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TRENDS AND GROWTH RATES OF RAINFALL AND FISHERIES PRODUCTION IN NIGERIA (1981-2022)

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Abstract:
The study was carried out to analyze the Trends and Growth Rates of Rainfall and Fisheries Production in Nigeria. The study made use of time series data that spanned from 1981 to 2022. Data on the variables of the study were collected from the records of the Food and Agriculture Organization (FAO), National Bureau of Statistics (NBS) and World Bank database. Data for this study were analyzed using both descriptive and inferential statistics such as mean, maximum and minimum with trend graphs as well as growth model. The results of the growth rate and direction of growth showed an acceleration in fisheries production with instantaneous growth rate and compound growth rates of 4.47% and 4.57%, respectively. Similarly, the result also showed stagnation in rainfall with instantaneous and compound growth rates of 7.26% and 7.53%, respectively. Furthermore, the direction of growth of food supply showed acceleration with instantaneous and compound growth rates of 0.427% and 0.428%. The result showed an upward trend in fisheries production with the year 2021 as the highest. The study concluded that in the long run, rainfall significantly influenced fisheries production over the period under review. This emphasizes the critical importance of rainfall in driving fisheries production in Nigeria's fisheries sector. Therefore, the study recommended that there is a need to actively promote climate-resilient farming practices in the fisheries sector.

Keywords: Trend, Growth Rate, Rainfall, Fisheries, Production.

1.0 Introduction:

The agriculture industry is a vital component of the economies of Nigeria and other emerging nations. The industry employs a sizable workforce and makes a large contribution to the GDP (Tsokar, 2022). In order to increase resilience, safeguard livelihoods, and guarantee food security, adaptation to climate change is crucial for many rural communities in Nigeria that rely on agricultural production as their main source of income and employment (Agesa et al., 2019). The agricultural industry includes forestry, Livestock, fisheries, and crop production. Crop production makes up 87.6% of the major activities, with livestock (8.1%), fisheries (3.2%), and forestry (1.1%) following closely behind (National Bureau of Statistics, 2020).

By providing a wholesome food, employment opportunities, and revenue, the fishing industry significantly affects the everyday activities of the majority of households in low- to middle-income nations. About 540 million people, or nearly 8% of the world's population, primarily from developing nations, depend on the fisheries and aquaculture industries for their livelihoods, either directly or indirectly. Agriculture accounts for 24.4% of Nigeria's GDP, whereas the fishing industry contributed 0.5% in 2015 (NBS, 2017; FAO, 2017).

According to Belton et al. (2014), Nigerians consumed over 13.9 kg of fish per capita in 2014, up from 7.6 kg in 2000. Urbanization, population expansion, the rise in middle-class families, growing knowledge of the negative health effects of red meat, and the ongoing sustainability of Nigeria's aquaculture production systems are all factors contributing to the increase (HLPE, 2017). Fisheries production in sub-Saharan African nations is anticipated to treble the yearly growth rate observed in 2020 in order to fulfill the rising demand for fish (World Bank Report, 2013). Only 0.78 million metric tonns (MT) of fish are produced in Nigeria at the moment, while 750,000 MT of fish valued at USD 600 billion are imported to meet demand (Grema, 2020). According to Belton et al. (2014), Nigeria must sustain a yearly per capita consumption level of at least 13.9 kg of fish, which requires a predicted demand of at least 2.66 million MT of fish annually.

In the tropics, rainfall is a climatic factor that influences fisheries output. The agricultural calendar is regulated by the rain, which is typically seasonal with distinct wet and dry seasons (Akintola, 1995). The intensity, duration, and frequency of precipitation events vary as a result of changes in the hydrologic cycle brought on by an increase in greenhouse gases (Mirhosseini et al., 2013). Rainfall variability indicates the extent to which wet and dry conditions may differ in a given area and explains how rainfall may vary over time. There will be a greater range of conditions and a greater difference between wet and dry days in areas with more variable rainfall (Met Office, 2019). It is clear that one of the effects of climate change on agricultural productivity is variations in rainfall patterns, particularly in poor nations like Nigeria, where rain is a major source of agricultural output (Oyinbo et al., 2014).

