Asymmetric Effects of Agricultural Production Components on Poverty Reduction in Nigeria

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Abstract

Poverty still remains a great challenge despite the promotion of agriculture in Nigeria which needs to be unraveled. The paper examined the asymmetric effect of agricultural production components on poverty reduction in Nigeria between 1976 and 2022. Ex-post facto design was adopted. Data were sourced from CBN annual statistical bulletin, the National Bureau of Statistics, the World Bank and Federal Ministry of Agriculture and Rural Development. Non-linear Autoregressive Distributed Lag (NARDL) was adopted for data analysis. Phillip-Peron Unit root tests revealed mixed order of integration while Co-integration Bounds test revealed the existence of long-run relationship between poverty, crop production and livestock production. Findings revealed that crop production has a significant positive asymmetric effect while livestock production does not have a significant positive asymmetric effect on poverty reduction in Nigeria. The paper concluded that the efforts made by the government, international donor agencies and other stakeholders to improve agricultural production have yielded long-term asymmetric effect on poverty. However, the support given to livestock production has not stimulated significant reduction in poverty and requires more commitment from the stakeholders to achieve the desired contribution of livestock production to poverty reduction in the country. The paper recommended that the government should sustain policies and programmes in crop production since they have impacted positively on beneficiaries' poverty levels. Also, the Federal Government and international donor agencies should improve on their efforts toward funding, training and subsequent supervision of participants in livestock ventures in Nigeria by giving adequate training on modern techniques of animal husbandry.

Keywords: Asymmetric Effect, Agricultural Production, Crop Production, Livestock Production, Poverty Reduction, NARDL.

Introduction

The importance of agriculture to poverty reduction cannot be overemphasized. This is in recognition of its contribution to nations' Gross Domestic Products (GDP), employment, exchange rate, inflation rate and its impacts on crime rate and general welfare of the citizenry, among others especially in developing countries. Statistics indicate that the percent of farmers who lived in poverty in India was 20%; it was 66% in South-Africa and 39% in Nigeria (Kayode, 2021). The implication of these statistics is that agriculture is strongly related to poverty reduction in developing countries.

According to UNECA (2022), agriculture is the main employer of labour, and hence a veritable means of livelihood in developing countries. The majority of the poor in sub- Saharan Africa relies on agricultural activities for a livelihood and hence the sector is fundamental to spurring growth, enhancing food security, alleviating poverty and generating income. In addition, Bjornlund, Bjornlund and Rooyen (2020) believed that agricultural sector possesses a multifunctional impact on a country's socioeconomic and industrial sector. It can therefore, be deduced from the aforementioned that adequate and active participation in agriculture can effectively reduce poverty especially in the rural areas where there is availability of labour and land distribution.

With a vast arable land that favours the cultivation of different varieties of crops and livestock production, Nigeria, is expected to explore the opportunities in agriculture to mitigate its poverty to a manageable level. UNECA (2022) noted that agriculture has been an important sector in the Nigerian economy in the past decades, and is still a major sector, despite the oil boom while Kolawole (2021) reveals that the Nigerian agricultural sector is diverse with over 25 crops and about seven livestock products. These provide potential for employment creation and poverty reduction.

In view of this recognition, the federal government has made efforts to reverse the rising trend of poverty in Nigeria. Some of these efforts include implementation of some poverty reduction programmes among them, the Operation Feed the Nation, The Green Revolution, The National Fadama Development Programme I, II and III, The National Economic Empowerment and Development Strategy (NEEDS) and the Agricultural Transformation Agenda (ATA) launched in 2012. More recently, the Federal Government also launched the Agricultural Promotion Policy (APP) in 2016 to improve food supply and output quality (IFAD, 2020).

However, despite these endowments in agriculture and a plethora of government agricultural policies and programs, Nigeria still suffers from extreme poverty as reported by the National Bureau of Statistics that 40% or 83 million people lived in poverty in 2021 (NBS, 2020). The NBS (2020) estimated that the number of poor people will increase to 90 million, or 45% of the population, in 2022. Consequently, The World Bank estimates that an additional one million people were 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 (World Bank, 2021). Efforts are current made to fund and encourage crop and livestock production in Nigeria because they have comparative advantage over other forms of agriculture in the country.

The paradox however, is despite the promotion of crop and livestock production with comparative advantages in poverty reduction, poverty still remains a key hurdle to economic growth and development in Nigeria (UNECA, 2022). The Central Bank of Nigeria (CBN, 2019) reported that poverty in Nigeria is concentrated in rural areas which accommodate more than 70% of the nation's poor. The question is: if crop and livestock production has a comparative advantage to improve the livelihood of the citizens; why has poverty continued to rise despite the credit facilities

by the federal government geared towards the promotion of crop and livestock production in Nigeria? The paper is prompted to find out if crop and livestock production has impacted on poverty levels of participants in Nigeria. The specific objectives of this paper are to investigate the asymmetric effect of crop production on poverty reduction in Nigeria; and examine the asymmetric effect of livestock production on poverty reduction in Nigeria.

