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Assessment of Impact of Climate Change on the Economy of Southeast Nigeria

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ABSTRACT: This study examines the impact of climate change on the economy of southeast Nigeria. Through a descriptive survey framework, the research focuses on three specific objectives: assessing climate change's effect on food production, analyzing its impact on transportation revenues, and evaluating the financial losses due to climate-induced crises. Utilizing multi-stage sampling, data was collected from 200 respondents using structured questionnaires. The analysis centers on mean and standard deviation statistics to unveil the far-reaching effects of climate change on the region's economy. The study's findings indicate that climate change has significantly harmed agricultural activities in southeast Nigeria. Crop yields have been negatively affected, leading to reduced food production and insecurity. Moreover, the transportation sector has experienced a considerable drop in revenues due to climate-induced challenges. These impacts have inflicted financial losses on the region, exacerbating economic hardships. As a result of climate change, the Southeastern region has experienced substantial revenue losses, affecting government income and investments. The resulting economic downturn has also translated into job losses, affecting individuals and communities. The cumulative effect has pushed more people into poverty, threatening the overall stability of the region's economy. As a response, the study proposes collaborative efforts among Southeastern states, through the Southeast Governor's Forum, to develop comprehensive policies and action plans to combat climate change in the region.

I. INTRODUCTION

Climate change, as defined by the Intergovernmental Panel on Climate Change [1] refers to a prolonged statistical variation lasting for a decade or more. It encompasses changes in sporadic weather events' frequency and magnitude and a gradual rise in the global average surface temperature. The German Advisory Council on Global Change [2] acknowledges climate change as a threat affecting both developed and developing countries, albeit with varying degrees of impact.

Developed countries have shown better resilience to climate change due to their natural advantages, high adaptation techniques, advanced technology, mechanized agricultural systems, and wealth status. In contrast, developing countries like Nigeria face more significant challenges given higher temperatures, limited adaptation capacity, and the absence of early warning systems.

One major economic area affected by climate change is agriculture, particularly in developing countries. Studies [3] indicate that climate change could lead to substantial reductions in agricultural productivity. The distribution of rainfall and temperature changes throughout the year plays a crucial role in determining crop yields, especially for rain-fed crops. Excessive rainfall can damage arable land, impair cultivated crops, and lead to post-harvest losses, while reduced rainfall can result in water scarcity, necessitating time-consuming irrigation practices and ultimately reducing crop yields.

Livestock production also suffers from climate change impacts, with reduced available pasture land, surface water scarcity, increased salinity, and evaporation due to higher temperatures. This results in decreased livestock production, leading to reduced supply and availability of animal protein and other animal produce.

Given these challenges, Nigeria has recognized the urgency of addressing climate change impacts. The Southeast region, affected by recent flooding and natural disasters, needs a comprehensive assessment of climate change's role in these problems and their subsequent effects on the economy. With many people in the region relying on agriculture for their livelihoods, climate change poses a severe threat to the agricultural sector, which serves as the foundation of the Southeastern economy.

Despite the clear significance of climate change on the region's economy, there remains a lack of a distinct connection. Therefore, this study is essential and timely, as it aims to examine the impact of climate change on Southeast Nigeria's



economy, providing valuable insights into the challenges faced by the region and its potential implications for the future.

II. REVIEW OF RELATED LITERATURE

2.1 The Relationship between Climate Change and the Economy with a Focus on Southeast Nigeria

[4] Posit that the environment encompasses all external conditions that influence the development of living organisms. This includes all circumstances, objects, or conditions surrounding a living organism, indicating that the environment comprises everything outside of human beings themselves. Similarly, [5] define the environment as the physical space and surroundings in which humans reside, encompassing all living organisms, air, water, soil, and other essential resources to sustain life. In essence, anything outside of humanity constitutes the environment. Throughout history, mankind's quest for survival and pursuit of an ever-increasing range of needs and desires have driven alterations in the environment, a phenomenon exacerbated by population growth and technological advancements. These human activities have led to changes in the natural environment, making it increasingly difficult to define or comprehend. Conversely, the environment, in turn, exerts influence on human beings and their activities, resulting in a reciprocal relationship between man and his surroundings. Despite the changing environment, humans have shown resilience by developing adaptive measures to continue thriving, as exemplified by adjusting agricultural practices in response to shifting environmental conditions.

