



## **SOCIO-ECONOMIC IMPACT OF RURAL ROAD INFRASTRUCTURE BY AFRICAN DEVELOPMENT BANK COMMUNITY-BASED AGRICULTURE AND RURAL DEVELOPMENT PROJECT IN SELECTED STATES OF NIGERIA**

<sup>1</sup>Nura, A. Y., <sup>2</sup>Sani M. H. and <sup>3</sup>Bawa, D. B.

<sup>1</sup>Federal Ministry of Agriculture and Rural Development, Ahmadu Bello Way, Bauchi, Nigeria

<sup>2</sup>Department of Agricultural Economics, Abubakar Tafawa Balewa University, Bauchi.

<sup>3</sup>Department of Agricultural Economics, University of Jos.

**Corresponding Author's E-mail:** aynura@gmail.com **Tel.:** 08069738688

### **ABSTRACT**

The study was carried out to assess the socio-economic impact of rural road infrastructure provided by the African Development Bank Community-based Agriculture and Rural Development Project (AfDB-CBARDP) in the States of Adamawa, Bauchi, Gombe, Kaduna and Kwara. Multi-stage sampling procedure was used to select samples for the study. A sample of 80 respondents were used for the study. The data was analyzed using descriptive statistics. The results revealed that the project had achieved 100% set target on the provision of road construction in each of the participating States. Also, 83.0%, 76.0%, 69.0%, 79.0% and 72.0% of beneficiaries' communities in Adamawa, Bauchi, Gombe, Kaduna and Kwara States rated the roads quality as very good. The result has shown that in Adamawa, Bauchi, Gombe, Kaduna and Kwara States, there was reduction in time of waiting for motor vehicle by 160, 15, 50, 40 and 10 minutes. There was also a concurrent reduction in the transportation fare (Naira/passenger) to the nearby town by ₦50, ₦200, ₦100, ₦150 and ₦50, respectively. The study equally revealed that average yield per hectare of maize has increased from 1500 kg to 2500 kg before and after the project in Adamawa State. In the same vein, average yield in Bauchi, Gombe, Kaduna and Kwara States before the project were 1100 kg, 1200 kg, 1745.6 kg and 1223 kg, while after the project intervention the maize yields more than double to 2500 kg, 2800 kg, 2309 kg and 2309 kg, respectively. Likewise, average yield of cowpea per hectare has increased considerably across the five States of Adamawa, Bauchi, Gombe, Kaduna and Kwara by 69.8%, 65.9%, 51.6%, 73.8% and 46.5%, respectively. Percentage change in income of the sampled respondents indicates an average increase of 67.6% across the beneficiary States. The study concluded a strong positive NPVs and BCRs greater than 1 in all the States. The BCR in all cases indicates that the road projects were worth investing. The study recommended that a willingness to pay analysis to be undertaken as a way of gauging future tariff plan for the use of the road infrastructure to justify and attract private investment.

**Keywords:** Socio-economics, Rural, Road infrastructure, AfDB-CBARDP, Nigeria.

### **INTRODUCTION**

Road's infrastructures play crucial role in uplifting the status of the rural areas by facilitating the provision of basic inputs for all-round socio-economic development activities through increased access to key agricultural inputs, markets, education, better health services and improved social interaction and mobility. Rural accessibility remains a major challenge in developing countries. About 900 million rural dwellers worldwide lack access to all-season roads because they are located farther than two kilometers (km) a 20-to-25-minute walk from main roads (World Bank, 2015). Rural infrastructures play crucial role in poverty reduction, economic growth and empowerment for the rural poor. Rural roads provide basic inputs for all-round socio-economic development of the rural areas. The provision and construction of



roads brings numerous benefits to the rural areas. World Bank (2001) report equally highlighted the importance of rural infrastructure by alluding that a significant improvement in socio-economic living conditions will be realized with increased rural roads investment.

