Influence of road transport infrastructure on agricultural sector development in Nigeria

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Abstract — The study investigated the effects of road transport infrastructure on agricultural sector development in Nigeria from 1985 to 2014, using secondary annual time series data on agricultural development (proxy by gross domestic product in the Agric sector) road transport infrastructure (proxy by length of paved road per square kilometer of area) export and capital, all obtained from the Central Bank of Nigeria (CBN) [3], and National Bureau of Statistics (NBS) [16], statistical bulletins. The data were analyzed using Granger Causality test and Ordinary Least Square estimation techniques. The study concluded that a positive and statistically significant relationship exists between road transport infrastructures (LRT) also evidence was found of a unidirectional causality from agricultural sector development to transport infrastructure. The study, therefore, recommends that adequate and timely maintenance of existing roads should be carried out as well as enacting appropriate regulations that ensure proper implementation and completion of new road construction contracts in the country in order to boost agricultural sector development, reduce wastage of farm produce and increase the possibility of economic diversification.

Key words — Road Transport, Transport Infrastructure, Agricultural Development.

I. INTRODUCTION

The importance of transportation in the development of economies around the world cannot be overemphasized. Transportation, according to reference [20], improves the operations of the manufacturing industry, retail, labor, and housing markets through improved accessibility to both geographical and economic regions. In the rural areas particularly where the major source of income for residents is farming, transportation facilitates the transfer of farm produce to the markets, encourages increased production, distribution and marketing and increases the livelihood opportunities available to local farmers [2]. Following this, one could presume that transportation plays a key role in the growth of both developing and developed economies.

In developed countries, the optimum performance of industrial sectors and economic growth recorded was due to the fact that full capacity in the area of transportation was reached, a good example of such is China [5]. Reference [18], also stressed that since agriculture forms the major element of the gross domestic product of many developing or low-income economies including Nigeria, the achievement of economic growth would depend on transportation.

This was explained by the bulky, highly perishable but low priced nature of the agricultural products which makes it necessary for the products to be transferred from the production area to the final consumption area (markets) within a short period of time and with a minimum cost. In line with these, there has been a generalization from developed to developing economies that investment in transportation, especially on road transport which is the predominant mode of transportation linking villages to market centers are for offsetting the high transaction costs on sales of agricultural products, reducing poverty, reducing the unemployment rate and achieving agricultural development.

Existing literature on road transport infrastructure and agricultural sector development, however, remain controversial in academics. While reference [8 &15], found that road transport infrastructure has a significant impact on agricultural sector development, reference [21], concluded that road transport infrastructure has minimal effect on agricultural sector development. Whereas [8], noted that availability

of good road transport infrastructure enables an efficient movement of agricultural products, raw materials, finished or semi-finished products, services from the point of production to the market centers. Consequently, this would affect the production, distribution, marketing, consumption, and influence the cost of the commodity consumed and the purchasing power of the consumers.

Reference [21], explained that availability of road transport infrastructures may not be enough to influence agricultural development as there may be other factors responsible for this influence, although the inadequacy and low quality of road transport infrastructure in many communities have serious implications on the agricultural sector development in the country. Nigeria's rural road network, for instance, is one of the least developed in sub-Saharan Africa. In some regions of the country, most of the roads where major farming operations are carried out are inaccessible; the roads are un-surfaced, narrow, poorly drained and winding thereby making it difficult to move produce from the farm to the marketplace. Even when such roads are in a fair condition, there is a problem of poor maintenance, lack of adequate execution capacity, lack of suitable materials and management problems. All these factors have contributed to the low agricultural production in Nigeria.

In the absence of good road network, farmers would not want to produce in large quantities because of the fear of the perishable nature of their farm produce, since they might not get to the point of sale before their expiration. If agriculture will respond to the growing demand of the increasing population, it will be necessary to ensure a good road network to reduce the cost of flow of agricultural commodities to the urban areas, provide the necessary information needed for rural services to enable the agricultural sector to contribute meaningfully to the general economic growth. This will help to accommodate the increased traffic flow of input and output moving from rural areas to urban centers.