The following formulated hypotheses guided the paper:

$H0_1$: Crop production has no significant asymmetric effect on poverty reduction in Nigeria

$H0_2$: Livestock production has no significant asymmetric effect on poverty reduction in Nigeria

The rest of the paper is structured into sections: section 2 covered materials and methodology, section 3 focused on results and discussion while Section 4 dwelt on analysis and discussion of the result of the findings.

Materials and Methodology

Conceptual Review

Three key concepts: crop production, livestock production and poverty reduction constitute the paper's conceptual framework. These concepts are reviewed in this section.

Crop Production: James Lind Institute (2019) defines crop production as the system of agriculture that is concerned with the production of crops for food and fiber. Production is a common agricultural practice followed by worldwide farmers to grow and produce crops to use as food and fibre. This practice includes all the feed sources that are required to maintain and produce crops. Some of the practices used during crop production include preparation of the soil, sowing of seeds, irrigation, and application of manure, pesticides, and fertilizers to the crops, protecting and harvesting crops, storage and preserving the produced crops (James Lind Institute, 2019).

To Acquaah (2012), the ultimate stages of crop production are mainly harvesting and storage. According to the author, harvesting requires art and practice because a large proportion of crops can be lost due to improper methods of harvesting. Another concern besides harvesting is storage. Storage of grains is to be given utmost priority as improper storage can result in the destruction of crops by pests or unfavourable environmental conditions. Thus, it requires proper knowledge of harvesting, methods of storage and protection of grains (Acquaah, 2012).

Acquaah (2012) stressed that once the crop is matured or fully ripens, it is cut and gathered (reaping) which are collectively called as harvesting. Harvesting depends on many factors like season, crop variety and maturity period, among others. Manual harvesting is done by using sickles but it is a tedious job as well as time-consuming. In recent times, machines called harvesters are used for harvesting, especially in large-scale farming. Following harvesting, threshing of the crop has to be performed. Threshing is the process, in which, the collected grains are separated from the chaff by beating or by the threshing machine. In small-scale farming, chaff and grains are separated from each other by a process called winnowing.

Livestock Production: Livestock production is the breeding and raising of animals for meat, milk, eggs, or wool, and for work and transport. Working animals, including horses, mules, oxen, water buffalo, camels, llamas, alpacas, donkeys, and dogs, have for centuries been used to help cultivate fields, harvest crops, wrangle other animals, and transport farm products to buyers (Thornton, 2010).

The scope of livestock production includes farm animals in the following categories; macro-livestock(cattle, sheep, goats, sheep, horses, donkeys, pigs, camels, among others), micro-livestock (rabbits, guinea pigs, snails api-culture, grass cutter, among others), poultry (chickens, guinea fowls, ostriches, quails, turkeys, ducks, geese, pigeons, among others) and pets (dogs, cats, among others). It also includes the following: animal breeding and genetics, animal nutrition, animal production and management, animal products, processing and handling, pasture/forage production and rangeland management, and micro-livestock production **(**Uchele, 2022**).**

Livestock production systems can be defined based on feed source, as grassland-based, mixed, and landless. Grassland based livestock production relies upon plant material such as shrub, rangeland, and pastures for feeding ruminant animals. Outside nutrient inputs may be used, however manure is returned directly to the grassland as a major nutrient source. This system is particularly important in areas where crop production is not feasible because of climate or soil, representing 30–40 million pastoralists. Mixed production systems use grassland, fodder crops and grain feed crops as feed for ruminant and mono-gastric (one stomach; mainly chickens and pigs) livestock. Manure is typically recycled in mixed systems as a fertilizer for crops (Ajmone-Marsan, 2010).

Landless systems rely upon feed from outside the farm, representing the de-linking of crop and livestock production found more prevalently in Organisation for Economic Co-operation and Development (OECD) member countries. Synthetic fertilizers are more heavily relied upon for crop production and manure use becomes a challenge as well as a source for pollution. Industrialized countries use these operations to produce much of the global supplies of poultry and pork. The FAO estimates that 75% of the growth in livestock production between 2003 and 2030 will be in confined animal feeding operations, sometimes called factory farming. Much of this growth is happening in developing countries in Asia, with much smaller amounts of growth in Africa. Some of the practices used in commercial livestock production, including the usage of growth hormones, are controversial (FAO, 2013).

Poverty Reduction: Poverty reduction which has been defined by Vanderschueren (1996) 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” (Avanger, 2005).

Theoretical Framework

The paper adopted the 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 influenced the programmes and policies of major multilateral and bilateral development agencies, and was the precursor to the human development approach.

In the 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 is important. Hence, the 1995 world summit on social development in Copenhagen 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."

Empirical review

Previous studies related to crop production, livestock production and poverty reduction reviewed in this section indicate a plethora of studies conducted on the subject-matter. Amarea, Cisséb, Jensenb and Shiferawa (2020) studied the impact of agricultural productivity on welfare growth of farm households in Nigeria: a Panel Data Analysis. The study sought to understand whether agricultural productivity, measured using land productivity, improves household consumption growth using nationally representative Living Standards Measurement Study - Integrated Surveys on Agriculture (LSMS-ISA) panel datasets from Nigeria, merged with detailed novel climate and bio-physical information. Panel regression was used for the analysis of data. Results showed that agricultural productivity was positively associated with labor and farm inputs. Consistent with the inverse land size-productivity relationship so often observed in the literature, land productivity decreased with increasing farm size. Another finding was that climate risk and bio-physical variables play a significant role in explaining agricultural productivity. Moreover, agricultural productivity had a significant and positive impact on household consumption growth. The results also indicated that while agricultural productivity has a positive impact on welfare growth for non-poor households, it had a negative impact for poor households.