The estimated benefits include improved accessibility to social infrastructure, increased opportunities to access education and health facilities and improved social interaction and mobility, which are important for social and economic development. Additionally, there is going to be improved access to markets by reducing transport costs; improvement of the marketability of perishable goods through timely and cheaper transport that will provide a direct incentive for more market-oriented agriculture; and with more profitable cash crops, an increase in rural income and also additional employment opportunities. According to David-West (2015), Nigeria with current 200,000 kilometers of road network has the largest road network in West Africa and the second largest, south of the Sahara. 95% of both passenger and freight movements in Nigeria are by road. Federal roads account for about 54% of the total bituminous national road network, as it also accounts for over 80% of the national vehicular and freight traffic. Accordingly, Nigeria has a road density of 0.21 km of road per square km of land area, which compares well with an average of 0.06 km per sq. km. for the West and Central Africa regions combined. The road density for Nigeria is roughly the same as that for South Africa, Mexico, Brazil, Indonesia, and Pakistan (Ajiboye and Afolayan, 2009). Roads are considered the country's biggest public capital asset, representing between 15 and 30% its Gross Domestic Product (GDP).

Lokesha and Mahesha (2017) classified agricultural infrastructures into three viz capital intensive, capital extensive and institutional infrastructure. Capital intensive are like irrigation, roads, bridges etc. Capital extensive on the other hand involves extension services and the likes, while institutional infrastructure are the formal and informal institutions. Adequate infrastructure has been shown to raises farm productivity and lowers farming costs. Among agricultural infrastructure road infrastructure plays a very significant role in accelerating agricultural production. Rural Roads Connectivity is one of the key components for rural development, as it promotes access to economic and social services, generating increased agricultural income and productive employment. Access roads provide the means to bring the rural population on to the main stream. A good road network reduce transport cost, accelerates efficient delivery of farm inputs and enhance special agricultural production and distribution. A good network of roads will expand the distribution of agricultural goods as well as open up additional opportunities for agricultural trade (Lokesha and Mahesha, 2017).

According to Sama and Aggarwal (2021), changes in the travel pattern and economic benefits are some of the impacts of the rural roads. The provision of rural roads results in increased mobility level, use of mechanized mode of transportation, speedier movement of passengers and goods, increased share of travel of journeys for social visits and educational purposes, reduction in travel cost. (Sama and Aggarwal, 2021). Increase access to rural roads will enable farming communities to produce more agricultural product by way of generated incentives for marketing their produce at low transportation cost and importing the fertilizer, manures and seeds at cheaper rate due to the reduced cost of transportation to the village. Thus, the productivity of agriculture which is a dominant economic sector in the rural economy is increased. Moreover, all weather road connection also reduces the time of transporting the perishable products like milk, vegetables, poultry products, etc. and ensures a remunerative price for such commodities throughout the year to the producer and a regular supply to the consumers. Inoni (2009) on the other hand, stated that good road infrastructure could open up the rural economy to greater competition. This may take the form of cheaper products from lower-cost sources of supply or new or improved products that may displace some locally produced items.



The Government of Nigeria initiated a Rural Sector Study with support from the World Bank and USAID in the year 2000. This resulted in the adoption of the new Rural Development Strategy in 2001, which aims at poverty reduction through the improvement of livelihood and living conditions of the rural communities. The AfDB-CBARDP is a multi disciplinary project whose sector goal is to reduce poverty through the improvements of the livelihood and living condition of the rural poor. The project objective is to contribute to food security and increase access to rural infrastructural facilities in the project areas. The specific objectives of the study were to:

- i. determine the number of kilometres and quality of the roads constructed/rehabilitated against the Project target.
- ii. estimate travelling time and cost of transportation to the main road and major market/nearby towns before and after the Project intervention.
- iii. access the number of agricultural service providers in the benefitting communities before and after the Project intervention.
- iv. access the effect of the road projects on crop productivity and income of benefitting communities.
- v. estimate benefit cost ratio of the rural roads constructed and compare it with other social and infrastructural projects.

## MATERIALS AND METHODS

### The Study Area

The study area covers five States of Adamawa, Bauchi, Gombe, Kaduna and Kwara. The total area of the project is about 200,000 km<sup>2</sup>. Most of the stakeholders were engaged in agricultural production. Major crops grown were millet, sorghum, rice, cowpea, groundnut and cassava.

