

# Assessment of Filling Station in Ilorin, Kwara State, Nigeria Using Geospatial Techniques

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## ABSTRACT

The level of noncompliance associated with filling stations in respect to the guidelines of the regulating bodies has become pervert. The study uses geospatial techniques to determine the distribution pattern and assess the level of conformity of the filling stations against the physical planning standards by the regulating bodies. Primary and secondary data were used as data sources. Roads were digitized from high resolution image of the area and a handheld Germin (GPSmap® 78) Global Positioning System (GPS) receiver was used to capture the coordinates of Filling stations. Analysis was done using analyzing pattern of the spatial statistic tools to determine the pattern of distribution and proximity (Buffering) Analysis to determine the level of conformity. The finding shows 225 filling stations in the study area with a clustered pattern of distribution. 71.6% of the filling station met the 15m distance from the edge of the road and 28.4% violation. Also, 97.3% of the filling stations violate the 400m apart with only 2.7% in compliance. 98.7% deviate from the 2km radius of four stations with 1.3% in compliance. However, all the stations ensured that the drainage from their site does not flow into a river and does not lie within pipeline or high tension cable Right Of Way. The study therefore concludes and recommended that the regulating bodies be firm in discharging their duties diligently in enforcing compliance at all level of the guidelines for the safety of the hosting communities and even distribution across the study area.

**Keywords:** GPS, GDP, AGO, DPK, GIS, NNPC, DPR, NNR, PHCN

## I. INTRODUCTION

In Nigeria, Filling stations operations started prior to independence; the production and distribution of petroleum products which did not gain much popularity until independence in 1960 as a result of the fact that the mileage of motor able roads rarely increased and are few vehicles plying these roads. However with the independence in 1960, Construction of more roads, schools, and factories started and consumption of Petroleum Products increased. Demands for all grades of Petroleum Products started to overtake the supply and this became more manifested after the civil war leading to opening of many filling stations across the country (Udoh, 2013).

The petroleum industry in Nigeria is the largest industry which provided approximately 90 percent of foreign exchange earnings and about 80 percent of Federal revenue and subscribe to the rate of growth of

Gross domestic product (GDP) (Baghebo and Atima 2013).

Petroleum is the largest source of Nigeria's income and foreign exchange. The petroleum industry in Nigeria is divided into two main segments. The upstream and the downstream sectors. The upstream refers to activities such as exploration, production and delivery to an export terminal of crude oil or gas. The downstream on the other hand encompasses activities like loading of crude oil at the terminal and its user especially transportation, supply trading, refining distribution and marketing of petroleum as well as activities of filling stations or petroleum outlets (Dominic, 1999).

Filling Station otherwise known as Petrol station, Gas Station, Refuelling Station, or Service Station across the world is a facility which sells fuel and lubricants for motor vehicles, generators and other machine. The most common fuel products sold is Premium Motor Spirit (PMS) known as petrol, Automotive Gas Oil

(AGO) and Dual Purpose Kerosene (DPK) known as kerosene. Filling stations should be located where they are less congestion and danger to the community as much as possible and should conform to the guidelines of the regulating bodies Keble (1968) in Samuel (2011). GIS is a tool that allows for the processing of spatial data into information which is used to make decisions about some portion of the earth (Demers, 2000 shayya, 2004).

According to Oloko-oba et' al (2016) the use of GIS technology as a planning tool can be employed to enhance the location of infrastructures and assessment for proper distribution.

Samuel (2011) examined the spatial distribution of filling stations in Kaduna North. The study identified the pattern and distribution problem in the area. The study found that there are 22 filling stations in the area and the distribution is uneven as the stations are mostly concentrated along major roads. In addition the study looked at the setbacks and locational situation of the stations and concluded that 69.5% did not conform to the standard. Though GIS was applied for mapping, it was not employed for measuring the standards compliances.

