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# Unraveling the Tragic Mystery Plummeting the Growth of Nigerian Livestock Sector

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**Abstract**

The present research determined the performance of Nigerian livestock sector using dated data that spanned from 1981 to 2019. The data were sourced from FAO, UNCTAD and Central Bank of Nigeria data banks; and, data analyses were achieved using both descriptive and inferential statistics. Based on the findings it was inferred that the livestock sector has efficient integration with the macro-economic indicators that prevailed in the economy. However, the degree of integration of the sector was inefficient despite the stability of the sector which owes to delay in the ability of the sector's equilibrium to correct its disequilibrium. Furthermore, poor utilization of sector's fund, high inflation, red-tapism and economic pilfering were the macro-economic indicators that affected the performance of the sector. The empirical evidences showed that the directions of the sector Gross domestic product (GDP) and production was influenced by the internal and external economics respectively. Thus, the study urge the policymakers to strengthen the internal mechanism that checkmate the utilization of the funds allocated to the sector and should encourage domestic production of agro-allied products so as to protect the economic from being vulnerable to foreign market shocks. Also, trade policies *viz*. export promotion of livestock products and stringent embargo on importation of livestock products should be enhanced, thus enhancing the stability of the sector's economy.

**Keywords**: GDP, growth, livestock, macro-economic, indicators, Nigeria

## Introduction

In the coming decades, Nigeria will change drastically as its population will increase exponentially and transform extensively in the next three decades. The Nigerian population is projected to hit more than 400 million by 2050 in a business-as-usual scenario, from about 198 million today and the size of the economy to about five times the size of the economy by 2050 (FAO, 2019). The country is promoting a "structural economic transformation" and "sustainable diversification" in response to a rapid and persistent decline in oil prices since mid-2014 that has constrained growth (Federal Ministry of Budget and National Planning, 2017).

The Nigerian government has often reiterated the need to diversify its economy from the previous oil sector overdependence that has unfortunately plunged the country into recent economic turmoil due to unwarranted neglect of other main sectors such as agriculture, which once made the country a major stakeholder in the world's food supply (Animal Care, 2020). The question therefore is how did the nation ignore the greatest gift that was bestowed upon it?

Undoubtedly, the emergence of crude oil in the 1970s suffocated the agricultural sector, through a huge rural-urban drift. As a result, people overlooked farms for white collar works in the city, leading the once food sovereign nation to rank among the 39 possible food insecure nations (Animal Care, 2020). According to FAO, as cited by Animal Care (2020), the most populous African nation with enormous potential ranging from inert human and natural endowment is stories of people screaming of hunger and thirst. Consequently, revitalizing and recovering itself with its inert agricultural prowess that has been strangulated by the oil boom has become inevitably important for the country.

A strong linkage exists between agriculture and the economy. Economic growth is important for poverty reduction, and Nigeria needs to concentrate on agricultural production to stay out of its current state of recession, and one of the areas of focus should be livestock production (Adams, 2016). As an essential component of general agriculture, the livestock industry is a crucial contributor to any nation's economic growth and development (Ojiako and Oloyede, 2008). In Nigeria, according to Ojiako and Oloyede (2008), despite its acknowledged importance, the livestock sub-sector tends to play a decreasing role in national development in view of its contribution to the agricultural GDP of the country.

As an integral part of the agricultural sector, the livestock industry has been highlighted as a major player that can help align the country with its economic diversification policy, taking stock of the country's livestock population (Premium Times, 2016). The then Minister of Agriculture (Audu Ogbeh) declared in 2016 that the nation had 19.5 million cattle, 72.5 million goats, 41.3 million sheep, 7.1 million pigs and 145 million chickens (Premium Times, 2016; Federal Ministry of Agriculture and Rural Development (FMARD), 2017; Makun, 2018). Comparing the above figures with the rising population of 180 million people, it is therefore rational to state clearly that there is a logical potential in the livestock industry that offers enormous economic prospects.

National Animal Production Research Institute (NAPRI) quoted the current Agriculture Minister (Sabo Nanono) as saying that the Nigerian livestock industry is a national asset worth ₦30 trillion ($96.77 billion) that should be handled with care (Mojeed, 2019). Nigeria has over 20 million herds of cattle and several million herds of goats, sheep, pigs, donkeys and horses, a United Nations study said. As quoted by NAPRI, the AgricultureMinister advised Nigerians to expunge from the agricultural sector what he described as "dirty politics" in order to allow it to make a significant contribution to the GDP and achieve the desired growth (Mojeed, 2019).

In the same vein, Professor Eustace Iyayi, Director General of the Nigeria Institute of Animal Science (NIAS), estimated that if all the right mechanisms are put in place over the next decade, at least the size of the Nigerian livestock industry could be ₦50 trillion ($161.3 billion) (This Day, 2020). Correct structures include adequate infrastructure for the growth of the supply chain, expansion and maintenance, funding, research and development for new breeds, and operator capacity development. In addition, the NIAS DG estimated that the industry's current valuation is at least ₦30 trillion ($96.77 billion) (This Day, 2020). Therefore the current value of the industry will represent approximately 20 per cent of Nigeria's Gross Domestic Product and more than 30 percent of today's GDP at the pace of the 10-year forecast figure.

The NIAS DG claimed that the industry was massively under-producing despite the growth rate, since Nigeria imports 70 and 25 percent of its beef and poultry, respectively. In

addition, about 1.3 million metric tons of milk is consumed annually by the nation and 60 percent of it is imported (This Day, 2020).

The increasing population, raising incomes and urbanization are contributing to higher demand for livestock products. Statistics suggest that Nigeria has already encountered meat shortages due to high local consumption levels (Essiet, 2019). Despite its competitive advantages, Nigeria has one of the lowest indices of animal productivity and value chain growth in Africa, according to FMARD (Vanguard Newspaper, 2020). The possible reason is high risk which jeopardize the development of the sector, thus having broader negative impacts on the public health, the environment and the livelihood. In livestock and livestock goods, there are large supply and demand gaps with the population steadily rising at an annual growth rate of 3.1 percent. Corroborating this, the Food and Agriculture Organization (FAO) estimated that consumption of beef, poultry meat and milk will increase from 117 to 253 and 577 percent in Nigeria between 2010 and 2050, respectively (Vanguard Newspaper, 2019).

The population of Nigeria has been extrapolated to reach 219.15 million by 2025 (FAO, 2019; Vanguard Newspaper, 2020). The demand for livestock and livestock products would further increase with this alarming geometric increase in population, predisposing the country to increased imports to fulfill its needs for animal protein. This therefore, implies that in view of the rising demand for meat, the livestock industry is a major business in Nigeria. Consumption of meat and milk is expected to rise as disposable incomes increase alongside population growth in the coming years.