### Sampling Procedure

The study was conducted in the five states that participated in the AfDB-CBARDP projects (Adamawa, Bauchi, Gombe, Kaduna and Kwara). Multi-stage sampling procedure was used to select samples for the study. In the first stage, a random selection of three LGAs was made in each of the states from the nine participating LGAs, which gave a total of 15 LGAs. In the second stage, 3 Rural Village Areas (RVAs) were selected from each of the selected LGAs, these gave a total of 45 RVAs that were sampled and visited during the course of the study. In every State, 9 RVAs were selected and at least 3 communities that benefitted from road infrastructure were visited. A sample of between 65 to 80 respondents were interviewed using a structured questionnaire. Focus Group Discussions (FGDs) were also conducted with stakeholders and Key Informants (KIs), to complement the information sought in the questionnaire. A total of 15 FGDs was conducted by means of a checklist as a guide.

### Analytical Techniques

Descriptive statistics were used to analyze the data for the study. Descriptive statistical techniques in form of percentages were used to summarize and organize the data obtained. Benefit Cost Analysis (BCA) was also performed to establish whether a project is economically worthwhile. The aggregate value of the Project roads is measured by its net social benefit, sometimes simply referred to as the net benefit, and usually denoted as:

$$NSB = B - C \quad \dots(1)$$

The BCA is the money value of the stream of benefits yielded by a project over its life span less cost outlay and associated expenses. Mathematically it is expressed as:

$$NPV = PV(B) - PV(C) \quad \dots(2)$$

The decision criterion is that, a project is economically worthwhile if NPV is  $\geq 0$ . Alternatively, this can be obtained using the Benefit Cost Ratio (BCR) which is the discounted



benefits divided by the discounted costs. In this case, a project is worthwhile if the ratio is  $\geq 1$ . When the NPV or the BCR are 0 or 1 respectively, the project is said have breakeven, meaning that the cost of the project is just equal to the benefits derived from it.

Anthony *et al.* (2018) cited that when there is more than one alternative to the existing Project being analyzed and all the alternatives are mutually exclusive, then the rule is: select the project with the largest NPV. This rule assumes implicitly that at least one NPV is positive. If no NPV is positive, then none of the specified alternatives are superior to the current Project, which should remain in place.

According to Shukla and Jani (2018), Cost- Benefit analysis is very commonly used tool for assessing the infrastructure investment especially for transport projects. CBA measured by the money value of cost and benefits for total investment. Once the all cost and benefits are quantified, then inter-temporal discount is used to translate future costs and benefits by means of a social discount rate, future can be compared with present. CBA also compare with the trade-offs, total benefits with total opportunity cost such as labor, time, monetary cost etc. to make project feasible, otherwise social cost will exceeds the social benefits and the project will be rejected.

## RESULTS AND DISCUSSION

### Number of Roads and Level of Target Achievement

Result from Table 1 shows the number of rural roads provided against their set target. It is revealed from the result that for the States of Adamawa, Bauchi, Gombe, Kaduna and Kwara the project had achieved the provision of the 54 km of constructed or rehabilitated roads resulting to 100% achievement for all the participating states. This shows articulated response to project implementation on the side of the stakeholders involved in the project.

**Table 1:** Distribution of Targets and Achievements of Rural Roads

State	Project Target	Number Provided	% Achievement
Adamawa	54	54	100
Bauchi	54	54	100
Gombe	54	54	100
Kaduna	54	54	100
Kwara	54	54	100
<b>Total</b>	<b>270</b>	<b>270</b>	<b>100</b>

Source: Field Survey, 2013

### Quality of Roads Provided

The roads quality assessment by beneficiaries across the project areas was analyzed using a quality rating scale: Very good; Good; Fair and Bad. The result shown in Table 2 indicated that 83.0%, 76.0%, 69.0%, 79.0% and 72.0% of beneficiaries' communities In Adamawa, Bauchi, Gombe, Kaduna and Kwara States, rated the roads quality as very good. The result indicates appreciable contentment of the beneficiaries on the roads infrastructure implemented by the Project.

