

ANALYSIS OF THE DISTRIBUTION PATTERN OF PETROL FILLING STATIONS AND ITS IMPLICATIONS IN KADUNA METROPOLIS, KADUNA STATE, NIGERIA

BY

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ABSTRACT

The present location of petrol filling stations in towns and cities of Nigeria hardly reflects the approved criteria for their location, thereby posing environmental problems. This study therefore analyzed the distribution pattern of petrol filling stations and its implications in Kaduna Metropolis. The list of petrol filling stations was collected from the Department Petroleum Resource [DPR]. Field survey was also carried out through which the geographic coordinates of petrol filling stations were captured using Global Positioning System receiver. Convenience sampling method was used to administer 400 copies of questionnaire to the respondents eliciting information on the implication of the location of petrol filling stations. Data were analyzed using overlay in ArcGIS 10.2 environment to determine the distribution of petrol filling stations while weighted mean scores was used to analyze the perceived implications of petrol filling station location. The findings revealed that there were 225 petrol filling stations and 69% were owned by independent marketers. About 76% of the filling stations were located along major roads in Kaduna Metropolis. The findings further revealed that traffic congestion due to queues at filling stations and air pollution with mean scores of 2.67 and 2.65 respectively were the most perceived implications of petrol filling station's location. The study therefore concludes that the distribution of petrol filling stations was uneven and has implications to the residents living within the environs. It is recommended that the government should enforce the relocation of petrol stations that were sited within residential areas which did not satisfy the DPR standards.

Key words: Distribution, Implications, Kaduna metropolis, Petrol filling stations.

INTRODUCTION

Petrol filling station is termed differently in different countries of the world which are "petrol station", "fueling station", or "service station". Nieminen (2005) defined petrol filling station as an area including fuel equipment and piping, storage tanks, forecourt and possible building premises for the sale of fuel (inflammable liquids) to customers (Hanekom, 2001; Genovese, 2004). Similarly, Ayodele (2011) viewed filling station, petrol station, gas station or petroleum outlet as any land, building or equipment used for the sale or dispensing of petrol or oil for motor vehicles or incidental thereto and includes the whole of the land, building or equipment whether or not the use as a petrol station is the predominant use or is only a part thereof. Most filling stations sell petrol or diesel; some carry specialty fuels such as liquefied petroleum gas, natural

gas, hydrogen, biodiesel or kerosene while the rest add shops to their primary business (Hamid et al., 2009).

According to Oetomo and Sesulihatien (2012) some of the variables considered when selecting location for any utility petrol filling station include: proximity to population centers, distance from neighbouring petrol filling stations, the easements of using existing utility, and the magnitudes of environmental pollution parameters. Mshelia, John and Emmanuel (2015) asserted that in locating petrol filling station, it is important to take some precautionary measures like locating them at a required distance from buildings; places of public assembly such as markets, hospitals and schools and areas of high traffic congestions and residential buildings. Therefore, the location of petrol filling station deserves adequate planning guidance and adherence to the locational guidelines because of its significance to the health and safety of the people and hence, the Department of Petroleum Resources (DPR) is the agency saddled with the responsibility in Nigeria.

Isabel et al. (2010) stated that filling stations were traditionally located in largely uninhabited areas. However, the present situation proves to be different since many filling stations are being built within urban areas surrounded by residential and public buildings. This trend has been observed regardless of the dangers and implications associated with filling stations. Filling stations come up in newly developed areas only when development reaches a point at which business potential of the areas can be assessed.

There are quite a number of empirical studies that have been carried out on the location of filling stations in Nigerian urban centres. Mohammed (2014) studied the location of petrol filling stations in Kano Metropolis and revealed that there were about two hundred and fourteen (214) petrol filling stations of which 69% were owned by the independent marketers. Also found was that most (96%) of the petrol stations satisfied the minimum set back of 15 metres distance from the road but did not meet the minimum distance of 400 metres away from one petrol station to another on the same road. Similarly, the spatial distribution of filling stations in Kaduna metropolis as studied by Sule et al. (2006) showed that there are 193 filling stations, and that independent marketers (68%) dominate the business. The study of Ayodele (2011) showed the uneven distribution of petrol filling stations mostly along major roads in Kaduna North Local Government Area (LGA).