Livestock supports the livelihoods of approximately1.3 billion people in developing countries and accounts for up to 30% of the Gross domestic product (GDP) of agriculture in sub-Saharan African countries. This is achieved in activities that have great value chains attached to each of them through the supply of meat, milk, wool, hides and skins (Kayode, 2020). Interestingly, demand for livestock products in sub-Saharan Africa is rapidly growing; fueled by increasing population, urbanization and improved incomes, leading to changes in diet, consumption habits and dietary support provided by high-value commodities such as meat and milk. Whereas the Nigerian landmass and increasing population would have been sufficiently harnessed and mobilized and targeted to function in the creation of the livestock value chain, a wrong approach has been implemented; the federal government is trying to be the sole player in this region. The poosible reason owes to the high cost associated with livestock intensification in order to have large societal impact beyound the livestock sector per se.

Livestock plays a critical role in the country's small-scale and marginal farmers' earnings and livelihoods. The production of livestock is an essential component of Nigerian agriculture with ample social and economic potential, as the sector has the resources to generate new opportunities for farmers and provide future generations with more sustainable and healthy diets. The livestock economy, despite the aforementioned ability, remains lowly productive, underdeveloped and hardly attracts investment. This is due to poor intensifiaction of the livestock sector.

In view of the above, the FAO has tasked the Federal Government of Nigeria to demonstrate greater commitment to improving the food security and economic development of the country in the livestock sector (Vanguard Newspaper, 2020). Essiet (2019) also stated that stakeholders urged the country to invest adequate resources in the livestock subsector in order to feed the rising population with the production of high-value food products. Pragmatic action is therefore required to help the livestock sector meet the rising demand and improve the food

security of the country. Achieving this requires a dynamic institutional response that can stimulate rural income and job opportunities, protect smallholder farmers' livelihoods and enhance the quality of resource usage at all levels of the value chain.

### *Trend Pattern of the Livestock Sector and its Contribution to the Economy*

The trend pattern of the Livestock's GDP both in the nominal and real value was marked by a steep increase for the past four decades, thus an impressive performance (Figure 1). Besides, there was no much inflation in the GDP as the real livestock's GDP trend was marginal farther from the nominal GDP. However, the growth pattern of the livestock GDP has not been impressive as both the nominal and real values were marked by a steep decline at slight intervals (Figure 2). The trend pattern of livestock's GDP contribution to total GDP witnessed a steep decline for three decades (1981-2000) and thereafter became stagnant in the last decade (2001-2019) of the studied period (Figure 3). However, the trend pattern of the livestock's GDP contribution to agriculture GDP has been stagnant for the past four decades (Figure 3).

The decade-wise results showed that the livestock GDP has been on the increase from 1981 to 2018; the incremental change between 1990 and 2000 was gentle while that between 2000 and 2010, and, 2010 and 2018 were steep (Table 1). The decade-wise results showed the annual average of the growth to be marked by a cyclical trend; the peak points been first and third decades while the second and the last decades ebbed. Furthermore, the contribution of the sector to both total and agriculture GDPs across the decades has been on the increase. Evidently, in the last decades (2011-2019), the average annual performance of the sector both to growth and contribution to the economy has plummeted.

Generally, it can be suggested that the sector has not farewell in the economy of the country, thus the need to determine the nexus of macro-economic indicators with the livestock's sector so as to identify the economic variables affecting the efficiency of the sector's economic reality. The importance of livestock's sector to the country's economy viz. employment creation, income generation, industrial growth and foreign exchange earning has made it indispensable to identifying the pros and cons of the sector so as to serve as a guide to policymakers in containing the inefficiency affecting the sector. Good guided empirical information will help in enhancing the growth and development of Nigeria's livestock sector in specific and the economic at large. Thus, in lieu of the above, a research on the effect of macro-economic indicators on the economic reality of Nigerian livestock sector was conceptualized. The specific objectives were to determine the effect and impact of macro-economic indicators on the economic reality of livestock sector and the causal relationship of the sector with the macro-economic indicators.

**Table 1.** Average annual livestock GDP

| Year | LGDP (₦) | RLGDP (₦) | Growth rate | | Contribution | |
|---|---|---|---|---|---|---|
| | | | NLGDP % | RLGDP % | % TGDP | % AGDP |
| 1990 | 413815.20 | 348217.70 | 3.12 | 5.69 | 2.66 | 14.87 |
| 2000 | 496080.40 | 395413 | 1.83 | 2.97 | 2.36 | 12.05 |
| 2010 | 749088.80 | 665244.80 | 5.88 | 5.39 | 1.94 | 7.85 |
| 2019 | 1104841 | 989570.80 | 2.69 | 2.93 | 1.69 | 7.07 |
| Overall | 669172.90 | 579087.40 | 3.42 | 4.32 | 2.19 | 10.64 |

Source: Authors' own computation, 2020
Note: LGDP: Livestock Gross Domestic Product; RLGDP: Real Livestock Gross Domestic Product; NLGDP: Nominal Livestock Gross Domestic Product; TGDP: Total Gross Domestic Product; AGDP: Agricultural Livestock Gross Domestic Product