In addition to the controversial results, literature [11, 23 & 20], on the effect of road transport infrastructure on the Nigerian agricultural sector have only covered certain local government areas and states, without giving consideration to the country, Nigeria as a whole. Apart from these, studies also used the infrastructural expenditure which covers water, air, and road and this does not truly reflect the road transport infrastructure which majorly links the rural areas to the market centers. The direction of causality between road transport infrastructure and agricultural development has not also been established in the literature. This research, therefore, seeks to evaluate the effect of road transport infrastructure on agricultural development in Nigeria as a whole and investigate the direction of causality between these factors. This would serve as a guide for the government and policy makers towards transport sector development which could increase agricultural activities that promotes economic growth and a means of reducing poverty in Nigeria.

II.   LITERATURE REVIEW

This section reviews theories on economic growth because agricultural sector development is a component of economic growth. The section further presents empirical evidence on road transport infrastructure and the agricultural sector, and the conceptual framework of agricultural development.

A. Theoretical/conceptual framework

There are historical models and theories developed by development economists on economic growth. These models and theories include Rostow Growth Model, Lewis Theory of Development, Harrod-Domar Growth Theory, Classical Growth Theory, Neoclassical Growth Theory, and New Growth Theory. For the purpose of achieving the objectives of this study, however, the modified conceptual framework of [14], was adopted since it accommodates all variables of interest in this study.

B. Lakshamanan conceptual framework

The modified framework of [14] is used as a basic framework for this study which seeks to examine the economic benefits of transport infrastructure. Modifying this framework is the agriculture output and transport infrastructure relationship. The diagram below offers one view of the mechanisms and processes underlying the wider economic benefits of transport infrastructure investments. It is a contemporary version of what [23 &17], call 'forward linkages' of transport infrastructure. The lower costs and increased accessibility due to transport improvements modify the marginal costs of transport producers, the households' mobility and demand for goods and services. Such changes ripple through the market mechanisms endogenizing employment, output, and income in the short run. Over time, dynamics, development effects derive from the mechanisms set in motion when transport service improvements activate a variety of interconnected economy-wide processes and yield a range of sectoral, spatial and regional effects, which augment overall productivity.

The lower costs enhanced accessibility due to transport infrastructure and service improvements expand the markets for individual transport-using firms. As such market expansion links the economies of different localities and regions, there is a major consequence in terms of shifting from local and regional autarky to increasing specialization and trade and the resultant upsurge in productivity. Opportunity for exporting and importing goods are enhanced, in turn, opening up several channels of economic effects, both in product and factor markets, in a manner analogous to the results from trade reduction and trade area expansion.

