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Transportation Network as an Impetus for Economic Activities: A Case Study of Agrarian Funtua Region in Katsina State, Nigeria

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Abstract
The aim of the study is to examine the relationship between the transportation network and industries of the agrarian Funtua region in Katsina State. It was prompted by the abandonment of the proposed project of establishment and operation of Container Freight Station/Inland Depot in Funtua by Nigeria's government, which generates a lot of concern to the people of the region. The project that was perhaps initially proposed due to strategic location of Funtua in relation to location of other towns in the northwestern geo-political zone and beyond as well as the presence of rail and road networks. GPS Device was used to record the coordinate points of identified industries. The rail lines and the roads locations in the study area were obtained from Google Earth that was used as a base map. Relevant information about productivity of the industries was obtained from supervisors and personnel mangers of the industries by administration of questionnaire and key informant technique. Kilometer Chart, diagram of rail line system were acquired from principal officers of Nigerian Railway Corporation in Zaria and Funtua stations. Sensitivity analysis was carried out to compare the freightage of agro-allied commodities by rail and by road. The study found out and concluded that the identified industries were found to be within ≤30 m *in relation to transportation network in Funtua, except four sophisticated agro-processing industries. The agro-based industries will make about 26% slash of their freight costs if their commodities were to be transported by rail in comparison to roads. The study recommended that governments at all levels should exhibit earnest concern about maintenance and construction of rail and road infrastructure due to their enormous advantages to economic activities.*

Keywords: *transportation network, Funtua region, Agro-based industries, freight, GPS Device.*

INTRODUCTION
Effective transportation makes up one of the major features adopted in measuring economic development (Ogunleye, 2013; Onokala and Olajide, 2020). This is because many of the socio-economic activities that improve the life of people depend on availability of adequate and excellent transportation networks (Igbokwe, 2004). This is obvious within the borders of

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economic geography and particularly in transport geography (Boyce, 1974). Boyce, (1974) argues that it is the transportation component that links up all the four activities of economic geography by supplying a series of material flow among them.

Due to favourable geographical location of Funtua region, it gives her an upper economic and social advantage over all other places in Katsina state as well as the northwest geo-political region (Adefila, 2014). According to Adamu (1987), Funtua is blessed with all required factors capable of spurring agricultural production: good climate; good clay-loam soil, coupled with able work force. This author reiterated further that these factors can be attributed to what attracted the British Colonial Administration to settle in Funtua thereby making it an agricultural site where cash crops such as seed cotton and Soy- beans were grown, processed and marketed.

The economic potentialities of Funtua prompted Federal Ministry of Transportation to issue license for the establishment and operation of Container Freight Station/Inland Container Depot (CFS/ICD) in Funtua (FGN-Gazette, 2007). Despite the legal framework within which the project was enshrined as ICDs/CFS gazette, FGN-Gazette, (2007), which categorically stated that, "The Federal Government of Nigeria has provided adequate framework for the implementation of the Inland Container Depots, ICDs and Container Flow Stations, CFS by gazetting their establishment". It is hoped that findings from this paper would apart from adding value to the literature, it would as well serve as an eye-opener for stakeholders to recognise the socio-economic importance of Funtua region in terms of its physical endowment as well as human resources, including transportation network, not only to the northwest region but to the entire country. That any attempt to abandon the establishment of ICDs/CFS in Funtua, as endorsed by the FGN, will imply neglect in the rehabilitation process of rail track that links up Funtua with the other seven approved ICDs/CFS located in all regions of Nigeria (FGN-Gazette, 2007).

Improvement in rail lines in Funtua for ICDs/CFS project will ensure free flow of materials from farmlands and processing industries of Funtua region in the hinterlands to the coast and vice versa. Several researchers, particularly scholars in economic geography have emphasized the importance of transportation network to economic growth and development (Timmer, 2002; Oni and Okanlawon 2012; Bosede and Afolabi, 2013; Nistor and Popa, 2014; Adeniran and Yusuf, 2016; Onokala and Olajide, 2020). While others investigated the potential factors that hinders economic development for example, Rephann and Isserman, (1994); Rietveld (1994); Beuthe, *et al.,* (2001); Liu and Zhou, (2006) were notable amongst the researchers who employed varying methodologies in their works which provided strong evidence of link between transport and the local/regional economy.

The aim of the study was to examine the relationship between the transportation network and industries of the agrarian Funtua. However, the specific objectives were to: i) identify the manufacturing/processing industries in Funtua region; ii) analyse through the use of maps to establish the relationship between the identified industries and the transport network in the study area; iii) carry out sensitivity analysis on freightage by road and rail line of selected industries. So that the simulative comparison of road and rail freightage (₦) would answer the question of what could have been the freightage of the industries from Funtua region *(ith)* to various destinations (*jth*), if transportation by rail lines were fully in operation?