However, a significant correlation between the number of filling stations and the road hierarchy was established by Tah (2017) in Kaduna metropolis. The study further revealed that 86% and 84% of the petrol filling stations did not meet the minimum distance of 100 metres from the healthcare facilities and 400 metres to other stations located on same road side respectively. Although, Tah (2017) analyzed the distribution of petrol filling stations in Kaduna metropolis and their compliance to DPR standards, but it failed to analyze the implications of the distribution of petrol filling station as perceived by the residents within petrol filling stations location.

Samuel, Ogoro and Amanoritsewo (2015) asserted that the proliferation of petrol service stations is a trend in most of our urban areas. The increased use of automobiles, generators and other petroleum demanding plants in a city like Kaduna metropolis has exacerbated increased demand for petroleum products. This has led to the proliferation of petrol filling stations with less consideration of its locational implications. However it is noticeable that despite the availability

of standards regulating the location of petrol filling stations in Kaduna Metropolis, most petrol filling stations are still located in a manner that is chaotic and poses some implications among the residents within the petrol filling stations location. This is so because it is relatively common to see petrol filling stations located within residential areas. The potential implications of the location of these petrol filling stations have raised concern in recent times. Thus, it is imperative to analyze the spatial distribution of petrol filling stations and its perceived implications in Kaduna metropolis which is the thrust of this study. The objective of the study was to analyze the distribution and perceived implications of petrol filling stations in Kaduna metropolis.

THE STUDY AREA

Kaduna metropolis is located between Latitudes 10°26'-10°38'N of the Equator and Longitudes 7°22'-7°32'E of the Greenwich Meridian (Figure 1). It comprises of four LGAs namely; Kaduna North, Kaduna South, part of Igabi, and Chikun.