First, the export expansion will lead to higher levels of output, which allow higher sales to cover fixed costs of operation yielding efficiencies as seen in figure 1 below. Second, increasing imports put competitive pressures on local prices. Such pressures lead not only to the removal of monopoly rents but also to improved efficiency. Third, lower transport costs and increased accessibility enlarge the markets for labor and other factor inputs. Firms will likely draw labor from a broader area and with a greater range of attributes improving labor supply and with lower costs. Similar effects in land and other factor markets are likely as transport improvements open up new land for economic activities.
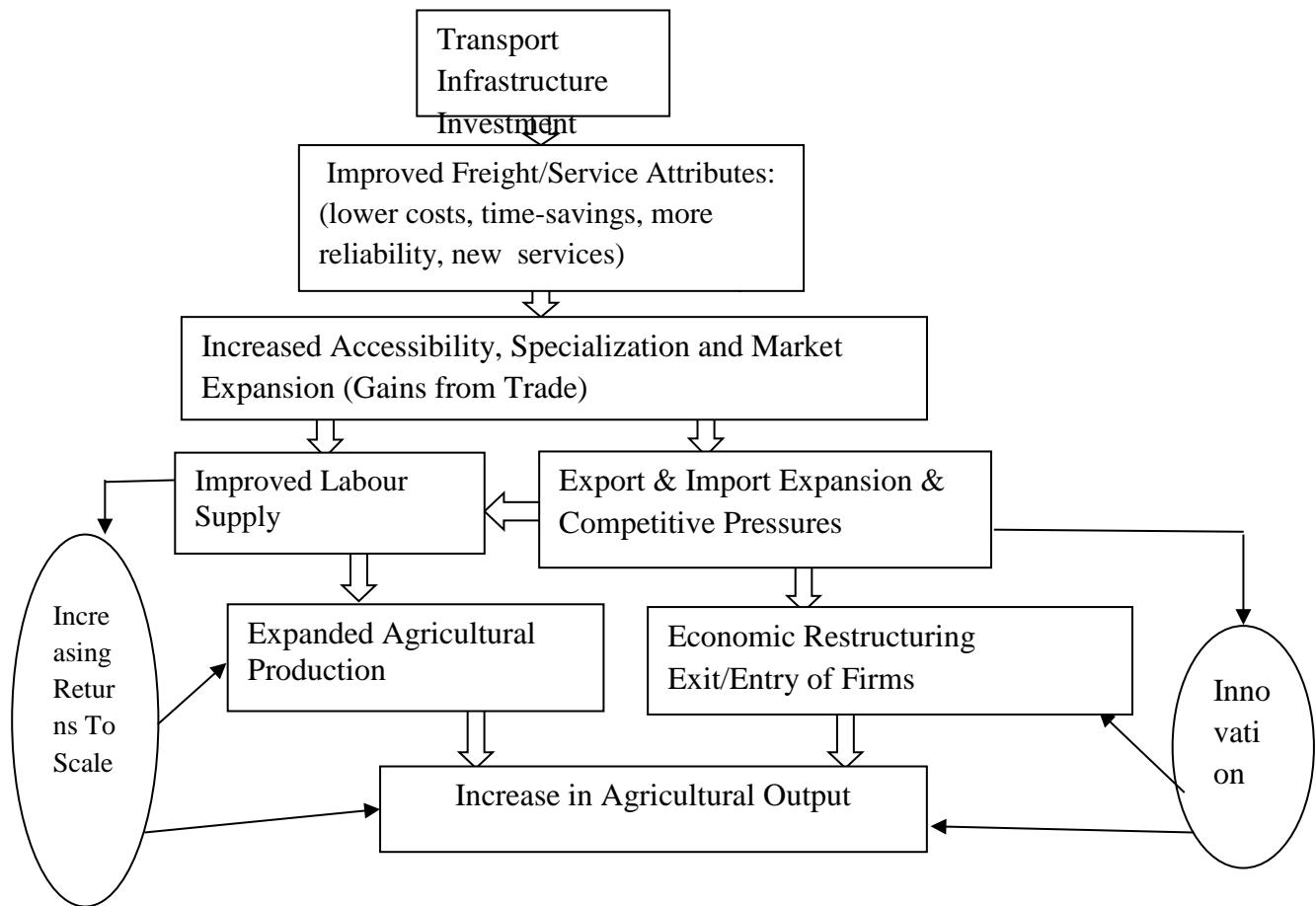
Fig. 1: Road Transport Infrastructure and Agricultural Sector Development
Source: Reference [14].

Finally, the diagram suggests that the two mechanisms in the oval boxes, one dealing with innovation and the other with the spatial arrangement in the economy. These two mechanisms create, in the context of transport infrastructure improvements, conditions which enhance economic performance and promote an increase in agricultural output and endogenous growth. Transport improvements can have an endogenous growth effect to the degree they impact the rate of growth of the economy through the creation and commercialization of new knowledge thereby promoting agricultural output and the rate of growth of the economy.

In the contemporary knowledge economy, firms are concerned with the reduction of a new class of costs; adaptive costs, incurred by the firm as it monitors the environment for changes in technology and products identify competitive strategies, and implement such strategies quickly enough to retain or improve market share [7 & 13]. The key notion in this case of spatial proximity is that innovation derives from the Jacobsian Economics [10], or the Economies of Variety [22], and the firms minimize their adaptive costs by participating in the economic network in the activity cluster or agglomeration made possible by transport infrastructure improvements.

Research on imperfect competition and the increasing returns to scale extends to locational analysis and emphasizes the importance of the interaction between transport costs on the one hand and market size and economies of scale on the other. With dropping transport cost and economies of scale, a firm in a location gains a larger market area and dominance, which in turn promotes the concentration of other firms in the same location. This idea of a location with good access to markets

and suppliers for one firm improves market and supply access for other producers there, and the process of cumulative causation (where a location becomes more attractive to successive firms as more firms locate) derives from earlier ideas in Economic Geography. The central feature of this theory of agglomeration (as has been noted for a long time in economic geography and regional science) is the presence of external economies of scale in the Marshallian sense [14].

Also, reference [14], posited that different firms clustered in a location experience positive externalities in the form of agglomeration economies, industrial complexes and social networks engaged in untraded interdependencies. In short order, regional specialization develops. Indeed, without increasing returns to scale in the context of transport improvements. It is impossible to account for the observed spatial concentration of firms and regional specialization in regional and national economies.

