

Assessment of Fire Service Station Response to Filling Stations Fire Outbreak and Vulnerable Healthcare Centers to Filling Stations in Urban Settlement

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ABSTRACT

Fire stations with the help of the fire-fighters play an important role in emergence of fire outbreak and explosions in terms of rescue and safety. Urban centre such as Ibadan, Oyo State and one of the most populated city in Nigeria experience hazard caused by fire outbreak either by person or organization leading to loss of life and properties and this has become a critical issue to addressed. Therefore, this study examines the response of fire service stations to filling stations fire outbreak and vulnerable healthcare centres in urban core area of Ibadan metropolis Nigeria using geographical information system application. Site investigations were done to obtain the spatial location information of fire stations, filling stations and healthcare centres using handheld GPS (Garmin 78s). The acceptable standard by the Nigerian Department of Petroleum Resources, Oyo State Urban and Regional Planning Board and the Federal Fire Service for the fire service station for the service area were considered. Further analysis was done using Microsoft excel 2007 and ArcGIS 10.3. The results showed that, out of the 153 filling stations within the study area, only 30 (9.6%) are within the 300m local authority standard interval. 11 (7.2%) are within the 400m regulation standard by the Department of Petroleum Resources. Moreover, 49 (32%) filling stations in the area had their dispensing pumps not less than 15m to the road as specified by Department of Petroleum Resources, Nigeria. 93 (60.8%) filling stations are within the radius of 2.7km to the fire service stations. Only 11 (7.2%) health care centres are of high vulnerability to filling stations within a radius of

200m, 20 (13.1%) was at moderate zone with radius of 300m while 122 (79.7%) was at low zone. The study showed that the fire station response to filling stations fire outbreak in the study area reduces the risk associated since larger percentage of filling stations was in line with the fire service station required distance thereby lowering the risk of healthcare centres to the filling station fire outbreak.

Keywords: Geographic information systems; Rescue and safety; Site investigation; Acceptable standard.

INTRODUCTION

Environmental planning especially land use planning play a vital role in ensuring the public safety as there are risks be it natural or artificial associated with environment. This is done to resolve conflicts and reduce the risks associated with the location of dangerous facilities ^[1]. At its simplest, land-use zoning should aim to separate densely populated areas from dangerous materials and their associated transport routes and reduce exposure to hazards through the creation of buffer zones around dangerous facilities ^[1]. The importance of fire service station and the firefighter to human lives, property, and natural resources from fire and other emergency disaster cannot be overemphasized. Risk is a combination of the interaction of a hazard, exposure and vulnerability ^[2]. Fire serves as a fastest chemical process in such a way that oxygen combines with other chemical substance through a source of heat ^[3]. In selection of

emergency service location, fire location serves as major consideration and in selecting such location optimally [4-9]. Hazard being a dangerous event and likely leading to loss of lives, harmful or other health effects, as well as inflict damage and loss to property, infrastructure, way of life and services, social-economic disruption as well as environmental damage” [2]. Due to increasing community’s population growth, it has become inevitable to rank up, reposition the existing stations or establish more fire stations to satisfy peoples demand for emergency services [10]. With this urbanization rate and consequent heavy traffic congestion, the location of new fire stations is becoming a huge problem in urban planning and development [11]. ESRI, 2012 and Badran, 1997 [12-13] relates fire hazard causes to overcrowding in houses and work places, increase in production and commercial activities in industrial zones of newly developed locations which constantly lack satisfactory measures to respond to fire hazards [14]. The increase in urbanization has put urban areas population growth in the developing countries in danger of occurrence of hazardous fire [15]. According to Habibi et al., (2008) [15], the major standard for location of fire station are distance among the stations; extent of fire risk at various parts of a city; ability to access; area covered; population, and city expansion trend. Most researchers chose to create the response area as a straight-line or Euclidean buffer rather than a network buffer because of computation time [9] or because the necessary network data was unavailable [16].

