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Analysis of Fishery and Forestry Ventures and Poverty Reduction in Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Fishery and forestry ventures are sub-sectors of agriculture with the potential for poverty reduction through employment creation, value addition, and improvement in export earnings. Nevertheless, they have received relatively less attention from all levels of government in Nigeria. This paper examined the effect of fishery and forestry ventures on poverty reduction in Nigeria between 1976 and 2022. Ex-post facto research design was adopted. Data were sourced from CBN annual statistical bulletin, the National Bureau of Statistics, publications of the World Bank, as the Federal Ministry of Agriculture and Rural Development. NARDL was adopted for data analysis. Phillip-Peron Unit root tests revealed a uniform order of integration, while Co-integration Bounds test revealed no existence of long-run relationship between the fishery and forestry ventures and poverty reduction. Findings revealed that agricultural production in fishery and forestry has no significant long-run nexus with poverty reduction in Nigeria. The paper recommended that the Federal Department of Fisheries should engage reputable research institutes and colleges in the fishery industry in Nigeria to train and retrain participants in the sub-sectors to provide skilled

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workforce in the development of sustainable fishery production towards poverty reduction in Nigeria. The paper also recommended that regulatory agencies in the forestry sub-sector in Nigeria appoint more supervisors and enforcement officers to ensure adequate regulation of the industry towards adding maximum economic value to the exploration and exploitation of the forestry resources in Nigeria by reducing leakages and ensuring that adequate taxes and levies are paid including collection of relevant penalties from defaulters in order to attain sustainable income generation and poverty reduction among the accredited participants.

Keywords: Agricultural production; GDP; NARDL.

JEL Classification Code: O13, Q22, Q23, C20, C13.

1. INTRODUCTION

"Agriculture remains the leading employer of labour and hence a veritable means of livelihood in developing countries. The majority of the poor in sub-Saharan Africa rely on agricultural activities for a livelihood. Hence, the sector is fundamental to spurring growth, enhancing food security, alleviating poverty, and generating income" [1]. Consequently, Ogen [2], as cited in Olajide, Akinlabi, and Tijani [3], believe that "the agricultural sector possesses a multifunctional impact on a country's socioeconomic and industrial sector. This indicates that adequate and active participation in agriculture can effectively reduce poverty, especially in rural areas where there is an availability of labor and land distribution".

"Nigeria is a significant producer and consumer of fishery and forestry resources. The Nigerian fishing industry comprises three major sub-sectors, namely artisanal, industrial, and aquaculture, of which the awareness of the potential of aquaculture to contribute to domestic fish production has continued to increase in the country" [4]. "Nigeria's annual demand for fish is 3.6 million tonnes, while it produces just 1.1 million tonnes of fish from all sources (artisanal, aquaculture, and industrial sectors). Nigeria is also blessed with a large expanse of forest cover but this important resource needs to be sustainably used, managed, and/or conserved. The Federal Department of Forestry records in 2016 show that Nigeria has 1,160 constituted forest reserves including 6 National Parks, 20 Game and Wildlife sanctuaries, 13 proposed Game Reserves/Wildlife Sanctuaries and 8 Strict Nature Reserves. These areas cover about 107,527 km2 designated for the conservation, management, and propagation of wild animals, including the protection and management of critical habitats" [5]. These provide the potential for employment creation and poverty reduction [3].

Given this recognition, the federal government has tried to reverse the rising trend of poverty in Nigeria. Some of these efforts include implementing some poverty reduction programs, among them Operation Feed the Nation of 1976, The Green Revolution of 1980, and The National Fadama Development Programme I, II, and III, which were launched in 1992, 2000, and 2009, respectively. Others are the National Economic Empowerment and Development Strategy (NEEDS) launched in 1999, the National Poverty Eradication Programme (NAPEP) launched in 2003, the Agricultural Transformation Agenda (ATA) launched in 2012. In 2016, the Federal Government also launched the Agricultural Promotion Policy (APP) to improve food supply and output quality, as well as National Agricultural Technology and Innovation Policy (NATIP), which covers the period 2022 - 2027 [6].

It could be noted that although the Nigerian government and key researchers have made efforts to promote agricultural production in Nigeria, such efforts have been skewed towards livestock agriculture including cattle, piggery, poultry and cash crops such as rice and cassava production while neglecting or poorly funding other agricultural sub-sectors like fishery and forestry. However, there has been rising interest in fishery and forestry in recent times owing to their reported impacts on poverty reduction. Reports from the study of Oriola [7] and the indicators from the Bureau of Statistics (2018) show that, over 10 million Nigerians participate in fish production with significant contribution to the Nigerian economy in terms of employment creation, income generation, poverty alleviation, foreign exchange earnings and provision of raw materials for the animal feeds industry. Similarly, Olujimi and Adekunle [8] reported that "the average annual value of forest products collected in Nigeria such as fuel wood, construction materials, wild fruits, and leaf litter was estimated

to be 39% of average gross cash income per year. They stressed further that an estimated charcoal supply across Nigeria earns between 60-80 million Naira monthly. Yet, there needs to be more studies on the contribution of fishery and forestry ventures on poverty reduction in Nigeria".