Reference [12], noted that in contemporary spatial agglomerations of economic activity where there are frequent transactions between suppliers and customers and where high-end business services often accompany goods delivery, the cost of transactions is likely to be lower inside such centers than outside them. Further, some interregional links gain advantages from the existence of increasing returns to transportation and transactions, which may help from transportation and transaction hubs. The notion of density (of economic activities, social opportunities, and transaction options) and economic milieu in such locations as leading to self-reinforcing and cumulative causations effects have been used by [4], cited in [14].

C. Empirical review

As far as nature is concerned, there are several kinds of infrastructure covering economic, financial, technological, social, agricultural, transport and so on. Amongst these infrastructures, transport plays a dominant role since it is capable of influencing industrial and agricultural sectors contributing to the growth of economies around the world. As a result, there have been many research-based studies on transport infrastructure and economic growth.

Reference [8], examined transport infrastructure and economic growth in Nigeria. Using the Granger causality test and Vector Error Correction Model (VECM) to carry out analysis of the road development variables and GDP, [8], found that no causality exists between transport and economic growth in Nigeria. The VECM result also shows that the road development variables are statistically significant in the determination of economic growth in Nigeria in the long run but, not significant in the short run. The study, therefore, recommended that rather than construct new roads, the government should adequately maintain the existing roads as this will further reduce the cost of transportation of goods and services, thereby reducing poverty and boosting economic growth in Nigeria.

Reference [1], further examined the effects of the transportation system on food marketing and security, as an indicator of economic growth in Nigeria. Reference [1], employed a total of 300 respondents randomly selected and interviewed representing 20% of the total registered food traders within the study area. The analysis of the data obtained was based on simple statistics supported by a series of tables showing percentage distribution of some variable. The study concluded that the inadequacy in transportation facilities, the high cost of transport and high level of wastage due to poor storage and processing facilities in the study area are responsible for the low level of food marketing and security in the area.

The agricultural sector, however, is one of the most important sectors of the Nigerian economy dated back to the pre-colonial era and agriculture is largely practiced by the larger population of the country residing in the rural communities. In other words, the level of transport infrastructure in the rural communities is one of the important factors determining agricultural development or growth. Since road transport is the most common network linking the villagers to the market where agricultural products are being sold.

Refence [9], examined the effect of road infrastructure on agricultural output. Using household agricultural production and income data from 288 rural dwellers, the study examined the effect of road infrastructural development on agricultural output and income of rural households in Delta State, Nigeria. The results indicated that rural roads have a significant positive effect on agricultural output. They associated the result with the reduction in transportation cost, stimulation of demand for rural labor and improvement of rural income caused by improved rural roads. Road quality instigated a strong positive response to output and income, as a 10% improvement in road quality caused a 12% and 2.2% increase in agricultural output and total household income respectively. The study further explained that road infrastructure promotes inter-sectoral linkages between the agricultural and non-farm sectors thereby enhancing income diversification strategies among rural households. The study, therefore, recommended that a policy thrust that will cut down the distance to markets through investment in transport infrastructure should be pursued vigorously by both the State and local government authorities in collaboration with the private sector, in order to reduce rural poverty, accelerate the process of rural transformation and achieve economic growth.

Reference [18], however, based on previous findings, examined road transportation as a lifeline of the economy in Western Nigeria from the year 1920 to 1952. The method adopted for the study is basically historical, involving the use of primary sources such as archival documents and oral interviews as well as secondary source- material. This study utilized several different datasets to analyze the relationship between transportation costs that households incur to access the nearest market (defined as cities with a population of at least 100,000) and several different measures of welfare. From the analysis of this study, it was shown that road transportation truly acted as an engine of economic change in Western Nigeria. It served as a lifeline of the economy. It transformed the hitherto simple traditional economic setting into something resembling a complex modern economy. Although it facilitated the exploitation of the wealth of the region, it equally created opportunities for indigenous participation in the colonial economy. The study concluded that improving the quality of roads, thereby lowering cost to market, significantly benefits the rural households.

Reference [20], further examined the impact of road transport on agricultural development in Ilorin East L.G.A of Kwara State. It employed the use of both primary and secondary data. Simple random sampling technique was used for the purpose of the study. One hundred and fifty copies of the questionnaire were distributed systematically to the farmers in the study area. Focus group discussion was also used to obtain information on the impact of road transport on rural development as a whole. Descriptive and analytical statistical methods were both employed to analyze the data gathered. The study found out that road transport has both positive and negative impact on agricultural development. However, they stressed that the bad conditions of the road affect the cost of transportation of agricultural produce which in turn affect the rural farmers' income and productivity. This study concluded by suggesting that an improvement in road transport system will lead to increased production by farmers.