All economic sectors are at risk from rainfall, but the agricultural sector is especially vulnerable (Abid et al., 2015). Rainfall variability, according to Ayinde et al. (2011), is seriously endangering and stressing Nigeria's agricultural sector. This suggests that since crop production accounts for a sizable portion of Nigerian agricultural operations, rural sustenance, food pricing, and food security are all seriously threatened.

Ayoola et al. (2011) looked at the impact of climate change in Nigeria; Ipinjolu et al. (2013) looked at the potential impacts of climate change on fisheries and aquaculture in Nigeria; Anyanwu et al. (2015) reviewed the effects of climate change and mitigation strategies on aquaculture; Essam and Senebe (2013) looked at the implications of climate change on fisheries for food security in Sub-Saharan Africa; and De Silva and Soto (2009) looked at Climate change and aquaculture: Potential impacts, adaptation and mitigation. The drivers, effects and policies of climate change on aquaculture were studied by Dabbadie et al. (2018). The trend and increase rate of Nigeria's rainfall and fisheries production, however, are not well documented empirically. Therefore, this study must be conducted in order to close the research gap and add to the body of existing knowledge.

2.0 Objectives of the Study

The broad objective of the study is to ascertain the Trend and Growth Rate of Rainfall and Fisheries Production in Nigeria.

3.0 Methodology

The study looked at the trend and growth rate of Nigeria's fisheries production using time series data from 1981 to 2022. The World Bank database provided the data on fisheries production, while the National Bureau of Statistics (NBS) records provided the data on rainfall. The study used both descriptive and inferential statistics to analyze the data, and the growth model and descriptive statistics like mean, maximum, and minimum as well as trend graphs were used to analyze the trend and growth rate of rainfall and fisheries production in Nigeria. The annual rainfall was measured in millimeters (mm), and the total amount of fish produced in Nigeria each year in tons. The model for this study is as follows:

The trend equation is given as:

$$Y_t = Y_0(1+r)^t \quad \text{...} \quad (1)$$

Where:

Y_t = Rainfall or fishery production in year t

Y_0= Rainfall or fishery production in the base year.

r = Compound rate of growth of Y,

t = time trend variable

By taking the natural logarithm of both sides, the linear form of the equation was obtained making it amenable to OLS as;

$\ln Y_t = \ln Y_0 + t\ln(1+r)$ ………...................………(2)

Substituting in $\ln Y_0$ with α and $\ln(1+r)$ with β, equation (2) is rewritten as

$\ln Y_t = \alpha + \beta_t$………………………....………………(3)

Adding the disturbance or error term to equation (3), we obtain

$\ln Y_t = \alpha + \beta_t + U_t$…………..…………………………(4)

Equation (4) is the growth rate model developed for this study.

Growth model used to ascertain direction and growth rates of variables of interest were specifically stated for the variables of interest as follow:

$\ln Y_t = \alpha + \beta_r t + \mu_t$ ………..……………………............…… (5)

$\ln Y_t = \alpha + \beta_f t + \mu_t$ …………………………………… (6)

Where:

α = intercept;

β = vector of the trend variable and μ is the econometric error term.

B_r, β_f,= coefficients of the trend variable for rainfall and fishery production respectively.

The parameter of utmost interest in equations (5-6) is coefficient of β, the slope coefficient which measures the constant proportional/relative change in Y for a given absolute change in the value of the regressor t.

Firstly, multiplying b by 100, gives the instantaneous growth rate (IGR) at a point in time.