Although the interest and participation in fishery and forestry ventures in Nigeria has increased, the level of poverty still remains high. Recent results from the National Bureau of Statistics show that 40% or 83 million Nigerians lived in poverty in 2021 (NBS, 2022). The NBS (2020) estimated that the number of poor people will increase to 90 million, or 45% of the population, in 2022. "The World Bank also estimates that an additional one million people will be pushed into poverty in Nigeria between June and November 2021, resulting in a total of about 8 million people being relinquished to poverty in 2021 and bringing the nation's poverty headcount to about 91 million" [9]. Consequently, the multidimensional poverty index reported by the National Bureau of Statistics (2022) indicates that 133 million Nigerians lived in poverty as of December 2021.

Therefore, examining the effect of fishery and forestry ventures on poverty reduction in Nigeria is pertinent. This is because a study on fishery and forestry production will unravel the potentials of these sub-sectors at creating employment and contributing to export earnings in the study area, thereby availing the opportunities for development and promotion with the ultimate aim of poverty reduction.

The question is: What relationship does the increased interest and consequent funding of fishery and forestry ventures have with poverty in Nigeria? Therefore, this paper aims to investigate the effect of fishery and forestry ventures on poverty reduction in Nigeria. In order to achieve these objectives, the paper is structured into four sections. Section 1 is an introduction, section 2 covers materials and methods, section 3 focuses on data and methodology of analysis while section 4 presents and discusses the results, and section 5 concludes the paper with policy recommendations.

2. MATERIALS AND METHODS

2.1 Conceptual Review

The concepts reviewed in this study are fishery production, forestry production and poverty reduction. These concepts are reviewed in this section.

Fishery Production: Fish farming is a form of aquaculture in which fish are raised in enclosures to be sold as food. It is an activity leading to fish harvesting within a defined area's boundaries [10].

"Fish are a very high source of proteins and have great nutritional value. About half the fish consumed globally is raised through fish farming. Some of the common fish species that are farmed, particularly in the northern hemisphere, include tuna, salmon, halibut, cod, and trout. Commercial fisheries include wild fisheries and fish farms, both in freshwater bodies (about 10% of all catch) and the oceans (about 90%). About 500 million people worldwide are economically dependent on fisheries" [11].

Fish production was initially dependent on fish capturing. However, most of the captured fish were used for industrial purposes and were hardly consumed by man. Therefore, an alternative method to increase fish production for use as food for man was devised that includes farming and husbandry, known as aquaculture. The aqua farms can be in the form of mesh cages submerged in water or concrete enclosures built on land. However, the fish farms can damage the ecosystem by introducing diseases, pollutants, and invasive species.

"Fish production can be done in two ways: capture fishery and culture fishery. Capture fishery refers to naturally occurring fish that are harvested by capture fishery. Capture fishery is sometimes also known as wild fishery. On the other hand, culture fishery is the controlled cultivation of fish in water bodies. It can also be referred to as fish farming or pisciculture. It is a form of aquaculture as aquaculture is the scientific rearing and management of all aquatic animals" (Stier, 2017).

Fish production is practiced using extensive, semi-intensive, and intensive methods. In extensive fish farming, economic and labor inputs are low. The natural culture of food production plays a major role in this type of farming. Fertilizers may be added to increase the fertility and production of plantations to feed the fish. The Semi-intensive fish farming method implies moderate levels of economic and labour inputs. The production can be increased by

supplementary feeding or addition of fertilizers. Thus, the production of fish is higher. Under intensive fish farming, the ponds are stocked with as many fish as possible. The fish are fed with supplementary feed.

Forestry Production: The General Multilingual Environmental Thesaurus (GEMET) [12] defines forestry production as a process involving a range of products including firewood and charcoal, lumber, paper, and crops such as coffee, oil palm, and rubber. With careful planning of growth and harvesting, wood and other forest products are, in principle, renewable resources. But achieving renewability takes time - often decades, sometimes centuries. Without careful management, pressure for short-term exploitation can lead to tree removal, soil degradation, and conversion of woodland to other uses. Unregulated consumption of forest resources can lead to environmental problems as well as loss of critical habitat and species.

Frouz and Frouzová [13] describe forestry production to mean the commercial production/harvesting of timber, bamboo, fuel-wood, charcoal, bio-fuels, or non- timber forest products from cultivated tree or perennial cane crops or from natural forests and woodland. This may include ancillary uses that is directly related to the primary use of forestry such as a sawmill, woodlots, a forestry nursery and forestry housing subject to the fact that a sawmill complies with the National Environmental Management Act No. 107 of 1998, the National Environmental Management: Waste Act No. 59 of 2008 and the National Environmental Management: Air Quality Act No. 39 of 2004 and that forestry housing will comply with the maximum density as set out within the Land Use Scheme per Zone.

Also, Fenton (2020) defines forest production as forests managed primarily for production of logs or other goods which may be subject to further processing. Similarly, Young (2012) define forest production as the means by which trees can be produced as a renewable resource for wood or biomass for direct timber sales, production of trees for ornamental plantings or woody material for composite products or for use as a combustion energy source.

Poverty Reduction: Poverty reduction has been defined by Vanderschueren [14] as a situation where specific manifestations of poverty are systematically reduced resulting in a short and long-term condition. Essentially, poverty, be it at individual or national levels, cannot be eradicated; rather, it can be reduced because "poverty is implicated by our mental, physical, emotional, religious and cultural states of being" [15].