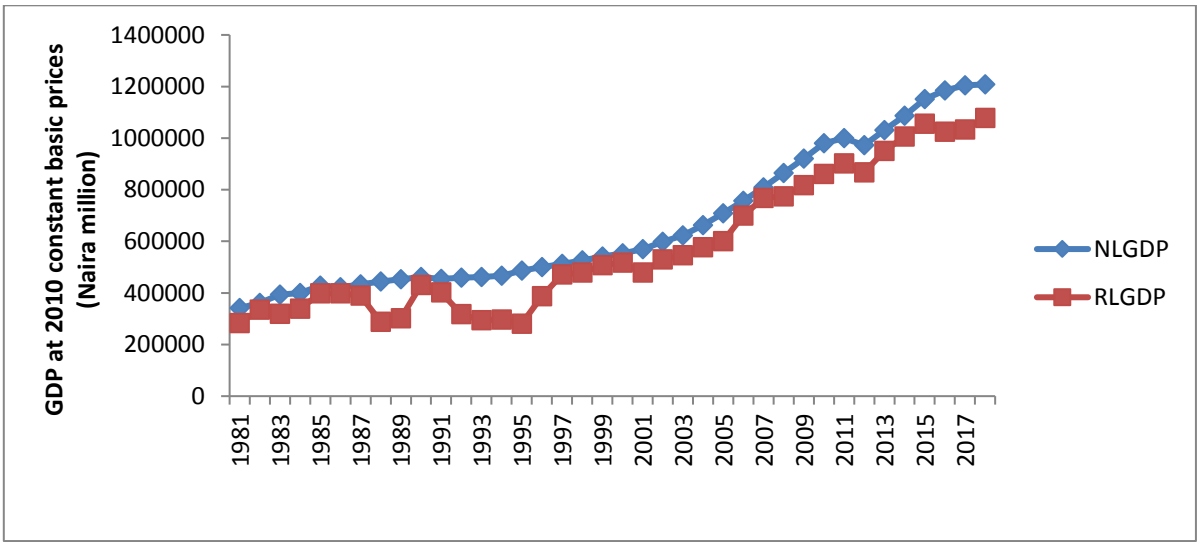


**Figure 1.**Trend pattern of Nominal and Real Livestock GDP (1981-2019) (CBN data bank, 2020)

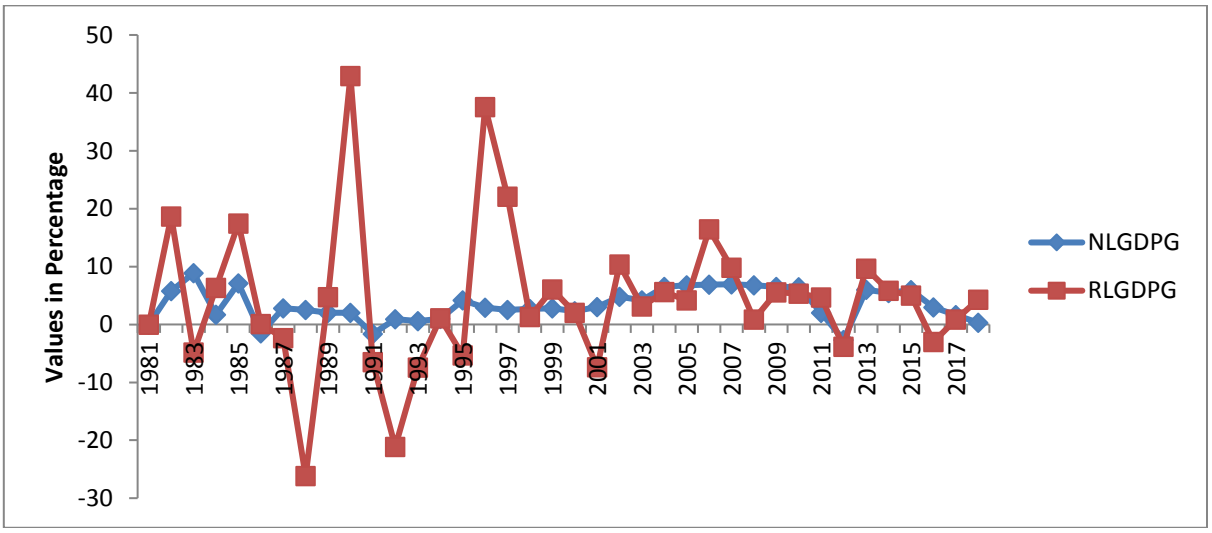


**Figure 2.** Growth rate pattern of Nominal and Real Livestock GDP (1981-2019) (Authors' own computation, 2020)

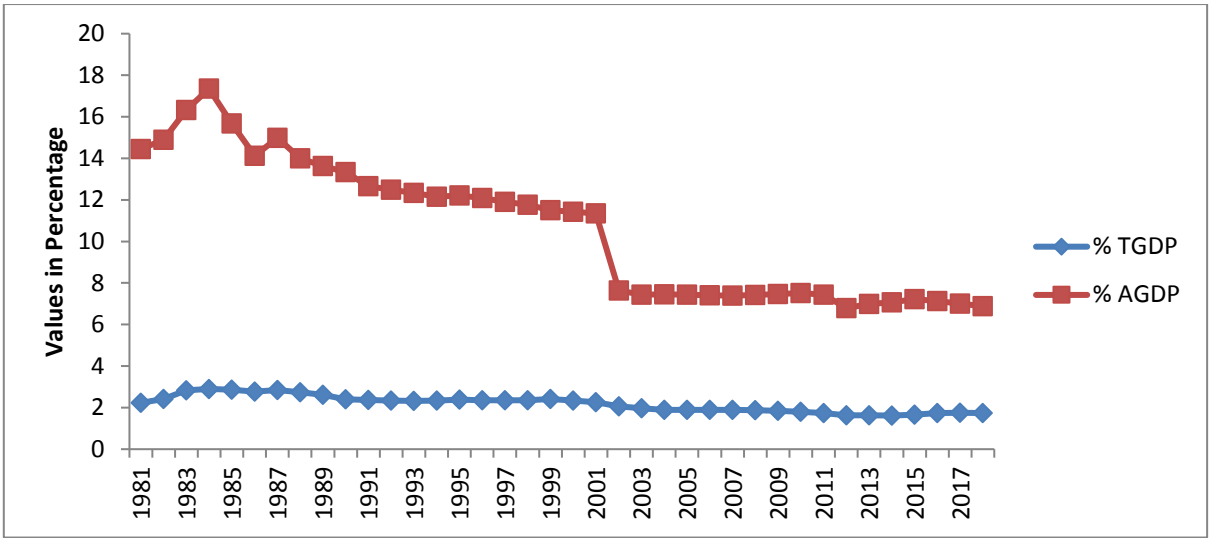


**Figure 3.** Percentage contribution of Livestock GDP to Total GDP and Agriculture GDP (1981-2019) (Authors' own computation, 2020)

## Research Methodology

The study used time series data that ranged from 1981-2019; sourced from Central Bank of Nigeria (CBN), FAO and UNCTAD databases. The data covered Livestock's Gross Domestic Product (LGDP), Gross livestock production index (GLP), General Government Final Consumption Expenditure (GCE), Share of General Government Final Consumption Expenditure as percentage of GDP (SGCE), Nominal Gross National Income (GNI), Nominal Gross National Income Per Capita (GNIC), Consumer Price Index (CPI), Agricultural Science and Technology Indicators (ASTI)-Expenditures (Total spending) (TSAT), ASTI-Expenditures (Share of value added) (SAT), ASTI-Researchers (Total researchers) (TAR), ASTI-Researchers (Per 100 000 farmers) (RPF), Credit to allied sector (CR), Exchange Rate, Export and Import values of agricultural products. Objective 1 and 2 were achieved using ADF, Engel-Granger cointegration test and Error correction model (ECM); and, Granger causality test.

