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# Health Implication on Residents Close to Petrol Station in Ife Central, Nigeria

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**Abstract:** The emergence and indiscriminate siting of fuel petrol stations all across the country call for urgent investigation of the impact of their siting at close proximity to residential areas and absurd places at Ife Central, Nigeria. This project was conducted to analyse the health implication of residents close to the petrol stations in Ife Central, Nigeria. The spatial locational pattern of fuel stations was analysed and its resultant impact on Ife Central, Nigeria to determine the degree of compliance of the PFS with planning standards and regulations; proximity to health care centres, physical, the social and economic relationship between the PFS and residential land uses in the study area. Fifty-two (52) were sampled for data collection. A two-phase mixed-method approach was adopted, using qualitative interviews to validate identified factors. Upon the validation of the location factors through an inductive approach, a quantitative questionnaire was formulated. Using a quantitative survey, data were collected from 340 respondents. The data were then analysed using factor analysis and structural equation modelling to determine the factors and their relationship with factors of location. The analysis reveals cumulative non-compliance to principles and standards by all the PFS. The PFS distribution was cluster distribution pattern of the fuel stations, portraying an unorganised distribution. This cluster distribution pattern impacts negatively on the residents' wellbeing, environment and socio-economic life. The study also identified owner preferential choice and planning standards; storage material and factor of location; environmental impact assessment; type of license; and distance between the tanks and site management and administration as the five factors that directly influenced the choice of location of the Petrol Filling Stations (PFS).

**Keywords:** Petrol Station, Health, Residential, Planning Standards

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## 1. Introduction

Fuels are primarily hydrocarbons containing volatile organic compounds such as benzene, some of which are injurious and harmful if in contact with skin and as well pose low dosage upon exposure to it [1]. The safety of lives and properties and protection of the environment are therefore of major concerns revolving round the petrol filling stations. At ambient temperature, petrol and other vehicle fuels are potentially hazardous. Petrol gives off vapour when mixed with air in appropriate proportions. It burns with explosive force if ignited. Moreover, all petroleum products are potential pollutants, which, if not properly handled or managed, can damage the environment - injurious to aquatic life, and harmful to human health if inappropriately handled

[2] Sequel to this development, many marketers take advantage of this need and build service station haphazardly without considering the possible effect of the locations of the stations. Sustainable economic development and activities such as population growth, urbanization, increased groundwater withdrawal for agriculture, absence of pollution control regulation etc. have been recognised as a major contributing factor of environmental degradation [3]. An improved understanding of natural resource base and mostly environmental systems that support national economies is needed for sustainable development patterns to be determined and recommended to the government. In recent years some scholars have carried out preliminary attempts in this field. Voiland pointed out that gas flaring affects the well-being of local communities; it poisons the environment and illuminates the skies in the evening [4]. The results of

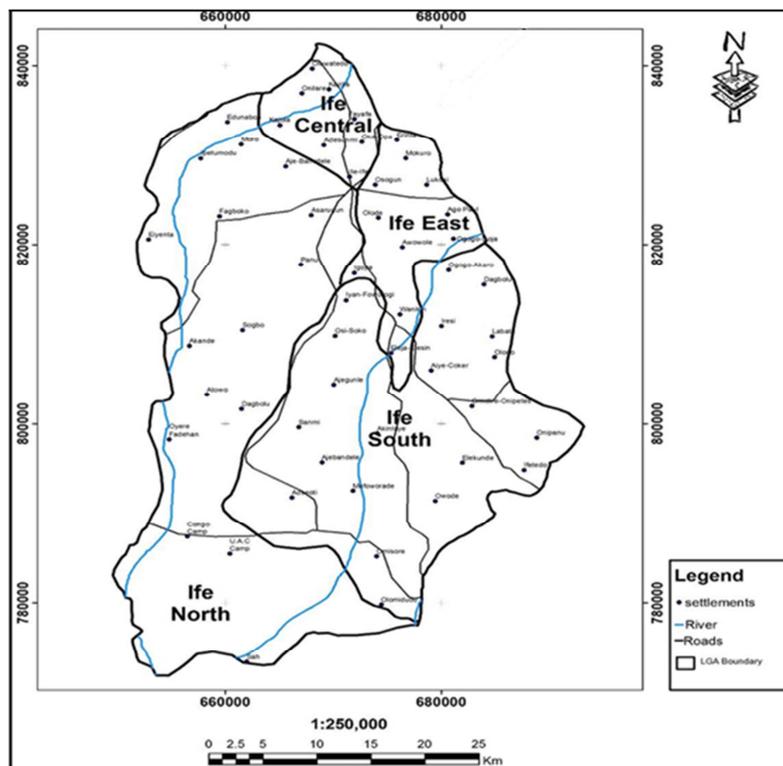
gas flaring include particle decomposition, sulphur dioxides, nitrogen dioxide, and carcinogenic organic instability. In the case of other gaseous outbreaks in populations, hazardous mixes seriously affect their wellbeing in the forms of respiratory illness, hypertension, diabetes, difficult coughing and chronic bronchitis. The source of acid rain which pollutes rivers and lakes and destroys vegetation was also identified as Flared gas [5].