Amarea, Cisséb, Jensenb and Shiferawa's (2020) study is relevant to the present study since both focuses on the development of agriculture in Nigeria. However, the panel regression adopted in

the former was misplaced since it was not cross-sectoral. The failure of the study to analyze productivity using relevant tools like stochastic frontier analysis also poses a great limitation.

A similar study was conducted by Udemezue, Chinaka and Okoye (2019) on cassava value chain as instrument for economic growth and food security in Nigeria. The study reviewed the cassava production trends, cassava value chain issues, value chain and the challenges for cassava production and processing in Nigeria. The study used questionnaire as the main instrument of data collection. This was augmented by secondary data obtained from the Federal Ministry of Agriculture and Natural Resources and the National Bureau of Statistics (NBS). Data were analyzed using impulse response functions and variance decomposition of the vector auto-regressive model.

Findings revealed that cassava value chains provide comprehensive information on the cassava production and processing as a guide for future and investment in the sector. Investment in cassava sector is more beneficial than other sectors in Nigeria since it has potentials to alleviate a nation from poverty states. Cassava value chain comprises input suppliers, farmer's/farmers' cooperatives, processors, traders, collectors, intermediate and final consumers within and outside the region. Cassava is now one of the priority crops to be used as a spring board to wriggle out of the menace of unemployment in the country since its production is increasing at 3 percent every day. Therefore, cassava value chain has the capacity to create new jobs and generate increased income and employment in the economy if properly harnessed. The study recommended that the extension linkage with research should be strengthened so as to facilitate the spread of improved cultivars and management practices to farmers. The involvement of more cooperative societies in the multiplication and sales of stems should be encouraged. Integration of information and supply of various inputs is necessary. A group approach to extension delivery should be further promoted and the use of existing and new cultivars should be made popular through an extended or expanded cassava multiplication programme. Effective strategies are needed for stakeholders to share their experiences with those of other countries of the sub region who are participating in the processing of cassava. Cooperation linkages are needed with other important stakeholders like agricultural research, microfinance institutions, quality standards organizations, and equipment fabricators.

Notably, the study's assessment of cassava production for economic growth and food security using the Vector Auto-regression (VAR) was plausible as the method of analysis was consistent with study objectives. This is because the standard VAR as a dynamic model treats all variables as endogenous which traces out the interdependent effects of shocks in each of the study variables on their corresponding innovations. However, the present paper does not adopt the value-chain approach which constitutes a departure of the focus of the present paper from that of the latter.

Yusuf., Egwaikhide., Saheed and Yahaya (2018) examined commercial livestock production and poverty alleviation in Kogi State: 2002-2016. The study used time series research design. The data were log normalized to eliminate heteroskedasticity and enhance normality. The data were analyzed by use of descriptive statistics (mean, standard deviation, minimum and maximum mean) and inferential statistics (correlation and multiple regression analysis). The results show that cattle

production has insignificant negative effect on poverty alleviation. However, sheep production showed a significant positive effect on poverty alleviation. Also, goat production showed a significant negative effect on poverty alleviation in the state, while pig production showed insignificant negative effect on the state's poverty alleviation. Similarly, poultry production showed a significant positive effect on the state's poverty alleviation. In view of these results, the study recommended that the state government should provide financial and technical support to sheep and poultry farmers in the state since their production activities positively help to reduce poverty level in the state through the enhancement of state per capita income. The state government should encourage new farmers to take to sheep and poultry farming.

The study emphasis on the analysis of livestock and poverty reduction is in line with contemporary research interests and its choice of cattle, goats, sheep and poultry is commendable since it is consistent with agricultural practices in Nigeria. However, the present paper is wider in scope as it also embraces crop production as part of the study variables.

While studying the effect of poultry production on poverty status of small-scale farmers in Oyo State, Nigeria, Babatunde, Adekunle and Olagunju (2012) used data from 104 small scale poultry farmers in Oyo state of Nigeria. The study examined the role of poultry production in rural poverty reduction using the questionnaire for data collection while descriptive statistics were used for data analysis. The results show that majority of the farmers were male (87 percent), married (87 percent), having family size of 5 to 7 persons (53 percent), above 44 years of age with farming experience of 7.5 years on average and with formal education (95 percent). The average net farm income (NFI) is N788, 164 per annum indicating that, the business is worth investing in. Poverty incidence, poverty depth, and severity of poverty are 49 percent, 23 percent and 13 percent respectively, the poor farmers need to generate an additional 23 percent of the fixed amount of income to cross the threshold of poverty. The result showed that male headed households and farmers without tertiary education are poorer. Poultry income and education level of the household head have significant, negative effects on poverty status of the households indicating that, additional increase in these variables will reduce the probability of being poor.