MATERIALS AND METHODS

The Study Area

The study area (Funtua) is located about 150 km Southwest of Katsina town at 7°43′ – 7°44′ East of longitude and 11° 50′ – 11° 52′ North of latitude in northern Nigeria. The scope of the study is limited to examination of selected processing industries vis-à-vis the transportation network in the area.

Funtua falls within the tropical savanna climate with distinctive wet and dry seasons. The climate is hot and dry for most of the year and maximum daily temperature of about 38°C and minimum daily temperature of about 22°C are common. Relative humidity falls considerably during the Harmattan, it never exceeds 20 to 25% because of the effect of the two air masses: Dry Tropical Continental (cT) air mass of Northern origin from the Sahara Desert and the moist, cool tropical maritime (mT) air mass of the Southern origin of the Atlantic Ocean. Average total rainfall is about 750 - 800mm per annum with rainfall duration of 5 - 6 months. August is the month of the year when the highest rainfall is recorded. The atmospheric humidity over the area is the lowest in the dry season as low as 15% and is highest in the wet season above 60% for most of time of the day. Evaporation is higher in the dry season and lower in the wet season (Adefila, 2014).

Cotton farming made Funtua region so much attractive to the British colonial administrators. It was the reason that has evidently encouraged the British to link up Funtua town with Railway to Kaura-Namoda from where the British obtained groundnut (Candotti, 2009). Even though, there had been a sluggish agricultural-industrial activity during the post-colonial era, Funtua region still remained relatively active economically, especially during 1970s. Despite the prevalent problems of industrial development in Nigeria: capital (for investment); adequate resource base; technical and managerial manpower, Onyemelukwe and Filani, (1983), yet a number of agricultural processing industries are still operational in Funtua region.

Data Collection and Evaluation

Data from primary and secondary sources were considered. Questionnaire administration and key informant technique were used to acquire relevant information about both production and transport operations of the identified industries. Supervisors and Personnel managers of the respective industries were co-operating in this regard. Information such as Kilometre Chart, diagram of the railway system Tariff, (1997) and raw data regarding the railway operation, were obtained from principal officers of Nigerian Railway Corporation (NRC) in Funtua and Zaria stations. These were used to perform sensitivity analysis using Microsoft Office Excel, in order to compare freightage by rail lines and road of the selected agro-based processing industries in Funtua region.

The transportation network that comprises major, minor roads as well as the rail line that passes through the region of Funtua was obtained from *Google Earth* – a computer programme that renders a 3D representation of Earth based primarily on satellite imagery – as base map for the study. The roads and rail line were stored in Geographic Information System (GIS) environment as polylines spatial data. The spatial locations of the industries in respect of the transportation network were identified using Global Positioning Systems *Garmin* (GPS) *map76CSx* to register the geographical locations of all the twenty identified industries: the northings *(x)* and eastings *(y)* of where they are positioned in relation to the transportation network of the study area.

In order to use these types of data in GIS, it is necessary to align it with existing geographically referenced data. This process is also called georeferencing, which is also a necessary step in the digitizing process. Digitizing process was then performed, whereby the transportation network was "traced", in a geographically correct way, from the *Google Earth's* image (Figures 2 – 5). The entire GIS work was conducted using *ArcInfo* package of *ArcGIS®* software.

Design of the Study

The study considered twenty registered processing and manufacturing firms of four kinds. Therefore, firms that are not registered with the Corporate Affairs Commission (CAC) were not considered in the study. These were firms that deal in various manufacturing/processing activities at various scales; the production of Bakery products industries, agro-allied processing industries, Sandcrete-Block/brick production industries and Metalwork and fabrication industries (Table 1).

Data Analysis

The coordinate points of the industries were overlaid on the satellite imagery of the study area from *Google Earth* program, within the GIS environment as point spatial data using *ArcGIS* package of Spatial Analyst. Tables (1-2) and charts (1-8) have been employed to analyse the data on the industries and their respective roads and rail lines.

