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ANALYZING THE EFFECTIVENESS OF GOVERNMENT MASS TRANSPORT FOR SECONDARY SCHOOLS IN AKURE, ONDO STATE, NIGERIA USING GIS TECHNIQUES

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Abstract: The problem of scheduling and routing school buses deals with the significant question of how to transport students to and from schools in the safest, most economical and most convenient manner. The existing routing pattern from the case study and from several reviewed literatures has shown that buses assigned to a particular route picks up students at designated bus stops along the route and only stop when they reach the final destination. This leads to creation of many routes, increase in the number of buses in use and several buses navigating the same route. More cost is incurred due to the manual routing method. Therefore, this paper aimed at analyzing the effectiveness of government mass transport for secondary schools in Akure, Ondo State, Nigeria with the objectives of Acquiring the attributes data from the Ministry of Transport through the use of questionnaire, obtaining of coordinate points of each bus-stops the school bus ply, acquiring of satellite imagery from Google Earth, creating a GIS based model of School Transport Management System will include: Bus stop allocations, Fastest and shortest route for the buses, maximum distance needs to trek to school and carrying out the spatial analysis. The scope adopted include: reconnaissance, obtaining data type and sources, data acquisition, data modelling and statistical analysis using descriptive model, data pre-processing and processing and production of results and analysis. This was successful with the use of software suitable for the applications involved in the processing, analysis(Arc GIS and SPSS)and presentation of information in form of map and plan.

Key Words: Transportation, Spatial data, Effectiveness, GIS, Public mass transit.

1.0 INTRODUCTION

Provision of adequate and equitable service for all groups is the essence of urban planning, while transportation is one of the most important elements of such service. Transportation is a process that involves the movement of commuters, goods and services from a given point of origin to a specific destination (Okoko, 2006). It determines the regional patterns of development, economic viability, environmental impacts, and maintenance of socially acceptable levels of quality of life. Public transport (also known as public transportation, public transit, or mass transit) is transport of passengers by group travel systems available for use by the general public, typically managed on a schedule, operated on established routes, and that charge a posted fee for each trip. Examples of public transport include city buses, trolleybuses, trams (or light rail) and passenger trains, rapid transit (metro/subway/underground, etc.) and ferries.

Spatial analysis is a type of geographical analysis which seeks to explain patterns of human behaviour and its spatial expression in terms of mathematics and geometry, that is, locational analysis. Examples include ***nearest neighbor analysis*** and ***Thiessen polygons*** (Wheeler, D.C. and A. Páez, 2010). **Spatial data** is largely comprised of data elements for which spatial or location coordinates exist, thus facilitating the development of spatial relationships across the elements that comprise the data set. Spatial data is critical to transportation planning and modelling because travel models are inherently concerned with analyzing behavioural phenomena that occur in space.

Geographic Information Systems (GIS) are software packages that allow the management, manipulation, editing, visualization, and analysis of spatial data. The spatial analysis technique using by Geographical information systems (GIS) plays a vital role in route optimization of government mass transportation for secondary schools in Akure.

Akure is one of the south western cities in Nigeria, West Africa. Students are transported to school through various means. Some students walk to school, some through public transports (taxi cabs/ motor cycles), or private cars. Majority of students make use of the free bus shuttle provided by the State Government as a means of transport to and from their schools. The free school bus shuttles in Akure, Ondo State, Nigeria are operational during week days. These buses pick up students in the morning at designated bus stops, while the students drop off at bus stops that are closest to their schools. In the afternoon, the students join the buses at the bus stops and drop off at bus stops closest to their homes. All buses are homogenous, that is they are of the same capacity. The buses can accommodate a maximum of one hundred (100) students.

This research aims at analysing the effectiveness of government mass transportation system for secondary schools in Akure using GIS techniques with the objectives of achieving the following:

i. To acquire the attributes data and to obtain coordinate points of each bus-stops.

ii. To create a GIS based model of School Transport Management System will include: Bus stop allocations, Fastest and Shortest route for the buses, maximum distance needs to trek to school.

iii. To carry out spatial analysis to determine the effectiveness of the government mass transport system for secondary students.

2.0 LITERATURE REVIEW / CONTEXT

Available literature was reviewed along subject matter of the research project, which are arterial road network and public mass transit; the central theme being road transport, accessibility and public mass transit.

