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Environmental Effects of Petrol Stations at Close Proximities to Residential Buildings in Maiduguri and Jere, Borno State, Nigeria

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Abstract: *Proliferation of petrol stations in Maiduguri and Jere has now reached a level of unimaginable nightmare with perceived consequences on both human health and the environment. It is against this the paper evaluates the environmental effects of the petrol stations in their neighbourhoods in Maiduguri and Jere. Specifically, it examined the presence of those petrol stations vis-a-vis residential houses within 100m radius of location in the township; hazards associated with their activities/operation; and the perception of residents/petrol stations workers on the effects pose by those petrol stations. Only purposed-built petrol stations both functional and non-functional as at 2010 were considered in the study. Out of the 138 petrol stations in the study area, 122 (88.41%) were functional and 16 (11.59%) were non-functional. These petrol stations are spatially located unevenly across the major road network in the township. Data for the study were therefore obtained through field survey where the functional statuses of those petrol stations were recorded and GPS (Garmin 76 CSX) devise was equally used to determine their co-ordinates. Three household heads around each of the 35 sampled petrol stations were randomly sampled to provide information on the activities of the petrol stations that are either improving on the well-being of the residents or detrimental to their lives. From the sampled petrol stations also, two workers each were selected at random to source vital facts on the way and manner they are carrying out their duties and knowledge with regards to DPR guidelines. Five staff of DPR and FSD, each were also used as samples for the study. Data sourced were then analyzed using simple descriptive statistics and GIS Software and the results presented in charts and tables. The finding revealed that the guidelines for siting petrol stations have not been adhered by most of the petrol stations thereby posing serious hazards on residence in close proximity to them even though some of these petrol stations were located much earlier than the residential houses close to them. It is expected of the State legislature therefore to enact law forbidding either government or individuals from converting plots of land for location of petrol stations within the township forthwith. Any attempt by either of the two sides to convert the use of any land within township should be resisted by the people and the court.*

Keywords: *Environment, Guidelines, Hazards, Perceptions, Petrol Stations, Township.*

I. Introduction

Considering the high risk and dangers associated with petroleum product as a highly inflammable product, its exploration, transportation, offloading, storing and sale points and facilities should not be taken for granted like other products. According to WHO (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. Hanekom, (2001); Genovese, (2004) and Spencer, (2004) are of the view that petrol station could be any petroleum facility, service station, public garage, highway filling station, petro part or fuel depot that sales 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. That is, a structure or building where petroleum products are sold to motorists or for other local consumption. For instance, in Australia the facility is called service station; in Canada, it is either garage, fueling station or gasbar; in some English speaking Common Wealth Countries it is also either petrol station or petrol pump; in India, petrol bunk; in Japanese English, gasoline; in Nigeria, filling station; in UK and South Africa, garage and in USA it is known as gas station. Location of petrol station generally despite its important to the economy, it is expected to be guided by a defined environmental rule. As affirmed by Helsink, (2000), the standard for environmental protection varies from country to country and the levels of the protection equally are determined by such factors as legislation and economic priorities of the individual state.

In Finland for example, the environmental protection Act 86/2000 (12) state that, within industrial operation, where contamination of the environment is possible, "Best Available Techniques" (BAT) should be applied in granting environmental permit after evaluating the circumstances for which the permit is being sought. Petrol stations activities therefore fall within this circumstance or the risk operational category because

they are hazardous workplace so required to be licensed properly. While in Nigeria, the Department of Petroleum Resources (DPR) Environmental Guidelines and Standards (EGAS) of 1991, serve the petroleum industry as a comprehensive working document with serious consideration for the preservation and protection of the Niger Delta and by extension the Nigerian Environment (Nerry et al., 1997). It operation falls under the Petroleum Regulation Act CAP 150 of 1967 which stipulated that application for the issuance of license to all petrol stations shall be through the DPR in order to aid save both the people and the environment from pollution. It was in line with this principle that in 2002 World Summit on Sustainable Development (WSSD) refocused its plan on promoting health through sustainable development and sustainable management of ecosystem and biodiversity so as to guarantee effective environmental sustainability for all.