RESULTS AND DISCUSSION

Table 1: SMIs of Funtua Region

Manufacturing/Processing Firm	Frequency (f)	Number of Employees	SMIs Rank		
			Large	Medium	Small
Agro-allied Processing Industry*	09	2348	08	-	01
Brick/Block Industry†	04	195	01	01	02
Bakery**	01	50	-	01	-
Metalwork/Light Industry	06	139	-	03	03
Total	**20**	**2732**	**09**	**05**	**06**

Source: Fieldwork, 2021

†The largest red-brick industry in this category is owned by the state government is in active

*Only five of these categories of industries are operational the remaining 4 are not

**Fifteen bakeries were identified, but only one is registered with the CAC

Identification of Registered Manufacturing/Processing Industries

According to the United Nations Industry Development Organisation [UNIDO] (1999) and as reported by Elaian (1996); Ceglie and Dini (1999), defined Small and Medium Industries (SMIs) in terms of number of employees as the basis of classifying developing countries' industries as: large - industries with 100 or more workers; medium – industries with 20 - 99 workers; small - industries with 5 - 19 workers and micro - industries with less than 5 workers. From Table 1 above, it can be found that agro-based processing industries are the most operational enterprises in Funtua region. They are the set of industries that may be regarded as large scale on the basis of number of employees, according to the UNIDO's SMIs classification yardstick. Total number of 2348 employees work in nine of such industries. Furthermore, based on the UNIDO's SMIs classification, eight of the industries were found to be of large scale only one is small scale. However, at present, only five of these industries are active and 1648 (70.2%) employees still work therein. The other four agro-based industries

have been shut down and 700 (29.8%) of their workers had been laid off, including the Cotton and Agricultural Processors (CAP), that was commissioned by the colonial administrators in 1929.

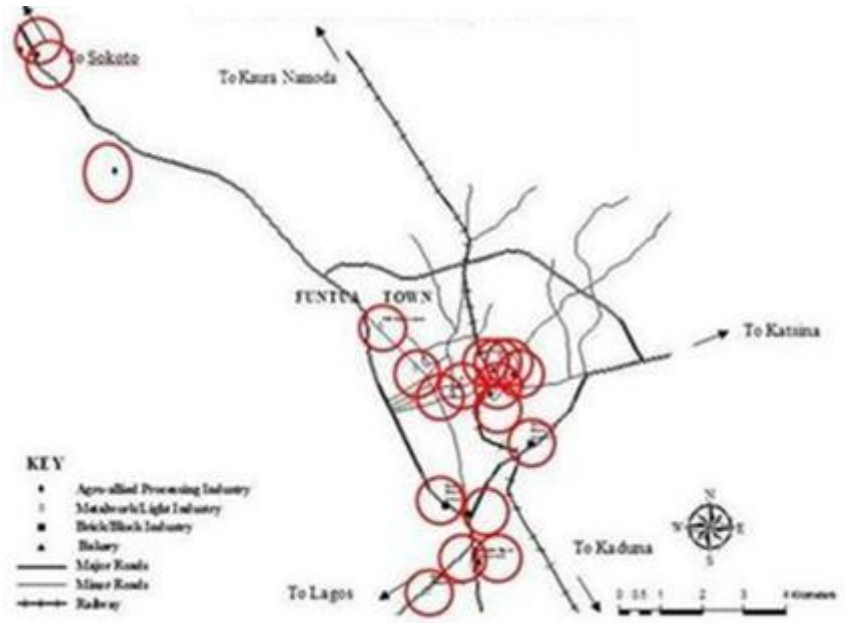

Figure 1: Distribution of industries relative to transport network
Source: Fieldwork, 2021

Locations of the Identified Manufacturing/Processing Industries

The obtained geographical information about the identified industries using the GPS *Garmin 76map CSx* have been presented (figure 1). The cycles indicate the relationship between the independent variable (transport network) and its corresponding dependent variable (industries) in Funtua region.

