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Infrastructural development, agricultural productivity and life expectancy in Nigeria

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ABSTRACT

As the global population rises, improving human health and agricultural productivity becomes vital for sustainable development. Infrastructural development is equally crucial, as it supports health and agriculture. This study examines the relationship among infrastructural development, agricultural productivity, and life expectancy in Nigeria from 1990 to 2024, using the Auto-Regressive Distributed Lag (ARDL) model. Key variables are life expectancy, agricultural output, infrastructural spending, and domestic credit to the private sector. The empirical results reveal a significant long-term positive effect of agricultural output and infrastructure on life expectancy. However, domestic credit to the private sector negatively affects life expectancy. Based on these findings, the study recommends increased investment in general infrastructure particularly the rural infrastructure such as roads, irrigation systems, storage facilities, and agricultural research to improve productivity and health. To counter the negative effects of private sector credit, the study suggests a stronger regulatory framework for credit allocation and borrower education programs to promote efficient and productive credit use.

Keywords: *Life Expectancy; Infrastructural Development; Agricultural Productivity; Domestic Credit to Private Sector.*

JEL Classification: H54, Q12, I15

1.1 Introduction

Infrastructural development is fundamental to Nigeria’s advancement and societal evolution, encompassing the establishment and improvement of vital facilities such as roadways, energy supply, transportation systems, and communication networks. Infrastructural development functions as the cornerstone of economic advancement, exerting influence across diverse sectors, including agriculture, energy, transportation, public health, and numerous additional domains (Audu & Otu, 2024). Nigeria, akin to various other nations within Sub-Saharan Africa, has been beset with the absence of functional

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infrastructure necessary for the stimulation of economic growth. A prominent obstacle in infrastructural development is the deficiency of sufficient funding. Nigeria encounters challenges associated with constrained financial resources and escalating debt, which frequently culminates in incomplete or inadequately executed initiatives (Edeme *et al.*, 2020). The dearth of financial resources further impedes the maintenance of pre-existing infrastructures, resulting in their progressive deterioration over time. Numerous infrastructural provisions endeavours encounter difficulties stemming from inadequate or ill-conceived plans and deficiency of a thorough feasibility assessments. Bureaucratic inefficiencies and protracted approval procedures also precipitate delays in the implementation of infrastructure initiatives. Administrative red tape, procedural bottlenecks, and discordant policies among various governmental entities frequently impede project progression, thereby escalating expenditures and diminishing their overall efficacy (Audu & Otu, 2024). Within this context of inefficacy, critical sectors such as agriculture have remained impeded and unable to realize their full productivity potentials. This systemic inefficiency has significantly contributed to Nigeria’s difficulties in attaining self-sufficiency in food production, notwithstanding the nation’s abundant agricultural resources.

In spite of Nigeria’s substantial potential within the agricultural domain, the levels of productivity and contributions to economic growth and foreign exchange earnings have been markedly low (Peterson & Collins, 2022). The nation has been unable to achieve self-sufficiency in food production and the establishment of value chains capable of fostering job creation and augmenting governmental revenue, a situation that has been ascribed to inadequate infrastructure essential for enhancing agricultural productivity. Agricultural productivity denotes the output generated by the agricultural sector relative to the inputs utilized. As articulated by Lakra (2024), agricultural productivity serves as an analytical metric for assessing the efficiency with which various agricultural inputs, namely land, labor, capital, and technology are transformed into outputs, encompassing crops, livestock, and other agricultural commodities. In more accessible terms, it signifies the quantity of agricultural produce derived from a specific allocation of resources, thereby serving as a crucial indicator of the agricultural sector’s efficacy.

The intricate relationship between agricultural productivity and life expectancy in Nigeria is particularly salient in economies where agriculture constitutes a fundamental source of sustenance, income, and employment, given that agriculture exerts a direct influence on nutrition and economic stability (Ndiwa *et al.*, 2020). Enhanced agricultural productivity guarantees a reliable food supply, thereby mitigating hunger and malnutrition two principal factors contributing to adverse health outcomes. In Nigeria, where a substantial segment of the population is dependent on agriculture for both sustenance and income, augmented productivity has a direct correlation with the accessibility and affordability of nutritious food, especially for economically disadvantaged households (Maiga, 2024). Improved nutritional status fortifies the immune system, diminishes susceptibility to diseases, and promotes both physical and cognitive development, particularly among children, thus contributing to increased longevity. Furthermore, the escalation of agricultural output results in augmented incomes for farmers, affording them the capability to invest in superior healthcare, education, and enhanced living standards (Peterson & Collins, 2022).

Notwithstanding the Nigerian government's initiatives aimed at stabilizing growth within the agricultural sector, the productivity metrics of the industry indicate that, despite employing approximately 60 percent of the labour force, agricultural output in the nation has persistently remained disappointingly low and fluctuating between 30% and 42% (Olakunle, 2021). The suboptimal agricultural output in Nigeria arises from a plethora of many factors, including inadequate infrastructure, restricted access to contemporary farming methodologies, and insufficient financial support for farmers. The deficiency of rural road networks and subpar storage facilities culminates in significant post-harvest losses, thereby diminishing the availability of agricultural products. Additionally, the reliance on traditional agricultural practices and implements constrains productivity, preventing farmers from optimizing yields. A lack of access to affordable credit inhibits smallholder farmers from investing in improved seeds, fertilizers, and irrigation technologies. Moreover, erratic weather patterns, exacerbated by climate change, adversely affect crop growth and yields, particularly in light of Nigeria's and most of other developing countries heavy dependence on rain-fed agriculture.

