

# ASSESSMENT OF LOCATION SUITABILITY, HEALTH AND SAFETY PRACTICES IN PETROL FILLING STATIONS, ILORIN, NIGERIA

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## ABSTRACT

*The recent proliferation of petrol filling stations in Ilorin town was assessed with the use of both site analysis report and questionnaire. In order to achieve the aim of this research, 43 petrol filling stations were systematically chosen and physically analyzed. More also, 150 carefully structured questionnaires were used to extract information from respondents who are attendants in these petrol filling stations. The results gotten from both the site analysis and questionnaire were subjected to Department of Petroleum Resources' standard criteria (Nigeria) and criteria of the Petroleum Enforcement Liaison (or simply the RED GUIDE) from the UK. It was established from this research that only 5% of the petrol filling stations considered is within these standard criteria, with 74% of the considered petrol filling stations having very low location suitability, suggesting that the city is sitting on an inflammable fuel waiting to be rekindled. Furthermore, it can also be established from this research, that most of the fuel attendants are not well acquainted with the proper health and safety measures required to be in such station. It was observed from this research, that the permitting requirements and standard criteria are probably just on paper or the corresponding ministries or agencies concerned are not proactive. Thereby, endangering the lives and properties of innocent citizens as well as exposing the environment to contaminations from petroleum products and subsequent climatic degradations.*

**Keywords:** environmental impact, petroleum, hazard, red guide, proximity, criteria and dispenser

## INTRODUCTION

In an effort to commensurate environmental considerations into a decision making phenomenon, it's quite important to completely understand all possible consequence or effect of a proposed action on the environment. However, the adjudication of a case or action is an offshoot of its complete understanding, i.e. before studying the effect of an action on the environment we need to understand the meaning of the word "environment". As such, the environment is a very encompassing word, which does not only constitute areas of the air, plants, animals and water, but also other features such as natural and/or human-modified features which constitute the totality of our surroundings. Hence, the environment is the amalgamation of our natural, physical surrounding and human's activities with respect to these surroundings,

which also include historic, economic, cultural and social influence. Therefore, in order to assess the environment, all these components are taken into consideration [1].

Environmental impact assessment (EIA) is a phenomenon aimed at showcasing and evaluating the most probable impact an action might have on the biophysical and socio-economical environment. However, EIA also consists of mitigations and methods that are required to be implemented in order to boycott those possible adverse effects while also showcasing measures to improve the possible positive impacts[2]-[3].

Indeed, the technological concept of man as regarding transportation and the discovery of petroleum has led to the development of petroleum product's driven

automobile transportation system, this in the other hand has contributed to the proliferation of petrol filling stations at strategic locations to meet the demand of consumers [1]. More also, the increase in population and vehicle users, as well as the attractive profit in the petroleum business, have also contributed to this proliferation [4][5]. However, marketers take the advantage of this demand for petroleum products to build petrol filling stations indiscriminately without giving any consideration to the probable effect of these stations. Meanwhile, economic development can sometimes be devastating to the environment if due processes are not taken into consideration [6].

Indeed, petrol filling stations are commercial outlets for petroleum products such as Premium Motor Spirit (PMS), Cooking gas, Dual Purpose Kerosene (DPK), Automotive Gas Oil (AGO) etc. However, despite the importance of these products in society, they are very inflammable as well as being a great source of soil and groundwater contamination [6].

### Health, Safety and Environment

It's disheartening, that in most states and cities of Nigeria, not adhering to planning standards have resulted to improper change of land-uses and careless constructions, thus the intentional citing of petrol filling stations in areas that are highly likely to cause hazards or negative impacts on the society [7]. Meanwhile, a study of BTEX (i.e. benzene, toluene, ethyl benzene and xylene) emission from gas stations established that concentrations of these gases are high at these stations thus increasing the risk of cancer [8].

Afolabi et al. [9], investigated the safety practices in petrol stations in Ile-Ife, Nigeria using SPSS to analyze data, directly gotten from questionnaires and site analysis checklist. As such, it was established from their research that 48% of petrol filling stations considered failed the standard criteria in terms of minimum distance from residential buildings while 90% of the stations failed the standard criteria, when the set-back from road criteria was used, also establishing low compliance to standard criteria.

Furthermore, in research was done by Ahmed et al. [10], the health, risk and safety measures in filling stations in Minna, Nigeria were considered using a descriptive

sectional and well-administered questionnaire in commensuration with physical observatory analysis. In their work, they showcased that 65% of the fuel attendants were not trained for the job, while also establishing a high level of -non-compliance with standard criteria in the constructions of those filling stations.

