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Locational Characteristics and Fire Prevention Mechanisms of Petrol Stations in Ogbomoso, Oyo State, Nigeria

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ABSTRACT: *Continuous increase in the number of petrol filling stations across major cities in Nigeria is becoming more worrisome. In the past, petrol stations in Nigeria were usually located along major roads where residential developments are sparsely distributed. Sadly, there is proliferation of petrol filling stations within residential areas exposing large number of residents to grievous loss of not just properties, but human lives. The regulatory agencies of government in Nigeria responsible for the approval and administration of petrol stations seem overwhelmed and ineffective. This study examines the locational attributes and distribution of petrol filling stations in Ogbomoso Township using nearest neighbor analysis. The result reveals that petrol filling stations are not evenly distributed, but clustered together thereby poses a serious threat to the members of the public. The study concludes by calling on all the regulatory agencies relevant to the development of petrol filling station to vehemently enforce their laws on the existing petrol stations and government at all levels to review various laws relating to the establishment and operation of petrol filling stations in the country in order to protect lives and properties*.

KEYWORDS: siting, fire, petrol, station, distribution, residents**,** Nigeria

INTRODUCTION

Petrol station is referred to differently by several nations based on their peculiarities. Ayodele (2011), in attempt to define it considers the different expressions as 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. Similarly, Nieminen (2005) sees petrol station as an area including fuel equipment and piping, storage tanks, forecourt and possible building premises for the sale of fuel (inflammable liquids) to customer's vehicles. Petroleum is a major essential commodity that drives both micro and macro economy in Nigeria. Adeniran *et al* (2017) posit that Premium Motor Spirit (PMS) also known as petrol is the second most used product after food in Nigeria. National Bureau of Statistics (2008) avers that petroleum accounts for as high as 78 percent of gross domestic product and up to 90 percent of the country's total annual revenue and

foreign exchange earnings. There is unprecedented high demand of petroleum products in Nigeria due to the increase in the usage of automobiles. This is not unconnected to population increase, especially in almost all the urban centers in Nigeria. High demand of petroleum products is a resultant effect of the mobility nature of man.

Proliferation and indiscriminate siting of petrol stations in Nigeria can never be divorced from the increasing level of urbanization and erratic power supply in the country. As many cities in Nigeria are becoming more congested with continuous competing uses of scarce land, many locations for residential developments are being converted to petrol stations, not only in Nigeria, but many African countries. In the same vein, Arokoyu *et al*., (2015) opines that high land demand results to land scramble and illegal conversion of land uses, leading to leap frog development and the deliberate location of petrol filling stations in unsuitable areas that are highly vulnerable to hazards. In a study in Zambia by Taylor *et al.,* (2016), it was affirmed that the nation is sitting on a keg of gunpowder when it comes to the evaluation of the siting of petrol stations and their level of preparedness in the case of fire hazards. The conclusion of Taylor et al., (2016) is even more applicable to the case of Nigeria. There is no gainsaying in the fact that petrol stations are located along almost every tarred road in most of the urban centers in Nigeria, irrespective of the dominant land use thereof. Regards for planning standards and the regulations of Department of Petroleum Resources (DPR) in the locational attributes and necessary measures to combat incidence of fire outbreak are seriously compromised.

Report from WHO (2004) indicates that over 2.3 million lives and properties worth more than 4.5 billion dollars are lost to fire outbreaks resulting from the mishandling of petroleum products yearly in Africa. It is pertinent to note that most of the petrol stations in Nigeria do not have personnel trained to combat fire outbreak at the petrol stations. There is no overstatement in the fact that fire extinguishers in some of the petrol stations are either expired or dried off. Similarly, hundreds of petrol stations in Nigeria are without necessary approvals, as their locations failed to satisfy required space standard. This assertion is not in contrary to the opinion of Afolabi *et al*., (2011), that a number of filling stations in Nigeria lack the requisite safety measures (fire standards, layout, location and waste management) for obtaining operational licenses from the regulatory bodies. Also, Ayodele (2011) opines that poor siting of petrol filling stations' culminate in traffic congestion, pollution, and fire hazards, Based on this premise, this study examines locational attributes of petrol stations in Ogbomoso Township and their level of preparedness in the case of fire incidence.

Study Area

Ogbomoso lies on latitude 8°10'North of the equator and longitude 4°10' East of the Greenwich Meridian within the derived savannah region of Nigeria. By location, the city serves as the gateway to the Northern part of Nigeria from the South. The city has Oyo town to its southwest, Ilorin to its North, while Iwo and Ede lie to the Southern and Eastern sides respectively. Ogbomoso remains the second largest city in Oyo state after Ibadan and it is located on the high way connecting the North and South of Nigeria on the west flank. Its development started from the traditional core

where the central mosque, market, iron works and other traditional informal activities are put together with residences to form an activity nucleus or traditional Central Business District (CBD) around the King's palace from where development radiates outwards especially in line with the direction of road development.

The City is blessed with two (2) Local Government Areas which are Ogbomoso North Local Government Area with its headquarters at Kinnira and Ogbomoso South Local Government Area with its headquarters at Arowomole. This study was conducted in Ogbomosho North Local Government Area being the most urbanized part of the Ogbomosho Township with the higher spatial distribution of petrol filling stations. It is the largest local government in the city being the city's major economic nerve with a population of 198,859 (NPC, 2006). Among other infrastructures and facilities in the study area, a top notch university (LAUTECH), teaching hospital (LTH), private college of education and the Oba's palace are located within Ogbomoso North Local Government Area. This implies that the local government contains both elements of advanced urban development as well as the relics of the historic past in the core areas.