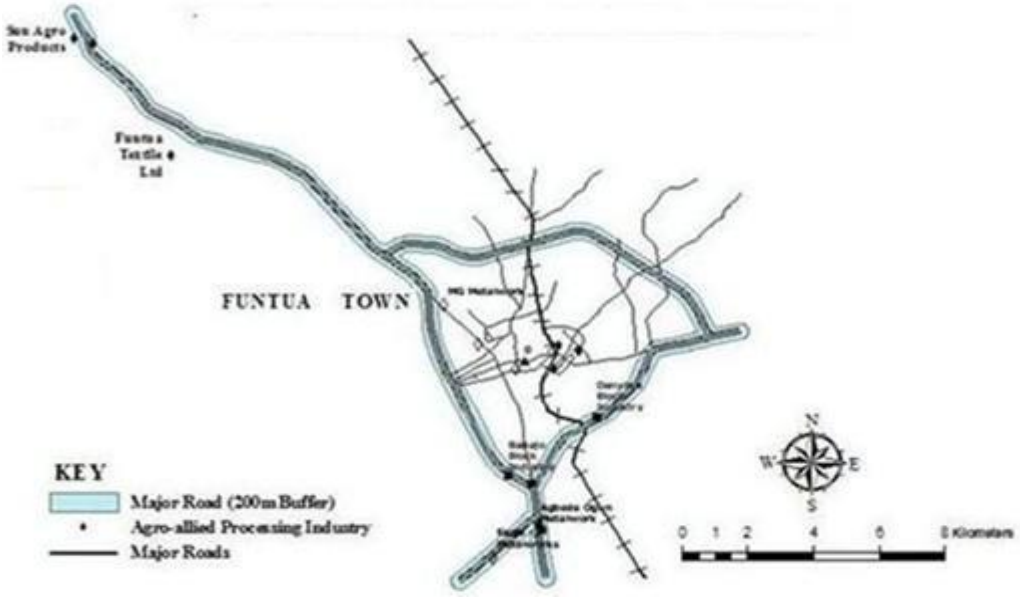

Figure 2: Major roadswith200 m buffer
Source: Fieldwork, 2021

The twenty identified industries were observed to have located along the transportation networks in the study area (Figure 1); most of the identified industries have aligned along

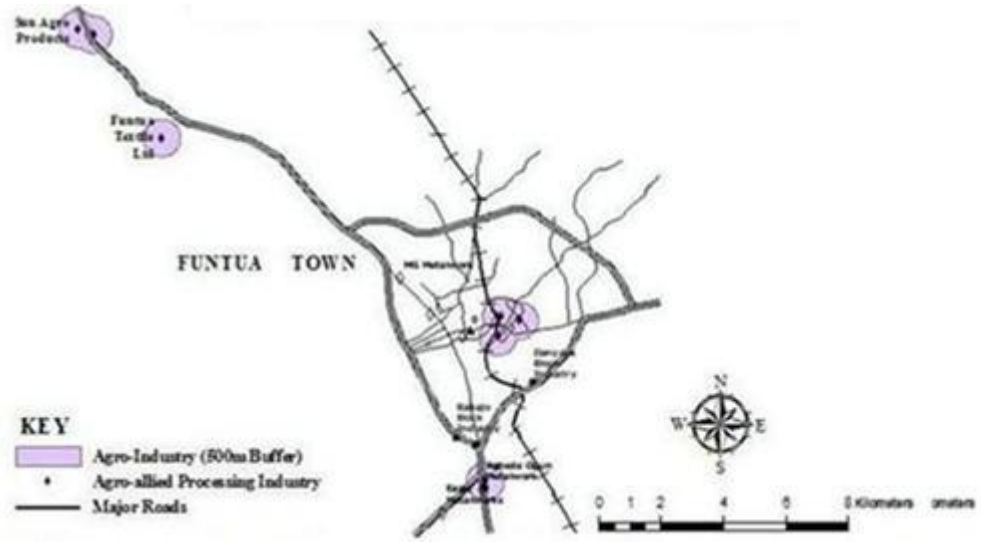

Figure 3: Agro-allied industries with 500 m buffer
Source: Fieldwork, 2021

The transportation network in the region within a marginal distance of ≤30 m away from either road or rail track. Their distribution is even more evident at the centre of the major roads enclosure, where the cycles (industries) depict a cluster pattern relative to the transportation network. This linear pattern of industrial location does not only promote accessibility, it as well allows for the display of the processed goods for people to see.

Nevertheless, four agro-processing industries; Alhaji Babangida Jargaba (ABJ) ginnery and oil mills Ltd; Cotton and Agricultural Processors Company, Ltd (CAP); Funtua textile, Ltd and Sun Agro Products, Ltd have fallen outside the ≤30 m limit. For example, the application of 200 m buffer around the major road (in figure 2) indicates that Sun Agro Products, Ltd has fallen within the boundary of 200 m. Furthermore, a buffer of 500 m around the agro-industries (in figure. 3) revealed that Funtua textile Ltd is farther from the same road by about 700 m distance, though feeder roads have linked the industries up with the major road. Figure 2 to 4 below show stages of the analysis:

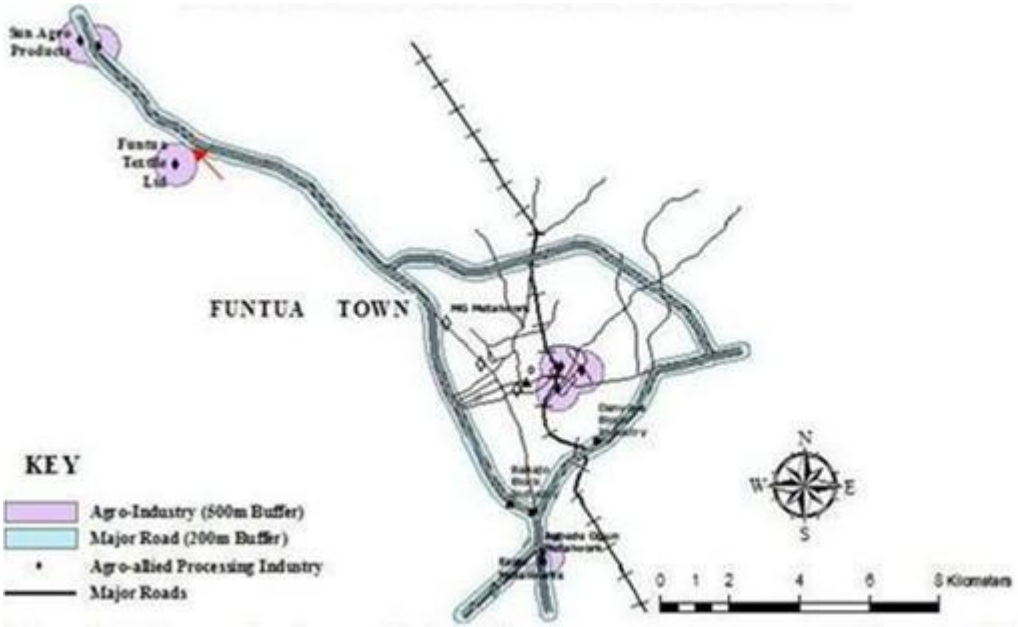

Figure 4: Major roads and agro-allied buffer
Source: Fieldwork, 2021

Sensitivity Analysis of Road and Rail freightage

Due to the fact that Agro-based industries are the most active that hold about 1,648 (70.2%) of the total 2,732 employees of the identified industries in the region (Table 1) it is as well the category of industry that surpassed other sort of industries in terms of advanced technical development and complexity. Secondly, sophistication is evidently identified in the seed cotton processing industries of the study region as depicted by their backward and forward linkages within the study region and beyond.

Boyce (1974) description about the importance of transportation sector in economic geography in terms of free flow of materials, have remarkably agreed with the economic activities of particularly seed cotton in Funtua region. Furthermore, the backward and forward linkages associated with cotton-textile industries are generally more noteworthy in terms of complexity when compared with other Nigerian agricultural commodities such as fruits, vegetables and livestock by about 60% (Department for International Development [DFID], 2005). Similarly, Boyce (1974) established that it was the transportation sector that determines the process of backward and forward flow of commodities (cotton) from farmlands (primary sector) to processing industry (secondary sector), from where products are processed and goods are transferred to the market.

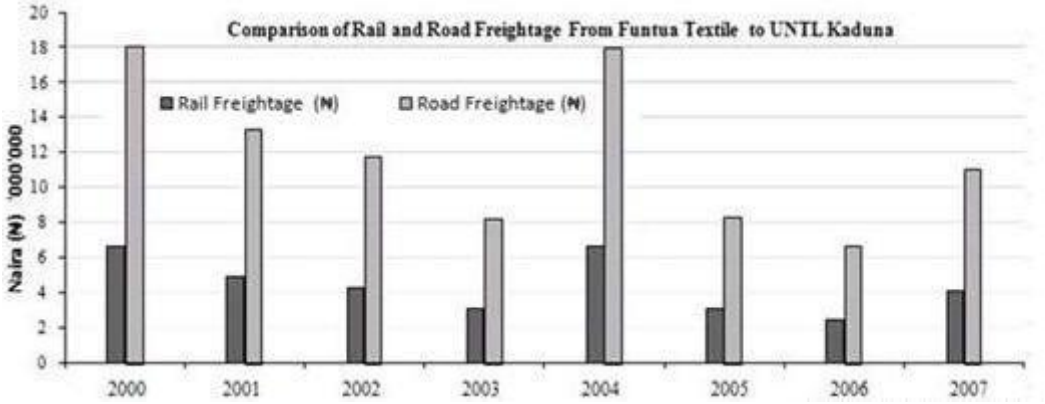

Figure 5: Cotton lint: rail line and road freightage
Source: Funtua Textile, Ltd

Due to those two reasons, the study analysed the truck-rail freight expenditure of selected agro-based industries, on the assumption that if rail were in operation on the same distance between the *ith* and *jth, w*hat then could be the transport spending of the identified agro-based industries?

Thus:

Rail freightage = rwd*ij* + (0.5%+VAT5%)

where,

r = rate/40 metric tonnes (₦4.7)

w = weight (40 metric tonnes)

d*ij* = distance between *ith* origin and *jth* destination (km).