### Land and Location Suitability

Shabir et al. [11] investigated the suitability of land for constructing a petrol station in Ipoh, Malaysia using GIS. It was established that only 74% of all the petrol stations are in safe zones while others are not. Although, the essence of the research was validated using the data layer of existing petrol stations generated using coordinates collected from Malaysian Geospatial Data Infrastructure (MyGDI).

In another research by Olokoba et al. [12], the filling stations in Ilorin were geospatially analyzed using an analyzing pattern of spatial statistics tools. It was established from the spatial nature generated that 97.3% of the petrol stations failed the 400m-apart standard criteria set by the Department of Petroleum Resources (DPR).

Also, when Dogara [13] used GIS to analyze petrol stations in Kaduna metropolis, Nigeria, it was observed that 84% of the petrol stations considered didn't meet up with the 400 m minimum-distance between adjacent petrol stations showcasing high-level disobedience to relevant authorities.

More also, the geo-information and distribution pattern of petrol stations in Sango-Ota was analyzed using Nearest Neighbor Analysis (NNA). It was established from the analysis that the major spatial distributions in the area are: the dispersed, random and clustered [14].

Hence, this paper unlike most previous works, combined the assessment of the site suitability, environmental impact and health safety practices in petrol filling stations in Ilorin, considering the standard constructing criteria of Department of Petroleum Resources, Nigeria (DPR) while comparing the results derived from DPR standard with the standards from Petroleum Enforcement Liaison (or simply the RED GUIDE) from UK. More also, the Site Report Analysis

(SAR) method was chosen in this research, unlike most previous studies, because it will not only showcase the grass-root environmental impact of these petrol stations but will also reveal the real situation on the ground in terms of land suitability assessment. This will also give the relevant authorities first-hand information as well as assist them in enforcing necessary actions.

**MATERIAL AND METHOD**

**Study Area**

Ilorin is the state capital of Kwara State in western Nigeria, the town has a population of more than a million and located within coordinates of 8°30'N 4°33'E and 8.500°N 4.550°E, the total area of about 765 km<sup>2</sup> and population density of 1,188/km<sup>2</sup>, It is about 254 km from Lagos and about 330 km from Abuja [12], [15].

**Methods**

This is a survey-based research in which both primary and secondary data were used. The primary data are locations and distances in-between petrol stations, nearness of the petrol station to utility lines and stations, public buildings, setbacks and responses from respondents. Secondary Sources

include relevant publications and documents from government ministries and agencies. Site Analysis Report (SAR) and Questionnaire were the methods used in retrieving data from the field. The Site Analysis Report (SAR) was used to evaluate the spatial set up of the area, activities and approximate distances of existing public facilities and utilities to each petrol filling station, while the questionnaire was used to evaluate respondent’s view toward the social and environmental impacts of the service stations. A sampling of petrol filling station was systematically to give a full representation of the town’s assessment as shown in Table 1.

Proximity assessment and environmental impact assessment based on the established standard criteria are used in this research to classify all the Petrol Filling Stations to four separate levels, depending on their conformity with the standard criteria:

1. High suitability (i.e. meeting 75% and above of the adopted standards )
2. Medium suitability (i.e. having 50-74% of the adopted standard)
3. Low suitability and (i.e. having 25-49% of the adopted standard )
4. Very low suitability (i.e. having 0-24% of the adopted standard)

