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ROAD TRANSPORTATION NETWORK CONSTRAINTS ON FOOD CROP PRODUCTION IN UZO-UWANI LOCAL GOVERNMENT AREA OF ENUGU STATE, NIGERIA

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ABSTRACT

This study examined the road transportation network constraints on food crop production in Uzo-Uwani L.G.A. Data for this study were obtained from questionnaire and interview of random survey of 160 farmers. Data were also obtained from field observations and current secondary data sources. Data collected were analysed using Graph Theoretic Techniques and Multiple Correlation Analysis. The results of the analyses showed low road network connectivity and accessibility in Uzo-Uwani LGA. The coefficient of of multiple determination ($R_{1.235}^2$) = 0.82^2 = 0. 67. Thus, 67 percent of the variations in total crop yield is determined by the combined variations in the independent variables of road density, road quality, nodal accessibility and farmers distance from house to farm at 0.05 signifance level; while 33% of the variations of total crop may be attributed to other factors as such a soil type, climate, farm size, and farming methods.The study further discovered that most of the agricultural activities are carried out mainly under subsistence basis with yam, cassava and rice comprising the major grown food crops which are mostly sold in the rural community markets known for low level of buyers mainly during period of surplus harvesting. The research concludes by suggesting that government should intensify efforts in the provision of road facilities and agricultural aids in the area while the communities should jointly ensure proper road maintenance and also be ready to accept innovation in their agricultural activities.

Keywords: *Road; transportation network; food; crop production; constraint*

INTRODUCTION

Agriculture stands as a deserved option for sustainable economic development considering its potential to create employment opportunity for the youth. The key to self sufficiency in food and raw material production for our industries lies on the level of importance attached to it. This can only be done through careful and articulated plans towards tackling agricultural constraints in Nigeria. Some of these problems include land tenure system, problem of basic amenities, poor financing, problem of good storage facilities, lack of good agricultural education, poor extension activities, inadequate machines or tools, pest and diseases, unpredictable climate, poor

transportation network and so on. Increased agricultural production is critically important to achieving the Sustainable Development Goals (SDGs), particularly for ending poverty (SDG1), achieving food security (SDG2) and ensuring healthy lives (SDG3). An efficient rural transport system is crucial to developing agriculture and reducing rural poverty. Reducing rural transport costs can raise farm-gate prices, increase farmers' incomes and help reduce the price of food in urban areas. It can also facilitate timely distribution of farm inputs (e.g. fertilizer, insecticide), increase agricultural yields and extend cultivated areas, and reduce post-harvest losses. Yet at present, rural transport systems in most developing countries, particularly in Africa, are still far from optimal{1}. About 90% of Africa's food production is by smallholders, who mostly have limited access to transport infrastructure. Poor road networks and unreliable transport services limit the levels of agricultural activities. The high cost of transportation they pay on their farm produce affects their farm income and reduces the money they would have used for taking care of other needs of their household[2].

The crude nature of road transportation network in Nigeria has negative effect on accessibility which affects every sector of the economy agriculture inclusive. The poor condition of road network in Nigeria is more pronounced in the rural areas than the cities and this is in line with the view of {3} "In spite of the fact that about 70% of Nigeria's population live in rural areas these areas have remained largely inaccessible". This reflects low level of regional planning in Nigeria which created geographical disparities of development across regions. Improved transport networks create and stimulate positive synergy and enhance social cohesion and integration by given the citizens access to some opportunities {4}. In other words, improved transportation networks open up employment opportunities in the agricultural sector. Agriculture creates demand for transport and on the other hand transportation facilitates market creation for agricultural products. It is transportation that completes the production processes through easy flow of agricultural products from the site of production to the final consumers. This reflects the facts that agricultural activities cannot fully respond to the immediate needs of food requirements of the society without the issue of evacuation being considered and planned for appropriately.

For Nigeria to meet up with her food requirements to eradicate extreme hunger and poverty, the near neglect of agricultural sector should be reformed for more efficiency especially in the area of food crop production. Rural road transportation has the potential to offer a helping hand to agriculture towards attaining this level of self sufficiency in food crop production{5}. This is because transportation as a derived demand serves to bridge the distance between origin and destination. In Nigeria where the bulk of crop production takes place under the traditional farming system, rural accessibility will help to increase the productive performance and reduce unattractiveness of rural agriculture{6} and maintained that lack of an efficient transportation means exposing rural farmers to various forms of exploitation. This is because the middlemen who buy from farmers claim a greater share of the farmer's expenditures when they buy farm products from farmers at their local markets and farm gates and transport the products to areas where they command high prices.