Similarly a study was carried out in Agege Local government Area of Lagos State by Abdullahi (2012). The study observed that filling stations are randomly distributed in the area. The study observed due to land shortage people build station wherever the land is available and this creates a pseudo development pattern. Mshelia et'al (2015) revealed that the guidelines for sitting petrol stations have not been adhered by most of the petrol stations thereby posing serious threat on residence in close range to them even though some of these petrol stations were situated much earlier than the residential houses close to them. It is expected of the State legislature therefore to enact law prohibiting both government and individuals from converting plots of land for location of petrol stations within the community straightaway. Further attempt by either of the two sides to convert the use of any land within community should be resisted by the people and the court. The study looked at proximity to residential buildings in the study area using simple descriptive statistics such as frequencies and percentages.

Samuel et 'al 2015 finds that the petrol filling stations in the study area neither conform to the required distance of 400m apart nor conform to the required distance of 15m from the road. Thus, the study recommends, among others, the need for the regulatory agency, DPR, to improve their capacity in enforcing the compliance of petrol filling stations with laid down regulations. The study is limited to just two level of conformity amongst many and does not consider the pattern of distribution of the petrol station in the study area.

Mohammed et'al 2014 The findings in the study revealed that there are 214 filling station located along the 43 roads in the study area, of which 69% are owned by independent marketers, 26% owned by Major Marketers and 5% owned by the NNPC. Most of the station satisfied the minimum requirement of 15m distance from the road (96%). Equally 98% of the filling stations met the minimum distance of 100 meter from the health care facilities. However many station had not meet the criteria of 400m minimum distance to other. The research however considers few level of conformity and does not look at spatial distribution and finally concludes that regulatory agencies need to look into the issue and take appropriate measures.

The fast growing population and the high increase of cars and other fuel consuming machines makes demand for fuelling products high which has in turn trigger the numbers of filling stations. This is because all the millions of cars on Nigeria roads as well as generators to power our homes and offices run on Petrol or Diesel. As a result of this, there is need to adequately study the distribution of filling station and examine the levels of conformity with respect to the guidelines of the regulating bodies Department of Petroleum Resources (DPR) and Urban Town Planning.

Suitability inspection of DPR guidelines for approval to construct and operate petroleum products filling station includes:

- (i) Size of the proposed land site.
- (ii) The site does not lie within pipeline or PHCN high tension cable Right Of Way (ROW).
- (iii) The distance from the edge of the road to the nearest pump will not be less than 15 meters.
- (iv) Total number of petrol stations within 2km stretch of the site on both sides of the road will

not be more than four including the one under consideration.

- (v) The distance between an existing station and the proposed one will not be less than 400 (four hundred) meters.
- (vi) The drainage from the site will not go into a stream or river.
- (vii) In some instances where site is along Federal Highway, a letter of consent from the Federal Highway is required.
- (viii) DPR guided/supervised EIA study of the site by DPR accredited consultant.

This study considers ii, iii, iv, v and vi of the suitability guidelines.

### Study Area

Ilorin is the host city of Kwara State which lies within Latitude 8° 24'N to 8°34'N and Longitude 4° 28'E to 4°39'E. It is situated in a transition zone between the Northern and South Western part of Nigeria with a total land area of approximately 105sq.km with a population of about 766,000 as at 2006 census which cuts across three Local Government Areas namely (Ilorin West, East and South) comprising of twenty political wards.

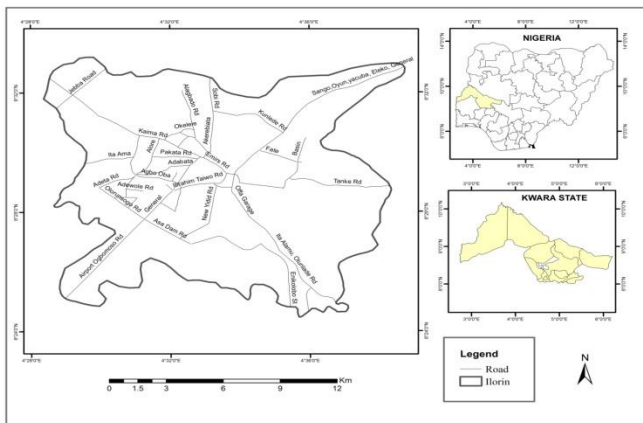


Figure 1: Study Area Map

## II. METHODS AND MATERIAL

The study utilizes primary and secondary data. The primary data was acquired through handheld Germin (GPSmap® 78) Global Positioning System (GPS) receiver to acquire the coordinates of Filling stations. The secondary data used is a high resolution image of the study area to extract road network using onscreen digitizing. GPS coordinate of filling stations and other