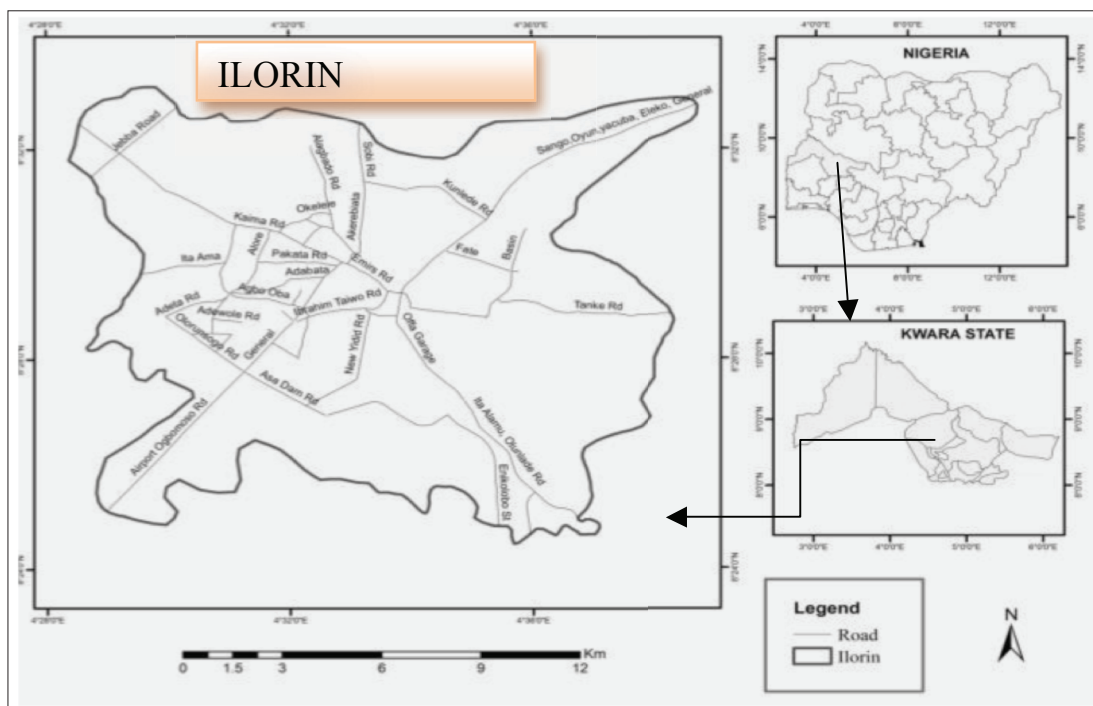


Figure 1 Map of the study area

**Table 1** The 43 assessed filling stations

S/N	PFS NAME	PFS LOCATION	S/N	PFS NAME	PFS LOCATION
1	Legacy energy	Sango	12	NNPC	Share ojaoba road
2	Ragas integrated service	Sango	13	Delight	Share ojaoba road
3	Bay star	Sango	14	Aminhaj	Share ojaoba road
4	Oando	Sango	15	Shabigan ventures	Share ojaoba road
5	Rims rawat	Sango	16	Solace global resource	Share ojaoba road
6	Bakem-top	Sango	17	Allahu akbar	Share ojaoba road
7	Ayo timide	Sango	18	Oando	Oloje junction
8	Joab interbiz limited	Sango	19	Accolade	Oloje road
9	Abdul YekinMubiz	Oyun	20	J&J petrol station	Agba dam estate road
10	Albarka	Oyun	21	Bekind petrol station	University road tanke
11	Towobolar petroleum	Oyun	22	Total petrol station	Okeodotanke
23	Alabi	Oyun	34	Faab petrol station	Tipper garage tanke
24	Total	Share ojaoba road	35	A.A Sanusi	Share ojaoba road
25	Dolabimbola	Okeodotanke	36	D&B	Share ojaoba road
26	Sanrab	University road tanke	37	Total	Post office
27	Total	Beside reomichs garage offa	38	MRS	Post office
28	NNPC	Tanke university road	39	Ajibatpetro station	Share ojaoba road
29	Bovas petrol staion	Fate road	40	Sharex ventures	Share ojaoba road
30	Asco	Ajaseipo road	41	Lanregada	Share ojaoba road
31	Lubcon oil	Stadium road	42	Iyi bare	Share ojaoba road
32	Olak petrol station	Opposite A division	43	Unilorin petrol station	Tanke university road
33	NNPC Mega Station	Along asa dam road			

**Adopted Criteria for the Study**

While there are similarities between the local and the guide criteria for constructing Petrol Filling Stations there are also some disparities. The local criteria are those of the Department of Petroleum Resources (DPR) [16]. Thus, to achieve the essence of this research, the suitability guidelines or standards of the Red Guide and the DPR were considered, and necessary comparisons were ascertained. Where the DPR and the Red Guide had similar criteria or standard, only one of such was used. In other cases where two similar standards had different components, both were evaluated and compared.