All these problems pose difficulty towards adopting fully mechanized system of agriculture and are pronounced in Uzo-Uwani local government area which is a rural agricultural economy whose population is 98% dependent on their agricultural output{7} and also, pointed that the people of Uzo-Uwani lose as much as 482 million naira annually to perishable farm produce, undervalued pricing and wasted investment. Therefore, in recognition of the obvious spatial roles of road transportation on food crop production, the overall economic and regional development and other outstanding benefits through rural road transformation, the focus of this research work is therefore to examine the road transportation network constraints on food crop production in Uzo-Uwani local government area and to proffer solutions to enhance productivity through improved accessibility

The Study Area

Uzo-Uwani L.G.A. of Enugu state is located between latitude $6^{o}55^{I}$N and $7^{o}15^{I}$N and longitude $6^{o}30^{I}$E and $7^{o}00^{I}$E. It shares boundary with Nsukka, Igbo-Etiti, Udi and Ezeagu L.G.A. respectively and Anambra State in the west and Kogi State in the North West (see figure 1).

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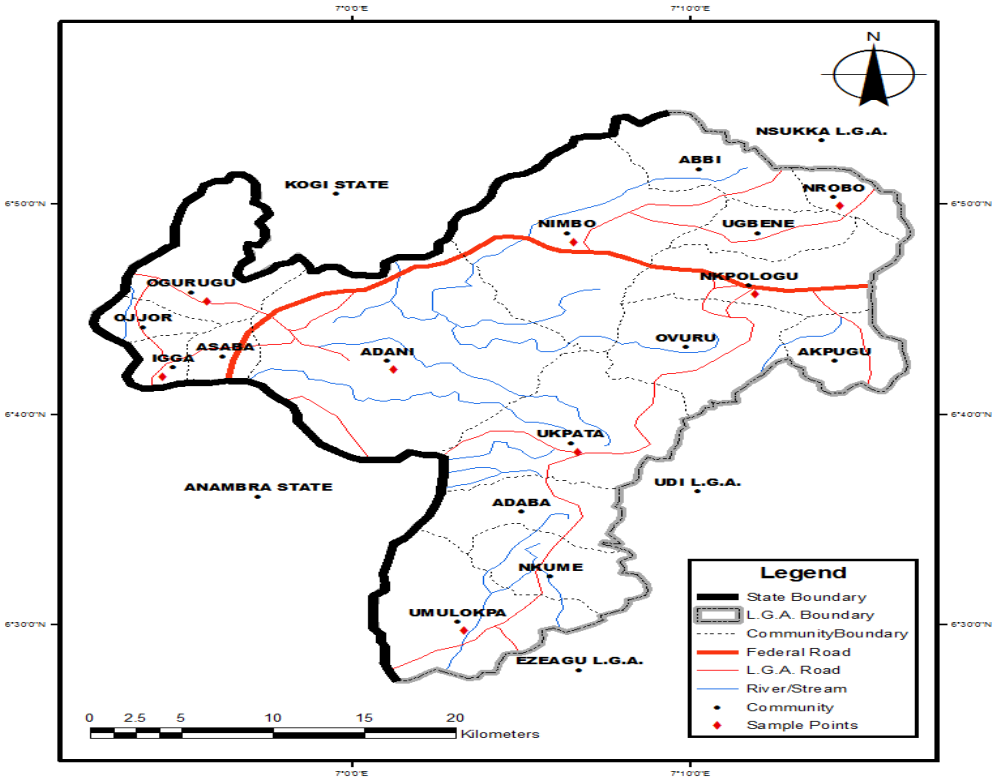

Fig 1: Map Of Uzo-Uwani L.G.A Showing The Study Area. Source: Uzo-Uwani L.G.A. Town Planning Authority (2014)

The geology of Uzo-Uwani L.G.A falls into two main geological groups: the Imo clay shale which occupies the western extremities within the northern section of Anambra plain and the rest of the area made up of the lower and upper coal measures and false-bedded sandstones{8}. The climates of Uzo-Uwani L.G.A. belong to the tropical wet-and-dry (savanna) type. The mean annual rainfall ranges from approximately 1,650mm on the north east plateau to 147mm in the western low land. Uzo-Uwani L.G.A is located in the western low land area of Nsukka plateau with a gentle and gradual sloping surface down to Anambra plain at the western side. The plateau is characterized by isolated peaks (500m+) and wide flat- bottomed dry valleys (200m+){9}.. The soil is underlained by pale brown hydromorphic molted clay soil derived from the impervious Imo shales within the northern section of Anambra plain in the

west{8}..Away from the river basin (365m above sea level), the soils tend to be shallow and gravelly.

