

Spatial Distribution of Petrol Filling Stations in Yakurr Lga of Cross River State-Nigeria

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ABSTRACT

Petrol filling stations are vital but their location can also pose safety risks hence, there is need to adhere to regulatory guidelines. This study utilizes Geographic Information System (GIS) tools to analyze the placement of fuel stations in Yakurr local government areas of Cross River State. Quantitative research method was employed for the study. This involved acquiring primary and secondary data. Petrol filling stations coordinates were captured using Garmin 76CSX Handheld GPS, the attributes data such as name of business/roads were recorded, distance between filling stations and setback were measured directly on the ArcGIS 10.3. The results of the analysis showed that the stations are concentrated along Calabar-Ikom Highway. Furthermore, (54.17%) petrol filling stations complied with the 400M spacing rule, while 46.83% did not. 41.67% kept the minimum setback of 15M, while 58.33% of the filling stations have a setback of less than 15M. Many lacked essential firefighting equipment: fire extinguishers, sand buckets and water. In conclusion, the study suggest that regulatory bodies should be more proactive and effective by conducting frequent inspections of petrol filling stations to ensure compliance with recommended regulatory guidelines.

Keywords: Filling, Guidelines, Petrol, Spatial, Station

INTRODUCTION

Petrol filling station is a place where fuel is sold for road vehicles, often with small shops. It is a facility which may dispense/sells petroleum products such as Automated Gas Oil (AGO), also known as diesel, Dual Purpose Kerosene (DPK), and Premium Motor Spirit (PMS), also known as petrol. It has been described as a location with fuel equipment and pipelines, storage containers, a service station, and building spaces for selling fuel (inflammable liquids) to customers (Nieminen, 2005). A petrol filling station (also known as a fueling station, gas station, or petroleum outlet) is any land, building, or equipment used for the sale or dispensing of gasoline or oil for motor vehicles or incidental thereto, and includes the entire land, building, or equipment whether the use as a petrol station is the predominant use or is only a part thereof (Ayodele, 2011, Mohammed, and Jeb 2014, Magaji and Umar 2020). Fueling station is a retail establishment where motor vehicle are refueled, lubricated serviced and sometimes repaired. Hence, fueling station should be located not only where they are accessible but where they can be easily sighted by visitors to town, they should be placed where the risk are at lowest ebb, because petrol is a highly volatile compound.

The rapid growth rate of most urban centers has increased the use of automobiles, generators and other petroleum demanding plants on one hand and on the other according to Afolabi, Olajide & Omotayo, (2011), the pathetic power situation in Nigeria has exacerbated the increasing demand for petroleum products, leading to the proliferation of petrol filling stations and consequently, with less consideration of the minimum environmental safety requirements for their operations Rapid growth driven by urbanization has increased the demand for vehicles and machines, leading to more fuel usage and the establishment of additional filling stations (Enwezor and Ojiako, (2024),. The surge in automotive ownership occasioned by urbanization, epileptic power supply for domestic, commercial and industrial use are the reasons for development of more filling stations in Yakurr Local government Area to attend to the demands of customers.

Evidence abounds that despite the guidelines controlling the location of petrol filling station in Nigeria, most of them are in a disorderly and potentially hazardous manner (Afolabi, Olajide, and Omotayo, 2011; Olapeju, 2017; Jia, Nwaogazie, and Mmom, 2022; Ulakpa, Ulakpa & Eyankware, 2022)

The manner in which some petrol filling stations are sited in Nigerian cities, particularly in undesirable locations, is an indication of poor adherence to town planning standards. According to Ogunkan, (2022), bad seating, insufficient size, a limited setback from the road, and inadequate distance allowance from important buildings like churches, schools, mosques and churches, are all manifestations of utter disregard for planning regulations. Unfortunately, this situation may continue to persist, especially when the regulatory bodies; Nigerian Upstream Petroleum Regulatory Commission (NUPRC) formerly known as Department of Petroleum Resources (DPR), Fire Service and Town Planning Department are yet to ensure strict compliance to the standards by developers.

