

Full Length Research Paper

Geospatial analysis of end-of-life/used Vehicle dumps in Africa; Nigeria case study

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Abstract

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Spatial interaction is the hub and wheel of any human society; and immobility in whatever form is the bane of individual poverty and national backwardness. However, the threats of energy shortage, climatic change and urban traffic gridlock globally has necessitated the crusade for biofuel series, sustainable transport system, green mobility and ITS among the nations of the world. Sub-Saharan countries among others are now the dumping ground for out-modelled automobiles that may have global consequences. This study uses ArcGIS 10.0 to analyse LandSat ETM+ imageries of four selected cities in examine the spatial implication of used and end-of-life vehicle trade in Africa with focus on Nigeria. The study reveals that in Abuja alone (Nigeria,), there are approximately 42 used vehicles dealers occupying about 0.19km² of the city total land area, in Kaduna there are seven (20) major vehicle dealers occupying about 0.32km² of land area, in Minna about 7 major dealers occupying about 0.14 km² and in Akure; with about 23 major dealers occupying about 0.21km². It is therefore recommended that enforceable rules regarding the differentiation between ELVs and used cars at EU level and other vehicle exporting countries should be enhanced. The Organization of Africa Unity (OAU) should as a matter of urgency redefine their policy on used vehicles importation and smugglers, while doggedly enhancing the pathway to home-built vehicles.

Keywords: Transportation, e-waste trade, End-of-Life Vehicle, GIS, Land use, Sustainable transport.

INTRODUCTION

Globally, Climate change is now a household term that dazzle the present generation and it calls for urgent solution due to its apparent incidences worldwide. Presently, about 15 percent of manmade carbon dioxide comes from cars, trucks, airplanes, ships and other vehicles. Research reveals that the major sources of transportation GHGs as at 2006 were passenger cars (34%) and light duty trucks, which include sport utility vehicles, pickup trucks, and minivans (28%). Together with motorcycles, these light-duty vehicles made up about 63% of transportation GHG emissions. The next largest sources were freight trucks (20%) and commercial aircraft (7%), along with other non-road sources (which combined, totalled about 7%) (USDoT, 2014, 2015). These figures include direct emissions

from fossil fuel combustion, as well as HFC emissions from mobile air conditioners and refrigerated transport allocated to these vehicle types. The remain GHGs comes from other modes of transportation, including freight trucks, commercial aircraft, ships, boats, and trains as well as pipelines and lubricants, (IPCC, 2007a,b). The transport sector of every economy generally depend on the combustion of fossil fuels that generates sulphuric, carbonic, and nitric acids, which fall to Earth as acid rain, impacting both natural areas and the built environment. In 2000, about 12,000 tonnes of thorium and 5,000 tonnes of uranium were released worldwide from burning coal (Karl et al, 2003), see Figure 1 for typical urban traffic scenes. Zachary (2010), reiterated the fact that global warming endangers human health, jeopardizes national security, and threatens other basic human needs. Some impacts—such as recorded high temperatures, rising seas, and severe flooding and droughts—are

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Figure 1: Typical Lagos and Abuja urban traffic scenes.

already increasingly common.

Literatures

Global response to the transport oriented climatic change, the challenge of Africa.

In response to GHGs challenges, global crusade on climate change and the need for smart city is on the increase. Intelligent Transport System (ITS) as one of the responses to energy crises and climate change refers to the application of communications and information technology to transport infrastructure and vehicles to improve the efficiency of transportation networks (John, 2001). One of the unique quality of ITS is its ability to address the basic movement needs of people in an urban environment as well as relating it to the resources which are consumed by transportation systems. ITS encompasses all of the applications of computers and telecom to road transportation by cars, buses, and trucks. The rapid development of new technologies and of innovation processes has resulted in a new city model (Smart City).

Smart city crusade

Conventionally, a Smart City has been defined as a city that uses information and communications technology to make its critical infrastructure, its components and utilities more interactive, efficient, making citizens more aware of them. In a broader definition, a city can be considered as "smart" when its investment in human and social capital and in communications infrastructure actively promote sustainable economic development and a high quality of life, including the wise

management of natural resources through participatory government (Giffinger et al, 2007 and UCLG, 2012). The new model cities promote innovation and knowledge management, bringing together 6 key fields of performance (*i.e. the economy, mobility, the environment, citizenship, quality of life and, finally, management*).