*The Red Guide Criteria*

The planning requirements and guidelines for petrol filling station’s construction extracted from the Red Guide (2007) are as follows,

- a. The tanker delivery stand should be wide enough to accommodate tankers, to be positioned freely within it during delivery. (e.g. 15 m long and 5 m wide) and in case of a fire outbreak, it should be able to leave without stress.
- b. Metering pump and dispenser:
  - i. Should be located where there are abundant ventilation and open air.
  - ii. The distance from the boundary of the station to public thoroughfare should not be less than four meters (4 m).
  - iii. Should not be less than nine meters (9 m) from living residences and six meters (6 m) from other occupied superstructures.
- c. Vent pipe: should be more than three meters (3 m) from a boundary with height higher than any possible tanker.

- d. Storage tanks off-setting points and pipe network:
  - i. Should not be less than six (6 m) from the basement.
  - ii. While the opening should be about four and a half meters (4.5 m) from a public thoroughfare [17].

*Department of Petroleum Resources (DPR), Nigeria*

As regarding DPR's standard criteria for granting approval for the construction and operation of petrol filling station in Nigeria, in accordance with the Decree of Petroleum Amendment, number 37 of 1997 safety rules and requirements:

- a. The dispenser should be located such that the distance from the edge of the road to the nearest dispenser will not be less than fifteen meters (15 m).
- b. In order to create a buffer zone, the petrol filling station should have at least a fifty meters (50 m) allowance, away in all angles from built-up areas. However, these buffer zones can be dedicated to all other -non-residential land use.
- c. There should be at least a distance of 400 m between two petrol filling stations [16].

**RESULTS AND DISCUSSIONS**

**Assessment of Their Proximity**

This is a method that is standard criteria specific, in other words, the suitability of these existing petrol filling stations was assessed with respect to their nearness to various land-uses, other petrol filling stations, public thoroughfare and the size of these filling stations, considering the aforementioned standard criteria.

*Distance of Residential Houses to Petrol Filling Stations*

The result of the research showcased that 65.11% of Petrol Filling Stations in the study area are located less than 9m from residential land uses, with only 14.89% Petrol Filling Stations meeting the criteria, thus increasing the vulnerability of dwellers of these houses to Petrol Filling Station associated risks. However, when the DPR's standard was used to assess the distance of Petrol Stations to dwellings. The result shows 95.3% are within 15 m range from a road, with

only 0.7% of the Petrol Filling Stations meeting the criteria. The percentage of defaulters here is higher than that derived using the Red Guide standard, thus more residential dwellers are vulnerable to possible Petrol Filling Station's associated risks as far as DPR standard is concerned.

*Land Area for Tanker Delivery*

The result of the analysis using the land area of the petrol stations shows that 79.07% of the total size used for the survey have sizes less than the stipulated 15 m long and 5 m wide (Red Guide, 2007) for tankers' freedom of maneuvering . These sub-standard sizes are not suitable to be used for Petrol Filling Station as they would pose problems to the Petrol Filling Station's owners, users and commuters alike.

*Distance of Dispensers to the Road*

The survey revealed that 95.3% of the Petrol Filling Stations have dispensing pumps very close to the roads (less than 15 m) and only 4.65% of the Petrol Filling Stations, adhere to DPR 15 m standard criteria while this result remain almost the same even when analyzed with the Red Guild criteria which only set 4 m as the minimum criteria, some filling stations even have dispensers just 1 m from the road.

*Distance between Two Petrol Filling Stations*

The Department of Petroleum Resources (DPR) specified a standard distance of 400 m as a minimum interval between two Petrol Filling Stations on the same axis. The result of the survey shows that more than 50 percent of the petrol station on the same axis did not observe this 400 m buffer areal distance. Many were at bottleneck to each other especially those at axis between yana estate at Sango and Oyun. Also, Oando Petrol Station and Accolade Petrol Station in Oloje are at less than 50 m from each other.

*Vent Pipe Location*

The Red Guild stipulated that it should not be less than 3 m from a boundary in the PFS and higher than any possible Tanker. The result from this survey shows clearly that many PFS does not care about the vent pipe as almost all the Petrol Filling Stations considered have their vent pipes hanged close to the fence or shorter than many tankers height.



**Fuel Station and Environmental Impact Assessment**

*Drainage System*

The department of petroleum resources (DPR) stated that the drainage from a Petrol Filling Station should not go into a Stream or River, without clearly stating where it should be channelled to. The Red Guild on the other hand describes clearly different situations of spillages and how it should be addressed, so as not to contaminate surface or groundwater. However, all the observed Petrol Filling Stations did not take cognizance of their spillages or their drainages at all.

