

GEOGRAPHICAL ANALYSIS OF RURAL MARKET FREIGHT DISTRIBUTION AND TRAFFIC FLOW PATTERN IN SOUTH WESTERN NIGERIA

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Abstract

The study attempts to analyze the spatial flow pattern of rural freight and vehicular traffic characteristics generated by rural markets in the South Western Nigeria. A questionnaire survey of commodities loaded and transported as well as rural freight operators in selected rural market locations was carried out to determine their types, volume and destinations. In addition, vehicular traffic flow count was carried out to estimate the flow and type of vehicles used for rural freight transport operations. The findings reveal that rural market goods are mainly demanded within the region; 73.6% of goods are attracted within region. Only about 26.4% of rural market goods are attracted by other states outside the region. The spatial flow pattern show that rural freight transportation is bedeviled with numerous challenges; the major ones among them are extortions by security agents, poor road condition and insecurity constituting 24.3%, 21.4% and 16.2% respectively. Based on these findings, some policy recommendations like adopting rural market with high volume of goods as major centres for rural goods distribution where modern freight handling facilities, such as storage, shed, warehousing and other auxiliary services are provided to facilitate rural freight operations. This will not only improve freight distribution and transportation in the study area but the country in general.

Key Words: Rural freight, market, distribution, flow, transportation, vehicular traffic

Introduction

Transport, particularly road transport is a crucial factor of spatial and economic development, which also contributes to rapid changes that occur in physical, social and economic landscape across the world both in urban and rural areas. Sustainable rural developmental changes are a function of a number of factors in which transportation is of paramount. Efficient and effective rural transportation especially road, serves as

one of the means through which rural goods are collected, consolidated and transferred to urban areas for consumptions thereby promotes rural economy (Holl and Mariotti, 2017, Adedeji *et al.*, 2014, Kuznetsova and Yakolleva, 2011). The need to understand the factors responsible for these changes demand studies on various aspects of transport and land use interactions both at rural and urban centres. The flow of traffic be it

passengers and freight influences the landscape and socio-economic development of an area Michael (2008). A proper understanding of the freight flow in terms of their production and distribution is crucial to spatial development and planning of an area. The demand for freight is a factor that influences its production and distribution. The demand for freight transport especially at international level is also determined by a country's GDP and geographical area (Esra *et al.*, 1992).

On the other hand, it was observed that the general increase in freight transport especially road freight traffic in some developed countries is not as a result of the new production method but it is caused by the liberalization of the transport sector which, results to extremely low transport cost (Strutynski, 1995). Rodrigues (2003), further argued that the increase in the flow of freight have been a fundamental component of contemporary changes in economic systems at global, regional and local scales. In addition, regional areal differentiation of places create localized surpluses that can be transferred to deficit areas and this agrees with the concept of complementarity (Ola, 1978 and Ullman, 1956)

One of the major constraints of freight demand in rural areas is the size of the rural transport market, which largely depends on population densities. In general, Africa has low rural population densities and a less intensive form of agriculture than Asian countries. Additionally, markets are generally more distant and less accessible in Africa (Sieber, 2009). In Nigeria, demand for freight transport is influenced by the volume of industrial and agricultural production and attributes of transport

modes available to the users (Alokan, 1995). However, Ogwude (1993) argued that the annual sales of the firm, vehicle ownership, freight charges, transit time, and reliability of delivery time are important determinants of modal choice of freight transportation in Nigeria.

At an urban market level, the demand for freight is considered to be influenced by the size of the market, in terms of patronage level of the buyers and sellers and the market proximity to the buyers and sellers (Murayama (2000) and Ogunsanya (1987). Previous studies on freight transportation and distribution in developing countries particularly in Nigeria focused mainly on urban centres with little or no attention on rural freight distribution. This paper therefore tries to fill this gap by examining the factors that influence rural freight distribution pattern generated from rural markets in the South Western Nigeria. It is believed that the findings of this study would be useful to policy makers in formulating appropriate policy for rural transportation, rural goods marketing and distribution in Nigeria.

Conceptual Issues and Literature Review

Freight refers to goods and materials that are in transit or are loaded for transportation (Stopher and Meybury, 1975). They also referred to as consignment. The freight transported from rural markets in Nigeria are mainly agricultural goods which are purchased by dealers of agro- commodities, who in turn sell them either for domestic or industrial consumptions in the cities. Freights are classified into various groups depending on their types and nature.

