

Suitability Of Petrol Stations Sites And Their Implications On Maiduguri Urban Settlements, Borno Sate, Nigeria.

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Abstract: Location of petrol stations particularly in the urban center most at times subject the nearby settlements to high risk of hazards especially when environmental guidelines designed for their locations are not properly followed. With respect to this, the paper therefore examined the suitability of petrol stations sites at close proximities to residential houses in Maiduguri urban keeping in mind their: absolute locations; relief sites (elevations) of locations; how some plots of land were acquired for location of petrol stations and the implications of such location on Maiduguri urban settlements. As at 2010, there were 122 functional petrol stations located across 9 designated routes in Maiduguri urban with Airport/Kano route having the highest percent (19.67%) and Ali Kotoko-Gwange axis with the least (3.28%). Data for the study were sourced from field survey which ascertained the spatial location of the petrol stations, their elevations and co-ordinates using GPS (Garmin 76 CSX) devise. Structured interview with sampled residents within 100m radius of location to the sampled petrol stations and managers/workers of the petrol stations were also conducted. Questionnaires were equally issued to officials of MLS, DPR, FSD and URDB. The data obtained were therefore analyzed using descriptive statistics and GPS software and the results presented in charts, tables, and map. From the results, as revealed from the study, is evident that many residential hoses/shops co-exist with petrol station not in conformity with the standard urban planning as postulated by DPR requirements. As such, the residents were encouraged to form a central and recognized association or union which should serve as a medium through which individuals and collective rights to environmental safe living of the members are pursuit and protected. Before siting any petrol stations within the neighbourhoods of the members, the association should monitor the EIA exercise and resist any form of non-compliance to the report with respect to the DPR proximity guidelines.

Keywords: Profile, Co-ordinate, Petrol stations, Relief sites, urban settlements.

I. Introduction

Petrol Stations are installations that sells Petrol (PMS - Premium Motor Spirit), Diesel (AGO - Automobile Gas Oil) and Kerosene (DPK - Domestic/Dual Purpose Kerosene) for public consumption. The locations of these facilities are expected to follow a well-laid-down rules and regulations which are designed to be tolerably environmental friendly when effectively observed. That is, they are to be located on highways and in communities with convenient access roads for automobiles and away from crowded environments (Genovese, 2004). The fuel and oil in petrol stations are kept in underground metal reservoirs, while the pumps are placed on concrete platform where the fuel dispensers or bowsers are used to pump the petrol/gasoline, ethanol fuel, biodiesel, kerosene, or other types of fuel into vehicles, other types of machines or for local consumption (Spencer, 2004).

The first places to sell petrol in the world were pharmacies as their side business. Whereas the first Petrol station in the world was the City pharmacy in Wiesloch, Germany where Bertha Benz refilled the tank of the first automobile on its maiden trip from Mannheim to Pforzheim and back in 1888 (Daniel, 1979). Daniel further observed that, since 2008, a Bertha Benz Memorial Route therefore, commemorates this event. However, the world first purpose built petrol station was constructed in 1907 by Standard Oil of California (now Chevron) in Seattle Washington at what is called "Pier 32". Although, "Reighard's Gas Station" in Altoona Pennsylvania which was dated to 1909 claimed to be the oldest existing gas station in the United States of America; still, it was the "Standard Oil" who began erecting road side signs as their logo to advertise their petrol stations. Belson, (2008) affirmed that it was as a result of increase in automobile especially in the United States after "Henry Ford" started to sale automobile which the middle class can afford in the 1950s that resulted in a greater demand for petrol stations. In Nigeria, the first petrol station was established in Lagos by Total in 1956. Thereafter the number multiplied to other regions of the country. However, their classification and standard slightly differs from that of the other parts of the world. In accordance with the Department of Petroleum Resources (DPR) Nigeria, specification, purpose, capacity and location of a petrol station could determine its classification into either category 'A' or 'B'. Category 'A' Petrol Stations referred to industrial petrol stations. That is, petrol

stations located within the premises of institutions, establishments, companies and industries for their local consumptions. These petrol stations have few facilities and have small capacities. Category 'B' Petrol Stations are commercial petrol stations located on sites along major highways and streets within towns, cities, outskirts of towns/cities and in villages' en route major highways to dispense fuel/oil to public at payment of regulatory price.

It is important to note also that petrol station activities fall within risk operational status. Because, they are hazardous workplace that stored and sales highly flammable liquid so they are required to be licensed properly. As such, their immediate environment is subjected to great risk as viewed by European Fuel Oxygenated Association, (EFOA, 1999). In view of this, such socio-economic project is expected to be considered in terms of the society's demography, local community, transport and traffic, housing and employment. It equally advanced that the safety of people and protection of the environment should at all times be the major concerns at petrol stations because they are potentials for accident especially where the general public has unrestricted access. In designing, construction and operation of such facilities the necessity for caution should be of paramount importance. This paper therefore aims at examining the suitability of location sites of petrol stations with their implications on residents in Maiduguri urban considering only functional petrol stations as at 2010 that falls under category 'B' as provided for under the Petroleum Regulation Act CAP 150 of 1967 and certified for "Approval To Construct" (ATC).