Alam *et al.* in their research study showed that there was a significant difference from the control (those not working at the stations) in the lung functionality test results of petrol pump staff, which pointed to the fact chronic exposure to fuel fumes, hampers the mechanical properties of their breathing [6]. Blamah *et al.* considered 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 [7]. The (United Nations [8]; World Health Organisation [9] pointed out that the health of the people living close to these areas become endangered as a result of constant exposure to traffic and vapour emission. Fuels dispensed at PFS most especially petrol contain volatile organic compounds like benzene which are flammable and can give off vapour even at low temperatures. Sangotola *et al.*, said that that there is always a risk of fire or explosion if ignited [10]. Also, they float in water and many travel long distances eventually causing danger away from the place where they have escaped. The inhalation of petrol fumes constitutes a high potential risk to the environment and the general population. According to World Health Organisation

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 [11]. Daily Mail Reporter, 01:38 BST suggested that the location of filling stations and petroleum products should maintain some distance from public places because of their vulnerability, bad odour and air pollution [12]. They concluded that a minimum distance of 50 meters should be maintained between petrol stations and housing, and 100 meters facilities such as hospitals, health centres, schools, and old people's homes.

## 2. Study Area

The city of Ile-Ife (Figure 1) is the headquarter of Ife Central Local Government Area of Osun State, Nigeria. It is located on latitudes 7°26' N and 7°32' N of the equator and longitude 4°29' E and 4°37' E of the Meridian. The population of the area is about 167,254 persons consisting of 88,403 males and 78,801 females based on the 2006 census result [13]. The vegetation in Ile-Ife is made of three canopy heights the tallest trees up to 25m high with canopies far apart, the middle layer 10-15m high with rather discontinues and irregular canopy and the third layer comprises of dense saplings and shrubs generally less than 5m high. The vegetation in Ile-Ife is made of three canopy heights the tallest trees up to 25m high with canopies far apart, the middle layer 10-15m high with rather discontinues and irregular canopy and the third layer comprises of dense saplings and shrubs generally less than 5m high. The floor is originally covered by a fairly thick layer of little of a forest.



Source: Author's Fieldwork (2019)

Figure 1. Map of Ife showing Ife Central Local Government.

### 3. Materials and Methods

The following data were used in carrying out this research work: The primary source included the administration of structured and unstructured questionnaires, oral interview, personal observation, topographical map of Ile-Ife of 1966 with the scale 1:50,000 produced by the survey department of the state, Geographic information system (GIS), Global Positioning System (GPS). Two different questionnaires were prepared; one for fuel station owners or managers and the other for residents in the study area. There were fifty-two fuel stations were covered or analysed in the study area and they were all enumerated to determine their level of compliance with the guidelines set by the Department of Petroleum Resources. The second questionnaire was used to conduct a survey of residents' opinion regarding the location of fuel stations and their implications around them. The entire filling stations located in the study area were altogether sampled. A purposive sampling method was adopted to administer questionnaires. This sampling technique represents a group of non-probability sampling techniques; and a judgmental or selective sampling of which the researcher relies on his whims and whims to select the respondent. A total of ten (10) respondents in close proximity to each petrol station were randomly sampled, forming the sample size for residents living around the filling station. A total of three hundred and forty (340) questionnaires were administered to get the necessary information for this research. The Global Positioning System (GPS) was used to pick the coordinates of the petrol stations in the study area, while the satellite imagery was used to randomly sample the number of buildings within 50 meters and 100 meters range to the petrol stations.