related dataset (Names, Address and Type) were further geo-coded and integrated into ArcGIS database. Nearest neighbor analysis of the spatial statistics tools was used to determine the pattern of distribution using Filling station location, total number of stations and the total area covered in kilometer as criteria. Proximity Analysis (Buffering) was used to determine the level of conformity of filling stations in the study area with respect to the guidelines of the regulating body.

## III. RESULTS AND DISCUSSION

A total number of two hundred and twenty five (225) filling stations were discovered in the study area in the cause of field survey among which thirty six (36) were owned by major marketers, one hundred and eighty four (184) independent and five (5) NNPC as shown in fig.2

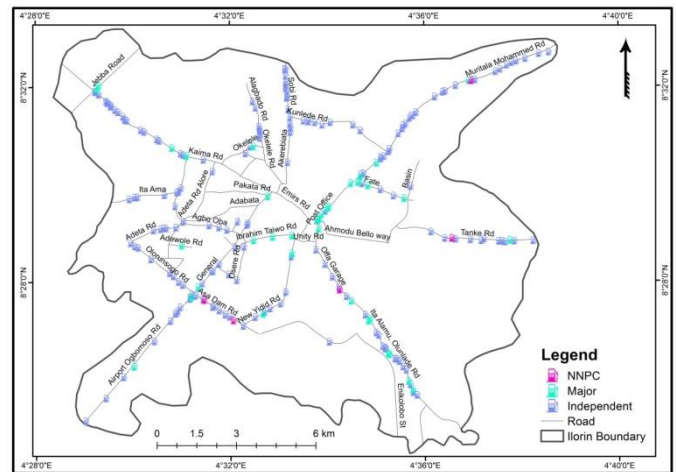
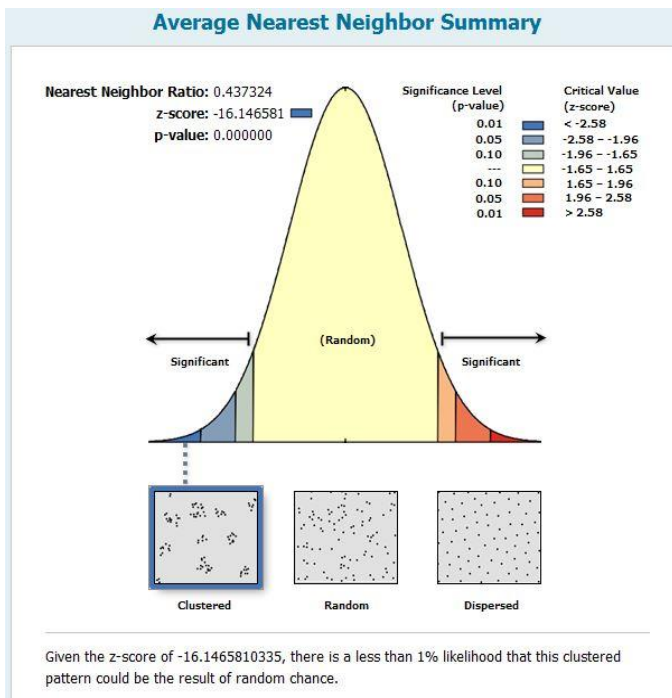


Figure 2: Distribution of Filling Station with Respect to Types of Ownership

The result of spatial pattern of distribution of filling stations in the study area shows a clustered pattern of distribution with Nearest Neighbor Ratio (NNR) of 0.43 and a Z-Score of -16.14 as shown in fig.3 below. This means that majority of the stations are close to the same location than been uniformly distributed.