Statement of Problem

Since petrol is a mixture of many organic substances and has properties that can cause fire, explosion, health and environmental hazards if misused, any site chosen for petrol stations should be sufficiently spacious to minimize the risk of any unauthorized person to be at, or near them (EFOA, 1999). They should be located away from normal human traffic and isolated from other building entrances and exits or places of public assembly such as: places of worship, schools, hospitals, shopping centers/malls, hotels, offices, town centers, cinema/theaters, bus interchanges, community club/centers, cinemas/theaters, railway stations, airports, hawker centers/restaurants/fast food centers/night club, galleries/museum, stadiums, swimming complex, custom check points, amusement centers, recreational premises, zoos and parks. Even the route for tank-vehicles leading to petrol stations should not pass through or be near them (Wikipedia, 2010).

In Nigeria, for instance the guidelines for location and operation of petrol stations which affect category 'B' as provided for under the Petroleum Regulation Act CAP 150 of 1967, stipulated clearly that the application for the issuance of license to all petrol stations categories shall be through DPR. DPR is vested with the responsibility to determine whether or not an application is suitable for "Approval to construct" (ATC). Despite this however, it is common to see petrol stations located in the midst of residential houses or sharing walls with people houses in Maiduguri urban. It is against this the paper examined the suitability of those petrol station sites in relation to their implications on the residents.

Objectives of the Study

The paper examine the suitability of petrol stations sites and their implications on the residents of Maiduguri urban. Specifically, it examined: the absolute location of the petrol stations; the relief sites (elevations) of these petrol stations; how some plots of land were acquired for location petrol stations and the implications of the locations of the petrol stations on Maiduguri urban settlements.

Study Area

Maiduguri is the capital of Borno State and the most populated settlement in the Northeast, Nigeria (1,197,497 people on a landmass of 137,356 sq km) (NPC, 2010). Located between Latitudes $11^{\circ} 46' 18''\text{N} - 11^{\circ} 53' 21''\text{N}$ and Longitudes $13^{\circ} 02' 23''\text{E} - 13^{\circ} 14' 19''\text{E}$ (Google Earth, 2012), its topography is made up of undulating plains of the Chad Formation that lies at a mean level of 320m asl with gradual sloping towards the Lake Chad level at 282m asl. These urban landforms therefore are classified as plains and ridges comprising of palaeo-locustrian and flood plain with undulating terrain drained by River Ngadda into the Ngadda delta popularly called the "Jere-Bowl" (Nyanganji, 1996). As such, the topography largely favours the locations of structures like petrol stations which require spacious and relatively flat terrain for convenient location.

II. Methodology

Petrol stations in Maiduguri were classified into: functional (fl) 122, non-functional (nf) 16 and under-construction (uc) 19. However, only 'fl' petrol stations were considered in this paper. Data for the study were therefore obtained through administration of questionnaires, interview schedules and field measurement. Records from DPR, MURD, FSD, MLS offices and proprietors/managers of petrol stations were equally sourced. GIS (Garmin 76 CSX) device was equally used to determine the co-ordinates and elevations of the petrol stations across the entire routes.

Purposive and random sampling techniques were employed at different stages for obtaining data based on the petrol stations routes in the urban: Thirty percent of the 122 functional petrol stations were selected at random to give 38 sampled petrol stations across the 9 routes (Table 1). Around each of the sampled petrol stations, 3 household heads and 1 shop operator (where the two were available) within 100m radius of location were randomly selected and issued questionnaire/interview schedule to give a total of 152 respondents. In each of the sampled petrol stations also, 3 workers were equally selected at random to give a total of 114 respondents. Five officials of DPR, MURD, FSD each and 15 officials of MLS were equally picked at random as samples that gave a total of 30 respondents. The data were then analyzed using simple descriptive statistics such as frequencies, percentages and the use of GPS Software to plot the elevation sites of the petrol stations and the results presented in figures, charts, tables and map.

III. Result And Discussion

Profile of Petrol Stations in Maiduguri According to Routes

Tables 1. Showing petrol stations based on routes, year of establishments, elevations and co-ordinates.