Petroleum products are highly inflammable hence are stored in subsurface tanks where they are dispensed at PFS by meter pumps. Because of the importance of retail outlet sites to people's health and safety, sufficient planning guidance and adherence to existing location criteria are required. The Nigerian Upstream Petroleum Regulatory Commission (NUPRC) of the Nigerian Federal Ministry of Petroleum Resources (FMPR) is a government body that controls the sale of petroleum products throughout Nigeria. The NUPRC, offers instructions and guidelines regarding how to set up and run a filling station that may sell petroleum products (AGO, DPK and PMS).

The NUPRC, was established in August 2021 pursuant to the passage of the Petroleum Industry Act of 2021 is responsible for the technical and commercial regulation of upstream petroleum operations in Nigeria (<https://www.nuprc.gov.ng/>). Hence is required by law to ensure adherence to petroleum laws, guidelines and regulations in the oil and gas industry to ensure safety and prevent health risks. In addition to NUPRC guidelines, the location of PFS is regulated and controlled by urban and regional planning agencies, such as planning commissions, boards, and authorities. In the case under study, the authority concern is the Ugep Area Planning Authority (Ministry of Lands and Urban Development in Cross River State) that is saddled with the responsibility of controlling physical development in Yakurr Local Government Area.

Statement of the Problem

Petroleum products occupies prime position in the minds of Nigerians as a necessity, hence, it is very necessary that certain measures/regulations are adhered to in the location of petrol filling stations. For instance, the Department of Petroleum Resources and Fire Service established that minimum space between two nearest petrol stations should be 400 metres and between a petrol station to the nearest residential building should not be less than 50 metres and petrol filling stations should be more than 100 metres from markets, hospitals, schools, and areas of high traffic congestion including residential buildings (Samuel, Ogoro and Amanoritsewo, 2015).

A pilot survey within Yakurr shows that such standards were not taken into cognizance in the location process. The situation on ground points to inadequacies in knowledge of the relevance of maintaining the space standard that stipulates location requirements for the siting of Petrol Filling Stations.

Conceptual Framework/Literature Review

Concept of Sustainable Development

The concept of sustainable development is aimed at preventing resource waste through conservation, maximization of product utility and availability, minimization of environmental degradation and deliberately steering and directing actions and attitudes of resource producers.

There are several definitions of the term sustainability. While some have defined sustainability in relation to the ability of man to preserve the available natural resources and not over-use the resources in a way that it will be deficient in the future. Severally definitions abound but the most frequently quoted definitions is the one given by the United Nation Commission on Economic Development in its 1987 Bruntland Report, titled *Our Common Future*, defines "Sustainable Development" as development that meets the needs of the present without

compromising the ability of future generations to meet their own needs.

When a petrol filling station is sustainably located, risks are minimized to the barest minimum as this will reflect in minimal conflicts at point of location. Accessibility will not be hindered, Njoku and Alagbe, (2015) stated that, in as much as petrol filling stations should be located where they can be easily accessible, other criteria that guarantee users safety must not be compromised.

Concept of Filling Station

A filling station is a retail establishment, where motor vehicles are refueled, lubricated, serviced, and sometimes repaired. Most gasoline stations sell petrol or diesel, some carry specialty fuels such as liquefied petroleum gas (LPG), natural gas, hydrogen, biodiesel, kerosene, or butane while the rest add shops to their primary business, and convenience stores (The American Heritage Dictionary, 2004). Meanwhile, Petrol retailer or entrepreneur is any person who carries on a business which sells petrol, lubricants and other petroleum products to motor vehicles. The term filling Station or service station is a place of retail business, engaged in supplying goods or services that are essential for the normal operation of automobiles.