An understanding of climate change commences with an appreciation of the term "climate," which originates from the Greek word "klinein," signifying "slope." This refers to the variation in the angle at which the sun's rays strike the Earth across different regions [6], leading to distinct climates in different areas of the world. The concept of "weather" is closely related to climate, as both are determined by the angle at which sunlight sustains on the Earth, affecting atmospheric conditions such as temperature, pressure, wind, precipitation, humidity, and sunshine [7]. The key distinction lies in the temporal and spatial scale of measurement: weather pertains to short-term conditions measured in hours, days, or weeks, whereas climate encompasses long-term trends measured over years and even millions of years [7], [6].

The present state of the Nigerian economy is a cause for concern not only for Nigerians and the Nigerian government but also for concerned foreign governments and donor agencies. As indicated by the Human Development Index (HDI) report of 2019, Nigeria ranks among the 48 least developed countries globally, with a combined Gross Domestic Product (GDP) that falls significantly short of the assets owned by the three wealthiest individuals in the world. This decline is starkly contrasted with Nigeria's status as one of the wealthiest fifty countries in the early 1970s, only to regress and become one of the 25 poorest nations by the turn of the twenty-first century, thus earning the unfortunate title of "world capital of poverty" [8]. Paradoxically, Nigeria is the sixth-largest producer and exporter of crude oil, yet it finds itself classified among the world's most impoverished nations and holds the position of the most populous country in Africa [9]. Statistical data further illustrates a fluctuating trend in poverty incidence, using a benchmark of one US dollar (USD1) per day, which has now become an understatement. A larger proportion of Nigerians currently live well below this benchmark [10], indicating a worsening situation. Available records from the National Bureau of Statistics (NBS) and other international economic data repositories reveal Nigeria's poor performance across various developmental indices, except for population growth rate, which is projected to reach a staggering 300 million by the end of this century. Moreover, the annual percentage growth of GDP has experienced a sharp downward trend, hovering at 1.9% in 2018, a stark contrast to neighboring countries like Ghana (4.3%) and Egypt (4.6%) [11].

The economy of Southeast Nigeria faces further challenges if effective measures are not taken to mitigate the impacts of climate change. The region has already witnessed the displacement of numerous people due to flooding, leading to significant job losses and economic setbacks. Agriculture and entrepreneurship predominantly drive the economy of the Southeast region, making it particularly vulnerable to the adverse effects of climate change. Consequently, many businesses in the area are grappling with various challenges arising from climate change.

As climate change continues to exert its influence on the environment, its repercussions on economies, such as Nigeria's, are becoming increasingly apparent. Addressing these challenges necessitates strategic interventions to safeguard vital sectors like agriculture and entrepreneurship. By recognizing the reciprocal relationship between man and his environment and embracing adaptive measures, nations can strive to navigate the complexities of climate change and foster sustainable economic growth and development. In this context, the plight of Southeast Nigeria serves as a pertinent example of the urgent need for proactive approaches to address climate change's impact on regional economies.



2.2 Empirical Review

Ogbuabor and Egwuchukwu [12] conducted a study titled "The Impact of Climate Change on the Nigerian Economy" to examine how climate change affects the overall growth of the Nigerian economy. The researchers employed the ordinary least squares (OLS) estimation technique and utilized data spanning the period from 1981 to 2014. Climate change was represented by changes in annual rainfall, carbon emissions, and forest depletion, while control variables included changes in government expenditure, domestic private investment, and the exchange rate. The study's findings revealed that both in the long-run and short-run, carbon emissions have an adverse impact on economic growth. Furthermore, forest depletion was found to have a negative effect on growth in the short-run.

Akuwudike, Mac-ozigbo, and Igbokwe-Ibeto [11] conducted a study titled "Climate Change Impact on Business Opportunities in Southeast Nigeria" with the aim of highlighting the effects of climate change on small and medium-scale enterprises (SMEs) in the Southeast region of Nigeria. Employing a descriptive research design, the study gathered data through online interviews with 500 respondents. The results indicated that the impact of climate change influenced the establishment of new businesses, particularly in the renewable energy subsector, where respondents reported the creation of businesses focused on solar energy as an alternative to hydrocarbons. Other ventures included repair works, tree planting projects, embankment projects to prevent river banks and water bodies from causing flooding, fumigation services to disinfect flooded or contaminated environments and curb the spread of diseases like the recent COVID-19 pandemic.