Road freightage = rw

where,

r = rate/tonne

w = weight (20 metric tonnes)

Charts were used to depict the rail and road simulative/comparative analysis results between the *ith* and *jth*:

From figure 5 above, Funtua textile Ltd between year 2000 and 2007 paid out about ₦95,280,000 for transporting about 23,867 metric tonnes of cotton lint to UNTL Kaduna by road in the year 2000. If it were by rail line the factory would have spent ₦35, 224,000 in transporting the same commodity with similar weight and destination. This implies that a total slash of about 46% would have been realised. The reduction in the transport expenditure would have enormous impact in the years 2000 and 2004, when the factory produced about 4,533 and 4,475 metric tons of lint, respectively. In these years alone, 18.9% and 18.7%, respectively cut down could have been realised if the same commodity of similar weight had been transported by rail line.

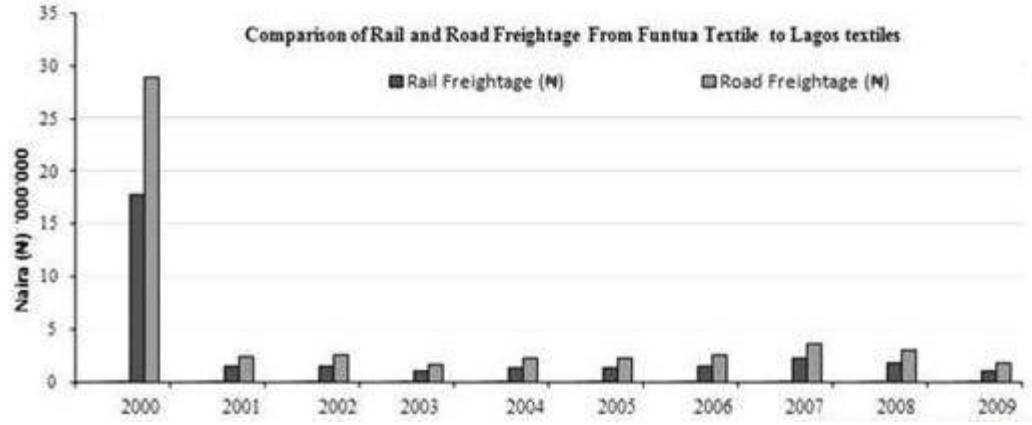

Figure 6: Cotton lint: Rail and road freightage
Source: Funtua Textile, Ltd

Similarly, between years 2000 and 2009, from the same Funtua textile factory, a total 29,472 metric tonnes of cotton lint was produced and transported to United textile (Lagos) by road. The total transportation cost was found to be ₦510,170,000. The results from the computed values of similar commodity and destination

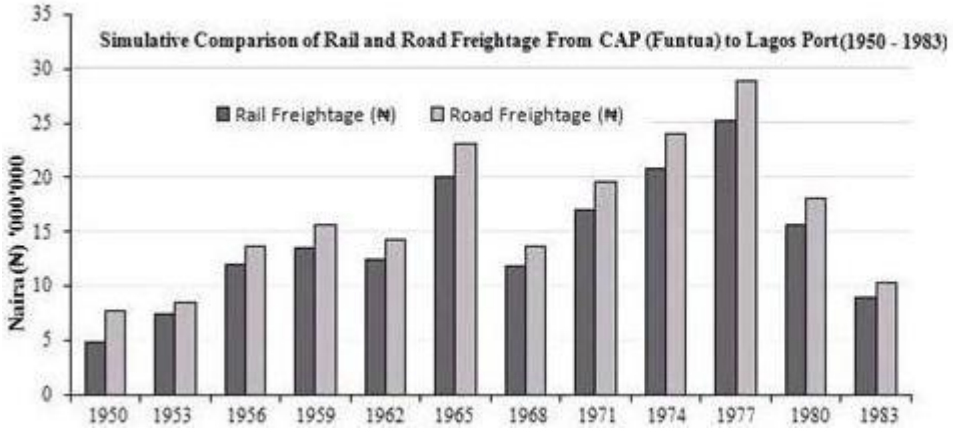

Figure 7: Cotton lint: Rail and road freightage
Source: Cotton & Agricultural Processors, Ltd

by rail line, revealed that ₦313,064,821 would have been spent, which is about 24% less of what has been spent by using truck. This is obvious especially in respect of the year 2000 with highest lint production, where about ₦289,340,000 was spent in transporting about 3,404 metric tonnes. If it were by rail line, about ₦177,730,669 would have been spent, which is about 23.8% less of what has been spent by road.

Lint production at CAP Ltd started production in 1929 and stopped operating in the early 1990s. The cotton lint production in metric tonne for 1950 to 1983 was subjected to computation according to the current transport truck charge rate (₦170,000/20 metric tonne); the freightage for both was collated. Figure 7 and table 2, show that the difference of rail-truck freightage (in Naira and percentage) was marginal, with insignificant difference.