Freight vehicles on the other hands, according to Stopher and Meybury (1975) are defined as those that are

wholly or largely purchased for the carriage of goods. These include articulated Lorries whose capacities are determined by the size of the carrying units and the nature of the routes. However, Alokani (1988) observed that this definition of a freight vehicle is somewhat arbitrary. He argued that the potential for joint carriage of both passenger and freight in one vehicle prevents any rigorous or exclusive delineation of passenger and freight vehicles especially in rural Nigeria where goods and passengers are loaded in the same vehicle.

The types of vehicles used in freighting can be classified into two; these are the lorries and trailers. Technically, the types differ in terms of their size and whether or not the motive power unit is physically combined with the cargo unit. The lorry constitutes a total transport unit as the cargo unit is combined with the motive power unit. This limits the size of the cargo it can carry. The axle loads of these Lorries range from 3 to 10 tons (Alokani 1988).

The trailers (or articulated vehicles), on the other hand, have their engines separated from the cargo unit and so variability of capacity can be achieved. In addition, this physical separation enables the truckers to achieve quick turn-around time because a driver can leave a load without waiting for the trailer (the cargo unit) to be unloaded (Resengren and Webb, 1981). This feature could be very useful in situations where very large consignments are concerned.

It also allows the haulage operator to change the cargo unit of the trailer to meet customer's specification. Trailers have different capacities they range from 30 to 40 tons, net weight and they are built to handle different types of goods.

Trailers can be further classified into four types according to the type of freight they are specially designed to carry (Alokani, 1988). These are "sided", "flat" trailers, liquid tank truck (commonly referred to as tankers) and the dry bulk carriers. The sided vehicle refers to those whose cargo units have rail-guards on either side, while the "flat" ones do not have rail guards. The latter are more suited for hauling containerized goods, while the former are suited for general cargo. The tank trucks and dry carriers are more specialized than the "flat" and "sided" trailers, in that they are neither suitable for general cargo nor containerized freight. They are useful mainly for the distribution of petroleum products as well as certain imported materials in powdery form, such as wheat flour and unbagged cement.

Several factors influence the allocation of freight to the Lorries or trailers. Some of these include the volume of the freight, the type of freight involved, the nature of the road and the distance between the origin and destination of goods (Guzman *et al.*, 2016, Alokani, 1988). Ogunsanya (1981) observed that Lorries are more suitable for intra-urban movement while trailers are best for long distance freight movement. Various factors have been identified as reasons for non-suitability of trailers in urban freight transport; these include the size, weight, length and height of trailers. Similarly, these trailers are also unsuitable in rural areas because of the narrow and winding nature of most rural roads (Ojekunle, 2006 and Obok, 1986). The freight locations are also dispersed and the volume in each location is usually small for a trailer load (Oluwole *et al.*, 2016).

Apart from Lorries and trailers, there are other types of vehicles being used for freight transportation in rural areas in Nigeria, these include ‘pickups, vans, buses, taxis and motorcycles. All these means of transportation are used for carriage of both passengers and freight simultaneously because of the non availability of suitable vehicles for passenger movement, as such these vehicles cannot be exclusively defined as wholly freight vehicles.

The structure and pattern of rural freight attraction and distribution are diverse in Nigeria. Musa (2009), pointed out that, agricultural produce constitute a significant percentage of commodities of inter-regional trade transported by road, he listed some of these agricultural commodities as potatoes, yams, grains, tomatoes, vegetables and fruits. Others include live stocks such as cattle, sheep and goats.

Methodology

The South western Nigeria, which is the study area comprises of six states namely: Lagos, Oyo, Ogun, Ondo, Osun and Ekiti States. Out of these, three of them were purposively selected namely; Oyo, Ondo and Ogun. Their selection was justified on the ground of their rurality, distinct vegetations, number of rural markets located in them, and the diversity of their agricultural produce. These three states were therefore selected with the assumption that whatever data obtained from them would be a good representation of the entire region. Lagos was however not considered because of its cosmopolitan nature. Most of its markets are not really rural but more of urban in nature which is at variance to the aim of this study.