Informed by these identified challenges, this study seeks to investigate the influence of infrastructural development on agricultural productivity and life expectancy in Nigeria from the year 1990 to 2024. Infrastructural development is an essential ingredient for agricultural output enhancement and which eventually increased life span of the people. By enhancing agricultural productivity through expansion in infrastructures (either hard infrastructure (roads, railways, energy, etc.) which directly impacting productivity, or soft infrastructure (for example, education, healthcare, etc.), it can lead to increased food security and improved nutrition, ultimately contributing to better health and longer lifespans. Infrastructure, particularly in rural areas, provides access to markets, technology, and resources, boosting farm output and income.

A study on infrastructural development, agricultural productivity, and life expectancy in Nigeria could also offer valuable insights for other developing countries across Africa, Asia, and Latin America that face similar structural challenges in infrastructure, agriculture, and health. By examining how targeted investments in rural infrastructure such as roads, irrigation, electricity, and storage facilities combined with agricultural modernization can enhance food security and public health, the Nigerian case can serve as a practical model for formulating integrated development policies and the study's empirical findings and policy recommendations could guide other states in designing strategies that leverage their agricultural base and infrastructure potential to boost life expectancy and drive inclusive growth. Furthermore, it contributes to the broader discourse on achieving the Sustainable Development Goals (SDGs), especially SDG 2 (zero hunger), SDG 3 (good health and well-being), and SDG 9 (industry, innovation, and infrastructure), by demonstrating how local reforms can have transformative effects on human development outcomes.

1.2 Literature review

1.2.1 Conceptual review

a. Infrastructural development

Infrastructural development denotes the systematic construction, enhancement, and upkeep of the essential physical and organizational frameworks requisite for the effective operation of a society, which encompasses transportation networks, energy systems, communication infrastructures, and water supply systems (Lawson & Aseminachin, 2020). In the context of Nigeria, infrastructural development is paramount for the sustenance of economic growth and the elevation of living standards. The focus on infrastructural development in Nigeria is of critical importance, given its profound influence on economic advancement and societal welfare. Notwithstanding the initiatives aimed at enhancing infrastructure, persistent challenges such as financial constraints, corruption, and insufficient maintenance continue to obstruct progress (Audu & Otu, 2024). The government has embarked on various reforms and projects; however, the momentum of development remains sluggish in relation to the escalating demands posed by the population (Günay & Atılgan, 2020). These infrastructural enhancements are vital for improving connectivity and diminishing the costs associated with business operations.

b. Agricultural productivity

Agricultural productivity pertains to the quantification of the efficiency with which agricultural inputs including land, labour, capital, water, and technology are transformed into outputs, such as crops, livestock, or other agricultural commodities. It serves as a fundamental metric for assessing the performance of the agricultural sector and encapsulates the capacity of farmers to optimize yields while concurrently minimizing resource utilization (Maiga, 2024). The enhancement of agricultural productivity is imperative for attaining food security, improving rural livelihoods, and stimulating economic growth, particularly in developing nations. Productivity enhancement can be realized through the implementation of contemporary farming methodologies, mechanization, irrigation practices, the utilization of high-yield crop varieties, and the adoption of sustainable agricultural techniques. The augmentation of agricultural productivity transcends mere output increment; it also necessitates the consideration of environmental issues and the assurance of long-term sustainability (Peterson & Collins, 2022).

Agriculture remains an indispensable cornerstone of the Nigerian economy, furnishing employment opportunities for a substantial segment of the population and contributing significantly to food security (Peterson & Collins, 2022). The agricultural productivity landscape in Nigeria is characterized by a predominance of smallholder farmers who predominantly engage in subsistence farming (Olakunle, 2021). A considerable number of farmers continue to depend on traditional tools and methodologies, thereby constraining their capacity to achieve optimal yields. The productivity levels of crucial crops such as cassava, maize, rice, and yams have witnessed improvement in recent years; however, they continue to lag behind the productivity levels observed in more industrialized agricultural economies. The presence of inadequate rural roads, insufficient storage facilities, and unreliable electricity supply impedes the efficient production, transportation, and processing of agricultural products (Peterson & Collins, 2022). A significant number of farmers face barriers in accessing improved seeds, fertilizers, and pesticides, attributable to exorbitant costs or deficient distribution networks. Furthermore, the lack of access to affordable credit severely limits farmers' ability to invest in modern agricultural technologies.

Nigeria has implemented some policies to improve agricultural output such as The Agricultural Transformation Agenda (ATA) Launched in 2011, this policy aimed to modernize agriculture by encouraging private sector participation, improving access to inputs like fertilizers and seeds, and reducing post-harvest losses. Anchor Borrowers' Programme (ABP) introduced by the Central Bank of Nigeria, this program provides smallholder farmers with access to credit and inputs to boost productivity (Johnson & Thompson, 2020). It focuses on linking farmers to processors, ensuring a ready market for their produce. National Agricultural Technology and Innovation Policy (NATIP) which emphasizes the adoption of modern farming technologies, mechanization, and climate-smart practices to enhance productivity and sustainability.Presidential Fertilizer Initiative (PFI) also aims to make fertilizers affordable and accessible to farmers by reviving local production and reducing dependency on imports.