S/n	Route	Establishment	Elevation	Co-ordinate
a. AIRPORT/KANO ROAD				
01	Total Petroleum Co. Nig. Ltd	1986	295.8m	N 11° 50' 05.3" / E 013° 06' 43.9"
02	Mobil Petroleum Co. Nig. Ltd.	1987	337.6m	N 11° 50' 05.7" / E 013° 06' 39.5"
03	Tafida Bafari Oil Co. Nig. Ltd	1990	337.4m	N 11° 50' 05.6" / E 013° 06' 36.7"
04	A.A. Rano Nig. Ltd.	1995	351.6m	N 11° 50' 04.7" / E 013° 06' 33.3"
05	NNPC Affiliate (A. U. N. Petroleum)	1999	332.8m	N 11° 50' 05.0" / E 013° 06' 28.4"
06	Kagum Oil Co Nig. Ltd.	1988	335.3m	N 11° 50' 04.8" / E 013° 06' 25.2"
07	Omar Oil Nig. Ltd.	1995	330.7m	N 11° 50' 05.8" / E 013° 06' 07.1"
08	Ali Adamu Nig. Ltd.	1985	339.5m	N 11° 50' 06.2" / E 013° 06' 05.6"
09	Oando Petroleum Co. Nig. Ltd.	1980	336.8m	N 11° 50' 05.8" / E 013° 05' 57.9"
10	Oando Petroleum Co. Nig. Ltd.	1982	333.6m	N 11° 50' 06.4" / E 013° 05' 55.7"
11	NNPC Affiliate (Usman N. Petrol.)	2008	329.4m	N 11° 50' 04.6" / E 013° 05' 54.3"
12	Rahamaniyya Oil & Sons Nig.	2001	338.5m	N 11° 50' 08.3" / E 013° 05' 31.1"
13	NNPC Affiliate (Halima S. Nig. Ltd)	2002	333.5m	N 11° 50' 11.2" / E 013° 05' 12.9"
14	Oil NC Angus Oil (WA) Ltd.	1997	339.6m	N 11° 50' 37.0" / E 013° 03' 56.0"
15	Alh.Umar Ngelzarma Co Ltd	1997	331.1m	N 11° 50' 38.7" / E 013° 03' 38.9"
16	Lakebato Petroleum Ltd	1993	334.1m	N 11° 50' 39.9" / E 013° 03' 30.2"
17	Asaija Oil Nig.Ltd	2001	329.7m	N 11° 50' 42.3" / E 013° 03' 06.9"
18	Alh. Adamu Garba Nig. Ltd.	1976	328.9m	N 11° 50' 43.9" / E 013° 02' 57.1"
19	Kime & Sons Nig. Ltd	1996	325.9m	N 11° 50' 41.3" / E 013° 02' 45.0"
20	Conoil Petrol. Co. Nig. Ltd.	1983	334.0m	N 11° 50' 40.5" / E 013° 02' 53.6"
21	NNPC Affiliate (Bukar Kolo & Sons)	2006	329.4m	N 11° 50' 37.1" / E 013° 03' 31.3"
22	Gana Petroleum Co. Nig.Ltd.	1984	330.3m	N 11° 50' 07.7" / E 013° 05' 13.6"
23	Gumalti Petroleum Ltd.	2008	331.4m	N 11° 50' 02.9" / E 013° 05' 50.7"
24	Masida Nig. Ltd.	2010	332.6m	N 11° 50' 02.7" / E 013° 06' 30.7"
b. AHMADU BELLO WAY				
01	NNPC Affiliate (Bar Beach Petrol. Ltd.)	1990	320.9m	N 11° 49' 11.5" / E 013° 10' 13.3"
02	A.A. Kime & Sons Nig. Ltd	1985	328.3m	N 11° 49' 13.3" / E 013° 10' 08.4"
03	NNPC Affiliate (Fezzan Oil Nig. Ltd.)	2002	322.5m	N 11° 49' 30.5" / E 013° 09' 23.5"
04	Conoil Petroleum Co. Ltd. (Shell Petrol)	1965	325.2m	N 11° 50' 12.6" / E 013° 08' 59.8"
05	A.P. Nig. Co. Ltd. (B. P. Co. Ltd.)	1975	315.3m	N 11° 50' 14.2" / E 013° 08' 57.1"
c. ALI KOTOKO/GWANGE AXIS				
01	Joslim Petrol. & General Marketing Co.	1981	324.0m	N 11° 50' 01.4" / E 013° 09' 31.5"
02	Kime & Sons Nig. Ltd.	2008	320.6m	N 11° 50' 00.2" / E 013° 09' 29.5"
03	Alh.H. Yahaya & Sons Petroleum Ltd.	1979	317.7m	N 11° 50' 03.4" / E 013° 09' 44.4"
05	Isaram Nig. Ltd.	2007	319.7m	N 11° 50' 34.8" / E 013° 09' 55.6"
d. BAGA ROAD				
01	Abelson & Haulage Co. Ltd.	2009	323.7m	N 11° 51' 35.4" / E 013° 08' 55.9"
02	Oil Links Lubrication. Ltd.	2008	329.8m	N 11° 51' 45.1" / E 013° 08' 42.7"
03	Umar Gujja Nig. Ltd.	2006	323.2m	N 11° 51' 46.2" / E 013° 08' 40.6"
04	A. Bukarye Petroleum Ltd.	2000	319.4m	N 11° 51' 38.9" / E 013° 08' 17.5"
05	Oando Petroleum Co. Nig. Ltd (Agip)	1982	317.8m	N 11° 51' 41.1" / E 013° 08' 15.1"