**Table 2:** Assessment of Road Quality by Respondents

State	Very Good	Good	Fair	Bad
Adamawa	83.0%	12.0%	1.0%	4.0%
Bauchi	76.0%	17.0%	6.0%	1.0%
Gombe	69.0%	26.0%	3.0%	2.0%
Kaduna	79.0%	12.0%	5.0%	4.0%
Kwara	72.0%	14.0%	10.0%	4.0%

Source: Field Survey, 2013

### Effect of the Road Projects on Time Saving and Reduction in Transportation Costs

Table 3 shows the benefits derived due to reduction in time and transportation fare by the respondents. According to the result obtained in Adamawa, Bauchi, Gombe, Kaduna and Kwara, there was reduction in time (minutes) of waiting for motor vehicle as follows, 160, 15, 50, 40 and 10, respectively. This indicates reduction in time of between a minimum of ten minutes to a maximum of over 2 hours in waiting. The time saved could be utilized for other economic activities thereby increasing labor productivity in the area. A study by Damania *et al.* (2018) reported that a 10% decline in transport costs would increase the production of bananas by 7.9% and 17.5%, groundnuts by 6.3% and 20.9%, rice by 5.4% and 20.5%, cassava by 2% and 18.8% and maize by 0.5% and 9.7%, respectively.

The result in Table 3 also shows waiting time for motor cycles has also reduced with the following minutes, 115, 28, 100, 55 and 10 for the states of Adamawa, Bauchi, Gombe, Kaduna and Kwara. For reduction in transportation fare (naira/passenger) to the nearby town, results for the five states revealed the following decreases of ₦50, ₦200, ₦100, ₦150 and ₦50, respectively. On the cost (naira) of hiring pickup van from the respondents' farm to the major markets, the cost was found to reduced significantly. An average reduction in cost of hiring a pickup van of between ₦1,000 and ₦3,500 was recorded across the five States.

**Table 3:** Time Spent and Transportation Costs Before and After the Project

Parameters	Adamawa project			Bauchi project		
	Before	After	Time reduction	Before	After	Time reduction
Distance to nearest nearby town (km)	3.5	3.5	0	5	5	0
Distance to nearest major market (km)	5	5	0	4.5	4.5	0
Time taken to wait for motor vehicle transport (minutes)	180	20	-160	20	5	-15
Time taken to wait for motorcycle transport (minutes)	120	5	-115	30	2	-28
Travel time by motor vehicle to all-weather road (minutes) <sup>1</sup>	30	5	-25	40	10	-30
			<b>Reduction in cost of transportation</b>			<b>Reduction in cost of transportation</b>
Fare by motor vehicle <sup>1</sup> to the nearby town (Naira/passenger)	150	100	-50	300	100	-200
Fare by motor vehicle <sup>1</sup> to the major market (km) (Naira/passenger)	150	100	-50	230	100	-130
Distance to nearest all-weather road (km)	3.5	3.5	0	4.5	4.5	0
Cost of hiring one pickup truck (from farm to the nearby town)	2000	1000	-1000	4100	2000	-2100
Cost of hiring one pickup truck (from farm to the major mark		2500	-2500	6500	3200	-3300

Source: Field Survey, 2013





**Table 3:** Time Spent and Transportation Costs Before and After the Project **Cont'd.**

Parameters	Gombe project			Kaduna project			Kwara project		
	Before	After	Reduction in time travel	Before	After	Reduction in time travel	Before	After	Reduction in time travel
Distance to nearest nearby town (km)	2.3	2.3	0	3.6	3.6	0	1.5	1.5	0
Distance to nearest major market (km)	5	5	0	4	4	0	4	4	0
Time taken to wait for motor vehicle transport (minutes)	60	10	-50	50	10	-40	160	60	-100
Time taken to wait for motorcycle transport (minutes)	120	20	-100	60	5	-55	120	20	-100
Travel time by motor vehicle to all-weather road (minutes) <sup>1</sup>	2.3	2.3	0	3.6	3.6	0	4	4	0
			<b>Reduction in cost of transportation</b>			<b>Reduction in cost of transportation</b>			<b>Reduction in cost of transportation</b>
Fare by motor vehicle <sup>1</sup> to the nearby town (Naira/passenger)	200	100	-100	250	100	-150	100	50	-50
Fare by motor vehicle <sup>1</sup> to the major market (km) (Naira/passenger)	250	150	-100	300	150	-150	200	50	-150
Distance to nearest all-weather road (km)	60	20	-40	24	10	-14	30	5	-25
Cost of hiring one pickup truck (from farm to the nearby town)	3500	1500	-2000	3100	1400	-1700	12000	8000	-4000
Cost of hiring one pickup truck (from farm to the major market)	6000	3000	-3000	5000	1500	-3500	20000	10000	-10000