c. Life expectancy

Life expectancy at birth signifies the anticipated duration of years that an individual within a specific community is projected to live (Lawal *et al*., 2023). This metric also constitutes an average estimate of the years an individual is likely to endure, which is contingent upon the comprehensive spectrum of mortality rates across various age groups within a defined society. Furthermore, it reflects the expected lifespan of a neonate, taking into account the prevailing mortality statistics observed within the geographical context (Abu, 2013). Life expectancy denotes the mean number of years an individual is anticipated to survive, predicated upon the existing socio-economic and health conditions within a particular environment or nation (Ndiwa *et al*., 2020). It serves as an essential demographic indicator that encapsulates the overall quality of life, healthcare standards, and living conditions prevailing in a society. The determination of life expectancy is influenced by an array of factors, including access to healthcare, nutrition, sanitation, education, and income levels, as well as the incidence of diseases and environmental conditions (Etikan *et al*., 2019).

In Nigeria, life expectancy has exhibited a gradual upward trend over recent decades; however, it continues to fall short of the global average. According to statistics from the World Bank and World Health Organization (2024), the life expectancy in Nigeria is estimated to be approximately 54-56 years, in contrast to the global average exceeding 70 years. A significant challenge stems from the high incidence of preventable diseases, such as malaria, tuberculosis, and HIV/AIDS. Moreover, malnutrition persists as a pressing issue, with a substantial portion of the Nigerian population lacking access to adequate and nutritious food (Etikan *et al*., 2019). This predicament is frequently associated with low agricultural productivity and pervasive poverty. The inadequately developed state of healthcare infrastructure, marked by insufficient facilities and a scarcity of medical personnel, exacerbates the challenges, resulting in many individuals being deprived of essential medical care. Additionally, environmental challenges such as pollution, unsafe water sources, and inadequate sanitation further facilitate the proliferation of diseases that diminish life expectancy.

d. Roles of infrastructural development and agricultural productivity on life expectancy

Globally, infrastructural development plays a pivotal role in improving agricultural productivity and eventually have substantial impact on life expectancy by enhancing access to essential services such as healthcare, clean water, sanitation, and transportation. Well-developed infrastructure reduces mortality through improved healthcare delivery systems and facilitates the efficient movement of goods and services, which includes food distribution and medical supplies (World Bank, 2022). Similarly, agricultural productivity contributes significantly to life expectancy by ensuring food security, reducing malnutrition, and improving the overall nutritional status of populations. Increased agricultural output leads to better diets and reduced incidences of hunger-related diseases, particularly in developing countries (Udeuhele & Eze, 2022). When these two sectors are adequately developed and synchronized, they create a supportive environment for health and longevity.

In the Nigerian context, the lack of adequate infrastructure such as rural roads, electricity, irrigation systems, and storage facilities has hindered agricultural efficiency and, by extension, affected the health and wellbeing of the population. Nigeria's infrastructural deficit has limited access to healthcare services, especially in rural areas, resulting in high maternal and child mortality rates (Audu*et al*., 2021). Moreover, low agricultural productivity has led to food insecurity and malnutrition, which are major contributors to Nigeria's low average life expectancy, which remains below the global average (WHO, 2023).

The interconnection between poor infrastructure and underperforming agriculture has created a vicious cycle that undermines public health outcomes and economic growth.

Theoretical review

The study was premised on human capital theory, endogenous theory and Lewis model

Human capital theory

Human Capital Theory elucidates the significance of education, health, and competencies in the context of economic development. Investments in agricultural infrastructure and productivity exert a direct influence on food security and nutrition, which are vital components of human capital. Enhanced nutrition fosters cognitive and physical development, thereby contributing to an increased life expectancy. The theory advocates for the formulation of policies that synergistically integrate education, healthcare, and agricultural advancement to attain comprehensive growth. Human Capital Theory underscores the necessity of infrastructure, including educational institutions, healthcare facilities, and transportation networks, in promoting the expansion of human capital. Sufficient infrastructure facilitates access to education and healthcare, which are fundamental prerequisites for cultivating a skilled and healthy workforce. For example, well-established transportation infrastructure enables individuals to access educational institutions and medical facilities, while the availability of electricity and digital connectivity supports the provision of contemporary education and telemedicine services. When infrastructure aligns with the requirements of human capital, it engenders an enabling environment that propels economic activities and societal advancement.

In the realm of agriculture, Human Capital Theory underscores the significance of education and vocational training in equipping farmers with the necessary skills to implement contemporary farming methodologies, utilize mechanized tools, and adopt sustainable agricultural practices. Proficient agricultural labor is capable of effectively leveraging infrastructural resources, including irrigation systems and storage facilities, to optimize productivity levels. Moreover, access to healthcare services diminishes absenteeism due to health-related issues, thereby ensuring a reliable labor force for agricultural pursuits. By allocating resources towards human capital development through agricultural extension services and vocational training initiatives, Nigeria possesses the potential to surmount obstacles that hinder agricultural productivity. This theoretical framework also delineates a robust correlation between investments in human capital and increased life expectancy. The availability of healthcare infrastructure enhances physical health and lowers mortality rates, while educational initiatives promote awareness regarding healthful practices and nutritional knowledge. For example, enhanced agricultural output, bolstered by skilled farmers, contributes to food security and improved nutritional standards, which in turn positively influences life expectancy. Human Capital Theory accentuates the importance of infrastructure and productive labor in the realization of these health-related outcomes.