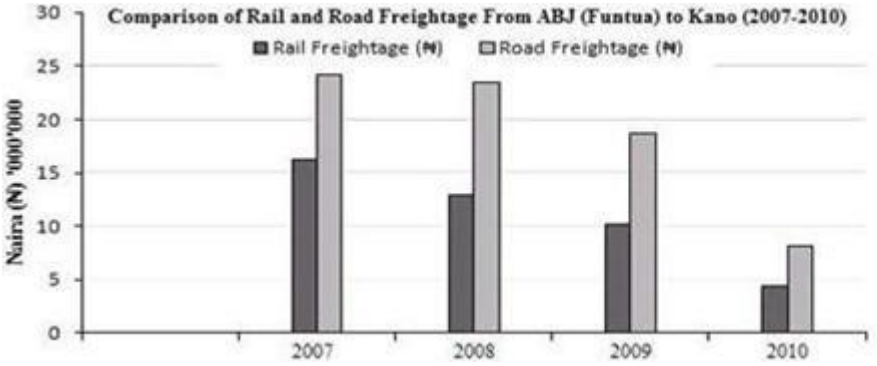

Figure 8: Cotton lint: Rail and road freightage
Source: ABJ Cotton & Oil mills, Ltd Funtua

A total amount of ₦74,366,000 was spent between 2007 and 2010 by the ABJ Ginnery and Oil mill agro-processing company in transporting its 29,590 metric tonnes of cotton lint to Kano textile. Figure 8 and Table 2 revealed that if it was by rail line, the company would have spent about ₦43,776,406 (37%) to transport same weight of commodity to Kano textiles for fabric production.

Table 2: Rail-road freightage difference of Agro-industry in Funtua region

	Freightage in Percentage (%)		
Agro-industry (*ith –jth*)	**Rail**	**Road**	**Difference**
Funtua textile – United textiles Lagos	38	62	24
Funtua textile – United textile Kaduna	27	73	46
CAP* – Lagos Port	46.2	53.7	7.5
ABJ – Kano textiles	37	63	26
Total	**148.2**	**251.7**	**103.5**

*Cotton & Agricultural Processors, Ltd
Source: Fieldwork, 2021

The difference of the rail-road freightage amongst the four agro-industries was observed in Funtua textile to United textile (Kaduna) with about 46% difference. It was moderate for Funtua textile to United textile (Lagos) and ABJ Ltd to Kano textiles with 24% and 26%, respectively. The difference was in the case of CAP Ltd to Lagos Port with 7.5%.

The study found out that the overall transport expenditure of all the combined agro-industry in the study region by rail and road was 148.2% and 251.7% while their corresponding averages amounted to 37% and 63%, respectively.

CONCLUSION AND RECOMMENDATIONS

As it is known in geography, the emphasis is commonly upon the study of industry in a region or area, rather than on the systematic study of a specific industry. For this reason, the manufacturing/processing industries in Funtua region of Katsina of Katsina state vis-à-vis the transportation network were studied. The use of GPS Device, GIS analysis and mapping

tools have established visual facts about the direct and relationship between the twenty identified manufacturing/processing industries and transportation network of Funtua region.

The proximity of the examined industries to the transportation networks in the study area conformed to Alfred Weber's theory of location of industries, the basis of which is the study of general regional factors that pull an industry towards different or specific geographical regions. In the case of the present work, it was the transportation costs that influenced the agro-based industries to be located at a proximal distance from roads and rail lines in Funtua. This is obvious in our case, for instance. All the identified industries were found to be within ≤30 m except four sophisticated agro-processing industries: ABJ ginnery and oil mills Ltd; CAP, Ltd; Funtua textile, Ltd and Sun Agro Products, Ltd.

In view of the slight slash of 26% rail freightage of the studied industries, the work hopes for the resuscitation of railway systems in Nigeria, so that the abandoned Container Freight Station (dry port) project in Funtua becomes a reality. This could diversify employment opportunities in the rural areas through the establishment of rural-based, small scale agricultural commodity processing industries, as one of the stated objectives of the 1988 Agricultural Policy for Nigeria document for agricultural commodity processing.

It is recommended that governments at all levels should show their earnest concern about maintenance and construction of roads and rail lines due to enormous advantages that they incur to economic activities: one, by connecting rural remote areas with urban centers there is going to be smooth flow of agricultural commodities to where they can be processed and marketed.
Secondly, the economy of transport activity can have direct effects to the availability of markets in which case it provides connections to large market outlets and saving time and money. Moreover, it as well creates multiplier effect when the price of goods or services increases with increase in diversification.

REFERENCES

Adamu, I.A. (1987) Socio-economic History of Funtua in the 20th Century. B.A Thesis, Bayero University Kano.