The technological advancement in the transport sector has introduced more environmental friendly vehicles and less stressful like the autonomous vehicle, hence the de-registration of old model ones and their shipment to other less developed countries of the world. Sub-Saharan Africa countries appear to be handicapped economically hence their over dependent on the importation of out modelled used cars popularly called "Tokunbo" and even End of Life Vehicles (ELVs) (Myrsini et al, 2007). Although Nigeria is said to be one of the largest growing ICT economy, the level of her ITS and e-governance is still very poor when compared to Cities like Dubai that is on the move.

Legal and illegal Vehicle importation into Africa (Nigeria)

Generally now, there is a paradigm shift in the scope and definition of waste trade as revealed in the trading between African countries and the technologically advanced industrialized world. The trend has gradually shifted from industrial waste to the environmentally challenging end-of-life refrigerators, air conditioners and finally to End-of-Life Vehicles (ELVs), (Myrsini et al, 2007). The Port of Antwerp is said to be the dominant Belgian port and an important gateway for trade with West Africa offering high capacities for both containers and car loading. Antwerp terminals also handle used cars in containers originating from the USA and



Figure 2: Arrays of cars at Benin and Togo sea
Source: After Sophie Ribstein and Jason Boswell (2014)

destined for Africa. Belgian customs authorities assume that 90% of illegal waste shipments are conducted by co-loading electronic waste (e-waste) into used cars, (Öko, 2010).

In hunger for information technology and motorized transport system but with limited capacity to manufacture them, Africa has become the world's latest destination for obsolete electronic and vehicles. Much of these materials are more or less provided in good faith by well-meaning donors, but the brokers who arrange these exports often pad shipping containers with useless junk, essentially saddling African importers with electronic garbage of which the country has little or no capacity to recycle, (Agbo, 2011). In 2002, the Basel Action Network (BAN), a Seattle-based environmental group, made headlines with its investigation of e-waste exports to Asia (see "e-Junk Explosion," *EHP* 110:A188–A194 (2002)), and more recently, BAN explored Africa's e-waste problem, and described its findings in an October 2005 report titled *The Digital Dump: Exporting Re-use and Abuse to Africa*.

When it comes to the importation of vehicles into West Africa, and particularly Nigeria, illegal importation through porous Nigeria border dominate the legal ones. Stephen (2012) asserts that smuggling is pervasive in Africa and that the most pronounced version of this is the development of 'entrepôt states' in West Africa notably Benin, Togo and The Gambia. These countries serve as duct for both legal transits to landlocked countries (Mali, Niger and Burkina Faso) and illegal trade to more protectionist neighbouring countries like Senegal and Nigeria (World Bank, 2009, 2010). In Benin, goods declared for domestic use are quite often smuggled to Nigeria, because Nigerian protection is so

high that it is still lucrative to smuggle even after paying import duties in Benin and Togo (World Bank, 2009, 2010). See Figure 2 for the arrays of cars at Benin and Togo sea ports awaiting both legal and illegal movement to other West African countries. Deloitte (2016) estimates that in the three African countries under review (Ethiopia, Kenya, Nigeria) at least 8 out of 10 imported vehicles are used vehicles.

Shipment of end-of-life vehicles

The European Environment Agency estimated the number of end-of-life vehicles arising in the EU-25 to be about 14 million in 2010, compared to 12.7 million in 2005. This is a number that differs significantly from the 6.2 million end-of-life vehicles in 2008 as published by Eurostat and based on data reported by 24 Member States. A certain number of de-registered passenger vehicles are commercially exported as second-hand cars, (EU Policy on ELV, 2010). According to the COMEXT database, the official European Foreign Trade Statistics, about 893,000 used cars were exported out of the EU by Member States in 2008, (see Figure 3 for the export routes), (IMPEL 2006). The question then is 'when does a used car ceases to be product and becomes waste' according to the Waste Framework Directive (2008/98/EC) is answered differently across EU Member States, (Azam., 2007; Berg, 1985)),

Nigeria's trade policies

West African countries receive the highest ELVs/used



Figure 3: Known and Suspected Routes of e-waste, used cars and ELVs
Source: COMEXT database (IMPEL 2006)