Source: Field Survey, 2013

### Change in Number of Service Providers

The result obtained indicated an appreciable increase in number of service providers across the benefitting communities due to the road improvement. Service providers studied include improved agricultural seed dealers, fertilizer suppliers and agro-chemical selling outlets. These are essential agricultural inputs necessary for improved farm output. The study observed the availability of these services in the affected states before and after the projects. Table 4 shows percent increases recorded in the number of these services across the states which ranged from a minimum of 200% to a maximum of 1100%. Improved seed providers increased sixfold, threefold and seven-fold in Adamawa, Bauchi and Gombe States, respectively, representing 600%, 300% and 700% increases in the number of improved seed dealers in these States. Similarly, Kaduna and Kwara states recorded 475% and 240% increases in the number of improved seed dealers. Number of fertilizer merchants also increased dramatically after the road project with Adamawa, Bauchi and Gombe States recording 525%, 867% and 533% up surge in the number of fertilizer outlets in the affected communities. The number of fertilizer merchants after the project rose by more than tenfold (1100%) in Kaduna State and three-fold (300%) in Kwara State.

The result also shows considerable rise in the number of agro-chemical outlets in all the states. The number of agro-chemical dealers increased by 400%, 200% and 240% in Adamawa, Bauchi and Gombe State, respectively. While Kaduna state witnessed a dramatic rise amounting to 617%, Kwara recorded a whopping 600% increase in the number of agro-chemical dealers after the project. It is instructive to note that the influx of more agro-inputs suppliers in the areas shows increased demand for their commodities and its attendant increased in the farm output. These finding is in line with the report of Sangwan (2010) where he cited that rural road were not only providing connectivity to rural area but also affecting change in cropping pattern due to access to markets, increasing productivity by facilitating availability of inputs like seeds, fertilizer and pesticides.

**Table 4:** Change in Number of Service Providers Before and After the Project

State	Seed			Fertilizer			Agro-chemical		
	No. Before	No. After	% Increase	No. Before	No. After	% Increase	No. Before	No. After	% Increase
Adamawa	1	7	600.0	4	25	525.0	1	5	400.0
Bauchi	3	12	300.0	3	29	866.7	0	2	200.0
Gombe	2	16	700.0	6	38	533.3	5	17	240.0
Kaduna	4	23	475.0	2	24	1100.0	6	43	616.7
Kwara	5	17	240.0	4	16	300.0	3	21	600.0

Source: Field Survey, 2013

### Effect of the Road Projects on Crop Productivity

The increased presence of agro-inputs dealers in the affected communities is a justification for the sustained demand for their products. As a result, tremendous increases in crop productivity were recorded and this cut across all the affected communities in the states studied. Table 5 presents percent increases in the productivity of the predominant crops grown, before and after the projects. Maize and Cowpea were the predominant crops grown across the five states and were therefore used for the study.

Average yield per hectare of maize increased from 1500 kg to 2500 kg before and after the project representing a 66.7% increase in yield per hectare in Adamawa state. The average yield in Bauchi, Gombe and Kaduna states before the project were 1100 kg, 1200 kg and 1745.6 kg, while after the project intervention the maize yields more than double with 2500 kg, 2800



kg, and 2309 kg representing 118.2%, 133.3% and 103.7%, respectively. Average maize yields per hectare in Kwara State grew from 1223.4 kg to 2309.3 kg before and after the project amounting to 88.8% yield increase. In the same vein, average yield of cowpea per hectare increased considerably across the five States. A 69.8%, 65.9% and 51.6% increases were recorded in Adamawa, Bauchi and Gombe States, respectively. Similarly, Kaduna and Kwara States witnessed average yield increase of 73.8% and 46.5%, respectively. It could be said that yield increased recorded in the major crops grown in the area is partly due to access to improved agricultural inputs occasioned by the improvement in the transportation system. In a related study, Wang and Sun (2016) disclosed that a 1% increase in the size of the rural road network led to a 0.05% and 0.19% change in cereal yield in the short and long term, respectively. Similarly, Nakamura *et al.* (2019) posited that rural households were 3.6% more likely to use fertilizer when provided with access to a rural road resulting in an average 32.2% increase in the number of crops sold. In a related study, Binswanger *et al.* (1989), used macro data from eight-five randomly selected districts of India to examine the role of rural roads construction among other factors in agricultural investment and output. The study found that road investment contributed directly to the growth of agricultural output, due to increase use of agricultural inputs especially fertilizer. However, Asher and Novosad (2018), did not find any evidence of substantial changes in agricultural production in villages after a new road was constructed. The study further found no indication of a movement away from subsistence crops, or of changes in the distribution of land ownership.