In their study titled "Reviewing the Links between Climate Change and Resource Conflict," Abugu, Yero, Odele, and Amahagbor [8] sought to establish the nuanced connection between climate change and conflicts in Nigeria, with a particular focus on farmer-herder conflicts. The researchers employed a literature review methodology, analyzing existing literature that links climate change to resource conflicts. The selected literature covered the period from the late 1990s to 2021. The findings revealed a consensus that climate change does influence resource conflicts. However, the authors also noted that climate change may not directly cause resource conflicts but rather impact other factors affecting resource availability, accessibility, and utilization, making resource conflict a secondary or tertiary effect of climate change.

Durodola [13] conducted a study titled "The Impact of Climate Change-Induced Extreme Events on Agriculture and Food Security: A Review on Nigeria's Agricultural Sciences," which focused on reviewing the effects of extreme events, such as floods and droughts, caused by climate change on agriculture and food security in Nigeria. The researcher identified relevant literature through electronic and non-electronic databases, encompassing research on climate change's effects on agricultural productivity. The review highlighted the significant impact of extreme events, such as droughts and floods, on agriculture and food security.

Tarfa et al. [14] conducted a study titled "Climate Change Perception and Adaptation in Nigeria's Guinea Savanna: Empirical Evidence from Farmers in Nasarawa State, Nigeria." The researchers aimed to analyze farmers' perception of climate change, comparing it with meteorological data, and identify the factors influencing farmers' adaptation efforts in the Nasarawa State region of Nigeria. The study combined time-series data on climatic variables from a weather station with cross-sectional data from 160 smallholder farmers in the area. Analytical methods such as descriptive statistics, trend analysis, and the multivariate probit model were employed to analyze the collected data. The study revealed a reduction in rainfall volume and a significant increase in surface temperature, confirming farmers' firm perception of these climate changes.

III. METHODOLOGY

3.1 Area of the Study

The study was conducted in Southeast Nigeria, an area characterized by its tropical rainforest nature. Geographically, the zone spans latitudes 5°N to 6°N of the equator and longitudes 6°E and 8°E of the Greenwich meridian [15]. The region experiences a mean maximum temperature of 27°C, and its total annual rainfall exceeds 2500 mm [16]. Covering a land mass of 10,952,400 hectares, the zone is home to a population of approximately 16,381,729 people [17]. In Southeast Nigeria, two major seasons are observed: the Dry season, which occurs between November and March, and the Rainy season, which spans from April to October. However, owing to climate change, distinguishing between these seasons has become increasingly challenging in recent decades. The region has witnessed heavy rainfall during supposed dry spells and dry conditions during seasons that typically experience abundant rains. The economy of Southeast Nigeria is predominantly agrarian, with the dense population averaging around 1000 people per square kilometer heavily reliant on land resources. The climate of the region is influenced by three major air masses: the

equatorial Maritime, the Equatorial Estuaries, and the Tropical continental air masses [18]. Notably, rainfall stands out as the key climatic variable, shaping the region's agricultural activities and overall ecological dynamics. The soil type prevailing in Southeast Nigeria is primarily loamy, favoring agricultural productivity. Moreover, the major cropping system practiced in the region is mixed cropping, as reported by [11]. The interplay of these geographical and environmental factors creates a unique and diverse ecosystem in Southeast Nigeria, making it a crucial area of study for understanding the impacts of climate change and its effects on the local population and agricultural practices.

3.2 Determination of Sample Size

The study utilized a multi-stage sampling technique to capture three categories of respondents addressing the three research questions. Category one involved purposively selecting three states from the five states in Southeast Nigeria based on their contribution to farming in the economy. These states were identified as Ebonyi, Enugu, and Anambra. In the second stage, the most viable Agricultural Zones were chosen from each state, resulting in three Agricultural zones for the study: Enugu North in Enugu state, Anambra North in Anambra state, and Ebonyi South in Ebonyi state. From each of these zones, one local government area was randomly selected, leading to the selection of three local government areas: Uzo-Uwani from Enugu North, Ayamelum from Anambra North, and Ohaozara from Ebonyi South. In the fourth stage, two communities were purposively selected from each of these three local government areas, resulting in a total of 6 communities. The selection was based on the fact that agriculture, the major means of livelihood and economic contribution to Southeast Nigeria, was significantly affected by climate change in these communities. Finally, two villages were sampled from each of the six communities, totaling 12 villages.

