground water level, water temperature, river flow, and water quality of

lakes and marshes, by impacting precipitation, evaporation, and soil moisture content. In particular, the increase of precipitation by climate change leads to an increase of outflow while the temperature rise increases evaporation, resulting in the reduction of outflow and soil nutrient.

Producing more food out of the land that is already used for agriculture often requires heavier use of nitrogen-based fertilisers, which in turn release nitrous oxide emissions and contribute to climate change. Intensive fertiliser usage also releases nitrates to the soil and to water bodies. Although not directly linked to climate change, high concentrations of nutrients (especially phosphates and nitrates) in water bodies cause eutrophication. Eutrophication promotes algae growth and depletes oxygen in the water, which in turn has severe impacts on aquatic life and water quality. The changing climate is having far reaching impacts on agricultural production, which are likely to challenge food security in the future. The continuous negative impact of climate change on crop production is likely to lead to food insecurity in the future, by increasing food prices, and reducing food production. Food may become more expensive as climate change mitigation efforts increase energy prices. Water required for food production may become scarcer due to increased crop water use and drought. Competition for land may increase as certain areas become climatically unsuitable for production.

In addition, extreme weather events, associated with climate change may cause sudden reductions in agricultural productivity, leading to rapid price increases. These rising prices may force growing numbers of local people into poverty, providing a sobering demonstration of how the influence of climate change can result in food insecurity. This is in support of Eregha, Babatolu & Akinnubi (2014) assertion that with the growing population, food production could not keep up. So, there is a connection between climate change and food shortage. These days, the twin evils of food hunger and climate change have been recognized as pressing global issues. This is due to the threat that the emergence of climate variability poses to food security, which is primarily dependent on agriculture. Agriculture is one of the most vulnerable sectors to this threat. For instance, in Nigeria, crop production accounts for more than 48% of the non-oil GDP and more than 80% of the country's agricultural GDP (CBN, 2011). According to Ayinde, Muchie, and Olatunji (2011), climate change is seriously endangering and stressing Nigeria's agricultural sector. Babatunde, Eregha, and Akinnubi (2014) suggested that food security and rural subsistence in Nigeria are seriously threatened because crop production accounts for a sizable portion of the country's agricultural activity. But as the population grew, food production could not keep up. So, there is a connection between climate change and food shortage. These days, the twin evils of food hunger and climate change have been recognized as pressing global issues. This is due to the threat that the advent of climate variability poses to food security, which is mostly dependent on agriculture and is one of the most vulnerable industries. reduced crop quantity and quality due to the reduced growth period following high levels

of temperature rise; reduced sugar content, bad coloration, and reduced storage stability in fruits; increase of weeds, blights, and harmful insects in agricultural crops; reduced land fertility due to the accelerated decomposition of organic substances; and increased soil erosion due to the increased rainfall. Ezeala in Ezechinnah, (2019) identified the impacts of climate change on crop production to include:

Low productivity: A decrease in agricultural crop production is a result of climate change; crops that are planted during droughts and periods of heavy rain produce poorly. During times of drought, the number of insects, pests, and diseases that affect crops increases.

Loss in biodiversity: Biodiversity refers to the variety of plant and animal life in a specific habitat. Some of them might become extinct if they are not adequately managed. Biodiversity will be lost or reduced as a result of climate change. Rainfall has increased as a result of climate change. Desertification is caused by increased spring runoff, drought, soil erosion, and landslides. The loss of animal habitat and plant species that results from the removal of forest cover directly impacts biodiversity. Along with some significant wildlife species, some medicinal plants have become extinct.

Conflict/communal crisis: The Fulani herdsmen have fled their parched grazing lands due to desertification in search of nourishment for their livestock. Due to the disputes that have resulted, certain farmlands have been destroyed, making it difficult for farmers to access their land, as was the situation in some villages in Emohua Local Government Area of Rivers State in. Farmers and the roving Hausa/Fulani herdsmen engage in pitched battles. There have been reports of clashes between farmers and herdsmen in Oyigbo, Rivers State, in the past, as a result of the herdsmen's cows eating crops that some farmers in this Local Government Area had planted.

Displacement of farming communities: Common effects of climate change include rainfall, sea level rise, flooding, and other extreme weather occurrences. A torrential downpour can cause flooding, which has frequently flooded farmlands in Rivers State. Communities that depend on farming for a living, such as Ngene, Oboburu, Rundele, Ibaa, and Rumuji in the local government areas of Emohua, Ahoada West, and Ogba Egbema, respectively, have been forced to relocate owing to severe flooding and erosion.