Endogenous growth model

The Endogenous Growth Theory, as articulated by Romer (1994), serves as the foundational theoretical framework for this investigation. This theory posits that economic growth is contingent upon investments in human capital, innovation, and knowledge management (Romer, 1994). The model accentuates the significance of investments in human capital, technological advancements, innovation, and infrastructural development as pivotal elements driving sustained economic growth from within an economy, instead of relying exclusively on external influences. According to the Endogenous Growth Model, infrastructure is instrumental in promoting innovation and enhancing productivity. Investments in transportation networks, energy systems, irrigation facilities, and digital infrastructure augment accessibility, connectivity, and operational efficacy. In the context of Nigeria, infrastructural advancements directly bolster agricultural development by facilitating farmers' access to markets, technology, and resources. For instance, the construction of rural roads diminishes transportation expenses and mitigates post-harvest losses, while dependable electricity supply empowers the utilization of modern agricultural implements.

The model elucidates how technological advancement, underpinned by infrastructure, elevates productivity across various sectors, including agriculture. Allocations towards research and development (R&D) yield innovations such as enhanced seed varieties, pest-resistant crops, and optimized irrigation methods, which substantially increase agricultural productivity. Nigeria has the opportunity to harness these innovations to address challenges such as climate variability and suboptimal yields. Improved agricultural productivity not only enhances food security but also raises income levels, in accordance with the model's premise that endogenous growth arises from the effective optimization of knowledge and resources. The Endogenous Growth Model suggests that growth driven by infrastructure and innovation exerts a favorable influence on social indicators, such as life expectancy. Enhanced agricultural productivity contributes to better nutrition and health outcomes, thereby reducing malnutrition and the incidence of diseases. Furthermore, infrastructural investments in healthcare facilities and sanitation systems expand access to essential services, which further elevates life expectancy. An increase in life expectancy also fosters economic growth by cultivating a healthier and more productive workforce, thus perpetuating the cycle of development.

Lewis model

The Lewis Dual Sector Model of Economic Development, proposed by W. Arthur Lewis in 1954, explains development as a process driven by the structural transformation of a traditional agrarian economy into a modern industrial one. Lewis assumed that the traditional agricultural sector has a surplus of labour with zero or negligible marginal productivity, while the modern sector offers higher productivity, wages, and capital accumulation. The theory posits that transferring excess labour from the agricultural sector to the modern sector fuels industrial growth without reducing agricultural output in the short term. Infrastructure development such as roads, electricity, and communication networks plays a critical enabling role in facilitating this transition by reducing transaction costs and linking rural areas to urban economic centers.

One of the key tenets of Lewis' theory is that capital accumulation in the modern sector leads to its expansion, which gradually absorbs the surplus labour from agriculture. In this process, agricultural productivity must also improve, often through mechanization, research, and better infrastructure (like irrigation systems), so that fewer workers can produce more food. This transformation enhances food security and raises rural incomes, which in turn improve health outcomes and life expectancy by increasing access to nutritious food, clean water, and healthcare services. Thus, according to Lewis, infrastructure and agricultural productivity are not only economic catalysts but also fundamental drivers of improved human development indicators such as life expectancy.

Tevin-Anyali *et al*. (2024) explored the relationship between infrastructure development and agricultural growth in Nigeria through the application of various econometric tools, including the Ordinary Least Squares (OLS) method, the Augmented Dickey-Fuller (ADF) test, and Johansen cointegration analysis. The variables assessed included public capital expenditure on economic services (PCEES), employment in agriculture (EMPA), research and development (RD), domestic credit to the private sector (DCPS), and agricultural output. Findings indicated that, with the exception of research and development, all variables were stationary at their first difference. The Johansen cointegration test confirmed the presence of a long-term equilibrium relationship involving two cointegrating vectors. Further analysis using OLS revealed that PCEES, DCPS, and RD positively influenced agricultural output, while EMPA was found to have a negative impact.

Kaur and Kaur (2023) conducted an empirical investigation into rural infrastructure and its ramifications on agricultural development in India. The research meticulously examined the trends associated with rural infrastructure variables and the agricultural output value throughout the period from 1990 to 2018. The findings of the study indicate a substantial influence of irrigation, fertilizer utilization, credit availability, regulated agricultural markets, and road infrastructure on agricultural productivity. Conversely, the effects of electric pumps, tractors, and village electrification were not found to be statistically significant. This suggests that infrastructural elements such as roads, irrigation systems, and electricity exert a more pronounced effect on agricultural growth than personal infrastructure components like electric pumps and tractors. This outcome corroborates the assertion of a positive and significant correlation between rural infrastructure and agricultural growth in India.

Udeuhele and Eze (2022) conducted an analysis of rural access roads in relation to agricultural development, specifically evaluating the conditions prevalent in the southeastern region of Nigeria. The research employed a quantitative methodological framework alongside a cross-sectional survey design. The instrument utilized, namely the questionnaire, underwent a rigorous validation process and was subjected to pre-testing. The reliability assessment conducted on the questionnaire yielded a Cronbach's Alpha Index of 0.823, indicative of a high level of internal consistency. A total of five sample units, representing five chapters of the All Farmers Association of Nigeria (AFAN) across Abia, Anambra, Ebonyi, Enugu, and Imo States, were selected to derive 328 respondents through stratified random sampling techniques. Data analysis was performed utilizing descriptive statistics, including frequency counts and percentages. Three hypotheses were formulated for examination through the application of Simple Linear Regression and ANOVA methodologies. The results indicated that bush-paths, classified as rural access roads, did not significantly enhance the production volume of food crops by rural farmers, that gravel-surfaced roads did not lead to an elevation in the income levels of these farmers, and that tarred roads, categorized as rural access roads, did not make a substantial contribution to the overall agricultural Gross Domestic Product (GDP).

