

# Causes and Environmental Problems of Petrol Filling Stations in Residential Domain of Nigeria Town

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**Abstract:** The study identified the causes and environmental problems of petrol filling stations found in residential domain of some developing nations. The study was a survey research in which data was obtained through a 6 items questionnaire on population of 228 respondents randomly sampled from the residential Neighbourhoods of Port Harcourt city local government. The data analysis was computed using Mean and Standard Deviation on a 5- point likert scale. Findings of the study reveal among others that the main causes for locating petrol filling station in residential domain of Port Harcourt city are high population, outdated and inefficient urban planning practices, and non-compliance to physical development control regulation, poor economic policies and corruption /ignorance, among others. The findings also revealed that the environmental problems of developed petrol filling station in residential domain are also numerous and such are volatile organic compound, methane and carbon monoxide to mention a few. The paper recommended among others that international bodies should organize in-service training, seminar and symposia for federal and state ministries of housing, urban development, environment, health, energy and natural resources and all the income class in Nigeria on the implications of such significant changes in urban residential districts.

**Keywords:** Causes, Problems, environmental, Petrol Filling Station and Residential Domain

## I. INTRODUCTION

The easy-going processes and littering of petrol filling stations in designated residential land uses are hazardous, conterminous and forbidding in physical planning practices all over the world. In developing nations of the globe, anthropogenic actions such as petrol filling stations and related commercial land use development are common in residential neighborhoods even when they continue to fail the environmental impact evaluation test of acceptance, compactible, suitability and standard on daily basis. However, the formal examination of other land uses including petrol filling stations in a direction to understand their social and environmental advantages and disadvantages in layout or neighborhoods labeled residential is no longer a necessity in sub-Saharan countries (field work 2020).

The vigorous increase of built- up petrol filling station in neighborhood purely designated residential in developing countries and deed Nigeria continues to be worrisome and poses challenges for sustainable environment and violation of land use arrangement and environmental aesthetics. Opinions shows the amassing and obstinate glassy of these phenomenon

in Port Harcourt residential zones accentuated by quick approval, poor evaluation and control of such developmental projects in residential areas by the relevant agencies safekeeping physical planning and urban development without minding the attendant environmental and health implications.

The condition also occurs as one of the consequences of land use change or conversion with the continuation of escalated petrol stations in various classes of residential location. It poses challenges as highly flammable petroleum products are commonly stored on built underground tanks for retail purpose in residential zones. In addition, deficiency of strict control by the appropriate agencies and inability of petrol stations developers to comply with the necessary laws guiding the development of such activities, contribute to the location of such commercial land use in residential domain of Nigeria urban areas. Prudently, the ways and manners petrol fuel stations are sandwiched in residential neighborhoods of Nigerian urban centers without consideration of the health and environmental implications are not encouraging. The empirical research of Okonkwo, Orji and Onwuamaeze (2014) piloted a research on contaminants discharges from petrol places and their influence on the air value. The analysis applied vapor observers on the course of determining the contemporary contaminants athwart the location air quality. Their analysis revealed that the key contaminants found in the environment air were volatile organic, methane and carbon monoxide. The analysis further proved that the rate of impurities was higher than the FEPA air quality stipulated standard. Particulate matters with minimal contaminants absorptions within the limit stipulation of FEPA were considered non harmful. In addition, regression result counted volatile organic compounds and methane as the important contaminants existing within the surrounding air caused by the location of petrol places. Accordingly, the authors maintained that both or the two contaminants had a robust undesirable connection with space from the zone under investigation. However, the statistical arc in respect of the unstable organic combinations (UOCs) recorded a closely faultless curve including exponential purposes as the reversion reckonings of methane pointed direct. In detail, the two UOCs and methane showcase a connection constant (R) higher than 0.9 for the zones under examination. It is the utmost view of this work that the major contaminants that must be put into attention before the location of a petrol station were UOCs and methane and the slightest harmless setback for locating

any petrol station should consider 80m setback from built-up residential zone.