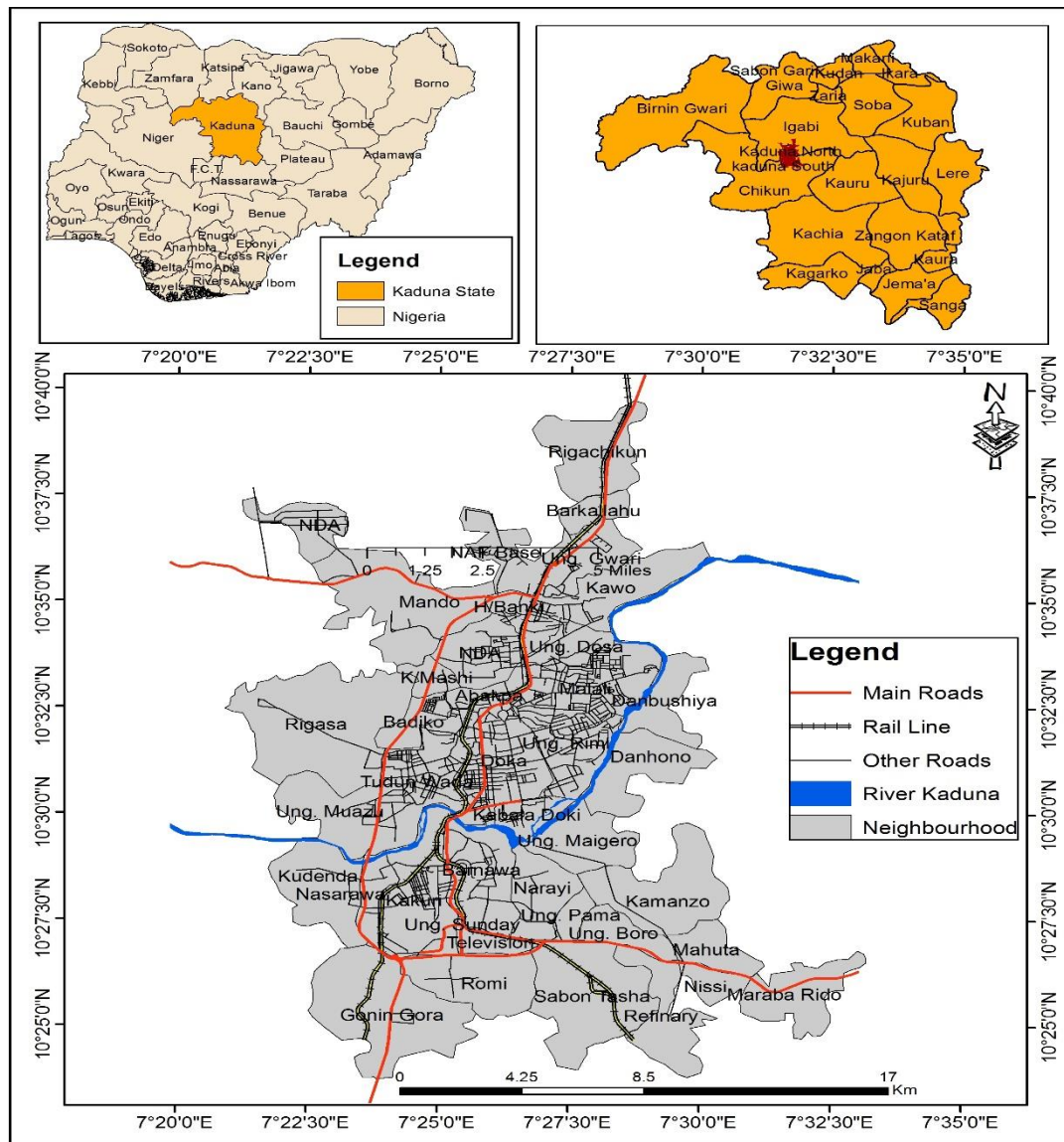


Figure 1: Kaduna Metropolis

Source: Google Map, 2018

According to Ayoade (1988), Kaduna state has a tropical continental climate characterized by wet and dry season. The tropical continental is more pronounced in the dry season, particularly in December and January. The dry season is dominated by the north-east trade wind, called Harmattan which prevails between November-February. The wet season is dominated by the southwest trade wind, which starts around May to October. The area has a mean daily temperature showing a major peak in April. The maximum temperature seldom falls from about 36°C as in April to about 27°C in the heart of rain season (August-October). The annual rainfall is about 1000mm (Ayoade, 1988). The population of Kaduna state is at 1,570,331 as of the 2006 Nigerian census (National Population Commission [NPC], 2009).

MATERIALS AND METHOD

The list of petrol filling stations as at year 2018 was obtained from the records of DPR, Kaduna State. The absolute geographical locations of the petrol filling stations were acquired using a handheld Global Positioning System (GPS) receiver. The geographic coordinates of the petrol filling stations were imported into ArcGIS 10.2 environment which was overlaid on the road network shapefile of Kaduna metropolis obtained from Open Street Map. This was used to create map showing the distribution of the petrol filling stations. The 2006 population figures of the twenty-seven neighbourhoods that made up Kaduna metropolis were projected to the year 2018 which stood at 1,833,427. Using the projected population size as the study population, Yamane (1967) formula was used to calculate 400 respondents as the sample size.

Convenience non-probability sampling method was used to administer 400 copies of questionnaire to the adult members of the neighbourhood where petrol filling stations were located at household level. The questionnaire elicited residents' responses on perceived implications of petrol filling stations distribution. This was collected on three point Likert scale rating. The weighted mean scores and ranking in descending order was used to analyze the data and presented using table.

RESULTS AND DISCUSSION

Distribution of Petrol Filling Stations by Neighbourhoods

Table 1 show that there were 225 petrol filling station distributed across the various neighbourhoods in Kaduna metropolis. This is inconsistent with the finding of Tah (2017) which revealed that there were 228 petrol filling stations in Kaduna metropolis. The graphical representation is as shown in Figure 2.