06	Haladu/Sons Nig. Ltd.	1982	325.4m	N 11° 52' 04.1" / E 013° 07' 24.3"
07	M.M. Gana Nig. Ltd	*	322.5m	N 11° 52' 04.9" / E 013° 07' 22.6"
08	A.I.M. Kore Petroleum Ltd.	*	329.7m	N 11° 52' 10.6" / E 013° 07' 19.4"
09	A.B. Malum Petroleum Ltd.	2010	322.3m	N 11° 52' 17.2" / E 013° 07' 12.0"
10	Alh. Auwal Ali & Co. Ltd.	1986	296.8m	N 11° 52' 14.6" / E 013° 07' 29.4"
11	Texaco Petroleum Nig. Ltd.	1981	323.7m	N 11° 52' 34.6" / E 013° 07' 04.6"
12	Fanna Dore Invest. Nig Ltd.	1988	324.6m	N 11° 52' 41.7" / E 013° 06' 58.4"
13	Falari Invest. Nig. Ltd.	2002	321.2m	N 11° 53' 04.6" / E 013° 06' 47.7"
14	Hamsad/Sons Nig. Ltd.	1998	321.3m	N 11° 53' 05.4" / E 013° 06' 49.6"
15	Gambos Interprise. Nig. Ltd	1998	322.4m	N 11° 53' 14.6" / E 013° 05' 38.5"
16	Gajiram Nig. Ltd.	2000	317.1m	N 11° 54' 10.0" / E 013° 05' 53.3"
17	NNPC Affiliate (Mohiba Oil Nig. Ltd.)	1972	320.5m	N 11° 52' 24.9" / E 013° 07' 05.4"
18	Oando Petroleum Co. Nig. Ltd (Texaco)	*	315.4m	N 11° 51' 41.0" / E 013° 08' 09.3"
19	Gamaye Petroleum Nig. Ltd.	2008	315.8m	N 11° 51' 19.2" / E 013° 07' 56.0"
e. BAMA ROAD				
01	NNPC Affiliate (Shetiram Petrol. Co.)	1985	322.7m	N 11° 50' 18.1" / E 013° 10' 33.0"
02	Moh'd Mustapha Ali Nig. Ltd.	1980	335.4m	N 11° 49' 54.2" / E 013° 10' 40.5"
03	Total Petroleum Co. Ltd.	1982	322.3m	N 11° 49' 09.9" / E 013° 10' 48.9"
04	A.B. Hassan & Co Ltd.	1989	321.1m	N 11° 49' 08.3" / E 013° 10' 48.8"
05	A.B.M. Oil Nig. Ltd.	1988	326.5m	N 11° 49' 06.1" / E 013° 10' 49.5"
06	Oando Petrol. Co. Ltd. (Agip Petrol.)	1979	320.4m	N 11° 48' 43.3" / E 013° 10' 54.3"
07	Moh'd Ahmed Oil Nig. Ltd.	1980	328.5m	N 11° 48' 39.5" / E 013° 10' 56.9"
08	Oando Petrol. Co. Ltd. (Bams Concept)	2008	334.0m	N 11° 48' 24.8" / E 013° 11' 04.3"
09	Total Petrol.Ltd(Hassan Petrol./ eLf Oil)	1986	331.8m	N 11° 48' 13.7" / E 013° 11' 12.5"
10	Hassan Petroleum Co. Nig. Ltd.	1986	342.3m	N 11° 48' 13.4" / E 013° 11' 13.5"
11	Ferrobe Brothers & Co. Nig. Ltd.	1988	323.3m	N 11° 48' 12.0" / E 013° 11' 14.4"
12	A.P. Nig. Co. Ltd. (Dunoma Ventures)	2007	327.4m	N 11° 47' 56.0" / E 013° 11' 35.4"
f. DAMBOA ROAD/ GRA AXIS				
01	Citi Centa Petroleum Product Ltd.	2009	334.1m	N 11° 47' 15.2" / E 013° 07' 26.9"
02	Umar Gamaye & Sons Nig. Ltd.	2009	333.7m	N 11° 47' 21.1" / E 013° 07' 36.3"
03	S. Baba Brothers Nig. Ltd.	1993	330.8m	N 11° 47' 32.1" / E 013° 07' 38.0"
04	Tri Quest Energy Nig. Ltd.	1996	330.0m	N 11° 47' 35.4" / E 013° 10' 15.2"
05	Mohammed Ahmed Oil Co. Ltd.	1993	330.0m	N 11° 47' 47.5" / E 013° 07' 43.6"
06	A. P. Petroleum Nig. Ltd.	1984	313.4m	N 11° 49' 00.0" / E 013° 08' 28.5"
07	Borno Supply Co. Ltd.	1983	330.7m	N 11° 48' 39.3" / E 013° 09' 01.6"
08	Total Petroleum Nig. Ltd.	1998	335.9m	N 11° 50' 00.1" / E 013° 07' 02.3"
09	Bilyam Marketting Co. Nig. Ltd.	1996	333.2m	N 11° 49' 24.2" / E 013° 07' 04.3"
10	Kolomi Yusuf & Co. Ltd.	1992	331.5m	N 11° 49' 21.6" / E 013° 07' 04.0"
11	Gutti Nig. Ltd.	1993	331.2m	N 11° 49' 17.5" / E 013° 07' 06.5"
12	M. K. Monguno & Co. Ltd.	2002	331.4m	N 11° 49' 21.3" / E 013° 07' 05.3"
13	Biu Oil Nig. Ltd.	1990	331.2m	N 11° 49' 07.2" / E 013° 07' 09.9"
14	KABS Merchants Nig. Ltd.	2000	332.1m	N 11° 49' 05.5" / E 013° 09' 09.7"
15	NNPC Affiliate (Mega Station)	2010	330.8m	N 11° 27' 37.5" / E 013° 07' 20.4"
16	M. L. Mahabub Nig. Ltd.	2006	331.3m	N 11° 49' 01.9" / E 013° 07' 11.2"
17	Wudi Ventures Nig. Ltd.	2008	332.0m	N 11° 49' 00.3" / E 013° 07' 11.6"
18	M. B. Maidoki Nig. Ltd.	1996	326.7m	N 11° 48' 09.5" / E 013° 07' 17.9"
19	M. B. Maidoki Nig. Ltd.	2010	324.3m	N 11° 48' 45.3" / E 013° 07' 15.3"
20	NNPC Affiliate (Mega Station)	2007	342.4m	N 11° 46' 34.4" / E 013° 07' 04.7"
g. GAMBORU - NGALA ROAD				
01	Bintu Petroleum Co. Ltd.	2000	315.2m	N 11° 51' 02.4" / E 013° 10' 56.0"
02	A.B.M Babawo Nig. Ltd.	2010	323.2m	N 11° 51' 06.6" / E 013° 11' 02.1"
03	NNPC affiliate (Usman Namnam Petrol)	2009	314.6m	N 11° 51' 06.9" / E 013° 11' 12.1"
04	A.G.U. Imam Petroleum Co. Ltd.	2009	316.2m	N 11° 51' 08.6" / E 013° 11' 21.2"
05	Total Petroleum (eLf Petrol.)	2001	311.9m	N 11° 51' 13.2" / E 013° 11' 37.9"
06	Shetiram Petroleum Co. Ltd.	1995	318.2m	N 11° 51' 35.6" / E 013° 12' 54.1"
07	Umar Wade Wade Petrol. Co. Ltd.	2008	314.8m	N 11° 51' 49.7" / E 013° 13' 56.8"
08	Makoa Adam & Co. Ltd.	2008	260.4m	N 11° 51' 52.2" / E 013° 14' 01.0"
09	A.M.T. Abubakar (NNPC Affiliate)	1985	328.9m	N 11° 51' 33.6" / E 013° 12' 55.1"
10	Oil Links Lubrication Ltd	1999	284.2m	N 11° 51' 37.6" / E 013° 13' 02.4"
11	Gamaye Petroleum Co. Ltd.	1997	325.2m	N 11° 51' 37.0" / E 013° 13' 48.0"
12	Insha-Allahu Co. Ltd	1992	319.2m	N 11° 51' 38.5" / E 013° 13' 13.5"
13	Alh. Fantami Ali & Co. Ltd.	1988	327.9m	N 11° 51' 40.2" / E 013° 13' 20.7"
14	Daujid International Co. Ltd.	2010	313.3m	N 11° 51' 56.6" / E 013° 14' 20.9"
15	Alh. Bukar Gujiari & Co. Ltd.	1997	306.3m	N 11° 52' 01.7" / E 013° 14' 32.0"
16	A.B. Kori Ventures Nig. Ltd.	2000	307.5m	N 11° 52' 00.6" / E 013° 14' 36.8"
17	A.A Kime Petroleum Co. Ltd.	2000	324.4m	N 11° 52' 04.6" / E 013° 14' 54.6"
18	Ambursah & Sons Ltd.	1986	308.6m	N 11° 52' 09.3" / E 013° 15' 02.4"
19	Hassan Hussain Co. Ltd.	1999	330.7m	N 11° 52' 11.8" / E 013° 15' 19.5"
20	NNPC Affilia. (Waal Manawagi)	2009	307.6m	N 11° 52' 16.3" / E 013° 15' 37.9"
21	Lariskee Nig. Ltd.	1990	323.7m	N 11° 52' 16.3" / E 013° 15' 37.9"
22	Wal Amire Petroleum Co. Ltd.	2000	313.3m	N 11° 51' 56.2" / E 013° 14' 22.9"

