AFRICA HABITAT REVIEW 14(2) (2020)

ISSN: 2524-1354 (Online), ISSN: 2519-7851 (Print)
Africa Habitat Review Journal
Volume 17 Issue 1 (December, 2022)
http://uonjournals.uonbi.ac.ke/ojs/index.php/ahr

Locational Effects of Petrol Filling Stations on Environmental Safety and Health in African Cities:

A case of Lagos, Nigeria

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Received on 20th May, 2022; Received in revised form 4th October, 2022; Accepted on 18th October, 2022.

Abstract

Past studies predominantly focused on profit maximization, efficiency and standards compliance in the locational analysis of petrol filling stations. The study, therefore, examined the locational effects of petrol filling stations on the environmental safety and health. Specifically, the study examined the distances of the petrol filling stations from the residential buildings, safety and health conditions of the environment in assessing the effects. A survey approach combined with the use of Global Positioning System (GPS) and Geographic Information System (GIS) was adopted where 384 residents were selected from the estimated 1,002 buildings located 100m from the petrol filling stations to collect data using multi-stage sampling technique. Data collected were analysed using frequency, percentages, mean and correlation analysis. Findings showed that the petrol filling stations location did not comply with planning standard, mostly located between 0 – 25m from residential buildings; with oil leakages as the perceived hazard and respiratory diseases being mostly prevalent. Also, the findings showed that there was a strong, negative correlation between distance of petrol filling station and oil leakages ($r = -.523$, $n = 384$, $p < .001$), general ailment ($r = -.562$, $n = 384$, $p < .001$), skin diseases ($r = -.548$, $n = 384$, $p < .001$), respiratory diseases ($r = -.652$, $n = 384$, $p < .001$) and sight problems ($r = -.511$, $n = 384$, $p < .001$); with increase in the perceived oil leakages and diseases associated with decrease in distances of the stations from residential buildings. The conclusion is that risks and diseases perceptions increase with the location of the petrol filling stations near to the residential buildings. The study recommends strict compliance to the planning standards by the filling stations operators and activation of their social corporate responsibilities in the safety and health services to the cities as well as compensation for the affected persons.

Keywords: Health, location, petrol filling station, planning standards, safety

INTRODUCTION

No doubt, Africa is the most urbanizing continent of the world with its consequences. Urbanization concept in Africa is not only a demographic shift in terms of proportion of population living in urban areas but also a structural transformation of the activities of the whole population. So, the nature of urbanization in Africa is a function of population growth characterized by the location and development of various land uses such as residential, commercial, industrial, institutional and services activities like the Petrol Filling Station. According to Ayodele (2011), "petro filling station, or petroleum outlet is defined as any piece of 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". Due to the fact that fuel, a product of petroleum resources, is highly inflammable, petrol station needs to be appropriately located in relation to other activities to avoid its consequent impact on the immediate environment. This is why Agbola (2004) stated that "Nigerian cities are least aesthetically pleasing and dangerously unsafe for living because their physical growth and development had not been properly managed and controlled".

The location of petrol filling stations deserves adequate planning, guidance and adherence to the existing location guidelines because of its significance to the health and safety of the people. The situation in most cities in Nigeria is that of "indiscriminate location and haphazard development of petrol filling stations

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in disregard of the guidelines and regulations governing its erection, location and development" (Ogundahunsi, 2014). The indiscriminate location and development of the product could be as a result of "high competition among land uses whereby residential land use is converted to petrol station use" (KASUPDA, 2009); and also because of significant impact on the economy of African countries that possess such resources. For instance, the petroleum industry in Nigeria contributes approximately "90 percent of foreign exchange earnings and about 80 percent of Federal revenue and subscribe to the rate of growth of Gross domestic product (GDP)" (Baghebo and Atima, 2013). Despite the importance, the resources ought to be appropriately located and sustainably developed to ensure the safety and health of the environment.

"Environmental safety is the practice of policies and procedures that ensure that a surrounding environment, including work areas, facilities, is free of danger that could cause harm to people living and working in those areas" (Resnik et al, 2008). Therefore, safety practices in locating petrol filling stations are of utmost importance in preventing hazards and reducing potential risks that could affect humans and their environment. On the other hand, "environmental health refers to the state or quality of human health that are determined by physical, chemical, biological, social and psychosocial factors in the environment, of which the state of health could be in form of physical or mental diseases or illness" (Resnik et al, 2008). To ensure environmental safety and health with respect to location of petrol filling station, certain standards were provided by Department of Petroleum Resources (DPR) in Nigeria. According to Mohammed, Musa, and Jeb (2014), "the standards provide that the land which a petrol filling station is sited should have been zoned for commercial/industrial use or designated specifically for the purpose of petrol filling station in the land subdivision of the area. The prospective land should not be less than 33 x 33 square meters or two plots of land to allow for free flow of traffic". Furthermore, "the distance from the edge of the road should not be less than 15 meters and the total number of petrol filling stations within two km radius of the site should not be more than four and should not be located less than 100 meters from school, hospital, and other public buildings, including residential buildings" (DPR, 2010).