Literature Review

Literature abounds on the influence of transportation on agricultural production in both developed and developing countries respectively. The literature not only evolved from geogra phical point of view alone but also from other disciplines that are related to transportation. The role of transport is at the centre of agricultural production activities. This is because most of the agricultural products are bulky and highly perishable. Inputs to agriculture equally require efficient transport system to make them available to farmers for use in time. Transport is a part in production process which is not complete until the product is in the hand of the final consumer{10}. Availability of transport facilities is a vital investment factor that invigorates agricultural production through increased accessibility, its efficacy/ productiveness and cost – effectiveness. All have an effect on the basic function of agricultural food crop production, distribution, marketing and consumption of agricultural products in many ways. In assessing the state and effects of transportation facilities on agricultural development of rural farmers in Moro Local Government Areas of Kwara State, it was found that the mode of transportation in the study area is mostly through head porterage and to a short distance, limiting number of produce that are hulled to the market with little income realized{11}. Perishable crops like tomatoes, okra, pepper and yams get damaged in the course of transporting as a result of excessive heat and poor winding and bending roads resulting in loss of quality and reduction in farmers' income; eventually discouraging farmers in expanding his farm size in the next growing season. The study also found that about 60% of the farmers sell produce at farm gates as a result of high cost of transportation constraint which affect their accessibility to agricultural facilities. This has a long devastating effect on agricultural development of the study area. Mobility in rural areas could be hampered by the lack of transportation facilities and unavailability of good roads {12). He canvases the need to study how transport systems affect the marketing channels and therefore the long term agricultural productivity. The list of the benefits of improved transport to agriculture are: (i) agricultural surplus reach collection points and markets in good time; (ii) a reduction of time burden for farmers and (iii) a reduction of damages of perishable crops due to transport activities.

In the study of road connectivity, population and crop production in sub-Saharan Africa and taking into account agro- ecological and other factors, it was found that there is a statistically significant association between travel time and agricultural production, suggesting that improvements in road infrastructure could facilitates a substantial increase in agricultural production{13}. Road is the life–blood of human civilization{14}. Improvement of transportation through road networks in between any two points leads to increasing specialization reducing transportation cost, accelerate rural growth and expand their markets.

In Nigeria, transportation is regarded as a crucial factor in improving agricultural productivity{15}. It enhances quality of life of the people, creates markets for agricultural products, facilitate interaction among geographical and economic regions and open a new market focus. Hunger is a complex crisis; to solve it we must address the interconnected challenges of agriculture and transportation. Poor road network, inadequate transport facilities and inefficient transportation system are arrow head to low agricultural productivity and increase in price of agricultural products{4}. Using inefficiency analysis in the study of effect of rural transportation system on agricultural productivity in Oyo State indicates positive effect of distance, crop diversification and un-tarred type of road on farmer's productivity, while poor level of education among farmers, use of bicycle, trekking and weekly working time negatively affect farmer's efficiency{16}. The negative effect of trekking and use of bicycle and excess working time according to them, suggest the adoption of more IMT of motorized type to optimize farming time and increase farmer's productivity. In spite the fact that about 70% of Nigeria population lives in rural areas, these areas have remained largely inaccessible(3)..The study further found that rural areas lack motorable roads and organized public transport and that the best approach to boost agricultural production in the rural areas is by taking measures to tackle rural inaccessibility problems. The development of rural transportation networks has suffered neglect in comparison with urban road networks in the country{17}. The study also observed that rural travel and transport in most rural areas in Nigeria still take place with great difficulties there by compounding and worsening the problems of rural productivity and rural poverty. The rising agricultural productivity has been most concomitant of successful industrialization. Although agriculture no longer serves as the leading contributor to Nigeria gross national

product due to growth in petroleum sector, agriculture is still the dominant economic activity in terms of employment and linkages with the rest of the economy{18}. Transport is regarded as an important factor involved in agricultural development all over the world{19}. Transport creates markets for agricultural produce, enhances interaction among geographical and economic regions and opens up new areas to economic focus.

Inefficient and high costs of transportation are some of the major problems militating against agricultural activities in Uzo-Uwani Local Government Area{20}. Good transportation system was identified to be an important variable that will help farmers in transporting their farm input, products to and fro markets for maximal benefit in Adani, Uzo-Uwani Local Government Area{21}. From the aforementioned literatures reviewed, it is clear that a lot of researches have been carried out on transportation effects on agricultural production in different areas but none has been done with special regards to determine the transportation network constraints on food crop production in Uzo-Uwani Local Government Area and this is the gab which this research intends to fill.

Research Hypotheses.

Let Ho be: "There is no significant relationship between total crop output (tonnes), road density, road quality, nodal accessibility and farmers distance from house to farm''.