h.	POMPOMARI BY-PASS			
01	Jakana Brothers Petroleum Nig. Ltd.	2010	330.6m	N 11° 51' 11.8" / E 013° 06' 24.4"
02	Chachabe Investment Co. Ltd.	2010	335.2m	N 11° 51' 05.2" / E 013° 06' 20.2"
03	Umar Alad & Sons Nig. Ltd.	2010	329.9m	N 11° 50' 56.8" / E 013° 06' 09.5"
04	Fulawama Nig. Ltd.	2010	327.7m	N 11° 50' 29.1" / E 013° 05' 53.8"
05	NNPC Affiliate (Ta'aye & Sons Ltd.)	2008	334.5m	N 11° 50' 14.5" / E 013° 05' 49.2"
i.	SIR KASHIM IBRAHIM – OLD MAID.			
01	Avenue of Sudan Nig. Ltd. (AP Co. Ltd)	1973	323.2m	N 11° 50' 56.2" / E 013° 10' 25.8"
02	NNPC Affiliate (Alh. Umar G. Petrol.)	1970s	318.0m	N 11° 51' 23.6" / E 013° 09' 49.0"
03	Shetiram Co. Nig. Ltd.	2007	310.3m	N 11° 51' 31.2" / E 013° 09' 21.6"
04	Conoil Petroleum Co. Ltd.	1960	324.7m	N 11° 51' 03.9" / E 013° 08' 35.8"
05	Oando Petroleum Co. Nig. Ltd.	1960s	320.8m	N 11° 51' 01.7" / E 013° 08' 34.4"
06	M.R.S Petroleum Co. Ltd.	*	319.2m	N 11° 50' 59.9" / E 013° 08' 34.9"
07	Total Petroleum Co. Nig. Ltd.	1979	320.8m	N 11° 50' 51.9" / E 013° 08' 36.8"
08	Mobil Petroleum Co. Nig. Ltd.	1989	343.4m	N 11° 50' 47.0" / E 013° 08' 39.4"
09	A.P. Petroleum Co. Nig. Ltd	1982	322.7m	N 11° 50' 34.4" / E 013° 08' 49.8"
10	Issalam & Sabur Investment Ltd.	2010	308.9m	N 11° 53' 30.2" / E 013° 10' 46.0"
11	Montering R.M.I. Nig. Ltd.	2001	315.9m	N 11° 52' 43.4" / E 013° 10' 34.2"

