GRAPH MEASUREMENT OF ROAD NETWORK CONNECTIVITY & ACCESSIBILITY ON FARMING ACTIVITIES IN AKOKO SOUTH-WEST LOCAL GOVERNMENT AREA OF ONDO- STATE, NIGERIA

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ABSTRACT: This paper examined the impact of rural road connectivity and accessibility on farming activities in Akoko South-West Local Government Area of Ondo State. Using graph measurement analysis to determine the relationship between structure of transport network, flow of traffic to and from the hinterlands as well as to measure the accessibility of the routes within the study area. A grids of 20km by 20km were first superimposed on a larger-scale route map of the study area of scale 1cm to represent 20km.Thereafter, the length of the routes in each grid was measured and summed up and the answer was placed in the centre of each grid as the accessibility index for the concerned grids which was later subjected to the Beta index network analysis of Kansky (1964). The result obtained was B = 0.98, this shows that road network is not well connected to support highly integrated farming activities in the study area. This does not only, has negative impact on food crop production but has seriously reduced the economic status of 'the rural farmers. The paper recommends that both state and local governments should attach much importance to the improvement of rural road network accessibility such that farm sites in different locations can be well connected for easy means of food passage and raw materials to the people and industries in urban centres as well as its overall positive effect on the rural famers in the study area.

KEYWORDS: Graph-measurement, Road Network, Connectivity, accessibility and Farming Activities.

1 INTRODUCTION

Rural transportation network in most developing countries are still in poor state and under developed. It is noted that rural area households' farmers and their women spend much time and efforts on transport activities to fulfill their basic needs, for example, rural communities in Nigeria still do not have reliable access to main road networks and or easily connected to motorized routes within their locality. The rural transport network system is, therefore, an essential requirement for rural development: although, it is by itself not sufficient to guarantee form of success in farming activity in the rural environment.

However, improvement on the access and well connected routes from farms-to-farms, farmstead to villages as well as access to the local markets and the provision of all season basic motorized access, if affordable and appropriate, are essential conditions for rural development [1 and 2] . Scholars from their various studies sees rural road accessibility and connectivity as a set of policies which seeks to promote the well being of the rural and non-rural inhabitants by the means of supplying agricultural products both to the local markets as well as secondary industries in the sub-urban and in the urban centers. They also pointed out that, improved accessibility as well as highly connected road will create market for agricultural produce, opens up new land for economic opportunities and at the same time encourages farmers to improved on their various farming in other to increase agricultural productivity and as well reduces spoilage and wastage of agricultural produce at various collection centers in the study area [2and 3].

However, an efficient, accessible and well connected transportation system is a tool for high productivity, improvement in the income of the local farmers, employment generation and reduction in poverty level of the rural dwellers; since it will be easier to move both farm inputs, farm workers and farm outputs among others to the market and agro-allied industries [4 and 2].

Rural transport contributes to improving rural well-being and increase rural businesses as well as farming activities, which have overriding objectives of poverty reduction and in improving economic growth. Several authors have attempted to relate transport provision to the well-being of the people in various settlements [5 and 6]. These studies only addressed the issue of rural road development. Similar studies were carried out on evolution of rural transport network in the South-Western Nigeria [7[. All these studies failed to address issues on rural road transport network improvement on farming activities, hence, this study focussed on the effect of rural transport network on farming activities as well as agricultural food crop production in the study area. In the study, the objective is to examine the level of road accessibility and connectivity on farming activities as well as food crop production in Akoko South-West Local Government Area of Ondo State.

Despite the significance of roads on development, most rural roads in Nigeria are poorly managed and not well maintained. As pointed out by the World Bank report [Ref 8 and 9], the rural inhabitants live far from development, pay a very high cost for transport services, spent longer periods of time travelling and waiting for infrequent and unreliable bus services, due to inadequate and poor transport infrastructure and services. The aforementioned problems are often compounded by the inaccessible and unconnected feeder roads network, which usually causes delay that reduces productivity and inefficiency of vehicles.[10, 8 and 9].