Rapid population growth has created and constitutes significant challenges on the government to make available the important infrastructure to everyone and also make compulsory law on the people [17]. Everyday increase in population lead to increase in the number of automobiles, thereby necessitating the need for fueling services and thereby requiring the construction of more petrol filling stations. Petrol filling station is a place where fuels and lubricants

such as Premium Motor Spirit, liquefied natural oil, kerosene, dual purpose kerosene, etc. for automobiles and other uses are sold [18]. Petrol stations are, therefore, one type of technological invention that poses a threat to individuals, society and surrounding environments [19]. Petrol stations should be located not only in places where they are accessible, but also cause as little danger and congestion as possible [20]. Research indicates that over concentration of petrol stations in a small area within a city has resulted in problems like traffic congestion, health risks, fires and explosions, and in some cases, hampered emergency response [21-22]. Facilities such as petrol stations in the urban environment should be located away from schools, hospitals and densely populated areas as argued by [1, 23]. Some petrol stations carry specialty fuels such as liquefied petroleum gas (LPG), natural gas, hydrogen, biodiesel, kerosene, or butane, while others add shops or convenience stores to their primary business [24]. The potentially hazardous nature of these facilities necessitates special care in their design and location in order to avoid fires or explosions [25]. Even though these facilities may have different names depending on the part of the world, the purpose remains the same [23]. More than 2.3 million lives, and properties worth more than 4.5 billion US Dollars, are lost to fires associated with mishandling of petroleum products in African countries as reported by [26]. Between 2007 and 2014, approximately 11 Liquefied Petroleum Gas (LPG)-related accidents in Ghana killed more than 39 people, leaving approximately 186 others with various degrees of injuries [27]. Failures in human behaviours, lifestyle and processes are the primary causes of fires at petrol stations as stated by [25].

In Nigeria, the Department of Petroleum Resource (DPR) stipulates that a petrol station should be located at a minimum of 50 meters away from built-up areas, to create a buffer zone devoted to non-residential land-use [28]. Petrol stations should be at least 100 meters from schools,

hospitals, theatres, clinics and other public and semi-public buildings ^[28]. The regulations state that there should be a distance of at least 15 meters from the edge of the road to the nearest pump ^[28]. In addition, the DPR states that petrol stations should be located at least 400 meters apart ^[28]. To approve a new development, they stipulate that there should be no more than four other petrol stations within a two-kilometer radius of the proposed site ^[28]. In South Africa's GDoACELA guidelines, a minimum safety distance is three kilometers ^[29] while it is two kilometers in Nigeria ^[28]. Globally, many countries do not seem to adhere to the standards. For example in Nigeria, research conducted at approximately 153 petrol stations in the Niger Delta Region shows that only 35 (23%) petrol stations conform to the DPR 2007 guideline of 400 meters between stations, while 118 (77%) were in breach of the guideline ^[30]. Moreover, only 50 (33%) petrol stations conformed to the rule that the nearest pumps should be at least 15 meters away from the edge of the road; 103 (67%) petrol stations did not ^[30]. Similar cases were identified in the townships of Maiduguri and Jere ^[23].

However, this phenomenon is not unique to Nigeria. Petrol stations are a lucrative business in Nigeria ^[23], creating incentives to bypass the rules ^[23]. However, the threat posed by petrol stations is poorly studied, with the result that it is often inadequately integrated into land-use planning ^[31]. In citing fire station in a country, region, state and local level, some major criteria should be followed. Though, Federal Fire Service stipulated a standard distance of 2,700 meters to filling stations ^[32]. The response radius of 2km, time response of 3-5 minutes and distance between two stations of 2,500 meters was stipulated by ^[15], radius response of ≈ 0.5 km – 8.5km, time response of 5 minutes (proposal of 5 min. local authority). And distance between nearest station of 1km to 9km ^[9].

Vulnerability refers to the characteristics of persons, a group or properties and their situation that influences their capacity to anticipate, cope with, resist or recover from the impact of hazards ^[33]. Location and sitting of fire service station, filling stations to place of public assembly in an urban settlement should be on how vulnerable the settlement is. Vulnerability is a state of susceptibility to harm from exposure to stress associated with environment and social change and from the absence of capacity to adapt ^[34].

Geographical information system is a powerful tool connected by computer networks, bringing together different data sets that may be separated across space in a widely varied data holdings from which connection can be recognized and conclusion are reached ^[35]. With the benefit of information technology, spatial and non-spatial data can be made available through Geographic Information Systems thereby leading to its specific roles in managing, integrating, query and analyzing, and visualization data ^[36]. With GIS, analysis can be made to determine the closeness of filling stations to main roads, residential areas, prominent buildings etc. By applying GIS in managing disaster, it could help in reducing the risk and the result of such effect of a dangerous event ^[37]. Nisanci (2010) ^[38], in their study, database for fire incidence was created with GIS and analysis for location of fire hydrant was carried out. Also, fire information system was created for urban area and its importance was highlighted. Moreover, the system created was used to determine the optimum distribution of hydrants, fire stations location, fire areas classes according to fire type and the creation of area that need quick action plans. Combination of GIS approaches was used to discover the position of fire station in Belgium ^[39]. Incessant fire disaster outbreak has become a critical issue long ago most especially to a populated environment thereby leading to panic and fear whenever there is fire outbreak. Different survey shows that petrol