Table 1. Destinations of exported used cars in Africa

Destination	Units
Eastern Africa	11,203
Middle Africa	86,561
Northern Africa	12,694
Southern Africa	816
Western Africa	186,960
Total	298,234

Source: COMEXT database (IMPEL 2006)

vehicles destined for African countries as in Table 1 compared to that of South African. The complexity in the ELVs/used vehicles trade is largely caused by socioeconomic circumstances that foster trade with some element of illegality as captured the EU Implementation and Enforcement of Environmental Laws reports (IMPEL 2006). Among the West African countries, Nigeria is the major final destination of the imported vehicles both legal and illegal. Despite long-standing ECOWAS plans for a customs union, little progress has been made, largely because of Nigeria's unwillingness to participate. According to Kumolu (2013) and Chibuike (2015), the prohibition of the importation of some categories of cars that came through the National Automotive Policy (NAP), is aimed at reducing the huge amount expended annually on importation of cars. It was perhaps against this backdrop that Nigerian engineers, who were at the Shell Eco-Marathon in Rotterdam, Netherlands unveiled plans to design, build and test ultra-energy-efficient and environment-friendly vehicles by 2014. The project is being supported by

Shell Petroleum Development Company, SPDC, on behalf of Shell Companies in Nigeria. Nigeria has relatively developed but often inefficient manufacturing and agricultural industries, with powerful interest groups favouring protection.

Aim of study

This study is aimed at examining the spatial implication of these ELVs on the land use/land cover of some selected cities in Nigeria as a major importer of those vehicles and possibility of boomeranging globally.

Objectives

- i. Assess the various governmental planning policies evolved in responding to the global environmental challenges,
- ii. Examine the trend of ELVs/used vehicles

- importation into Sub-Saharan African countries,
- iii. Identify and map the spatial distribution of the major vehicle dealers across the study areas.
 - iv. Analyse the spatial implication on the general land use budgeting and the attendant socio-economic challenges for the region

METHODOLOGICAL APPROACH

The study area

Nigeria is located in Western Africa on the Gulf of Guinea and has a total area of 923,768 km² (356,669 mi²), making it the world's 32nd-largest country (after Tanzania). It is comparable in size to Venezuela, and is about twice the size of California. It shares a 4047 km border with other countries (Benin, 773 km; Niger, 1497 km; Chad, 87 km; Cameroon, 1690 km), and has a coastline of at least 853 km ([Encyclopædia Britannica](#)). This study is designed to cover six major state Urban capitals from north to south of the country to capture possible geopolitical or socio-cultural environment that may influence the patronage of car market as follows:

- Kaduna was founded by the British colonialist in 1913 and became the capital of Nigeria's former Northern Region in 1917 and retained this status until 1967. Kaduna is an industrial centre of Northern Nigeria, manufacturing products like textiles, machinery, steel, aluminium, petroleum products and bearings. The Population figure as at 2006 is 760,084 with area coverage of about 46,053 km². As a nodal city, the city also derived her initial growth from the development of the Lagos-Kaduna and the Port Harcourt – Enugu rail lines in the 1990s ([Encyclopædia Britannica](#)).
- Minna, the capital of Niger State derived her initial growth and importance from the development of the Lagos-Kaduna rail line in the 1990s and the creation of the Federal Capital Territory. Geographically, the town lies between latitude 9° 38' - 9° 45' N and Longitude 6° 33' - 6° 39' East, a total land area of 6,784 km² and is about 140 km away from Abuja the Federal Capital Territory (FCT) in the middle belt of Nigeria. In 1991 census figure, it was 143,896 people but in 2012, it was estimated at 291,930 people. Minna is the home town of two former Nigeria heads of state (Gen. Ibrahim B. Babangida and Gen. Abdulsalam Abubakar).
- Abuja, the capital city of Nigeria is located in the centre of the country, within the Federal Capital Territory (FCT). As a planned city, it officially became Nigeria's capital on 12 December 1991, replacing Lagos which is similar to Brazil building its capital Brasília. At the 2006 census, the city of Abuja had a population of 776,298 and estimated land area of 713 km². Some areas around Abuja have been reported to have been

growing at about 20 – 30% ([Encyclopædia Britannica](#)).