### *Model Specification*

### Augmented Dickey-Fuller Test (ADF)

Following Blay et al. (2015); Singh et al. (2016) and Sadiq et al. (2016), the Augmented Dickey-Fuller test (ADF) used is shown below:

$$\Delta P_t = \alpha + P_{t-1} + \sum_{j=2}^{it} \beta_i \Delta P_{it-j+t} + \varepsilon \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where, $P_{it}$is the $i^{th}$variable at the time $t$;$\Delta P_{it}(P_{it} - P_{t-1})$and $\alpha$is the trend and intercept terms respectively.

### Engel and Granger Co-integration Test

Following Engel and Granger (1987); Reddy (2012), the formulation tests on residual from the co-integration test is given below:

$$P_1 = \alpha + P_2 + P_n + \varepsilon \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where, $P_1, P_2$ *and* $P_n$are different economic series, α is constant, and $\varepsilon$ is noise

The residuals from the above equation are considered to be temporary deviations from the long-run equilibrium. ADF unit root test isthen conducted on the residual obtained from equation (2)

**Engel-Granger two-step Approach**

The Engel-Granger two-step approach also called ECM used by Sadiq et al. (2018) is presented below:

$$RLGDP_t = \beta_0 + \beta_1 GCE_t + \beta_2 SGCE_t + \beta_3 GNI_t + \beta_4 GNIC_t + \beta_5 INF_t + \beta_6 SAT_t + \beta_7 TSAT_t + \beta_8 TAR_t + \beta_9 RPF_t + \beta_{10} CR_t + \beta_{11} REER_t + \beta_{12} GLP_t + \beta_{13} TT_t + \beta_{14} TOP_t + \varepsilon_t \quad (3)$$

$$\Delta RLGDP_t = \beta_0 + \beta_1 \Delta GCE_t + \beta_2 \Delta SGCE_t + \beta_3 \Delta GNI_t + \beta_4 \Delta GNIC_t + \beta_5 \Delta INF_t + \beta_6 \Delta SAT_t + \beta_7 \Delta TSAT_t + \beta_8 \Delta TAR_t + \beta_9 \Delta RPF_t + \beta_{10} \Delta CR_t + \beta_{11} \Delta REER_t + \beta_{12} \Delta GLP_t + \beta_{13} \Delta TT_t + \beta_{14} \Delta TOP_t + ECT_{t-1} + \varepsilon_t \quad (4)$$

$$GLP_t = \beta_0 + \beta_1 GCE_t + \beta_2 SGCE_t + \beta_3 GNI_t + \beta_4 GNIC_t + \beta_5 INF_t + \beta_6 SAT_t + \beta_7 TSAT_t + \beta_8 TAR_t + \beta_9 RPF_t + \beta_{10} CR_t + \beta_{11} REER_t + \beta_{12} TT_t + \beta_{13} TOP_t + \varepsilon_t \quad (5)$$

$$\Delta GLP_t = \beta_0 + \beta_1 \Delta GCE_t + \beta_2 \Delta SGCE_t + \beta_3 \Delta GNI_t + \beta_4 \Delta GNIC_t + \beta_5 \Delta INF_t + \beta_6 \Delta SAT_t + \beta_7 \Delta TSAT_t + \beta_8 \Delta TAR_t + \beta_9 \Delta RPF_t + \beta_{10} \Delta CR_t + \beta_{11} \Delta REER_t + \beta_{12} \Delta TT_t + \beta_{13} \Delta TOP_t + ECT_{t-1} + \varepsilon_t \quad (6)$$

$$REER_t = (CPI_{Nigeria}/CPI_{USA}) * Nominal\ Exchange\ rate \quad (7)$$

$$INF_t = [(CPI_{current} - CPI_{base})/CPI_{base}] * 100 \quad (8)$$

$$TOP_t = (Export + Import)/LGDP \quad (9)$$

$$TT_t = Export/Import \quad (10)$$

$$RLGDP_t = Nominal\ LGDP_t/(1 + INF)_t \quad (11)$$

Equation (3&5) and (4&6) are long-run and short-run dynamics respectively. The real LGDP is the proxy for growth rate; INF is inflation; REER is real effective exchange rate; TT is term of trade; TOP is trade openness; ECT is the error correction term coefficient/attractor coefficient; $\varepsilon$ is the white noise;Δ is difference operator; $\beta_0$ is intercept; $\beta_{1-n}$are the parameter estimate coefficients; *'t'* is time; and, '*t-1*' is lag 1 of time '*t*'. Information on the other symbols are presented in the body text of the methodology.

**Granger Causality Test**

Following Granger (1969) the model used to check whether indicatort $P_1$ Granger causes indicator $P_2$or vice-versa is given below:

$$P_t = \alpha + \sum_{i=1}^{n} (\emptyset P_{1t-i} + \delta_i P_{2t-i}) + \varepsilon_i \quad (12)$$

A simple test of the joint significance of $\delta_i$was used to check the Granger causality i.e.

$$H_0 : = \delta_1 = \delta_2 = \ldots\ldots \delta_n = 0.$$

## Resultsand Discussion

### *Unit Root Test*

At level all the economic variables had unit root as evidenced by their respective tau-statistics which were not different from zero at 5% degree of freedom (Table 2). But after first difference, all the economic series became stationary as indicated by their respective tau-statistics which were within the plausible margin of 5% probability level. Therefore, it can be inferred that all the variable series are integrated of order one i.e. I(1). Furthermore, the residuals of the co-integrating regression for both LGDP and GLP at level were found to be stationary as evidenced by their respective tau-statistics which were lower than the Engel-Granger critical value at 5% significance level (Table 2). With the unit root hypothesis being accepted for each of the individual economic series at level and the rejection of unit root hypothesis for the residuals from co-integrating regression at level, thus there is evidence of co-integration regression. Therefore, it can be inferred that both LGDP and GLP have long-run association in the economic phenomena.