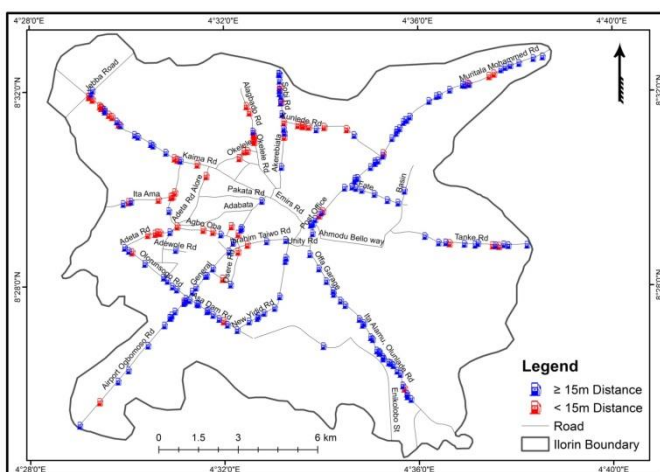


**Figure 3:** Nearest Neighbor Analysis of Filling Station.

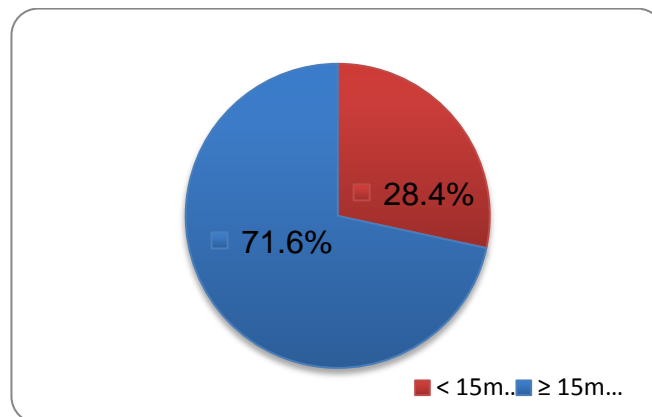
### 3.1 DPR Guidelines for Approval of Construct and Operation.

A. The distance from the edge of the road to the nearest pump will not be less than 15 meters.

The result of the analysis revealed that 71.6% meet the criteria of  $\geq 15m$  while 28.4% violate the criteria as shown in Fig. 4 and Fig.5 below.



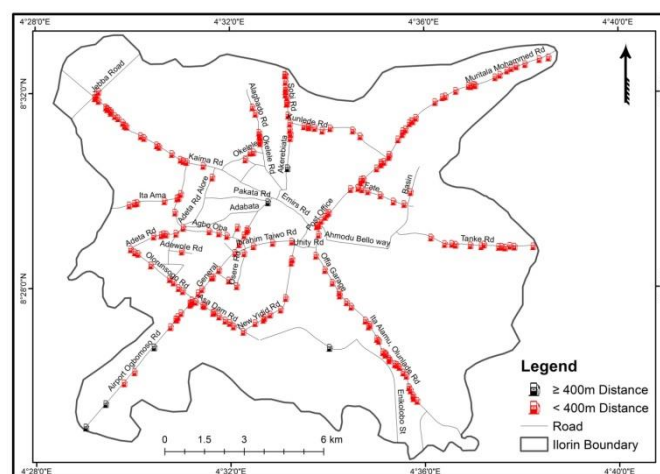
**Figure 4:** Filling Station Conformity with Respect to 15m Distance to Road



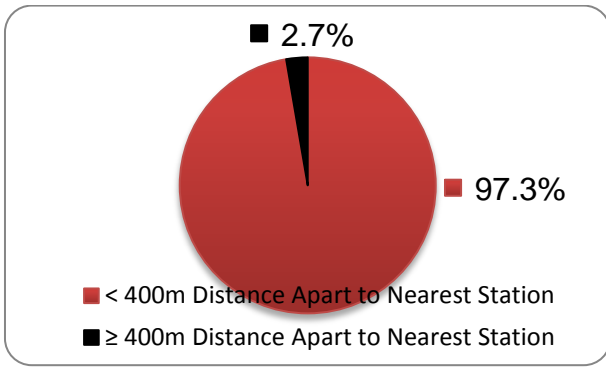
**Figure 5:** Pie Chart showing percentage of conformity of 15m Distance to Road

B. The distance between an existing station and the proposed one will not be less than four hundred meters (400m).

The result of the analysis revealed 97.3% of the filling station does not satisfy the 400m distance apart from the nearest station while only 2.7% are in conformity to the guideline with respect to distance apart. See Fig. 6 and Fig. 7.