In most of the urban areas of developing countries, there has been a rapid increase in the growth of petrol filling stations which serves the transportation industry and other industries in the countries. This trend is however associated with issues and challenges that relates to environmental safety and health of the people within the vicinity. Several studies with different methods and findings have examined the locational impact of petrol filling stations on the environmental safety and health (Abdullahi, 2012; Blamah et al, 2012; Mshellia et al, 2015; Monney et al, 2017). However, this study adopted survey approach combined with Global Positioning System (GPS) and Geographic Information System (GIS) techniques to validate these past studies in assessing the locational effects of petrol filling stations on environmental safety and health in Surulere L.G.A of Lagos in Nigeria, for the need to ensure compliance to physical planning policy. Specifically, the objectives were to identify and map out locational distances of the filling stations from the residential buildings as well as examine the conditions of environment in terms of safety and health in the area; examine the effects of petrol filling stations location on the environmental safety and health of residents; and finally, examine the compliance level of the filling stations location to physical planning standards, for policy recommendations.

THEORY

The unprecedented increase in number of petrol filling stations has been attributed to urbanization due to growing number of people and the attendant increase in the purchase of vehicles; as well as "the attractive price of petrol both at control price and black market prices that make more people to go into the petrol retailing business" (Uchegbu, 2002). "Rowdiness and indiscriminate locations of petrol filling stations have made possible for a guideline for a proposed filling station to be located 450m away from any other filling station within the nearest vicinity" (KASUPDA, 2009).

Studies are copiously available with respect to the locational analysis of petrol filling stations in urban spaces with geographic information system (GIS). Camille (2010) observed that "it was possible for motorists in Abidjan to be afforded the comfort of finding the nearest petrol filling station because of the application of GIS". In his work on the utility of GIS in the management of information

and services offered in petrol station in Mombasa road, Kenya, Emwendogo (2013) used GPS and GIS technology for comprehensive database and equally integrated digital mapping for efficient and effective management of information on petrol filling stations. Adsavakulchai and Huntula (2010) in their analysis of the best site for natural gas vehicles in Bangkok applied GIS, and equally revealed that "there are 76 petrol filling stations in the area and the optimal district site location for the facility is Nongjok district". Moreover, in a study conducted by Ayodele (2011) in Kaduna, GIS based technology was demonstrated and proven to have efficient capacity for analysing the spatial spread of petrol filling stations. These studies, however, did not focus on the environmental safety and health of residents but on the efficient location of the petrol filling stations, using GIS.

Olaniyi (2021) studied location pattern of petrol filling stations in Oyo town in Oyo State of Nigeria, and it was observed that there were a lot of abuses in relation to compliance to planning regulations and standards as specified by the Department of Petroleum Resources. Oloko-oba et al (2016) had also observed that most of the petrol filling stations in Ilorin in Kwara State of Nigeria, exhibited clustered pattern distribution which violates guidelines for petrol stations location. Furthermore, Samuel et al (2015) revealed that "the petrol filling stations in Obio Akpor LGA in Rivers State of Nigeria neither conform to the required distance of 450m apart nor conform to the required distance of 15m from the road". Except Abuja, the Federal Capital Territory of Nigeria, most of the Nigerian urban settlements share the same characteristics, especially in the South Western part. The characteristics in areas of non-compliance show that "developers of petrol filling stations suffer a lot of challenges ranging from lack of enough spaces, incompatibility with the existing land uses, poor construction, and disregard for implementation of mitigation measures and general ecological distortion" (Ayodele, 2011). It is therefore pertinent that the agencies of government at all levels in charge of development control, and the Department of Petroleum Resources (DPR) in particular have to wake up actively in order to effectively control the development of retail outlets in our environment. These studies focused more on the issues of compliance to standards and not the environmental safety and health consequences of the non-compliance.

There are planning criteria for the location of petrol filling stations. According to Department of Petroleum Resources, DPR (2010), petrol filling stations should be located within a growth centre or an urban area except in circumstances where it can be shown through appropriate studies that the need exists or otherwise. Specifically, some of the criteria include: "stations should be located at a minimum of 100m from any public institution such as schools, churches, public libraries, auditoriums, hospitals, public playgrounds, etc.; distance between one petrol station and another should not be less than 100m; buildings are to be located a minimum of 12m from road property boundaries to provide adequate area for manoeuvring of vehicles in the service area; petrol pumps shall be located a minimum of 100m from any residential building; proper facilities for storage and disposal of used and waste oil and gas must be provided, etc." (DPR,2010). This study examined the extent to which these criteria were complied with in the study area.

The issue of compliance is to ensure sustainable development because of the consequences of non-compliance, especially the environmental effects. Sustainable development here implies development, such as location of petrol filling stations, that caters for the needs of people without compromising the needs for the future generations (Barrow, 2006). For instance, "petrol filling stations need to be developed to cater for the needs of the larger amount of cars on the road networks and not to the detriment of the environment" (Barrow, 2006). However, studies have shown that the inappropriate locations of petrol filling stations have resulted to various environmental consequences. KASUPDA (2009) stated that "the conversion of some residential building sites to petrol filling stations without any consideration to the physical planning implication is the cause of some environmental hazards and fire outbreaks in cities due to oil leakages". Furthermore, inhalation of benzene in the petrol filling stations environment causes "mucous membrane irritation, heart attack, cancers of the lung, brain and stomach, leukemia, aplasia, dermatitis and bone marrow depression" (Brugnone et al, 1998). There are cases of "hematological disorders and respiratory failures due to exposure of persons to benzene at petrol filling stations in less developed countries" (Udonwa et al, 2009). Also, studies have shown that people who came in contact in

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some way with oil or fuel due to leakages or spills revealed symptoms that can be grouped into "respiratory problems, skin and eye irritations, headache, dizziness, chest pain, fatigue, nausea, serum liver enzymes symptoms, etc" (Aguilera et al, 2010; D'Andrea and Reddy, 2014; Laffon et al, 2016; Ramirez et al, 2017). This study therefore is aimed at validating these safety and health issues of petrol filling stations' location.