filing station has high potential hazard to the society [40] and such hazards may be environmental, hydrological, geological and socio-economical. Therefore, this study assesses the fire service station response to filling stations fire outbreak and vulnerable healthcare centre's in urban core area of Ibadan metropolis, southwest Nigeria and recommended the likely solution that will curb the menace of incessant fire outbreak and its effects to the environment as well as precaution to be taking by the filling stations owner and the dwellers.

MATERIALS & METHODS

Description of the study area

The study area consists of five Local Government Areas which are; Ibadan North, Ibadan North East, Ibadan North West, Ibadan South East, and Ibadan South west and they are the urban core (inner) part of Ibadan metropolis. The population of Ibadan North as at 2006 population census was 306,795 with landed area of 145.58km²,

Ibadan North East was 330,399 with land area of 81.45km², Ibadan North West was 152,834 with land area of 31.38km², Ibadan South East was 266,046 with land area of 80.45km², and Ibadan South West was 282,585 with land area of 124.55 [41]. Nigeria population annual growth rate of 2.553% according to [42] and the projection formula by [43] as $P_t = P_o (1 + (R) n)$ where P_t = Projected population, P_o = Base year population R = Annual growth rate (2.553%) n = Time interval, was used to calculate population as at 2019, then the projected population of Ibadan North is calculated as 408,617, Ibadan Northeast as 440,055, Ibadan Northwest as 203,558, Ibadan Southeast as 354,344, and Ibadan Southwest as 376,372 people. The study area are characterized by a combination of traditional, transitional, modern housing and culture, representative of the contemporary changes taking place in most cities in Africa.