2   CONCEPTUAL ISSUES AND LITERATURE REVIEW

The concept of Accessibility

The concept of accessibility is used in the explanation of growth of both urban and rural areas in relation to the location, functions as well as the juxtaposition of various facilities and land use patterns [11, 12 and 13] . However, several scholars from their individual works have put different definition in relation to the goal of their study. According to Ref 12 and Ref 11].Accessibility is the inherent characteristics of overcoming some form of spatially operating sources of friction in terms of time and distance. In addition, it is an extent to which the land-use transport systems enable groups of people or an individuals and goods to reach points of activities and or destination by means of a combined transport mode [14].

However, accessibility determines the systematic relationship between the spatial distribution and intensity of development as well as the quantity and quality of travel within and between an urban or rural area. In other words, accessibility can therefore be conceptualized in different aspects.In many cases, the objective of transport infrastructure investment is to improve the accessibility of a given region by reducing travel time or increasing the potential to travel. Accessibility can be measured as the quantity of economic or social activities that can be reached using the transport system. Improvement in accessibility will increase the market size for manufacturing, tourism and/or labour, leading to increased competition and/or centralisation. On the other hand, the impact for the region concerned could be both positive and negative, depending on its initial level of competitiveness.

Concept of Connectivity

The concept of connectivity according to [Ref 15] is the degree to which all pairs of lines or routes are connected or the degree of completeness between riders. *Connectivity* refers to the density of connections in path or road network and the directness of links. A well-connected road or path of network has many short links, numerous intersections, and minimal dead-ends. As connectivity increases, travel distances decrease and route options increase, allowing more direct travel between destinations, creating a more accessible and resilient system. Connectivity can be applied both internally (streets within that area) and externally (connections with arterials and other neighborhoods).

A well-connected road or path network has many short links, numerous intersections, and minimal dead-ends. As connectivity increases, travel distances decrease and route options increase, as this allowing more direct link between the rural settlement and farm sites creating a more accessible and connectivity in terms of easy movement of both farm inputs and farm

outputs to the market and other places of demand within the neighborhoods Natural barriers such as big rivers, roads that are seriously eroded and its major arterials sometimes create barriers to direct local movement, particularly for non-motorized movement, called the *barrier effect*.[16]. Various design strategies can help to improve road connectivity and accessibility across such barriers such design, including construction of bridges, surface dressing of arterial roadways, among others, which are walking networks within major rural centers that connect farm sites and transportation terminals.

Efforts to increase roadway connectivity also helps to improve community livability, encourage non-motorized transportation and increase traffic safety as well as increasing in time and cost savings .It also allow productivity gains to be achieved by improving their farm production as well as improving distribution of farm outputs [17]. Wider access to the market will also create both new business opportunities and increased competition, leading to further increases in profitability. Thus, improve in rural road connectivity and accessibility could be said to have an impact on high productivity, and hence on overall economic growth of the rural settlement.

Definition of 'Rural' and Dimensions of Rurality

'The term 'rural' is a concept that is easily understood at a common-sense level, yet difficult if not impossible to define [18]. What is immediately apparent from the literature is the variation in how areas are classified as rural and urban from one Study to the other. What is considered rural in one country may not correspond to what is considered rural in another. For example, in America, classifications of rural go as far as classifying rural 'states and some have even compared rural and urban centres. The two areas differ significantly, with one area having a high number of inhabitants, while the other with little number of people. There is also Considerable variation between rural areas.[Ref 19] argues that "the experience of living on a remote Scottish island may be as different from living in a large suburban village in Oxfordshire as living in a city such as Durham is from living another such as Birmingham". Over generalising rural areas into just 'rural' will miss these qualitative differences. Thus, just as aggregating results across a variety of different areas can be problematic. Failing to recognize that risks way vary considerably even between 'similar' areas can also result in a misleading picture of crime risk. The problem lies in capturing the many types of rural areas that exist. These range from common farmsteads settlements on the fringe of large towns to remote farms many miles from the nearest urban settlement. In much of the literature, rural areas have been defined in terms of the population size and/or density of a settlement. However, it has been suggested that the demography of an area represents just one of four dimensions of the meaning of rurality. The other three being economical, social, structural and cultural