Reference [19], also investigated the effects of road transport on agricultural productivity in Ayamelum Local government area of Anambra state. The study employed primary data collected from the structured questionnaires designed and administered to 20 farmers randomly selected from each of the seven communities in the study area. In order to achieve the objectives of the study, the descriptive and graphical methods were used. Results show that road transport has both negative and positive effect on agricultural development.

Similar to developing country such as Nigeria, [5] studied transportation infrastructure and agricultural production in China. This study used cross-sectional data from 83 countries and 30 provinces in China to assess the effect of transportation infrastructure and electricity on agricultural production and productivity. Evidence from both datasets suggested that, in accordance with economic theory, the density of roads and the availability of electricity are significant predictors of production and productivity in agriculture. Results of the analysis suggested that access to

transportation infrastructure and electricity will be crucial to the modernization of Chinese agriculture.

Reference [6], also studied agriculture, road and economic development in Uganda. A static general equilibrium model was used to explore the relationships between high transportation costs, low productivity, and the size of the quasi-subsistence sector. They parameterized the model to replicate some key features of the Ugandan data and then performed a series of quantitative experiments. The results suggested that the population in quasi-subsistence agriculture is highly sensitive both to agricultural productivity levels and to transportation costs. The model also suggested positive complementarities between improvements in agricultural productivity and transportation.

III.   METHODOLOGY

For the purpose of achieving the objectives of this study, the Ordinary Least Square method of data analysis and Granger-Causality Test was adopted. This study employed secondary data of Agricultural output proxy by GDP of the agricultural sector, Road Transport Infrastructure proxy by the length of paved road per square kilometer of the area, Export and Capital for analysis. The data utilized were obtained from the publications of Central Bank of Nigeria [3], and National Bureau of statistics [16], Statistical Bulletins.

A. Model specification

In order to investigate the effect of road transport infrastructure and agricultural sector development, the conceptual framework developed by [14], was adopted and it is stated as follows:

$$Y= f (RT, EX, K) \text{ -- (1)}$$

The model is modified in simple implicit form as follows:

Let $Y = AG$

$$AG= f (RT, EX, K) \text{ -- (2)}$$

This can be expressed in econometric form as:

$$AG= \beta_0 + \beta_1 RT + \beta_2 EX + \beta_3 K + U \text{--- (3)}$$

Where;
AG = Agricultural output proxy by GDP of agricultural sector

RT= Road Transport Infrastructure proxy by the length of paved road per square kilometer of area.
EX= Export
K= Capital
U= Error term
β_0 = Constant intercept
β_1 β_2 β_3 = Co-efficient of associated variables

B. A prior expectation

$\beta_1 > 0$: positive relationship

$\beta_2 > 0$: positive relationship

$\beta_3 > 0$: positive relationship

Hypothesis

Ho: $\beta_1 = 0$ {Road Transport infrastructure has no relationship with agricultural output}

H1: $\beta_1 \neq 0$ {Road Transport infrastructure has a relationship with agricultural output}

C. Description/measurement of variables

 i. Road Transport Infrastructure: This is proxy by the length of paved road per square kilometer of area.
 ii. Export: This is a function of international trade whereby goods and services are shipped out of the port of a country. This means shipping of goods and services out of the port of a country.
 iii. Capital: This can be financial assets or the financial value of assets, such as cash. It can also be factories, machinery and equipment owned by a business and used in production. It is more durable and is used to generate wealth through investment. This is proxy by gross capital fixed formation.

IV.   RESULTS

This section presents the data analysis and interpretation. This includes the empirical analysis which estimates the effect of road transport infrastructure on agricultural sector development using the OLS method; and the Granger causality test which checks the existence and the direction of causality between the variables.

A. Empirical Analysis of the Effect of Road Transport Infrastructure on Agricultural Sector Development

This section shows the effect of the road transport infrastructure on agricultural development from 1985 to 2014. Table 1 below reveals the result of the analysis.