Table 1: Distribution of Petrol Filling Stations According to the Neighbourhoods

Neighbourhood	No. of PFS	Percentage
Abakpa	3	1.3
Badiko	11	4.9
Barnawa	9	4.0
Doka	15	6.7
Gonin Gora	13	5.8
Hayin Banki	6	2.7
Kabala Doki	1	0.4
Kakuri	10	4.4
Kawo	2	0.9
Kudenda	5	2.2
Kurmin Mashi	8	3.6
Mahuta	2	0.9
Malali	1	0.4
Mando	24	10.7
Maraba Rido	13	5.8
NAF Base	5	2.2
Narayi	2	0.9
Nassarawa	6	2.7
Nissi	3	1.3
Refinery	1	0.4
Rigachukun	12	5.3
Rigasa	7	3.1
Romi	4	1.8
Sabon Tasha	4	1.8
Television	10	4.4
Tudu Wada	26	11.6
Unguwar Boro	8	3.6
Unguwar Gwari	1	0.4
Unguwar Muazu	8	3.6
Unguwar Rimi	1	0.4
Unguwar Sunday	4	1.8
Total	225	100

Source: Field Survey, 2018

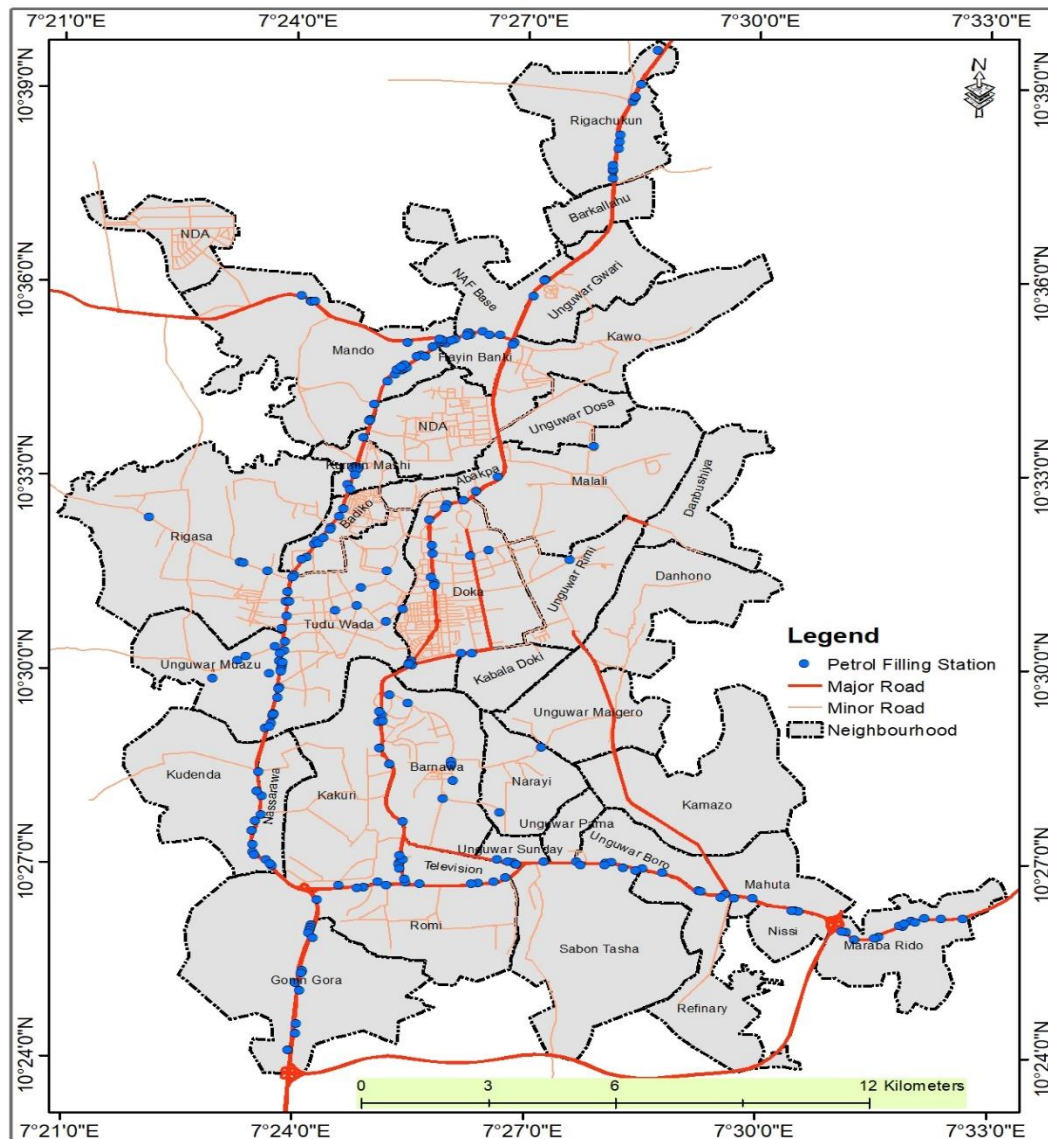


Figure 2: Distribution of Petrol Filling Stations by Neighbourhoods

Source: Field Survey, 2018

The variation could be attributed to non-operation status of a few petrol filling stations during the field survey. The distribution according to the neighbourhoods showed that Tudun Wada (11.6%), followed by Mando (10.7%), and Doka (6.7%) have the high distribution of the petrol filling stations in Kaduna Metropolis. This result is expected because these neighbourhoods serve as entry and exit points into the Kaduna Metropolis and most petrol filling stations are situated along exit road. That most car drivers fuel their vehicle when moving out of the city could be the possible explanation for the location of most petrol filling stations along exit roads in the study area. Also, the fast growing population and the increased car ownership as well as other fuel consuming machines like generators, due to unreliable power supply, have made demand for petrol products high, which has in turn triggered the proliferation of petrol filling stations. The least number of petrol filling stations were located in Kabala Doki, Malali, Refinery, Unguwar Gwari, Unguwar Rimi with 0.4% each. This implies that motorists and