Information on the number, names and location of rural market centres were retrieved from local newspapers (such as “Iroyin Yoruba” and “Gboungboun”) and State Annual Economic Reports. These local newspapers and reports usually carry reliable information on the number of existing rural markets in the south Western Nigeria and the days of their operation. From the review of the local newspapers and State Annual Economic Reports collected from Ministries of Rural Development in the three states selected, a total of 248 rural market centres excluding the markets located in the urban centres were identified in the study area.

The next stage was the selection of rural markets among the sampled states. There are two issues involved here. The first is the determination of the sample size since all the markets cannot be surveyed. The second is the choice of the actual markets to be surveyed. In respect of the first one, a 10% sample was deemed appropriate. Previous works such as Fadare (1992) lend credence to this sample size. For the choice of the actual market, a systematic random sampling procedure was adopted. This was done by assigning number to all the rural markets identified in each State, one out of every ten markets in each state was then selected as a sampled rural market. By doing this, ten (10) rural markets were selected in Oyo state, 8 were selected in Ogun state and 7 were selected in Ondo state making a total of 25 sampled rural markets. Figure 1 shows the map of the study area, the location of rural market centres and the sampled rural markets. A reconnaissance survey was carried out to identify the actual location of the sampled rural market centres before the commencement of the main survey. This

assisted in guide the conduct of the survey, as well as the recruitment and training of the field assistants.

To elicit the required data, a structured questionnaire was designed to collect information from transport operators who load and carry goods from the sampled rural markets. To administer the questionnaire on transport operators, a systematic sampling procedure of one out of every ten vehicles that loaded and transported goods out of the markets was selected. The drivers of the vehicles selected were interviewed at the loading point/motor parks. The information on types of goods carried, freight charges, the cost of operation, the final destinations of the goods, journey time and distance from markets to the final destination were collected from the operators. A total of 915 questionnaires were administered, but after sorting the defective ones, only 887 transport operators' questionnaires were used for analysis. The defective questionnaires are those that were wrongly filled by the respondents or the field assistants and could not be used for analysis.

A manual traffic flow count was conducted at the entry points or gates of the rural market centres, this procedure was carried out between 6.00am and 6.00pm on a market day with the aid of field assistants recruited within each locality. A traffic count form designed for classification of vehicles into taxi/car, small buses, midi buses, big buses, pick up, truck/lorry, articulated vehicle, motorcycle and bicycle was used by field assistants. The tally count method was adopted for each vehicle type entering and going out of rural market. Most rural markets in the study area operate periodically on every 5-day of the week. On the each market day, they open as

early as 6:00 am. and closes as late as 7:00pm. With the exception of Odo-oba and Elekara which open to traders every day of the week, in spite of the fact that they also have their own official market day where the volume of trading activities are at their peak. The data collected were used to determine the volume and characteristics of traffic attracted and generated by the sampled markets. SPSS computer package version 16.1 was used to analyze the data collected.

During the survey, it was discovered that different measures were used to package rural goods. To solve this problem, the weight of a randomly selected freight types was obtained using weighing scale. The weights were summed up and an average weight was then computed. This method was used during the field work and the average weights of different freight types were obtained.

Thus, the term "standard weight" in the context of this study refers to the weight resulting from the average weight of randomly sampled related commodities. The standard weight is obtained by weighing different measures of agricultural produce on weighing scales and converting them all into single unit of measurement (i.e tons). The above procedure has made it possible to convert all the goods that were originally packed in different measures into weights. This makes for easy comparison. The raw data collected in the field were factored using the standard weight adopted to estimate the quantity of goods generated by the sampled markets. It is not unlikely that this procedure may have introduced some errors, either as a result of over estimation or underestimation. It has been adopted in the absence of any other

known favourable solutions and with the belief that occasional underestimation and overestimation often cancel out in the final analysis.

For the purpose of estimating the volume of freight flow from the various rural markets to different destination states, different units of measures for

different commodities for each vehicle loaded at the markets were counted and recorded by field assistants which were subsequently multiplied by the “standard weights” adopted by the authors to arrive at a total volume of goods transported by different categories of vehicles from the markets to different destinations.