**Table 2.** Unit root test

| Items | Stage | ADF | | Decision |
|---|---|---|---|---|
| | | tau-stat | t-critical | |
| **LGDP** | **Level** | -2.1733 | 0.2197 | Non-stationary I(0) |
| | **$1^{st}\Delta$** | -4.5986** | 0.0011 | Stationary I(1) |
| **GCE** | **Level** | -0.7732 | 0.8112 | Non-stationary I(0) |
| | **$1^{st}\Delta$** | -3.7777** | 0.00832 | Stationary I(1) |
| **SGCE** | **Level** | -1.2195 | 0.6515 | Non-stationary I(0) |
| | **$1^{st}\Delta$** | -4.6517** | 0.00098 | Stationary I(1) |
| **GNI** | **Level** | -0.76090 | 0.8293 | Non-stationary I(0) |
| | **$1^{st}\Delta$** | -3.66147** | 0.01094 | Stationary I(1) |
| **GNIC** | **Level** | -0.88729 | 0.7929 | Non-stationary I(0) |
| | **$1^{st}\Delta$** | -3.5863** | 0.01303 | Stationary I(1) |
| **INF** | **Level** | -2.5227 | 0.11 | Non-stationary I(0) |
| | **$1^{st}\Delta$** | -5.1396** | 0.000287 | Stationary I(1) |
| **SAT** | **Level** | -1.6939 | 0.4233 | Non-stationary I(0) |
| | **$1^{st}\Delta$** | -5.3757** | 0.00015 | Stationary I(1) |
| **TSAT** | **Level** | -0.92813 | 0.764 | Non-stationary I(0) |
| | **$1^{st}\Delta$** | -5.53128** | 0.0001 | Stationary I(1) |
| **TAR** | **Level** | -1.6917 | 0.7281 | Non-stationary I(0) |
| | **$1^{st}\Delta$** | -4.6596** | 0.00482 | Stationary I(1) |
| **RPF** | **Level** | -1.7772 | 0.6886 | Non-stationary I(0) |
| | **$1^{st}\Delta$** | -4.6592** | 0.00483 | Stationary I(1) |
| **CR** | **Level** | -0.82916 | 0.7951 | Non-stationary I(0) |
| | **$1^{st}\Delta$** | -5.5204** | 0.0001 | Stationary I(1) |
| **REER** | **Level** | -2.3968 | 0.6266 | Non-stationary I(0) |
| | **$1^{st}\Delta$** | -4.8650** | 0.00169 | Stationary I(1) |
| **GLP** | **Level** | -2.0367 | 0.2704 | Non-stationary I(0) |
| | **$1^{st}\Delta$** | -4.6044** | 0.0001 | Stationary I(1) |
| **TT** | **Level** | -1.4043 | 0.5819 | Non-stationary I(0) |
| | **$1^{st}\Delta$** | -6.5213** | 6.04E-9 | Stationary I(1) |
| **TOP** | **Level** | -1.64057 | 0.7504 | Non-stationary I(0) |
| | **$1^{st}\Delta$** | -3.4863** | 0.0120 | Stationary I(1) |
| **ECT(RLGDP)** | **Level** | -9.4076** | -3.34^^ | Stationary I(0) |
| **ECT(GLP)** | **Level** | -5.5255** | -3.34^^ | Stationary I(0) |

Note: ** & ^^ indicate rejection of unit root at 5% significant level and Engel-Granger critical value at 5% respectively.

### *Effect and Impact of Macro-Economic Indicators on Livestock GDP and Production*

Given that both LGDP (Livestock gross domestic production) and GLP (Gross livestock production index) have co-integration with economic variables, Engel-Granger two-step approach was applied to see whether they established a long-run equilibrium. A cursory review of the results showed the speed of adjustment coefficients of LGDP and GLP to conform to *a priori* expectation-have the appropriate sign and size i.e. negatively signed and significant at a plausible margin of 10%, thus implying the presence of long-run equilibrium (Table 3). In addition, it reveals the ability of LGDP and GLP in the short-run to correct any distortion in their respective equilibriums due to any shock that may emanates from the economic parameters. In other words, it means that both LGDP and GLP have the tendency to absolve any shock that will distort their respective equilibriums. Empirical evidences showed that the speeds at which LGDP and GLP will corrects their respective disequilibrium from equilibrium annually will be 14.16 and 9.80 months respectively, as indicated by their negative significant attractor coefficients of -1.179 and -0.817 respectively. Therefore, it can be inferred that both LGDP and GLP equilibriums are weakly inefficient as sufficient time lengths are required to make the economic phenomena responds to shocks that distort equilibrium stability. However, the weakness in the stability of LGDP equilibrium is more than that of GLP as it takes almost twice period of the latter to re-establish equilibrium.

It was observed that in the long-run, LGDP and GLP were influenced by TOP, GLP, GCE, SGCE and TSAT; and, TOP, SGCE, GNI, GNIC, INF, TAR and RPF respectively as evidenced by their respective estimated coefficients which were within the acceptable margin of 10% probability level. In the short-run, except GNI, GNIC, TAR and REER, all the remaining economic variables influenced LGDP; while GLP was influenced by TT, GNI, GNIC, INF, SAT, TAR and RPF as indicated by their respective estimated coefficients which were different from zero at 10% degree of freedom.

The positive sign and significant of GLP on LGDP implied that increase in domestic production of livestock's output stimulated growth in the livestock's sector, thus increased the LGDP. Thus, the marginal implication of a unit increase in the GLP would increase LGDP by 1.42 and 1.02% in the long and short-runs respectively.

The significant of TOP is evidence of global economic integration of both the LGDP and GLP. The negative sign associated with LGDP revealed the plummeting effect of economic pilfering viz. smuggling of livestock processed products on the growth of the domestic economy. On the other hand, the positive sign associated with GLP showed that subsidy on livestock inputs stimulates increase in the output production of livestock in the country. Therefore, the marginal implication of a unit increase in the TOP would plummets LGDP by 3.82 and 3.84% in the long and short-runs respectively. Whereas, a unit increase in the TOP will increase GLP by 0.64 and 0.09 in the long and short-runs respectively.

The positive sign of TT depicts that favourable term of trade viz. trade policies-export promotion of livestock, embargo on importation of processed livestock's products triggered growth in the sector's GDP. However, subsidy on importation of livestock production inputs viz. vaccines, medications, importation of raw material for feed formulation: maize, cowpea; makes the sector to be prone to unfavourable term of trade as indicated by the negative sign associated with TT in respect of GLP. Thus, the marginal implication of a unit increase in the TT will lead to an increase in LGDP by 36.45% in the short-run while it will decrease GLP by 5.27% in the short-run. Though, the consequence on the sector is mild given the low TT of

GLP in comparison to the TT coefficient of LGDP. However, policymakers need to look inward on how to boost domestic production of livestock's inputs especially agro-allied products so as to contain the vulnerability of the country's economy to foreign market shocks.