Let H_1 be: "There is significant relationship between total crop output (tonnes), road density, road quality, nodal accessibility and farmers distance from house to farm''

Research Methodology

The data for this study were collected from both primary and secondary sources. The primary sources include direct field observation, oral interview during field work, taking of photographs and the use of questionnaire. First, the systematic sampling technique was used to select eight communities out of the sixteen communities in the study area. This sampling technique was adopted because of its ability of ensuring even coverage throughout a sample frame. In each of the communities selected, twenty copies of questionnaire were administered to farmers which were selected based on random technique. On the whole, 160 copies of questionnaire were distributed and the copies were collected. Personal interviews were conducted with graduate

farmers who are field officials in Adarice farm to find out the operational pattern of the scheme and crop production system. Some farmers who are illiterate in different communities were interviewed in their local languages with the help of research assistants who are indigenes. The selected communities based on simple systematic sampling are Umulopka, Adani,Nrobo, Ogurugu, Igga, Nimbo, Nkpologu and Ukpata (see fig.2). Secondary data were collected from existing current literature such as published texts, journals, reports, and government records

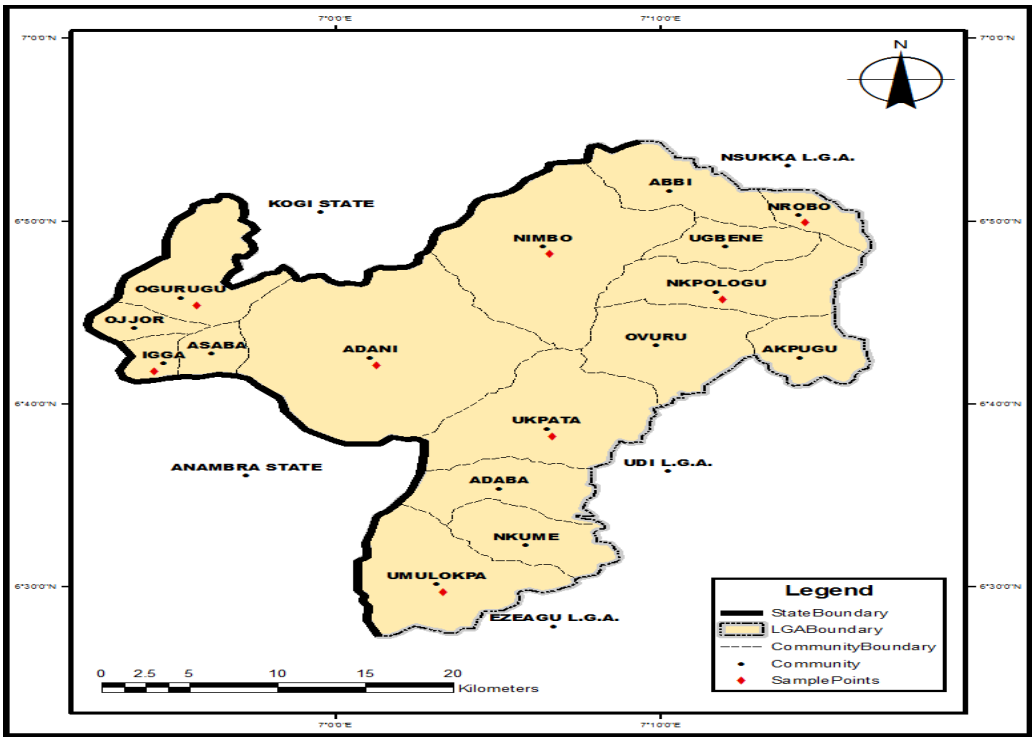

Fig 2: Map of Uzo-Uwani L.G.A. Showing the Sampled Communities

Data on Connectivity and Nodal Accessibility

The map used to extract the indices of road network connectivity and nodal accessibility was obtained from the Uzo-Uwani L.G.A town planning authority(See Fig 1) from which the topological road network which is an abstract configuration of real road network was derived. The communities and road network is transformed into points and straight lines respectively to form the topological road network which represent the real world structural pattern of road network in Uzo-Uwani L.G.A. from which the road network data on connectivity and nodal accessibility were extracted (see fig.3). The data include the nodes or vertices which represent

the interception of two or more lines or links. The edge, link or arcs which represent the lines that link the nodes at the interception point.