Results and Discussions

Rural Freight Generation

Rural markets constitute the centres for rural freight generation particularly agricultural products. Rural periodic markets are not just for goods marketing they are also centres of freight generation and consolidation particularly on market days. Rural transport operators target market days of different rural market centres for operations (Ojekunle 2016). Figure 2 shows the estimated daily volume of goods (in tons) generated per day by different rural markets in each market day in the study area. From the figure, it shows that volume of goods generated varies from market to market. The markets have been classified into five (5) groups based on the total quantity of goods they generated in tons on each day of their operation. Only Odo-oba

market falls into the group with the highest quantity of goods estimated at 1,201 tons and above per market day. The second highest volume of goods ranges from 901 to 1200, only Gambari market also falls into this group. The third highest group is within the range of 601 to 900 tons, Omi-Adio and Aba-Serafu markets belong to this group. The fourth group ranges from 301 to 600 tons, the market in this group are Eleekara, Kolawole, Bolorunduro, Owena and Bamikemo. The least group generated goods ranges from 1 to 300 tons. Majority of the markets falls into this group they include, Olorunda, Ago-Are, Olorunfe, Ajegunle, Wasangare, Ajura, Ibafo, Ogunmakin, Mamu, Atikori, Atan, Dagbolu, Ago-Iwoye, Ajegunle, Fagbo, and Ala.

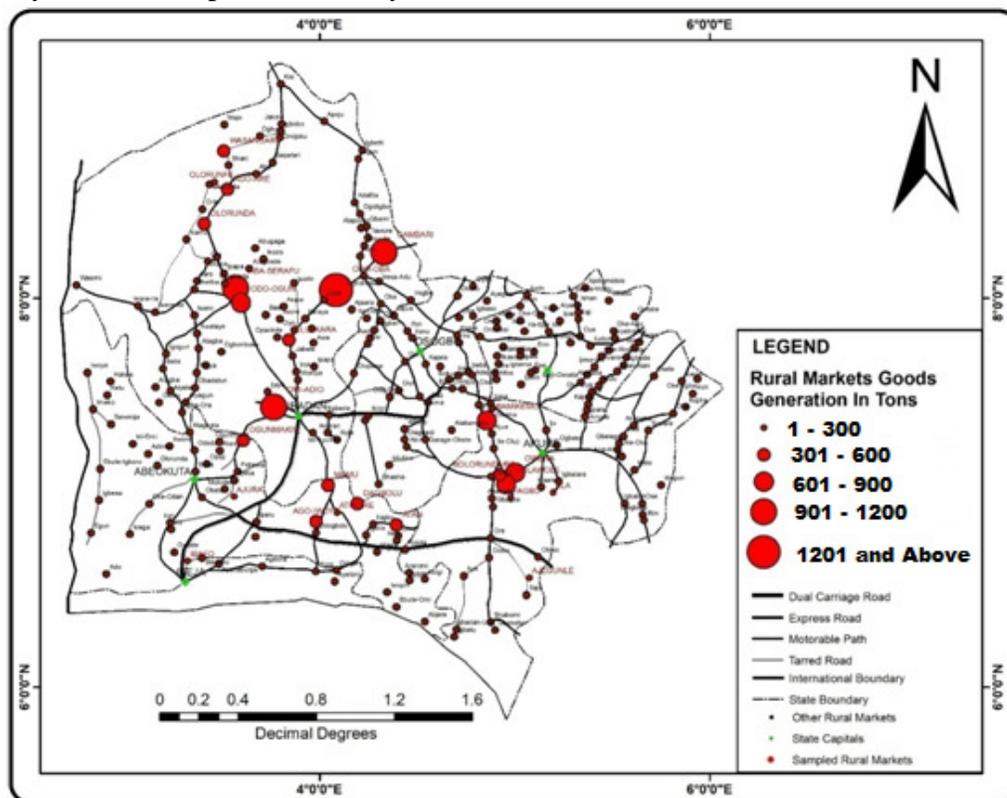


Fig. 2: Volume of Rural Freight Generation by Sample Markets

Pattern of Rural Freight Distribution

The issue being addressed in this paper is how the freight generated is distributed across geographical and economic landscapes of Nigeria and what factors really determine their distribution. Table 1 shows the immediate destinations of goods generated by each market. The table shows that most markets serve their immediate environment, which is intra-state freight demand was dominant. For certain goods, they serve other states. In terms of attraction on state basis, the table also indicates that Oyo State attracts the largest volume of goods of 4,169 tons, which constitutes 41.1% of the total volume of goods attracted to all the states. The next highest volume of 1,715 tons representing 16.9% was attracted by Ogun State, This is followed by Lagos state with 1,290 tons representing 11.8% of the total volume of goods attracted to all the states. The state that attracts the least volume of goods is Rivers State, it attracts only 24 tons, representing 0.2% of the total volume attracted to all the states. The flow pattern is shown by “desire lines” in Figure 2.