The positive sign of GCE coefficient showed that government investment on infrastructure, utilities and services stimulated growth of livestock's GDP. Therefore, the marginal implication of a unit increase in the GCE will lead to an increase in LGDP in both long and short-runs by 0.002%. On the other hand, empirical evidences showed that the negative skewed of government recurrent expenditure vis-à-vis current expenditure had positive effect on the GLP while it negatively affected the LGDP as indicated by the signs and size associated with SGCE. High government recurrent expenditure at the expense of capital expenditure will have a direct effect on the GLP viz. increase in per capita consumption; and an indirect effect on the LGDP due to shrinking of limited infrastructure. Therefore, the marginal implication of a unit increase in the SGCE would lead to a decrease in LGDP by 5.61 and 5.19% in the long and short-runs respectively. While on the other hand side, a unit increase in SGCE will lead to an increase in GLP by 3.35% in the long-run.

The positive sign of GNI implied that pooled income flow- internal and external inflows stimulated increase in livestock's production in the country. However, the negative sign that characterized GNIC depicts that the increase in the gross national income which translates into increase in per capita income induced expansion in the consumers' expenditure budget *viz.* increase in consumption of non-food consumables – asset's inventories, thus the decline in the livestock's gross output in the country. Also, the negative sign associated with GNIC may be attributed to decrease in per capita purchasing power on continuous basis due to high inflation that pervades the sector. Thus, the marginal implication of a unit increase in the GNI will lead to an increase in GLP by 0.001 and 0.0001% in the long and short-runs respectively. Besides, the marginal implication of a unit increase in GNIC will lead to a decrease in the GLP by 0.08 and 0.02% in the long and short-runs respectively.

The negative sign of the TSAT implied inefficiency *viz*. corruption and mis-management of the fund allocated to agricultural research and technology, thus affected growth of Livestock's GDP. Besides, this inefficiency in the capital allocation to agricultural research was re-affirmed by the negative sign of SAT. Thus, the marginal implication of a unit increase in the TSAT will lead to a decrease in LGDP by 0.009% in the short-run. In the same vein, the marginal implication of a unit increase in the SAT will lead to a decrease in LGDP and LGO by 26.60% and 17.11% respectively in the short-run.

The negative sign of TAR revealed the tendency of a red-tapism due to glut of research manpower employed for technology enhancement of the sector, thus affected the production of livestock. Empirical evidences showed that in monetary term there is inefficiency in the labour productivity of researchers to farmers' ratio as indicated by the negative sign of the RPF, thus a decline in the LGDP. On the other hand, in physical term, the labour productivity of the researcher to farmers' ratio is efficient as evidenced by the positive sign of the RPF, thus stimulated an increase in the gross livestock's output. Thus, the marginal implication of a unit increase in TAR will lead to a decline in GLP by 0.73 and 0.36% in the long-run and short-runs respectively. The marginal implication of a unit increase in the RPF will lead to a decrease in LGDP by 46.74% in the short-run; while it will results in an increase in the GLP by 92.03 and 47.34% in the long and short-runs respectively.

It was observed that poor utilization of credit *viz.* diversion for other purposes by the upstream stakeholders, underpinned the productive and productivity of credit supplied to the

livestock sector, thus the reason for the declined growth in the LGDP. Therefore, the marginal implication of a unit increase in the CR will lead to a decrease in LGDP by 0.007%.

The behaviour of the REER revealed an insignificant export of livestock products from the country, thus the non-significant of the estimated coefficient. However, the positive sign implies that currency devaluation will enhance exportation in this sector, thus a source of increase in the country's foreign reserve.

The coefficients of multiple determination for the LGDP in the long and short-runs are 0.8959 and 0.9531% respectively, thus implying that the explanatory variables accounted for 89.59 and 95.31% variations in the LGDP long and short-runs respectively. Besides, the coefficients of multiple determination for the GLP were 0.9486 and 0.4486 in respect of long and short-run dynamic models. These imply that 94.86 and 44.86% variation in the GLP in the long and short-runs respectively were explained by the economic variables- control variables included in the model.

**Table 3a.** Long-run and short-run predictions of LGDP

| Variable | Long-run dynamic model | | | Short-run dynamic model | | |
|---|---|---|---|---|---|---|
| | **Coefficient** | **SE** | **t-ratio** | **Coefficient** | **SE** | **t-ratio** |
| Intercept | −26.236 | 20.744 | $1.265^{NS}$ | 2.4943 | 1.5018 | $1.661^{NS}$ |
| $GCE_t$ | 0.00158 | 0.00057 | 2.773** | 0.0015 | 0.0004 | 3.685*** |
| $SGCE_t$ | −5.6138 | 2.1218 | 2.646** | −5.1932 | 1.4320 | 3.627*** |
| $GNI_t$ | 9.40634e-05 | 0.000196 | $0.479^{NS}$ | 2.82686e-05 | 0.000128 | $0.220^{NS}$ |
| $GNIC_t$ | −0.0042 | 0.0326 | $0.129^{NS}$ | 0.0029 | 0.0216 | $0.136^{NS}$ |
| $INF_t$ | −0.1452 | 0.0888 | $1.635^{NS}$ | −0.4024 | 0.0795 | 5.058*** |
| $SAT_t$ | −28.644 | 20.373 | $1.406^{NS}$ | −26.600 | 14.586 | 1.824* |
| $TSAT_t$ | −0.0084 | 0.0038 | 2.221** | −0.0085 | 0.0013 | 6.419*** |
| $TAR_t$ | 0.1628 | 0.4545 | $0.358^{NS}$ | 0.3252 | 0.1843 | $1.764^{NS}$ |
| $RPF_t$ | −24.823 | 57.498 | $0.431^{NS}$ | −46.742 | 23.824 | 1.962* |
| $CR_t$ | −0.0088 | 0.0061 | $1.447^{NS}$ | −0.0072 | 0.0010 | 7.417*** |
| $REER_t$ | 0.0408 | 0.0312 | $1.306^{NS}$ | 0.0269 | 0.0222 | $1.214^{NS}$ |
| $GLP_t$ | 1.4218 | 0.2943 | 4.831*** | 1.0189 | 0.2767 | 3.681*** |
| $TT_t$ | 37.135 | 23.220 | $1.599^{NS}$ | 36.447 | 2.5169 | 14.48*** |
| $TOP_t$ | −3.8238 | 0.2497 | $15.31^{NS}$ | −3.8368 | 0.2064 | 18.59*** |
| $ECT_{t-1}$ | - | - | - | −1.1796 | 0.1363 | 8.652*** |
| $R^2$ | 0.8959 | | | 0.9531 | | |
| $R^2$Adjusted | 0.7917 | | | 0.8944 | | |
| F-statistic | 1538.3*** | | | 541.9*** | | |
| BLM | $18.40(0.188)^{NS}$ | | | $9.217(0.865)^{NS}$ | | |
| D-W | $2.200(0.115)^{NS}$ | | | 1.865(0.329) | | |
| ALM | $0.240(0.631)^{NS}$ | | | $0.253(0.624)^{NS}$ | | |
| Arch LM | $0.890(0.345)^{NS}$ | | | $0.470(0.492)^{NS}$ | | |
| Normality test | $6.924(0.031)^{**}$ | | | 16.4(0.000)*** | | |
| CUSUM test | $-2.864(0.133)^{NS}$ | | | $0.236(0.817)^{NS}$ | | |
| RESET test | $0.580(0.459)^{NS}$ | | | $1.191(0.343)^{NS}$ | | |