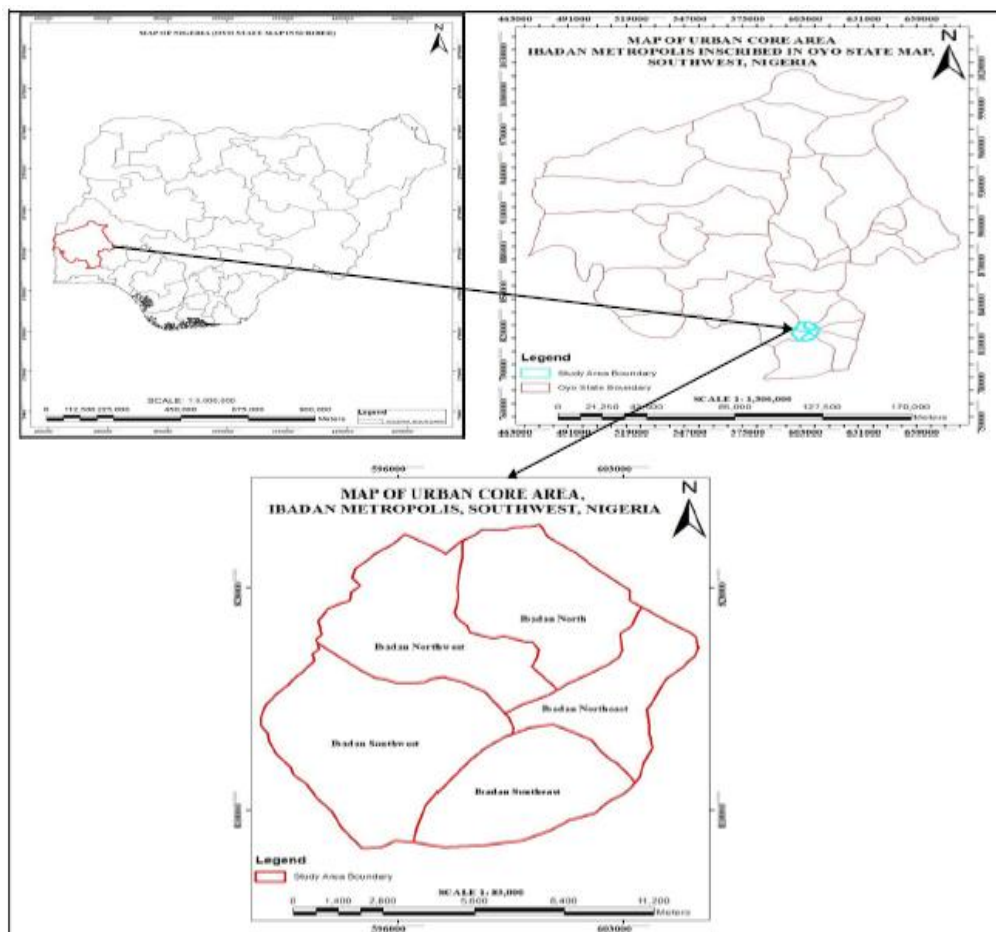


Figure 1. Geographic location of the study area

Method of Data Acquisition

For the purpose of this study, primary and secondary data were used. The primary data source involved the field Survey method in which the spatial coordinate (x, y) of the filling stations, fire service stations, healthcare centers owned by governments and private were acquired with Handheld GPS (Garmin 78s). The secondary data was gather from different sources, such as research journal articles, conference proceedings/Seminars downloaded from internet mainly used for related work pertaining to the study, Oyo state administrative map in which the study area was extracted, and the road map of Ibadan. The planning requirements and guidelines for sitting filling stations were acquired from the Ministry of Physical Planning and Urban development Oyo State Secretariat in accordance with their Section 49 (1) of their planning law (2011) and from the National criteria from the Department of Petroleum Resources (DPR), Ibadan, Nigeria in accordance with their amendment decree No. 37 of 1997 which were sourced from their official website [44]. The following regulations were followed in this study.

a. The least distance between two filling stations along the same axis must be 300m (OSURPB).

b. A setback of 7m from every place of residence should be used (OSURPB).

c. At least a distance of 15 meters should be used from the edge of the road to the nearest pump (DPR).

d. Filling stations should be at least 100 meters from schools, hospitals, theatres, clinics and other public and semi-public buildings (DPR).

e. Distance between one Petrol Filling Station and another must not be less than 400 meters (DPR).

Data Conversion

The study area was digitized and extracted from the Oyo State map in ArcMap 10.3 environment (Figure 1). The geographic longitude and latitude of filling station, fire service station, and healthcare centres obtained from the field was converted to UTM coordinates (x, y) zone 31N in order to make the projection of the study area conform to the data obtained with the Handheld GPS. Line features such as roads as well as the study area boundary were digitized and extracted from the street road map of Ibadan metropolis in ArcMap 10.3. The location and distribution according to local government area for the filling stations, fire service stations, and healthcare centers were determined using selection by location in ArcMap 10.3.

Table 1: Location and distribution of fire service stations, filling stations, healthcare centre’s in the study area.

Local Government Area	Number of filling stations	Number of fire stations	Number of Healthcare Centres
Ibadan North	51	1	9
Ibadan Northeast	30	NA	01
Ibadan Northwest	34	2	5
Ibadan Southeast	06	NA	NA
Ibadan Southwest	32	1	11
Total	153	4	26

Source: Field survey 2019

Table 2 shows the name, coordinate (x, y), and location of filling stations, fire stations and healthcare centre’s as obtained during the field observation.

Table 2: Attribute Table showing Geographic Coordinates of Filling Stations, Fire Station and Hospital and their Respective Locations