- Akure is a city in South-Western Nigeria and is the capital city of Ondo State, which is one of the thirty six states of Nigeria. While the 1991 census put the population of Akure at 324,000, the population of the city is projected to be about 1.8 million people in 2015 which is not unconnected to the impact of industrial growth with landed area of 41.2 km². The city has been classified as a Millennium Development City. Also the *Homo/sapiens* fossil ever found in West Africa thus far was discovered there, dating back to around 11,000 years ago, ([Encyclopædia Britannica](#)); Oriye and Fakere, 2015).

MATERIAL AND METHOD

This Study uses both direct field survey and secondary data that address the research subject area. For the field survey, Garmin 78 GPS model was used to determine the coordinate location and area coverage of the vehicle dealers in all the cities selected. Interview on National Automotive Council of Nigeria and vehicle dealers was also conducted to ascertain their mode of operation and selection of sites. Landsat MSS Enhanced Thematic Mapper (ETM+) imagery of Kaduna Minna, Abuja and Akure were acquired and used for the study. The imageries were subjected to image enhancement processing to improve the identification of the dealers distribution, while the individual area coverage of car dumps and dealers were calculated using the on-screen area computation menu in ArcGIS 10.0 software.

The total land coverage and distribution of vehicle dealers' spots within the selected cities were computed as a percentage of the entire land area that is highly competitive, particularly in Abuja. The secondary data on vehicular exportation, importation and re-exportation including smuggling activities were acquired from the Nigeria Custom Service website, EU trade online publication and periodicals. Other relevant information was derived from journals and books.

Data analysis

In Kaduna, the total developed urban area is about 614.77 km² of which used (Tokunbo) vehicle dealers occupied about 0.32 km² of the land area. This is apart from the ELVs and private car junks at mechanic workshops and other institution open yards. The major dealers are along Ahmadu Bello Way, Constitution Road, Zaria Road, and Station Road as indicated in table 2 and mapped in Figure 4. This is not unconnected to the fact that in the northern part of Nigeria, ownership of private cars is a symbol of wealth and arrival into the middle or upper socio-economic status of life. Political

Table 2. GIS attribute data location of major used vehicle dealers in Kaduna

Vehicle Sales Outlet						
OID	x	y	location	area	Shape *	
0	329350.1	1170513.17	Mando Park	65368.26	Point	
1	330226.11	1170435.99	Zaria Park	38776.75	Point	
2	329875.87	1169999.95	Zaria Park	15347.93	Point	
3	329726.11	1167337.72	Amadu bello way	16672.09	Point	
4	327905.71	1164081.99	Leventis Area	22811.23	Point	
5	328112.37	1163577.42	Yakubu Gowon road	7841.19	Point	
6	327643.1	1155961.02	Sarki Pawa road	40863.97	Point	
7	327000.02	1158293.89	Dasuki Avenue area	111397.84	Point	

Source: Generated from the field survey.