The study indicates a clear semblance with the present paper on the basis of their convergence on livestock production and poverty reduction since poultry is part of livestock production. However, the descriptive statistics adopted by the former in analyzing data was too simplistic in clearly unveiling the rudiments of livestock production that affect respondents' poverty in Nigeria. The present paper shall therefore, adopt non-linear auto-regressive distributed lags (NARDL) for data analysis.

Methodology

Research Design: *Expost-facto* research design was employed for this paper. The design was considered appropriate for this paper because it describes the statistical association between two or more variables using time series data. It thus, allows for the testing of expected asymmetric effects of crop production and poverty reduction on one hand, and livestock production and poverty reduction on the other hand.

Sources of Data Collection: The purpose of this paper is to examine the asymmetric cause–effect relationships among the study variables and hence, the data used comprises secondary data collected from the publications of the Central Bank of Nigeria (CBN) statistical bulletin for a period of 46 years (1976-2022). These data were generated on crop production (Billion Naira); livestock production (Billion Naira); and poverty (%).

Method of Analysis: The formal pre-estimation diagnostics tests used in the paper were Phillip-Perron unit root test to ascertain the stationarity of the data and NARDL bound test for co-integration test analysis that would not permit us to obtain a robust estimate of the parameters. Phillips-Peron (PP) was adopted due to the fact that, the data generating process was not an Auto Regressive (AR) (1) process. According to Okpanachi, Ezie and Ropheka (2021), PP test is non-parametric and corrects the statistic to conduct for autocorrelation and heteroskedasticity (Stock, 1994). The evolution of the Phillips-Perron test came about to overcome the weaknesses of the Augmented Dickey Fuller (ADF) test which assumes that residual errors are statistically independent and have a constant variance.

The Non-Linear Autoregressive Distributed Lag Model (NARDL) advanced by Shin, Yu and Greenwood-Nimmo (2014) was used for data analysis. This is in anticipation of a non-linear relationship between the dependent and the independent variables used in the paper. The main advantage of this model lies in its' ability to simultaneously capture the short-run and long-run asymmetries through positive and negative partial sum decompositions of changes in the dependent variables. In addition, the approach is less computationally intensive and also has computational advantages over other models particularly in terms of dealing with time series of different orders of integration. It also allows modeling the cointegration relation that could exist between the dependent and independent variables as well as it permits to test both the linear and nonlinear cointegration. Post-estimation tests employed in the paper were Breausch-Godfrey serial correlation LM test, Breausch-Pagan-Godfrey Heteroskedasticity test and stability test.

Model Specification: With the aim to ascertain the asymmetric effect of crop and livestock production on poverty reduction in Nigeria, the paper assumed that poverty (POV) is a function of agricultural production. Mathematically, this implies that POV = f (AGP) (1)

Where Pov = Poverty; and

AGP = Agricultural Production.

The independent variable, AGP will be disaggregated into its two (2) main components as follows: crop production (CRP) and livestock production (LSP). Meanwhile the ratio of crop production contribution to GDP (CGDP) will be used as proxy for crop production, and the ratio of livestock production contribution to GDP (LGDP) was proxy for livestock production.

Transforming equation 1 into Econometrics form leads to:

$$POV_t = \alpha_0 + \alpha_1 AGP_t + \mu_t \quad (2)$$

Where AGP = CGDP & LGDP

Thus, equation 2 becomes:

$$POV_t = \alpha_0 + \alpha_1 CGDP_t + \alpha_2 LGDP_t + \mu_t \quad (3)$$

Where:

POV = Poverty (%)

CGDP = Ratio of Crop Production to GDP (%)

LGDP = Ratio of Livestock Production to GDP (%)

t = Time Trend

α_0 , β_0 , λ_0 = Intercept or Constant Parameter

α_0 ,- α_2 , = Slope of the explanatory variables or parameters to be estimated.

μ_t = Error Term or white noise.

Equation (3) is the baseline model for determining the effect of crop and livestock production on poverty reduction. To capture the possible asymmetric effect of crop and livestock production on poverty reduction in Nigeria, NARDL technique decomposes the independent variables which are crop production and livestock production into two parts: 1) partial sum of positive change denoted by $CGDP^+$ and $LGDP^+$; 2) partial sum of negative change denoted by $CGDP^-$ and $LGDP^-$and including both of them as separate regressors in the model, the model becomes:

$$POV_t = \Phi_0 + \Phi_1 CGDP^+ + \Phi_2 LGDP^+ + \Phi_3 + CGDP^- + LGDP^- + \mu_t \quad (4)$$

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

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

$$+ \sum_{k=1}^{o} (\pi_K^+ \Delta LGDP^+_{t-K} + \pi_K^- \Delta LGDP^-_{t-K}) + \delta ECT_{t-1} + \mu_t \quad (5)$$

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

$$+ \sum_{k=1}^{m} (\pi_J^+ \Delta CGDP^+_{t-J} + \pi_J^- \Delta CGDP^-_{t-J}) + \sum_{k=1}^{n} (\theta_K^+ \Delta LGDP^+_{t-K} + \theta_K^- \Delta LGDP^-_{t-K}) + \mu_t \quad (6)$$