2.2 Theoretical Framework

The paper adopts the framework of Basic Needs Theory postulated by the International Labour Organization's World Employment Conference (WEP) in 1976. Traditionally, the thrust of the theory is that the immediate basic needs are food (including water), shelter and clothing. However, in modern times, the basic needs also include sanitation, education, and healthcare. The theory is one of the major approaches to the measurement of absolute poverty in developing countries that attempts to define the absolute minimum resources necessary for long-term physical well-being, usually in terms of consumption goods. The poverty line is then defined as the amount of income required to satisfy those needs.

The World Employment Conference of 1976 proposed the satisfaction of basic human needs as the overriding objective of national and international development policy. The approach was endorsed by governments and workers' and employers' organizations from all over the world. It has influenced the programmes and policies of major multilateral and bilateral development agencies, and was the precursor to the human development approach.

In the human development discourse, the basic needs model focuses on the measurement of what is believed to be an eradicable level of poverty. Development programs following the basic needs approach do not invest in economically productive activities that will help a society carry its own weight in the future, rather they focus on ensuring each household meets its basic needs even if economic growth must be sacrificed today. These programs focus more on subsistence than fairness. Nevertheless, in terms of measurement, the basic needs or absolute approach to development is important. Hence, the 1995 World Summit on Social Development in Copenhagen, Sweden, had, as one of its principal declarations, that all nations of the world should develop measures of both absolute and relative poverty and should gear national policies to "eradicate absolute poverty by a target date specified by each country in its national context".

2.3 Empirical review

Ashley-Deji and Adelaja [16] studied economics of catfish hatchery farmers and its contribution to household poverty alleviation in Nigeria. The study made use of the data gathered from the farm and household levels through the use of questionnaire to analyze the economics of catfish hatchery farming and its contribution to household poverty alleviation in Oyo and Osun States, Southwest Nigeria. The study adopted profitability analyses, Foster-Greer-Thorbecke index and Tobit regression models in its analysis. The findings indicated that fish hatchery farming is profitable, although 43.1% of fish hatchery farmers interviewed were above the poverty line. Thus, the enterprise significantly ($p < 0.05$) reduced poverty in the study area. Furthermore, the effects of socioeconomic variables, gender, education level, and farming experience ($p < 0.01$); marital status and household size ($p < 0.1$); labour employed, hatchery units, quality of fish seed produced and membership of cooperative society ($p < 0.05$) indicated several interactions between poverty and the variables analyzed. The study concluded that policy makers, government and non-governmental organization should give the enterprise adequate attention and support as this could be adopted in lifting the country from poverty.

Ashley-Deji and Adelaja's work, which focused on the economics of hatchery and household poverty alleviation, is similar to the present study's objective to examine the effect of fishery production on poverty reduction. However, while fish production constitutes the main aim of the former, it is only one of the objectives of the present study. Thus, the present study is broader in scope than the former, as the present study also embraces forestry production. Also, while the former used a primary data approach, the present study adopts a secondary data approach.

Abbas and Ahmed [11] examined fish farming business and its capability to reduce poverty and invariably foster wealth creation in Akure South and Owo Local Government Areas of Ondo State, Nigeria. A multi-stage sampling technique was used to select 100 fish farmers for the study during the 2013 production season. Data obtained were analyzed using net farm income model, descriptive statistics, Foster, Greer and Thorbecke poverty measurement technique and expenditure approach of determining poverty line value. The result of the study revealed that fish farming was profitable in the study areas, with a net farm income of N2423.37/m 2 being realized at the end of the production cycle. The study also revealed a poverty line value of N461.89/day among the fish farmers, which is higher than the one dollar-a-day benchmark of the World Bank. Other results showed that poverty depth among fish farmers was 9% while poverty severity was 2%. It was recommended that fish farmers need to be trained on how to produce fish feeds in order to reduce the cost of feeding fish, make maximum profit from their investment in fish farming which can significantly lead to poverty reduction. It was also recommended that lending institutions should be encouraged by the government through measures such as reduced bank rates, lower reserve ratios, and selective credit policies, among others, to grant loans to practicing fish farmers at a reduced interest rate so as to enable them to expand their scale of fish production and thereby boost domestic production of fish.

Abbas and Ahmed's study, as reviewed, is closely related to the present study since both of them are targeted at examining the level of poverty reduction from the effect of fishery production. However, while Abbas and Ahmed's study focused strictly on fishery, the present study embraces both fishery and forestry ventures. This makes the present study more extensive and more embracing than the former.

Ani, Nwadike and Anikelechi [17] evaluated "the level of timber production and forest reserves as well as its implications for food security in Nigeria from 1981 to 2014. The objective of the study was to evaluate the significant impact of timber production and forest reserves on food security in Nigeria. In an attempt to examine this, error correction model diagnostic tests process ECM, ADF unit root test, Structural VAR approach, and Co-integration test were employed in the data analysis. The research findings revealed that timber production and forest reserves have a significant impact on food security in the Nigerian economy within the period under review. In light of the research findings, the researcher recommends that Timber production and forest reserves should be strengthened to increase the effect of forest reserves on food security in the country. This can be achieved through increased productivity and the development of agriculture value chain in federal government policy and implementation process".

The study's conceptual and methodological nexus with the present study is not in doubt as

both studies are poverty reduction and agricultural production inclined. However, while the former made use of VAR for data analysis, the present study has adopted NARDL. Moreover, while the former is restricted to timber production, forestry constitutes one of the two variables of the present study as the other borders on fishery production.