Considering the whereabouts of many petrol stations across Kano urban in the year (2007), Mohammed, Musa and Jeb used Names and streets with petrol stations, global positioning system (GPS) quick bird imagery, street map, and boundary map to examine how the location of petrol stations agreed with the urban planning standards put in place by department of Petroleum Resource. However, the acquired data were introduced before Arc map platform of ArcGIS 10 and geo-referenced while the necessary examines were carried out via spatial statistics, spatial predictor and nearness techniques existing in the software. Their result showed that exactly 214 petrol services located in 43 circulatory standards in the research region, to the extent of 69% petrol stations belong to autonomous marketers, 26% belong to major marketers and 5% NNPC. Their work further explained that some of the petrol station pleased the average condition of 15 metre distance from the road which accounted for (96%). while 98% met the least reserve of 100 meter from the health care facilities and various petrol station to met up 400 meter basic distance standard for stations.

In a comparable research, Olapeju(2017 ) employed arena surveys and remote sensing method particularly geographic information system (GIS), for locating all the prevailing filling stations including the calculation and the side by side acquiescence of the petrol filling places with existing stipulated planning standards. The purposes of the research was to evaluate the setting and latitudinal arrangement of petrol satisfying stations while the specific objective anchored on classification and mapping out all the existing petrol stations in the zone and as well as measuring their agreement with planning criteria and ascertain the locational design of the petrol filling stations. In a manner to prove the research work, the nearest neighbor method of examination was held to define the locational design of the facilities. The analysis recorded Rn value of 0.36 and discloses that the locational pattern of petrol filling stations in vicinity have a tendency of locating in a particular zone. The work endorses the suspension and restriction of petrol stations in and around developed road flight path of the town and purely designated residential areas.

Sulaiman (2019) used a purposively sampling method and global positioning system (GPS) to assess all the surviving filling stations. The research also obtained data on prevailing urban infrastructure to qualify check mentation compliance and spatial location of petrol filling stations and their smooth of submission to department of petroleum resources criteria. In furtherance, the work considered their fire care alertness to determine manipulation of submission of urban fire safety guidelines for bearable development. The research adopted nearest neighbor (NNA), spatial interrogation approach and buffer analysis while their result proved indiscriminate location design and location of all filling stations with 15m impediment from the road and 100m minimum setback from

critical infrastructures. However, more than 50% of the petrol stations complied with the 400m distance from consecutive stations. The researchers further expressed that the preparedness were ranked based on the adequacy, functionality and sophistication of the available extinguishing facilities. They recommended that implementation of setback standards and safety preparedness policies should be improved for sustainable urban development. That influx human population and urban expansion for the past years triggered the increases of vehicles to enhance proficient voyage of goods and commuters within and outside area, as well as brought the spread of filling stations owing to increase consumption of fuel.

Within and around the Ilesa geographical location, Dele (2019) considered institutional tool and development (IAD) basis while studying the locational pattern of fuel stations and the underlying implications in a commercial density of Osun city Nigeria. The aim anchored on petrol station submission to urban planning criteria, code of practice and assessment of the physical, social and economic similarity that exist in the domain of petrol stations and various land uses urban planning recognize in the region. On the process, the research used environmental surveillance and (50) fifty questionnaires to appraise petrol stations while the result proved uneven peripheral intensification and location of petrol posts in the region, of which approximately 60% of the fuel anthropogenic activities were built between 2000 to 2012. The result further maintained that about 6 % of the located petrol stations conformed to the rules guiding building distances from the road and failed to act in accordance with the stipulated setback before connecting residential buildings while 56% observed the area coverage rules. However, the analysis of nearest neighbour index accounted 0.16 which implies that the locational arrangement of the petrol stations were clustering threatens safety in the area. The study calls for strategies reduces the siting of petrol station and guarantee the security of properties and human activities in the city and other part of Nigerian.