Source: Field Survey, 2011

Table 2. Summary of Spatial Location of Functional Petrol Stations in Maiduguri

S/n	Routes	Functional (fl)	Percentage (%)
01	Airport / Kano Road	24	19.67
02	Ahmadu Bello Way	05	4.10
03	Ali Kotoko / Gwange Axis	04	3.28
04	Baga Road	19	15.57
05	Bama Road	12	9.84
06	Damboia Road / GRA Axis	20	16.39
07	Gamboru-Ngala Road	22	18.03
08	Pompomari By-pass	05	4.10
09	Sir Kashim Ibrahim- Old Maid. Axis	11	9.02
	Total Routes:- 09	122	100

Source: Field Survey, 2011

The concise profile of petrol stations in Maiduguri as revealed in Table 1, shows the 122 functional petrol stations located unevenly across the routes. Out of the 122 petrol stations, Airport/Kano road has 19.67% which is the highest percentage (Table 2). This number might have been triggered as a result that, it is one of the routes that connect Maiduguri urban to some of the towns/cities in the country (Nigeria). As such, the volume of vehicles travelling through it were much, therefore the demand for petroleum products to power those vehicles might have necessitated the indiscriminate/proliferation of the petrol stations along the route. Moreover, over the years, they had been competition over plots of land for the locations of petrol stations, shops and residential houses along this route because of the likelihood of its economic viability which consequently leads most of the petrol stations sharing neighborhoods with residential houses/shops. This situation makes lives and the environment highly vulnerable to risk and hazards. Ali Kotoko/Gwange axis on the other hand had the least number of petrol stations with 4 (3.28%). This might equally be as a result of the fact that the route(s) is located within the heart of Maiduguri urban where the settlements pattern is clustered, unplanned, ancient and not convenient for petrol stations. However, some of those few petrol stations located within this route were squeezed in the few available spaces just to make good business.

Relief Sites (Elevations) of the Petrol Stations in Maiduguri

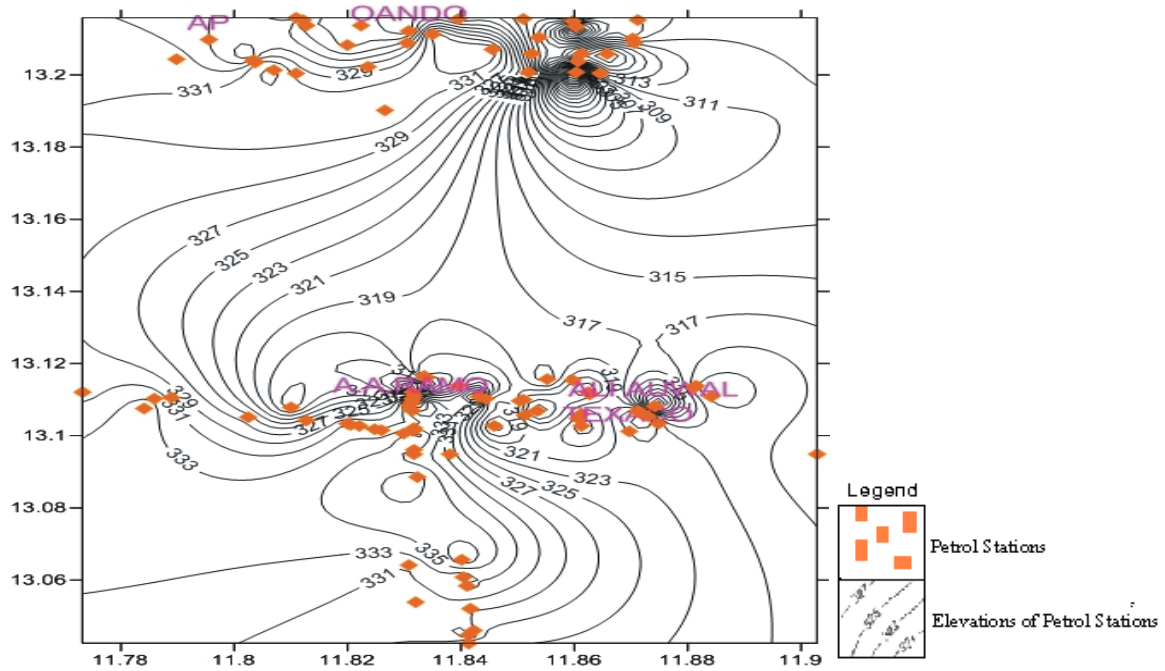


Fig. 1. Relief Sites of Petroleum Stations in Maiduguri

Source: Generated from DEM of the Relief Map, 2011

The relief sites of the petrol stations as shown in Figure 1 revealed the variations in the heights or elevations of the petrol stations in Maiduguri urban. The essence of taking the height of each petrol station along side their co-ordinates is to assess the elevations in relation to proximities of these petrol stations individually with the view to ascertaining the likelihoods of those sited on plains and those on higher elevations each of which was labeled by the GIS Software as obtained in the field. The height variance is one of the possible effects that might have influenced the distance and velocity of some of the pollutants generated by the petrol stations that travel round the residential houses in their neighborhoods. It equally aid in examining whether or not the height variance has significant effect on these residential houses of which their number plays vital role in the pollutants generation. From the result as revealed in Figure 1 therefore, the height variance of the petrol stations in the Maiduguri urban is insignificant as compared with the mean height of the entire urban (residential houses): 320m above sea level (Nyanganji, 1996). This implies that the elevations of these petrol stations have likely contributed little or no effect to the severity of some of the danger variables such as air and soil pollution on the residential houses at close proximity to the petrol stations.