residents within these neighbourhoods are expected to be the least served with petroleum products in Kaduna metropolis.

Distribution of Petrol Filling Stations by Road Type

Table 2 reveals that about 76% of the petrol filling stations in the study area were located along the major roads, whereas the minor road accounted for only 24.5% of the petrol filling stations.

Table 2: Distribution of the Petrol Filling Stations by Road Type

Road Type	Number of PFS	Percentage
Minor Roads	55	24.5
Major Roads	170	75.5
Total	225	100

Source: Field Survey, 2018

This finding corroborates with Mohammed (2014) in Kano metropolis which revealed that 78% of the filling stations were along major roads. Also, Ogunyemi et al. (2017) found that most of the petrol service stations in Ado-Odo Ota Local Government Area of Ogun State were located along the major roads that pass through the centre of Atan Ota, Iyana Ota, Onipanu Ota, Ojuore Junction, Lagos-Abeokuta highway. Easy access that these major roads provide and handling of higher vehicle traffic might be the possible explanation to most petrol filling stations situated along major roads. This is an indication that road classification is a crucial determinant in the location of petrol filling station in the study area.

Distribution of Petrol Filling Stations by the Operators

Table 3 reveals that about 69% of the petrol filling stations were owned and operated by independent marketers, while 24.9% were owned and operated by major marketers. Figure 3 illustrates the distribution of petrol filling stations by the operators.

Table 3: Distribution of Petrol Filling Stations by Operators

Operator	Number of PFS	Percentage
Independent Marketers	156	69.4
Major Marketers	56	24.9
NNPC	13	5.7
Total	225	100