1. The route network is a set of nodes representing spatial locations and displays topological and geometric variations, while topology itself refers to the arrangement and connectivity of nodes and links of a network (Lowe, 1998). The route network consists of primary and secondary roads known as arterial and minor roads respectively. White, (2002) opines that public transport is all modes of transportation available to the public irrespective of ownership. Mass transportation systems are varied, they are either land based (rail), road based mass transit system or water based. Transportation provides a very efficient means of moving large number of people with considerable flexibility in order to meet demand throughout the city (Armstrong-Wright, 1999). It plays a key role in shaping urban and rural landscape through its influences on the form and size of settlements, the style and pace of life by facilitating trade, permitting access to people and resources, and enabling greater economies of scale (Saranya and Selvakumar, 2013). Basorun, and Rotowa, (2012), investigate the public transport operations in Lagos Island sub-region of Lagos State to ascertain the level of performance. Their study adopts simple descriptive statistics such as frequency counts and percentages as well as a pair-wise association between the level of service of the private sector in public transport system and patronage by commuters through the use of the Pearson's Correlation test. Their study highlights the various modes of transport in Lagos Island LGA and their levels of operation. Their findings show the levels of satisfaction of commuters to the public transport services, traffic congestion is intense in the study area particularly during the peak periods and especially along major transport routes. Their result indicates that the role of the private sector in the public transport services associates highly 0.95% and policy measures are recommended based on their research findings.

Gabriel (2013), shows from his research that urbanization level in developing world indicates that more people live in urban area than in rural areas and this pattern induces pressure on traffic flow in urban areas in Nigeria. He explained further that, the situation has started to manifest in Akure, Ondo State capital; a medium urban centre in Nigeria. His research work investigated traffic congestion which has become a common sight in recent times in Akure, especially along Federal University of Technology Akure Road/Oja-Oba Road. His methodology adopted is used of a survey pattern which was conducted and entities influencing traffic congestions were identified and documented. Also, he collected data from both primary and secondary sources which were the analysed. He also makes use of camera to capture traffic-congested zones; information on traffic congested junctions; the roads and the land use areas; and traffic census for some selected road junctions in the study area. His study further suggested the use of a dynamic Traffic Information System (TIS) structure to monitor congestions in Akure city. Wong et al. (2014) looked at 14 studies that used GIS to measure aspects of the built environment that might correlate with active school transport. The studies looked at factors such as distance to school, density, diversity of land use, street design, connectivity, sidewalks, safety, workability, and demographic factors. However, the only factor that consistently showed a correlation with active school transportation was distance to school. Distance from school is clearly the major factor in determining whether or

not children can walk to school. However, for children who live close to school, aspects of the built environment may encourage or discourage walking. Twenty-five percent of children who live less than 0.5 miles from school do not walk and 50% of children who live less than a mile from school do not walk (McDonald et al. 2007).

3.0 STUDY AREA

2. The study area is located in Akure, Ondo state. Akure is a city in south-western Nigeria, and is the largest city and capital of Ondo State. The city had a population of 484,798 as at the 2006 population census. Akure lies about 7°25[1] north of the equator and 5°19[1] east of the Meridian. It is about 700 km Southwest of Abuja and 311 km north of Lagos State. Residential districts are of varying density, some area such as Arakale, Ayedun Quarters, Ijoka, and Oja-Oba consist of over 200 persons per hectare, while areas such as Ijapo Estate, Alagbaka Estate, Avenue and Idofin have between 60-100 people per hectare. The town is situated in the tropic rainforest zone in Nigeria (Wikipedia)