On the contribution of non-timber forest products to poverty alleviation and forest conservation in Rufiji District in Tanzania, Kimaro and Lulandala [18] sought to "determine the contribution of Non-timber Forest Products (NTFPs) towards poverty alleviation and sustainable forest management in local communities surrounding Ngumburuni Forest Reserve in Rufiji District in the Coastal Region of Tanzania. Data were collected from three villages closest to the forest namely Mkupuka, Mangwi and Umwe North. The method of analysis employed was the participatory rural appraisal, structured interviews, focused group discussion and participant observation. A total of one hundred and sixty species distributed both in the forest reserve and general land were recorded. Local end-uses of NTFPs including fuel wood, food, construction materials, medicine and traditional rites items were identified. This indicated significant contribution of NTFPs to local community income and livelihood resilience and thus, provided incentive for sustainable forest management. While access to NTFP is important to guarantee the socioeconomic well-being of the forest adjacent communities, their sustainable management has not been taken seriously by local government officials and policy makers thereby contributing to reduction of biodiversity resources and irretrievable loss of most species. To ensure the sustainable utilization of NTFPs from Ngumburuni Forest Reserve and similar tropical forest environments, a number of conservation approaches were proposed".

Although both Kimaro and Lulandala and the present study bordered on forestry and poverty reduction, the former was skewed towards Non-timber Forest Products (NTFPs) while the present study embraces forestry as a whole. Also, while the former made use of participatory rural appraisal, structured interviews, focused group discussion and participant observation because of the primary data needs, the current study gathered data from the Central Bank of Nigeria and the Federal Ministry of Agriculture for its secondary data needs. The present study is also domesticated in Nigeria and bridges the currency gap since the former was conducted in Tanzania in 2013 and needs to be updated in view of constant changes inherent in the characteristics of economic and social variables.

In a study of non-timber forest products for poverty reduction in Ogun Waterside Local Government Area of Ogun State, Nigeria, Ogunbanjo and Aina [19] examined "the possibilities of Non-Timber forest products (NTFPs) in improving the standard of living of the people in the study area and consequently make life better for them. Primary data were collected using a set of structured questionnaire administered on one hundred and twenty (120) NTFPs harvesters/sellers who were selected using multi- stage sampling technique from three communities and markets in the local government areas and were analyzed using descriptive statistics. The major results showed that although there were numerous NTFPs available to the people of this area, but Beilshmiediamanni and Achatinaachatina had the major economic potentials or tendencies to improve their standard of living. It was, therefore, suggested that great efforts be made by government to multiply and sustain these products for their continued availability and for the use of the people".

The relationship between Ogunbanjo and Aina's and the present study is incontestable. This is because both studies are interested in the effect of forestry on poverty reduction. Both studies are also geographically restricted to Nigeria. However, while the scope of the present study covers Nigeria at large, that of the former was restricted to Ogun State. Hence, while the former made use of primary data, the present study adopted the secondary data approach. The present study also extended its periodic scope to 2022 to compensate for the lag in recency in the former.

3. DATA AND METHODOLOGY

The paper adopted *Ex-post facto* research design, considered appropriate for this type of study because it describes the statistical association between two or more variables using time series data. The design is also the most suited because it allows for the testing of expected effects of fishery production and poverty reduction on one hand, and forestry production and poverty reduction on the other hand.

Data used for this paper were secondary data for fishery production, forestry production and poverty reduction. These data were sourced from the publications of the Central Bank of Nigeria (CBN) Statistical Bulletin for a period of 46 years (1976-2022). These data were subjected to pre-estimation diagnostics tests such as Augmented Dickey-Fuller unit root test to ascertain the stationarity of the data and NARDL bound test for co-integration test analysis that provided a robust estimate of the parameters.

The Non-Linear Autoregressive Distributed Lag Model (NARDL) advanced by Shin, Yu and Greenwood-Nimmo (2014) was used for data analysis. This is in recognition of the non-linear nature of the relationship existing between economic variables as captured by Ezie and Ezie [20]. The relationship between fishery production and poverty, on the one hand, and forestry production and poverty, on the other hand, is, therefore, expected to be non-linear, hence the adoption of the NARDL approach. Post-estimation tests employed in the study were Breausch-Godfrey serial correlation LM test, Breausch-Pagan-Godfrey Heteroskedasticity and stability tests.

Model Specification: The study model was anchored on the Basic Needs Theory as a theoretical framework that identified immediate basic needs as food (including water), shelter and clothing, sanitation, education, and healthcare. According to the theory, the inability of the individual to satisfy these needs is termed poverty. For an agrarian economy like Nigeria where agriculture is the mainstay, participants depend on agricultural ventures such as livestock production, crop production, fishery production and forestry production from where they derive income to reduce poverty. With the aim to ascertain the effect of fishery and forestry ventures on poverty reduction in Nigeria, the paper assumed that poverty (POV) is a function agricultural production. Mathematically, this implies that

$$POV = f(AGP) \quad (1)$$

Where

POV = Poverty; and
AGP = Agricultural Production.

This makes poverty reduction a primary function of agricultural production as specified in Equation (2):

$$POV_t = \alpha_0 + \alpha_1 FSGDP_t + \alpha_2 FRGDP_t + \mu_t \quad (2)$$

Where:

POV = Poverty (%)
FSGDP = Ratio of Fishery Production to GDP (%)
FRGDP = Ratio of Forestry Production to GDP (%)
t = Time Trend
$\alpha_0, \beta_0, \lambda_0$ = Intercept or Constant Parameter
$\alpha_0, -\alpha_2,$ = Slope of the explanatory variables or parameters to be estimated.
μ_t = Error Term or white noise.