Looking at this pattern of goods distribution, Odo-oba has the largest area of influence and it has its goods distributed to fourteen (14) states. Gambari market records the second largest area of influence distributing its goods to seven (7) states. This is followed by Eleekara market which distributes its goods to six (6) states in the country. One common locational attribute about these markets is that they are all located on major interregional highway, which enhances their level of their accessibility. Their high level of accessibility no doubt may be one of the factors that accounted for their dominance. In addition, some of these markets over the years have become centres of rural goods consolidation and interregional freight terminal in the transportation and distribution of interregional goods in the country.

The variation in the volume of goods attracted to different states is due to many factors such as the proximity of the destination, the market’s density and the degree of attractiveness of the destination states.

Table 1: Spatial Flow of Rural Freight from Rural Markets to Destinations (measured in tons per market day)

Destination Origin	Lagos	Ogun	Osun	Oyo	Ondo	Kwara	Kogi	Kaduna	Sokoto	Abia	Rivers	Anambra	C/Rivers	Imo	Abuja	Kebbi	Edo	Kano	Total	%
Eleekara	50	-	-	184	-	2	33	-	-	-	-	-	-	-	-	-	-	60	329	3.25
Gambari	25	-	81	743	-	141	-	-	-	-	-	24	-	24	-	-	-	23	1061	10.48
Omi-Adio	93	107	-	657	-	-	-	-	-	-	-	-	-	-	-	-	-	-	857	8.46
Aba-Serafu	-	-	-	857	-	-	-	-	-	-	-	-	-	-	-	-	-	-	857	8.46
Olorunda	80	-	-	113	-	-	-	-	-	-	-	-	-	-	-	-	-	-	193	1.91
Odo-Oba	308	185	194	294	-	60	31	121	31	31	31	93	93	31	31	31	31	-	1596	15.15
Ago-Are	68	-	-	161	-	-	-	-	-	-	-	-	-	-	-	-	-	-	229	2.26
Olorunfe	-	-	-	98	-	-	-	-	-	-	-	-	-	-	-	-	-	-	98	0.97
Odo-Ogun	-	-	-	617	-	-	-	-	-	-	-	-	-	-	-	-	-	-	617	6.09
Wasangare	-	-	-	149	-	23	-	-	-	-	-	-	-	-	-	-	-	-	172	1.70
SUB TOTAL																			6009	
Ajura	12	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	35	0.35
Ibafo	38	35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	73	0.72
Ogunmakin	119	412	-	198	-	-	-	-	-	-	-	-	-	-	-	-	-	-	729	7.20
Mamu	20	172	-	64	-	-	-	-	-	-	-	-	-	-	-	-	-	-	256	2.53
Atikori	-	152	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	152	1.50
Atan	92	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	285	2.81
Dagbolu	25	221	-	34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	280	2.76
Ago-Iwoye	79	215	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	294	2.90
SUB TOTAL																			2104	
Kolawole	55	-	-	-	450	-	-	-	-	-	-	-	-	-	-	-	-	-	505	4.99
Bolorunduro	-	-	-	-	321	-	-	-	-	-	-	-	-	-	-	-	-	-	321	3.17
Owena	94	-	-	-	412	-	-	-	-	-	-	-	-	-	-	-	-	-	506	5.0
Ajeganle	32	-	-	-	104	-	-	-	-	-	-	-	-	-	-	-	-	-	136	1.34
Bmikemo	-	-	109	-	231	96	-	-	-	-	-	-	-	-	-	-	-	-	436	4.30
Fagbo	-	-	-	-	64	-	-	-	-	-	-	-	-	-	-	-	-	-	64	0.63
Ala	-	-	-	-	77	-	-	-	-	-	-	-	-	-	-	-	-	-	77	0.76
SUB TOTAL																			2045	
Total	1190	1715	384	4169	1659	322	64	121	31	31	31	117	93	55	31	31	31	83	10158	100
%	11.8	16.9	3.8	41.1	16.4	3.2	0.3	1.5	0.3	0.3	0.3	0.2	0.9	1.2	0.3	0.3	0.3	0.8	100	

NB: All the markets surveyed are periodic rural markets, the figures in Table 1 represent the total weight of goods in tons generated on a single market day by each market.