### 4. Data Analysis and Presentation

#### 4.1. Spatial Location of Petrol Stations and Their Coordinates

The spatial distribution showing the locations of the PFS across the study area with the satellite imagery is presented in

Figure 2. From the figures, it is clear that the PFS is widely located across the study area, particularly along the major transportation routes of the town with concentration at the hub of the study area

*Table 1. Socio-economic status of the respondents living in the neighbor.*

Socio-economic	Frequency	Percent
Gender of the respondents		
Male	181	53.2
Female	159	46.8
Age distribution of the respondents		
18-35	246	72.3
36-60	89	26.2
60 and above	5	1.5
Marital status of the respondents		
Single	157	46.2
Married	175	51.5
Divorced	8	2.4
Educational qualification of the respondents		
Primary	5	1.4
Secondary	137	40.3
Tertiary	171	50.3
Technical	27	8.0
Occupation of the respondents		
Farming	4	1.2
Trading	180	52.9
Civil servant	43	12.6
Others	113	33.2
Years		
Less than 5 years	53	15.6
5-10	52	15.3
10-20	71	20.9
Above 20	164	48.2
Total	340	100
Nativity of the Respondents		
Native	175	51.5
Non-Native	165	48.5
Total	340	100

Source: Author's Fieldwork (2018)

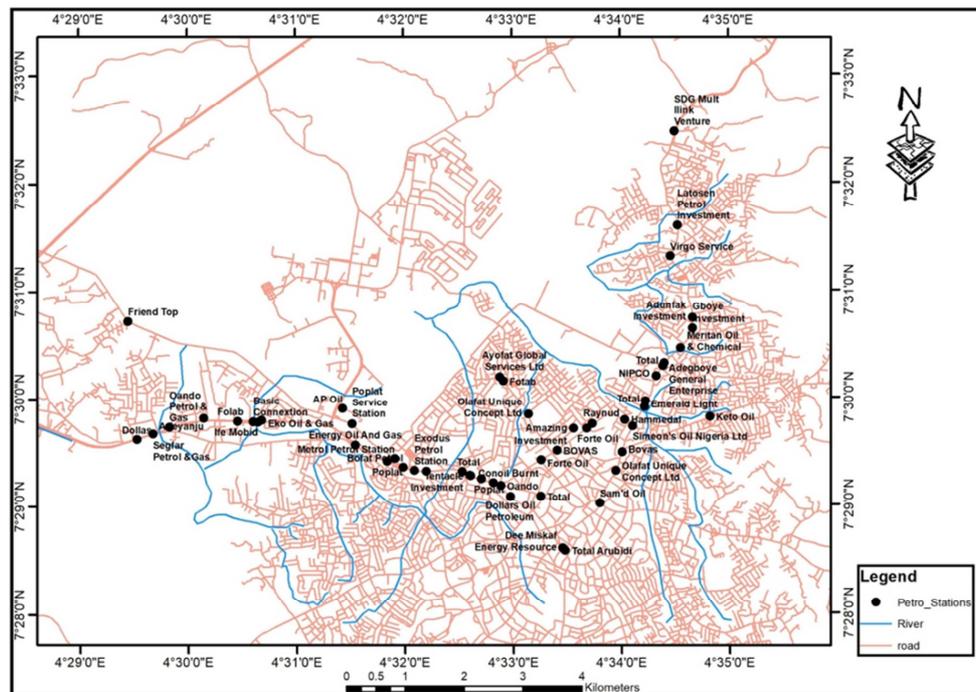
The geographic coordinates of all the petrol filling stations in the study area are presented in Table 2.

