

Road Infrastructure as a Catalyst for Regional Development in North-Central Geo-Political Zone of Nigeria: Evidence from an Empirical Model.

SAKA L. A.¹, SOMUYIWA A. O.², AWOREMI J. R.³

^{1,2,3}*Department of Transport Management, Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria.*

Abstract- Road infrastructure serves as a critical catalyst for regional development, influencing economic productivity, social inclusion, and accessibility to services. In Nigeria, the North-Central Geo-Political Zone continues to experience challenges associated with deteriorating road networks, affecting transportation efficiency, travel time, and regional economic outcomes. This study investigated the effects of road infrastructure on regional development in the North-Central Zone. A descriptive research design was adopted, employing a structured questionnaire administered to 322 respondents, including 95 commercial drivers, 75 logistics operators, 52 transport union members, and 100 commuters across Benue, Kogi, Kwara, Nasarawa, Niger, Plateau, and Abuja FCT. Stratified, snowballing, and incidental sampling techniques were used to ensure comprehensive coverage of all road user categories. Data were analyzed using multiple regression analysis to determine the influence of Road Safety Perception (RSP), Road Quality Index (RQI), Road Connectivity (RC), Travel Time Efficiency (TTE), and Rural Access Index (RAI) on regional development. Findings revealed that Road Safety Perception ($p = 0.000$), Road Quality Index ($p = 0.000$), and Rural Access Index ($p = 0.006$) positively and significantly influence regional development, whereas Travel Time Efficiency ($p = 0.001$) exhibited a negative effect and Road Connectivity ($p = 0.258$) showed an insignificant impact. The study concludes that user-oriented improvements in road quality, safety, and rural accessibility are essential for stimulating sustainable regional development in the North-Central Zone of Nigeria. Recommendations include prioritizing targeted road rehabilitation, routine maintenance, and strategic infrastructure investment to enhance economic activities, social mobility, and regional competitiveness.

Keywords: road infrastructure, regional development, north-central nigeria, road safety perception, road quality index, road connectivity, travel time efficiency, rural access index

I. INTRODUCTION

Road infrastructure stands today as one of the most decisive catalysts for accelerating regional transformation, shaping economic productivity and determining the spatial trajectory of development (Adeniran & Olatunji, 2020). Across the world, no nation has achieved sustainable regional development without a functional and resilient road network. This reality is even more pronounced in developing countries, where road transport accounts for over 90% of passenger mobility and commercial freight movements, making it the backbone of economic integration and social connectivity (Ngugi & Mwangi, 2019).

In Nigeria, the quality of road infrastructure continues to exert a profound influence on the pace, distribution, and inclusiveness of regional development. Scholars note that road accessibility not only reduces travel time and transportation costs but also unlocks the latent economic potential embedded within regions, particularly those with agricultural and mineral-based livelihoods (Ogunleye, 2021). The North-Central region represents a critical development corridor in this regard. Positioned as a demographic and geographic bridge between the North and the South, its growth trajectory is deeply tied to the condition, reach, and efficiency of its road infrastructure (Adeosun & Alabi, 2022).

Empirical and theoretical evidence converges on one point; road infrastructure is a powerful enabler of socioeconomic expansion. It enhances land-use efficiency, stimulates agricultural commercialization, and strengthens social interactions, while also improving access to schools, healthcare, and

employment opportunities (Ojo & Ibrahim, 2023). The presence of robust road networks attracts investment, widens markets, improves purchasing power, and facilitates the distribution of goods and services factors that serve as engines of regional competitiveness (Okafor & Utomi, 2024).

Beyond economic advantages, functional road systems foster territorial cohesion, promote regional equity, and reduce spatial disparities, thereby aligning with global development frameworks such as the Sustainable Development Goals (SDGs), especially those centered on reducing inequalities, building resilient infrastructure, and promoting sustainable industrialization (United Nations, 2020). In essence, the road network becomes a lifeline for regional prosperity and social mobility.