IGR= β X 100 ……………………………………..…… (7)

Where:

IGR = Instantaneous growth rate and

β = is the least-square estimate of the slope coefficient

Secondly, the compound growth rate (CGR) in percentage in each of the five cases can be recovered from the equations 5-6 in the following manner:

$CGR = (e^{\beta i} - 1)*100$ ………………………………………………….……… (8)

Where:

β_i = the coefficient of the trend variable in the respective cases

e= Euler's exponential constant (=2.71828)

In order to estimate the direction or pattern of growth so as to determine whether there is acceleration, deceleration or stagnation, quadratic equation in time trend variable was fitted as follows:

$LinY_t = \beta_o + \beta_1 t_i + \beta_2 t_i^2 + Ut$ …………….................................……………….. (9)

As previously stated, βo, β1, and β2 are all variables that need to be estimated. The dependent variable's (Yt) circular route is shown by the linear and quadratic time factors in equation 9's specification. It is possible to ascertain whether there was acceleration, deceleration, or stagnation during the study by using the quadratic time variable (t2) (Maikasuwa and Ala, 2013). The primary focus when identifying the growth pattern or direction is on β2, or the coefficient of ti2, which shows the growth pattern's measure.

In conclusion, equation 9 shows that growth accelerates if β2 is positive and statistically significant, decelerates if β is negative and statistically significant, and stagnates if β is not statistically significant.

4.0 Results and Discussion

4.1 Trend of Fisheries Production

Figure 1 depicts the productivity trend of fisheries. With outputs ranging from 245353 metric tonns to a maximum of 1212475 metric tonns annually and a mean yield of 588248.3 metric tonns annually, Fig 1 displays a range of peaks and troughs. The outcome is consistent with the findings of Giwa et al. (2021), who found that Nigeria's average fisheries output yield was 588,248.3 metric tons each harvesting season, which is much lower given the country's growing population of almost 200 million.

In particular, the production of fisheries remained steady from 1980 and 1984, with a minor decline in 1985. From 1986 to 1990, there is a continuous, gradual growth. This might be the consequence of government policies that support fish farming, which raises fish productivity. Between 1991 and 1993, the trend fluctuated between rising and falling. It then resumed its upward trajectory in 1994 and continued to rise steadily until 1998. From 1999 to 2005, the trend continued its little upward rise. Additionally, there is a rapid and dramatic increase in the trend of fisheries production from 2006 to 2013, followed by a decline from 2014 to 2016.

Ultimately, it rose from 1.98 metric tonns in 1980 to a record high of 2.4 metric tonns/ha in 1987, then decreased after increasing in 2017 and 2018. A number of agricultural programs implemented by various governments, including the River Basin Development Authorities, the Agricultural Credit Guarantee Scheme Fund, which called for an increase in agricultural production, and the new Agricultural Promotion Policy of President Muhammadu Buhari's Administration, may have contributed to the remarkable performance of fisheries production during the upward trend.

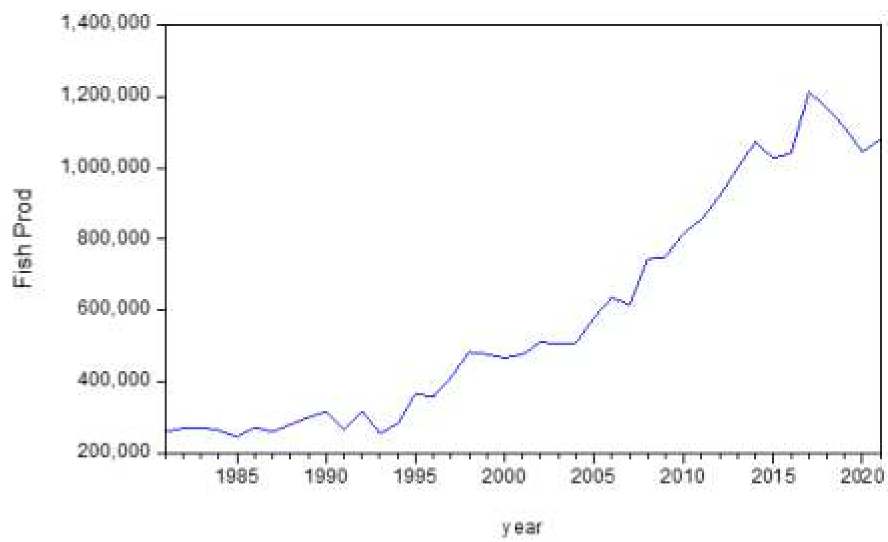

Figure 1: Trend of Fisheries Production

Source: Data Analysis (2024).