Source: Field Survey, 2018

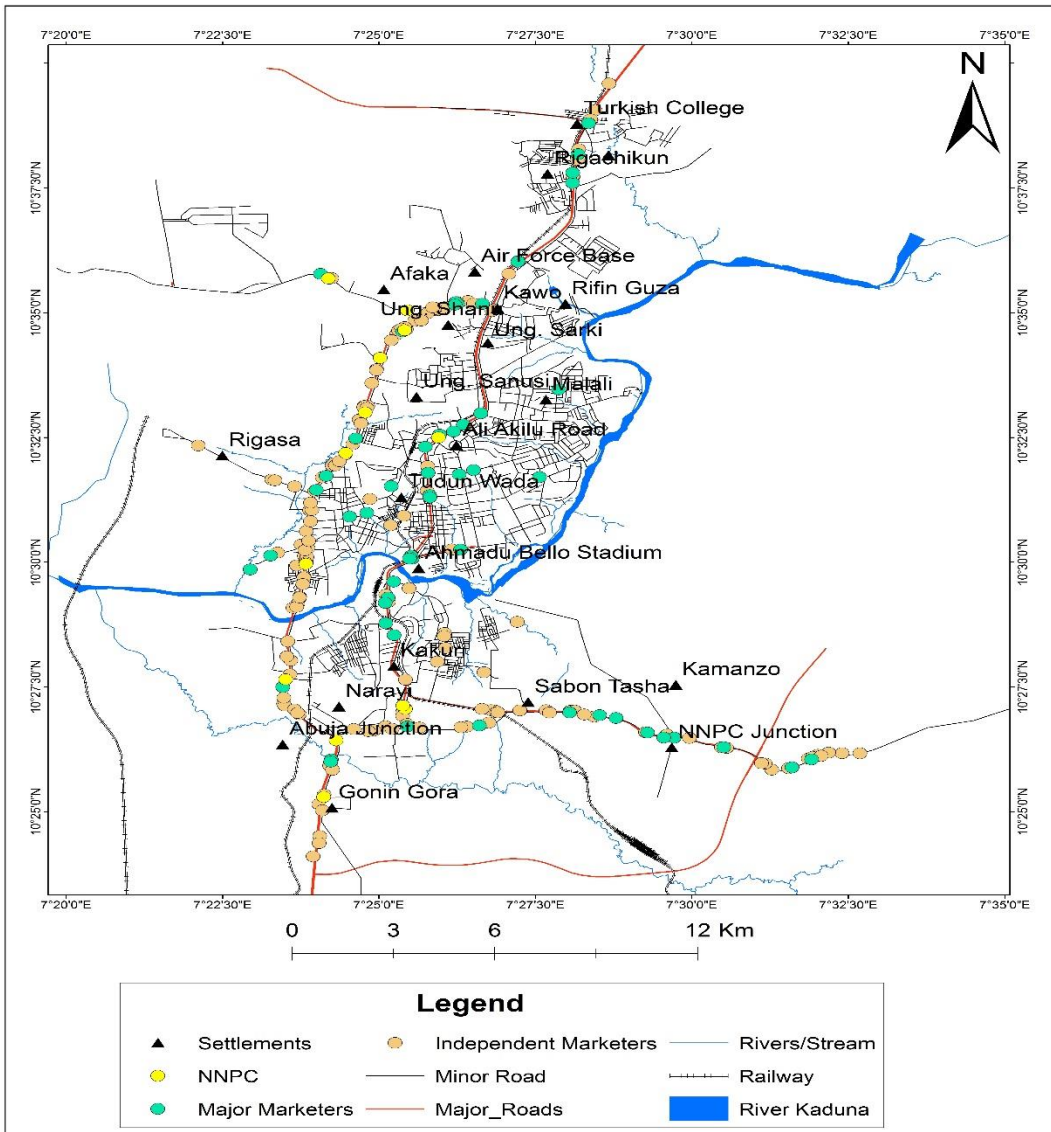


Figure 3: Distribution of Petrol Filling Stations by Operators in Kaduna Metropolis
Source: Field Survey, 2018

The high proportion of independent marketers owned and operated petrol filling stations in Kaduna Metropolis is expected to improve distribution efficiency of petroleum products. Although, it is claimed that the problem facing effective distribution of petroleum products stem from unpatriotic behaviour of some independent marketers through diversion of the product, as a result not making the product readily available. This result agrees with the findings of Mohammed, Musa and Jeb (2014) which revealed that 69% of petrol filling stations were owned by independent marketers, while 26% owned by major marketers. Also, Oloko-oba et al. (2016) found that in Ilorin, Kwara State, 16% of the petrol filling stations were owned by major marketers, 81.8% by independent marketers while 2.2% owned by Nigerian National Petroleum Corporation (NNPC).