As revealed by the Figure 1 also, the heights (elevations) of these petrol stations were determined by the use of the height values of the GPS devise (Garmin 76 CSX). However, because of the closeness and volume of the data of these petrol stations (Tables 1), if each is considered, the out put may be clumsy. Only few petrol stations therefore were labeled.

Acquisition of Plots of Land for Petrol Stations

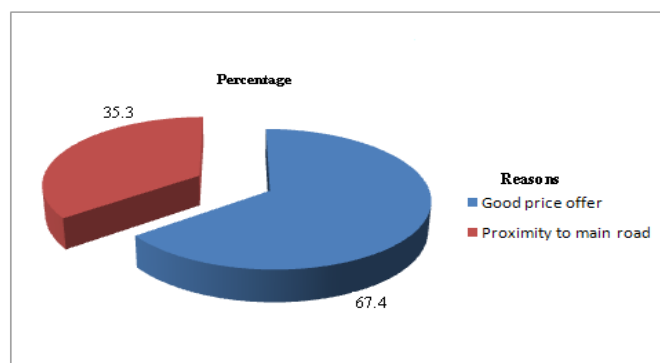


Figure 2: Residents Response on how Plots of Land were acquired for Petrol Stations

Source: Field Survey, 2011

The study also revealed major reasons for the selling of already built houses or plots of land initially reserved or meant for residential purpose for locations of petrol stations (Figure 2). This include good price offered (67.4%) and proximity to main road (35.3%). The combination of these factors therefore, often leads to the mass and indiscriminate locations of petrol stations at the expense of human health and environmental safety in the study area.

From the study as gathered generally, land in Maiduguri like any other part of Nigeria is owned by individuals who to some extent reserve the right to access them based on choice of usage. Some of these plots of land found at strategic locations in Maiduguri and which are suitable for lucrative businesses such as petrol stations were inheritance from the original owners who possessed them as farmlands and residential plots of land when urban development was not well pronounced. On claims of such plots by usually numbers of heirs, most at times family conflicts due compelled them to sell-off those plots or the houses to higher bidders who were mostly petrol stations business people. Government over the years also has not shown much interest or commitment in the control of land matter in the urban. This is evident in the way some individuals managed land usage with total disregard to urban planning and EIA Laws as a result of institutional weakness in governance.

Residents at close Proximities to Petrol Stations' Fear

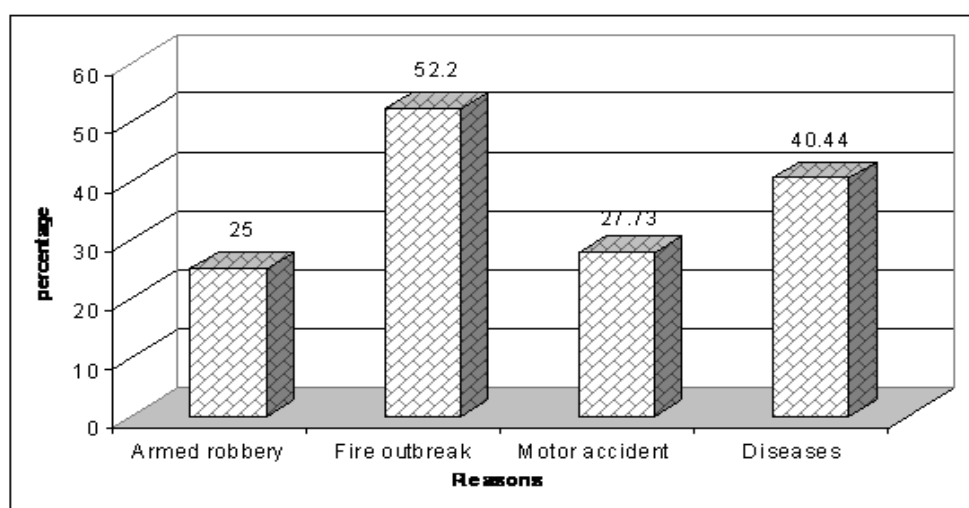


Figure 3: Residents at Close Proximities to Petrol Stations Response to Fear (n = 136).

* Multiple responses, thus percent > 100%

Source: Field Survey, 2011

The likelihood of residents at close proximities to petrol stations living in fear as a result of the locations and activities of the petrol stations as presented in Figure 3 was ascertained. The result as shown in the Figure 3 indicates that more than half (52%) of the residents attributed their fear to possibility of fire outbreak. The least percent (25%) mentioned armed robbery. These feelings are in agreement with the assertion of EFOA, (1999) that robbery of goods or cash may place petrol stations workers and the people living close-by at risk of violence. In general assessment, such types of economic activities are likely to pose threat to both people and the environment. Helsink, (2000) also affirmed this in his work when he observed that petrol stations are hazardous work place because they sale highly flammable liquid. As such, their immediate environment is subjected to risk. From the result therefore, siting petrol stations viz-a-viz residential homes have significantly impacted negatively on the residents' psychological wellbeing as a result of its adverse implication.