Profit maximization is one of the reasons why petrol filling station is always located at the road side where it will be "easily accessible by the consumers" (Taylor et al, 2016). In their contribution, O'Neill et al. (2002), stated that "the demand for petrol can be expressly linked to local geographical and demographic factors such as; population, income, number of cars, proximity to airport, downtown and highways". Finally, customers' preference of fuel retail stations that are "close to work and home and convenience and accessibility to enter and exit" is becoming increasingly important factors (O'Neill et al, 2002; Wambugu, 2009). The focus of these studies was on location factors for profit maximization and not the effects of such locations on the safety and health of the environment in which there were located. Arising from the reviews, this study examined the locational effects of petrol filling stations on the safety and health of environment in order to encourage compliance to physical planning standards while maximizing profit.

RESEARCH METHODS

Surulere local government Area of Lagos State is a residential and commercial area, with a land area of 27.05 sq. km, located between 6˚05'N and 6˚30'N of the equator and 3˚21'E and 3˚35'E of the Greenwich meridian. In **Figure 1** Surulere L.G.A has three Local Council Development Authorities (LCDA), namely Surulere LCDA, Itire-Ikate LCDA and Coker-Aguda LCDA **(Figure 2),** with a total projected population of 2,038,087 in 2021 (LSG, 2006) and 12 wards. The major commercial hubs include Aguda and Iponri markets, Ogunsanya and Ogunlana streets while the main transport node is the Ojuelegba area, with many petrol filling stations located and developed.

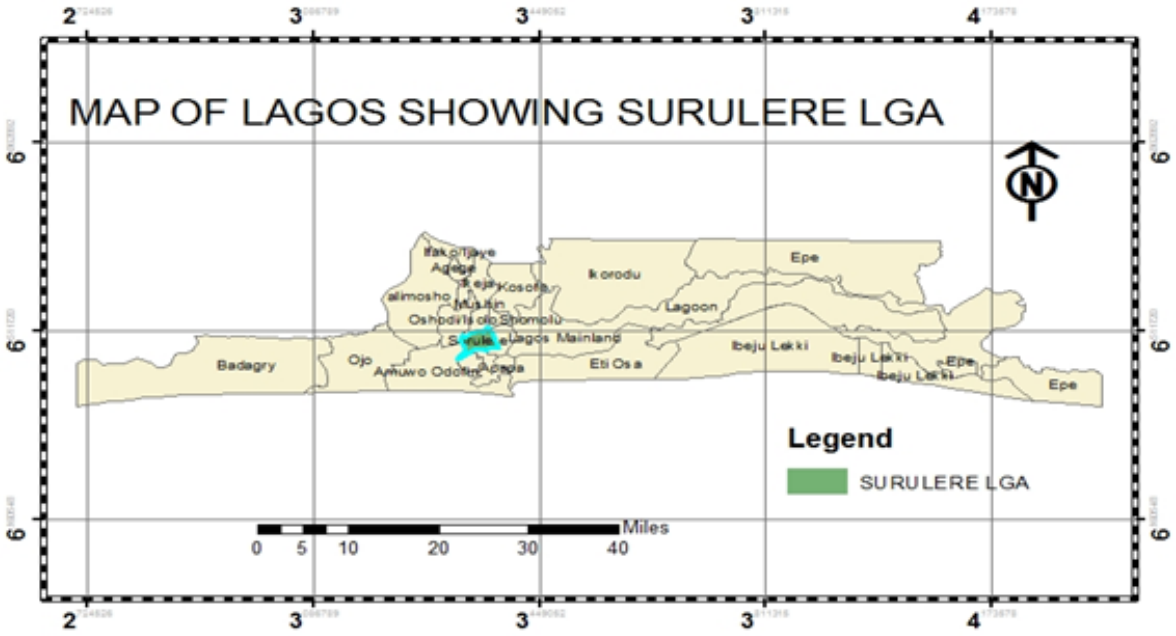

FIGURE 1
Map of Lagos Showing Surulere L.G.A, 2019.
Source: LASG, Ministry of Physical Planning & Urban Development, 2019