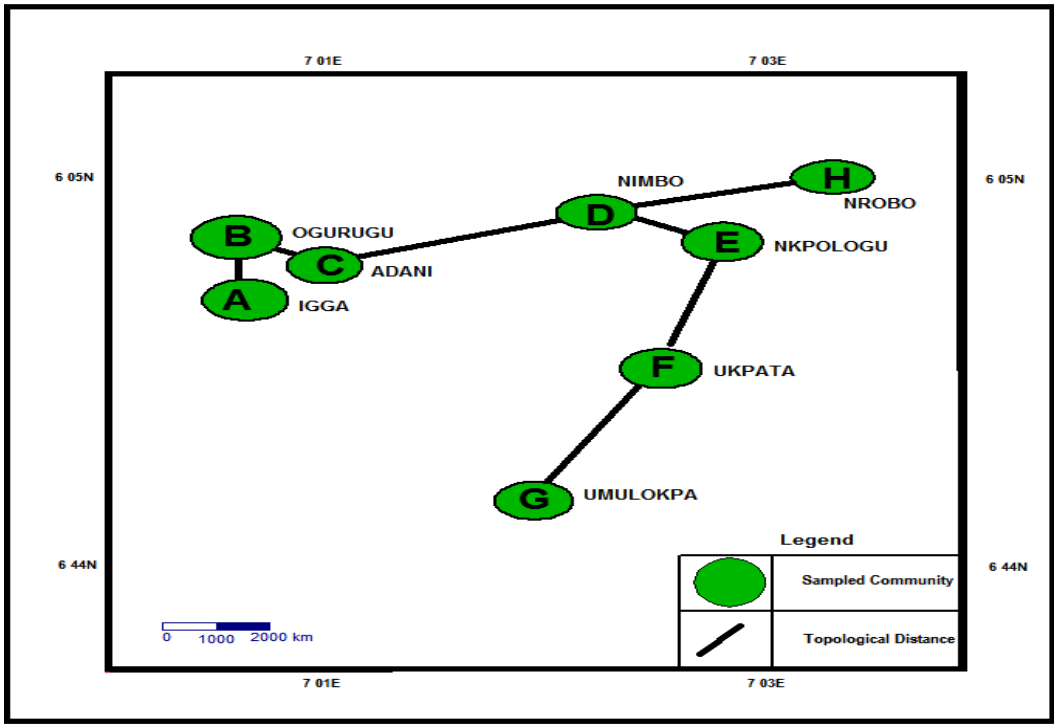

Fig. 3: Topological Representation of Road Network of the Sampled Communities

Data Analysis:

(1) In analysis of the data obtained in this research, statistical techniques such as multiple correlation technique will be used to analyze the effects of road density, quality of road, nodal accessibility and farmers distance from house to farm on total crop out. The formula is given as:

$$1 - R_{1.2345}^2 = (1 - r_{12}^2)(1 - r_{13.2}^2)(1 - r_{14.23}^2)(1 - r_{15.34}^2) \quad \ldots\ldots (1)$$

Where $1 - R_{1.2345}$ is the multiple corration, r_{12} is the partial correlation between total crop output (x_1) and road density, $r_{13.2}$ is the partial correlation between total crop output (x_1) and road quality (x_3) holding road density (x_2) constant, $r_{14.24}$ is the partial correlation between the amount of total crop output (x_1) and nodal accessibility (x_4) while holding road density (x_2) and road quality (x_3) constant and $r_{15.34}$ is the partial correlation between the amount of crop output (x_1) and farmers distance to farm (x_5) while holding road quality (x_3) and nodal accessibility (x_4)

constant.Aslo charts, tables and graph will also be used to give more detail discussion in the main work.

(2) To analyze the road network connectivity and nodal accessibility in the study area, the real road network was abstracted into topological graph representation (figure 2) and some of the graph-theoretic techniques or indices such as alpha index (α), beta index (β), gamma index (γ), and network density are used. The alpha index (α) is given by the formula

$$\alpha = \frac{e - v + p}{(2v - 5)} \text{ (for planar graphs)} \ldots\ldots \text{(2)}$$

Where e is the number of edges, v is the number of vertices and p is the number of sub-graphs of the network. Alpha index is the ratio between the observed number of circuits and the maximum number of circuits in a given graph. The beta index (β) is given by

β = e/v……………………………………………………...…... (3)

The beta index measures the relationship between two individual elements of the network.

The gamma index (γ), = $\frac{e}{3(v - 5)}$ (for planar graphs) ………………………………….. (4)

It is the quotient of the observed number of edges to the maximum number of edges {22}

(3) Network density is given by: ND = $\frac{L}{S}$ ……………………………………………...… (5)

Where ND is the network density; L is the total length of road and S is the land area. The greater the density, the more developed is the road network in terms of linkage and extent

(4) The nodal accessibility is calculated with the use of shimbel index. This is a better measure of relative accessibility because it measures shortest topologic routes or distance between nodes. $ac_i = \sum_{j=1}^{n} dij$ ……………………………………………….…………. (6)

Where ac_i = the shimbel index of accessibility, d = shortest distance between nodes, i and j = represent different nodes. The koning number (eccentricity) is used to identify the centrality of a node. It is the sum of the highest value in each row in the matrix table of shimbel index. The lower the value of koning value, the higher the centrality of a node and vice versa.