Filling Stations	Easting	Northing	Address/Location	Filling Stations	Easting	Northing	Address/Location
1st October Filling Station	596038.14	811117.92	Oluyole Ibadan	Conoil Station	596391.23	817343.12	54, Magazine Road, Ibadan
Adolak Filling Station	603938.90	816759.65	Old Oyo Road Samonda, Ibadan	Conoil Station	598194.13	818141.79	Oyo Road, Ibadan
Agboola Petrol Station	604930.48	816956.50	Old Ife Road, Ibadan	Conoil Station	598455.25	813833.40	Ogunmola Street Ibadan
Agip Filling Station	599790.59	817274.59	Yemetu Oja, Ibadan	Conoil Station	599386.33	816040.63	Sabo road, Ibadan
Alleluya Petrol	598731.40	814103.50	Orita Apeerin-Brere road, Ibadan	Conoil Station	600454.92	817043.01	Irefin OjeIbadan
Amazing Filing Station	597626.00	812040.00	Fajeminsin crescent, Ibadan	Conoil Petrol Station	603465.60	818377.43	Academy Area, Ibadan
AP Petrol station	604187.87	817082.58	Sawmill market, old ife rd ibadan	Crestfield filling station	601358.50	814544.99	Orita Aperin-Beere Rd, Ibadan
Ap Station	595675.78	813931.10	New GRA, Ibadan	Dammagok Oil	598628.57	816872.02	Off Ire Akari Road, Ibadan
Ap Station	598069.27	817882.79	Oyo Road, Ibadan	Davatos Nigeria Ltd.	601952.10	816395.05	Odo Aje Oloolu Rd, Ibadan
Ascon Petrol Station	595697.48	820098.75	Sango Eleyele Road, Ibadan	Doyin Oil	598508.62	811005.90	Challenge,Lagos-Ibadan
Azeez Ayinla Petroleum Ltd	597228.83	810682.32	Lagos Ojoo Expressway, Ibadan	Dutum Petrol Station	596674.26	816664.71	Ward, 08, Sw7, Ibadan
Bambol Petrol Station	604502.77	817199.98	All motors Junction, Old Ife Rd, Ibadan	Emolaj Nigeria limited	597456.21	817268.16	58, Adekunle Fajuyi Rd Ojoo, Ibadan
Bee Deen Oil & Gas	595946.08	816816.13	Forestry Road, Jericho, Ibadan	ENYO Service Station	602656.77	813832.07	Olorunsogo, Ibadan
Bigropet Nigeria Limited	602002.76	817464.03	Agodi Gate, Ibadan	Fatgbems Oil	599011.12	810954.66	Challenge,Lagos-Ibadan
Big Ropet Filling Station	602071.92	817882.53	Odejayi Street,Ibadan	First Royal Oil	598525.37	819400.85	Ibadan
Bovas	603239.76	817832.86	Iwo Road, Ibadan	Forte Oil	597282.75	815429.61	105, Obafemi Awolowo way, Ibadan
Bovas	603173.47	818434.97	Idera Close, Iwo Road, Ibadan	Forte Oil	595037.17	814479.90	Beside Access Bank, MKO Abiola Way, New GRA, Ibadan
Bovas	593942.40	815927.62	odo-ona, apata road, ibadan	FO Station	601828.10	818038.09	Opposite Yidi, Agodi Gate, Ibadan
BOVAS Filling Station	600445.67	821058.18	Kenneth Dike Road, Ibadan	Forte Oil	601163.13	817672.84	Olomi Olorunsogo, Ibadan
Bovas	597917.84	817736.35	Queen Elizabeth Road Mokola Ibadan	Forte Oil	602149.02	815148.40	Koloko-Lagos-Ibadan Express Link Rd, Ibadan
Bovas Filling Station	599778.36	817260.51	Adeoyo Street, Off Yemetu Ibadan	Forte Oil	600609.17	819706.82	State Sec. Road, Ibadan
Bovas fuel station	597191.53	817067.01	Yemetu Oja, Ibadan	Friendly Top Station & Mini Mart	592530.58	814280.44	Olubadan Avenue, Oluyole, AlaafinAvenue, Ibadan
Bovas Petrol Station	597187.78	821007.77	Royejo st., Dugbe, Ibadan	Friendly Top Filling Station	600917.76	812345.55	Ibadan
Bovas Service Station	600305.39	817924.57	Queen Eliz. II road agodi ibadan	Friendly Top Nigeria Ltd	602984.50	813509.08	Orita Aperin Beere Rd, Ibadan.
BOVAS Service Station	600298.37	817918.98	Opposite Oritamefa Baptist School Ibadan	Gasland Nig Ltd	594065.18	814323.56	Oluyole Ibadan
Bumad Petrol Station	598484.19	810801.91	Soka Area, Off Lagos/Ibadan Expressway	Gastab	597269.59	815725.67	Beside Ibadan boys high school Ibadan
Citee Oil	597218.62	812672.02	Ogunmola Street Ibadan	Gabstab Filling Station	598850.32	816792.18	Ibadan