**Table 5: Percent Increase in Crop Productivity After the Project**

State	Maize Yield (kg)		% Increase	Cowpea Yield (kg)		% Increase
	Before	After		Before	After	
Adamawa	1500	2500	66.7	1675.4	2845.56	69.8
Bauchi	1100	2400	118.2	1543.2	2560.48	65.9
Gombe	1200	2800	133.3	1723	2612.2	51.6
Kaduna	1745.6	3556.6	103.7	1864.2	3239.88	73.8
Kwara	1223.4	2309.3	88.8	1435.3	2103.42	46.5

Source: Field Survey, 2013

### Effect of Rural Road Project on Beneficiaries Income

The effect of the road projects on income of beneficiaries in the five participating states was presented in Table 6. According to the result obtained, Percentage change in income of the sampled respondents indicates an average increase of 67.6% across the beneficiary states. On a state-by-state basis, incomes of beneficiaries increased from an average of ₦172,088.25 before the project to ₦286, 862.79 after the project, representing a difference of 66.7% in Adamawa State. The result showed similar increases across the states with income growth of 61.1%, 59.8%, 74.1% and 76.2% in Bauchi, Gombe, Kaduna and Kwara States, respectively. The implication of this finding is that the road project impacted positively to the incomes of beneficiaries. AfDB-CBARD Project therefore has the tendency of reducing rural poverty and its attendant consequences. Wang and Sun (2016) found that a 1% increase in the size of the rural road network in China leads to a statistically significant 0.14% increase in per capita net income of rural households in the short term. However, no statistically significant long-term impact was identified in the study. In a related study on effect of rural road on income, Ahmed and Nahiduzzaman (2016) reported an overall 47% increase in household income for poor households in Bangladesh. Limi *et al.* (2015) has equally reported significant increase in

agricultural employment (+17%) and monthly household income (rising between US\$48 and US\$67) due to provision of rural road infrastructure in Brazil.

**Table 6: Percentage Change in Income After Road Project**

State	Income Before (NGN)	Income After (NGN)	% Increase
Adamawa	172,088.25	286,862.79	66.7
Bauchi	161,543.80	260,319.57	61.1
Gombe	168,464.00	269,200.00	59.8
Kaduna	143,267.86	249,484.13	74.1
Kwara	212,670.27	374,822.82	76.2
<b>Total</b>	<b>171,606.84</b>	<b>288,137.86</b>	<b>67.6</b>

Source: Field Survey, 2013

### Cost Effectiveness of Road Projects

Cost effectiveness (CE) is a measure of how effective is the money invested in a project in relation to the target beneficiaries. The measure expresses per capita expense incurred on any of the target beneficiary. When mutually exclusive projects are considered, the CE indicates which project to finance based on the relative costs of the individual projects. The rule is that project that has lower cost per capita is selected for financing given the project's main goal. When more than one project that is not mutually exclusive is to be chosen based on financial constraint, the one with the lowest cost is first considered. In this analysis the CE of the benefitting states were computed and compared to ascertain the level of CE of the road projects in the respective States.

The CE of the road projects were estimated using the initial costs of investments and estimated number of beneficiaries. The result presented in Table 7 shows that road investment in Kaduna State was the most cost effective being the one with lowest cost per target beneficiaries. The result is indicative of the fact that the road project benefits more people in Kaduna state than in any of the other states where road projects were implemented. Following Kaduna State closely is Bauchi state with a CE of ₦36,613. This is then followed by Adamawa and Kwara States. Gombe State was the least cost-effective project among the five States.