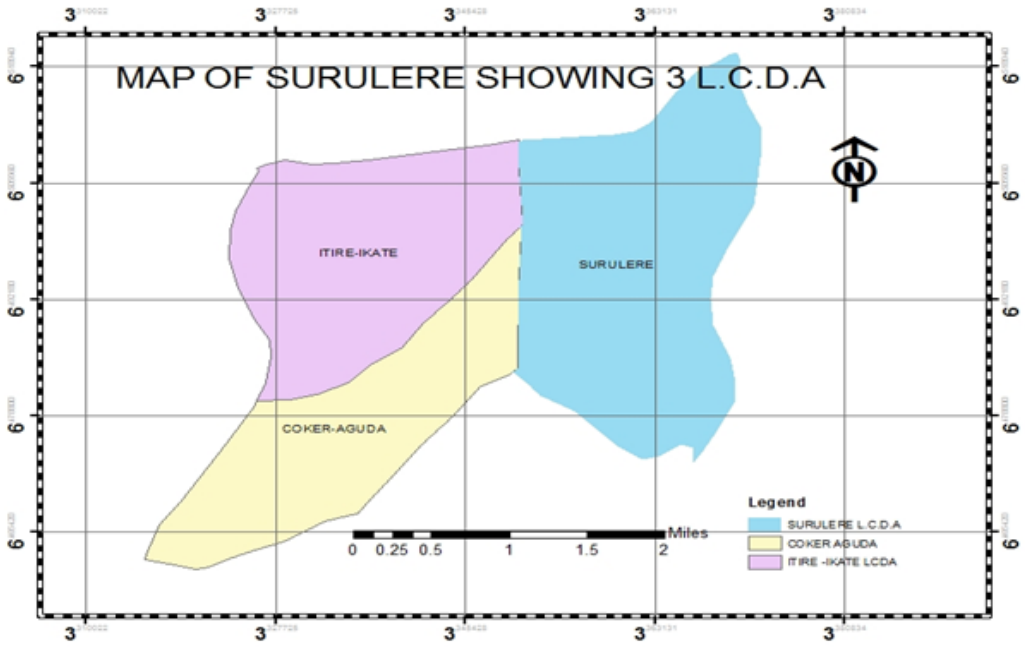

FIGURE 2
Map of Surulere showing 3 L.C. D. A, 2019.
Source: LASG Ministry of Physical Planning & Urban Development, 2019

The choice of the study area is as a result of the rapid rate of location and development of petrol filling stations in Lagos State, of which Surulere L.G.A is one of the areas with increased number of establishments, numerous transport nodes, motor parks and hubs of commercial activities. The situation has led to "uncontrolled location and development of petrol filling stations with several consequences" (Ogunkoya, 2016), of which environmental safety and health is examined in the study. The spatial distribution of the 19 petro filling stations in the study area is shown in **Figure 3.**

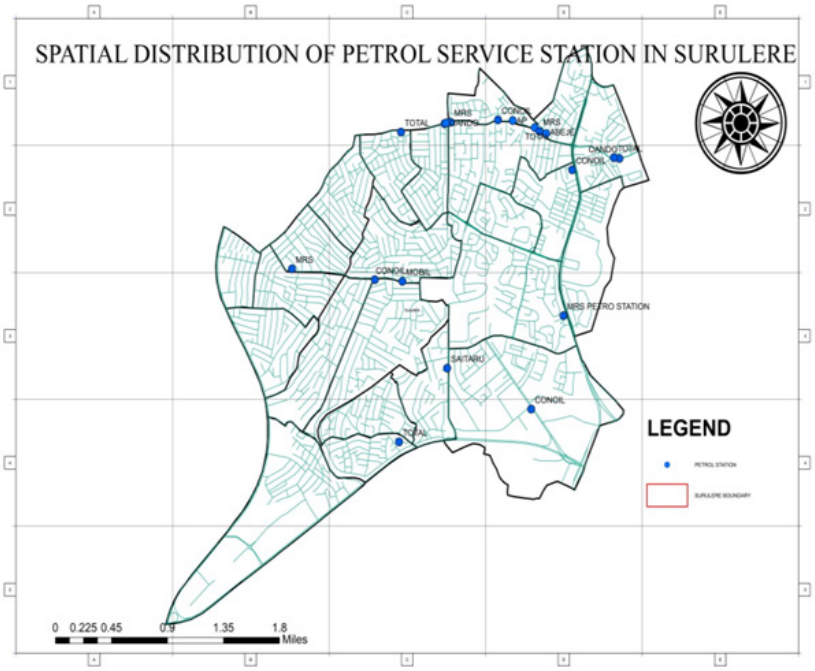

FIGURE 3
Spatial Distribution of Petrol Filling Stations in Surulere, 2019.
Source: Authors' Field Survey, 2019

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The study adopted survey approach as well as global positioning system (GPS) and geographic information system (GIS) techniques to investigate the locational effects of petrol filling stations on environmental safety and health. GPS was used to acquire the coordinates of each petrol filling station while GIS was used to measure the distances of the filling stations from the residential buildings.

In the survey approach, data were collected from the randomly selected eight out of 19 petrol filling stations located 100m from buildings; and 384 out of the estimated 20,048 residents in approximately 1,002 buildings within the 100m location in the 12 wards of the LGA, using Kothari's formula (**Table 1).**

TABLE 1
Sample frame and Sample Size Distribution

s/n	Selected Petrol Filling Station	Selected Streets within 100m location	Estimated No of Buildings within 100m location	Estimated No of Residents @ 20 residents per building	No. of Respondents
1	Mobil	Ogunlana str. Ijesha Rd	134	2680	50
2	AP	Lawanson Rd Adegbola Str	141	2828	54
3	Total	Ojuelegba Rd Lawani Str	130	2604	50
4	Oando	Pandel Ave. Fadipe Str	125	2500	50
5	SAITARU	Babs Animashahun Rd Adetola Str	112	2240	44
6	MRS	Ogunsanya Str Bode Thomas Rd	123	2450	46
7	MRS	Funsho Willians Ave. Alh. Masha Str.	120	2408	46
8	Total	LUTH Rd Olorusogo Str.	117	2338	44
	Total		**1,002**	**20,048**	**384**