The geographical information system, site suitability assessment method and department of petroleum resources (DPR) served as standard for petrol filling stations in Oyo town. The results showed that, out of the 113 PFSs in the area, only 3, representing just 2.654 percent are in high suitability zone, 6 PFSs (5.309 percent) in in medium as well low and 98 stations(86.725 percent) in very low suitability zone. Considering the OSURPB criterion, 76 PFSs are at unacceptable distances to residential land use and as much as 102 PFSs considering the DPR criterion. Also, assessing the size of PFSs, 41 stations (39 percent) have the standard land area while 69 PFSs (61 percent) were deficient. Furthermore, only 6 stations, representing 5 percent of PFSs in the area have their dispensing pumps at least 15m off the road. More so, the assessment of the spatial pattern of PFSs in the area showed that the distribution of petrol stations are very clustered with less than 1 percent likelihood that the clustered

pattern could be a result of random chance. However, the work summarized that the PFSs across area, bearing in mind that both indigenous and general location canons are not properly positioned and failed to comply with planning criterions. In addition, the deficient requirements multiplied by the native planning authorities, who the work termed insolent of the general standards indisputably multiplied the terrorizations on human condition and protection and populaces within the environment of the PFSs.

Boison, Asamoah, Addison and Esther (2018) asserted the factors that influence sales performance and siting of a fuel station project. The research applied assorted method and explanatory research design on designated fuel points. The result proved that location stood as the prominent variable that demonstrated the highest influence on sales capacities. They added that service volume does not persuade a progressive power on sales measurements on the other hand, raises overhead cost. In continuance, the research stressed that volume was influence by different variable such as promotion, brand, pump price, service quality, opening hours, local authority assessment and size of the place. Also considered include fuel station located at traffic bulk, struggle along the road, land use activities of the area, the road condition including environmental and legislative desired. The study recommended for dependable ideal to predict the retail sales capacity of fuel that may be gainful in wholesale fuel places assessments, possibility investigation or analysis by project directors and other experts.

In Port Harcourt urban of Nigeria, Ojika (2020) using primary database and spatial attribute questions for locational analysis of petroleum station, its safety and guiding principles. Their findings opined that seven filling stations were converted to residential houses while 14 among the of 38 filling stations function with suitable fire extinguishers. He added that 14 filling/ petrol dispensable engines are located near the road and 1 was found close to high tension. The study concluded that modifiable agencies must carry out consistent to satisfy the official operation of petrol confirm the properly usage of the necessary paraphernalia.

Joan (2020) considering proximity of buildings to petrol stations, building materials, distance between buildings, wind speed, temperature, slope and vegetation. The work applied analytical pyramid and compared pairwise weight and its parameters centered on their reasonable position. The authors generated weighted quantity tool to obtain the fire risk maps between December to February, March - November 2008 and 2013. The study found that proximity of the buildings to stations, building materials and separation between buildings contributors while the building affected mostly showed the sign of rusted corrugated iron sheets and wood. The study further explain that houses located 100m from stations were prone to sensible height and those 50 meters analysis were rated the peak of the risk. The research narrated how planners and strategy producers on building location, material and developers on how to implement physical developments.

Considered serviceable and non-serviceable petrol station in 2010, Mshelia and Emmanuel (2015) look at the attendance petrol stations attendance in residential houses of 100m dimension in the urban areas including the hazards linked in their operation and insight on residential properties. Their result shown that the processes for locating petrol filling stations were failed to comply by almost all the petrol stations and pose critical environmental problem on residence in near proximity despite the fact that many petrol stations were developed before the residential houses that served as their boundary neighbourhood. The study recommended that law makers at the state height should make law unfriendly both for the government and individuals on changing of land uses for development of petrol filling places around the urban areas. They maintained that a step to attempt by the government or individual to change land uses around the urban areas must be battled via the people and before court of competent jurisdiction.