Implications of Faulty Location Sites of Petrol Stations on Maiduguri Urban Settlements

Urbanization, which is the transformation of settlements from a rural to urban character, can be viewed also as a process by which towns and cities are growing and developing (Ojo, et al. 1999; Emielu, 2003). In virtually every country of the world therefore, there are large cities, some of which have several millions people. Cities generally are the main centers of economic, political and social activities of their respective regions or counties (Ojo, et al. 1999). In their planning process for development therefore, Susan, (2008) affirmed that it is important to give much consideration to measures that reduces hazards. Urban planners are expected at all times to assess possible hazards in the planning in order to promote ways of avoiding hazards, risk and vulnerability. Norson, (1999) equally observed that hazards associated with urban development are usually threat and future source of danger because they have the potential to cause harm to people (death, injury, disease and stress); harm to human activities (economic and educational activities); harm to property (property damage and economic loss)

and environmental harm (loss of fauna and flora, pollution and loss of amenities). All these pose risk to individuals and the community.

Locations of petrol stations within towns and cities in Nigeria as observed by DPR, (2011) is part of urbanization that become imperative to meet the ever increasing demand for petroleum products by motorists, industries, institutions, shops, residences and individuals to serve their needs. In the recent years therefore, there had been progressive increase in the number of petrol stations particularly Maiduguri urban. From 1960 to 1989 (a period of 30 years) for instance, there were only 42 petrol stations in Maiduguri urban (Tables 1). Between 1990 and 2010, 115 petrol stations were added to the number given rise to 157 petrol stations with 122 as functional. This clearly shows that there was 274% increase within the space of ten years. It is also important to note that even though the locations of these petrol stations within the immediate neighborhoods of residential houses, places of public assembly and close to one another in Maiduguri urban boost economic activities; facilitate urban growth; provide employment and other essential services, as confirmed by John et al.(1994) that many petrol stations also have convenience stores which sell food, beverages, cigarettes, lottery tickets, motor oil and sometimes auto parts and in some U.S states they even sell beer, wine and liquor are sold in petrol stations. Squeezes, towels, toilet facilities, air compressors for tire gauge and water machine were equally provided for customer's uses, yet they pose threat to both human and environmental safety. With regard to this, such conveniences should not be enough to mortgage people's lives and the environment.

Taken Pompomari by-pass (route) as a typical example of urban growth devoid of adherence to effective urban planning culture, the road was transformed into dual carriage by the Borno state government in 2008. Within two years of its transformation, seven petrol stations were already sited along this route. The presence of the road might have stimulated the location of the petrol stations which in effect might have serve as contributing factor as to why good number of residential houses, hotels, companies, security outfit, private and government establishments were attracted to the neighborhoods of these petrol stations. This therefore, has confirmed the assertion of Genovese, (2004) that, the presence of petrol stations usually provide avenue for food outlets, hotels, arcade games, shops and restrooms for people travelling through the petrol stations routes. However, as important as these petrol stations are to the development of Maiduguri urban, their negative effects on its environment are evident. This is as a result of the non-conformity of most of them to the guidelines provided by the DPR with regard to their suitability on their present sites.

IV. Conclusion

Petrol stations activities become lucrative business in Maiduguri over the years due to the growing population and increment in means of transportation. However, their number and suitability on sites within the urban as provided by DPR guidelines have not been followed. In consequence their proliferations at close proximity to one another, residential areas or places of public assembly became evident. It is common to see residential houses and shops being demolished and their plots being converted to petrol stations in the midst of public areas. This is a gross violation to DPR guidelines and EIA Decree of 1992. Moreover, since the Ministries and Agencies responsible for land allocation did not specified or educate the populace on categories of commercial purpose a land designated as "Commercial Land" should be use, the proliferation of those petrol stations might have capitalized on this faulty prescription. This situation has therefore led to negative effects such as location of petrol stations in chains close to residential houses and shops with their attending implications like: arm robbery, fire outbreak as a result of fuel spill and motor accident, respiratory tract infections diseases as a result of pollutions from spill and improper wastes disposal. The resultant effects, subjects the residents to petrol stations related hazards leaving most of them with very slim option of relocation.

V. Recommendations

- Individual residents already affected by the petrol stations related hazards, should promptly seek for medical help and avoid self medication. They should equally look for alternative locations in order to mitigate the severity of the health and environmental threat associated with the petrol stations activities.
- Ministry of Environment in collaboration with DPR should assist the petrol stations by formalizing their staff training in an institute. This institute should be affiliated to recognized institutions where they should receive periodic training on environmental matters and other important aspect relating to their work to help them in mitigating any potential risk that may arise in the cause of working.
- The residents living at close proximities to petrol stations in Maiduguri should be encouraged to form a central and recognized association or union where the individuals and collective rights to environmental safe living of the members will be pursuit and protected. Before siting any petrol stations within the neighborhoods of the members, the association is to monitor the EIA exercise and resist any form of non-compliance to the report with respect to DPR proximity guidelines.

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