Source: Authors' Field survey, 2019

Using multi-stage sampling technique, petrol filling stations within 100m from buildings were identified and eight were randomly selected in the first stage. The selected petrol filling stations were Mobil, AP, Total (two), Oando, SAITARU, MRS (two). In the second stage, streets and buildings within 100m location of the selected petrol filling stations were identified and average of two streets each were randomly selected. The selected streets are as shown in table 1. Finally, in the last stage, residents in the identified buildings in the chosen streets were randomly selected for the administration of questionnaire. A total 384 residents were randomly selected as the respondents as shown in **Table 1**

Data collected were distances of the petrol filling stations from residential buildings, perceptions of the prevalent hazards and diseases in order to determine the effects or relationship. Data collected were analysed using frequencies, percentages, mean and correlation analysis to determine the locational effects of petrol filling stations on the safety and health of environment.

RESULTS AND DISCUSSION

The results of the data analysis are presented and discussed as follows:

Distances of Petrol Filling Stations to Residential Buildings

Using GPS and GIS the positional location and distances of the petrol filling stations were obtained as presented in **Table 2.** The table showed that the average distance of the petrol filling stations to the nearest residential building is approximately 13m.

TABLE 2

Distance of Petrol Filling Station to Residential Buildings

s/n	Petrol Filling Station	Locational address	Coordinates		Distance to residential building
			Easting	Northing	
1	Mobil	Ogunlana str.	538495.1	719853.7	13m
2	AP	Lawanson Rd	539314.1	719900.2	15m
3	Total	Ojuelegba Rd	539657.4	719815.6	11m
4	Oando	Pandel Ave	535621.2	751238.9	15m
5	SAITARU	Babs Animashahun Rd	538575.2	716345.4	13m
6	MRS	Ogunsanya Str	532489.3	754680.1	11m
7	MRS	Funsho Willians Ave.	533030.7	718219.3	13m
8	Total	LUTH Rd	538697.9	718516.9	9m

Source: Authors' Field survey, 2019

Residents perceptions of the distances were also obtained as shown in **Table 3**, to corroborate the identified and mapped out distances in table 2. The distances of the petrol filling stations to the residential buildings were classified as follows: 0 – 25m; 25 – 50m; 50 – 75m and 75 – 100m. For the Mobil filling station along Ogunsanya Street axis, 13.02% of the residential buildings were observed out of which 5.73% and 4.69% were within 0 – 25m and 25 – 50m respectively while 1.82% were between 50 – 75m and only 0.78% of the buildings were between 75 – 100m. At AP filling station location along Lawanson road axis, 14.06% of the observed residential buildings showed that 5.21%, 4.43% and 3.12% were located between 0 – 25m, 25 – 50m and 50 – 75m respectively from the filling station while 1.30% of the buildings were located between 75 – 100m distance. At the location of Total filling station along Ojuelegba road axis, 13.02% of the residential buildings were sampled and 5.47%, 3.65%, 2.86% were between 0 – 25m, 25 – 50m, 50 – 75m respectively from the filling stations and only 1.04% were located between 75 – 100m distance. Also, 13.02% of residential buildings were observed along Pandel avenue axis where Oando filling station was located and 5.73% of the buildings were located at distance between 0 – 25m from filling station, 4.69% between 25 – 50m, 1.82% between 50 – 75m and only 0.78% were located between 75 – 100m from the station.

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TABLE 3
Residents Perceptions of Distances of Petrol Filling Stations to Buildings (n = 384)

		Distance to Residential Buildings (in Meters)									
s/n	Petrol Stations	0 – 25		25 - 50		50 - 75		75 - 100		Total	
		No	%	No	%	No	%	No	%	No	%
1	Mobil	22	5.73	18	4.69	7	1.82	3	0.78	50	13.02
2	AP	20	5.21	17	4.43	12	3.12	5	1.30	54	14.06
3	Total	21	5.47	14	3.65	11	2.86	4	1.04	50	13.02
4	Oando	22	5.73	18	4.69	7	1.82	3	0.78	50	13.02
5	SAITARU	20	5.21	15	3.91	6	1.56	3	0.78	44	11.46
6	MRS	21	5.47	16	4.17	6	1.56	3	0.78	46	11.98
7	MRS	20	5.21	17	4.43	6	1.56	3	0.78	46	11.98
8	Total	19	4.95	14	3.65	7	1.82	4	1.04	44	11.46
	Total	**165**	**42.98**	**129**	**33.62**	**62**	**16.12**	**28**	**7.28**	**384**	**100.00**

Source: Authors' Field survey, 2019

In another observation, 11.46% of residential buildings were sampled from SAITARU filling station along Babs Animashahun road axis and 5.21% and 3.91% of the buildings were located at the distance of 0 – 25m and 25 – 50m respectively while 1.56% were between 50 – 75m and only 0.78% were located between 75 – 100m from the station. From MRS filling station along Ogunsanya street axis, 11.98% of the residential buildings were observed out of which 5.47% and 4.17% were within 0 – 25m and 25 – 50m respectively while 1.56% were between 50 – 75m and only 0.78% of the buildings were between 75 – 100m. Also, from another MRS filling station along Funsho Willians Avenue axis 11.98% of residential buildings were observed and 5.21% of the buildings were located at distance between 0 – 25m from filling station, 4.43% between 25 – 50m, 1.56% between 50 – 75m and only 0.78% were located between 75 – 100m from the station. Finally, from the Total filling station along LUTH road axis, 11.46% of the residential buildings were sampled and 4.95%, 3.65%, 1.82% were between 0 – 25m, 25 – 50m, 50 – 75m respectively from the filling stations and only 1.04% were located between 75 – 100m distance.