Maiduguri and Jere (conobated into one township) are the most populated settlements and by implication have the highest concentration of transportation system in Borno State. With these, and coupled with the short fall in the supply of electricity from the National Grid to provide sufficient power within the township, the demand for petroleum products becomes very high. The sale of fuel/oil has therefore become one of the most lucrative businesses which might have prompted the mass location of petrol stations in almost all the strategic areas of the settlements with some of them sited not in conformity with DPR Guideline. Although there has been the issue of purported wavers of EIA Degree of 1992 by the DPR/Borno State Government in order to encourage indigenous participation in petroleum marketing business in the state. The study was aim at examining the environmental effects of petrol stations at close proximities to residential buildings in Maiduguri and Jere. Specifically, it examined: the presence of petrol stations in these township and their distances vis-a-vis residential houses within 100m radius of location; conformities to location guidelines along side the hazards associated with their activities/operation; and the perception of the residents/petrol stations workers on the effects pose by those petrol stations.

Statement of problem

In locating petrol stations, it is important to take some precautionary measures like locating them at a required distance from buildings; places of public assembly such as markets, hospitals and schools and areas of high traffic congestions and residential buildings. This should be in accordance with the guidelines provided by the Department of Petroleum Resources and Fire service safety rules that the distance between two nearest petrol stations should be 400m and between a petrol station to the nearest residential building should not be less than 50m to shun possible hazards. Unfortunately in Maiduguri/Jere in the recent years, these guidelines have not been followed. As a result, there have been proliferations of petrol stations that are located close to residential areas. This might have constituted serious hazards to residence in close proximity to such petrol stations. It is therefore against this background that the study examined the spatial pattern of location of these petrol stations and the possible hazards associated with their locations in Maiduguri and Jere.

The Study Area

Maiduguri and Jere township on a landmass of 137,356 sq km (NPC, 2010), is located between Latitudes 11^0 46' 18"N – 11^0 53' 21"N and Longitudes 13^0 02' 23"E – 13^0 14' 19"E (Google Earth, 2012). These township has a population of 1,197,497 people as at 2009 with Kanuri as the predominate tribe (World Gazetteer, 2007). The area lies within the Lake Chad Basin Formation at a mean level of 320m asl with gradual sloping towards the Lake Chad Level at 282m asl. Its landform is classified into plains and ridges comprising of palaeo-locustrian and flood plain drained by River Ngadda (Nyanganji, 1996). Founded (Maiduguri/Jere township) in 1907 by British colonial masters for administrative purposes (Encyclopedia Britannica, 2007); it has been the headquarters of Northeast sub region of Nigeria since 1967 and the most populated settlements in the region (Waziri, 2009). As a result, there has been mass/proliferation of petrol stations within the township over the years to make good business.

II. Methodology

As at 2010, there were 138 petrol stations in Maiduguri and Jere out of which 122 (88.41%) were functional and 16 (11.59%) were non-functional. The functional petrol stations were those actively in service dispensing petroleum products to customers; while the non-functional were those which previously were actively in service, but as at the time of the survey, were closed down. Data for the study were obtained through structured questionnaire and interview schedule administered to the respondents in the area, field measurement and the use of GIS (Garmin 76 CSX) devise.

Purposive and random sampling techniques were employed in the study. Following the DPR petrol stations routes in the area (Table 1), 25% (35) of the 138 petrol stations were selected as samples to across the routes. Three household heads within 100m radius of each of the 35 sampled petrol stations were randomly selected to give 105 respondents. Two workers from each of those petrol stations were equally selected at random to give 70 respondents. Five officials of DPR and FSD each were also selected at random as samples.

The data obtained were then analyzed using simple descriptive statistics such as frequencies and percentages. GPS (Garmin 76 CSX) devise was also used to digitally determine the elevations/co-ordinates of the petrol stations and the results presented in tables and charts. Hazards variables assessed in relation to distance between petrol station and the residential area were: air pollution, fire outbreak, traffic congestion, felling of trees, traffic accidents, noise and soil pollution.

III. Results And Discussion

Proximities Guidelines for Petrol Stations Location

The guidelines for the location and operation of petroleum stations in Nigeria which affects category 'B' petrol stations as provided for under Petroleum Regulation Act CAP 150 of 1967, which stipulated that 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). Some of these requirements expected of petrol stations before being suitable for licensing to operate which relate to this study are:

i. Environmental Impact Assessment (EIA) Report carried out on the proposed petrol station by DPR accredited consultants must be presented.
ii. The total number of petrol stations within 2km stretch should be 4 on both sides of the road, including the one under construction for a single carriage. For dual carriage way, 4 petrol stations on the same side could be considered.
iii. The distance between existing between petrol stations on approved sites and the proposed one should be 400m apart
iv. The distance between one petrol station to the nearest residential building should be 50m apart.
v. The distance between one petrol station and the nearest place of public assembly should be 90m apart.