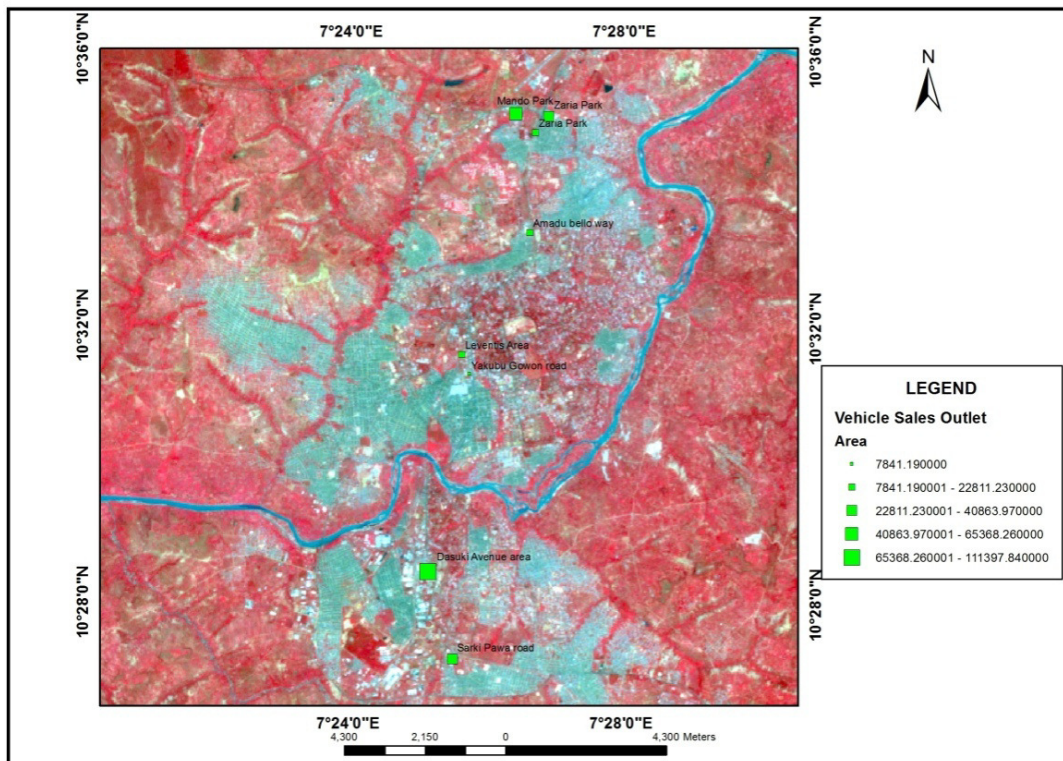


Figure 4: Spatial distribution of major used vehicle dealers in Kaduna.

office holders without personal house can afford to assemble three to four cars in rented houses. At Minna in the middle belt of Nigeria, there are about seven (7) major vehicle dealers as indicated in Table 3. They are occupying about 0.14 km² of land while other motor mechanic junk shops cover about 2.15 km² in the town, see Figure 5 for their distribution. This is apart from the ELVs and private car junks at mechanic workshops and other institution car junks open yards. The

unfortunate thing is that these junks of ELVs are the abode of criminals and dangerous reptiles, and virtually all private and public structures are landscaped with one or more ELVs in the city. Abuja the Federal Capital City of Nigeria is the home of who-is-who in the country and the converging point of the affluent in the country. After Lagos, Abuja is the most concentrated city with used high class vehicles and dealers. Although they are very few within the

Table 3. GIS attribute data location of major used vehicle dealers in Minna.

Vehicle Sales Outlet						
OID	x	y	location	area	Shape *	
0	230316.76	1067850	Gwari motors	40000.1	Point	
1	230283.36	1066258.37	TeeJay motors	6000.26	Point	
2	230081.24	1066616.68	Yasidac motors	5000.11	Point	
3	232687.04	1061005.49	Mustapha motors	5000.01	Point	
4	233074.24	1093809.69	Ok motors	6000.21	Point	
5	232717.63	1059896.92	Western bypass	34000.28	Point	
6	232638.91	1059981.69	City motors	26000.21	Point	
7	230053.8	1060877.94	Western bypass 1	15000.14	Point	

Source: Generated from the field survey.