Genovese, (2004) is of the view that petrol stations could be any petroleum facility, service station, public garage, highway gasoline station, petro part or fuel depot that sells fuel and lubricants for motor vehicles. Even though this facility may have different names depending on the part of the world, the purpose to which it is located still remains the same, as a structure or building where petroleum products are sold to motorists or for other local consumption, (Hanekom, 2001).

Filling Station, Petrol station, gas station or petroleum outlet is defined as any land, building or equipment used for the dispensing of petrol or oil for motor vehicles. Most filling stations sell petrol or diesel, some carry specialty fuels such as liquefied petroleum gas (LPG), natural gas, hydrogen, biodiesel, kerosene, or butane while the rest add shops to their primary business (Ayodele, 2011).

LITERATURE REVIEW

The essence for the establishment of the petrol filling stations is purely profit oriented and as a commercial venture most often than not, the proponent pride profit over safety. However, the guidelines for the operation of the outlets as stipulated by NUPRC must be complied with. See table 1.

Table 1: Standards for Sitting Gasoline Filling Stations

1	Sitting of petrol station a. Residential areas b. Commercial/industrial areas	<ul style="list-style-type: none"> - A petrol filling station should be sited for every 5000 people. - A petrol filling station should be sited 200 metres away from the next petrol station.
2	Distance between filling stations	<ul style="list-style-type: none"> - Distance of filling station from another should be within the range of 400 and above metres within the buildup areas. - NB: These distance are applicable to single carriage way. - A petrol station can be on either sides of carriage way.
3	Distance from centre of the Road.	<ul style="list-style-type: none"> - The minimum distance from centre of the road to the dispensing pump on single carriage way should be 20 meters. - The minimum distance from centre of the dispensing pump on dual carriage way should be 50 metres. - Petrol should not be sited on areas prone to erosion or flooding. - A petrol station should not be sited near endangered plant and

		<p>animal species.</p> <ul style="list-style-type: none"> - A petrol station should be sited 50 metres away in all angles of the build-up areas to create a buffer zone for the residential houses. - The buffer zone can be devoted to any non-residential use.
4	Set-back requirement	<ul style="list-style-type: none"> - The minimum of the plot within the buildup area should (1000m²) - Plot size beyond peripheral area should be 60m x 80 (4800m², 0.4 hectares 1.186 acres) - NB: sitting a petrol station within build up areas, should be discouraged as much as possible.
5	Land requirements	<ul style="list-style-type: none"> - A petrol station provides at least two (2) public conveniences when submitting application for the grand of planning permission. - Application for a petrol filling station must have an E.I.A report, feasibility study report, and service report. - A petrol filling station should provide detailed drawing to the firefighting measures to be installed which should be in accordance with national firefighting code of Nigeria when submitting plans for the grant of planning permission.

Source: DPR (Now NUPRC)

Effects of Poor Siting of Filling Gasoline Stations

One of man’s actions of technological initiative is about automobile development and the discovery of petroleum which triggered the building of petrol stations, which have impacted our society in diverse ways, (Omole, 2001). The spatial location of petrol stations have a Socio- economic or psychological impact on the attitude, health, safety, economic, cultural or social life of the people (Michael, 2008). According to World Health Organization (W.H.O 2004) report, more than 2.3 million lives and properties worth more than 4.5 billion are lost to fire outbreaks associated to petroleum product mishandling, which invariable suggest the danger attributed with the indiscriminate location of petrol stations in our society.

Spatial Factors for the Location of Gasoline Station

According to the planning criteria, a petrol station should not be located within a growth centre or an urban area except in circumstances where it can be shown through appropriate studies that the need exist. In addition, the land should be zoned for commercial and/or industrial use. A petrol station is not allowed to be located on a site that will cause traffic obstructions. Therefore, a strategic location for petrol station should not interfere with traffic flow. Also, a petrol station should be located at a minimum of 100 feet from any residential building (Adewuyi, Sanni, and Abudulawal, 2021).