In Summary, 42.98% of the filling stations were located 0 – 25m from the residential buildings, followed by location between 25 – 50m (33.62%), 50 – 75m (16.12%) and 75 – 100m (7.28%). This trend revealed that majority of the filling stations (42.98%) were located at average distance of 12.5m from the residential buildings, thereby corroborating the average distance of approximately 13m as mapped out by the GIS. However, none of these distances conformed to the physical planning standard provision as confirmed by Samuel at al (2015), Oloko-oba (2016) and Olaniyi (2021). The standard provides that petrol filling stations shall be located a minimum of 100m from any residential building (DPR, 2010) This is an indication of non-compliance to the distance regulation by all the filling stations with their environmental consequences. Therefore, the likely environmental consequences of the petrol filling stations locations were then examined.

Perceived Environmental Hazards of the Petrol Filling Stations Location

To assess the environmental safety in the study area, the hazards perception of the petrol filling stations location considered was oil leakage and the responses were as presented in **Table 4.** Oil leakage has potential for fire hazard as witnessed recently in Egbema community in Imo State in April, 2022 that killed hundreds of people and destroyed properties; as well as pollution of drinking water and food contamination (Nwilo and Badejo, 2005). The "Yes" responses to oil leakage were based on the visual sighting and smell of oil spread in the petrol filling stations vicinity, which the respondents perceived to be as a result of the underground fuel tank and pumps leakages. However, other respondents perceived no evidence of oil leakages from the petrol filling stations. In summary, the table showed that 51.82% of the respondents perceived oil leakages from the

filling stations while 48.18% did not perceived any leakages. The variations in the responses showed that there were more evidences of oil leakages that required the need for investigation of their level of perceptions with distances of the residential buildings in assessing the environmental safety.

TABLE 4
Perceived Responses of Oil Leakages

Oil Leakage Responses							
s/n	Petrol Filling Station	Yes		No		Total	
		No	%	No	%	No	%
1	Mobil	27	7.03	23	5.99	50	13.02
2	AP	28	7.29	26	6.77	54	14.06
3	Total	30	7.81	20	5.21	50	13.02
4	Oando	20	5.21	30	7.81	50	13.02
5	SAITARU	15	3.91	29	7.55	44	11.46
6	MRS	30	7.81	16	4.17	46	11.98
7	MRS	21	5.47	25	6.51	46	11.98
8	Total	28	7.29	16	4.17	44	11.46
	Total	**199**	**51.82**	**185**	**48.18**	**384**	**100.00**

Source: Authors' Field survey, 2019

Perceived Environmental Diseases of the Petrol Filling Stations Location

From the literature, the common prevalent diseases considered in the study area include general ailment, skin rashes, respiratory disorder and sight problem, which were caused by either inhalation, physical contact or contamination of petroleum resources. Examples of general ailment are abdominal pain, leukemia, fever, malaria, fatigue, headache, dizziness, hepatitis, food poisoning, cholecystitis, allergies etc. The skin problems are itching, skin cancer, eczema, chickenpox, measles while the sight problems include eye cancer, glaucoma, deaf blindness. Some respiratory diseases are lung cancer, chest pain, asthma, diabetes, diarrhea, sore throat, cough, catarrh, nausea, serum liver enzymes symptoms, etc.

The perceptions of the prevalent diseases in relation with the location of the petrol filling stations were ascertained and presented in **Table 5.** For the Mobil filling station along Ogunsanya Street axis, 13.02% of the residential buildings were observed and responses showed that 6.77%, 3.13% and 1.82% of the residents perceived respiratory, general ailment and skin diseases respectively while 1.30% perceived sight problems. At the AP filling stations along Lawanson road axis, out of the 14.06% of residents in the buildings, 7.55% perceived respiratory diseases in the environment while 3.65%, 1.56% and 1.30% perceived general ailment, sight and skin diseases respectively. Further, out of the 13.02% of residential buildings around Total filling station located along Ojuelegba road axis, 4.43% of the residents perceived general ailment diseases, 3.91% respiratory diseases, 2.60% skin diseases and 2.08% sight problems.

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TABLE 5
Perceived Responses of Prevalent Diseases.