Conoil Sango Ibadan	598629.32	821198.58	The Polytechnic Ibadan, Sango Eleyele Road	Gmath Nigeria Limited	602011.64	814271.20	Beere Road, Orita Aperin, Ibadan
Gracious Love oil	602370.77	818866.87	Bibilari Junction, Bashorun Road, Ibadan	NNPC Petrol Station	596499.66	809593.72	Ibadan-Lagos Road, Ibadan
Halleluyah Fuel Station	599856.06	814897.89	Old Quarter, Ibadan	Nofiu & Badmus Petroleum Nig. Ltd.	603978.34	817041.68	Old Ife Road, Ibadan
House of cheelah beauty	598995.00	820785.00	The Polytechnic Ibadan	Nurdok filling station	597227.75	815547.30	Ijebu Bypass, New GRA Odeon Oke Bola, Ibadan
J.F. World Nig. Limited	601787.39	813228.53	Lagos Ibadan Expressway Ibadan	Oando	598122.51	818827.29	Mokola Oyo Road, Ibadan
Jofes filling Station	596157.38	810466.67	New Garage Road, Ibadan	Oando	598347.84	818136.11	Mokola, Ibadan
La Sheu Oil	603773.19	817900.99	Iwo Road, Ibadan	Oando	600376.60	817919.78	Total Garden Rd, Ibadan
Lister Petrol Station	599194.32	815737.45	Old Quarter, Ibadan	Oando - Egarton Filling Station	598365.14	817317.35	Inalende Ibadan
Manbay Fuel Station	600673.33	816082.22	Kosodo stree, Ibadan	Oando	598772.51	819873.84	Oyo Road, Ibadan
Mobile filling station	599025.34	818192.31	Dandaru Junction, Queen Elizabeth II Road, Ibadan	Oando - Lister Service Station	602147.81	818322.25	Idi Ape Ibadan
MOBIL	595012.12	814387.28	MKO Abiola way, Ibadan	Oando - Oyo Road Service Station	598772.51	819873.84	Oyo Road, Ibadan
Mobil	604711.88	817999.01	new ife road, by iwo road round about ibadan	Oando - Filling Station	598911.78	815723.99	Isale Alfa Beere Road, Ibadan
Mobil filling Station	600102.13	821745.24	University of Ibadan Sango Road, Samonda, Ibadan	Oando Filling Station	595014.33	820055.92	Jericho Eleyele Road, Ibadan
Mobil filling station	601920.44	817993.07	Samonda Sango, Ibadan	Oando Filling Station	601703.14	817769.04	Agodi Gate, Ibadan
Mobil filling station	595842.31	808500.89	Podo Old Road, Ibadan	Oando Petrol Station	603711.93	817936.42	Lagos Ibadan Expressway old-Ife road, Ibadan
Mobil filling Station	596535.30	809893.36	Ibadan, Lagos Road, Ibadan	Oando SouthBound	598605.00	814640.00	Ibadan
Mobil filling Station	593901.08	815920.19	Oluyole, Ibadan	Oando filling Station	597717.16	814122.59	Liebu Bypass, Ibadan
Mobil Mart	600554.39	819872.35	Secretariat Agodi, Ibadan	Oando filling Station	599688.40	816353.78	Agodi Gate, Ibadan
Moore Petrol	594181.93	815673.92	Ibadan-Abeokuta road	Oando - Taffy North Service Station	596616.47	809623.50	Ibadan
MRS Petrol station	597287.04	815322.14	Oke Ado, Ibadan	Obat Oil	593231.60	812313.35	Zartech road, Ibadan
MRS Petrol station	598744.19	819759.85	Oyo Road, Ibadan	OCTANE Petrol Station	602040.42	817583.29	Along Old-Ife road, Ibadan
MRS Petrol station	605247.72	817009.82	Gbagi Old Ife Road, Ibadan	Ola Shehu filling station	603059.81	819752.35	close to Bashorun Market, Bashorun, Ibadan
Nofiu & Badmus Petroleum Nig. Ltd.	603978.34	817041.68	Old Ife Road, Ibadan	Olarem Prime Int'l Ltd.	604880.67	817839.13	All motors Junction, Old Ife Road, Ibadan
NIPCO station	602515.82	814736.56	Lagos-Ibadan Expressway, Ibadan	Poplat Oil	605253.64	817594.40	New ife road ibadan