Table 1: Spatial Location of Petrol Stations across the Routes

S/n	Routes	fl	nf	Total Petrol	Percentage (%)
01	Airport / Kano Road	24	04	32	20.28
02	Ahmadu Bello Way	05	-	05	3.62
03	Ali Kotoko / Gwange Axis	04	-	04	2.90
04	Baga Road	19	04	23	16.67
05	Bama Road	12	01	13	9.42
06	Damboa Road / GRA Axis	20	02	22	15.94
07	Gamboru-Ngala Road	22	05	27	19.57
08	Pompomari By-pass	05	-	05	3.62
09	Sir Kashim Ibrahim- Old Maid. Axis	11	-	11	7.97
	Total Routes:- 09	122	16	138	100

Percentages (%): Petrol Stations: Functional (fl) = 88.41%; Non-functional (nf) = 11.59%
Source: Field Survey, 2011

Distance between One Petrol Station to the Next one and Between Petrol Stations to the Residential Houses within 100m Radius

Table 2: Proximities between sampled petrol stations to the nearest one to them along each route

Location	Distance in Meters						
	< 100	100 - 199	200 - 299	300 - 399	> 400	Total	DPR Requirement
Ahmadu Bello way	1	-	1	-	-	2	
Air port/Kano road	7	-	-	-	-	7	
Ali Kotoko/Gwange axis	-	-	-	-	1	1	
Baga road	4	1	-	-	1	6	
Bama road	3	1	-	-	-	4	
Damboa road/GRA axis	2	1	-	-	3	6	400 meters
Gamboru/Ngala road	2	3	-	-	2	7	
Pompomari by-pass	-	-	-	1	1	2	
Sir Kashim/Old maid. axis	1	-	-	-	2	3	
Total	20	6	1	1	10	38	
	Not complied = 74%				Complied = 26%		

Sources: Fieldwork, 2011

Table 3: Proximities between sampled petrol stations to the nearest houses/shops to them along each route

Location	Distance in Meters											
	<20	20 - 29	30 – 39	40 - 49	50 - 59	60 - 69	70 - 79	80 - 89	90 – 99	100 >	Total	DPR Requirement
Ahmadu Bello way	-	3	1	-	3	-	1	-	-	-	8	
Air port/Kano road	7	2	2	5	-	2	2	-	3	2	25	
Ali Kotoko/Gwange axis	-	2	-	-	1	-	-	1	-	-	4	
Baga road	3	5	-	2	2	3	-	3	1	1	20	
Bama road	6	2	3	1	-	-	3	-	-	1	16	
Damboa road/GRA axis	-	3	-	-	4	3	1	2	2	5	20	50 meters
Gamboru/Ngala road	8	2	1	4	-	-	4	-	1	5	25	
Pompomari by-pass	-	-	-	-	-	-	-	-	-	6	6	
Sir Kashim/Old maid axis	2	-	1	4	-	2	1	-	2	-	12	
Total	26	19	8	16	10	10	12	6	9	20	136	

Not complied = 50.74% Complied = 49.26%

Source: Field Survey, 2011

The proximities between some of the petrol station and the nearest one (petrol stations) to them as given in Table 2, revealed clearly that 74% of the sampled petrol stations did not adhered to the 400m distance between them as required by DPR (Table 2). From the result therefore, only 26% were located in conformity with the guidelines. It is common to see some of these petrol stations located at close proximity only to be separated by a wall or narrow path in the township. Table 3 on the other hand show the same proximities, but with respect to residential houses or shops located close to petrol stations. From the Table 3 therefore, cumulative percent (50.7%) of the sampled residential houses were located at unfriendly distances to petrol stations (< 50m), while 49.3% (cumulative percent) were sited at a convenient distance to those petrol stations (50m >). This gross violation of the DPR proximities requirement guideline by the petrol stations and residents in terms of location sites increase the residents' vulnerability to the petrol related hazards. However, the study revealed that some of these affected petrol stations were located much earlier than some of the residential houses. However, over the years and at present could do nothing to stop the encroachment or stiff competitions over land close to major roads for location of shops, residential houses or the petrol stations even though such situation clearly undermined the guidelines and subject the environment to serious effects because of the economic viability of those choice plots of land.