Equation (2) is the baseline model for determining the effect of fishery and forestry production on poverty reduction. To capture the possible effect of fishery and forestry production on poverty reduction in Nigeria, NARDL technique decomposes the independent variables which are fishery production and forestry production into two parts: 1) partial sum of positive change denoted by $FSGDP^+$ and $FRGDP^+$; 2) partial sum of negative change denoted by $FSGDP^-$ and $FRGDP^-$and including both of them as separate regressors in the model, the model becomes:

$$POV_t = \Phi_0 + \Phi_1 FSGDP^+ + \Phi_2 FRGDP^+ + \Phi_3 + FSGDP^- + FRGDP^- + \mu_t \quad (3)$$

Equation (2) takes the NARDL form of Shin, Yu, and Greenwood-Nimmo (2014) as:

$$\Delta POV_t = u\delta_{t-1} + \sum_{i=1}^{n} \alpha_6 \Delta POV_{t-1} + \sum_{j=1}^{m} \alpha_5 \Delta FSGDP_{t-1} + \sum_{j=1}^{m} \alpha_6 \Delta FRGDP_{t-1} + \sum_{k=1}^{o} (\pi_J^+ \Delta FSGDP^+_{t-J} + \pi_J^- \Delta FRGDP^-_{t-J})$$

$$+ \sum_{k=1}^{o} (\pi_K^+ \Delta FRGDP^+_{t-K} + \pi_K^- \Delta FRGDP^-_{t-K}) + \delta ECT_{t-1} + \mu_t \quad (4)$$

$$\Delta POV_t = \Phi_0 + \Phi_1 POV_t + \Phi_2 FSGDP_t^+ + \Phi_3 FSGDP_t^- + \Phi_4 FRGDP_t^+ + \Phi_5 FRGDP_t^- + \sum_{i=1}^{n} \gamma \Delta POV_{t-1}$$

$$+ \sum_{k=1}^{m} (\pi_J^+ \Delta FSGDP^+_{t-J} + \pi_J^- \Delta FSGDP^-_{t-J}) + \sum_{k=1}^{n} (\theta_K^+ \Delta FRGDP^+_{t-K} + \theta_K^- \Delta FRGDP^-_{t-K}) + \mu_t \quad (5)$$

Using the ECM proposed by Inder [21] with some modification to the focus of this study, the model is specified as follows:

$$\Delta POV_t = u\,\delta_{t-1} + \sum_{i=1}^{n} \gamma \Delta POV_{t-1} + \sum_{k=1}^{m} (\pi_J^+ \Delta FSGDP^+_{t-J} + \pi_J^- \Delta FSGDP^-_{t-J}) + \sum_{k=1}^{n} (\theta_K^+ \Delta FRGDP^+_{t-K}$$

$$+ \theta_K^- \Delta FRGDP^-_{t-K}) + \mu_t \quad (6)$$

Where δ is the speed of adjustment parameter or coefficient, and δ_{t-1} (which is the lagged Error Correction Term) is the residual obtained from the long run estimation. The coefficient (δ) is expected to be less than one, negative and statistical significant. The negative sign of the ECT_{t-1} term indicates long-run convergence of the model to equilibrium as well as explaining the proportion and the time it takes for the disequilibrium to be corrected or restored back to equilibrium; that is, the disturbed system to return to equilibrium.

However, the underlying hypotheses for co-integration involve the long-run asymmetric parameters. In other words, the null hypothesis of no co-integration expressed as H_0:$\varphi_1 = \varphi_2 = \varphi_3 = \varphi_4 = \varphi_5 = \varphi_6$ is tested against the alternative hypothesis of co-integration given as H_1:$\varphi_1 = \varphi_2 = \varphi_3 = \varphi_4 = \varphi_5 = \varphi_6$. In addition, the study also employed the Wald test for testing restrictions to ascertain whether the asymmetries matter both in the long run and short run. For the Wald test, the null hypothesis of no asymmetries: H_0:$\varphi_1 = \varphi_2 = \varphi_3 = \varphi_4 = \varphi_5$ (for long run) and; H_1: $\sum_{j=0}^{m} \pi_J^+ = \sum_{j=0}^{n} \pi_J^- = \sum_{j=0}^{o} \theta_J^+ = \sum_{j=0}^{p} \theta_J^+$ (for short run) is tested against the alternative of presence of asymmetries- (for long run) and is tested against the alternative of presence of asymmetries- H_1:$\varphi_1 = \varphi_2 = \varphi_3 = \varphi_4 = \varphi_5$ (for long run) and H_1: $\sum_{j=0}^{m} \pi_J^+ = \sum_{j=0}^{n} \pi_J^- = \sum_{j=0}^{o} \theta_J^+ = \sum_{j=0}^{p} \theta_J^+$.

4. RESULTS AND DISCUSSION

In this section of the paper, the results of descriptive statistics, trend analyses, the Unit Root test and the NARDL are presented, analyzed and discussed.