Using the ECM proposed by Inder (1993) with some modification to the focus of this study, the model is specified as follows:

$$\Delta POV_t = u\,\delta_{t-1} + \sum_{i=1}^{n}\gamma\Delta POV_{t-1} + \sum_{k=1}^{m}(\pi_J^{+}\Delta CGDP^{+}{}_{t-J} + \pi_J^{-}\Delta CGDP^{-}{}_{t-J}) + \sum_{k=1}^{n}(\theta_K^{+}\Delta LGDP^{+}{}_{t-K} + \theta_K^{-}\Delta LGDP^{-}{}_{t-K}) + \mu_t \quad (7)$$

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: $\sum_{j=0}^{m}\pi_J^{+} = \sum_{j=0}^{n}\pi_J^{-} = \sum_{j=0}^{o}\theta_J^{+} = \sum_{j=0}^{p}\theta_J^{+}$.

Results and Discussion

This paper begins by conducting descriptive statistics to examine the mean, standard deviations and auto-correlation properties of the dataset. This is followed by trend analyses of the study variables before carrying out the Unit Root test to ascertain the stationarity properties of the series. The NARDL is then conducted as well as pre-estimation test results. The result of descriptive statistics is presented in Table 1.

Table 1: Summary of Descriptive Statistics of the Study Variables

Variable	Mean	Std. Dev.	Skewness	Kurtosis	JarqueBera	Probability	Obs
POV	328411.6	251.699	-0.625100	3.425274	6.775343	0.0338	46
CGDP	309735.7	330.184	0.8053231	3.047490	0.179783	0.9140	46
LGDP	260513.4	140,290	-0.663290	4.563416	9.073568	0.0107	46

Source: *Extract from Results of E-views 10, (2023)*

Statistics presented in Table 1 on the summary description of the variables used in the paper were used to test for normality properties of residuals in the data set. To achieve this purpose, the paper compared skewness values with the standard value of Skewness of a symmetric distribution, such

as normal distribution, which is zero. Results reveal that the Skewness values for all the series were close to zero, suggesting that they were Skewness normal. While some of the values are skewed to the left (POV, CGDP & LGDP) the value of CGDP skewed to the right. This suggests that the series exhibit the characteristics of a normal distribution.

The Kurtosis of a distribution which measures the peakness of the distribution that is assumed to be normal is 3. In Table 2, the series values were all close to 3. Thus, the series do not exhibit characteristic of a distribution with a high peak and flat tails called leptokurtic (k>3). They do not also have substantially flat-topped curves and thinner tails called platykurtic (k<3), but they have generally exhibited mesokurtosis (k=3) suggesting a normal distribution.

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.

3.1 Trend Analyses of the Study Variables

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

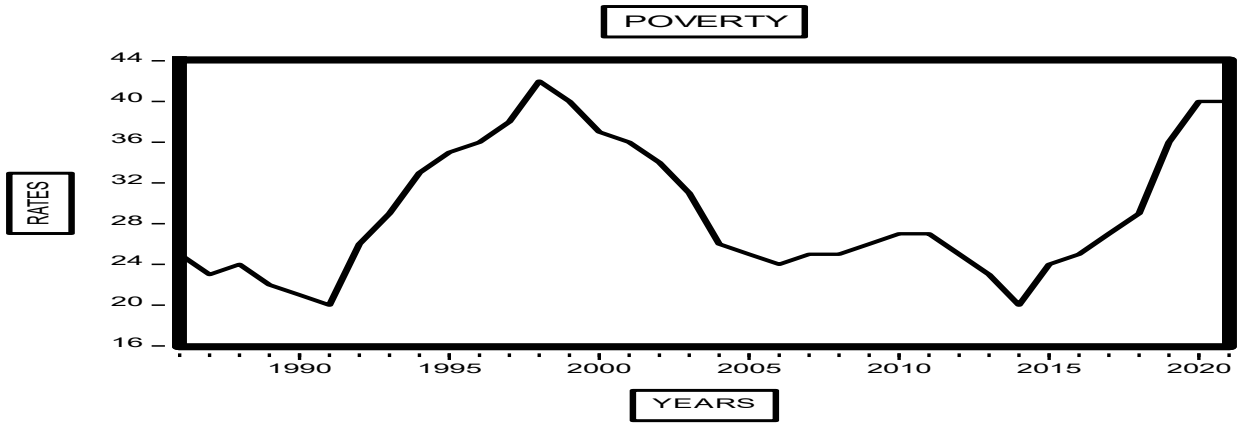

Figure 1: Trend of Poverty in Nigeria

Source: *Extract from Results of E-views 10, (2023).*

The trend analyses of Figure 1 shows that poverty trended at low ebb before 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 to 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.