Yet, despite the acknowledged importance of road infrastructure, Nigeria struggles with persistent challenges that undermine its catalytic potential. Chronic underinvestment, corruption, poor maintenance culture, and institutional inefficiencies continue to deteriorate road quality and limit the benefits expected from transport development (Olagunju & Salau, 2019). These structural weaknesses exacerbate regional inequalities, restricting economic flows and deepening developmental imbalances in regions such as the North-Central zone.

Consequently, the question is no longer whether road infrastructure influences regional development but rather how strongly, in what dimensions, and through which socioeconomic variables this influence manifests. Understanding these dynamics is essential for designing evidence-based policies capable of transforming road infrastructure into a lever for balanced and sustainable regional growth.

Against this backdrop, this study investigates the effects of road infrastructure on regional development in the North-Central region, drawing from empirical evidence and scientific reasoning to clarify the magnitude of influence across factors such as land-use systems, social interactions, literacy levels, purchasing power, and distribution networks. By doing so, the study contributes critical insights to

ongoing debates on the infrastructural foundations of regional transformation in Nigeria.

Aim of the Study

The primary aim of this study is to critically examine the extent to which road infrastructure serves as a catalyst for regional development, with particular attention to how improved road networks stimulate economic growth, enhance accessibility, promote social inclusion, and strengthen regional competitiveness.

Research Hypothesis

Based on the aim of the study, the null hypothesis is formulated:

H01: Road infrastructures have no significant effect on regional development in North-Central Geo-Political Zone of Nigeria.

II. LITERATURE REVIEW

Review of Previous Studies

Ogunleye and Adebayo (2017) assessed the relationship between road infrastructure quality and agricultural market access in Oyo State. Using a purposive sampling technique, data were obtained from 410 farmers and traders across four local governments. Regression analysis and ANOVA were used to test the hypotheses. The findings indicated that poor road conditions significantly hindered agricultural distribution, increased transport costs, and reduced farmers' access to regional markets.

Eze and Nwosu (2018) studied the influence of road transportation on regional economic development in Southeast Nigeria. A sample of 265 traders, transport workers, and commuters was selected using stratified sampling. The researchers applied ANOVA and correlation analysis. Findings revealed that improved road networks enhanced trade activities, reduced travel delays, and facilitated regional economic integration.

Adelakun and Olabiyi (2020) investigated road infrastructure development and its effects on socio-economic growth in Lagos State. Data were collected through surveys and GIS mapping involving 350 road users and business operators. Multiple regression

analysis was used to examine the relationships. The results showed that road expansion and maintenance significantly reduced congestion and improved commercial productivity in the region.

Ibrahim and Hassan (2021) examined the impact of road transportation infrastructure on regional integration in Northern Nigeria. The study employed a quantitative explanatory design and sampled 280 respondents across three states. Panel regression and descriptive statistics were used. The findings indicated that upgraded federal highways improved mobility, strengthened inter-regional trade, and enhanced labor movement.

Olawale and Adeyemi (2023) assessed the effect of road development on logistics performance in Southwest Nigeria. Data were collected from 180 logistics operators, truck drivers, and distribution managers. The study used multiple regression and cost-benefit analysis. Results revealed that road quality, maintenance availability, and network coverage had significant positive effects on delivery time, logistics efficiency, and operating costs.

Udo and Akpan (2025) explored the contribution of road infrastructure to sustainable regional development in Akwa Ibom State. Structured questionnaires were administered to 300 respondents drawn from rural and urban communities. Path analysis and descriptive statistics were used for analysis. Findings indicated that improved road infrastructure enhanced employment opportunities, supported environmental sustainability initiatives, and stimulated regional socio-economic expansion.

Zaw and Naing (2018) examined the influence of road infrastructure development on rural-urban integration in Myanmar. Data were collected through a structured survey administered to 385 rural households across three regions. Multiple regression and travel-time elasticity models were used to analyze the data. Findings revealed that improved road connectivity significantly reduced transportation costs, enhanced farmers' access to markets, and strengthened rural participation in regional economic activities.