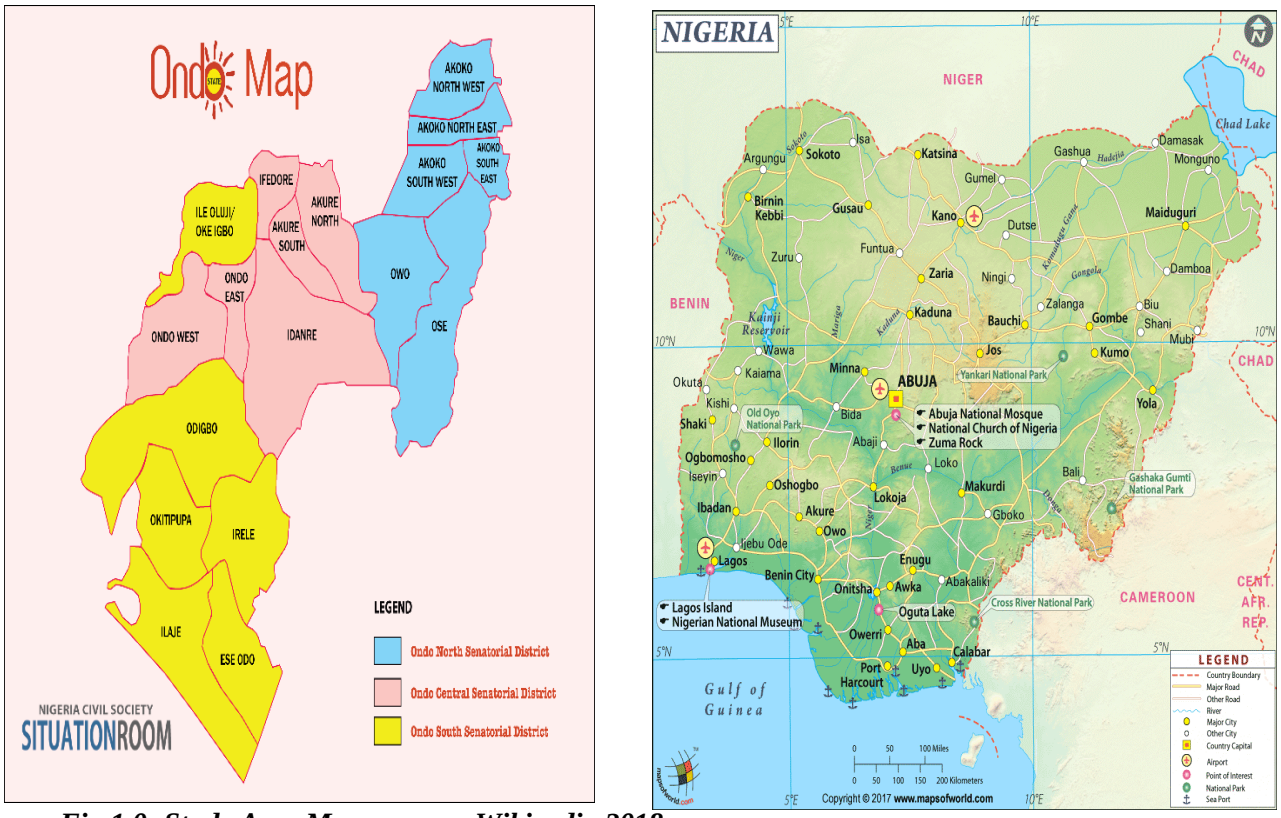

Fig 1.0: Study Area Map; source: Wikipedia 2018

4.0 MATERIALS, METHODS AND ANALYSIS

These are various methods and principles employed in executing this research work. This section describes the data types and sources, tools and procedures that were used in this research.

4.1 DATA ACQUISITION

4.1.1 Reconnaissance Survey

A reconnaissance survey of the study area (Arakale, Oja-oba, Araromi, Ijomu, Fiwasaye, Shagari village, Adofure, Adebowale, Agbogbo, Alakure, Old garage and St.Loius) was carried out. This enable us to have an idea or have a better view of the total size of the study area, the localities and number of public secondary schools within the area and other important information which was of use during the data collection phase. The two (2) phases of reconnaissance carried out are office planning and field reconnaissance.

4.1.2 Data type and Sources

i. Primary data and Sources:

- Google Earth Image of Akure Metropolis. This was obtained from Google Earth.
- Attribute data on the available number of vehicles available, the turns and routes they ply each day, average number of vehicles release per day, capacity of each buses, security for the students, maintenance of the vehicles etc. These was obtained by administering questionnaires from ministry of transport, Akure.

ii. Secondary Data and Sources:

- Geographic Coordinates of Public Secondary Schools using a handheld Global Positioning System (GPS).
- Geographic Coordinates of each of the bus-stops.

4.2 DATA COLLECTION

Both spatial and attributed data were collected for effectiveness analysis of the mass transport system for secondary schools in Akure.

4.3 DATA PROCESSING

This involves the processing of the acquired data obtained from the project site with the use of hand-held GPS as the instrument used.

5.0 PRESENTATION AND DISCUSSION/ANALYSIS OF RESULTS

5.1 Presentation of results

The results of this project are the coordinates of the secondary schools and bus-stops along the eight (8) routes which are (Adofure - Adebowale), (Ejioba – Futa junction), (Agbogbo – Adebowale), (Alakure – Mega school), (Araromi – Ijomu), (Ijoka – Fiwasaye), (Old Garage – St. Loius) and (Shagari village – Onigari) obtained using hand held GPS (Garmin III) with minimum accuracy of 3m. Also, results were obtained for the questionnaires administered to the students through the use of SPSS software.

Table 1.0: The result of the coordinates obtained for the bus-stop at the project site.