MATERIALS AND METHODS

Study Area

The study area “Yakurr Local Government Area”, was created out of Obubra Local Government Area in 1987, shares boundaries with Abi, Obubra, Biase Akampa and Biase Local Government Areas it is partly located on the fringes of Oban mass, located in central senatorial district of Cross River State and has Ugep as the Council Headquarters. It comprises the following settlements; Ugep, Mkpani, Idomi, Ekori, Inyima, Nko, Assiga, Agoi Ibami, Agoi Ekpo, and Agoi Ibami etc.. It is located approximately on longitude 8^o 11’ and 8^o20’ and latitude

5°45' and 5°55'. The study area has a land mass of about 670.438sqkm (Association of Cross River State Local Government Pensioners, 2015) It is located 120KM North West of Calabar, with an annual temperature ranges between 15-30 C, while the annual rainfall ranges from 1300-3000mm with relative humidity of 70-80% (Ofem, Ediene, Kingsley and Akpan-Idiok, 2019).

Transportation and communication: The study area can be accessed through land and water. Calabar- Ikom Highway traversed the study area from East to West, while Ugep-Itigidi-Abomege-Abakaliki road runs from Ugep towards the North. Commercial mode of transportation within the study area is mainly with buses, cars and motorcycles. Most of the roads are tarred and are in good and fair conditions.

Population:

Yakurr, in 2006 has a total population of 196,271 (NPC) This population projected for 18 years with a growth rate of 3% puts Yakurr population at 334,188 in 2024.

Methods

Quantitative research method was adopted for this study. Petrol filling stations in Yakurr LGA were identified and their coordinates taken using a hand held GPS (Garmin 76CSX) the attribute data which include the name of the facilities as well as the name of road that provide access were recorded in Microsoft Excel which was later imported into Arc GIS 10.3 as points data, the roads were digitized as lines data. The digitized file was saved in JPEG format.

Table 2: Petrol Filling stations in Yakurr

Location	Number of Gasoline Stations	Status	
		Functional	Not Functional
Ugep	16	12	4
Ekori	5	3	2
Mkpani	1		1
Nko	2	1	1
Total	24	16 (67%)	8 (33%)

Source: Field Survey, 2024

As contained in table 2. Twenty four (24) petrol filling stations were identified in four settlements (Ugep has 16, Ekori has 5, Mkpani 1 and Nko 2) in the study area, 16 (67%) of the stations are functional while 8 (33%) are not functioning. It was further observed that these functional stations in the study area have facilities that support the services offered in the stations. Such facilities include mini mart, lubrication and car washing.

Table 3: Services in Functional Petrol Filling Station

Location	Facilities			Total
	Mini Mart	Car Washing	Lubrication	
Ugep	5	3	1	
Ekori	1	2	0	
Mkpani	0	0	0	
Nko	0	1	1	

Total	6	7	3	16
Percentage	(37.5%)	(43.75%)	(18.75%)	100%

Source: Field Survey, 2024

The data gathered on the type of support services offered at the functional petrol filling stations showed in table 2, has it that six (6) stations have mini mart services, while car washing services was operational in 7 filling stations, 3 were observed to have facilities for lubrication. In all, it is obvious that different activities and accompanying services are supported in gasoline stations in the study area. In summary, as shown in table 3, Petrol Filling Station (PFS) that have mini mart constitute 37.5%, PFS with car washing services 43.75% and PFS that provide lubricant service is 18.75%.