Generally, as stipulated in the DPR Procedure Guide (2010) under the Petroleum Act CAP 150 of 1967 and captioned "Specific Directives," the implications for flouting the DPR guidelines by petrol station ranges from classifying that petrol station as illegal to revocation of license depending on the gravity of the offence. This is because as the petrol stations operate under such condition, both human health and the environment are threatens. However, the study gathered that DPR has done very little over the years to discourage the situation. It claimed that most of the petrol stations affected were either given EIA wavers or clearance by the state government compelling DPR to licensed them. Whereas, the encroached residential building continues because of lack of government political will to enforce the urban planning Law, as such, the use of land in the town is left in the hands of the landowners' discretion.

Petrol Stations Located Amidst Places of Public Assembly

Table 4: Petrol Stations Located Amidst Places of Public Assembly in Maiduguri Urban

Petrol Station	Location	Year	Co-ordinate	Site
Conoil Petrol. Co. Ltd.	Post Office Area	1965	N 11^0 50' 12.6" / E 013^0 08' 59.8"	Near Bank, market, park, shops
AP. Nig. Co. Ltd.	Post Office Area	1975	N 11^0 50' 14.2" / E 013^0 08' 57.1"	midst of motor park and shops
AA Ali & Co Petrol. Ltd.	Baga Rd. Fish market	1975	N 11^0 52' 14.6" / E 013^0 07' 29.4"	midst of market & motor park
Gamaye Petrol. Nig. Ltd.	Bolori market	2008	N 11^0 51' 19.2" / E 013^0 07'56.0"	Near market, Shops & houses
Avenue of Sudan Nig. Ltd	Custom Roundabout	1973	N 11^0 50' 56.2" / E 013^0 10' 25.8"	midst of motor park & market
A.A. Kime Petrol. Ltd.	Muna Garage	2000	N 11^0 52' 04.6" / E 013^0 14' 54.6"	midst of motor park & shops

Source: Field work, 2011

The result as revealed in Table 4 shows that, some of the petrol stations were operating at close proximities to markets, Banks, motor parks or other public areas. However, based on their dates of location and history as obtained, it was obvious that it was the presence of some these petrol stations that attracted the locations of most of those markets, commercial shops, motor parks, Banks and other commercial activities

because of the strategic locations of the petrol stations sites for business. The clustering of those markets, motor packs and commercial shops around the petrol stations without observing the 90m proximity (DPR, 2011) had made the petrol stations be found right in the midst of those structures. For instance, Gamaye Petroleum Nigeria Limited (Table 4) which was located 43m away from Bolori market, Baga road, was sited in 2008 (years after the market were located). This might have contributed to the environmental problems such as indiscriminate/perennial waste disposal, noise and flooding the immediate neighborhoods were facing.

As a matter of importance and rule, petrol stations are expected to be sited away from places where people normally gathered for any form of activities (Wikipedia, 2010). However, this was not given due consideration in Maiduguri and Jere. The origin of these proliferations as affirmed by DPR, (2011) can be traced back to periods before Nigerian independence and shortly after the independence, when most petrol stations were owned and managed by foreigners who by extension were products of colonialism. Those people sited their petrol station at choice places of their interest without consideration to future urban planning and environmental problems such may cause in the long run. Moreover, EIA Act was not in place when most of those petrol stations were located and even when it came on board in 1992; it was not enforced until 2005. This was because; Borno State Government left it as a waver in order to encourage indigenous participation in petroleum business and since then, enforcement has been epileptic. The wavers have now served as major contributing factor to the issue of environmental problems faced by the residents within the immediate neighborhoods of the petrol stations in the town.