3 STUDY AREA

Akoko South West Local Government Area is the study area and it is located in the northern part of Ondo State, with an area of 796 sq km. Its lies between latitude 5° 31 and 6° 01 North of the equator and between longitude 7° 21^1 and 7^0 31^1 East of the Green which meridian. It is bounded in the west by Emure Local Government Area in Ekiti State, to the East by Akoko South East Local Government Area of Ondo State, to the North and South by Akoko North East and Owo Local Government Area of Ondo State respectively. The study area has a total population of 121,764 people [20]. In general, the hilly nature of the relief in areas like Akungba, Supare, and Oba allows construction of access route through the available pass to promote easy evaluation of food crops to the market. The main mode of transport in the study area is basically road transport. The Local Government has about 569kms of road both intra-rural and inter-rural roads network. Most of these inter rural roads are tarred but poorly maintained while the villages and the farmsteads are mostly connected by untarred.
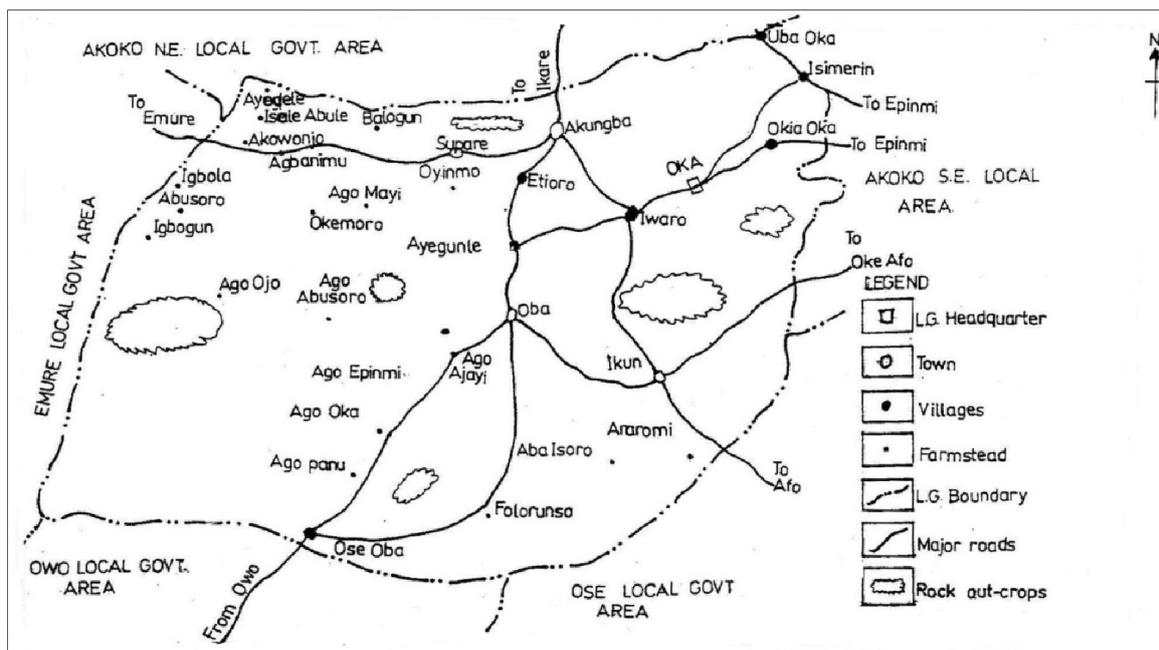
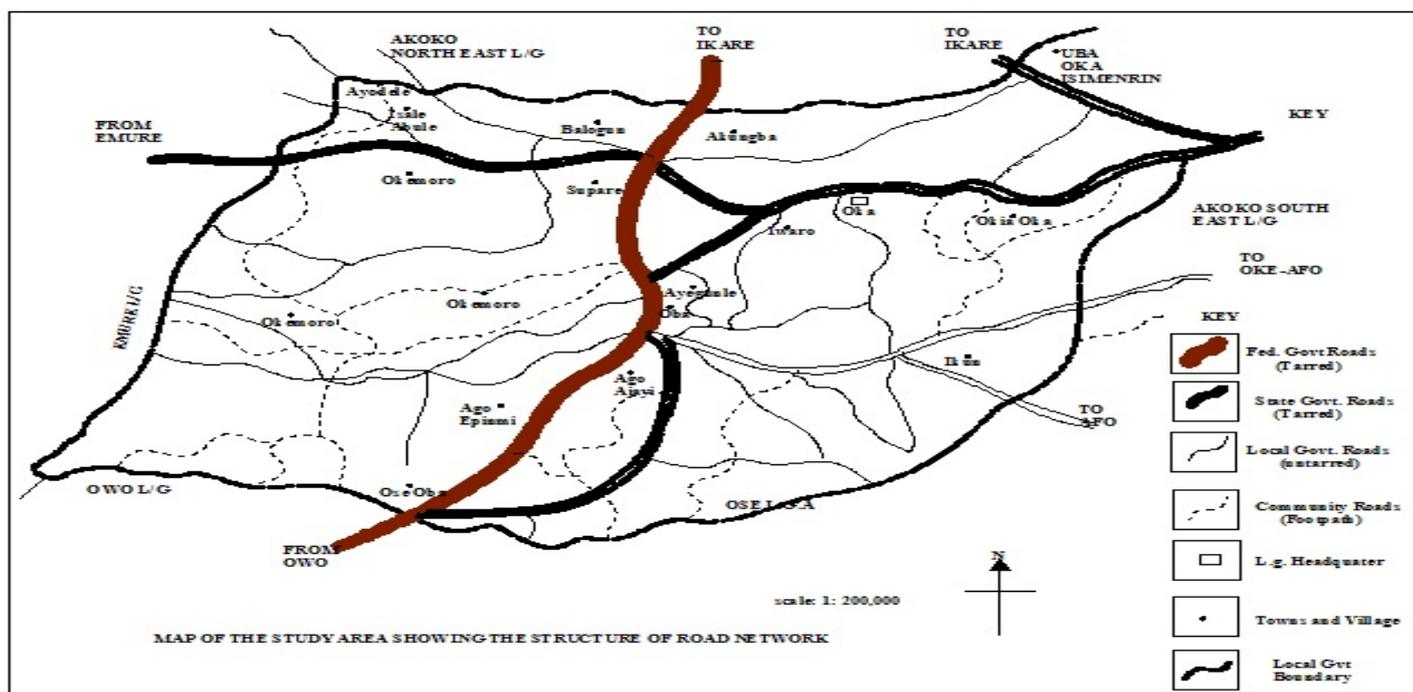*Fig. 1 map of the study area showing towns and villages*