The presence of a first class university in the study area plays a significant role in the spike of automobile usage, as tens of thousands of students, staff and other persons connected to the university need to move a longer distance on daily basis, as the institution has no provision for accommodation facilities, for either students or staff. The electricity supply in the study area is highly erratic and this also necessitates the need for thousands of the residents to be running on generators daily. Therefore, as automobiles and generators largely depend on petrol to function, then, it is not shocking to witness a proliferation of petrol filling stations in the study area, but it is a shock to see them sited in locations that are highly unexpected and risky to human lives.

LITERATURE REVIEW

The term location is used to identify a point or an area on the surface of the earth or elsewhere, which may be through the use of absolute or relative terms. Location is believed to be relative when it is described in relation to other point or area, while absolute when a specific pair of latitude and longitude in a Cartesian coordinate grid is used for the description of such location (Mohammed *et al.*, 2014). Selecting a better site or location for a business is at the mind of every government and entrepreneur who invests capital to earn profit. Factors to take into account when making a decision about the location of a business or service includes proximity to customers, transportation, the neighborhood, finances and the long term future of the business or service being set up (Oetomo and Sulihatien, 2012; Mohammed *et al.*, 2014). However, the locational impact of some land uses, businesses or enterprise can be detrimental to the people and the environment around it. Location consideration is germane to the success of any enterprise. From the assumptions of Alfred Weber in his Industrial Location Theory in the late 18th century, two decisions are either made on where to locate an industry or enterprise, either to locate it close to the raw materials or close to the market or consumers. Petrol filling stations in Nigeria are fast coming closer to the consumers by competing with the residential use.

The fuel sold at filling stations include Petrol (Premium Motor Spirit [PMS]), Liquefied Natural Gas (LNG), Diesel (Automated Gas Oil [AGO]), Kerosene (Dual Purpose Kerosene [DPK]) etc. A Petrol filling station, also known around the world as a fuelling or gas station (United States and Canada), gasoline stand or Service Station (Japan), petrol pump or petrol bunk (India), petrol station (Australia, Hong Kong, South Africa, United Kingdom), service station (Australia, France, Japan, New Zealand and United Kingdom) or fuel station (Israel) and filling station (Nigeria) is defined as a facility that sells fuel and engine lubricants for motor uses (Mshelia *et al.*, 2015). Filling stations are a major feature in societies around the world especially in urban areas. They are mostly located along roads where there is traffic flow with some facilities having stalls built into them (Ayodele, 2011). They come in all manner of types and sizes, from well-known multinationals, to little known local service providers, but all serve the same purpose (Karanja and Gatithu, 2018). The petroleum industry in Nigeria is divided into two main segments, the upstream and the downstream sectors (Akinsulire and Fadare, 2020). The upstream refers to activities such as exploration, production, and delivery to an export terminal of crude oil or gas. The downstream on the other hand encompasses activities like loading of crude oil at the terminal, transportation, supply, trading, refining distribution, and marketing of petroleum. Activities of filling stations or petroleum outlets across the country are part of the downstream sector (Akinsulire and Fadare, 2020).

It is worthy of note that the first places to sell petrol in the world were pharmacy stores. The first Petrol station in the world is believed to be the City Pharmacy in Wiesloch, Germany in 1888 (Daniel, 1979). However, the world first purpose built petrol station was constructed in 1907 by Standard Oil of California (now Chevron) in Seattle Washington. However, it was about 50 years after the first petrol station was constructed in California before Nigeria recorded the very first petrol station in 1956, constructed by Total in Lagos, Nigeria. Thereafter the number multiplied to other regions of the country. The increase in the number of filling stations in an area could be an indication of a booming economy. However, the observed proliferation and indiscriminate location of these facilities especially in developing and under developed societies around the world is worrisome. The reasons for this development are not far-fetched. Mohammed *et al* (2014), attributes this development to be a result of urban growth and the increase in the number of cars and other automobiles that generate various demand including fuels. In Nigeria, the pathetic state of the power sector has further heightened the demand for filling stations as majority of people provide their own power through the use of generating sets which run on fuel (Olapeju, 2017). In view of this development, many marketers and filling station developers take advantage of this demand and build stations haphazardly without giving considerations to the possible effects of the location of these stations.

Petrol stations pose a risk to the health and safety of the people and the environment in which they exist. Similarly, asides the fact that their presence can cause constant traffic, vapor emission, pollution of the air among others, Sangotola *et al* (2015) note that petrol stations majorly pose a risk of fire outbreak or disaster due to the products they sell. These products contain volatile organic compound like benzene which is flammable and can give off vapor when ignited even at

low temperatures. These products can also float in water and may travel long distances eventually causing danger away from the place where they have escaped (Afolabi *et al*, 2011). Although in developing countries such as Nigeria, records of occupational health and safety deficiencies are barely kept (Mirza *et al*, 2012); the World Health Organization (WHO, 2004) noted that more than 2.3 million lives and properties worth more than 4.5 billion dollars are lost to fire outbreaks associated with petroleum mishandling in African countries (Oyeniyi, 2017).