*Table 2. Names and coordinates of petrol stations.*

SN	Longitude	Latitude	Petrol Stations	Streets Name
1	671883.00	826751.00	Dee Miskaf Energy Resource	Aderemi Road
2	671924.00	826707.00	Total Arubidi	Aderemi Road
3	673270.11	829167.54	Emerald Light	Aladanla
4	673287.11	829267.54	Total	Aladanla
5	673770.11	833884.54	SDG Mult Ilink Venture	Alakowe
6	668305.11	828872.54	Poplat Service Station	Ede-Road Beside OAU
7	672065.11	828793.54	Amazing Investment	Fajuyi
8	672291.11	828793.54	Forte Oil	Fajuyi
9	672380.11	828878.54	Raynud	Fajuyi
10	670811.00	829679.00	Ayofat Global Services Ltd	Hezekiah Oluwasanmi Road
11	670871.00	829607.00	Fotab	Hezekiah Oluwasanmi Road
12	671298.00	829039.00	Olafat Unique Concept Ltd	Hezekiah Oluwasanmi Road
13	666621.11	828905.54	Basic Connexion	Ibadan Road
14	666765.11	828928.54	Eko Oil & Gas	Ibadan Road
15	666357.11	828911.54	Folab	Ibadan Road
16	666707.11	828899.54	Ife Mobid	Ibadan Road

SN	Longitude	Latitude	Petrol Stations	Streets Name
17	668356.00	828505.00	Energy Oil and Gas	Ife-Ibadan Express Road
18	668898.00	828226.00	Poplat	Ife-Ibadan Express Road
19	672510.00	827517.00	Sam'd Oil	Ifewara Road
20	674082.11	830514.54	Gboye Investment	Ikoyi
21	672934.11	828946.54	Hammedal	Ilesha Garage
22	671508.00	827628.00	Total	Iremo Road
23	664499.11	830626.54	Friend Top	Kajola Akile Alewe Eran
24	674085.11	830699.54	Adunfak Investment	Kojumole
25	670701.11	827859.54	Conoil Burnt	Lagere
26	670315.11	827982.54	MRS Petrol Station	Lagere
27	670498.11	827924.54	Poplat	Lagere
28	670172.11	828051.54	Total	Lagere Ife-Ife
29	670304.11	827987.54	Tentacle Investment	Lagere Ife-Ife
30	669562.11	828057.54	Access Inter-Biz	Mayfair Road
31	669169.11	828121.54	Bofat Petrol	Mayfair Road
32	669363.11	828069.54	Exodus Petrol Station	Mayfair Road
33	669027.11	828271.54	Metrol Petrol Station	Mayfair Road
34	672889.00	828388.00	Bovas	More Road
35	672780.00	828069.00	Olafat Unique Concept Ltd	More Road
36	673067.00	828834.00	Simeon's Oil Nigeria Ltd	More Road
37	670830.00	827812.00	Oando	No 1 Aderemi Road
38	670996.00	827620.00	Dollars Oil Petroleum	No 28 Aderemi Road
39	673580.11	829870.54	Adegbeye General Enterprise	OUA Phase 2
40	673606.11	829921.54	Total	OUA Phase 2
41	673880.11	830179.54	Meritan Oil & Chemical	OUA Phase 3
42	673470.11	829698.54	NIPCO	OUA Phase 1
43	665201.11	828811.54	Oando Petrol & Gas	Ooni Layout Ibadan Road
44	673824.11	832286.54	Latosen Petrol Investment	Opa
45	673707.11	831754.54	Virgo Service	Opa
46	674381.00	828995.00	Keto Oil	Reinhard Bonnke Road
47	668139.44	829131.83	AP Oil	Road 1 OUA Campus
48	671784.11	828415.54	BOVAS	Sabo Junction
49	671513.11	828251.54	Forte Oil	Sabo Junction
50	665782.11	828964.54	Adeyanju	Toll Gate
51	664652.11	828595.54	Dollas	Toll Gate
52	664925.11	828692.54	Segfar Petrol & Gas	Toll Gate

Source: Author's Fieldwork (2018)



Source: Author's Fieldwork (2019)

Figure 2. Spatial distributions of petrol stations Ile-Ife Central.

#### 4.2. Setback to the Health Care

The setback of the petrol stations to health care is presented in Table 3. The result shows that 50 m 36.5%, 100 m 5.8%, 150 m 19.2% and 200 m 38.5%. According to the criteria set by the DPR, filling stations are not allowed to operate adjacent to public institutions like hospitals. In case they are to operate, a minimum distance of 100 meters has to be maintained.