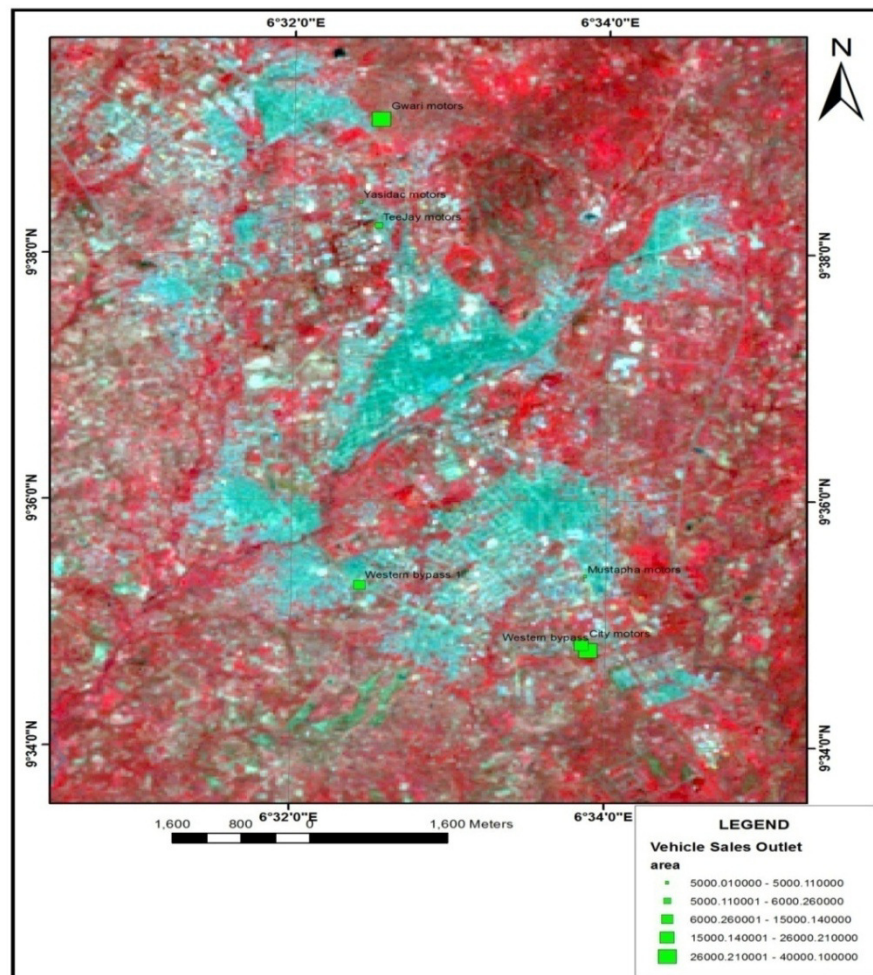


Figure 5: Spatial distributions of major used vehicle dealers in Minna.

central area, they landscape the major expressways into the city, particularly along Kubwa expressway as

reveal in Figure 6. There are about 42 dealer locations with approximate total area coverage of 761.01 km²,

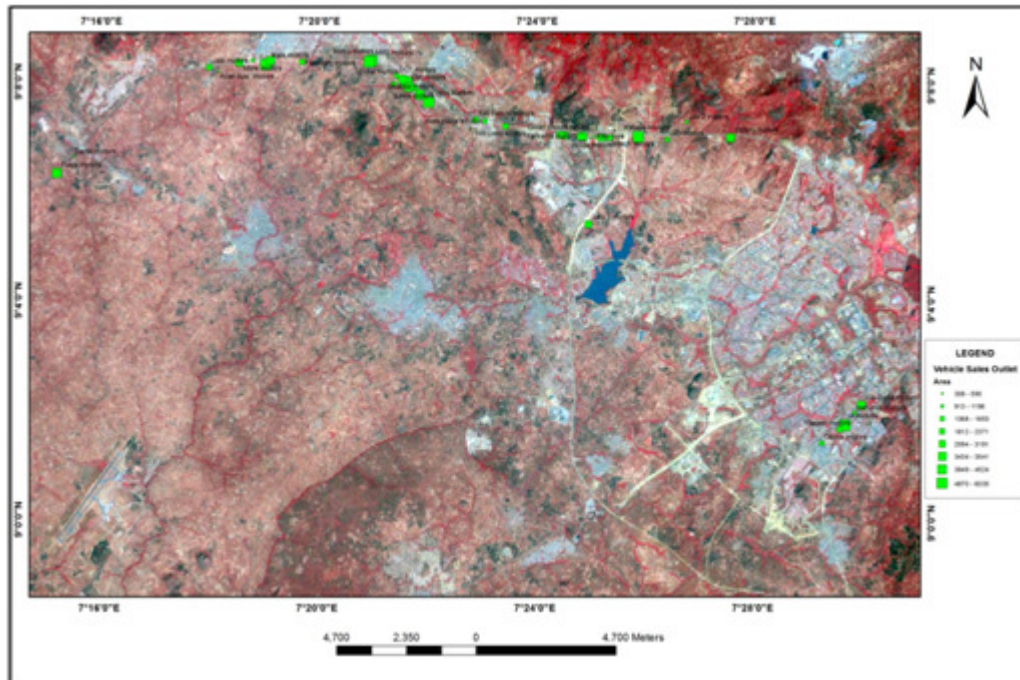


Figure 6: Spatial distribution of major used vehicle dealers in Abuja.