The location, development and operation of filling stations are expected to be guided by defined environmental rules. In Nigeria, the agencies saddled with the task of upholding the conformity of these facilities to the laid down rules include the Department of Petroleum Resources (DPR), the respective Physical Planning Authority of each State in the Country and the Federal Fire service. However, with the proliferation of these facilities observed around urban centers in the Country, one begins to questions if the guidelines put in place by these agencies are being adhered to. Similarly, Afolabi et al., (2011) are of the opinion that filling stations are being located too close to one another and in residential areas, as against the guidelines from the Department of Petroleum Resources (DPR) that such facilities should be developed in either commercial or industrial zones. The major problem in Nigeria is the lack of master plans to guide developments in majority of the urban centers, where there will be various zones allocated for different homogenous or complementing developments.

Studies and reports have revealed the proliferation and arbitrary siting of Petrol filling stations, and its implications on the safety and health of urban dwellers with most facilities flouting the regulations put in place by the Planning authority and the Department of petroleum resources (Ogundahunsi, 2014). Several reasons for these actions cited including the need by Petrol filling station owners and operators to access a larger customer base, broader profit margin and faster rate of turnover (Mohammed *et al*., 2014 and Yunusa, 2017). As the demand for petroleum products continue to spike in Nigeria, the tendency for this trend to continue is very high. According to the Department of Petroleum Resources (DPR), the guidelines for setting up a filling station include:

i. Three (3) copies of approved plan showing the building existing or proposed on the site and the relation to the roadways and adjoining properties.
ii. A certificate signed by the Chief Federal/ State Fire Officer, or by an officer authorized in that behalf, that the arrangements proposed for the prevention of fire at the site are satisfactory.
iii. A certification by the Area/Town Planning Authority for the construction of a Petrol Filling Station on the proposed site.
iv. A certificate signed by the divisional police Officer or a superior police officer in-charge of the police motor traffic that he is satisfied that the site and layout of the proposed filling station do not constitute an unnecessary traffic hazard.
v. Evidence that company applying is duly registered as a limited liability company by the appropriate Federal Ministry/Corporate Affairs Commission to deal in petroleum products.
vi. Tax receipt and/or tax clearance certificate for the preceding 3years.

vii. Land should be zoned for commercial/industrial use or be designated specifically for the purpose in a subdivision.
viii. The parcel of land should not be less than 33 x 33 square meters or equivalent of two plots of land that allows for the free flow of traffic
ix. A petrol filling station should be sited 400 meters away from the next petrol station.
x. A petrol station should be sited 50 meters away in all angles of the build-up areas to create a buffer zone for the residential house-the buffer zone can be devoted to any non-residential land use.
xi. That the distance from the edge of the road to the nearest pump should not be less than 15meters.
xii. The total number of stations within 2 km radius of the site should not be more than four (4) including the one under construction
xiii. Filling station should not be located less than 100 meters from school, hospital, theaters, clinics and other public and semi-public buildings.
xiv. The site (for filling station) should not lie within NNPC/PPMC pipeline right of way or PHCN transmission or railroad lines. (Procedure guide for granting of approvals to construct and operate of a petrol products retail outlet by DPR, 2007).
However, several contraventions by these facilities have been documented in studies.

Olapeju (2017) in a research assessing the location and spatial distribution of petrol stations in Ilaro, Ogun State, concluded that none of the filling stations in Ilaro, Abeokuta, were worthy of Town Planning approval when parameters for assessing locational appropriateness for filling stations in Ilaro, Abeokuta were critically considered. Also, a study conducted by Arokoyu *et al*., (2015) on Petrol filling station location and minimum environmental safety requirement revealed that the Petrol filling stations in the Obio Akpor LGA area of Port-Harcourt neither conform to the required distance of 400m apart nor conform to the required distance of 15m from the road set by the DPR (Department of Petroleum Resources). Similarly, Ogundahunsi (2014) avers that locational pattern of fuel stations in Ilesa, Osun State, Nigeria is haphazard which manifests unhealthy competition among fuel station owners and failure of the regulatory bodies. He posits further that the haphazard locational attribute of fuel stations violates the fundamental objective of planning which is providing the right site for the right use in order to achieve spatial functionality.

RESEARCH METHODOLOGY

A preliminary survey was carried out to identify and document the functional filling stations in the study area. The types of data obtained for the study include the names and coordinates of each filling stations and the name of the area and street where the filling stations are located. This study was carried out using both primary and secondary sources of data. The primary source includes data obtained through field survey, measurements, observations and questionnaire administration. A type-1 questionnaire was administered to the owners, managers and/or staff of petrol filling station in the study area. Also, a type-2 questionnaire was administered to the residents living within 100m radius to the sampled filling stations in order to examine their perception on the risk

of fire associated with the location and operation of petrol filling stations in the area. The secondary sources include the map of the study area obtained from Ogbomoso North Local Government secretariat and data on approval guidelines of petrol stations from the Department of Petroleum Resources.