NIPCO station	598411.58	821108.65	Ibadan	Poplat Oil	603523.97	817329.18	Lagos-Ibadan Expressway, old-Ife road, Ibadan
Nipco Filling Station	602203.14	814142.51	Lagos - Ojoo Expressway, Ibadan	Prudent	602365.25	817240.43	old-Ife road, Ibadan
NMPC Filling Station	596398.98	820243.55	Ward II Nw7, Ibadan	Sao Filling Station	594344.11	815630.09	Ibadan-Abeokuta Road, Oluyole Ibadan
NNPC	602622.31	815029.05	Lagos Ibadan Expressway Ibadan	Sao Petroleum	603786.10	817043.07	Sawmill Old Ife Road, Ibadan
Shayab Filling Station	601674.65	815938.15	Ode-Aje Alase Ibadan	Total Filling Station	600363.79	817872.53	A5, Agodi, Ibadan
Taska Energy Resources Ltd.	594371.00	811154.47	Akala Express, Adekunbi Layout, Oluyole, Ibadan	Total Filling Station	597372.21	820771.19	Ring road, Ibadan
Texaco Filling Station	602837.00	816994.00	Ibadan	Total Filling Station	597372.21	820771.19	Aleshinloye, Ibadan
Total - Akanran Service Station	602245.85	817210.59	Wesley College Road, Labo, Ibadan	Total Filling Station	602557.71	818512.71	Iwo Road, Ibadan
Total - Apatapete Service Station	597090.12	816894.26	Abeokuta Road, Near NNPC Depot, Ibadan	Total Filling Station	604270.36	818327.01	R/about Iwo Road, New Ife
Total Amunigun Service Station	598277.51	815626.13	Agbeni Market, Ibadan	Total Filling Station	602076.42	817778.39	Olatunbosun Street, Ibadan
Total Eleyele I Service Station	596328.03	818158.70	Onireke/Jericho Road, Jericho Road Close to Rail line, Ibadan	Total Filling Station	599432.99	820972.55	Oyo Road, Ibadan
Total - Lagos Bypass Service Station	595995.92	816068.89	Yinka Ayefele House, New Lagos Road Challenge Ibadan	Total Filling Station	599222.73	817604.59	Garden, Yemetu Street, Ibadan
Total Eleyele II Service Station	597377.61	820774.47	Jericho Road, Along Eleyele-Sango Road Close to Rail line, Ibadan	Total Filling Station	600712.27	821530.71	Kenneth Dike Road, Ibadan
Total - Mokola Service Station	598223.78	818071.99	Mokola, Ibadan	Total Filling Station	599609.33	818487.01	Agodi Gate, Ibadan
Total - New Res. Service Station	595804.70	815355.46	Iyaganku Road, close to Aleshinloye, Ibadan	Total Filling Station	601165.001	817598.19	UMC Road, Molete, Near UBA, Ibadan, Nigeria
Total - Ojoo Service Station 1	599094.69	820641.59	Oyo Road, Ibadan	Total - Gaiser Service Station	596074.470	811353.40	Orita Challenge, Ibadan
Total petrol station	600053.93	816760.02	Oje Street, Ibadan	Total petrol station	600335.490	816939.34	School of nursing, Ibadan
Total - Ring Road Service Station	595758.04	813786.35	Liberty Road, Ibadan, Off Ring Road, olusanya	Total Filling Station	600360.240	817850.31	Queen Elizabeth Road, Near K. S. Motel, Ibadan
Total - Service Station	593322.97	814096.87	Oluyole Estate, Alaafin Avenue, Oluyole Ibadan	Total - Queen Eliz Service Station	596810.160	816673.28	J. Allen, Dugbe, Ibadan
Total - UCH Petrol Filling Station	601163.13	817672.84	University College Hospital, Ibadan	Total Filling Station	604315.010	817094.55	Old Ife Road, Ibadan
Total Bodija Service Station	600706.82	821509.68	Off Railway Station, Bodija, Ibadan	Unique Rock Fuel Station	597862.200	817664.75	Oyo Road Service Station Ibadan
Total Agodi Service Station	601402.79	817758.07	Agodi Gate, Beside Spare Parts Market, Near Agodi Prison, Ibadan	Waskha Petrol Station	597949.360	817723.20	Ibadan
Total - Sango Service Station	599131.84	820624.17	Sango Junction Oyo Road, Ibadan	Watt oil and Gas	603170.320	816862.01	Mufu Olanihun Area, Lagos/Ibadan Expressway
Total Oke Ado Service Station	601163.13	817672.84	Molete Road, Oke Ado, Near first Bank, Ibadan	Weel Drop	603917.670	818227.40	Iwo Road, Lagos-Ibadan