Fig.2 Route Map of the study area

4 METHODS AND MATERIALS

Purposive sampling method was used to select 15 rural communities in the study area the data required for this study was gathered using secondary source. Aided by route survey, the road accessibility of the study area was determined by using a scale of 1cm to represent 20km to superimposed 20 km x 20km grids on a larger-scale route map of the study area. Thereafter, the lengths of routes in each grid were measured, summed up, and the answer got was regarded as the accessibility index of the concern grid [17]. Following the method adopted by [21], points with equal accessibility indices in

the study area were joined together to indicate categories of accessibility within the study area.(see table 2) Similarly, the route connectivity of the study area was determined by counting the numbers of links (arcs) and nodes (vertices) using the map of the study area. Thereafter, the level of route connectivity in the sampled settlements was determined using Beta index graph measurement [22] other secondary data were sources from test-books, journal and magazines.

5   FINDINGS AND DISCUSSION

Rural Accessibility Measurement

Table 1.0: Frequency table of Routes Per grid of 2 by 2 km^2

	Length of rouad per grid in km	Frequency (no of grids)	percentage
01	0	17	31.4
02	0.1 – 2	28	51.9
03	2.1 - 4	09	16.7
04	4.1 - 6	0	0
	Total	= 54	100%

Source: Author Field Survey,2014

From the table 1.0, it could be observed that a total of 31.4% of the grid squares contain no road at all. In the same vein, 51.9% of the farm locations in the area are located in an inaccessible rout that is not easily link with vehicles for easy evacuation of farm outputs. As against 16,7% of the farms that are linked with more access routes. In line with [Ref 17 and 23], three different categories of route accessibility were identified in the study area and these are; very low (inaccessible zones) low or (fairly accessible zones) and areas that are averagely accessible (Figure 2). The foregoing observation shows that 83.3% of roads in the study area are inaccessible signifying that easy evacuation of farm outputs is a big problem in the study area.