Outbreak of climate-related diseases: continue rise in global temperature will lead to birth of different diseases such hookworm, polio, hepatitis B, and malaria among the farmers who are displaced by flood, drought, erosion, and so on.

Natural disaster: Extreme weather conditions result in other natural disasters such as forest fire, hurricane, extreme rainfall, storms, tornadoes, cyclone, desertification and drought

Unemployment in agricultural sector of the economy: farmers whose farmland has been submerged by flood or other climate change related environmental problems will be faced with unemployment.

Loss in Gross National Product (GNP) and Gross Domestic Product (GDP) of the country: Nearly 94% of Nigeria's agricultural economy is made up of crops, and some regions have already noticed a 20% reduction in the number of growing due to climate change impact. For example, temperature increases hinder the growth of rice, millet, guinea corn, and maize. For individuals without access to refrigerators, warming trends make it harder to store vegetables and root crops. The time and amount of rainfall will vary more frequently, which will have a negative effect on agriculture. Water shortages may also affect animal and crop production, reducing food production, thus leading to reduction in GDP and GNP which are partly dependent on crop production.

In northern Nigeria, a change in crop cultivation has been brought on by climate change. Guinea corn, groundnuts, and maize were the farmers' favourite crops, but as a result of rising temperatures and changing rainfall patterns brought on by climate change, the farmers began producing millet in 2007 before switching to maize and beans. The shrinkage of arable lands in Nigeria is another significant issue for agriculture caused by climate change. While the sea's intrusion is reducing the amount of arable land in coastal plains, the desert's invasion and the accompanying sand dunes are robbing farmers of their farmland and grazing lands.

III. THE WAY FORWARD

Since crop production is crucial to food security in Rivers State and also for the sustainability of farmers household means of livelihood, farmers should take some mitigation and adaptation measures to limit the impact of climate change on their crop and productivity. Mitigation of climate change involves taking steps to lower greenhouse gas emissions or increase their ability to be absorbed into the atmosphere. Mitigating climate change impact on crop requires directing attention to the reduction of green house gasses (GHGs). Some of methods for reducing GHG emissions on crop production requires emissions reduction; emissions avoidance or displacement, and the development of emission sinks. Mitigation must be viewed in light of the choices made by farmers. It will be a side benefit for the majority of farmers while also boosting agricultural productivity in a climate-smart way. In IPCC (2007) it was observed that improving soil carbon storage, maintaining soil carbon that already exists, and reducing carbon dioxide, methane, and nitrous oxide emissions are number of farming techniques and technologies can lower GHG emissions and stop climate change.

Adaptation is another way forward for crop farmers to combat the impact of climate change, locally farmers have been practising different adaptive measures such as intercropping. Bello, Wahab, Ganiyu, Azeez, et al (2012) pointed out that farmers in an attempt to save their crops from climate change impact, practice the following mitigation and adaptation strategies, which include:

1. Organic systems of production increase soil organic matter levels through the use of composted animal manures and cover crops. Organic cropping systems

- also eliminate the emissions from the production and transportation of synthetic fertilizers;
2. Conservation farming such as usage of higher yielding crops or varieties;
3. Land restoration and land use changes that encourage the conservation and improvement of soil, water and air quality typically reduce greenhouse gas emissions.;
4. Improvements in water use efficiency, through measures such as irrigation system;
5. Improving fertilizer efficiency through practices like precision farming tracking system and use of cover crops and manures (both green and animal), nitrogen-fixing crop rotations, composting and compost teas, and integrated pest management
6. Agriculture methane collection and combustion systems;
7. Farmers grow more biofuels feedstock;
8. Soil carbon sequestration;
9. Usage of renewable and sustainable energy; and
10. Tree planting within the cities

In support of this, Alawa, Asogwa & Ikelus (2014) asserted that measures which could enhance the mitigation of climate change and encourage the crop production to include carbon sequestration, use of bio-energy, farm level mitigation approaches, livestock and manure management, fertilizer management, avoidance of bush burning and deforestation, and adoption of appropriate tillage practices. However, for all people in Rivers State and beyond to have physical and economic access to sufficient, safe and nutritious food crop to meet their dietary needs and active and healthy life, farmers in the state must practices different climate change adaptation and mitigation measures.

IV. CONCLUSION

Crop farmers in Rivers State is unlikely to meet future demand of food accessibility by teaming population in the state with the present climate change impact on crop production in the state unless they intensify effort toward adopting appropriate climate change mitigation and adaptation strategies in their localities, this will promote food security and rural subsistence in the state.

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