Olakunle (2021) examined the influence of agricultural production on human life expectancy in Nigeria over the period from 1981 to 2019 using the Autoregressive Distributed Lag (ARDL) model. The analysis showed that agricultural activities, on the whole, did not significantly affect life expectancy. However, the third lag of agricultural output had a positive and statistically significant short-term effect. Despite theoretical expectations, only agricultural output showed alignment with the hypothesized direction, although its effect, along with other indicators, was not significant at the 5% level. On a magnitude scale, a 10% rise in both agricultural output and interest rates led to an approximate 1.59% and 1.64% increase in life expectancy, respectively. Conversely, industrial production, inflation, and exchange rates were reported to negatively affect life expectancy.

In another study, Lawson and Aseminachin (2020) assessed the impact of infrastructural amenities on the life expectancy of cash crop farmers in Nigeria's South-South region. Employing a mix of descriptive statistics, multiple regression analysis, ANOVA, and stepwise regression, the study concluded that infrastructure significantly influences life expectancy. Their findings highlighted infrastructure as a pivotal factor in enhancing wellbeing and sustaining economic development. The authors warned that neglecting infrastructural development could hinder progress and potentially reduce life expectancy among this demographic.

Aigheyisi (2020) focused on determining whether agricultural productivity plays a role in shaping life expectancy in Nigeria, analyzing data from 1981 to 2016 using ARDL, cointegration, and error correction models. The study found that improvements in agricultural productivity had a beneficial impact on life expectancy in the short term, but this turned negative over the long run. Additionally, inflation and unemployment consistently exerted negative effects across both short- and long-term horizons. Real per capita income was shown to have a short-term adverse impact, possibly due to income inequality and though the long-term impact was also negative, it lacked statistical significance. Moreover, exchange rate fluctuations and recurrent government spending on education did not significantly influence life expectancy. However, public expenditure on health services showed a consistent positive effect over both time frames.

1.3 Methodology

Given the nature of the work, this study adopts an ex-post facto research design. Data for the selected variables were obtained from multiple credible sources, including various publications by the Central Bank of Nigeria (CBN), the World Health Organization (WHO), the International Monetary Fund (IMF), and the 2024 edition of the World Bank Development Indicators (WDI) database. To assess the influence of infrastructural development and agricultural productivity on life expectancy in Nigeria, the study employed the Auto-Regressive Distributed Lag (ARDL) co-integration technique. This methodological approach is adapted with minor adjustments from the framework used by Tevin-Anyali *et al*. (2024). The specified econometric model illustrates the relationship between the dependent variable, life expectancy (LEX), and the independent variables namely infrastructure (INFS), agricultural output (AGO), and domestic credit to the private sector (DCPS) as outlined below:

$LEX = f\ (INFS, AGO, DCPS)$ ....(1)

Equation (1) was further linearized as;

$LEX = \beta 0 + \beta 1 INFS + \beta 2 AGO + \beta 3 DCPS + \mu$ ....(2)

The model is specified in double log form and is specified below:

$In\mathrm{LEX}t = \alpha + \partial In\mathrm{INFS}_t + \boldsymbol{\phi} In\mathrm{AGO}_t + \lambda In\mathrm{DCPS}_t + \varepsilon_t$................................. (3)

α, ∂, $\boldsymbol{\phi}$&λ represent the long run coefficient of intercept, infrastructural spending, agricultural output, domestic credit to private sector and life expectancy respectively while εt is the error term and In denotes the natural logarithm. However, to estimate the co-integrating relationship between the explained and explanatory variables, the study adopts the ARDL of Pesaran *et al*. (2001) by specifying the equation (2) as a bounds test co-integrating framework as:

$$\Delta\text{In}LEX\text{t} = \alpha + \sum_{i=1}^{N1} \beta\text{i}\, \Delta\text{In}LEX_{t-i} + \sum_{j=0}^{N2} \gamma\text{j}\ \Delta\text{In}INFS_{t-j} + \sum_{i=0}^{N3} \varPhi_i\, \Delta\text{In}AGO_{t-i} + \sum_{k=0}^{N4} \varPhi_i\, \Delta\text{In}DCPS_{t-i} + \partial\text{In}LEX_{t-1} + \phi\text{In}INFS_{t-1} + \phi\text{In}AGO_{t-1} + \lambda\text{In}DCPS_{t-1} + \mu\text{t} \quad \ldots\ldots (4)$$