**Table 7: Cost Effectiveness of Road Projects by States**

State	Cost (NGN)	No. of Beneficiaries	Cost Effectiveness
Adamawa	169,072,619	4,536	37,274
Bauchi	202,593,167	6,212	36,613
Gombe	161,703,670	1,453	111,270
Kaduna	118,619,932	6,754	17,563
Kwara	259,771,601	3,936	65,999
Total	911,760,989	22,891	39,831

Source: Computed from Field Data, 2013

The implication of this finding (Table 7) is that, the cost of the road project in Gombe can generate benefits more than two times in Kaduna State or with half of the funds in Gombe more beneficiaries could be targeted in Kaduna State. On the average, the overall road projects across the States yielded a CE of ₦39,831, indicating mean per capita cost incurred in providing roads to 22,891 beneficiaries.

### Benefit Cost Analysis for Road Projects

The benefit cost analysis (BCA) of the infrastructures was performed to ascertain the economic worthwhile of the projects. This part of the analysis presents the BCA of the road projects executed across Adamawa, Bauchi, Gombe, Kaduna and Kwara States. In performing this analysis, project benefits were derived by means of direct and indirect estimation. The source of direct estimation was the money saved from reduction in the cost of transportation due to the improved nature of the roads. The indirect estimation was based on the time saved both in waiting for vehicle and the time saved on transit to destinations. The time saved was calculated and converted to money value based on the prevailing wage rate in the respective communities. The cost component was estimated as the sum of contract cost and annual maintenance cost of the roads.

Some assumptions were made for lack of relevant data and for ease of estimation. It was assumed that the roads will last for five years before any major repairs would be required therefore the BCA assumed a five-year life span of the project without considering any salvage value. Furthermore, the benefits are assumed to be constant throughout project life. Number of the road users was based on the estimated number of people in the benefitting communities thus, did not account for casual visitors as such data were not feasible given the time it requires to obtain. The annual road maintenance cost was assumed to be ₦250,000 per km and is constant throughout the project life span.

Table 8 presents the summary of BCA of road projects in the five states where the projects were implemented. The rule is that, a project is economically worthwhile with a positive NPV ( $\geq 1$ ) or a BCR of 1 or over ( $\geq 1$ ). The results showed strong positive NPVs and BCRs greater than 1 in all the States. The BCR in all cases indicates that the road projects were worth investing. The high BCR shows the level of benefits that can be derived in relation to the money invested in the projects. In Adamawa, Bauchi, and Kaduna States, benefits derivable from the infrastructure outweighed the cost of investment and maintenance more than ten times and more than 45 times in Kwara State. In Gombe however the BCR of 2:1 means that benefits measured two times the cost of investment.

**Table 8:** Summary of Benefit Cost Analysis for AfDB-CBARD Road Projects

State	Benefit	Cost	NPV	BCR
Adamawa	2,653,459,141	210,085,619	2,443,373,522	12.6:1
Bauchi	2,607,224,792	243,804,167	2,363,420,625	10.7:1
Gombe	414,922,040	202,716,670	212,205,340	2.0:1
Kaduna	2,229,766,520	159,632,932	2,070,133,588	14.0:1
Kwara	1,377,773,676	300,724,601	1,077,049,075	46.0:1

Source: Computed from Field Data

### CONCLUSION AND RECOMMENDATIONS

In conclusion, the project had achieved its set target of constructing 54km rural road resulting in 100% achievement for all the participating states. There is also appreciable satisfaction shown towards the road's infrastructure implemented by the Project by the benefitting communities. There was also an apparent reduction in time of waiting for motor vehicle between minimum of 10 minutes to a maximum of over 2 hours across the Project areas where the roads were sited. Furthermore, there was also a noticeable corresponding decline in transport cost in the road infrastructure benefitting communities. The average reduction of fare by motor vehicle to market (naira/passenger) was reported to be ₦50, ₦130, ₦100, ₦150 and