Perceptions of Prevalent Diseases											
s/n	Petrol Stations	General Ailment		Skin Problem		Respiratory Problem		Sight Problem		Total	
		No	%	No	%	No	%	No	%	No	%
1	Mobil	12	3.13	7	1.82	26	6.77	5	1.30	50	13.02
2	AP	14	3.65	5	1.30	29	7.55	6	1.56	54	14.06
3	Total	17	4.43	10	2.60	15	3.91	8	2.08	50	13.02
4	Oando	11	2.86	12	3.13	18	4.69	9	2.34	50	13.02
5	SAITARU	14	3.65	9	2.34	10	2.60	11	2.86	44	11.46
6	MRS	11	2.86	13	3.39	12	3.13	10	2.60	46	11.98
7	MRS	18	4.69	10	2.60	9	2.34	9	2.34	46	11.98
8	Total	15	3.91	8	2.08	11	2.86	10	2.60	44	11.46
	Total	**112**	**29.17**	**74**	**19.27**	**130**	**33.85**	**68**	**17.71**	**384**	**100.00**

Source: Authors' Field survey, 2019

Out of the 13.02% of residential buildings around Oando filling station located along Pandel avenue axis, 4.69%, 3.13% and 2.86% of the residents perceived respiratory, skin and general ailment diseases respectively while 2.34% perceived sight problems. Similarly, 11.46% of residential buildings were sampled from SAITARU filling station along Babs Animashahun road axis and 3.65%, 2.86% and 2.60% of the residents perceived general ailment, sight and respiratory diseases respectively while 2.34% perceived skin diseases. At the MRS filling station along Ogunsanya street axis, 11.98% of the residential buildings were observed out of which 3.39% and 3.13% of the residents perceived skin and respiratory diseases respectively, while 2.86% perceived general ailment and 2.60% sight problems. In another MRS filling station along Funsho Willians Avenue axis, 11.98% of residential buildings were also observed and 4.69% of the residents perceived general ailment, 2.60% skin diseases and 2.34% each perceived respiratory and sight problems. Finally, at the Total filling station along LUTH road axis, 11.46% of the residential buildings were sampled and 3.91%, 2.86% and 2.60% of residents perceived general ailment, respiratory and sight diseases while 2.08% perceived skin problems.

Summarily, the most perceived prevalent diseases in relation to the petrol filling stations locations were the respiratory diseases (33.85%), followed by general ailment (29.17%), skin diseases (19.27%) and sight problems (17.71%). Respiratory diseases were the most prevalent as corroborated in past studies (Aguilera et al 2010; D'Andrea and Reddy, 2014; Laffon et al, 2016, Ramirez et al 2017). These perceptions of the prevalent diseases were then examined along with the distances of the residential buildings from the petrol filling stations in assessing the environmental health.

Petrol Filling Stations Distances from Residential Buildings, Environmental Hazards and Diseases

In order to examine the locational effects of petrol filling stations on environmental safety and health, the narratives in **Tables 3, 4 and 5** were cross tabbed and results presented in **Tables 6 and 7**, which were later subjected to correlation analysis to determine the magnitude and strength of the effects.

Petrol Filling Stations Distances from Residential Buildings and Environmental Hazards

The observed distances of the petrol filling stations from the residential buildings were examined along with the perceived hazards and the results presented in **Table 6.**

TABLE 6

Petrol Stations Distances and Environmental Hazards

Oil Leakages							
s/n	Petrol Stations Distances (in meters)	Yes		No		Total	
		no	%	no	%	no	%
1	0 – 25	85	22.13	80	20.83	165	42.98
2	25 – 50	67	17.45	62	16.15	129	33.62
3	50 – 75	32	8.33	30	7.81	62	16.12
4	75 – 100	15	3.91	13	3.39	28	7.28
	Total	**199**	**51.82**	**185**	**48.18**	**384**	**100.00**

Source: Authors' Field survey, 2019

Table 6 showed that at all the petrol stations distances or location, there were evidences of oil leakages reported by the residents. However, there were variations in the leakages with more being observed within the 0 – 25m (22.13%) petrol station distance from residential buildings, followed by 25 – 50m distance (17.45%), 50 – 75m (8.33%) and 75 – 100m (3.91%). This implied that more oil leakages were experienced with the petrol filling stations located near residential buildings and hence more vulnerable to risks of fire outbreaks, loss of lives and properties.

Petrol Filling Stations Distances from Residential Buildings and Environmental Diseases

The prevalent diseases were examined in relation to the distances of the petrol filling stations to determine the locations that were mostly affected as presented in **Table 7.** At all locations of the petrol filling stations from the residential buildings, the most prevalent diseases perceived were respiratory problems (33.85%). But, there were variations in the perceptions of the respiratory diseases with more being observed within the 0 – 25m (14.58%) petrol station distance from residential buildings, followed by 25 – 50m distance (11.46%), 50 – 75m (5.47%) and 75 – 100m (2.34%). This implied that more diseases, especially respiratory, were experienced with the petrol filling stations located near residential buildings and hence making the environment more vulnerable to diseases like lung cancer, chest pain, asthma, diabetes, diarrhoea, sore throat, catarrh, cough etc.

TABLE 7

Petrol Stations Distances and Prevalent Diseases

Prevalent Diseases											
s/n	Petrol Stations Distances (in meters)	General Ailment		Skin Problem		Respiratory Problem		Sight Problem		Total	
		No	%	No	%	No	%	No	%	No	%
1	0-25	48	12.50	32	8.33	56	14.58	29	7.55	165	42.98
2	25-50	38	9.90	25	6.51	44	11.46	23	5.99	129	33.62
3	50-75	18	4.69	12	3.13	21	5.47	11	2.86	62	16.12
4	75-100	8	2.08	5	1.30	9	2.34	5	1.30	28	7.28
	Total	**112**	**29.17**	**74**	**19.27**	**130**	**33.85**	**68**	**17.71**	**384**	**100**

Source: Authors' Field survey, 2019

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The relationship between the petrol filling stations locations, environmental hazards and diseases were examined using correlation analysis.