Table 4: Spatial location of petrol filling stations

S/N	Names	Description of location	Eastings	Northings
1	Don Café FLS	Cal-Ikom H/Way Ugep	397152	640149
2	Ekoko Nig.	Cal-Ikom H/Way Ugep	3981194	641743
3	Forgobest Oil	Cal-Ikom H/Way Ugep	397595	641102
4	Best Renches	Cal-Ikom H/Way Ugep	397978	641610
5	Ce-Brighter Days	Cal-Ikom H/Way Ugep	397998	641648
6	Nobeg Oil	Cal-Ikom H/Way Ugep	398351	642137
7	Cen-strong Oil	Cal-Ikom H/Way Ugep	398391	642608
8	Wenwonmuka	Cal-Ikom H/Way Ugrp	398393	642684
9	Omilakwa	Cal-Ikom H/Way Ugep	398352	643038
10	Yenen-ba Thompson	Cal-Ikom H/Way Ugep	398379	643085
11	Ugoetz Nig.	Cal-Ikom H/Way Ugep	398806	644096
12	Wenwonmuka (2) Nig	Cal-Ikom H/Way Ugep	398943	644886
13	Meza-Oil Nig	Cal-Ikom H/Way Ugep	391136	644540
14	NNPC Nig (1)	Ediba Rd, Ugep	391543	641456
15	Ugotex	Ediba Rd, Ugep	398143	641564
16	Total Oil	Lukpal, Ugep	398765	641264
17	Okonosah Oil	Cal-Ikom H/Way Ekori	402616	648671
18	Tonimas	Cal-Ikom H/Way Ekori	402731	648789
19	Hokins	Cal-Ikom H/Way Ekori	402727	648902
20	Ekori	Ekori Town	403876	648782
21	Obemeo Oil	Cal-Ikom H/Way Ekori	4033603	648812
22	Mkpani	Cal-Ikom H/Way Mkpani	406654	645994
23	Kimmos Oil	Cal-Ikom H/way, Nko	409450	648009
24	Ogu Nig	Cal-Ikom H/way, Nko	409456	648015

Source: Field Survey, 2024

Table 4, contained the coordinates of the location of petrol filling in the study area which were captured with Garmin 76CSX handheld GPS receiver, description of the location and the name of the petrol filling station were all documented. The total number of the petrol filling station are 24 (both functional and non-functional) and are majorly located along (Calabar-Ikom Highway. See figure 1.