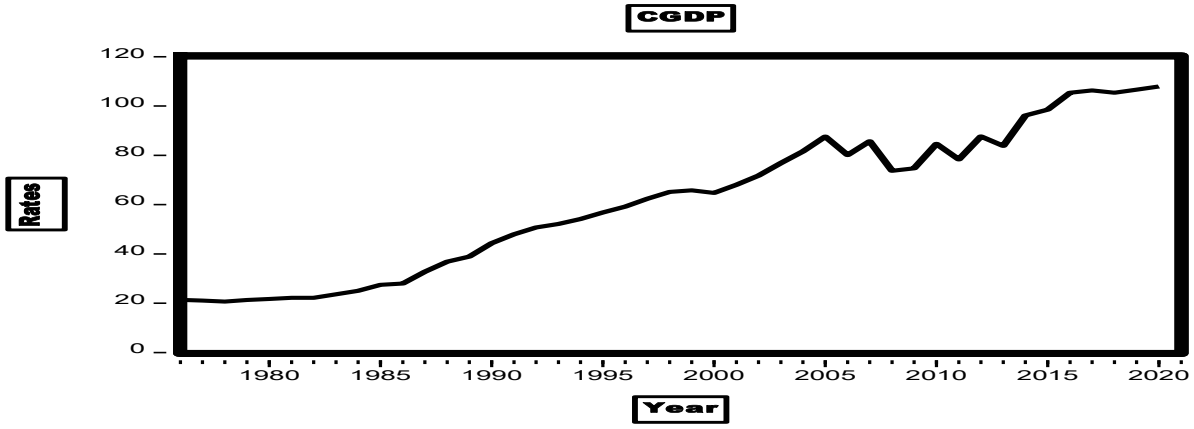

Figure 2: Trend of Crop Production's contribution to Gross Domestic Product in Nigeria
Source: *Extract from Results of E-views 10, (2023).*

The trend of Crop Production's contribution to Gross Domestic Product in Nigeria as depicted in Figure 2 indicates a steady rise in crop production over the years. From 20% in 1980, the rate of crop production's contribution to GDP rose to 60% in 2000 and further to 80% in 2005. There were mild fluctuations from 2010 to 2015, probably due to increased insecurity between farmers and herders. The trend has however, stabilized thenceforth. Thus, efforts at promoting crop production in Nigeria have yielded little but positive results within the study period.

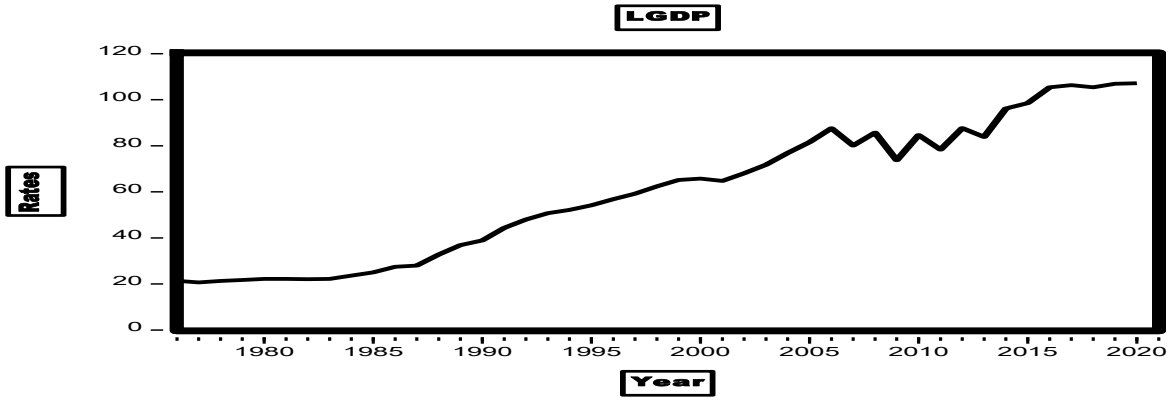

Figure 3: Trend of Livestock Production's contribution to Gross Domestic Product in Nigeria
Source: *Extract from Results of E-views 10, (2023).*

Figure 3 revealed a similar trend of livestock production and crop production in Nigeria. Like crop production, the trend of livestock production'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 2005. Again, there were mild fluctuations from 2010 to 2015, which could be due to increased insecurity between farmers and herders. The trend has however, stabilized thenceforth. Thus, efforts at promoting livestock production in Nigeria have also yielded little but positive result within the study period.

Unit Root Test Result

In order to estimate the trend of series and its direction so as to ensure that the data for the variables used in the model do not fluctuate unnecessarily, unit root test was conducted to ascertain the stationary status of the variables using Phillips Perron (PP) technique. The results of the unit root tests are presented in Table 2:

Table 2: Summary of Unit Root Test Result

Variable	PP Test Statistics	Critical Values	Order of Integration
POV	-1.694171**	-2.928142	I(1)
CGDP	-0.167481**	-2.928142	I(1)
LGDP	0.580563*	-2.928142	I(0)

Note: The tests include intercept and trend; ** significant at 1%; ** significant at 5%*

Source: Authors Computation, 2023 (Eviews-10)

As shown in Table 2, results of PP test indicate that two of the variables (POV and CGDP) were found non-stationary at levels and at 5% level of significance respectively. They were however, stationary at first difference. Hence, the unit roots PP test for the variables were accepted at levels for the two variables of interest. The variable LGDP however, was found to be stationary at level when considered at 5 percent level of significance. Thus, the variables were found to integrate in a mixed order which satisfies the condition for using asymmetric bounds approach to co-integration test.