A total survey of all the identifiable petrol stations in the study area was done and their locational coordinates obtained with the use of GPS. However, for administration of the type-1 questionnaire, simple random sampling technique was employed. Twenty-five (25) functional petrol stations were randomly sampled from the 50 identified filling stations in the study area, while two (2) questionnaires were administered at each of the sampled filling station to a petrol attendant and the manager or owner of the station. Thus, a total of fifty (50) questionnaires were administered at the sampled filling stations. However, type-2 questionnaire was administered to the residents living within 100meter radius of the sampled filling stations. In this regard, five (5) buildings were randomly sampled within each sampled filling station. House head or representative of each of the sampled residence served as the respondents. In total for the study, one hundred and seventy-five (175) questionnaires were administered to the respondents to acquire data used for this study. The obtained data was then analyzed descriptively with the application of Statistical Package for Social Sciences (SPSS). Finally, Nearest Neighbor Analysis was used to examine the distribution pattern of the petrol filling stations in the study area.

Table 1: Inventory of Petrol Stations in the Study Area and the Sampled Stations

S/N	NAME	LOCATION	LATITUDE	LONGITUDE	SAMPLING STATUS
1.	Salawu Ajadi and Sons	Idi Araba, Masifa	8.1388	4.25159	Not sampled
2.	**Rubbie filling station**	**Old Ogbomoso/Ilorin rd**	**8.178005**	**4.266481**	**Sampled**
3.	**BOVAS Petroleum**	**Aroje, Old Ilorin Road**	**8.190471**	**4.273792**	**Sampled**
4.	Ademola Afaran	Oke-Owode area	8.12488	4.2564	Not sampled
5.	Missassco System	Oke-Aanu area	8.13934	4.24723	Not sampled
6.	**Ballahh plus**	**Sabo area**	**8.1446**	**4.2493**	**Sampled**
7.	**Adekitan Com. Nig Ltd**	**Idi Abebe, Ikoyi road**	**8.13894**	**4.23605**	**Sampled**
8.	**Sola Iyaniwura**	**City area, Ikoyi road**	**8.14198**	**4.23396**	**Sampled**
9.	Salawu Ajadi	Ikirun road	8.12588	4.25474	Not sampled
10.	S.O Olawuwo	Ikirun road	8.11465	4.27874	Not sampled
11.	O.C Petroleum ltd.	Ikirun road	8.11595	4.27289	Not sampled
12.	Adeyi Akanmu Nig. Ltd	Ikirun road	8.11498	4.27627	Not sampled
13.	Adekiitan and co.	Apake area	8.13984	4.24186	Not sampled
14.	**Modern option**	**Oja Tuntun**	**8.14123**	**4.2452**	**Sampled**
15.	**Bunvic Investment**	**Oja Tuntun**	**8.14153**	**4.24321**	**Sampled**
16.	Olaiya petroleum	Opp. FGC, Ikoyi road	8.15479	4.22766	Not sampled
17.	Alayog Oil and company	Opp. FGC, Ikoyi road	8.12475	4.25007	Not sampled
18.	**Sulawog filling station**	**Under G/ Stadium rd.**	**8.15282**	**4.25856**	**Sampled**

19.	**NNPC**	**Starlight area**	**8.12797**	**4.23394**	**Sampled**
20.	**G71 Nig. Ltd.**	**Under G area**	**8.16072**	**4.2641**	**Sampled**
21.	**S.A Adeniran Tetteh**	**Starlight area**	**8.14198**	**4.24616**	**Sampled**
22.	Jufes Oil	Oke Babe, Ikoyi road	8.14288	4.24232	Not sampled
23.	**Salawu Ajadi and sons**	**Isale General**	**8.15534**	**4.25537**	**Sampled**
24.	**Alade global link**	**Isale General**	**8.15417**	**4.25456**	**Sampled**
25.	**Risadet**	**Along Ikoyi road**	**8.14094**	**4.23492**	**Sampled**
26.	Nagasco	Baaya-Oje rd., Owode	8.12551	4.26198	Not sampled
27.	**Teejraf Investment**	**High court road**	**8.14514**	**4.25256**	**Sampled**
28.	Buntop filling station	Papa Alajiki area	8.14067	4.2309	Not sampled
29.	**Total filling station**	**Opp. LAUTECH gate**	**8.17139**	**4.26343**	**Sampled**
30.	Sola Iyaniwura	Sekoni area	8.13019	4.25226	Not sampled
31.	Divine K filling station	Ojude Oba area	8.13901	4.25622	Not sampled
32.	Saoyad filling station	Saja area	8.13019	4.25226	Not sampled
33.	YUS-DAUD	Saja area	8.12949	4.25218	Not sampled
34.	SA- Oyegbile	Kara area	8.12785	4.30107	Not sampled
35.	**Nuismag**	**Idi Abebe area**	**8.13617**	**4.24497**	**Sampled**
36.	**Bovas Petroleum**	**Takie**	**8.13538**	**4.23688**	**Sampled**
37.	**Yusfadamik**	**Under G**	**8.16346**	**4.26651**	**Sampled**
38.	Chimobi Oil and gas Ltd.	Aguodo area	8.13548	4.24774	Not sampled
39.	NNPC	Old Ilorin road	8.16609	4.2606	Not sampled
40.	Bovas Petrol station	Oke-Owode area	8.12587	4.25862	Not sampled
41.	Musalat Investment Ltd.	Papa Alajiki	8.14007	4.23296	Not sampled
42.	Musalat Investment Ltd.	Isale Afon area	8.13573	4.24799	Not sampled
43.	Nayog Oil and company	Baaki area	8.12475	4.25007	Not sampled
44.	Yusuf Oladunni Ayinla	Oko Baba area	8.17519	4.26532	Not sampled
45.	**A.I.B**	**Isale General**	**8.155124**	**4.255459**	**Sampled**
46.	**Bisfarn**	**Takie**	**8.136041**	**4.238237**	**Sampled**
47.	**Madam Atoke Mariana**	**Orita naira**	**8.138702**	**4.251539**	**Sampled**
48.	**Musalat Investment**	**Stadium road**	**8.149797**	**4.257184**	**Sampled**
49.	**Abese investment**	**Oke Babe, Ikoyi road**	**8.151976**	**4.229240**	**Sampled**
50.	**Oando Plc**	**General**	**8.15009**	**4.25258**	**Sampled**