Here, the specification (4) follows the normal ARDL template which frame the short run and long run estimates such that the estimates of α, $\partial\&\lambda$ are expressed over ρ and yield $-\alpha/\rho$, $-\partial/\rho$, $and - \lambda/\rho$ as the long run coefficients of intercept, infrastructural spending, agricultural output, domestic credit to private sector and life expectancy respectively, since ΔInINFSt= ΔInAGOt = ΔInDCPSt = $\Delta InLE$Xt = 0 in the long run because the variables INFS, AGO, DCPS and LEX are independent of one another. Meanwhile, the short run estimates are obtained as, γj and φj for infrastructural spending, agricultural output, domestic credit to private sector and life expectancy while $N1$ to $N4$ stands for the lag length order for the variables and it is selected following the Schwarz Information Criterion (SIC). Additionally, the speed of adjustment to long run equilibrium due to short run dynamics is missing in the preceding specification. Thus, to include the error correction term in the ARDL specification, the study specifies the error correction mechanism framework as;

$$\Delta\text{In}LEX\text{t} = \emptyset\text{v}_{\,t-i} + \sum_{i=1}^{N1} \beta\text{i}\, \Delta\text{In}LEX_{t-i} + \sum_{j=0}^{N2} \gamma\text{j}\ \Delta\text{In}INFS_{t-j} + \sum_{i=0}^{N3} \varPhi_i\, \Delta\text{In}AGO_{t-i} + \sum_{k=0}^{N4} \varPhi_i\, \Delta\text{In}DCPS_{t-i} + \mu\text{t} \quad \ldots\ldots (5)$$

Where v_{t-1} is the lagged error correction term calculated as $v_{t-1} = In\text{LEX} - \hat{\alpha} - \hat{\partial} In\text{INFS}_{t-1} - \hat{\lambda} In\text{AGO}_{t-1} - \Omega In\text{DCPS}_{t-1}$ and $\hat{\alpha} = -\alpha/\rho$, $\hat{\partial} = -\partial/\rho and \hat{\lambda} = -\lambda/\rho$. To assume co-integration among the variables, $\emptyset$ which represent the speed of adjustment to long run equilibrium must be negative and statistically significant, thus, the null hypothesis of $\emptyset = 0$ is tested against the alternative hypothesis of $\emptyset < 0$; also complemented by the bounds test to co-integration. For long run co-integration inference, the F-statistic must be greater than the critical values of the upper bound, however, if the F-statistic is less than the lower bound critical values, there exists a short-run relationship, while the test becomes inconclusive if the statistic value is between the upper and lower bound critical values.

1.4 Results and discussion of findings

Table 1: Unit root test (augmented dickey fuller (ADF))

<table>
<tr><th>Vari-ables</th><th>Levels</th><th colspan="2">Critical values</th><th>First Difference</th><th colspan="2">Critical values</th><th>Order of Integration</th><th>Remark</th></tr>
<tr><td rowspan="3">LEX</td><td rowspan="3">2.093412</td><td>1%</td><td>-3.098665</td><td rowspan="3">-6.674097</td><td>1%</td><td>-3.760897</td><td rowspan="3">I (1)</td><td rowspan="3">Stationary at 1st different</td></tr>
<tr><td>5%</td><td>-2.098544</td><td>5%</td><td>-2.988712</td></tr>
<tr><td>10%</td><td>-2.898008</td><td>10%</td><td>-2.098644</td></tr>
<tr><td rowspan="3">INFS</td><td rowspan="3">3.659221</td><td>1%</td><td>-3.600987</td><td rowspan="3">-4.097651</td><td>1%</td><td>-3.605593</td><td rowspan="3">I (0)</td><td rowspan="3">Stationary at level</td></tr>
<tr><td>5%</td><td>-2.935001</td><td>5%</td><td>-2.936942</td></tr>
<tr><td>10%</td><td>-2.609711</td><td>10%</td><td>-2.608654</td></tr>
<tr><td rowspan="3">AGO</td><td rowspan="3">-4.870098</td><td>1%</td><td>-3.609875</td><td rowspan="3">-8.980661</td><td>1%</td><td>-3.769593</td><td rowspan="3">I (0)</td><td rowspan="3">Stationary at level</td></tr>
<tr><td>5%</td><td>-2.935001</td><td>5%</td><td>-2.936942</td></tr>
<tr><td>10%</td><td>-2.605836</td><td>10%</td><td>-2.686412</td></tr>
<tr><td rowspan="3">DCPS</td><td rowspan="3">-3.409453</td><td>1%</td><td>-3.609765</td><td rowspan="3">-8.986654</td><td>1%</td><td>-4.912487</td><td rowspan="3">I (1)</td><td rowspan="3">Stationary at 1st different</td></tr>
<tr><td>5%</td><td>-2.930897</td><td>5%</td><td>-2.098712</td></tr>
<tr><td>10%</td><td>-2.809664</td><td>10%</td><td>-2.097643</td></tr>
</table>

Source: Author's computation, 2025.

Table abovepresents the unit root test result. It is cognizant to establish the stationary of the data to check if they move in the same proportion and to check if the variables are significant. This was carried out using the Augmented Dickey Fuller (ADF) unit root test. The decision rule is that the absolute value of the ADF test statistic value must be greater than the critical value at 5%. From the above summary, the ADF unit root test shows that life expectancy and domestic credit to private sector is stationary at the 1%, 5% and 10% level of significance at first difference which is represented by I(1) in the order of integration, while the variables agricultural output and infrastructural spending are stationary at levels and this is the reason why the order of integration is written as I(0).