LENGTH OF ACCESSIBILITY ROUTE PER GRID

	A	B	C	D	E	F
1	$a_1 = 0$	$b_1 = 0$	$c_1 = 0.25$	$d_1 = 0.25$	$e_1 = 0$	$f_1 = 0$
2	$a_2 = 0$	$b_2 = 1.75$	$c_2 = 1.50$	$d_2 = 2.0$	$e_2 = 0$	$f_2 = 0$
3	$a_3 = 1.75$	$b_3 = 1.0$	$c_3 = 2.75$	$d_3 = 2.75$	$e_3 = 0.5$	$f_3 = 0.5$
4	$a_4 = 1.75$	$b_4 = 1.78$	$c_4 = 0.9$	$d_4 = 1.0$	$e_4 = 1.25$	$f_4 = 1.2$
5	$a_5 = 1.25$	$b_5 = 1.75$	$c_5 = 2.7$	$d_5 = 1.1$	$e_5 = 1.1$	$f_5 = 0.25$
6	$a6 = 1.50$	$b_6 = 2.0$	$c_6 = 1.00$	$d_6 = 2.75$	$e_6 = 1.0$	$f_6 = 0$
7	$a_7 = 1.75$	$b_7 = 2.15$	$c_7 = 2.00$	$d_7 = 2.20$	$e_8 = 0$	$f_8 = 0$
8	$a_8 = 1.50$	$b_8 = 2.50$	$c_8 = 3.5$	$d_8 = 2.20$	$e_8 = 0$	$f_8 = 0$
9	$a_9 = 0$	$b_9 = 0.7$	$c_9 = 0$	$d_9 = 0$	$e_9 = 0$	$f_9 = 0$

I. a_1, a_2, a_3 -- a_n
II. b_1, b_2, b_3 -- b_n
III. c_1, c_2, c_3 -- c_n
IV. d_1, d_2, d_3 -- d_n
V. e_1, e_2, e_3 -- e_n
VI. f_1, f_2, f_3 -- f_n

Number of grids per box

Source; Field survey, 2014

This observation collaborate the findings of[Ref1 and Ref 2] that well improved access road is a catalyst of achieving optimal rural benefits as well as necessitate agricultural development.

Rural Road Connectivity Measurement

The connectivity of roods network is determined by the extent to which nodes in a network are directly connected to one another. in this study beta index graph measurement of kansky were employed to determine or measure the degree of connectivity of routes within the study area. This was done by dividing the total number of links (arc/edges) in the network by the total number of nodes (vertices /settlements) found at the junction of any two or more arcs as well as at end of an arc. (See figure below).