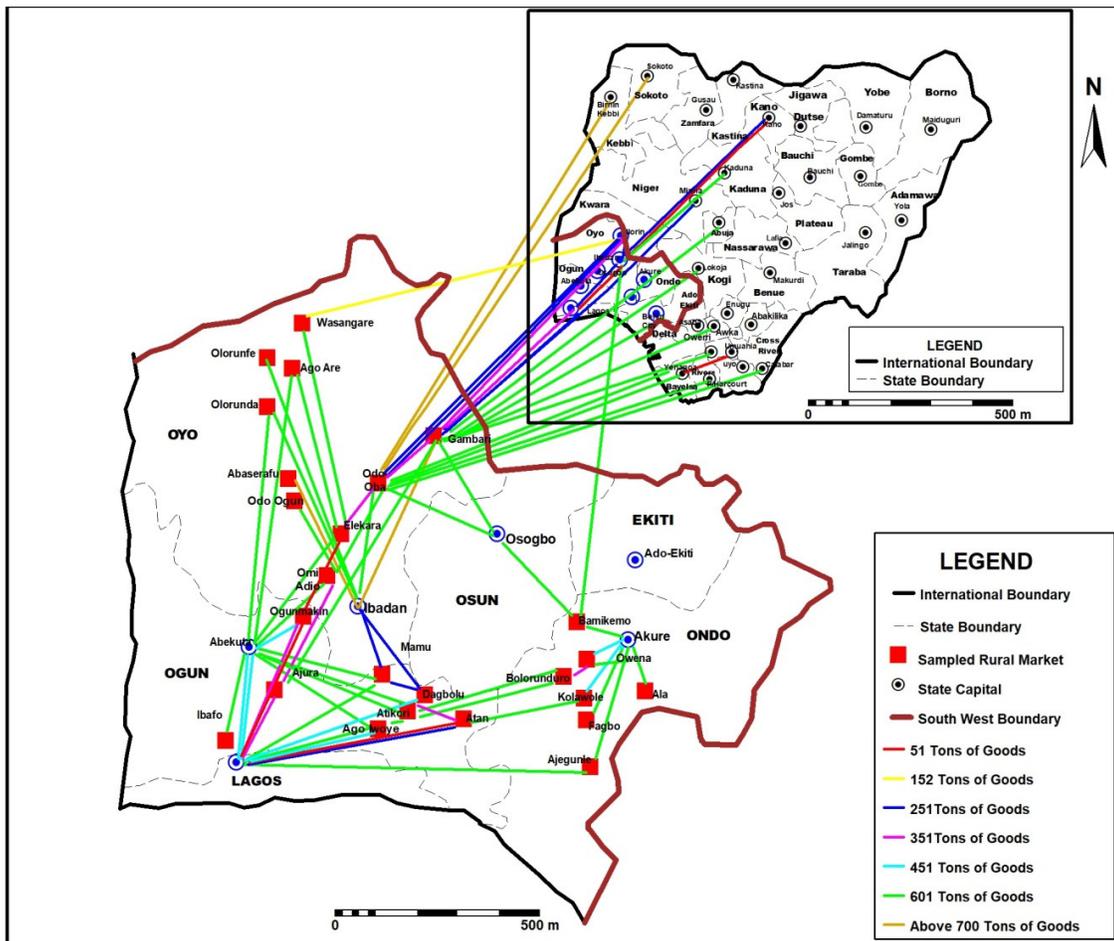


Fig. 3: Freight Flow Pattern from rural markets to different states in Nigeria

Rural Freight Vehicular Flow

Attempt was made to examine the types of freight vehicular generated and attracted to rural markets of south Western Nigeria. Figure 3 presents a summary of this analysis. Surprisingly, taxis/cars and unpainted taxis popularly known as “kabukabu” record the highest traffic of 5,256 representing 38.8% of the total vehicular traffic volume. The next highest traffic of 3112 representing 22.9% is recorded for mini buses and this is followed by motorcycles with 2,312 representing 17.0% of the total traffic. The least vehicular traffic volume of 19 was recorded for big buses, this represents only 0.1% of the total traffic.