NAMES OF BUS-STOPS	EASTING	NORTHING
ADOFURE	738892	795752
AFUNBIOWU ESTATE 2A	739919	797048
AFUNBIOWU ESTATE 2B	739924	797133
AFUNBIOWU ESTATE A	740216	797871
ILUPEJU QUARTERS	740357	798079

Table 2.0: The result of the coordinates obtained for the schools from the project site

NAME OF SCHOOLS	EASTING	NORTHING
ECWA GROUP OF SCHOOLS	802374	744078
FIWASAYE GIRLS GRAMMAR SCHOOL	802887	744603
ST.FRANCIS ACADEMY IJAPO	803294	745144
ESTATE HIGH SCHOOL SHAGARI VILLAGE	805869	745129
MUSLIM HIGH SCHOOL	806473	742215
AKURE HIGH SCHOOL	804702	743657

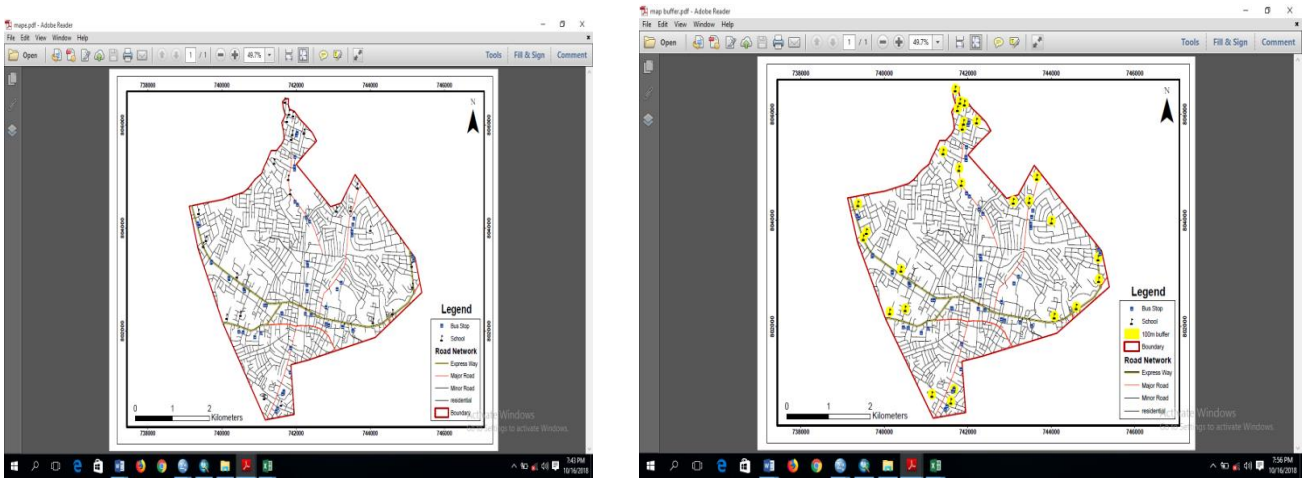

Fig. 2.0: Map showing the plotting of the coordinate points of schools, bus-stops on the ArcGIS and

Figure 3.0:Map showing the buffering points at 100m to determine the maximum distance to be trekked by the studentsfrom the Express way and the major road to their schools on the ArcGIS 10.2 environ.

Distance away from bus stop (in meter)	Walking Distance in minute	Number of School
0 – 200	0 - 2.4	6
200 – 400	2.4 - 4.8	13
400 – 800	4.8 - 9.6	8
800 - 1600	9.6 - 19.2	0

5.2 Analysis and Discussion of results

(a) the bus arrived very early in the morning and the afternoon for conveying of the students to schools and return them back to their various destination after school.

(b) the number of schools available is limited to the bus-stops available, which means that most students come to join the bus at the most used and popular bus-stops terminals and also nearer to their residence.

(c) for morning shift it occur between 7 - 8:30a.m, by this time the students will have being in their various schools and for afternoon shift, conveying of students occur between 2:00pm – 4:00pm, which means latest by 4:30pm to 5:00pm all the buses will have return to their terminals (garage) at the ministry of transport, Oyemekun Akure.

(d) there are lapses in respect to senior classes student due to the fact that their coaching classes start as early as 7am in the morning.

(e) the transport is not effective for the students who did not ply the major and express road network, which means all these students have to take private cab to their various destination.

(f) the students did not pay for the transportation service and did not registered for it.

(g) the bus conveys both the primary and secondary students which leads to overcrowding in the bus which is very detrimental to the student's health.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusion

Looking into the current trends in technology and the need for spatial information in digital format, the acquisition and management of effectiveness of transport system information is a basic necessity. The use of digital equipment and GIS application have become a germane and veritable tool that must be used by all and sundry if the needed highly accurate spatial information system must be provided for spatial decision making.

Furthermore, aim of analysing the effectiveness of the mass transport system for the study was achieved through the application of GIS techniques and analyses of data using SPSS software to the study area and the use of ArcGIS 10.2 software.

6.2 Recommendations

With utmost considerations of stages for the spatial analysis of the effectiveness of government mass transport for secondary schools in Akure, I hereby recommend the following;

i. There should be a routine and systematic documentation of all spatial database for all projects carried out by the students for future reference and usage.

ii. There should be continuous updating of the spatial data for better effectiveness in the government mass transportation system.

iii. The importance of spatial analysis of the effectiveness of government mass transportation should be made known to the general public for proper planning towards effective transportation system.

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