Adu-Gyamfi and Asiedu (2019) investigated road infrastructure investment and regional competitiveness in Ghana. Using a cross-sectional design, data were gathered from 220 business owners and transport operators across 10 regions. Spatial regression and descriptive statistics were used to test the study's assumptions. The results showed that better road density and quality contributed significantly to increased business productivity, regional trade expansion, and migration inflows.

Mwangi and Karanja (2020) studied the role of road infrastructure in promoting socio-economic welfare in Kenya. The study sampled 320 households and transport users in Nairobi and its surrounding counties. Structural Equation Modeling (SEM) and ordinal regression were applied for analysis. Their findings indicated that road improvements greatly enhanced access to education, healthcare, and employment, thereby improving regional social development.

Rahman and Chowdhury (2021) investigated the impact of transport infrastructure on economic growth in Bangladesh. Time-series data spanning 1980–2019 were collected from national economic archives. The Autoregressive Distributed Lag (ARDL) model was used to assess long-run and short-run effects. Findings showed a significantly positive long-run relationship between road infrastructure investment, GDP growth, trade volume, and manufacturing productivity.

Gould and Esposito (2022) examined road transport infrastructure and spatial development in Brazil using geospatial datasets and satellite imagery covering 15 states. The study employed GIS-based spatial autocorrelation and regression techniques. Results revealed that improved road corridors promoted industrial clustering, reduced regional imbalances, and stimulated urban expansion around major highway networks.

Sato and Nakamura (2024) explored the effects of rural road upgrades on labor mobility and economic diversification in Southeast Asia. Data were collected from 460 respondents in Indonesia, Vietnam, and Thailand using a mixed-method survey design. Panel

data analysis and thematic content interpretation were used. Findings indicated that improved rural roads increased labor mobility, stimulated small business growth, and integrated rural regions into national economic markets.

III. METHODOLOGY

The study was conducted on 322 road users across the North-Central Geo-Political Zone of Nigeria, comprising Benue (45), Kogi (40), Kwara (38), Nasarawa (42), Niger (47), Plateau (40), and Abuja FCT (70). The respondents included 95 commercial drivers, 75 logistics operators, 52 transport union members, and 100 commuters, all selected for their direct exposure to road infrastructure and transportation dynamics. Data were collected using a structured questionnaire designed to capture respondents' perceptions of Road Safety Perception (RSP), Road Quality Index (RQI), Road Connectivity (RC), Travel Time Efficiency (TTE), and Rural Access Index (RAI), alongside their perceived effects on regional development. A stratified sampling technique was employed to ensure proportional representation of respondents across states and categories. Additionally, snowball sampling facilitated access to drivers and logistics operators with irregular schedules, while incidental sampling captured available commuters during fieldwork, ensuring comprehensive coverage of all transport actors. All data were analyzed using multiple regression analysis to examine the effects of the independent variables on regional development, allowing assessment of both individual and combined contributions of road infrastructure variables.

IV. RESULT AND DISCUSSION

The analysis of the effects of road infrastructure on North-Central regional development, as presented in Tables 4.1 to 4.3, demonstrates a robust and statistically significant relationship between the selected road infrastructure variables and regional development outcomes. The model summary (Table 4.1) reveals a strong positive correlation ($R = 0.868$) between the independent variables Road Safety Perception (RSP), Road Quality Index (RQI), Road Connectivity (RC), Travel Time Efficiency (TTE),

and Rural Access Index (RAI) and regional development. The coefficient of determination ($R^2 = 0.754$) indicates that approximately 75.4% of the variance in North-Central regional development is explained by these road infrastructure variables, with an adjusted R^2 of 0.750 confirming the model's explanatory strength while accounting for the number of predictors and sample size. The relatively low standard error of estimate (0.69148) further supports the predictive accuracy of the model.