Methods of Wastes Disposal Adopted by Petrol Stations in the Environment

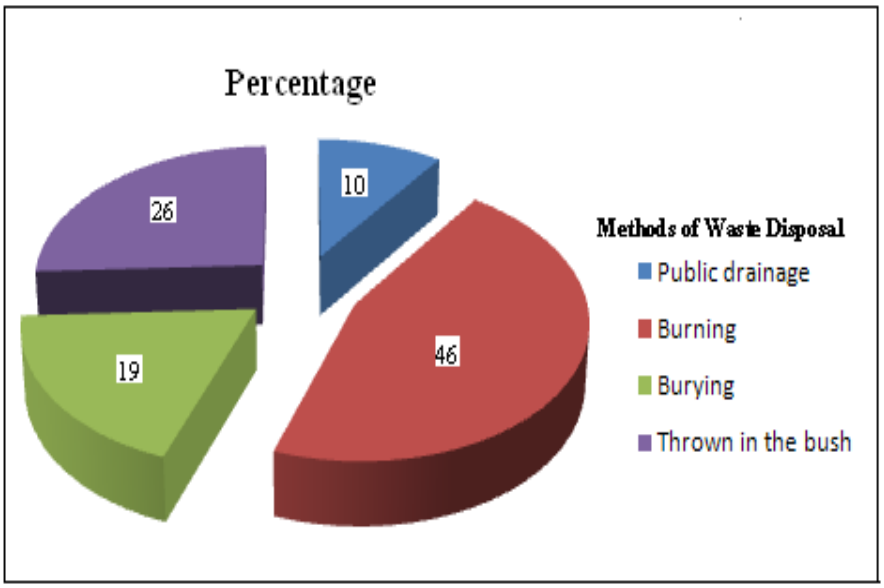

Figure 1: Methods of Waste Disposal Adopted by Petrol Stations
Source: Field Survey, 2011

The methods adopted by the petrol stations for disposing of their wastes as presented in Figure 1 reveals were not the same. These wastes generally comprised of engine oil drained from generators and vehicles during servicing, empty containers of various oil products, empty container of injectors' cleaner, oil filter, leaking oil gallons and other forms of waste. The result as presented in the Figure 1 shows that 10% of the petrol station disposes of their waste in public drainages. Those that burn their waste constitutes 46%, 19% bury the waste and 26% throw the waste in the bush. However, it is likely that all those methods have their varying magnitude of effects on human health and the environment over time and space. For instance, the cumulative percent (35%) that dispose-of their wastes in the public drainages and in the near-by bush are contributing significantly within short space of time to serious environmental problems. These are in form of air, water and soil pollution with their dreadful consequences on the immediate neighborhoods.

How these wastes were disposed is important also. Because, they are mostly of chemical sources (petroleum products), as such, are toxic or harmful to both human and the environment if not properly disposed-of. This observation was in agreement with Cointreau, (1982) who pointed out that in most developing countries especially Nigeria, waste generally are indiscriminately disposed closed to residential houses, markets, farms, road sides and drainage channels constituting threat to human/aquatic lives and environmental safety. Olurunfemi et al., (1998) equally affirmed this observation as he state that waste generated by industries and commercial centers such as chemicals, paints, pesticides, grease and oil sludge disgust the aesthetic value of the

environment. This in consequence creates breeding sites for parasites; alters the delicate balance of the nature and the fragile ecosystem and reduce the qualities of life of people. The study equally revealed that the petrol stations owners have never deem it fit to address such matters as waste disposal and accidental oil/fuel spillage in their neighbourhoods. This is because; Government has been so reluctant in protecting the right of its people and the environment.