Source: Authors' field survey (2022)

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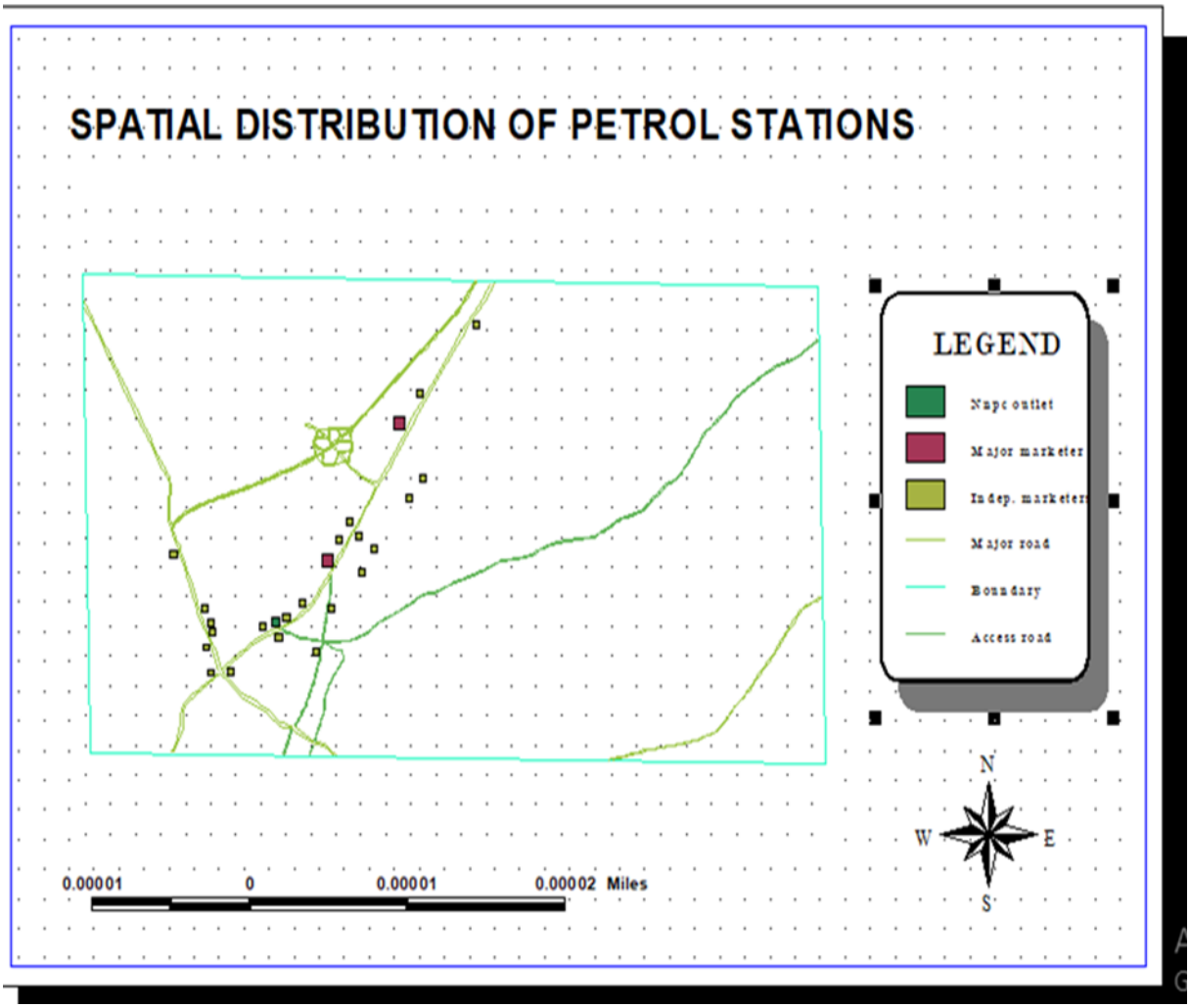

Figure 1: Spatial Distribution of Petrol Filling stations in the Study Area
Source: URP Department, Lautech, Oyo State, 2019

RESULTS AND DISCUSSIONS

Adjoining Land Uses to the Sampled Petrol stations

The category of land use observed around sampled petrol stations in the study area as indicated in Table 2 shows residential land use (16%), commercial land use (32%), and mixed land use (52%). Mixed land use (i.e. mixture of residential and commercial land use, institutional and residential land uses etc.) was observed to be the most prevalent land use category around sampled filling stations in the study area with 52%. This explains the pattern of housing in Ogbomoso where buildings are used for multiple purposes in order to maximize the use of such buildings irrespective of the safety and comfort of the residents. Professionally, any area with mixed land use

predominating shows uncoordinated developments and lack of adequate planning. The consequence of this is the increasing incompatibility of land use and environmental disorderliness in the study area.