**Table 3.** Distance from health care.

Distance from Health care	Frequency	Per cent
50	19	36.5
100	3	5.8
150	10	19.2
200	20	38.5
Total	52	100.0

Source: Author's Fieldwork (2018)

**Table 4.** Factor loadings after Varimax rotation.

	D1	D2	D3	D4	D5
Distance to built-up area	0.8063	0.0666	-0.0158	0.0537	-0.2513
Turning radius	0.7794	0.0937	-0.1777	-0.2660	0.1908
Setback to residential landuse	0.7172	0.3910	-0.2197	0.0944	0.1969
Pump setback to pavement	0.6862	-0.2003	0.2795	-0.0192	0.0723
Reason for location	0.6439	-0.0598	-0.0030	0.5778	-0.2096
Distance to the road	0.5814	0.3740	-0.0462	-0.2134	-0.3293
Material for storage	0.0573	0.8800	-0.0652	0.0222	0.1291
Factors influencing location	0.2151	0.5933	0.3205	-0.1197	0.3528
Suitability before siting	-0.1245	0.1458	0.7647	0.0956	0.2499
Assessment before siting	0.0849	-0.1609	0.7068	-0.1342	0.0516
Approved by govt	0.0157	-0.0423	0.6609	0.0103	0.2493
Original land use	0.0731	-0.2701	-0.5450	0.0529	0.2518
Distance between the tanks	-0.1384	-0.1248	-0.1343	0.7133	0.2950
Type of licence required	-0.0654	0.4826	-0.0014	0.6286	-0.3067
Other services in the stations	-0.0997	0.0743	0.1361	0.2381	0.7583
Size of the station	0.2827	0.2667	0.1561	0.1195	0.5159
Distance from healthcare	0.1459	-0.0728	-0.0505	0.2607	-0.7772
Setback to infrastructure	0.0544	0.2354	-0.2738	0.1964	0.1317

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization

Source: Author's Fieldwork, (2018)

#### 4.3. Awareness of Residents and PFS Operators on the Locational Effect of PFS on Residential Land Use

The study revealed that there is a high level of awareness among the residents on the impact of siting the PFS close to residential land use on the wellbeing (health) of residents and the environment. The result revealed that 56.2% were aware of the potential risks associated with the PFS both to the health of the residents and the environment, while 43.8% tend to not attach any risk with the PFS location and services (Table 5).

**Table 5.** Health risk of the respondents.

Health risk	Frequency	Per cent
Yes	191	56.2
No	149	43.8
Total	340	100

Source: Author's Fieldwork, (2018)

The awareness of health-related issues by the petrol stations operators in the study area is presented in Table 6. The result shows that the operators of the PFS claimed ignorance of the impact of their business on the residents and the environment as 37.8% claimed to be aware of the effect, while 62.2% claimed ignorance of associated and impacted health problems.

The complaints of the residents around the petrol stations present a wide range of health challenges they encounter

(Table 7.) The results show that respiratory disease as the highest percentage of 73.1%, nervous system breakdown and others returned 11.5% each and leukaemia 3.8%. This wide range of these health threats was obtained based on the perception of the residents concerning the distance between the petrol stations and their residential houses. This is with the view to determine the variation in the risk variables.

The respondents also presented common ailments peculiar to them in Table 8. The results show that fever and cough each return 38.8%, while cold and asthma 13.8% and 8.5% respectively as shown in Table 8.

The study, therefore, reveals that residents in close proximity to these petrol stations suffer respiratory-related health problems. "This finding is consistent with the report of Mshelia which submitted that PFS or related activities releasing fuel gasses into the atmosphere produce environmental hazards that present health hazards when inhaled, swallowed or in contact with the skin or eye" [14].