Source: Authors' computation, 2020

Note: *** ** * & NS mean significant at 1, 5, 10% and non-significant

BLM= Breusch-Pagan heteroskedasticity Langrage Multiplier test; ALM= Autocorrelation Langrage Multiplier; D-W= Durbin-Watson statistic

The residuals of both LGDP and GLP in the long and short-run dynamic models were homoscedastic, devoid of Arch effect and serial correlation as evidenced by their respective t-statistics which were not different from zero at 10% degree of freedom (Table 3). Also, the

diagnostic tests showed adequacy in the specified model and stability in the parameter estimates as indicated by the RESET and CUSUM test statistics for the former and latter which were also not different from zero at 10% probability level (Table 3). However, the residuals of the LGDP long and short-run dynamic models failed the test of normality i.e. not normally skewed as evidenced by the plausibility of their respective $Chi^2$ test statistics at 10% significance level, while that of GLP passed the test of normality (Table 3). Though, non-normality in the distribution of residual is not considered a serious problem as most data in their natural form are not normally distributed. Thus, it can be inferred that estimated parameters in the dynamic models of both LGDP and GLP are reliable for future prediction with certainty, efficiency and accuracy.

**Table 3b.** Long-run and short-run predictions of GLP

| Variable | Long-run dynamic model | | | Short-run dynamic model | | |
|---|---|---|---|---|---|---|
| | **Coefficient** | **SE** | **t-ratio** | **Coefficient** | **SE** | **t-ratio** |
| Intercept | 69.009 | 10.308 | 6.695*** | 1.3163 | 1.2987 | $1.014^{NS}$ |
| $GCE_t$ | −0.00065 | 0.00046 | $1.416^{NS}$ | −0.00061 | 0.00058 | $1.039^{NS}$ |
| $SGCE_t$ | 3.3530 | 1.6727 | 2.004* | 2.6596 | 1.9749 | $1.347^{NS}$ |
| $GNI_t$ | 0.00048 | 0.00017 | 2.801** | 0.000135 | 6.97837e-05 | 1.931* |
| $GNIC_t$ | −0.0782 | 0.0270 | 2.893** | −0.0221 | 0.0123 | 1.800* |
| $INF_t$ | −0.1616 | 0.0368 | 4.391*** | −0.1673 | 0.0545 | 3.067*** |
| $SAT_t$ | −7.6251 | 11.866 | $0.642^{NS}$ | −17.109 | 9.1467 | 1.871* |
| $TSAT_t$ | −0.0029 | 0.0025 | $1.142^{NS}$ | 0.00013 | 0.00146 | $0.086^{NS}$ |
| $TAR_t$ | −0.7289 | 0.1818 | 4.009*** | −0.3614 | 0.1256 | 2.877** |
| $RPF_t$ | 92.031 | 22.920 | 4.015*** | 47.343 | 15.677 | 3.020*** |
| $CR_t$ | 0.00027 | 0.00376 | $0.071^{NS}$ | 0.00068 | 0.00158 | $0.434^{NS}$ |
| $REER_t$ | 0.0246 | 0.0164 | $1.496^{NS}$ | 0.0072 | 0.0212 | $0.338^{NS}$ |
| $TT_t$ | −11.823 | 7.0059 | $1.688^{NS}$ | −5.2711 | 2.9521 | 1.786* |
| $TOP_t$ | 0.6359 | 0.2593 | 2.452** | 0.0895 | 0.1466 | $0.611^{NS}$ |
| $ECT_{t-1}$ | - | - | - | −0.8169 | 0.2096 | 3.897*** |
| $R^2$ | 0.9486 | | | 0.4486 | | |
| $R^2$Adjusted | 0.9039 | | | 0.0633 | | |
| F-statistic | 62.47*** | | | 9.989*** | | |
| BLM | $6.02(0.137)^{NS}$ | | | $10.71(0.707)^{NS}$ | | |
| D-W | $1.831(0.115)^{NS}$ | | | $1.878(0.376)^{NS}$ | | |
| ALM | $0.159(0.696)^{NS}$ | | | $0.075(0.788)^{NS}$ | | |
| Arch LM | $0.465(0.494)^{NS}$ | | | $0.002(0.959)^{NS}$ | | |
| Normality test | $1.411(0.493)^{NS}$ | | | $0.615(0.73)^{NS}$ | | |
| CUSUM test | $-0.864(0.401)^{NS}$ | | | $-0.222(0.827)^{NS}$ | | |
| RESET test | $2.315(0.137)^{NS}$ | | | $0.786(0.477)^{NS}$ | | |

Source: Authors' computation, 2020

Note: *** ** * & NS mean significant at 1, 5, 10% and non-significant

BLM= Breusch-Pagan heteroskedasticity Langrage multiplier test; ALM= Autocorrelation Langrage multiplier; D-W= Durbin-Watson statistic

### *Prediction Extent of LGDP and GLP Livestock's Sector*

A perusal of the granger causality results showed that LGDP has forward and backward unidirectional causalities with INF, REER; and, GCE and TT, respectively (Table 4a). Thus, for the former, it implies that LGDP contains useful information that predicts the future of INF and REER while for the latter it means that GCE and TT contains useful information that predicts the future of the LGDP. In pair, it can be seen that bidirectional causality exists between LGDP-TAR and LGDP-RPF, thus implying that both variables in each pair contains

information that predicts the future of each other. However, LGDP has no causal relationship with GLP, TOP, SGCE, SAT and TSAT as evidenced by their respective $Chi^2$ which were not different from zero at 10% significance level, thus implying strong exogeneity between LGDP and the foregoing variables in pair (Table 4a).