Perceptions of Residents on Danger Associated with Petrol Stations

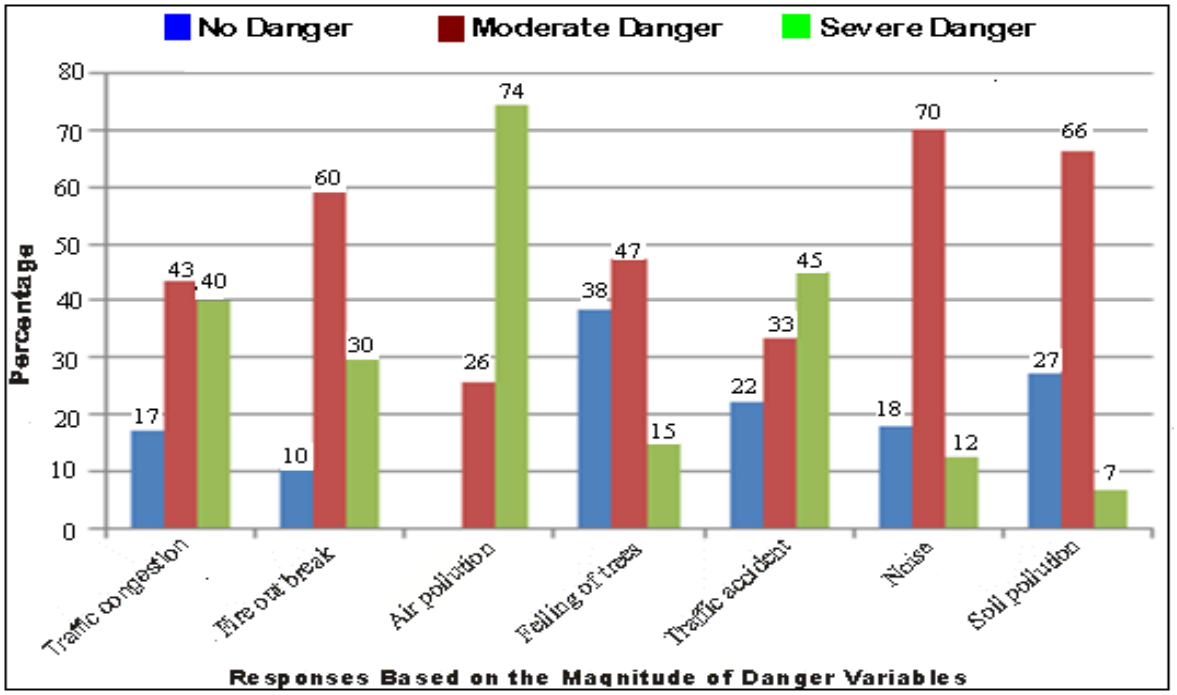

Figure 2: Perceptions of Residents on Danger of the Presence Petrol Stations Close-by * (n = 105)
Source: Field work, 2011

The magnitudes of these dangers were obtained based on the perception of the residents in relation to the distance between the petrol stations and their residential houses. This is with the view to determine the variation in the risk variables. Indices of the dangers include: traffic congestion; fire out break; air pollution; felling of trees; traffic accident; noise and soil pollution. Figure 2 shows the variation in responses of the respondents to the danger variables across the routes. The result therefore indicates that, air pollution has the highest percent (74%). This implies that air pollution is the highest danger in relation to the distance between the petrol stations and the residential settlements. That is, the closer the houses are to petrol stations, the more likely the residents will be exposed to air pollution as vehicles move in and out of petrol stations to take fuel and the use of generator to power pumping machines. Traffic accident, traffic congestion and fire outbreak have 45%, 40% and 30% respectively. This means the three variables are less severe compared to air pollution. However, the result equally implies that the nearer the petrol station is to residential areas; the more likely the residents will be affected by the traffic congestion especially during fuel scarcity. The vehicles queuing to take fuel usually cause obstructions and other related hazards to the nearby houses; they will equally be exposed to risk of fire outbreak from petrol stations and accident especially as vehicles rush to queue during fuel scarcity.

The result in Figure 2 also revealed felling of trees and noise with 15% and 12% respectively while soil pollution has 7% as perceived by the residents. This shows that noise as a danger variable is less severe compared to traffic accident, traffic congestion, and fire outbreak. From the result therefore, even though noise pollution is produce as people clamour to buy fuel, yet it is perceived by the residents to be less severe.. From the Figure 2 generally, the perceptions of the residents in the study area shows that, in the order of severity of dangers affecting them, air pollution is the most severe danger variable. Traffic accident, traffic congestion and fire outbreak are the next severe dangers. Noise has lesser danger than compared to air pollution, traffic accident, traffic congestion and fire out break. While soil pollution and felling of trees are the least danger variables as perceived by the respondents in relation to the distance between the petrol stations and the residential houses. In summation of these effects, hazards are eminent when living close-by petrol stations even though the magnitudes vary.

Effects of Pollution on Residents and Petrol Stations Workers

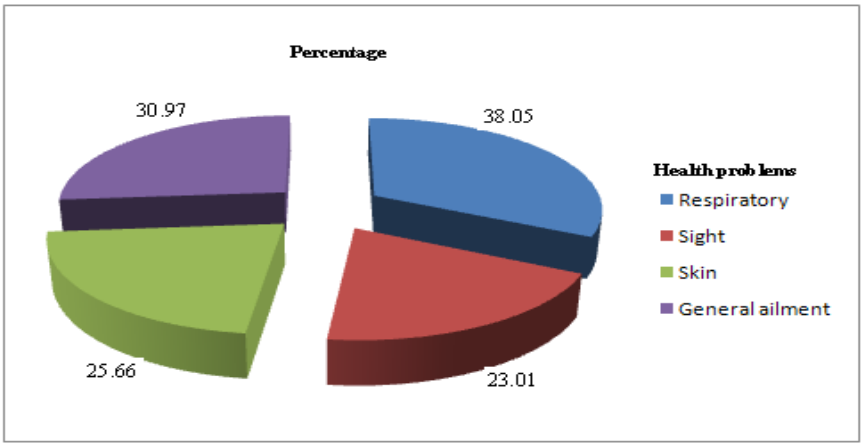

Figure 3: Effects of Pollution on Residents and Petrol Station Workers Workers
* Multiple responses, thus percent > 100%