The descriptive statistics, as presented in Table 1, were used to test for the clustering and normality properties of residuals in the data set. To achieve this purpose, the paper examined the mean and standard deviations of study variables, and compared skewness values with the standard value of Skewness of a symmetric distribution, such as normal distribution, which is zero. Results reveal that the mean values of the study variables were all above their respective standard deviations. This suggests that the data set is clustered around the mean, thereby ruling out the existence of outliers in the data set. Skewness values for all the series were close to zero, suggesting that they were Skewness normal. The Kurtosis of a distribution which measures the peakness of the distribution that is assumed to be normal is 3. In Table 1, only FSGDP value was close to 3. Thus, the series do exhibit characteristic of a distribution with a slightly high peak, but the series have generally exhibited mesokurtosis (k=3) suggesting a normal distribution.

Table 1. Summary of descriptive statistics of the study variables

Variable	Mean	Std. Dev.	Skewness	Kurtosis	JarqueBera	Probability	Obs
POV	55.44404	14.11124	0.433656	1.958939	3.595577	0.165665	46
FSGDP	108.9732	40.91518	0.961682	2.372813	8.014855	0.018180	46
FRGDP	67.35660	35.40963	0.106683	1.701135	3.392963	0.183327	46

Source: Extract from Results of E-views 10

Jarque – Bera results show that the series failed to reject the null hypothesis of a normal distribution. It is, therefore, clear that the series are subject to distribution that is not different from the normal one. The paper proceeds to inspect the trend of the variables used.

4.1 Trend Analyses of the Study Variables

This section focuses on the trend analyses of the study variables.

The result of poverty trend analyzed in Fig. 1 shows that the poverty trend was low before the period of 1990 and in 1992 when rolling plans were implemented as unfriendly foreign policies reigned supreme, poverty rate rose steadily from below 20%, peaking at 42% in 1999. However, with the return to democracy in 1999, poverty rate turned downwards in 2000, and continued to decline till 2005 when there were signs of resurgence. Nevertheless, the rates rallied around 25% between 2006 and 2010 in response to the global financial crises witnessed. After this period, the rate declined precipitously, getting to as low as 20% in 2014. Hit by another economic crisis between 2014 - 2018, the country experienced resurgence in poverty rates within the period which has continued to rise till date. This suggests that efforts at reducing poverty in Nigeria have not been successful.

The result of fishery venture growth (the contribution of fishery venture to Gross Domestic Product) in Nigeria indicates a crawling growth in the fishery venture before the year 1990. From 1991, the rate of fishery's contribution to GDP exhibited a steady but mild growth until 2000 when a rapid growth in fishery was witnessed. The steady and rapid growth in fishery in Nigeria has continued till date.

It could be recalled that the National Agricultural Land Development Authority (NALDA) was established in 1992 which gave strategic public support for land development, assisting and promoting better uses of Nigeria's rural land and their resources, boosting profitable employment opportunities for rural dwellers, raising the level/standard of living of rural people, targeting and assisting in achieving food security through self reliance and sufficiency. This coincided with the resurgence in the growth of fishery, as shown in Fig. 1. Also, the rapid growth in fishery ventures in Nigeria from the year 2000 coincided with the launching of the National Economic Empowerment and Development Strategy (NEEDS) in 1999, which empowered farmers to increase fish production in Nigeria (Ayoola, 2015).

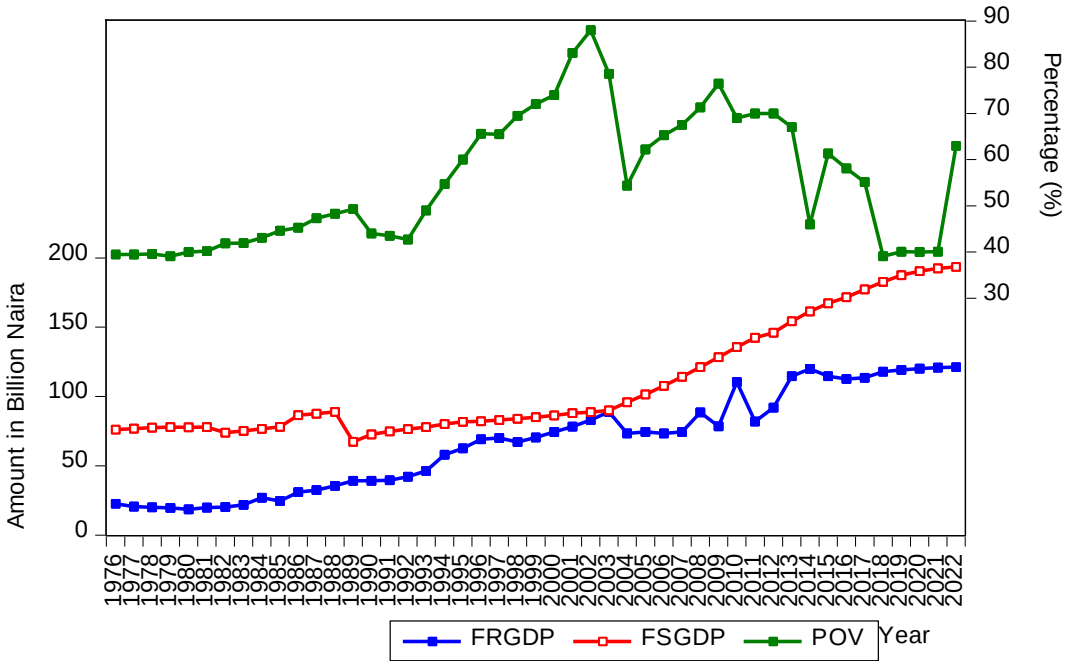

Fig. 1. Trend of poverty in Nigeria
Source: *Extract from Results of E-views 10*

The trend of forestry venture's contribution to Gross Domestic Product (GDP) in Nigeria rose steadily over the years. From 20% in 1980, the rates rose to 60% in 2000 and further to 80% in 1995. Again, there were mild fluctuations from 2005 to 2015, which could be due to increased insecurity between farmers and herders. The trend has, however, stabilized thenceforth. Thus, efforts at promoting forestry production in Nigeria have yielded little but positive results within the study period, with the result getting more profound in recent times.