Table 2: ARDL table
Panel A: Long run estimates

Dependent variable: LEX				
Variable	**Coefficient**	**S.E**	**t-stat**	**Prob**
INFS	0.008302	0.023913	0.029333	0.0112
AGO	0.325008	3.000312	1.300312	0.0015
DCPS	-0.534300	1.009321	0.390045	0.0230
C	-0.763245	0.029861	-0.086409	0.0970

Panel B: Short run estimates

Dependent variable: LEX				
Variable	**Coefficient**	**S.E**	**t-stat**	**Prob**
INFS	0.324250	0.823933	-1.728006	0.1023
AGO	0.354009	0.053430	1.076091	0.0809
DCPS	0.870012	0.430093	0.883390	0.0902
ECM(-1))	-0.780092	2.029912	-0.427301	0.0083
Panel C: Diagnostic Tests		**Statistic**	**Prob.**	
Normality Test		1.5769	0.6814	
ARCH		0.1094	0.7099	
Breusch-Godfrey LM		0.1656	0.8901	
Ramsey RESET		0.1819	0.8968	
		CUSUM		
Stability Test		Stable		

Source: Author's computation, 2025.
Notes: ***, **, and * respectively represent statistical significance at 1%, 5% and 10% levels.

The table below presents the results of the Autoregressive Distributed Lag (ARDL) model estimation, where life expectancy serves as the dependent variable, and the independent variables include agricultural output, domestic credit to the private sector, and infrastructure expenditure. The parameter "C" represents the model's constant term. In the long-term analysis, the findings indicate a positive relationship between life expectancy, agricultural output and infrastructure investment. Specifically, a one-unit increase in agricultural output and infrastructure expenditure is associated with increases of approximately 0.325008 and 0.008302, respectively, in life expectancy within the studied period in Nigeria. On the other hand, the relationship between life expectancy and domestic credit to the private sector is negative in the long run, suggesting that a one percent increase in domestic credit to the private sector leads to a reduction of approximately 0.534300 in life expectancy over the observed timeframe. The finding corroborate the work of Kaur and Kaur (2023) who found that infrastructural elements such as roads, irrigation systems, and electricity exert a more pronounced effect on agricultural growth and state that there is a positive and significant correlation between rural infrastructure and agricultural growth in India.

In the short-run dynamics, the model reveals a positive relationship between life expectancy and all three explanatory variables: agricultural output, infrastructure spending, and domestic credit to the private sector. The coefficients indicate that a unit rise in agricultural output, infrastructure investment, and domestic credit to the private sector leads to increases in life expectancy by 0.354009, 0.324250, and 0.870012, respectively. These findings are consistent with previous studies such as Tevin-Anyali et al. (2024) and Lawson and Aseminachin (2020), reinforcing the critical role of infrastructure and agriculture in promoting public health and longevity.

Furthermore, the coefficient of the error correction term (ECMt-1), reported in Panel B, is negative and statistically significant (ECM = -0.780092, t = -0.427301, $p < 0.0083$), suggesting that approximately 78% of any disequilibrium in life expectancy from the previous period is corrected in the subsequent year. This reflects a relatively rapid adjustment speed toward long-run equilibrium, implying steady improvements in life expectancy over time in Nigeria. To ensure the validity and reliability of the model, several diagnostic tests were conducted. The normality test confirmed that the residuals follow a normal distribution, as the probability value exceeds the 10% significance threshold, leading to the non-rejection of the null hypothesis. The Breusch-Godfrey LM test demonstrated the absence of serial correlation, while the ARCH LM test provided evidence supporting the assumption of homoscedastic error terms. Additionally, the Ramsey RESET test yielded an insignificant result, which confirms that the model is correctly specified and supports the null hypothesis of a linear functional form.

1.5 Conclusion and recommendations

This study explored the relationship among infrastructural development, agricultural output, and life expectancy in Nigeria over the period of 1990 to 2024, employing the Auto-Regressive Distributed Lag (ARDL) methodology. The theoretical expectation of a positive linkage between infrastructure, agricultural productivity, and life expectancy was validated in both the short and long run. Empirical results confirm that investments in infrastructure and agriculture exert a significant and positive influence on life expectancy over the long term, suggesting that improvements in these sectors contribute to better health outcomes and overall societal well-being. However, the analysis also reveals a negative long-term association between domestic credit to the private sector and life expectancy, emphasizing the importance of optimizing credit allocation and ensuring that financial resources are directed toward productive and socially beneficial activities. The statistically significant error correction term underscores a strong and stable equilibrium relationship, indicating that deviations from the long-term life expectancy trend are swiftly corrected, and that improvements in the contributing factors effectively translate into gains in life expectancy. In the short run, the study further affirms the positive influence of agricultural output, infrastructure spending, and domestic credit on life expectancy, though the latter's impact is context-dependent and requires careful financial governance. The robustness of the model is supported by various diagnostic tests, which confirm the validity and reliability of the empirical results.

Based on these results, the following recommendations are suggested:

i. Strengthen investment in agriculture and infrastructure: Given the established positive long-run effects, there is a clear need to increase public and private sector investment in both agriculture and infrastructural development. Prioritization should be given to essential rural infrastructure such as roads, irrigation systems, storage facilities, and agricultural research initiatives. These measures will not only enhance productivity but also indirectly improve health outcomes and longevity.

ii. Improve the efficiency of domestic credit utilization: To address the negative long-term effect of domestic credit on life expectancy, policymakers should implement regulatory reforms that channel credit into high-impact sectors like agriculture and infrastructure. Additionally, financial literacy and capacity-building programs should be introduced to help borrowers use credit more effectively, ensuring it contributes to sustainable development and well-being.

iii. Foster sustainable development practices: To maintain long-term balance between infrastructure, agriculture, and health outcomes, Nigeria must adopt environmentally sustainable strategies. This includes integrating renewable energy, climate-resilient agricultural methods, and durable, eco-friendly infrastructure designs. These practices not only support longevity but also align with broader goals of environmental sustainability and economic resilience.