Source: Field Survey, 2011

From the study, the workers in the petrol stations and the residents living nearby these petrol stations have in one time or the other suffers vary health effects as a result of working in petrol stations or being their close neighbours as presented in Figure 3. The result therefore show that respiratory problems (diseases) to have the highest percent with 38.05%. This by implication means it was the most prevalent health problems affecting both the workers and some of the residents as a result of the inhalation of fuel contaminated air. However, skin and sight problems along side other health complications were also issues of concern. It is important to note also that this assertion is in agreement with the work of European Environmental Agency (1994) which state that apart from creating environmental hazards, petrol can also pose health hazards if it is inhaled, ingested or come into contact with the skin or eye. EFOA (1999) equally noted that exposure to petroleum vapour with a concentration of between 500ppm and 1000ppm can cause irritation of the respiratory tract. If the situations continue thereafter, such could lead to narcotics effects with symptoms including headache, nausea, dizziness and mental confusion.

Petrol Stations Hazards Mitigation

Hazards as viewed by Burton et al. (1978) are those elements of all the physical environments that are harmful to man and are caused by forces extraneous to him. Hazards also are threat to future source of danger and 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). This is in conformity with EFOA, (1999) that safety of people and protection of the environment should at all time be the major concerns at petrol stations because they are potentials for accident especially where the general public has unrestricted access. The necessity therefore for well designed, construction and operation of such facilities should be of paramount importance. Noting that, petrol and other fuel are potentially hazardous at ambient temperature and they give off vapours which when mixed with air in a proportion and ignited, can burn with explosive force. In addition, all petroleum products are potential pollutants which if released, can cause injury to aquatic life, harmful effects to humans' health and environmental damage if incorrectly handled.

It is generally important in the planning process for development particularly in the urban centers, to give much consideration to measures that reduces hazards. Planners should at all times assess possible hazards in planning and promote ways of avoiding or mitigating damage that might cause hazards, risk and vulnerability. These (hazards, risk and vulnerability), as ascertained by Joseph (2005), are uniquely intertwined in the development of death and destruction from disaster. It is therefore appropriate to reassert that, disaster mitigation is best realized from the potential that the people need to unite, to persevere and to understand what affect them and to take common action towards their sustainable development particularly in the cities where the larger population dwells, and where most of the economic activities are taking place. This, as affirmed by Blaikie et al. (1994) vulnerability to hazard and risk from the social perspective are more pronounced on urban poor who most at times find it hard to reconstruct their livelihood after a disaster than the rich. This is because, a time dimension is relevant since reconstruction in poor areas can take a long time, which affect the economy and the livelihood of the area drastically. Also, the poorer population groups do not always have a choice of location, as such, may be force to live in risky areas.

IV. Conclusion

In proper environmental management, it is expected that, people and their needs must be placed at the forefront of concern so as to serve their physical, psychological, developmental, cultural and social interest equitably. That is, such attempt must be integrated, acknowledging all the elements of the environments which are linked and interrelated taking into account the effects and decision on all aspects of the same environment and the people by pursuing the selection of the best practicable environmental options such as environmental health and safety, consequences of policy, programme, project, product, process, service or activities for the purpose of overall environmental protection, conservation and safety of human life and property.

V. Recommendations

- State legislature should enact law forbidding either government or individuals from given out plots of land for location of petrol stations within Maiduguri and Jere forthwith. Any attempt by either of the two sides to convert the use of any land within the township should be resisted by the people and the court.
- Petrol stations operating within the township should be made by law to establish central private waste management board (Petrol Stations Private Waste Management Board), with well trained staff on waste management. The board should be responsible for constant cleaning, evacuations and management of all waste produced by petrol stations. They should equally be made to offer periodic community services (free medical service) to the residents living close to them.
- Ministry of Environment in collaboration with all the petrol stations should constantly mount public enlightenment campaign using posters, bill boards and media houses to educate the public on the hazards associated with petroleum products with respect to human health and the environment so as to discourage residing close to petrol stations.

References

[1]. Blaikie, P., Cannon, T., Davis, I. and Wisner, B. (1994). At Risk. Natural Hazards, People's Vulnerability and Disaster. London: Routledge. Pp. 66 – 67.