Vehicle Sales Outlet						
	x	y	name	location	area	Shape *
▶	73878	80571	Rad Automobiles	CLUB 20 Bus Stop	500	Point
	73895	80527	Cleaners Automobile	Josat	300	Point
	73899	80514	Ayo Automobiles	Council B/stop	10000	Point
	73012	80473	Ade Motors	beside Super Hotel	400	Point
	73928	80425	Lambert Automobile Plaza	<Null>	10000	Point
	73939	80396	Elizade Autoland	Opposite Ilesha garage	490	Point
	73953	80361	Akinleye Martins Street	<Null>	250	Point
	73958	80349	OBC Motors	Lafe b/stop	250	Point
	73972	80331	Akure depot	<Null>	6000	Point
	74007	80320	Ayus hotel	Oyemekun road	200	Point
	73996	80313	Leo hospital junction	Oyemekun road	1800	Point
	74007	80307	KIA Motors	Fanbi Junction	2100	Point
	74014	80303	Biya Motors	Champion junction road	1500	Point
	74076	80270	Ayus Motors	<Null>	5000	Point
	74076	80296	Covenant Motors	Duduyemi Bus Stop	150	Point
	74098	80257	A.A. Motors	<Null>	2500	Point
	73883	80617	J.J. Kuteyi Motors	<Null>	500	Point
	73983	80576	Auto Mart	Ilesha-Owo Express road	16000	Point
	74518	80291	Fiwasaye junction	behind Mobil	1620	Point
	74140	80053	Fadaka junction	<Null>	1040	Point
	74054	80205	Thomas cemetery Junction	<Null>	630	Point
	74060	80242	Behind St. Louis	<Null>	2160	Point
	74179	80136	Odole	<Null>	1008	Point

Source: Generated from the field survey.

which is about 0.19 km² of the entire city land area, see table 4. This is apart from the ELVs and private car

junks at mechanic workshops at the outskirts of the city and organization yard; virtually all private and public

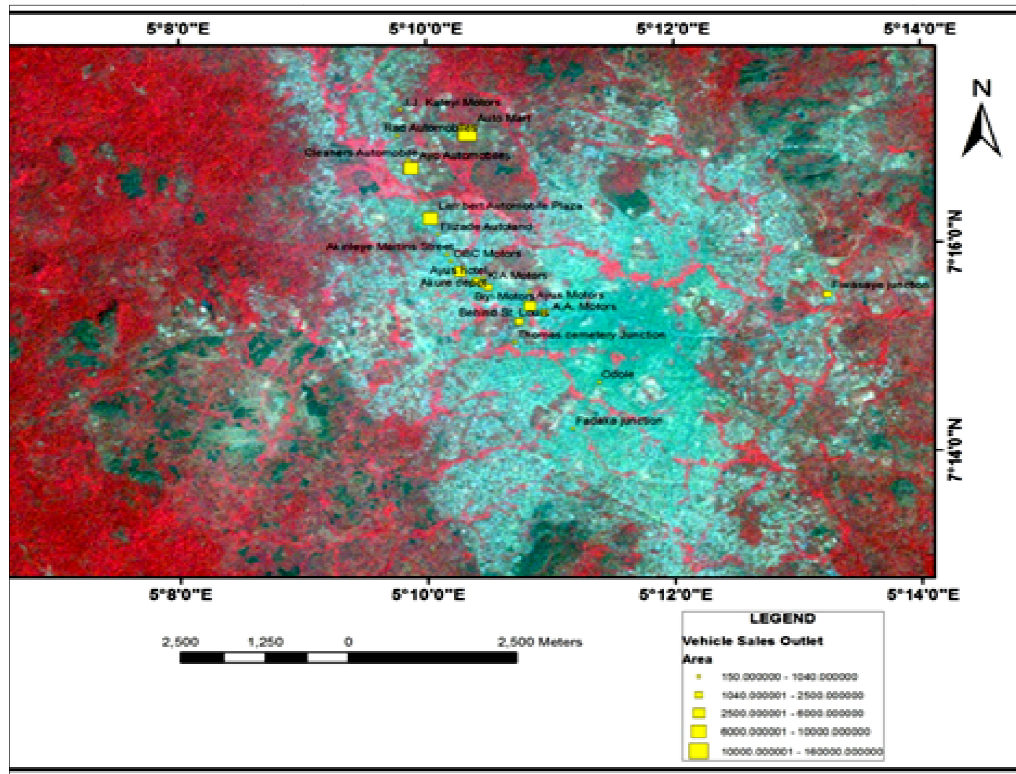


Figure 7. Spatial distribution of major used vehicle dealers in Akure.

structures are landscaped with one or more ELVs in the city.