Asymmetry Test

The paper conducted the asymmetry test to investigate the long-run and short-run asymmetric properties of the variables under study. The null hypothesis of the test is that the decomposition of the study variables in partial sums of positive and negative changes in CGDP and LGDP is not significant (i.e. no asymmetries), and the alternative is that the decomposition of the changes is significant (i.e. there is asymmetries).

Table 3: Results of the Asymmetry Wald Test

	Wald Statistic		Evidence of Asymmetry	
Variables	Long-run	Short run	Long-run	Short-run
POV	7.554491 (0.0060)*	5.25422 (0.0011)**	Yes	Yes
CGDP	12.70954 (0.0000)*	9.591129 (0.0000)*	Yes	Yes
LGDP	11.65101 (0.0000)*	9.086425 (0.0000)*	Yes	Yes

Note: The tests include intercept and trend; ** significant at 1%; ** significant at 5%*

Source: Authors Computation, 2023 (Eviews-10)

The result of Wald test presented in Table 3 showed that the null hypotheses that there is no asymmetry in the short and long-run coefficients are rejected for all the variables. The result further confirms the justification of the NARDL model adopted in this paper.

Co-integration Test Result

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

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	21.58237	10%	3.03	4.06
K	4	5%	3.47	4.57
		1%	4.4	5.72

Source: Authors Computation, 2023 (Eviews-10)

From the result of bounds test presented in Table 4, the F statistic value of 21.58237 is greater than the upper and lower bound of 3.47 and 4.57 at 5% level of significance. This implies that long-run relationship exists among the variables. This suggests the rejection of the null hypothesis of no co-integration among the variables. Hence, there is an asymmetric long-run relationship between poverty, livestock production and crop production in Nigeria.

Table 5: NARDL-ECM Regression Result

NARDL-ECM				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
D(POV(-1))	0.443046	0.113047	3.919143	0.0007
D(LGDP_POS)	0.099748	0.704260	0.141635	0.8887
D(LGDP_POS(-1))	-4.706718	0.812369	-5.793820	0.0000
D(LGDP_POS(-2))	-3.698609	0.854772	-4.327012	0.0003
D(LGDP_NEG)	2.573615	1.452107	1.772332	0.0902
D(LGDP_NEG(-1))	-0.632543	1.159367	-0.545593	0.5908
D(LGDP_NEG(-2))	-2.655214	1.061058	-2.502422	0.0203
D(CGDP_POS)	-0.905162	0.541040	-1.673005	0.1085
D(CGDP_POS(-1))	4.202502	0.778905	5.395394	0.0000
D(CGDP_POS(-2))	4.721760	0.889323	5.309390	0.0000
D(CGDP_POS(-3))	1.861095	0.488893	3.806755	0.0010
D(CGDP_NEG)	1.009062	0.455480	2.215381	0.0374
CointEq(-1)	-0.297062	0.144287	-8.989445	0.0000
R-squared	0.966648			
Adjusted R-squared	0.939361			
S.E. of regression	3.418346			
Sum squared resid	257.0720			
Log likelihood	-95.81005	.		
F-statistic	35.42429			
Prob(F-statistic)	0.000000			
Long-Run NARDL				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
LGDP_POS	9.080733	0.737229	12.317377	0.0000
LGDP_NEG	3.497803	0.929809	3.761851	0.0011
CGDP_POS	-10.092587	0.810491	-12.452441	0.0000
CGDP_NEG	-1.171279	0.940516	-1.245357	0.2261

Source: Authors Computation, 2023 (Eviews-10)

Table 5 shows that the lagged error correction model satisfies all the three requirements of being negative, significant and less than unity. The speed of adjustment was however, slow as a shock in the system will be returned to equilibrium at an average speed of 29.7%. The R-Square result of 0.966648 implies that the NARDL model has very high explanatory powers of 96.7% while the remaining 3.3% were due to other factors summed up in the error term and added to the model. The F-statistic value of 35.424229 was significant at 1% level which indicates overall fitness of the NARDL model.

Robustness Test Results

Robustness tests conducted in this study were Breusch-Godfrey-Serial-Correlation Test, Heteroscedasticity-ARCH Test, Normality test and CUSUM test for stability of residuals.

Table 6: Robustness (Test) Result

Test		Outcomes	
		Coefficient	Probability
Breusch-Godfrey-Serial-Correlation Test	F-stat.	0.515819	0.6047
Breusch-Pagan-Godfrey Heteroscedasticity Test	F-stat.	0.644538	0.8262
Normality test	Jarque-Bera	3.359363	0.1893

Source*: Extract from E-views 10, (2023).*

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 (0.6047 and 0.8262) were found to be greater than 0.05. Also, the normality test as presented in Table 6 revealed that Jarque-Bera test result of 3.359363 with probability value of 0.1893 has attained normality at 5% level.