Furthermore, bidirectional causality holds between GLP-TSAT as indicated by their respective $Chi^2$ statistics which were within the plausible margin of 10%, thus meaning that both variables granger causes each other (Table 4b). A unidirectional causality was found between the pairs of TAR-GLP and RPF-GLP as evidenced by their respective $Chi^2$ statistics that were within the plausible margin of 10% probability level, thus implying that in each pair, only the former granger causes the latter whereas the latter does not granger causes the former. However, in pair, GLP has no causality with TT, TOP, GCE, SGCE, GNI, GNIC, INF, SAR, CR and REER; thus implying strong exogeneity between GLP in pairs with these economic variables (Table 4b). Therefore, it can be inferred that internal system dominates in determining formation of LGDP while external system dominates in shaping the direction of the GLP.

**Table 4a.** Granger causality test results of LGDP

| Null hypothesis | $Chi^2$ | P < 0.10 | Granger cause | Direction |
|---|---|---|---|---|
| $LGDP \leftrightarrow GCE$ | 0.49407 | 0.482 | No | Unidirectional |
| | 3.1119** | 0.078 | Yes | |
| $LGDP \leftrightarrow SGCE$ | 1.5138 | 0.219 | No | None |
| | 1.8761 | 0.171 | No | |
| $LGDP \leftrightarrow GNI$ | 5.9737** | 0.015 | Yes | Unidirectional |
| | 0.38485 | 0.535 | No | |
| $LGDP \leftrightarrow GNIC$ | 4.6958** | 0.030 | Yes | Unidirectional |
| | 0.40769 | 0.523 | No | |
| $LGDP \leftrightarrow INF$ | 10.444** | 0.001 | Yes | Unidirectional |
| | 0.78313 | 0.376 | No | |
| $LGDP \leftrightarrow SAT$ | 0.18936 | 0.663 | No | None |
| | 0.29245 | 0.589 | No | |
| $LGDP \leftrightarrow TSAT$ | 0.29035 | 0.590 | No | Unidirectional |
| | 4.2051** | 0.040 | Yes | |
| $LGDP \leftrightarrow TAR$ | 3.5513** | 0.060 | Yes | Bidirectional |
| | 5.9707** | 0.015 | Yes | |
| $LGDP \leftrightarrow RPF$ | 3.2877** | 0.070 | Yes | Bidirectional |
| | 5.9993** | 0.014 | Yes | |
| $LGDP \leftrightarrow CR$ | 0.12438 | 0.724 | No | None |
| | 0.75124 | 0.386 | No | |
| $LGDP \leftrightarrow REER$ | 5.7303** | 0.017 | Yes | Unidirectional |
| | 1.7637 | 0.184 | No | |
| $LGDP \leftrightarrow GLP$ | 0.07215 | 0.788 | No | None |
| | 1.0339 | 0.309 | No | |
| $LGDP \leftrightarrow TT$ | 0.17861 | 0.673 | No | Unidirectional |
| | 9.2368** | 0.002 | Yes | |
| $LGDP \leftrightarrow TOP$ | 2.3217 | 0.128 | No | None |
| | 0.08743 | 0.767 | No | |
| $LGDP \leftrightarrow ALL$ | 33.407** | 0.003 | Yes | Multidirectional |

Note: ** denotes rejection of the $H_0$ at 10 % level of significance
NS: Non-significant
→ ← means forward and backward directions respectively

**Table 4b.** Granger causality test results of GLP

| Null hypothesis | $Chi^2$ | P < 0.10 | Granger cause | Direction |
|---|---|---|---|---|
| $GlP \leftrightarrow GCE$ | 1.224 | 0.269 | No | None |
| | 0.04029 | 0.841 | No | |
| $GLP \leftrightarrow SGCE$ | 0.62601 | 0.429 | No | None |
| | 0.42794 | 0.513 | No | |
| $GLP \leftrightarrow GNI$ | 0.24516 | 0.621 | No | None |
| | 0.08272 | 0.774 | No | |
| $GLP \leftrightarrow GNIC$ | 0.07852 | 0.779 | No | None |
| | 0.08898 | 0.765 | No | |
| $GLP \leftrightarrow INF$ | 0.01692 | 0.896 | No | None |
| | 1.1347 | 0.287 | No | |
| $GLP \leftrightarrow SAT$ | 5.3095** | 0.021 | Yes | Unidirectional |
| | 1.5861 | 0.208 | No | |
| $GLP \leftrightarrow TSAT$ | 0.71959 | 0.396 | No | Unidirectional |
| | 13.835** | 0.000 | Yes | |
| $GLP \leftrightarrow TAR$ | 0.10854 | 0.742 | No | Unidirectional |
| | 2.7465** | 0.097 | Yes | |
| $GLP \leftrightarrow RPF$ | .3326 | 0.564 | No | Unidirectional |
| | 5.1016** | 0.024 | Yes | |
| $GLP \leftrightarrow CR$ | 0.98988 | 0.320 | No | None |
| | 0.4549 | 0.500 | No | |
| $GLP \leftrightarrow REER$ | 0.15248 | 0.696 | No | None |
| | 0.95111 | 0.329 | No | |
| $GLP \leftrightarrow TT$ | 0.00128 | 0.971 | No | None |
| | 0.16617 | 0.684 | No | |
| $GLP \leftrightarrow TOP$ | 0.27592 | 0.599 | No | None |
| | 0.11174 | 0.738 | No | |
| $GLP \leftrightarrow ALL$ | 29.426** | 0.006 | Yes | Multidirectional |

Note: ** denotes rejection of the $H_0$ at 10 % level of significance
NS: Non-significant
→ ← means forward and backward directions respectively

## Conclusion and Recommendations

It can be inferred that both LGDP and GLP moves together with the economic variables in the economy. In addition, LGDP and GLP are stable as they established equilibrium, however, the long time length required by both LGDP and GLP in responding to shocks make their respective equilibrium stability weak. Thus, it can be inferred that both LGDP and GLP are weakly efficient. Empirical evidences showed that both the growth of livestock's sector was underpinned by poor utilization of sector's fund, high inflation, red-tapism and economic pilfering. Furthermore, the active synergy of the LGDP with the host of the economic variables and the passive synergy of GLP with the host of the economic variables reveals that the internal system shape the economic direction of LGDP while the external system dominates in determining the direction of GLP's economic system. Therefore, based on the foregoing, the study advises the policymakers to put in place holistic mechanism that will checkmate the excesses in fund utilization and red-tapism, thus enhancing rational resource utilization in the sector. In addition, there is need to enhance local production of livestock's inputs especially agro-allied inputs, thus insulating the country's economy from foreign market price shocks. There is need to tighten the import ban of livestock products so as to contain economic pilfering viz. smuggling and enhance export promotion for the growth and development of the sector.

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