*Vapor Recovery System and Air Pollution*

Vapor recovery is the phenomenon of recovering the vapors of petroleum products, so as not to escape into the atmosphere. This is provided for by the Red Guild (2007) in other to reduce hazardous, potentially explosive fumes and pollution. All the filling stations considered does not have a recovery system, this indicates that various greenhouse and ozone-depleting gasses are being evolved into the atmosphere.

*Leakages*

Leakage detection device alert station attendants when there is a leak in the underground storage or pipeline system. However, in all the Petrol Filling Stations considered there is no special device installed to detect leakages they all depend on the inventory method of detection. Meanwhile, the Red Guild (2007) stipulated that when a Petrol Filling Station is located where a leak of petroleum would cause contamination to groundwater, a leak prevention device should be installed.

**Results from Questionnaires**

*Fuel Station and Safety Practices*

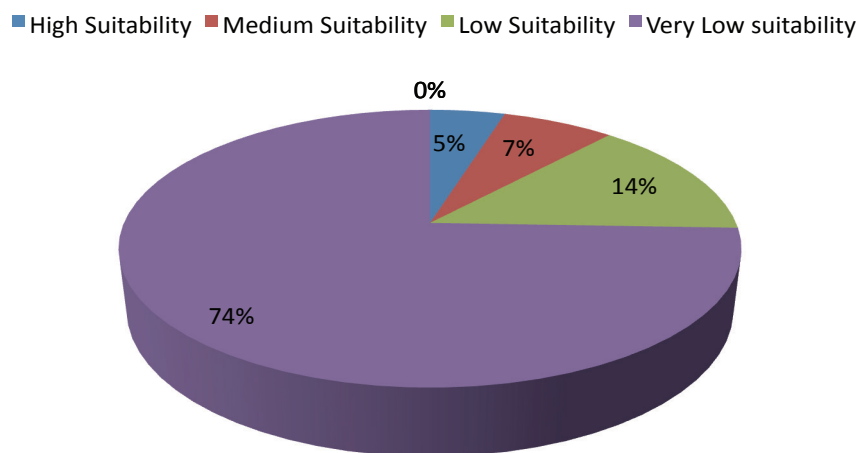
This section of the research looked at safety practices and safety training at the Petrol Filling Stations. More also, perception of safety by fuel station attendants and people who live around the station is examined. 96 percent of the attendants surveyed indicated that they were trained about safety issues before they started working, only 4% did not get training. While at work 89 percent of the attendants surveyed agreed they were not regularly trained there after the first training they received while the remaining 11 percent claimed they are often trained on new safety measures. Also, 69 percent of the attendants feel well protected as far as danger like a fire is concerned.

*Supply of Petroleum Products to Children*

The Red guide (2007) stated that petroleum products should not be sold to children less than 16 years of age. In contrary, results gotten from fuel attendants shows they see nothing wrong in supplying such products to children less than 16 years of age.

**Suitability Assessment Ranking**

As shown in Figure 2, only 5% of the Petrol Filling Stations considered in this research using both Department of Petroleum Resources (DPR) and the Red Guide's standard, met the high suitability standards (i.e. meeting more than 75% of suitability standard criteria adopted), while 74% fall within the very low suitability ranking, this is indeed outrageous and devastating.



**Figure 2** Suitability ranking

## CONCLUSIONS AND RECOMMENDATIONS

It can be concluded without doubt from this research that petrol filling stations are not only indiscriminately situated in Ilorin, standard criteria were not also observed. Thereby exposing a lot of innocent city occupants to serious danger. It can,, be concluded, that most probably the permitting requirements and standard criteria are just on paper or the corresponding ministries or agencies concerned are not proactive.

More also, when environmental issues were considered almost all the petrol station considered were found not to have vapor recovery in place, in fact, such requirement as regarding vapor recovery was not found in the DPR requirements for both gas and petrol filling stations. More also, there were no serious implementations put in place by all of petrol filling stations considered to handle leakages and spillages thereby exposing both the groundwater and surface water to serious contaminations. As regarding safety, 69 percent of the respondent (i.e the filling station attendants) consider their safety intact while the corresponding data from standard criteria does not support their argument. It is possible they are not well acquainted with the hazardous nature of their working environment.

Finally, there is an urgent need for the government to take palliative measures as regarding this proliferation, while reviewing their approach of granting approvals to petrol filling stations in Ilorin and Nigeria as a whole. It should also be ensured that the environmental impact assessments of prospective filling station sites are carried out so as to ensure the general safety of the environment.

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