For category two, the remaining two states, Imo and Abia, were purposively sampled due to the high number of transporters moving farm produce, particularly rice, from the three states in category one to these two states. In the second stage, the state capitals, Umuahia for Abia state and Owerri for Imo state, were purposively selected. In the third stage, three motor parks were purposively selected from each of these capitals, resulting in the selection of six motor parks.

To determine the sample size for the final stages of category one and category two, the Yamene (1967) sample size determination technique was applied. This allowed for the specific number of respondents to be sampled from the villages and motor parks, respectively. The multi-stage sampling approach ensured a representative sample to address the research questions effectively.

The formula is stated thus;

$$n = \frac{N}{1 + N(e)^2} \quad (3.1)$$

where

n = sample size

N = total population under study

e = error limit (an error limit of 0.05 was used for the study).

Against this backdrop, out of the 400 farmers in the 12 villages, 200 farmers were sampled consequently, and out of 110 drivers from the ten commercial motor parks, 86 drivers were sampled.

Finally, the third category involved purposive sampling of persons considered knowledgeable and privy to the crisis occasioned by climate change in Southeast Nigeria. Against this backdrop, 10 persons were purposively selected from the five south eastern states. This sums up to 50 respondents.

Therefore, the total sample size for the study is 336 respondents. However, it is to be noted that the sample size to address research question one is 200, while the sample size to address research question two is 86 and the sample size to address research question three is 50.



IV. RESULT AND DISCUSSION

4.1 Research Question One

Table 4.1: Result of descriptive statistical analysis on research question one

RESEARCH QUESTION ONE

QST.	How does climate change affect food production in Southeast Nigeria and hence the economy?	Mean	SD
i	Farmers do not know the right planting seasons due to variation in weather.	4.00	0.00
ii	Drought has been increasing severely in the past few years.	4.00	0.00
iii	Excessive flood has destroyed many farmlands.	4.00	0.00
iv	Wild fire has destroyed many farms and plantations.	3.88	0.40
AVERAGE MEAN / SD		3.97	0.20

The research findings suggest that climate change has a significant impact on food production and the economy in Southeast Nigeria. For sub-questions i, ii, and iii, the mean scores were the highest possible value of 4.00, indicating that the respondents strongly agree that climate change affects food production through factors such as uncertain planting seasons, increasing drought, and excessive flooding. In the case of sub-question iv (wildfire impact), the mean score was 3.88, which is still relatively high but slightly lower than the maximum score. The standard deviation for this question is 0.40, indicating some variability in responses, possibly suggesting that respondents' views were not as uniform as in the other questions. Overall, the average mean of 3.97 for all the research questions further supports the notion that climate change has a substantial negative impact on food production in Southeast Nigeria, which, in turn, affects the region's economy.

4.2 Research Question Two

Table 4.5: Data Analysis on Research Question Two

RESEARCH QUESTION TWO

QST.	Does climate change affect revenue accrued from transportation in Southeast Nigeria?	Mean	SD
i	There is decline in rural to urban transportation of farm produce.	3.51	0.73
ii	Many rural roads in Southeast Nigeria are no more motorable due to excess flooding that has destroyed the roads.	3.60	0.66
iii	There is reduction in the numbers of sea foods such as fish, crayfish etc. that drivers used to transport from riverine areas.	3.52	0.76
iv	Rural to urban drivers now find it difficult to pay their taxes due to low revenue.	3.80	0.50
AVERAGE MEAN / SD		3.6075	0.67

The research findings suggest that climate change has a notable impact on the revenue accrued from transportation in Southeast Nigeria. Each sub-question received a mean score above 3.0, indicating that the respondents acknowledged the negative effects of climate change on the transportation sector. Specifically, sub-questions i, ii, iii, and iv received mean scores of 3.51, 3.60, 3.52, and 3.80, respectively. The standard deviation values for these sub-questions (ranging from 0.50 to 0.76) indicate some variability in responses, but they are still relatively moderate, suggesting a general agreement among respondents. The overall average mean for all the sub-questions is 3.60, which is above the neutral value of 3.0. This indicates that, on average, the respondents perceived climate change as negatively impacting revenue accrued from transportation in the region.