The ANOVA results (Table 4.2) corroborate the significance of the model, with an F-value of 193.215 and a p-value of 0.000, indicating that the combined effect of the independent variables on regional development is statistically significant at the 5% level. This demonstrates that variations in road infrastructure significantly influence regional development outcomes in the North-Central Geo-Political Zone of Nigeria.

The regression coefficients (Table 4.3) provide a detailed understanding of the individual contributions of each variable. Road Safety Perception ($B = 0.591$, $t = 6.991$, $p = 0.000$), Road Quality Index ($B = 0.448$, $t = 4.851$, $p = 0.000$), and Rural Access Index ($B = 0.406$, $t = 2.761$, $p = 0.006$) exhibit positive and statistically significant effects on regional development, highlighting that improvements in these dimensions are critical drivers of socio-economic growth. Travel Time Efficiency, however, shows a negative and significant impact ($B = -0.390$, $t = -3.349$, $p = 0.001$), suggesting that inefficiencies in travel duration negatively affect developmental outcomes. Road Connectivity ($B = 0.084$, $t = 1.133$, $p = 0.258$) presents a positive but statistically insignificant effect, implying that connectivity alone may not sufficiently drive regional development without complementary improvements in other infrastructure components.

The empirical findings indicate that enhancing road safety, road quality, and rural accessibility should be prioritized in regional development strategies, while addressing travel time inefficiencies is equally crucial to maximize the developmental benefits of road infrastructure. These results provide actionable insights for policymakers, transport planners, and

stakeholders in North-Central Nigeria seeking to sustainable regional growth.
leverage road infrastructure as a catalyst for

Table 4.1: Model Summary on the Effects of Road Infrastructure on North-Central regional Development

Model	R Square	Adjusted R Square	Std. Error of the Estimate
1	.868a	.754	.69148

Table 4.2: ANOVA Table on the Effects of Road Infrastructure on North-Central Regional Development

Model	Sum of Squares	Df	Mean Square	F	Sig.
1 Regression	461.927	5	92.385	193.215	.000b
Residual	151.095	316	.478		
Total	613.022	321			

Table 4.3: Coefficient Table on the Effects of Road Infrastructure on North-Central Regional Development

Model	Unstandardised Coefficients		Standardised Coefficients		Sig.
	B	Std. Error	Beta	t	
1 (Constant)	.229	.104		2.204	.028
Road Safety Perception	.591	.085	.493	6.991	.000
Road Quality Index	.448	.092	.448	4.851	.000
Road Connectivity	.084	.074	.056	1.133	.258
Travel Time Efficiency	-.390	.116	-.368	-3.349	.001
Rural Access Index	.406	.147	.269	2.761	.006

Source: Author's Field Survey (2025)

The study revealed that road infrastructure significantly influences regional development in North-Central Nigeria. Road safety perception, road quality, and rural access positively and significantly impact development, whereas travel time efficiency showed a negative effect, and road connectivity was not statistically significant. These results align with existing literature emphasizing that improved road quality and safety enhance economic activities, reduce travel costs, and increase access to services (Rosik & Wójcik, 2023; Hlotywa & Ndaguba, 2017). The positive role of rural access underscores its importance in integrating remote communities into regional development processes (Sun et al., 2023). The negative coefficient for travel time efficiency suggests inefficiencies such as congestion and poor maintenance, highlighting that infrastructure presence alone does not guarantee development benefits (Kamaludin & Qibthiyyah, 2025). Similarly, the

insignificant effect of connectivity indicates that network expansion must be complemented by quality, safety, and accessibility improvements to achieve tangible regional development outcomes (Jain et al., 2024). Overall, the findings demonstrate that comprehensive, user-oriented road infrastructure including quality, safety, and rural accessibility is crucial for stimulating development in the North-Central region.

V. CONCLUSION AND RECOMMENDATION

The study concludes that road infrastructure significantly impacts regional development in North-Central Nigeria, with road safety, quality, and rural access promoting development, while travel inefficiencies hinder it. It is recommended that government agencies invest in road improvement,

safety, and rural connectivity to enhance regional growth.

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