₦150 for the States of Adamawa, Bauchi, Gombe, Kaduna and Kwara, respectively. The study equally showed an appreciable increase in number of service providers in the communities due to the road improvement across the five states. Conclusively, the result has equally shown that average yield per hectare of maize has increased to 66.7%, 118.2%, 133.3%, 103.7% and 88.8% in Adamawa, Bauchi, Gombe, Kaduna and Kwara States, respectively. In the same vein, average yield of cowpea per hectare has increased considerably across the five states of Adamawa, Bauchi, Gombe, Kaduna and Kwara by 69.8%, 65.9%, 51.6%, 73.8% and 46.5%, respectively. Percentage change in income of the sampled respondents indicates an average increase of 67.6% across the beneficiary states. Road investment in Kaduna state was the most cost effective being the one with lowest cost per target beneficiaries. This result is indicative of the fact that the road project benefits more people in Kaduna State than in any of the other states where the road projects were implemented. The study further concluded that there is a strong positive NPVs and BCRs greater than 1 in all the states. The BCR in all cases indicates that the road projects were worth investing. The study recommending among others that:

1. A willingness to pay analysis to be undertaken in the affected Project areas as a way of gauging future tariff plan for the use of the road infrastructure to justify and attract private investment.
2. Due to the poor maintenance culture especially for the public goods, a community maintenance community should be established and trained to oversee maintenance of the road infrastructure.

## REFERENCES

- Ahmed, S. and Nahiduzzaman, K.M. (2016). "Impacts of rural accessibility on women empowerment: The case of south west bangladesh." *Transport and Communications Bulletin for Asia and the Pacific*, 86: 41-57.
- Ajiboye, A. O. and Afolayan, O. (2009). The Impact of Transportation in Agricultural Production in a Developing Country: A Case of Kolanut Production in Nigeria. *International Journal of Agricultural Economics and Rural Development*, 2(2), 47-57.
- Anthony, E. B., David, H. G., Aidan, R. V. and David, L. W. (2018). *Cost-Benefit Analysis: Concept and Practices*. Fifth Edition. Cambridge University Press, United Kingdom. Pp. 24.
- Asher, S. and Novosad, P. (2018). *Rural roads and local economic development*. The World Bank.
- Binswanger, H. P., Khandker, S. R. and Rosenzweig, M. (1993). How Infrastructure and Financial Institutions Affect Agricultural Output and Investment in India. *Journal of Development Economics*, 41: 331-336.
- Damania, R., Russ, J., Wheeler, D. and Barra, A. F. (2018). "The road to growth: Measuring the tradeoffs between economic growth and ecological destruction." *World Development*, 101: 351-376.
- David-West (2015). *Road Sector Reform: An Imperative for Sustainable Development*. Paper presented at 2<sup>nd</sup> National Conference and Annual General Meeting of the Nigeria of the Institute in Abuja.
- Inoni, O. E, and Omotur, D. G. (2009). Effect Of Road Infrastructure on Agricultural output and income of Rural Households in Delta State. *Agricultura tropica et subtropica*, 42(2).
- Limi, A., Lancelot, E. R., Manelici, I. and Ogita, S. (2015). *Social and economic impacts of rural road improvements in the state of Tocantins, Brazil*. The World Bank.
- Lokesha, M. N., and Mahesha M. (2017). Impact of Road Infrastructure on Agricultural Development and Rural Road Infrastructure development programmes in India. *International Journal of Humanities and Social Science Invention*, 5(11): 01-07.
- Nakamura, S., Bundervoet, T. and Nuru, M. (2019). *Rural Roads, Poverty, and Resilience*:



- Evidence from Ethiopia.* The World Bank.
- Sama and Aggarwal (2021). *Socio-Economic impact of rural road and parameters for evaluation.* National Rural Infrastructure Development Agency.
- Sangwan, S. S. (2010). *Infrastructure for Agriculture Development.* Occasional Paper, 53 National Bank for Agriculture and Rural Development, Mumbai.
- Shukla, N. J. (2018). Social impact assessment of infrastructure Projects. *Global Journal of Commerce and Management Perspective*, 7(1):
- Wang, Z. and Sun, S. (2016). "Transportation infrastructure and rural development in China." *China Agricultural Economic Review*, 8(3): 516-525.
- World Bank (2001). *Roads Economic Decision Model (RED) for Economic Evaluation of Low Volume Roads.* March 2001. In Lombard, P. & Coetzer, L (n.d.) The Estimation of the Impact of Rural Road Investments on Socio-Economic Development.
- World Bank (2015). "Evaluating the Social and Economic impacts of rural road improvements in the State of Tocantins, Brazil". Report No. 95574-BR.