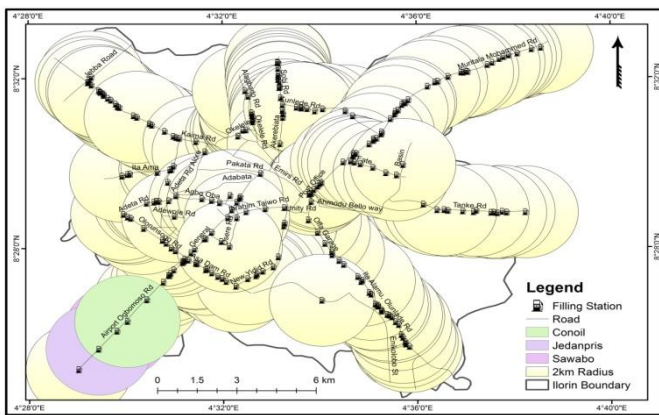
**Figure 6:** Filling Stations Conformity with Respect to Distance to Nearest Station.



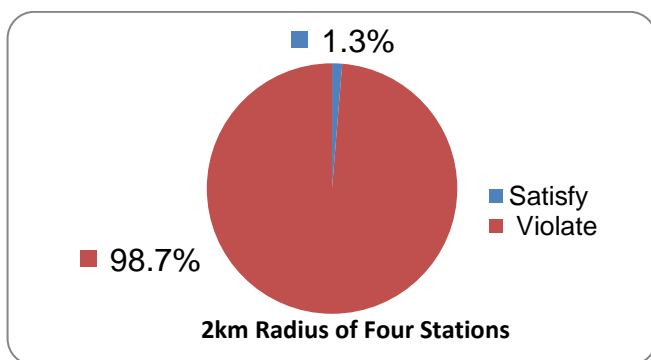
**Figure 7:** Pie Chart showing 400 Meters Apart to the Nearest Filling Station.

C. Total number of petrol stations within 2km stretch of the site on both sides of the road will not be more than four including the one under consideration.

The buffer analysis of 2km radius performed on the filling station in the study area reveals that only 1.3% satisfies the 2km stretch on both sides of the road while 98.7% as there are more than 4 filling stations observed in every 2km buffer radius as shown in Fig. 8 and Fig. 9 below.



**Figure 8:** 2km Radius of Four Stations



**Figure 9:** Pie chat of 2km Radius of Four Stations.

D. The drainage from the site will not go into a stream or river

The field review carried out in the study area shows that there is no drainage from the filling station that runs into a river or stream. Also none of the filling station lies within the Nigerian Electricity Transmission Network. (PHCN high tension cable Right Of Way (ROW).)

The filling stations satisfy both criteria 100% in accordance to the lay down guidelines of the regulating body.

#### IV. CONCLUSION

The use of GIS technology has proven powerful to the achievement of the assessment of filling stations in the study area. The study shows that the distribution of filling station is clustered with various level of conformity with respect to the regulating bodies guidelines. There is very huge violation observed in the 400m distance apart to the nearest station as well as the 2km radius stretch of four stations. However, a 100 % percent compliance is recorded in the area of drainage not running into the stream from the stations and not falling under the high tension cable right of way. It is therefore recommended that the regulating bodies be firm in discharging their duties diligently in enforcing compliance at all level of the guidelines for the safety of the hosting communities and even distribution across the study area. Further studies can be carried out to look into the size of the propose land for filling station construction in the area.

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