(5) Estimation of Crop Yield. The crop yield is calculated thus:

Yield (Y) = P/A ……(7)

Where Y is the yield per area of the crop, P is the weight of the crop harvested, and A is the size of the area planted in hectare{23}. The values for Y, P, and A will be based on yield-related data collected including farmer estimations of output and mean weights per unit (P) and land areas planted (A). If the farmer has more than one plot for a particular cropping system (pure stand crops or crop mixtures), the total production and total area for all plots planted under each crop system should be calculated and then the yield for each cropping system determined

RESULTS AND DISCUSSIONS

The nature of rural road network in Uzo- Uwani L.G.A when traced back to the early stage is characterized by foot paths and seasonal minor roads. The improvement in road network to some extent was influenced by the quest to tap the exploitable agricultural potential in the area by the government prior to 1960. The tarred and most smooth road is a federal road that connects Nsukka through Nkporogu, Nimbo (Ukpabi Nimbo), Opanda through Adani and linked the area with Anambra State. The state road linking Adani and Ogurugu was also tarred but now very rough(See Plate 1). Other communities except Umulukpa, the local government headquarters (see table 1) have not experienced any improvement in road network development.

Plate 1: Rough sealed road that linked Adani and Ogurugu

Table 1: Summary of surface road network quality in the sampled communities.

Sampled Community	Variable	Total road length (km) that is						Total road length (km)
		Tarred and smooth		Tarred and rough		Untarred		
		Length	%	Length	%	Length	%	
Adani	Surface	12.5	50.40	7.5	30.24	4.8	19.8	24.80
Igga	Surface	-	-	-	-	5	100	5
Ogurugu	Surface	-	-	4.5	52.94	4	47.06	8.5
Nimbo	Surface	10	45.45	-	-	12	54.55	22
Nrobo	Surface	-	-	-	-	4.75	100	4.75
Nkpologu	Surface	12.5	45.35	-	-	10.5	45.65	23
Ukpata	Surface	-	-	-	-	20.25	100	20.25
Umulokpa	Surface	8	38.55	1	4.82	11.75	56.63	20.75

Source: Field work, 2017.

Table 1 shows that majority of roads in the study area are not tarred. Many of the tarred roads have grown old and dominated by pot-holes. It is only 43km length of road recorded in Adani,Nimbo and Umulopka that is tarred and smooth. The untarred, rough road, low level of motorized means of transportation and other transportation network related problems compelled the farmers and traders to adopt some non-mechanically propelled means of transportation such as trekking, head porterage, wheel barrow etc in transporting food crop products.

Graph-Theoretic Measures of Road Network

Transportation network cannot be exhaustively and adequately discussed in this research work without a look at the layout of the network. This is because there is a strong affinity between graph-theory and geography. In this research, the analysis of road network connectivity is carried out with connectivity graph-theoretic indices and accessibility graph-theoretic indices respectively.

Connectivity Graph-Theoretic indices are used to compare the structural complexity and the degree of network connectivity. Road network connectivity studies the geometry or web form pattern of transportation linkages, interception or nodes and terminals. This was measured with some of the graph-theoretic indices such as alpha, beta and gamma indices (see table 2).

Table 2: Road network connectivity indices in the eight communities in Uzo-Uwani L.G.A

Sampled Community	Alpha index	Beta index	Gamma index
Umulokpa	0.20	0.80	0.44
Ukpata	0.20	0.50	1.00
Nkpologu	0.14	1.00	0.50
Nrobo	0.00	0.50	1.00
Nimbo	0.00	0.66	0.66
Adani	0.00	0.66	0.30
Ogurugu	0.00	0.50	1.00
Igga	0.00	0.50	1.00

Source: Field work, 2017.

The table shows that Umolokpa and Ukpata rank first with value of 0.20 when using alpha index to explain the level of network connectivity. This is followed by Nkpologu etc. Using the beta index to explain the level of network connectivity in the eight communities, Nkpologu ranks first with a value of 1.00 followed by Umulokpa with a value of 0.80. In terms of the gamma index, Ukpata, Nrobo, Ogurugu and Igga rank first with the same value of 1.00.