**Table 6.** Awareness of health-related issue by the PFS Operators.

Awareness	Frequency	Per cent
Yes	14	37.8
No	23	62.2
Total	37	100

Source: Author's Fieldwork, (2018)

**Table 7.** Health complaint.

Health complaint	Frequency	Per cent
Leukaemia	2	3.8
nervous system breakdown	6	11.5
respiratory diseases	38	73.1
Others	6	11.5
Total	52	100.0

Source: Author's Fieldwork, (2018)

**Table 8.** Common ailments of the respondents.

Common ailment	Frequency	Per cent
Fever	132	38.8
Cough	132	38.8
Cold	47	13.8
Asthma	29	8.5
Total	340	100

Source: Author's Fieldwork, (2018)

#### 4.4. Hazard Occurrence(s) of PFS in the Study Area

The occurrence of a fire outbreak in the petrol station is presented in Table 9. The study showed 82.7% of the PFS claimed that they had not experienced any case fire outbreak, while 17.3% claimed to have encountered such. This might be due to some cautions are taken in simple compliance with some rules such as no smoking, no use of phone, and others in the areas of dispense of fuel. This implies that fire extinguisher is very important in case of any fire outbreak in the petrol station to avoid casualties.

The study also showed the safety measures each station employs to combat the occurrence of the fire accidents. Over 98% of the PFS in the study area claimed to be equipped with a functional fire extinguisher in any case of fire occurrence, and about 2% claimed to be equipped with sand buckets for the same purpose (Table 10). This revealed that all the PFS knew potential hazards associated with their services and are at least equipped for the one they can handle.

**Table 9.** Fire outbreak in the petrol station.

Any fire outbreak	Frequency	Per cent
Yes	9	17.3
No	43	82.7
Total	52	100

Source: Author's Fieldwork, (2018)

**Table 10.** Environmental safety measure.

Environmental safety measure	Frequency	Per cent
Fire Extinguisher	51	98.08
Sand	1	1.92
Total	52	100.00

Source: Author's Fieldwork, (2018)

The residents have been feeling the impact of the PFS siting close to the residential areas, they presented the highest challenges they encounter is parking inconveniences which constitute about 50% of the complaints, traffic congestion was about 40% and pollution (water, soil and air) was about 5% (Table 11).

**Table 11.** Environmental complaint by the respondents.

Environmental complaints	Frequency	Per cent
traffic congestion	8	40
pollution	1	5
parking inconveniences	10	50
others	1	5
Total	20	100

Source: Author's Fieldwork, (2018)

#### 4.5. Type of Pollution in the Environment Caused by Petrol Stations

The impact of PFS on the surrounding has become noticeable to the residents, and Table 12. has a summary of their observation. The results show that the impact of the PFS activities and services on the air is conspicuous to the respondents and in fact constituted the highest percentage of air pollution 30.3%, noise pollution and unnecessary traffic also bore great impact with 22.9% and 26.2% respectively; water being polluted is high with 17.9%, and soil pollution with 2.6%.

The result, therefore, indicates that air pollution has the highest per cent (30%). This reveals that air pollution is the highest danger in relation to the distance between petrol stations and residential settlements. That is, the closer the houses are to the 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 generators to power-pumping machines. Soil pollution, water pollution, noise pollution and unnecessary traffic have 2.6%, 17.9%, 22.9% and 26.2% respectively. This means the three variables are less severe compared to air pollution. However, the result equally shows that the nearer the petrol station to residential areas; the more likely the residents will be affected by traffic congestion, especially during fuel scarcity.

**Table 12.** Type of Pollution in the environment caused by petrol stations.

Type of pollutions	Frequency	Per cent
Soil pollution	9	2.6
Air pollution	103	30.3
Water pollution	61	17.9
Noise pollution	78	22.9
Unnecessary traffic	89	26.2
Total	340	100

Source: Author's Fieldwork, (2018)

#### 4.6. Socio-economic Life

The respondents in the study area presented their views despite the mixed impacts of the PFS on the socio-economic life of the area in Table 13. The results show that about 47% of the respondents opine the siting of the PFS close to the residential areas was good (very good 31.5% and good 15.9%), while about 24.4%, opined their siting was not good and 28.2% were indifferent

This opinion reveals perhaps the degree of the impact each respondent was exposed to. some were blinded perhaps with livelihood they make because of the siting of the PFS at the expense of their wellbeing. While those with outright displeasure were those who tasted the bitter pill of the

negative impact of the PFS directly or indirectly.