Table 1. Ordinary Least Squares Regression Result

Variables	Coefficient	Standard Error	Probability
Intercept	-9.380694	4.782099	0.0606
LRT	1.011285**	0.463138	0.0382
LCAP	0.157905	0.100937	0.1298
LEX	0.595798***	0.112401	0.0000
R-squared = 0. 984769			
Adjusted R-squared = 0.983011			
F-statistics = 560.3371			
Prob (F-statistic) = 0.000000			
Durbin Watson = 1.670963			
***, ** indicates 1%, 5% level of significance respectively			

Source: Authors computation, 2017

B. Model Estimation

LAQ = -9.380694 + 1.011285LRT+ 0.157905LCAP + 0.595798LEX + U
S.E =   (4.78)   (0.46)   (0.10)   (0.11)
T-test =   (-1.96)   (2.18)   (1.560   (5.30)

C. Interpretation of Results

The independent variables (road transport infrastructure (LRT), export (LEX) and capital (LCAP) in the model explained 98.3% total variation in the dependent variable (agricultural sector development). The value of F-statistic is reasonably high and statistically significant at 1% level of significance, thus, the model is significant. The value of the Durbin Watson is approximately 2, implying that there is no serial autocorrelation problem.

The coefficient of capital (LCAP) is positive but statistically insignificant at 5% level of significance. The positive sign exhibited by the coefficient of capital indicates that when capital increases, agricultural output is expected to increase. Furthermore, a percentage change in the capital will result in 15.7% increase in agricultural sector development.

The coefficient of export (LEX) is positive and statistically significant at 1% significance level. The positive sign shows that when there is an increase in export, agricultural output is expected to increase. Furthermore, a percentage change in export will result in 59.6% increase in agricultural sector development.

The coefficient of road transport infrastructure (LRT) is positively signed and statistically significant at 5% significance level. The positive sign shows that when there is an increase in road transport infrastructure, agricultural output is expected to increase. Furthermore, a percentage change in road transport infrastructure will result in 101% increase in agricultural sector development.

D. Causality Test

This section shows whether there is a causal relationship between road transport infrastructure and agricultural sector development.

E. Interpretation of Results

From the table below, the result shows the existence of unidirectional causality from agricultural output to road transport infrastructure. Meaning that agricultural output granger causes road transport infrastructure.

F. Pairwise Granger Causality Tests

Table 2: Granger Causality Test Results of LRT and LAQ

Null Hypothesis	Obs	F-statistic	Prob
LRT does not Granger cause LAQ	32	0.34994	0.7079
LAQ does not Granger cause LRT		4.69807	0.0177

Source: Authors computation, 2017.

V. SUMMARY, CONCLUSION AND POLICY RECOMMENDATIONS

This section presents the summary, conclusion and policy recommendations for the effect of road transport infrastructure on agricultural sector development in Nigeria. It is divided into subsections.

A. Summary

This study examines the effect of road transport infrastructure on agricultural sector development from 1985 to 2014. The study used secondary annual time series data on the following variables; agricultural sector development, road transport infrastructure (LRT), exports (LEX) and capital (LCAP). The data of all variables were obtained from the Central Bank (2013) and National Bureau of Statistics (2013) statistical bulletins. The data collected were analyzed using granger casualty test and ordinary least square method. The findings of the result revealed that the coefficient of road transport infrastructure is positive and statistically significant at 5% level on agricultural sector development. The positive sign of road transport infrastructure indicates a direct relationship between road transport infrastructure and agricultural sector development which conforms to the conceptual framework by Lakshamanan (2007) adopted in this study. The result also reveals the

existence of unidirectional causality from agricultural sector development to road transport infrastructure.

B. Conclusion

The study concludes that road transport infrastructure has a statistically significant positive effect or influence on agricultural sector development in Nigeria. The trend of agricultural sector development and road transport infrastructure has shown an upward movement over the years but started to decrease in a recent year, this could be a result of situations whereby people collect money for construction of new roads but they failed to construct them.

C. Policy Recommendations

Based on the above-mentioned results, the study, therefore, recommends the following policies;

1. Policymakers should ensure that when contracts are being awarded to people for construction of new roads, certain regulations which ensure that the project is carried out are being put in place in order to ensure that the government is not wasting capital on abandoned projects thereby altering the agricultural sector development.
2. Policymakers should also ensure adequate maintenance of the existing roads as this will further reduce the cost of transportation of goods and services, thereby increasing the output of the agricultural sector and boosting economic growth in Nigeria.

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