Correlation Analysis between Petrol Filling Stations Location, Environmental Hazards and Diseases

The relationship between the petrol filling stations location, environmental hazards and diseases was investigated using Pearson Product Moment correlation analysis and the results were presented in **Table 8.** This is to determine the direction and strength of the locational effects of petrol filling stations on the environmental safety and health, using the variables as described. The variables used in the analysis were the distances of petrol filling stations from residential buildings, perceived hazard (oil leakage) and prevalent diseases (general ailment, skin, respiratory and sight problems). The analysis indicated that the relationship was in an inverse direction and that there was a strong, negative correlation between distances of the petrol filling stations from residential buildings and the perceived hazard and diseases.

TABLE 8

Results of Correlation Analysis between Petrol Stations Distances, Hazard and Diseases

	Variables		1	2	3	4	5	6
1	Distance	r	1.000					
		sig.(2-tailed)	.000					
		N	384					
2	Oil Leakage	r	-523**	1.000				
		sig.(2-tailed)	.000					
		N	384					
3	General Ailment	r	-562**	.463**	1.000			
		sig.(2-tailed)	.000					
		N	384					
4	Skin	r	-548**	.433**	.291**	1.000		
		sig.(2-tailed)	.000					
		N	384					
5	Respiratory	r	-652**	.502**	.254**	.231**	1.000	
		sig.(2-tailed)	.000					
		N	384					
6	Sight	r	-511**	.376**	218**	.215**	.206**	1.000
		sig.(2-tailed)	.000					
		N	384					

**. Correlation is significant at the 0.01 level (2-tailed)

Source: Authors' Field survey, 2019

The strength of the relationship showed that a decrease in the distances of the filling stations from the residential buildings was associated with severe increase in oil leakages ($r = -.523$, $n = 384$, $p < .001$), general ailment ($r = -.562$, $n = 384$, $p < .001$), skin diseases ($r = -.548$, $n = 384$, $p < .001$), respiratory diseases ($r = -.652$, $n = 384$, $p < .001$) and sight problems ($r = -.511$, $n = 384$, $p < .001$). This means that the hazard and diseases increase with the distances of the petrol filling stations near the residential buildings.

The r2 value of oil leakages showed that 27.4% of the variation in the distances of the petrol filling stations location were associated with severe oil leakage perceptions. This is confirmed by 51.82% responses that there were oil leakages either through the underground tanks or the fuel pumps with their associated risks such as fire outbreak, loss of lives and properties, water pollution and food contamination (Jaiyeoba, 2002, Nwilo and Badejo, 2005; Mshelia et al, 2015).

In the determination of the relationship coefficient with the environmental diseases, the r2 value of general ailment indicated that 31.6% of the variation in the distances of the petrol filling stations locations were associated with severe general ailment perceptions. This is confirmed by 29.17% responses of general ailment diseases such as abdominal pain, leukemia, fever, malaria, hepatitis, food poisoning, within all the locations of the filling stations. This was corroborated by Brugnone et al (1998) that the inhalation of benzene in the filling stations environment causes stomach pain, leukemia, dizziness, aplasia, dermatitis, hepatitis and fever.

The r^2 value of skin diseases showed that 30% of variation in the distances were associated with the perceived skin diseases like itching, skin cancer, eczema, chickenpox, measles, which is remarkable increase from the 19.27% responses of the survey. It has been explained that if petrol comes in contact with the skin it causes several irritation or itching that can lead to eczema or measles (European Environmental Agency, 1994; D'Andrea and Reddy, 2014).

Furthermore, the most serious prevalence disease was respiratory, whose r2 value showed that 42.5% of variation in the distances were associated with the perceived respiratory diseases in the residential building. The survey confirmed that 33.85% of respiratory diseases like lung cancer, chest pain, asthma, diabetes, diarrhea, sore throat, catarrh etc, were perceived in the residential buildings. Corroborating, Udonwa et al. (2009) and Ramirez et al. (2017) observed that there were respiratory failures due to exposure of persons to benzene at petrol filling stations, especially in less developed countries.

Finally, the r^2 value of sight problem indicated that 26.1% of variation in the distances were associated with the perceived sight problems in the residential building. In the survey, 17.71% of the responses showed that sight problems such as eye cancer were perceived in the residential buildings, if petrol comes in contact with the eye as explained by European Environmental Agency, EEA (1998).

The summary of the results is that the risks and perceived diseases increase with the location of the petrol filling stations near the residential buildings.

CONCLUSION AND RECOMMENDATIONS

The study observed that the location of the petrol filling stations has both environmental safety and health consequences, especially within residential areas. Apart from non-compliance to planning standards for petrol filling stations location, the effects showed that there were cases of fire outbreaks, pollution due to oil leakages and the prevalence of general ailment, skin, respiratory and sight diseases within the residential areas near the petrol filling stations location. Therefore, the study concluded that risks and diseases perceptions increase with the petrol filling station locations near to the residential buildings. The recommendations are to ensure strict compliance to the planning standards by the petrol filling stations operators and activate their social corporate responsibilities in the safety and health services to the cities as well as compensate the affected persons.

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