By and large, diverse urban areas in developing nations of the globe have dissimilar statutory method of locating or developing petrol filling stations in residential zones. But in spatial ordering of land use activities, avenues are not created for such amenities and land uses in residential areas without taking into account the control measures for pollutants and other disadvantages associated with such land use. This might cause the existences of incompatible land uses in different residential area of a city. By what method can this difficulty be settled? It is for that reason an important research need to be conducted so that problems associated with the location of petrol filling station in residential areas may perhaps be well captured by strategy architect and spatial manager for functional and efficient management of planned residential areas.

## II. STUDY METHODOLOGY

Port Harcourt city local government area of Rivers state Nigeria establishes the study region. The local government or region are among the largest ethnic nationality in the state with a crowd of ancient and developing environment considered suitable for researching the environmental problems and causes of locating Petrol Filling Stations in Residential Domain of Nigeria. The region under investigation shares physical boundary with obiakpor local government in the same state and fall surrounded by the humid hot rain forest cummerbund which has almost disappeared as a result of physical development and experiences the raining and dry season weather regimes in southern Nigeria. The developing town selected for research is Port Harcourt urban for the entire local government. This research was carried out using the mixed method approach involving quantitative and qualitative. It involves the collection of data from primary and secondary sources. Creswell (2000) noted that any moment a particular research applied both primary and secondary data; the secondary data always stand to explain the primary information. But Ghauri and Gronhaug (2005) demonstrated that secondary data assist

readers and academician to gain more understanding about topic under investigation.

*Primary and Secondary Sources*

The staff and key officers of the Rivers State Ministry of energy, works, environment, urban and other development agency issued information relevant for the research through the aid of questionnaires and oral interviewed while the information gathered were used as guidelines for the purpose of design decisions. Accordingly, data from indigenes, non-indigenes and environmental professionals were also obtained via questionnaire to determine the problems associated with the location of petrol filling station in designated residential areas. However, the research stratified the residential areas under investigation after which four neighborhoods were selected for study. An aggregate of 250 copies of questionnaires were disseminated to the respondents in five nominated residential areas (Port Harcourt) 228, signifying 83 percent were reverted for the research analysis. Mile 3 area of Port Harcourt took 68 questionnaires signifying (38. %), Mile 2 area of Port Harcourt had 64 questionnaire representing (15. %), Mile 1 area of Port Harcourt (17. %) and Port Harcourt Township (30%) of the sample size. In addition, the study also acquired secondary information from journals and other recorded researches related to the study were extensively reviewed. Government regulations, institutional guidelines and professional urban planning standards as concerned with the location of petrol station in residential areas were also drowning up.

Table 1: the sampled neighborhoods and populations

S/N	Residential Areas	Respondents	Questionnaires	Ratio
1	Mile 1 area of Port Harcourt	Indigenes	55	17%
2	Mile 2 area of Port Harcourt	Non-indigenes	50	15%
3	Mile 3 area of Port Harcourt	Professionals	68	38%
4	Port Harcourt Township	Government officials	60	30%
	<b>TOTAL</b>		<b>228</b>	<b>100%</b>

III. RESULT AND DISCUSSION

*Environmental Problems Associated with Petrol Filling Station in Residential Domain*

There is no significant<sup>1</sup> relationship between pollutants and location of petrol filling stations in residential zones of Port Harcourt garden city Nigeria. In the light of this assumption, three particular examinations were held through contaminants (volatile organic compound, methane and carbon monoxide). The pragmatic exploration was realized via the spearman’s rho correlation coefficient.

*Volatile organic compound:* The scrutiny on the relationship exist between volatile organic compound and presence of petrol filling station in residential environment gave a

‘contaminant correlation coefficient’ of ( $r = 534, p < .05$ ). The inference or suggestion is that a strong relationship exist between the common spread of volatile organic compound (benzene, ethylene, glycol, formaldehyde, methylene chloride etc.) and location of petrol filling station in residential zones of Port Harcourt metropolis. However, the analysis explained that the more the developments of petrol filling station in residential areas, the increase the percentage of voltage organic compound the residential areas of Port Harcourt. This implies that the spread, strength and relationship of the organic compound are strong and causes numerous health problems. The coefficient of determination is 53% which indicates 53 percent shared change implying that, the volatile organic compound assist to explain only nearly 53% of the spread of such unwanted pollutant in residential locations of Port-Harcourt.