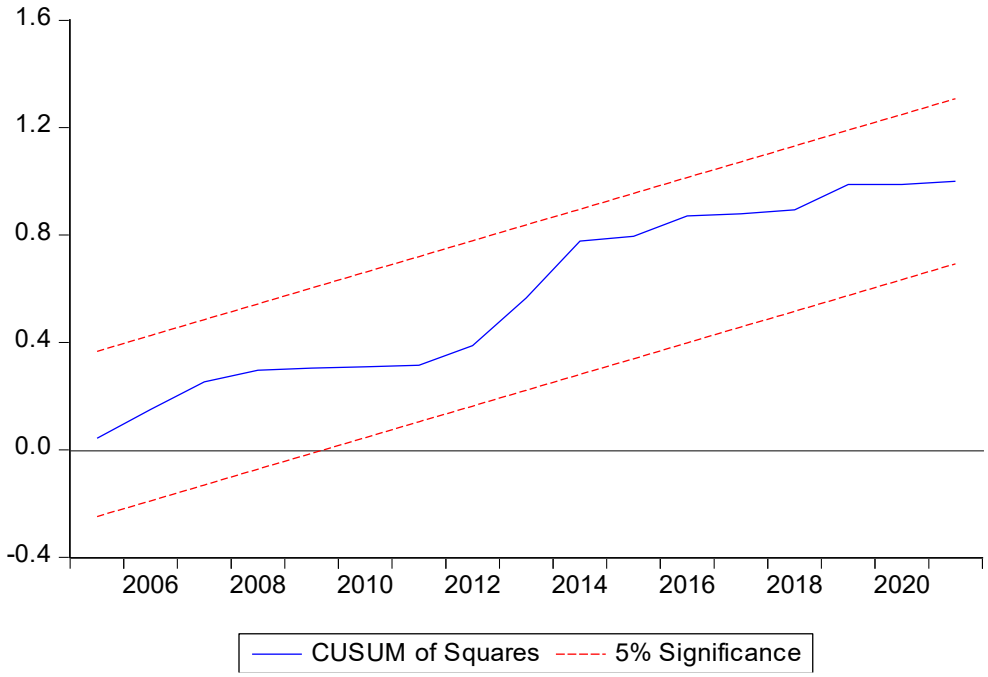

Figure 4: Cumulative Sum of Squares Recursive Residuals (CUSUMsq) Stability Test.

The results of Cumulative Sum of Squares Recursive Residuals (CUSUMsq) presented in Figure 4 indicated that the model is stable and the regression equation is correctly specified as the plot of the chart lies within the critical bounds at 5% significant level. Thus, the hypothesis of stability is not rejected.

3.2 Discussion of Findings

The impetus to this paper is to find out the asymmetric effects of crop and livestock production on poverty reduction in Nigeria. Results of the paper showed that there exist long-run joint negative asymmetric effects of crop production on poverty reduction and corresponding positive asymmetric effects of crop production in Nigeria. This indicates that the long-run negative effect

of crop production on poverty had a corresponding positive effect on poverty. Thus, as crop production decreases, poverty increases. This negative effect was not significant at 5% level while the corresponding positive effect was significant at 5% level. This means that crop production has impacted positively on poverty reduction in Nigeria. This finding agrees with that conducted by Udemezue, Chinaka and Okoye (2019) which found cassava as priority crop to wriggle out the menace of unemployment in the country since its production is increasing at 3 percent every day, concluding that cassava value chain has the capacity to create new jobs and generate increased income and employment in the economy if properly harnessed.

The paper also found that there exists a long-run joint positive asymmetric effect of livestock production on poverty reduction in Nigeria. This indicates that the long-run positive effect of livestock production on poverty had a corresponding positive effect on poverty. Thus, contrary to expectation, as livestock production increases, poverty also increases. However, these positive effects are not significant at 1% level. This suggests that efforts to reduce poverty through livestock production have not yielded remarkable results. This finding is consistent with that of Yusuf, Egwaikhide., Saheed and Yahaya (2018) whose study on commercial livestock production and poverty alleviation in Kogi State found that cattle production has insignificant negative effect on poverty alleviation, even as goat production showed a significant negative effect on poverty alleviation in the State, while pig production showed insignificant negative effect on the State's poverty alleviation.

Conclusion

The importance of agriculture to the Nigerian economy cannot be overstressed. As the mainstay of the economy, agriculture, especially crop and livestock production has employed over 70% of Nigerians (NBS, 2020). Efforts to improve agricultural production through increased funding of principal cash crops like rice, cassava, cocoa, guinea corn, tomato and yam, among others have yielded long-term asymmetric effect on poverty as the average rise in the production levels led to reduction of poverty in Nigeria. However, livestock production has not contributed significantly to poverty reduction and requires more commitment from the stakeholders to achieve its significant contribution to poverty reduction in the country.

Recommendations

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

i. The Federal Ministry of Agriculture and Rural Development as well as State Ministries of Agriculture should sustain policies while international donor agencies and other stakeholders should continue to support poverty reduction programmes through interventions in crop production such as the Anchor Borrowers, Fadama Programme and Federal Initiative on Rice production, among others since these programmes have been found to impact positively on beneficiaries' poverty levels;

ii. The Federal Government and international donor agencies like the World Bank, Food and Agricultural Organization and other similar agencies should improve on their funding, capacity building and supervision of participants and projects in livestock ventures in Nigeria by imparting adequate training on modern techniques on animal husbandry such as ranching, disease prevention and treatment, feeding and marketing to enhance positive effect of livestock production on poverty reduction in Nigeria.

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