Akure the capital city of Ondo State in the southwest of Nigeria is also dotted with about 23 major used vehicle dealers that occupy a total area of about 522.34 km² which is about 0.21km² of the total city land area as displayed in table 4 and in Figure 7.

RESULTS AND DISCUSSION

Urban dynamism and gentrification as it affect spatial land use allocation by the market forces is anti-sustainable city development as it is in most Nigerian urban centres. Used vehicle dealers are now occupying most urban open spaces and reserved areas for the display of their wares. Abuja, the Federal Capital City of Nigeria as a planned city is now becoming a replica of old Lagos city in term of traffic congestion and clusters of ELVs junks in any available spaces. This may not be unconnected to the absence of functional BRT system in the city. As a city of the affluent people, most of the vehicle dealers have their branches scattered all over without recourse to city zoning ordinances and other environmental implications.

The analysis that may readily come to mind is; if on the average, each cities in Nigeria losses about 0.315

km² to car junks apart from cars on the road that will eventually be parked and area occupied by garages and other parking lots, the 36 states and Abuja will have donated about 11.655 km² of land to used cars in 2015. Although the import statistics for used vehicles is a bit fuzzy, it is very obvious 2/3 of all imported vehicles in Nigeria are used vehicles. For instance, according to Udodiong (2016) quoting the Director-General of National Automotive Council: "About 50,000 new and 150,000 used vehicles are imported into the country yearly. Nigerians spend an average of N550 billion on importing passenger-cars and by the time you add trucks and other vehicles, the amount Nigerians spend on imported vehicles will be running into N600 billion annually)For instance, in a desperate move to keep afloat, the management of the only surviving automobile assembly plant in the country, Peugeot Automobile Nigeria (PAN), has unveiled plans to embark on massive importation of used cars into the country. In fact according to PAN, "If ownership of used cars (Tokunbo cars) is the problem of Nigerians, we have plans to bring what we call certified second hand vehicles. It is good as it is done globally and not the road-side Tokunbo market that we have where you do not have the history of the vehicle". The fact is that Sub-Saharan countries and Nigeria in particular are sick of used automobiles and must be healed if the desire to

have home-built vehicles will see the light of the day as advocated for by researchers like Adedeji (2015), and Black, A., and McLennan, T. (2015).

CONCLUSION AND RECOMMENDATIONS

This study has succeeded in analysing and making lucid to the Africa policy makers and global sustainable city crusaders the land lose to the continuing shipping of used vehicles and ELVs to African countries with Nigeria in focus. This will also arouse African countries on the need to as a matter of urgency spur up African engineers to design, build and test ultra-energy-efficient and environment-friendly vehicles in order to realize the continent's home-built vehicle dream

The way forward

Ban on used vehicles that is aimed at reducing the huge amount expended annually should be Africa-wide and doggedly implemented urgently to redress the trade deficit that is skyrocketing. African governments should as matter of urgency place capital punishment on vehicle smugglers across their border. This will enhance the present effort of South Africa automation of border surveillance.

Binding rules regarding the differentiation between ELVs and used cars at EU level and other vehicle exporting countries would facilitate effective action against illegal shipments of ELVs. There is a need for intensification of global thorough inspections of vehicles within and out of the EU and other vehicle exporting countries to reduce illegal shipments of used vehicles and ELVs.

Measures which make the disposal of ELVs in the country of deregistration strenuous should be made more attractive and also improve de-pollution of ELVs.

The industrialized developed countries should face the challenge of upgrading those useable deregistered vehicles; while at the same time pay the price fully of recycling those ELVs in a more environmentally friendly way as against what is obtainable in African with informal recycling activities that may boomerang globally (Climate change).

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