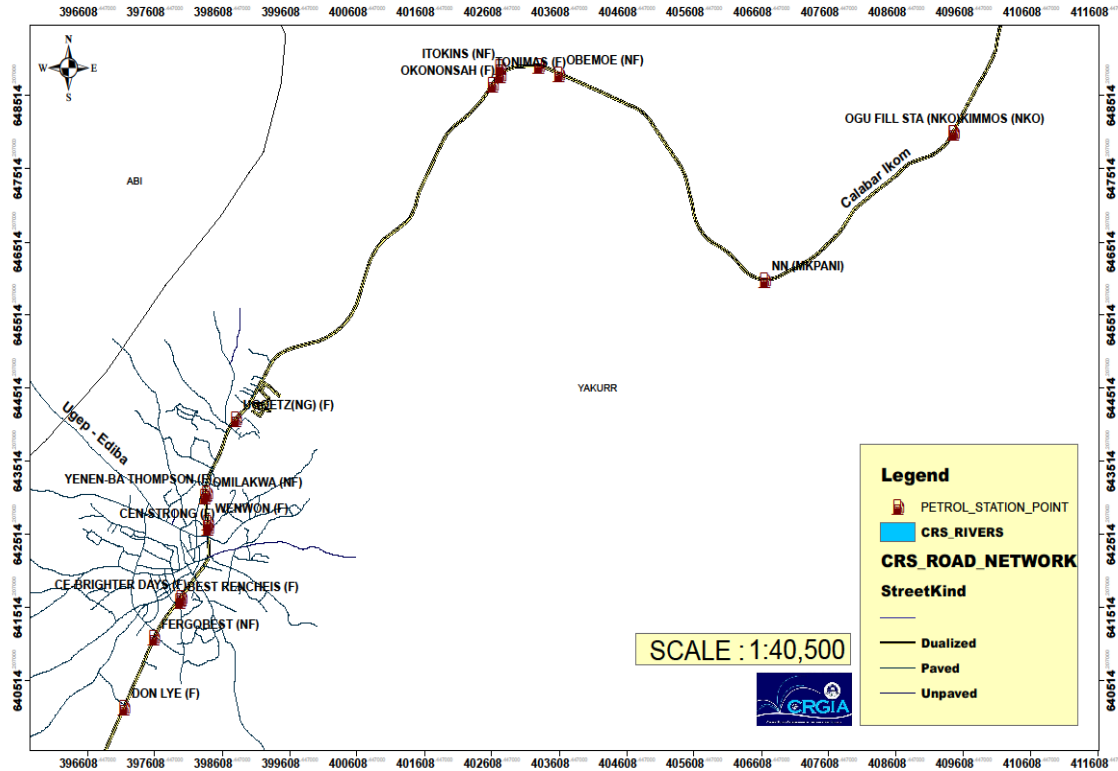


Figure 1. Map showing location of petrol filling stations in Yakurr LGA

Table 5: Level of compliance to 15M minimum setback allowable

S/N	Names	Description of location	Setback (m)	Remark	
				Adequate	Inadequate
1	Don Café FLS	Cal-Ikom H/Way Ugep	5m	-	Inadequate
2	Ekoko Nig.	Cal-Ikom H/Way Ugep	5m	-	Inadequate
3	Forgobest Oil	Cal-Ikom H/Way Ugep	6m	--	Inadequate
4	Best Renches	Cal-Ikom H/Way Ugep	16m	Adequate	-
5	Ce-Brighter Days	Cal-Ikom H/Way Ugep	15m	Adequate	-
6	Nobeg Oil	Cal-Ikom H/Way Ugep	17m	Adequate	-
7	Cen-strong Oil	Cal-Ikom H/Way Ugep	15m	Adequate	-
8	Wenwonmuka	Cal-Ikom H/Way Ugep	5m	-	Inadequate
9	Omilakwa	Cal-Ikom H/Way Ugep	6m	-	Inadequate
10	Yenen-ba Thompson	Cal-Ikom H/Way Ugep	5m	-	Inadequate
11	Ugotex Nig.	Cal-Ikom H/Way Ugep	5m	-	Inadequate

12	Wenwonmuka (2) Nig	Cal-Ikom H/Way Ugep	4m	-	Inadequate
13	Meza-Oil Nig	Cal-Ikom H/Way Ugep	5m	-	Inadequate
14	NNPC Nig (1)	Ediba Rd, Ugep	4m	-	Inadequate
15	Ugotex	Ediba Rd, Ugep	17m	Adequate	-
16	Total Oil	Lukpal, Ugep	6m	-	Inadequate
17	Okonosah Oil	Cal-Ikom H/Way Ekori	15m	Adequate	-
18	Tonimas	Cal-Ikom H/Way Ekori	8m	-	Inadequate
19	Hokins	Cal-Ikom H/Way Ekori	16m	Adequate	-
20	Ekori	Ekori Town	15m	Adequate	-
21	Obemeo Oil	Cal-Ikom H/Way Ekori	6m	-	Inadequate
22	Mkpani	Cal-Ikom H/Way Mkpani	13m	-	Inadequate
23	Kimmos Oil	Cal-Ikom H/Way Nko	15m	Adequate	-
24	Ogu Nig	Cal-Ikom H/Way Nko	15m	Adequate	-
Total			24	10 (41.67%)	14 (58.33%)

Source: Field Survey, 2024

According to the physical planning Standards set by DPR (2007), the distance from the road to filling station pump should not be less than 15meters. Direct measurement of the setback of the various stations were carried out and displayed in table 5. The number of filling stations that adhere to the minimum set back of 15 Metres are 10 (41.67%), while 14 (58.33%) do not adhere to the minimum standard. The level of compliance with set standard is quite poor.