Also, from the Table 2 below 36% of the sampled petrol stations share boundaries with residential developments. This indicates that any fire hazard in such stations could be so damaging in terms of loss of lives and properties, if necessary measures to curb such incidence are not effectively put in place. Similarly, it has been established in different studies that hazardous vapour to human health is released during the offloading of petroleum tankers to the underground tanks at petrol filling station. This in no small way would have health implications on the residents living close to the petrol filling station. Table 2 also shows that a high proportion of the sampled petrol stations (18 out of 25 i.e. 72%) do not conform with the nearest distance expected to the nearest petrol station. The implication is not far from the fact that petrol stations are not evenly distributed in the study area, but have clustering characteristics. This is also very dangerous in case of fire hazard, as fire can quickly spread from one station to another, which may increase loss of lives and properties.

Table 2: Locational characteristics of the sampled petrol stations in the Study Area

		ADJOINING LAND USE				SETBACKS TO ADJOINING LAND USE (M)				Space adequacy	Conformity to 50m setback or use as non-residential land use				Distance to nearest filling station	Conformity with distance of nearest filling station
		RD= Road R= Residential O= Others C= Commercial								Y= Yes N= No	Y= Yes N= No				400m minimum	C= Conform N= Not conform
S/N	NAMES	FRONT	REAR	LEFT	RIGHT	FRONT	REAR	LEFT	RIGHT		FRONT	REAR	LEFT	RIGHT		
1	S.A Tetteh	RD	O	C	C	5	0	0	0	N	Y	Y	Y	Y	59.06	Not conform
2	BOVAS Takie	RD	C	C	C	10	1	0	1	Y	Y	Y	Y	Y	64.40	Not conform
3	Alade Global	RD	R	C	C	11	2	3	1	Y	Y	N	Y	Y	180.85	Not conform
4	Modern option	RD	RD	RD	C	5	3	3	3	N	Y	Y	Y	Y	17.37	Not conform
5	Musalat Int. Ser.	RD	R	R	RD	5	0	0	4.5	Y	Y	N	N	Y	390.99	Not conform
6	Yusfadmik	RD	R	R	RD	6.5	0.48	1	4	N	Y	N	N	Y	397.86	Not conform
7	Sulawog	RD	O	O	RD	6	1.5	1	3	N	Y	Y	Y	Y	390.99	Not conform
8	Oando plc	RD	RD	RD	O	6.5	3.5	4	2	Y	Y	Y	Y	N	469.73	conform

9	**TOTAL LAUTECH**	**RD**	**RD**	**RD**	**C**	**6**	**5**	**4**	**1**	N	Y	Y	Y	Y	799.30	conform
10	**NNPC Starlight**	**RD**	**O**	**C**	**RD**	**5.5**	**0**	**0**	**4**	Y	Y	Y	Y	Y	17.37	Not conform
11	**A.I.B**	**RD**	**O**	**O**	**RD**	**6**	**0**	**1**	**3**	Y	Y	Y	Y	Y	10.85	Not conform
12	**G71**	**RD**	**RD**	**RD**	**C**	**5**	**3.6**	**3**	**0**	Y	Y	Y	Y	Y	397.86	Not conform
13	**S.A Ajadi & Sons**	**RD**	**O**	**RD**	**C**	**6**	**0**	**3**	**0.7**	Y	Y	Y	Y	Y	10.73	Not conform
14	**Risadet Nig. Ltd**	**RD**	**O**	**R**	**R**	**10**	**0**	**0**	**0**	Y	Y	Y	N	N	145.36	Not conform
15	**Nuismag**	**RD**	**R**	**R**	**RD**	**10**	**0**	**1**	**3.5**	N	Y	N	N	Y	77.79	Not conform
16	**Adekaitan**	**RD**	**RD**	**R**	**RD**	**12**	**3.5**	**0.5**	**4**	Y	Y	Y	N	Y	179.76	Not conform
17	**S. Iyaniwura**	**RD**	**RD**	**RD**	**O**	**11**	**4**	**3.4**	**0**	Y	Y	Y	Y	Y	140.83	Not conform
18	**Bisfarn**	**RD**	**O**	**C**	**C**	**11**	**0**	**1**	**0**	N	Y	Y	Y	Y	64.40	Not conform
19	**BOVAS Aroje**	**RD**	**O**	**C**	**R**	**9**	**1**	**0**	**0**	Y	Y	Y	Y	N	1581.16	conform
20	**Abese Inv.**	**RD**	**O**	**R**	**O**	**12**	**0**	**2**	**0**	Y	Y	Y	N	Y	433.38	conform
21	**Rubbie Oil**	**RD**	**O**	**RD**	**O**	**7**	**0**	**5**	**0**	Y	Y	Y	Y	Y	499.30	conform
22	**M.A Mariana**	**RD**	**O**	**R**	**C**	**4**	**0**	**2**	**1**	N	Y	Y	N	Y	716.91	conform
23	**Teejraf**	**RD**	**O**	**C**	**R**	**4**	**0**	**0**	**0**	Y	Y	Y	Y	N	716.91	conform
24	**Ballah Plus**	**RD**	**O**	**C**	**C**	**6**	**5**	**0**	**1**	N	Y	Y	Y	Y	59.06	Not conform
25	**Bunvic**	**RD**	**O**	**O**	**C**	**5.5**	**0**	**0**	**0.5**	N	Y	Y	Y	Y	217.54	Not conform