Beta index is given as: *Beta = e/v*

Where ; e = the total number of edges =42

V = the total number of vertices =43

B = 0.98

From the analysis, it shows that on the average, there is 0.98 links for each vertex of the rout in the study area. However, any route with Beta index value less than 1.0 such route network is considered to have low level of connected and such route is not viable for sustainable agricultural development. From the foregoing, it shows that the road network in the study area is poorly connected that could makes movement or flow of both farm inputs and outputs from the interior to the market for sale difficult. Hence from figure 3 the road network in the study area display very simple network connectivity. This is because there is no fundamental circuit in the network of the study area. In the final analysis, such network is considered not viable economically for proper harnessing of rural resources and or for motorist to maximize profit as well as for effective farming activities. This observation corroborates the findings of [Ref 24], that roads which are highly connected is a pivotal for social and economic development of a nation's economy.
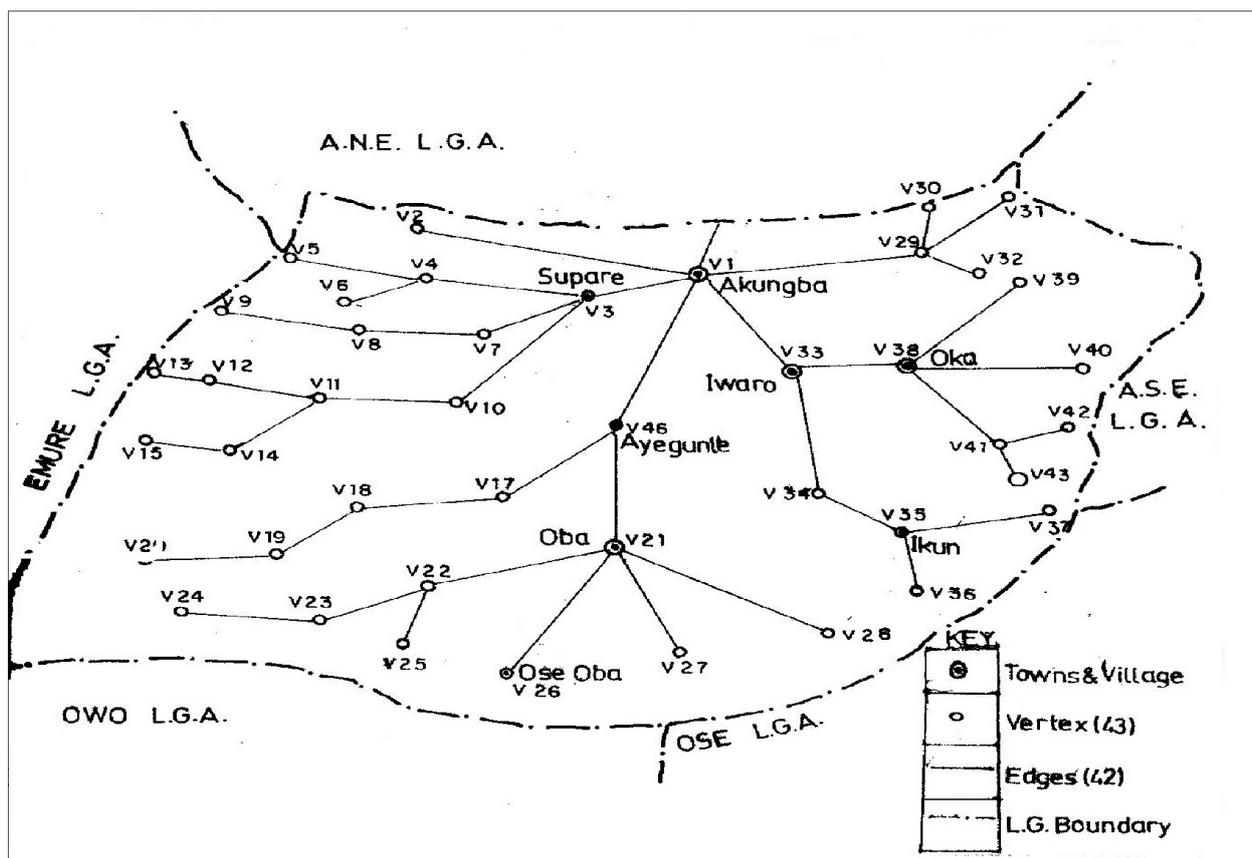

Fig3. Connectivity Routes-map of the study area.

Source: Field survey, 2014

6   CONCLUSION

The study had succeeded in showing that most of the road network in the study area are not accessible dew to their poor condition as a result of their neglect by the agencies responsible for the improvement or rehabilitation. The study has shown that road transport is poorly developed and, more often than not, rural communities have had to improve the road through community efforts for easy accessibility. In most cases, local materials were used for the rehabilitation of the routes. Hence, rural people required transport infrastructure that will link the rural areas with the urban centres so as to facilitate and enhance easy movement of people, goods and services in and out of the study area.

Fundamentally, it was revealed in the study that most of the routes were not adequately connected and accessible especially during the rainy season, thereby putting constraints to the maximum harnessing of food crops from the hinterlands to market points for sale; thus, leading to mass wastage and spoilage of food items in the field. The economic implication of this is that it leads to reduction in the profit margin of the farmers and the quantum of crops produced.

It was revealed that road improvement was a factor of farm size; that is, as the condition of the road improves, there is the tendency for the farmers to expand their farmland. This can as well lead to increase in output, since the trekking distances to farms have been overcome. Similarly, the neglect of village-to-farm and village-to-village accessibility by government in their development plan is a serious and costly omission, knowing fully well that the urban centres depend largely on the rural settlements for the supply of food stuffs. An investment in rural transport, therefore, will help a long way to solve the problem of rural-to-market accessibility in order to reduce drastically the wastage of human resources in the rural areas and, at the same time, improve the life style and standard of living of the rural populace.

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