4.2 Unit Root Test Result

In order to ensure a stable trend of series and estimate its direction, unit root test was conducted to ascertain the stationary properties of the variables using Phillips Peron (PP) technique. The results of the unit root tests are presented in Table 2.

As shown in Table 2, the results of the PP test indicate that all the variables were found non-stationary at levels and at a 5% level of significance. They were, however, stationary at first difference. Hence, the unit roots PP test for the variables were accepted at first difference for the variables of interest, indicating uniform order of integration. Since, the series were not integrated at levels; the Non-Autoregressive Distributed Lag can be used to estimate its short-run and long-run asymmetric inter-relationships.

4.3 Asymmetry Test

In order to investigate the short-run asymmetric properties of the variables under study, the asymmetry test was conducted using Wald Statistic for POV, FSGDP and FRGDP. The null hypothesis of the test is that the decomposition of the study variables in partial sums of positive and negative changes in FSGDP and FRGDP is not significant (i.e. no asymmetries), and the alternative is that the decomposition of the changes is significant (i.e. there is asymmetries).

The result of the Wald test presented in Table 3 showed that the underlying null hypothesis that there is no asymmetry in the short run is rejected for both variables. The result further confirms the justification of the NARDL model adopted in this paper. Since the result of Table 4 reveals that no asymmetric long-run nexus exists between poverty, fishery and forestry ventures in Nigeria, the long-run result of asymmetric Wald test was not explored.

4.4 Co-integration Test Result

The result of co-integration Bounds test is presented in Table 4.

As shown in the result of bounds test presented in Table 4, the F statistic value of 1.778654 is less than the upper and lower bound of 4.01 and 2.86 at 5% level of significance. This implies that there was no long-run relationship among the variables. This suggests the acceptance of the null hypothesis of no co-integration among the variables. Hence, there is no asymmetric long-run nexus between poverty, fishery and forestry ventures in Nigeria. The paper, therefore, proceeds to analyze the lagged NARDL Regression estimates.

Table 2. Summary of unit root test result

Variable	ADF Test Statistics	Critical Values	Order of Integration
POV	-1.979513	-2.926622	I(1)
FSGDP	2.155364	-2.926622	I(1)
FRGDP	-0.132500	-2.926622	I(1)

*Note: The tests include intercept and trend; * significant at 1%; ** significant at 5%*
Source: Authors Computation, 2023 (Eviews-10)

Table 3. Short-run results of the asymmetry wald test

Variables	Wald Statistic	Evidence of Asymmetry
POV	5.25422 (0.0011)*	Yes
FSGDP	0.983105 (0.032025)*	Yes
FRGDP	0.070871 (0.035846)*	Yes

*Note: The tests include intercept and trend; * significant at 1%; ** significant at 5%*
Source: Authors Computation, 2023 (Eviews-10)

Table 4. Summary of co-integration estimates

F-Bounds Test	Null Hypothesis: No Levels Relationship			
Test Statistic	**Value**	**Signif.**	**I(0)**	**I(1)**
F—statistic	1.778654	10%	2.45	3.52
K	4	5%	2.86	4.01
		1%	3.74	5.06

Source: Authors Computation, 2023 (Eviews-10)

Table 5. Lagged NARDL regression result

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	11.34457	6.134882	1.849192	0.0720
FSGDP_POS(-1)	0.207621	0.218770	0.949036	0.3484
FSGDP_NEG(-1)	-0.118692	0.201445	-0.589206	0.5591
FRGDP_POS(-1)	-0.035312	0.169486	-0.208350	0.8360
FRGDP_NEG(-1)	0.304630	0.227137	1.341174	0.1876
POV(-1)	-0.246579	0.130972	-1.882688	0.0672

Source: Authors Computation, 2023 (Eviews-10)

Table 5 shows that the 20.76 percent positive effect of fishery venture had a corresponding -11.87 % negative effect on poverty. This implies that an increase in fishery venture leads to decrease in poverty since the positive effect of fishery venture on poverty was higher than its negative effect. However, the positive effect and the corresponding negative effect of fishery venture on poverty were not significant at 5% level. This means that fishery venture has no significant nexus with poverty reduction in Nigeria. The table shows that the -3.53 percent positive effect of forestry venture on poverty had a corresponding 30.46% negative effect on poverty. Thus, an increase in forestry ventures does not lead to a decrease in poverty; hence, the positive effect of forestry ventures on poverty was less than its negative effect. Moreover, the positive effect and the corresponding negative effect of forestry venture on poverty were not significant at 5% level. This means that forestry venture has no significant nexus with poverty reduction in Nigeria.

4.5 Robustness Test Results

Robustness tests conducted in this study were Breusch-Godfrey-Serial-Correlation Test and Heteroscedasticity-ARCH Test.