Source: Authors' field survey (2022)

1. Location Distribution Pattern of Petrol Filling Stations in the Study Area

To determine the locational pattern of the filling stations in the study area, nearest neighbor analysis (NNA) was used. The formula used is defined as

$$\mathbf{Rn}=2\bar{d}\sqrt{\frac{n}{A}}$$

Where,

Rn = the nearest neighbor index
A = the size of the area concerned (11,393,583.50sqr. km)
$\bar{d}$ **=** the mean distance among the filling stations
n = the number of filling stations

The Rn values range from zero to 2.15 interpreted as follows; Rn = 0, the distribution is clustered; Rn = 1, the distribution is random and Rn = 2.15, the distribution is regular

STEP ONE (1): Calculation of the total distance between filling stations in the study area.

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Table 3: The Distance of one Filling Station to Another Closest Station

S/N	Sampled Filling Stations	Nearest Distance in Meters
1.	S.A Tetteh	59.06
2.	BOVAS	64.40
3.	Alade Global	180.85
4.	Modern Option	17.37
5.	Musalat	390.99
6.	Yusfadmik	397.86
7.	Sulawog	390.99
8.	Oando	469.73
9.	TOTAL	799.30
10.	NNPC	17.37
11.	A.I.B	10.85
12.	G71	397.86
13.	S.A Ajadi & Sons	10.85
14.	Risadet	145.36
15.	Nuismag	77.79
16.	Adekaitan	179.76
17.	S. Iyaniwura	140.83
18.	Bisfarn	64.40
19.	BOVAS Aroje	1581.16
20.	Abese investment	433.28
21.	Rubbie Oil	499.30
22.	M.A Mariana plc	716.91
23.	Teejraf	716.91
24.	Ballah plus	59.06
25.	Bunvic	217.54
Total Distance		**8039.78**

Source: Authors' field survey (2022)

STEP TWO (2): Calculation of the observed mean distance

Mean distance ($\bar{d}$)= $\frac{TOTAL\ DISTANCE}{NUMBER\ OF\ FILLING\ STATIONS}$

$\frac{8.039}{25}$ = 321.5912

Observed mean distance= 321.5912

STEP THREE (3): Calculation of density filling station in the area

Density of a filling station = $\frac{TOTAL\ NUMBER\ OF\ FILLING\ STATIONS}{SIZE\ OF\ AREA\ CONCERNED} = \frac{n}{A}$

$\frac{25}{11393583.50}$ = 0.000002194m²

STEP FOUR (4): Calculation of expected mean distance

Expected mean distance = $\frac{1}{\sqrt[2]{Density\ of\ a\ point\ in\ the\ area}} = \frac{1}{\sqrt[2]{0.000002194}}$ = 675.12m

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STEP FOUR (4): Calculation of the Nearest Neighbor Index

Nearest neighbor index= $\frac{OBSERVED\ MEAN\ DISTANCE}{EXPECTED\ MEAN\ DISTANCE} = \frac{321.5912}{675.12}$

Nearest neighbor index (Rn) = 0.48

With the *Rn* value of 0.48 which is less than 1.0, filling stations in the study area are not normally distributed, but clustered along the road networks where they are located. This shows that the distribution of petrol filling stations in the study area does not show effective planning. The observed clustered pattern of filling stations here poses a potential danger which includes a high tendency of fire outspread in case of fire outbreak. Also in times of petrol scarcity where long queues are a common sight, this clustering can result in a traffic jam as queues from clustered stations can link up and create a more serious traffic gridlock.

Sampled Petrol Stations length of Operation

Figure 2 shows that 60% of the sampled petrol filling stations in the study area came into operation in the last five (5) years from the time of this study. This trend shows that the pace of urbanization in Ogbomoso Township calls for effective and modern planning, in order not to jeopardize the safety and healthy living of the residents as the number of petrol filling stations continues to increase which is not unconnected to the geometric population increase experienced in the study area.

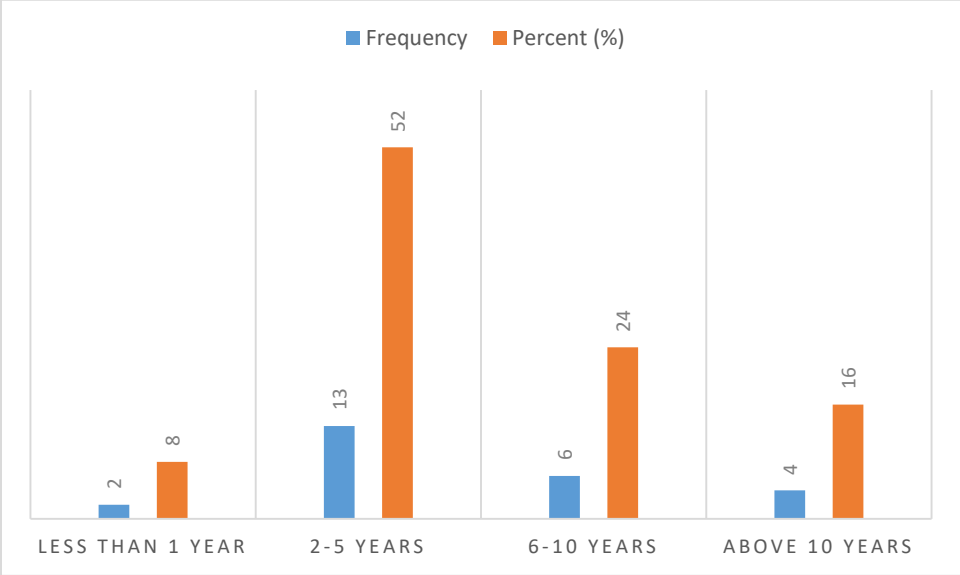

Figure 2: Length of existence of petrol station
Source: Authors' field survey (2022)