Adefila, J. O. (2014) Pattern of Agricultural Development in Southern Parts of Katsina State, Nigeria: Notion for Rational Planning. *IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS) e-ISSN: 2319-2380, p-ISSN: 2319-2372.Volume 7, Issue 1 PP 14-20.*

Adeniran, A.O. and Yusuf, T.B. (2016) Transportation and National Development: Emphasis to Nigeria.Developing Country Studies. ISSN 2224-607X (Paper) ISSN 2225-0565 (Online) Vol.6, No.9.

Beuthe, M., Jourquin, B., Geerts J. and Ndjang' Ha, C. (2001) Freight Transportation Demand Elasticities: A Geographic Multimodal Transportation Network Analysis. Transportation Research Part ELogistics and Transportation Review, doi: 253-266.

Bosede, A., Abalaba, B. and Afolabi, D. (2013) Transport Infrastructure Improvement and Economic Growth in Nigeria. *International Journal of Humanities and Social Science Invention I(Online): 2319 – 7722, ISSN (Print): 2319 – 7714 Volume 2 Issue 8, PP.26-31*

Boyce, R.R. (1974) The Bases of Economic Geography. Hold Rinehart & Winston, Inc. New York.

Candotti, M. (2009) Cotton Growing and Textile Production in Northern Nigeria from Caliphate to Protectorate c.1804-1914: A Preliminary Examination. *Paper for the African Economic History Workshop* – London School of Economics – May 2009.

Ceglie, G. and Dini, M. (1999) SME Cluster and Network Development in Developing Countries: the Experience of UNIDO. International Conference on Building a Modern and Effective Development Service Industry for Small Enterprises. Rio de Janeiro 2-5 March 1999.

Department for International Development-DFID (2005) Analysis of the Linkages Between Agriculture and Industry in Nigeria. Final Report Submitted to The Department for International Development (DFID).

Elaian, K. (1996) Employment Implications of Small-Scale Industries in Developing Countries: Evidence from Jordan". *Journal of Science, Technology and Development,* 14(1), pp. 80-101

FGN Official Gazette (2007) Inland Container Depots, ICDs and Container Flow Stations. **94** (30) Federal Government Printer, Lagos Nigeria.

Liu, N. and Zhou, Q. (2006) Quantitative Analysis of Effects of Transportation Infrastructure Investment on *Journal of Highway and Transportation Research and Development.* Available [Online] http:// en.cnki.com.cn/Journal_en/C-C034-GLJK-2006-05.htm.

Nistor, F. and Popa, C. C. (2014) The Role of Transport in Economic Development. "Mircea cel Batran" Naval Academy Scientific Bulletin, Volume XVII – 2014 – Issue 2 Published by "Mircea cel Batran" Naval Academy Press, Constanta, Romania.

Ogunleye, O.S. (*2013)* Towards Performance Measures of Transportation Networks in Nigeria: Lessons from the Developed Countries. *Kuwait Chapter of Arabian Journal of Business and Management Review Vol. 2, No.10.*

Oni, S.I and Okanla Won, K.R (2012) An Evaluation of Railway Infrastructural Development in Nigeria. A Paper Presented at 53rd Annual Conference Tagged LASU-EKO ANG 2011. Department of Geography and Planning, Faculty of Social Sciences, Lagos State.

Onokala, P. C. and Olajide, C.J. (2020) Problems and Challenges Facing the Nigerian Transportation System which Affect their Contribution to the Economic Country in the 21st century. Transportation Research Procedia 48 (2020) 2945–2962 2352-World Conference on Transport Research – WCTR 2019, Mumbai.

Onyemelukwe, J.O.C. and Filani, M.O. (1983) Economic Geography of West Africa. Longman Group Ltd, London.

Reid, D.J. (1968) The Theory of Industrial Location: Alfred Weber's Contribution Reappraised. An Extended Essay Submitted in Partial Fulfillment of the Requirements for the Degree of Maste of Arts in the Department of Economics and Commerce. Simon Fraser University.

Rephann, T. and Isserman, A. (1994) New Highways as Economic Development Tools: An Evaluatio using Quasi-experimental Matching Methods. *Regional Science and Urban Economics.* **24** (6). 723-751, doi:10.1016/0166-0462(94)90009-4.

Rietveld, P. (1994) Spatial Economic Impacts of Transport Infrastructure Supply. Transportation Research Part A: Policy and Practice. 28 (4) doi: 10.1016/0965-8564(94)90007-8. 329- 341.

Tariff No.11 (1997) Railway passengers and goods services. Railway Printers, Lagos.

Timmer, C.P. (2002) Agriculture and Economic Development. In Handbook of Agricultural Economics. Volume 2, Part A, 1487-1546.

Tukur, (2009) A history of Maska and Funua. *Alfikra* Publication Ventures, Kano Nigeria.