[2]. Burton, I., Kates, R. W. and White G. F. (1978). The Environment as Hazard. New York: Oxford University Press. Pp. 1 – 3.

[3]. Cointreau, S. J. (1982). "Environmental Management of Urban Solid Wastes in Development: A Project Guide". Urban Development Department, World Bank. http://www.worldbank.org/html/fpd/urban/solid-wm/trechpaper5.pdf

[4]. Department of Petroleum Resources (DPR, 2010). Procedure Guide for the Issuance of License, Establishment and/or Operations of Industrial Consumers, Petrol Stations, Kerosene and Liquefied Petroleum Gas (LPG). Revised Edition. P. 1-11

[5]. Department of Petroleum Resource (DPR, 2011). Maiduguri Zonal Office, Borno State.

[6]. E.F.O.A., (1999). European Fuel Oxygenates Association: Guidance for the Design, APEA/IP.1999. www.efoa.org. Pp. 5 – 9.

[7]. Encyclopedia Britannica (2007). http://www.britannica.com/ebc/article-9050153. Retrieved 2007-04-06

[8]. Environmental Agency PPG 1 & 7, (1994). General guide to the prevention of pollution, controlled waters and Fuelling stations: Construction and Operation. European Directive 94/63 EC. In: Guidance for the Design, Construction, Modification and Maintenance of Petrol Filling Stations APEA/IP. 1999. www.efoa.org.

[9]. Genovese, P. (2004). "Full-Service Gas Stations." In Lurie Maxine N; Mappen Marc. Encyclopedia of New Jersey. Piscataway. New Jersey: Rutgers University Press.

[10]. Hanekom, P. (2001). Guidelines for the Construction and Upgrade of Filling Stations and Associated Tank Installations. Agricultural, Conservation, Environmental and Land Affairs, Diamond Corner Building, 68 Eloff and Market Street, Johannesburg. South Africa. Pp. 1 – 17.

[11]. Helsinki, (2000). Environmental Protection Act 86/2000. 4th Feb. 2000. In: P. M. Nieminen, 2005: Environmental Protection Standards at Petrol Stations: A comparative study between Finland and selected European countries. Tempere University of Technology, Publication. 534. P. 27.

[12]. Joseph, F. S. C. (2005). At Risk: Natural Hazards, People's Vulnerability, and Disasters. Journal of Homeland Security and Emergency Management. (Psh) The Berkeley Electronic Press, New York. Vol. 2(2) Art. 4. Pp 1 – 5.

[13]. Nerry, E. and Akpofure, E. (1998). Environmental Impacts Assessment in Nigeria: Regulatory Background and Procedural Framework. UNEP Training Resource Manual. Case studies from Developing Countries. 25 Beckweri St., D/Line Port Harcourt, Nigeria.

[14]. N.P.C. (2010). 2006 Population and Housing Census Priority Table Vol. III. Population Distribution by Sex, State, Local Government Area and Senatorial District

[15]. Nyanganji, J. K. (1996). Towards a Sustainable Management of the Ngadda Catchments, Maiduguri, Borno State Nigeria: Issues in Environmental Monitoring in Nigeria. Letter Day Publishers, NGA, Geography Department, University of Maiduguri.

[16]. Olurunfemi, J. F. and Odika, C. O. (1998). Canal Use and Solid Waste Generation in Ilorin, Kwara State. The Environmentalist. 18: p 75.

[17]. Spencer, K. (2004)."Mobile Phone as Fire Risks". (BBC News Online) http://newsbbc.co.uk/1/hi/programmes/clickonline/3986509.stm. Retrieved 2010-08-22.

[18]. Waziri, M. (2009). The Geography of Borno: An Overview. In: (Eds). M. Waziri, A. Kagu, and K. M. Abubakar, Issues in the Geography of Borno State Vol. 1. Pp.6-8

[19]. Wikipedia, (2010). E.I.A.: The Free Encyclopedia: Predicted Environmental Impact and Mitigation Measures. EIA Residential Morcellement at Mon Chosy. Seayu Ltd.

[20]. "World Gazetteer," (2007). Free Encyclopedia: http://www.gazetteer.de/wg.php?x=&men=gcis&Ing=fr&dat=32&srt=pnan&col=aohdq&geo=158. Retrieved 2007-04-06.

[21]. World Health organization (2004). Safe Piped Water: Managing Microbial Water Quality in Piped Distribution Systems by Richard Ainsworth.