Fire Prevention Efforts of the Sampled Petrol Filling Station

It is revealed from Table 4 that all the petrol filling stations in the study area claimed to have gadgets to combat fire in case of such hazard. Similarly, almost all the petrol filling stations (96%) affirmed that their petrol attendants do pass through fire prevention training. Also, the major mechanism relied upon by the operators of filling stations for deployment when fire occurs is the use of fire extinguisher. Findings revealed that some of the fire extinguishers in petrol stations were dried while some have expired. It is pertinent for state and federal fire services to occasionally organize sensitization programme, training and retraining of workers in petrol filling stations on various measures to effectively manage fire hazard.

Table 4: Fire Prevention Measures Employed by the Filling stations

AVAILABILITY OF FIRE PREVENTION GADGETS	**Frequency**	**Percentage (%)**
Yes	25	100
No	-	-
Total	**25**	**100**
FIRE PREVENTION TRAINING	**Frequency**	**Percentage (%)**
Yes	24	96
No	1	4
Total	**25**	**100**
MEASURES ADOPTED WHEN FIRE OCCURS	**Frequency**	**Percentage (%)**
Use of fire extinguisher	23	92
Call for help	2	8
Total	**25**	**100**

Source: Authors' field work (2022).

Perceived Problems Associated with the Operation of Petrol Filling Stations

The operation of petrol filling station poses various challenges to members of the public, especially people living very close to the filling station. These challenges are presented in Table 5. According to Table 5, the highest proportion of the respondents in the study area with 82.4% believed that fire is the major challenge of petrol filling station. Another challenge that requires attention of DPR is the issue of water pollution. During the study, some residents living close to petrol filling stations 63.2% claimed that their wells sometimes get polluted with petroleum remnants, especially during rainy season due to underground leakages. Another common challenge resulting from the operation of petrol filling station is traffic gridlock especially during fuel scarcity.

Table 5: Challenges Identified by the Residents Living Around Petrol Filling Stations

S/N	Identified Challenges	Yes	%	No	%
1	Traffic Gridlock	51	40.8	74	59.2
2	Noise Pollution	42	33.6	83	66.4
3	Air Pollution	73	58.4	52	41.6
4	Water Pollution	79	63.2	46	36.8
5	Fire	103	82.4	22	17.6

Source: Authors' field work (2022).

CONCLUSION

From the foregoing, it is evident that the existing situation between petrol filling stations and the built up area in the study area is not conducive for living and therefore poses risk if fire disaster should happen. The interlock pattern of the locational distribution of petrol filling stations with the residential developments in the study area is very worrisome. Undoubtedly, it is a serious indictment on the agencies of government responsible for managing their development and operations. In order to manage the existing situation and ensuring future developments and operations of petrol filling stations in Nigeria there is need for serious planning so as to secure maximum practicable degree of economy, safety, and sustainability.

The following recommendations are proffered;

i. The bane of coordinated development in Nigeria is that development precedes planning. It is pertinent for all the State governments in Nigeria to develop Master Plans for their cities, and thereafter embark on urban renewal to savage these cities from the continuous leap frog developments.
ii. Government should ensure that every local government in Nigeria has at least one standard fire service station that is well funded, equipped and ready to combat any fire hazard anytime they are called upon.
iii. Town planning agencies at both local and state levels should step up their activities in the area of development control without any form of compromise. Any petrol filling station without the required planning standards should not be granted approval.
iv. The existing petrol filling stations that are closely knitted to residential developments without necessary approvals from the concerned government agencies should be thoroughly examined and made to conform to planning standards.
v. Both State and Federal Fire Services should make it mandatory for all the operators of petrol filling stations to enroll their workers for periodical training every year and their fire resistance facilities should be often evaluated by the fire agencies.
vi. All petrol filling stations operating on a small land area (less than 600sqm) as against the required standard of land size from DPR and Town Planning (not less than 900sqm) should be given operational ultimatum of not more than 24 months to cease their

operations. The land can be converted to other uses that are compatible with their adjoining land uses

vii. The common trend now is that petrol stations are also introducing the sale of liquefied petroleum gas that is used for domestic cooking by an average Nigerian. It is good to note that some of these stations did not plan for this second service at the design stage of their station. Government at all levels should discourage the marriage of petrol filling station with the sale of liquefied petroleum gas, especially those stations within residential areas. Any fire spike in such station can spell a serious doom for such area.

viii. It is high time all the regulatory bodies relevant to petrol filling station begin to review their various laws and pursue vehemently enforcement of their standards and compliance to their laws by the operators of petrol filling station in order to protect lives and properties in the country.

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