The above results show that the non conventional means of freight transport dominate the operation of rural road freight transportation and distribution in Nigeria. This may be due to a number of reasons. Firstly, rural goods are carried in small quantities especially for shorter distances, thus, vehicles with small capacities are found more suitable than bigger ones. More importantly, the flexibility advantage of taxis and minibuses for passenger and goods transport operations constitute one of the major factors for its adoption by users as a means of freight transportation. Secondly, rural markets serve neighbouring communities more than

long distant locations. Lastly, the type and conditions of rural roads in many occasions are not suitable for heavy duty

vehicles like lorries and articulated vehicles.

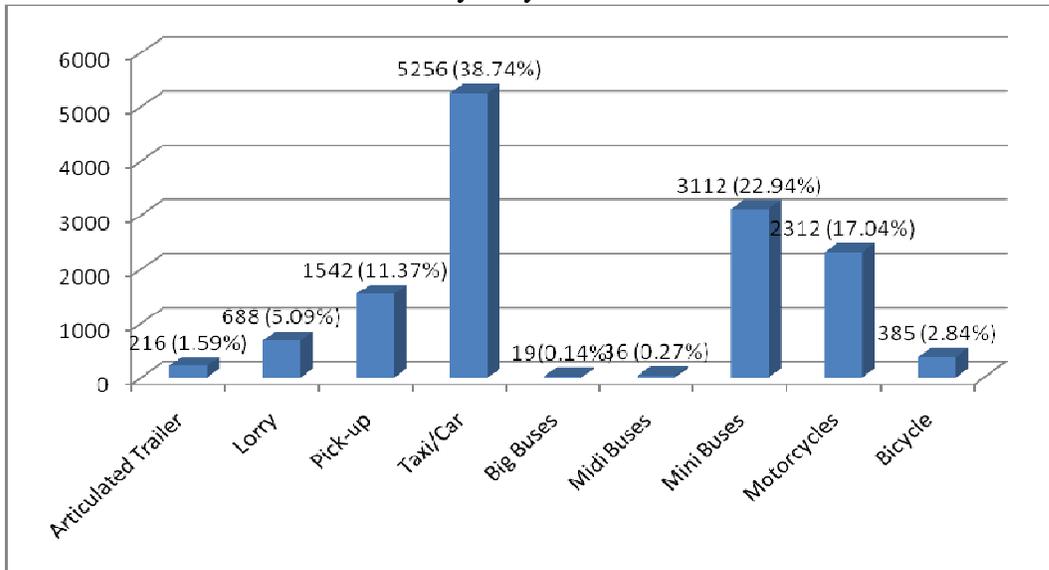


Fig. 4: Rural Freight Vehicular Types and Flow

Figure 5 below shows the volume of freight vehicular generation by the rural markets. Mamu and Odo-oba markets generated the highest flow of freight vehicles of 872 and 864 respectively on the market day, representing 8% each of the total vehicular traffic generated by all the sampled rural markets in the study area. Fagbo market recorded the least flow of vehicular traffic. The volume of

vehicular traffic generation by each market is a function of rural freight generation and attraction to each of the markets. Freight transport operators ply rural market roads where there is demand for their services. The level of market patronage also contributes to the volume of vehicular traffic generated in each rural market.