4.3 Research Question Three

Table 4.6: Data Analysis on Research Question Three

S/N RESEARCH QUESTION THREE

Does climate change causes loss of revenue in the Southeast Nigeria?		Mean	SD
i	Government and nongovernmental agencies spend huge sum of money on climate adaptation programme.	4.00	0.00
ii	Excess flooding and drought has destroyed investments in commercial farming such as rice farming, cashew plantation etc.	3.88	0.33
iii	Flooding has relinquished thousands people to internally displaced peoples' (IDP) camp.	4.00	0
iv	Herders forced Southward by climate change has destroyed many means of livelihood in Southeast.	3.62	0.67
AVERAGE MEAN / SD		3.875	0.37

The research findings suggest that climate change causes a significant loss of revenue in Southeast Nigeria. Sub-questions i and iii received the maximum possible mean score of 4.00, indicating that respondents strongly agree that climate change leads to substantial financial expenditures by the government and nongovernmental agencies for climate adaptation programs, as well as displaces people to IDP camps due to flooding. For sub-question ii, the mean score was 3.88, which is close to the maximum score, indicating that respondents believe excess flooding and drought have indeed led to the destruction of investments in commercial farming, affecting revenue generation. Sub-question iv received a mean score of 3.62, which is still above the neutral value of 3.0, suggesting that respondents agree that herders forced southward by climate change have negatively impacted means of livelihood in Southeast Nigeria. The overall average mean for all the sub-questions is 3.88, which is also above the neutral value, indicating a consensus among respondents that climate change is associated with revenue loss in the region.

V. CONCLUSION

This study delves into the significant global concern of climate change and its profound impact on the economy of Southeast Nigeria. By conducting a comprehensive review of existing literature, the research highlights the critical role climate change plays in shaping economic outcomes, prompting a focused investigation into the specific context of the Southeast region. Employing a descriptive survey approach, the study targets three distinct categories of individuals across the five states of Southeast Nigeria.

The findings of the study reveal that agriculture, a cornerstone of the Southeast Nigeria's economy and employing approximately 70% of the region's workforce, has been severely affected by climate change. One of the major consequences observed is the disruption of planting seasons, causing uncertainty among farmers regarding the appropriate time to commence their agricultural activities. Moreover, the region has experienced increased severity in droughts, leading to reduced crop yields. Additionally, excessive flooding has wreaked havoc on farmlands, plantations, poultry, and other agricultural infrastructure, leading to job losses and revenue decline.

The transportation sector has also suffered the adverse effects of climate change, particularly in the drop in rural-to-urban transportation. Factors such as reduced food production in rural areas, poor road conditions, and declining aquatic populations have contributed to this decline, impacting tax remittances for drivers who ply these routes. Consequently, the economy of Southeast Nigeria has faced negative consequences due to this distressing trend.

The study further demonstrates that the Southeast region has incurred substantial financial losses attributable to climate change. Resources that could have been allocated to capital projects and infrastructural development have been diverted to implement climate change mitigation programs. Additionally, the region has had to grapple with the consequences of increased insecurity caused by violent herdsmen migrating eastward due to extreme droughts in Northern Nigeria. This influx of herdsmen has resulted in disruptions to economic activities, negatively affecting the entire geopolitical zone. Furthermore, the region has witnessed a surge in internally displaced persons' camps, with thousands of Southeastern residents losing their livelihoods and becoming reliant on government and other donors for survival. These individuals,

who were once wealth creators, have fallen victim to excess flooding and other natural disasters induced by climate change, adding to the economic burden of the region.

In conclusion, the study unequivocally establishes the detrimental impact of climate change on the economy of Southeast Nigeria. The disruptions to agriculture, transportation, revenue, and security have posed significant challenges to the region's development and economic prosperity. As the global community grapples with the complexities of climate change, specific attention must be paid to local contexts like Southeast Nigeria, where tailored interventions and measures are essential for safeguarding livelihoods and promoting sustainable economic growth amidst a changing climate.

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