Table 6: Minimum distance between petrol filling stations

Names	Nearest Neighbour	Distance Apart (M)	Remarks	
			Adequate	Inadequate
Don Café FLS	Ekoko Nig	200.10		Inadequate
Ekoko Nig.	Don Café FLS	200.10		Inadequate
Forgobest Oil	Ekoko	300.80		Inadequate
Best Renches	Fergobest	400.20	Adequate	
Ce-Brighter Days	Best Renches	400.10	Adequate	
Nobeg Oil	Ce-Brighter	400.10	Adequate	
Cen-strong Oil	Nobeg Oil	300.20		Inadequate
Wenwonmuka	Cen-Strong	300.20		Inadequate
Omilakwa	Wenwonmuka	900.80	Adequate	
Yenen-ba Thompson	Omilakwa	300.30		Inadequate
Ugoetz Nig.	Yene-ba Thompson	300.00		Inadequate

Wenwonmuka (2) Nig	Ugotex	300.15		Inadequate
Meza-Oil Nig	Wenwonmuka(2)	300.15		Inadequate
NNPC Nig (1)	Meza-Oil	400.15	Adequate	
Ugotex	NNPC Nig	400.15	Adequate	
Total Oil	Ugotex	400.60	Adequate	
Okonosah Oil	Total Oil	300.90		Inadequate
Tonimas	Okonosah Oil	300.90		Inadequate
Hokins	Tonimas	800.60	Adequate	
Ekori	Hokins	500.00	Adequate	
Obemeo Oil	Ekori	400.85	Adequate	
Mkpani	Obemeo	500.00	Adequate	
Kimmos Oil	Mkpani	600.10	Adequate	
Ogu Nig	Kimmos oil	600.40	Adequate	
Total		24	13(54.17%)	11 (45.83%)

Source: Field Survey, 2024

Table 6, shows the nearest neighbours and the distance between filling stations. According to NUPRC regulation, a proposed petrol filling station should be sited 400 meters away from the existing one. Distances between the PFS in the study area were determined in the ArcMap environment using Nearest Buffering Operation. The result shows that 13 (54.17%) of the petrol filling station in the study area complied with the regulatory standard of minimum of 400 Metres distance between stations, while 11(45.83%) did not complied to the set standard.

Table 7: Compliance with Fire Service Guidelines

Location	Facilities		
	Fire Extinguisher	Water	Sand Bucket
Ugep	2	3	0
Ekori	1	2	1
Mkpani	0	0	0
Nko	0	1	0
Total	3 (18.75%)	6 (37.5%)	1(6.25%)

Source: Field Survey, 2024

From table7, it is apparent that only 18.75% of the Petrol filling station have Fire Extinguisher to fight fire, 37.5% have water and 6.25% has bucket filled with sand. The situation is quite absurd and requires urgent attention

CONCLUSION AND RECOMMENDATION

This study explored the spatial distribution of petrol filling stations in Yakurr LGA. There is concentration of

petrol filling station along the major Calabar-Ikom highway which passes through the study area. However not all the settlements has equal chance of hosting a filling station. This unequal distribution results in uneven accessibility to filling station services for residents of Yakurr LGA. Furthermore, it is evident that many filling stations in the study area do not comply with the guidelines established by the Nigerian Upstream Petroleum Regulatory Commission (NUPRC), Fire Service and the Town Planning standards for their location. This non-compliance raises concerns about safety of life, environmental impact, economic loss, emotional stress, property loss and psychological trauma people go through whenever there is fire outbreak in a petrol filling station. Based on the findings, the following recommendations are offered. The NUPRC and Area Planning Authority Ugep, should ensure that developers include the geographic coordinates of the proposed site in the application materials for PFS siting. This can assist in updating the spatial database for the PFS and checking compliance with the distance to the next PFS, public buildings, road setbacks and residential buildings. It is also imperative that relevant regulatory bodies takes proactive measures to ensure strict compliance with the necessary criteria for establishing and operating filling stations within Yakurr. This action will not only enhance regulatory compliance but also promote safety of lives and property that are usually loss in the wake of inferno.

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