An accessibility Graph-Theoretic index is carried out with a set of D-matrix known as shimbel index. To calculate the shortest distance between each point using equation (6) and the points of communities on the topological network representation , the differences between each point and every other one is calculated first (See table 3). The distance from A–B (1–2) = 1, the distance from A to C (1–3) = 2 and so on (irrespective of sign). The row sums (shimbel index) equal fewest number of steps to connect one node to all other nodes.

Table 3: The shimbel index of accessibility of the eight sampled communities.

	A	B	C	D	E	F	G	H	Shimbel index
Igga	0	1	2	3	4	5	6	4	25
Ogurugu	1	0	1	2	3	4	5	3	19
Adani	2	1	0	1	2	3	4	2	15
Nimbo	3	2	1	0	1	2	3	1	13
Nkpologu	4	3	2	1	0	1	2	2	15
Ukpata	5	4	3	2	1	0	1	3	19
Umulokpa	6	5	4	3	2	1	0	4	25
Nrobo	4	3	2	1	2	3	4	0	19
									Sum=150

Source: Field word, 2017

According to the shimbel index, the most accessible node is Nimbo which takes only 13 steps to connect it to all other nodes or communities.

The road network density (see equation 5) shows how clustered or compacted the road network appears in a given region (see table 4). The higher the value road network density, the higher the level of the road network development.

Table 4: Total road length (km), total land area (km) and road network density of the eight sampled communities.

Sampled community	Total road length (km)	Total land area (km/sq)	Road network density(km/sq) =TRL÷TLA
Adani	31.75	12.80	2.48
Igga	5.00	2.40	2.08
Ogurugu	8.25	6.40	1.90
Nimbo	24.25	9.60	2.53
Nrobo	5.00	3.20	1.56
Nkpologu	22.50	7.20	3.13
Ukpata	21.75	9.60	2.70
Umulokpa	22.50	5.60	4.02

Source: Field work 2017.

TRL and TLA represent total road length and total land area of each sampled community.

Methods of Food Crop Cultivation

Agricultural activities in Uzo-Uwani L.G.A. to some reasonable extents are carried out under the traditional farming system. This reflects in the nature of their farm tools such as the use of hoe, cutlass, sickle etc, family labour mostly used and their low level of output. Food crops cultivated in the study area include cassava, yam, cocoa yam, maize, groundnut, banana, plantain, rice etc. The three major food crops persistently grown by farmers on large scale compared to other crops include yam, rice and cassava (See Plate 2). Table 5 illustrates that among the three major grown food crops in the sampled communities, cassava has the highest total output of 16300 (kg), this followed by yam (14950kg) and finally rice with the total output of (8250kg). It is also very clear in the table 5 that rice cultivation is restricted to the western low land of alluvial soil always waterlogged comprising Adani, Igga and Ogurugu communities respectively.

Plate 2: The use of household labour for irrigation agriculture in village two in Adarice farm

Table5: Estimates of annual cultivated area (hectares), total yield (kg and tonnes), total yield per hectare and total crop output (tonnes) of 80 farmers for three major grown crops in the sampled communities in 2013.

Sampled Community	Yield (kg) of individual major grown crops.			Total yield (kg) TY	Total yield (tones) =TY÷ 1000	Total hectares (ha) TH	Total yield (tonnes) per hectares TY/H	Total Crop output (tonnes) = TY/H x TH
	Yam (kg)	Cassava (kg)	Rice (kg)					
Adani	800	1950	3950	6700	6.70	155	0.04	6.20
Igga	2100	1400	1450	4950	4.95	81	0.06	4.86
Ogurugu	550	1200	2850	4600	4.60	106	0.04	4.24
Nimbo	2500	3450	-	5950	5.95	122	0.05	6.10
Nrobo	3450	1800	-	5250	5.25	105	0.05	2.25
Nkpologu	950	3050	-	4000	4.00	79	0.05	3.95
Ukpata	2400	1050	-	3450	3.45	66	0.05	3.30
Umulokpa	2200	2400	-	4600	4.60	114	0.04	4.56
Total(Σ)	**14950**	**16300**	**8250**	**39500**	**39.50**	**828**	**0.38**	**35.46**

H = Hectare; TH = Total Hectare; TY = Total Yield; TY/H = Total Yield per Hectare

Source: Fieldwork 2017

The Effects of Nature of Rural Road Network on Food Crop Production

The major setbacks of untarred and bad road networks development in the study area manifest in what farmers and traders sacrifice to get the farms and their market locations respectively. This has in turn resulted into low level of public transportation and high transportation fare and freight due to the long distance on the untarred road (see table 6) reducing the farmers urges to go into extensive cultivation in farms too far from home and low level of traders who come to patronize the farmers.

Table6: The total and average distance (km) travelled by farmers from house to farm, farm to market and from house to market in each community.