4.2 Trend of Rainfall

Figure 2 illustrates the rainfall trend. The findings indicate that the average annual rainfall is 1266.28 mm, with a range of 1046.00 mm to 1596.00 mm. Rainfall specifically declined from 1981 to 1983. Rainfall did, however, sharply climb between 1983 and 1985 before declining until 1990, when Nigeria recorded its highest annual rainfall. In addition, rainfall varied greatly between 1990 and 2005, when it was at its lowest. A similar pattern of rainfall fluctuation was noted between 2006 and 2021. This findings agrees with Elisha et al. (2017), who found that drought, flooding, rising sea levels, and fluctuating rainfall were all signs of climate change in Nigeria. This implies that biological processes that are essential to fisheries output are limited by the volume and availability of rainfall. The dynamics of fish systems may be significantly impacted by even little changes in the quantity, frequency, and intensity of available rainfall.

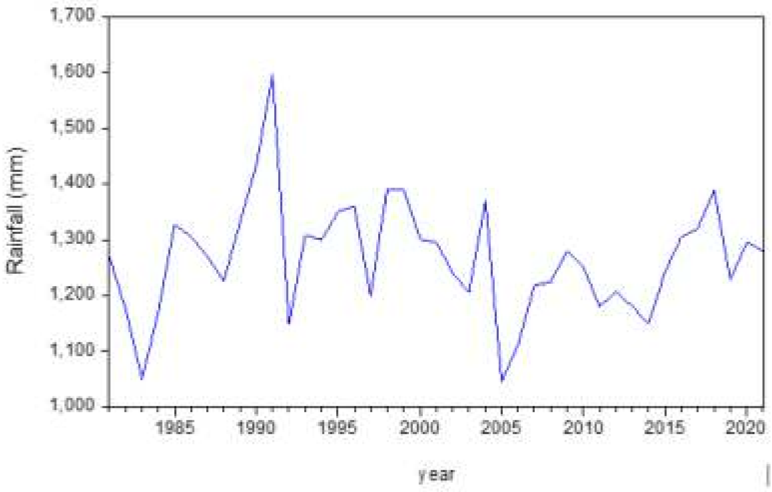

Figure 2: Trend of Rainfall. **Source:** Data Analysis (2024).

4.3 Growth Rate and Direction of Growth

Tables 1 and 2 show the growth rate and direction of the variables of interest (rainfall, food supply, and fisheries productivity). With instantaneous growth rates of 4.47% and compound growth rates of 4.57%, respectively, the results demonstrate an acceleration in fish output. At the 1% probability level, the fisheries production coefficient is positive and significant. This finding agrees with Obekpa et al. (2020), who found that over the reviewed period, fisheries productivity grew over time. This can be the result of government macroeconomic policies that support Nigerian fisheries production.

With instantaneous and compound growth rates of 7.26% and 7.53%, respectively, the finding likewise demonstrates rainfall stagnation. The annual rainfall's undulation over time could be the cause of this stagnation. This runs counter to the conclusion of Alam and Rabbani (2007), who found that Nigeria's rainfall pattern is changing over time and getting less frequent.

Table 1: Instantaneous and Compound Growth rates

Variable	Instantaneous growth rate	Compound growth rate
Fish production	4.47	4.57
Rainfall	7.26	7.53

Source: Authors computation (2024)

Table 2: Quadratic Equations for Growth Rate and Direction

	Fish production	Rainfall
Constant	12.243	3.1130
$Trend^2$	0.0447	0.072
t-statistic	27.489	0.5612
R^2	0.951	0.985
F-statistic	755.650	1293.6
Prob (F- statistic)	0.000	0.000
Decision	Accelerated	Stagnated

Source: Author's computation (2024).

5.0 Conclusion and Recommendations

The study concludes that in the long run, rainfall significantly influenced fisheries production over the period under review. This emphasizes the critical importance of rainfall in driving fisheries production in Nigeria's fisheries sector. Therefore, the study recommends that there is need to actively promote climate-resilient farming practices in the fisheries sector.

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