References

Aigheyisi, O. S. (2020). An empirical investigation into the factors influencing life expectancy in Nigeria with a focus on agricultural productivity.*KIU Interdisciplinary Journal of Humanities and Social Sciences*, 1(2), 194–210.

Audu, I. A., Garba, N., & Badema, A. (2022). Spatial analysis of physical accessibility to rural health care facilities in Nigeria: a review. *International Journal of Research Publication and Reviews*, 3(4), 49-56.

Audu, M. O., & Otu, M. A. (2024).A comprehensive review of infrastructural advancement in Nigeria.*CSID Journal of Infrastructure Development*, 7(3), 522–532.

Edeme, R. K., Nkalu, N. C., Idenyi, J. C., & Arazu, W. O. (2020). Infrastructural investments, agricultural sustainability, and employment generation in ECOWAS nations.*Sustainable Futures*, 2(1), 100–110.

Etikan, I., Babatope, O., Yuvah, M., & Ilgi, S. (2019).Socioeconomic determinants affecting life expectancy at birth in Nigeria.*Annals of Biostatistics and Biometric Applications*, 1(5).

Food and Agriculture Organization. (2023). The state of food security and nutrition in the world 2023: urbanization, agrifood systems transformation and healthy diets across the rural–urban continuum.

Günay, E., & Atılgan, D. (2020).Exploring the link between health expenditure and economic growth: evidence from selected OECD countries using modern panel co-integration methods.*Business & Management Studies: An International Journal (Bmij)*, 8(3), 3640–3654.

Johnson, D., & Thompson, H. (2020). Examining how agricultural efficiency drives economic performance: panel data insights. *Journal of Agricultural Economics*, 71(3), 780–800.

Kaur K. & Kaur M. (2023). Rural infrastructure and its impact on agricultural growth in India: an empirical analysis. *ESI Preprints*, 333-350.

Lakra, S. (2024).The role of agricultural output in driving national GDP growth.*International Journal for Multidisciplinary Research*, 6(6), 1–5.

Lawal, N. A., Opeloyeru, O. S., & Adegbola, O. C. (2023). Public health spending, economic performance, and life expectancy in Nigeria. *Studies of Applied Economics*, 41(3), 1–11.

Lawson, S., & Aseminachin, K. I. (2020). Investigating the effect of infrastructure on the longevity of cash crop farmers in Nigeria's South-South. *International Journal of Innovations in Management and Development Studies*, 7(3), 109–114.

Maiga, Y. (2024). The contribution of agricultural productivity to economic progress in African countries.*Journal of Agricultural Studies*, 12(2), 25–57.

Ndiwa, N. N., Simatwa, E. M. W., & Mugo, H. M. (2020). Assessing the role of rural infrastructure in shaping agricultural productivity and livelihoods in Western Kenya.*Journal of Agricultural and Food Systems*.

Olakunle, O. O. (2021). Agricultural productivity and its influence on life expectancy trends in Nigeria.*Asian Journal of Economics, Finance*.

Olatubi, M. I., Oyediran, O. O., Adubi, I. O., & Ogidan, O. C. (2018).Reviewing the impact of health expenditure on national productivity in Nigeria.*South Asian Journal of Social Studies and Economics*, 1(1), 1–7.

Pesaran, M. H., Shin, Y., & Smith, R. (2001). ARDL bounds testing approach for analyzing long-term relationships. *Journal of Applied Econometrics*, 16, 289–326.

Peterson, L., & Collins, M. (2022).Agricultural productivity as a determinant of economic growth in African nations.*African Journal of Agricultural and Resource Economics*, 17(1), 53–67.

Romer, P. M. (1994).Tracing the foundations of endogenous growth theory. *The Journal of Economic Perspectives*, 8(1), 3–22.

Salami, D. K., Olabode, O. S., Atoyebi, K. O., Lawal, S. A., & Danmola, R. (2017). Government spending on health and education and its implications for Nigeria's economic growth. *International Journal of Social & Management Sciences (IJSMS), Madonna University*, 1(1), 118–130.

Subhalaxmi, M. (2017).Exploring the causality between economic growth, public health expenditure, and infant mortality rates in India.*International Journal of Social Economics*, 44(12), 2–18.

Tevin-Anyali, C. L., Callistus, T. O., & Okaforocha, C. M. (2024). Investigating the link between infrastructure and agricultural performance in Nigeria.*African Journal of Economics and Sustainable Development*, 7(2), 161–173.

The National Health Accounts (NHA). (2020). Health expenditure data and insights for Nigeria.

Udeuhele, G. I & Eze, A. V. (2022).Rural access roads and the quest for agricultural development: an appraisal of the conditions in south-east in Nigeria. Global Journal of Social Sciences 21(2), 21-34.

World Bank. (2022). Infrastructure for development: unlocking economic potential and improving well-being.

World Health Organization (WHO). (2021). Tracking health indicators for Sustainable Development Goals (SDGs).

World Health Organization (WHO)(2024). Global health statistics and life expectancy trends.

World Health Organization. (2023). World health statistics 2023: Monitoring health for the SDGs.