The results of post-estimation test of NARDL model presented in Table 6 showed that there was no evidence of serial correlation and heteroscedasticity in the estimated model as the p-values of both (0.6361 and 0.0554) were found to be greater than 0.05.

The result of Ramsey Reset test presented in Table 7 shows that the predicted value of the normalized NARDL regression is properly

Table 6. Robustness (Test) result

Test		Outcomes	
		Coefficient	**Probability**
Breusch-Godfrey-Serial-Correlation Test	F-stat.	0.457851	0.6361
Breusch-Pagan-Godfrey Heteroscedasticity Test	F-stat.	2.382778	0.0554

Source: Extract from E-views 10.

Table 7. Ramsey RESET test

Equation: NARDL01			
Specification: FGDP FGDP(-1) FRGDP C			
	Value	**Df**	**Probability**
t-statistic	1.196736	42	0.2381
F-statistic	1.432176	(1, 42)	0.2381

Source: Extract from E-views 10

specified as the coefficients on all powers of the predicted were jointly insignificant (F= 1.432176, P = 0.2381). Thus, the study model was properly specified and linear.

Fishery and forestry ventures are sub-sectors that have received relatively less attention from the Nigerian government. Yet, these ventures hold the potential for poverty reduction through employment creation, value addition, and improvement in export earnings. This paper was to find out whether there is nexus between agricultural production (specifically fishery and forestry ventures) and poverty reduction in Nigeria.

Results of the paper revealed that an increase in fishery venture leads to decrease in poverty since the positive effect of fishery venture on poverty was higher than its negative effect. However, the positive effect and the corresponding negative effect of fishery venture on poverty were not significant at 5% level. This means that fishery venture has no significant nexus with poverty reduction in Nigeria. This finding disagrees with that of Ashley-Deji and Adelaja (2022) who studied economics of catfish hatchery farmers and its contribution to household poverty alleviation in Nigeria and found that fish hatchery farming is profitable, and that the fishery enterprise significantly ($p < 0.05$) reduced poverty in the study area. The present study covers a long period of time (1976 – 2022), thus its findings are likely to be influenced by past trends, hence the insignificant long-run nexus between fishery venture and poverty reduction in Nigeria.

The paper also found that an increase in forestry ventures does not lead to a decrease in poverty. The positive effect of forestry venture on poverty was, therefore, less than its negative effect. Moreover, the positive effect and the corresponding negative effect of forestry venture on poverty were not significant at 5% level. This means that forestry venture has no significant nexus with poverty reduction in Nigeria. This finding is in direct contradiction to that of Ani, Nwadike**,,** and Anikelechi [17], whose evaluation of the level of timber production and forest reserves,, as well as its implications for food security in Nigeria,, revealed that timber production and forest reserves,, have a a significant impact on food security in Nigerian. The study finding also contrasts that of Kimaro and Lulandala [18] which indicated significant contribution of Non-timber forestry products (NTFPs) to local community income and livelihood resilience in Tanzania. Again, the present study covers a long period of time (1976 – 2022), thus its findings are likely to be influenced by past trends, hence the insignificant long-run nexus between forestry venture and poverty reduction in Nigeria. Hence, the study finding was in line with that of Ogunbanjo and Aina [19] whose finding on non-timber forest products and poverty reduction in Ogun Waterside showed that, although there were numerous NTFPs available to the residents, only Beilshmiediamanni and Achatinaachatina had major economic potentials or tendencies to improve their standard of living.

5. CONCLUSION AND POLICY RECOMMENDATIONS

Agriculture remains the main employer of labour, and hence a veritable means of livelihood in developing countries. The majority of the poor in sub-Saharan Africa rely on agricultural activities for a livelihood,, and hence,, the sector is fundamental to spurring growth, enhancing food security, alleviating poverty,, and generating income [1]. The Nigerian government and key researchers have made efforts to promote livestock and crop production yet such efforts have been skewed towards cattle, piggery, poultry and cash crops like rice and cassava production, while neglecting or poorly funding other ventures like fishery and forestry. However, there has been rising interest in fishery and forestry in recent times owing to their reported impacts on the poverty. Yet, fishery and forestry ventures have no long-run nexus with poverty reduction in Nigeria.

In view of these findings, the following recommendations are made:

(i) The Federal Department of Fisheries which formulates polices and articulate strategies aimed at providing the enabling environment for the private sector to enhance fish production and drive the industry, should delve into new and innovative areas by engaging some reputable research institutes and colleges in the fishery industry in Nigeria such as the Nigerian Institute of Oceanography and Marine Research (NIOMR), National Institute for Fresh Water Fisheries Research (NIFFR), Federal Colleges of Fresh Water Fisheries Technology (FCFFT), among others, to ensure routine

training of the entrepreneurs in fishery and ensure the manpower development for sustainable fishery production, geared towards poverty reduction in Nigeria.

(ii) Regulatory agencies in the forestry industry in Nigeria such the National Bio-Safety Management Agency (NBMA) and National Environmental Standards and Regulations Enforcement Agency (NESREA) which presently lack adequate manpower relative to the vast forest reserve in Nigeria, should appoint more supervisors and enforcement officers to ensure adequate regulation of the industry towards adding maximum economic value to the exploration and exploitation of forestry resources in Nigeria by reducing leakages and ensuring that adequate taxes and levies are paid including collection of relevant penalties from defaulters in order to attain sustainable income generation and poverty reduction of accredited participants.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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