The opinion of the respondents on their social-economic life in the study area is presented in Table 14. The result shows that 25.6% opined that the social-economic life in the area was excellent; 29.5% claimed it was very good 34.1% voted for average socio-economic life and 10.9% very bad.

The implication of the pattern observed in the study area is that a clustered pattern has a higher concentration of petrol service station which may cause problems like traffic congestion, pollution, fire and explosion and these numbers of petrol service stations competing with residential buildings. An urban planner faces challenges of the location of facilities and services which, as a result, exposes our urban populace to some dangers. Since road transport remains a common mode of transportation in the study number of vehicles increases on a daily basis, this translates to higher consumption of petrol. Hence, indiscriminate locations of a petrol service station.

**Table 13.** Opinion of petrol Stations by the respondents.

Opinions	Frequency	Per cent
Very good	107	31.5
Good	54	15.9
Not good	83	24.4
Fair	96	28.2
Total	340	100

**Table 15.** Correlation of respondents' responses p-values (Pearson).

Variables	Health risk	Type of pollution	Water pollution	Proximity to gas stations	Opinion on gas station	Socio-economic life	Common ailments
Health risk	0						
Type of pollution	0.130	0					
Water pollution	0.174	< 0.0001	0				
Proximity to gas station	0.530	0.684	0.132	0			
Opinion on gas station	< 0.0001	0.022	0.046	0.403	0		
Social economic life	0.0002	0.052	0.310	0.129	< 0.0001	0	
Common ailments	< 0.0001	0.006	0.321	0.011	0.213	0.802	0

Values in bold are different from 0 with a significance level alpha=0.05

Table 15. above shows the correlation which exists between various response variables of the respondents. Health risks presented by siting the PFS close to residential areas is statistically significant to the opinion on gas stations, common ailments and socio-economic life of the respondents.

The type of pollution experienced by the respondents is statistically significant to water pollution, common ailments and opinions of respondents on gas stations. Likewise, proximity to the gas stations of the respondents is significant to the common ailments experienced by the respondents. The opinions of respondents on gas stations are also statistically significant to the socio-economic life of the respondents.

### 5. Conclusions

Based on the analysis done and the result obtained or presented, it can be concluded that:

1. The spatial distribution pattern of PFS at Ife Central, Nigeria is clustered using ArcGIS tool.
2. There was partial compliance with the principles, standards from concerned regulatory, monitoring

Source: Author's Fieldwork, (2018)

**Table 14.** Social-economic life of the respondents.

Social-economic life	Frequency	Per cent
Excellent	87	25.6
Very good	100	29.4
Average	116	34.1
Very bad	37	10.9
Total	340	100

Source: Author's Fieldwork, (2018)

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The type of pollution experienced by the respondents is statistically significant to water pollution, common ailments and opinions of respondents on gas stations. Likewise, proximity to the gas stations of the respondents is significant to the common ailments experienced by the respondents. The opinions of respondents on gas stations are also statistically significant to the socio-economic life of the respondents.

3. Using factor analysis and structural equation modelling, five factors were identified to have influenced the choice factors of locating the PFS, they are owner preferential choice and planning standards, storage material and factor of location, environmental impact assessment, type of license and distance between the tanks and site management and administration.
4. The clustered distribution pattern of the PFS impacted both on the wellbeing of the residents and the environment. Traffic congestion, parking inconveniences, noise pollution characterised the environmental discomfort created. Also, air pollution, noise pollution and water were strongly identified as the resultant effect of the services and operations of the PFS. Soil pollution was also identified.
5. The services of the PFS had negative impacts on the wellbeing of the residents, as respiratory diseases top the list, leukaemia and nervous breakdown was also reported. This confirmed the literature, thus

planning bodies from the side sides of the PFS. No single PFS met the cumulative standards.

categorising them as long-term non-carcinogenic health problems. Short-term health issues were also reported for being exposed to the vapours of gasoline dispensed by the PFS, they include fever, diarrhoea, cough, and cold.

6. The study revealed that there was a high level of awareness among the residents on the health and environmental effect of the PFS in the area. While there was low awareness among the PFS operators on the impact of their activities.
7. Non-synergetic principles and standards had been observed between the regulatory bodies and the local authorities

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