Sampled community	No. of farmers	Distance (km) travelled by farmers					
		From house to farm(km)		From farm to market(km)		From house to market(km)	
		Total distance	Average distance	Total distance	Average distance	Total distance	Average distance
Adani	20	140	7	148	7.4	86	4.3
Igga	20	58	2.9	84	4.2	67	3.35
Ogurugu	20	100	5	127	6.35	112	5.6
Nimbo	20	144	7.2	196	9.8	47	2.35
wNrobo	20	86	4.3	126	6.3	62	3.1
Nkpologu	20	40	2	66	3.3	42	2.1
Ukpata	20	66	3.3	84	4.2	21	1.05
Umulokpa	20	74	3.7	76	3.8	25	1.25
Total	**160**	**708**	**4.43**	**907**	**5.67**	**461**	**2.89**

Source: Field work 2017.

The Test of Hypotheses for the Relationship Between Total Crop Output (Tonnes), Road Density, Road Quality, Nodal Accessibility and Farmers Distance from house to Farm.

To perform the test, the null hypothesis is posited below:

Let Ho be: "There is no significant relationship between the total crop output, road density, road quality, accessibility and farmers distance from house to farm."

So, the combined degree of association or the multiple correlation coefficient between total crop yield (x_1), road density (x_2), road quality (x_3), nodal accessibility (x_4) and distance to farm is 0.82. To determine the percentage variation in total crop yield due to the combined variation of the independent variables, x_2, x_3, x_4, x_5, we take the square of the multiple correlation coefficient and multiply the value by 100 thus: $R_{1.235}^2 = 0.82^2 \times 100 = 67\%$. Therefore, 67 percent of the

variation in total crop yield (tones) is determined by the combined variation in the independent variables which are road density (x_2), road quality (x_3), nodal accessibility (x_4) and farmers distance from house to farm (x_5)

The significance of the correlation coefficient of 0.82 could be tested by applying the students 't' test with (n – 5) = 3 degrees of freedom. Where 'n' is the sample size and 5 represents the number of variables both dependent and independent variables. To perform the test, the null hypothesis is posited below:

Let Ho be: "There is no significant relationship between the total crop output,

road density, road quality, accessibility and farmer distance from house to farm."

We employ the version of students 't' test, given as:

$$r = \sqrt[r]{\frac{n-5}{1-r^2}} = \frac{0.82\sqrt{8-5}}{\sqrt{1-0.8^2}} = \frac{0.82\sqrt{3}}{0.33}$$

$$\frac{0.82X1.73}{0.57} = \frac{1.42}{0.57} = 2.49$$

At 0.05 level of significance and 3 degrees of freedom, the critical value of 't' is 2.35. Since the calculated value 2.49 is greater than the critical value 2.35, Ho is rejected. Therefore there is a significant relationship between the total crop yield and the independent variables which are road density (x_2), road quality (x_3), nodal accessibility (x_4) and distance to farm (x_5) at 0.05.In other words the percentage proportion of variation of total crop output(tonnes) that cannot be determined by the combined variation of road density, road quality, nodal accessiblity and distance to farm is 100 – 67 = 33%.Therefore 33% of total crop uotput (tonnes). This may be attributed to other factors as such a soil type, climate, farm size, farming methods.

RECOMMENDATIONS

Having studied the road transportation constraints on food crop production in Uzo-Uwani L.G.A, it becomes necessary to recommend that for an improved food crop production in the area, the road construction should be based on the expected benefits which the accessibility will bring. For this reason, the tremendous exploitable agricultural potential in Uzo-Uwani L.G.A should be

harnessed through articulated governmental policies in the provision of effective road transportation facilities, maintenance of existing roads for effective eradication of isolation barrier in the area and provision of crop seeds, agro-chemicals, financial aids, subsidizing of agricultural facilities, provision of services of the extension workers and given loan to farmers to assist them procure vehicles. This is not just the sole responsibility of the government; the active joint participation of various communities should be integrated especially in ensuring proper road maintenance. All these are life-blood of food crop production prosperity for greater output.

Conclusion

This study has examined the road transportation constraints on food crop production in Uzo-Uwani L.G.A, Enugu State. The study has shown that bad nature of rural road network has negative impacts on food crop production. Considering the fact that most of the areas are endowed with exploitable agricultural potential placed it at a high priority to attract an effective and efficient improvement in rural accessibility through provision of road network accompanied with the provision of agricultural facilities by the government. This will go a long way in improving the output and income levels of farmers. Appropriate recommendations have therefore been made and if adhered to strictly, Uzo-Uwani local government area will not only significantly contribute to the food crop production sufficiency within the state but also to the entire nation at large.

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