On the other hand, NNPC representing the least which accounted for only 5.7% of the total ownership of petrol filling stations in Kaduna metropolis. Undoubtedly, this indicates the

participation of a state-owned oil company in oil retail sales management. This has ensured thorough re-distribution of petroleum products via its Mega or Micro petrol filling stations nationwide. This has made NNPC a major player in both the upstream and downstream sectors of the Nigerian oil and gas industry.

Perceived Implications of Distribution of Petrol Filling Stations in Kaduna Metropolis

Table 4 indicated that traffic congestion due to queues at filling stations with mean score of 2.67, air pollution (2.65) and exposure to fire disasters (2.60) were the main perceived implications of petrol filling stations distribution. This implies that the closer the petrol station is to residential areas; the more likely the residents will be affected by the traffic congestion. The vehicles queuing to take fuel usually cause obstructions and other related hazards to the nearby houses such as accident especially as vehicles rush to queue. Again, the experience of air pollution in relation to the distance between the petrol stations and the residential areas is expected given that the closer the houses are the more likely the residents will be exposed to air pollution as a result of fumes from vehicles move in and out of petrol stations to take fuel.

This finding is in agreement with Samuel (2011) that identified traffic congestion, pollution and fire outbreaks as the consequent of petrol filling stations' location. Also, Isabel, Graciela and Monica (2010) stated that the disadvantage of petrol filling stations located very close to residential areas is air pollution caused by the continued emissions that originate from gasoline delivery to the stations, tank breathing which occurs due to temperature and pressure changes, and during vehicle refuelling.

Table 4: Perceived Implication of Petrol Filling Stations Distribution in Kaduna Metropolis

Implication	Mean Score	Std. Deviation	Ranking
Traffic congestion due to queues in filling station	2.67	.659	1
Air pollution	2.65	.618	2
Exposure to fire disasters	2.60	.662	3
More sales for petty businesses	2.57	.716	4
Easy access to means of transportation	2.57	.688	4
Increased traffic volume at road intersections	2.55	.663	6
Offers better business/job opportunities	2.53	.711	7
Occurrence of road traffic accidents	2.45	.728	8
High incidence of fire outbreak	2.36	.739	9
Increased neighbour ambient noise	2.33	.786	10
Reduce open space	2.27	.768	11
Exposure to high dose of fuel vapour	2.27	.817	11
Poor neighbourhood aesthetics value	2.19	.699	13
High crime rate	2.07	.702	14
Soil pollution due to oil spillages/leakages	2.07	.800	14

Source: Field Survey, 2018

Traffic congestion is a common feature at petrol stations situated especially close to each other, near a market place or next to road intersections or junctions. This is an indication that the petrol filling stations distribution in Kaduna Metropolis has perceived negative implication. This corroborates Ogundahunsi's (2014) finding that 78% of the respondents agreed that the observed

concentration of fuel stations had dire consequences for the residents of the city in Ilesa, Osun State.

Despite the negative implication associated with petrol filling stations distribution, a few positive implications were identified by the respondents which include more sales for petty businesses and easy access to means of transportation with a mean score of 2.57 each among others. It could be deduced that small scale business owners often take the advantage of petrol filling station being high attractors of both human and vehicular traffic to establish their businesses such as snack and soft drinks which motorists patronize while queuing to purchase petroleum products. Arguably, the situation of petrol filling station contributes to the locale economy of an area. However, high crime rate and soil pollution due to oil spillages/leakages with mean score of 2.07 each are the least perceived implications of petrol filling stations distribution in Kaduna Metropolis.

CONCLUSION

The location of petrol filling station, despite its importance to the economy, among other things is expected to be guided by a definite environmental law. The study has shown the uneven spatial distribution of petrol filling stations in Kaduna metropolis. It was common to see petrol filling station within the residential neighbourhood. From the results of the study, it can be concluded that distribution pattern of petrol filling stations in Kaduna Metropolis has both negative and positive implications especially among the residents within petrol filling station area. It is recommended that the government should enforce the relocation of petrol stations that were sited within residential areas which did not satisfy the DPR standards.

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