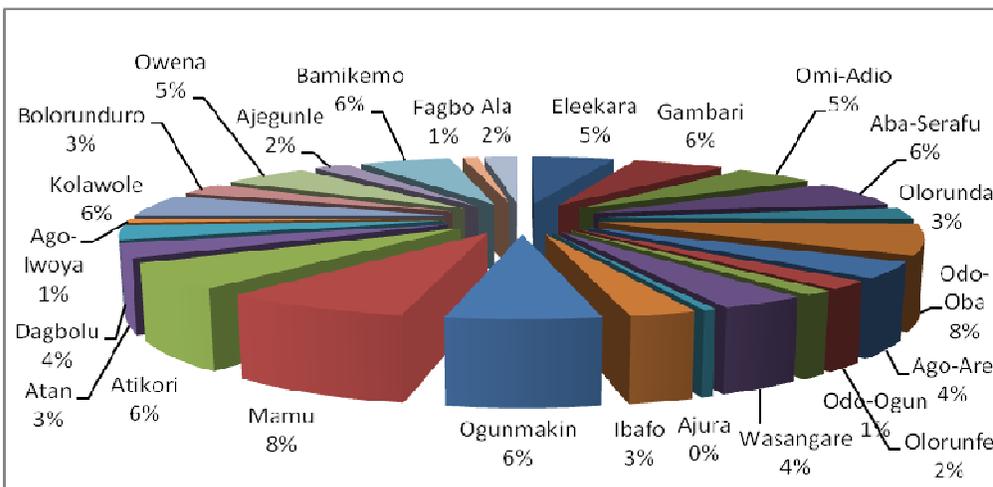


Fig. 5: Vehicular Traffic Flow Generated by Rural Markets

Problems of Rural Freight Distribution

Rural freight distribution in the study area is mainly by road transport mode and is associated with a number of problems. Table 2 shows the details of various problems confronting the operators. The most serious problem confronting the operators is extortion and

harassment by law enforcement agents particularly Police and Vehicle Inspection Officers (V.I.O). Extortion alone constitutes over 34% of the problems confronting the operators. This is followed by poor road conditions; this constitutes about 21% of the problems identified.

Table 2 Problems Associated with Road Freight Transport Operation

Problems	Poor road	Low patronage	Insecurity	Fuel Scarcity	High Cost of Spare Parts	Extortion by Law enforcement Agents	Others
No of Responses	315	147	239	128	230	357	56
%	21.4%	10.8%	16.2%	8.7%	15.6%	24.3%	3.8%

The operators are also confronted with problem of insecurity as they complained of harrowing experiences they often encounter through robbery attacks on rural roads. This also constitutes about 16.2%. This is closely followed by high cost of vehicle spare parts which they complain make the cost of vehicle maintenance exorbitant as this invariably affect the cost of goods transportation. The above analysis implies that extortion by security agents, poor road condition, insecurity and high cost of spare parts are major problems faced by rural markets freight transport operation in the study area.

Recommendations

The findings from this study have some implications for policy makers particularly in the area of rural transportation and regional economic planning. As revealed in the study, rural market with high volume of goods could be adopted as major centres for rural goods distribution where modern freight handling facilities, such as storage facilities,

shed, warehousing and other auxiliary services are provided to facilitate rural freight operations. The study reveals that the operation of rural freight transport is associated with many problems. One of the main problems identified is poor road conditions, this has the propensity to aggravate the cost of transportation, it increases vehicle operating cost and vehicle depreciation rate and prolonged transit time, which are eventually borne by the end users of transport services or freight owners. There is the need to embark on urgent repairs and rehabilitation of roads that provide access to these rural markets. This will help to improve socio-economic activities of the rural marketers and freight operators who service these rural markets. In addition to these problems, is the absence of regulation and lack of operational standards. There is, therefore, need for government to evolve a rural transport policy document for the country. Such a policy document should provide

direction on how the rural transport should be operated and regulated. It was observed presently, that there is no regulation in the operation regarding the maximum loads, the standards of vehicle to be used and freight rates charged. An appropriate rural transport policy if put in place will address these problems.

There is also the need to introduce standardized measures for rural goods so that uniform measurement can be done on categories of goods produced in the rural areas. This will facilitate data collection on rural goods and allow easy comparison of data on freight flows. In addition, the government at the federal and state levels needs to educate the law enforcement agents to stop their extortionist practices on rural freight operators but rather provide adequate security for both the operators of freight transport and freight owners.

Conclusion

The study has provided useful information on the spatial flow of rural freight from the market centres in the South Western Nigeria. The major constraints and determinants of rural freight distribution have been identified and the policy actions needed to ensure effective and efficient rural freight distribution have also been highlighted. It is believed that if those policy actions are implemented they will no doubt enhance rural economic growth and development of Nigeria.

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