*Methane:* The analysis on the relationship between the presence of methane and purely designated residential zones gave a contamination correlation coefficient of ( $r = 568, p < .05$ ) and which suggested that the location of petrol filling station proved high positive occurrence and has affected Port Harcourt metropolis residents. This implies the coefficient strength of character is 57% which means that the wrongful location of petrol filling stations assist to clarify exactly 57% of the unfriendly methane substances in the purely designated residential areas of Port-Harcourt. See Table 2. 0 for details..

*Carbon Monoxide:* The analysis for carbon monoxide and location of petrol felling station in designated residential location gave a ‘contamination correlation coefficient’ of residential location decision in Port Harcourt metropolis. ( $r = 513 p > .05$ ) See Table 2.0 for details. The analysis suggested that the location of petrol filling station show positive occurrence which affected Port Harcourt residential areas. This implies that the coefficient strength of character accounted 51% which means that the illegal location of petrol filling stations and its contribution at 51% of the unfriendly carbon monoxide emission from vehicles struggling for fuel purchases and consumption across residential areas of Port-Harcourt. See Table 2. 0 for details

Table 2: Problems Associated with Petrol Filling Station in Residential Domain

Associated Problem	Method	Analysis	Significant	Population
Volatile organic	Spearman Correlation	$r = 534$	.000	228
Methane	Spearman Correlation	$r = 568,$	.000	228
Carbon Monoxide	Spearman Correlation	$r = 513$	.000	228

Source: Researchers Survey 2021

*Causes of Locating Petrol Filling Stations in Residential Domain of Developing Nations*

The analysis on table 3 publicized 5 of the items presented had their weighed mean value ranged from 2.50 – 3.50. These values are above the cut-off point of 2.50 which implies that

the respondents accepted the items as the causes of scattered petrol stations in residential neighborhoods. On the same causes or location of petrol stations across residential territory, the study shown among others that causes of such location among include: high population growth, outdated and inefficient physical planning system, poor compliance to development control, poor governance and economic policies and ignorance/ corruption.

Table3: Analysis on Causes/ Location of Petrol Filling Stations in Residential Domain

S/N	Variables/items	Mean	SD	COMMENT
1	High Population Growth	3.00	1.1	Accepted
2	Outdated & inefficient Urban Planning	3.50	1.24	Accepted
3	Poor Compliance to Development Rules	3.21	1.58	Accepted
4	Poor Governance & Economic policies	2.78	1.86	Accepted
5	Corruption/Ignorance	2.85	1.48	Accepted

Source: Researchers Survey 2021

#### IV. RECOMMENDATIONS AND CONCLUSION

Based on the findings, the researcher recommends the following:

1. To decline or minimize the causes and problems of illegitimate spread of petrol filling station in zones purely designated residential domain in developing nations such as Nigeria, the government must ensure that new and standard residential areas free from accommodating incompatible land uses (illegal petrol filling stations) are developed to accommodate the uncontrolled human population of dissimilar income and the political class that develop such anthropogenic activities without compliance to town planning guiding rules.
2. The paper recommended among others that international bodies should organize in-service training, seminar and symposia for federal and state ministries of housing, urban development, environment, health, energy and natural resources and all the income class in Nigeria on the implications of such significant changes in urban residential districts.
3. There is an urgent need to inject efficient and contemporary town planning and architecture skills into development control component of urban planning to discourage poor technical and informal

spreading of petrol filling stations in residential domain via the higher income community of the society.

#### Conclusion

Based on the finding of the research, it can be concluded that strong relationship occur between the location or presence of petrol filling station and some environmental problem (volatile organic compound, methane and carbon dioxide. However, the identification of high population, outdated and inefficient urban planning practices, non-compliance to physical development regulation, poor economic policies and corruption /ignorance are the reasons behind the location of petrol filling stations in developing nations including Nigeria.

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