				Petroleum			Expressway, Ibadan
Total Filling Station	597327.82	815035.50	Oke-Ado service station	World Oil Mega Station			
Fire service stations							
Mapo Fire Station	598935.18	815367.43	Old Quarter, Mapo Hill, Ibadan	Molete Fire Station	597367.31	812750.40	2, Scout Camp Road, Molete, Ibadan
Fire Service HQs	599698.53	818933.8	secretariat Parliament way, Mokola Hill, Ibadan	Oyo State Fire and Safety Service	595826.52	816878.38	Fire Station Road, Aleshinloye
Hospital in Ibadan							
University College Hospital, Ibadan	599523.93	818312.20	Gate-Mokola road, Ibadan	Group Medical	598401.65	818101.50	Mokola, Ibadan
Molly Specialist Hospital	602179.51	818183.46	Agodi GRA, Opposite Nickdel Private School, Ibadan, Nigeria	Toun Memorial Specialist Hospital	604445.43	818064.78	New Ife road, Iwo road, Ibadan
Adeoyo Hospital	599645.90	816523.34	Total Garden road, Ibadan	Vine Branch Maternity Centre	599059.49	817689.71	
Catholic Hospital	601489.48	816655.78		Zoe Specialist Mission Hospital	593611.25	814118.37	4 Adeogu Street Oluyole Estate Ibadan, Nigeria
Avon Healthcare Teju Specialist Hospital	596394.58	813027.74	6, Alhaji Animashaun Street, Ajeigbe, Ring Road, Ibadan, Nigeria	King's Way International Hospital	600726.55	821046.84	Adenuga street, Ibadan
Beta Life Hospital	598478.09	814529.52	Ibadan	Castle Hospital	598924.02	820857.99	Sango Eleyele road, Ibadan
Kejide Hospital	596952.64	812235.01		Anu Oluwa Hospital	598178.21	819297.39	
Highland Specialist Hospital – House of Hearing	599850.63	817313.59	A1, Ibadan	Delight Hospital & Fertility Centre	596607.69	812395.25	No 1. Emmanuel Close, Elewura, Challenge, Ringroad, Abiodun Tomori Ave, Ibadan, Nigeria
Best Care Hospital	598048.42	819814.27	Along okutunu bye-pass	New Adeoyo Hospital	595145.58	812642.69	Ibadan
Femi Specialist Hospital	602328.12	818662.52	Basorun road, Ibadan	Fortune Hospital	596551.77	812766.41	Ibadan
Iye Hospital	596910.48	811531.39	Felele road, Ibadan	Avon Healthcare Lanark Specialist Hospital	595780.36	813701.83	SW 9/ 1423, State Hospital Rd, Ring Rd, Ibadan, Nigeria.
Oni And Sons Hospital	595280.49	813753.99	Oni & son way, Ibadan	Jericho Specialist Hospital	596084.55	817611.64	Jerico Ibadan, Nigeria
Immaculate Specialist Hospital	597570.64	814326.27	Liebu Bypass, Ibadan	Naomi medical centre	597898.98	816654.65	Ibadan

RESULTS AND DISCUSSION

The results presented here was as a result of information gathered based on the filling stations, fire stations, healthcare centre's are presented in form of maps, charts, and tables. Figure 2 presents the road networks of the study area; figure 3 present the filling stations in relation to fire stations and filling stations in relation to healthcare centres. Figure 4 presents composite map for the study. Figure 5-6 presents the filling stations conformity and non-conformity according to the Oyo State Urban and Regional Planning Board and the Department of Petroleum Resources (DPR).

Figure 7-8 present's variation and percentages in conformity.

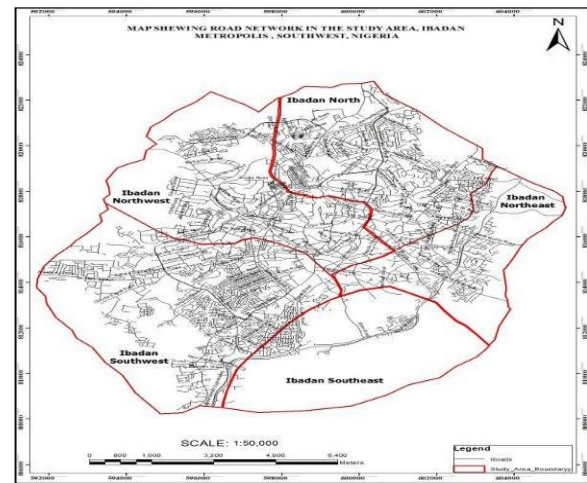


Fig. 2: Road Network within the study area

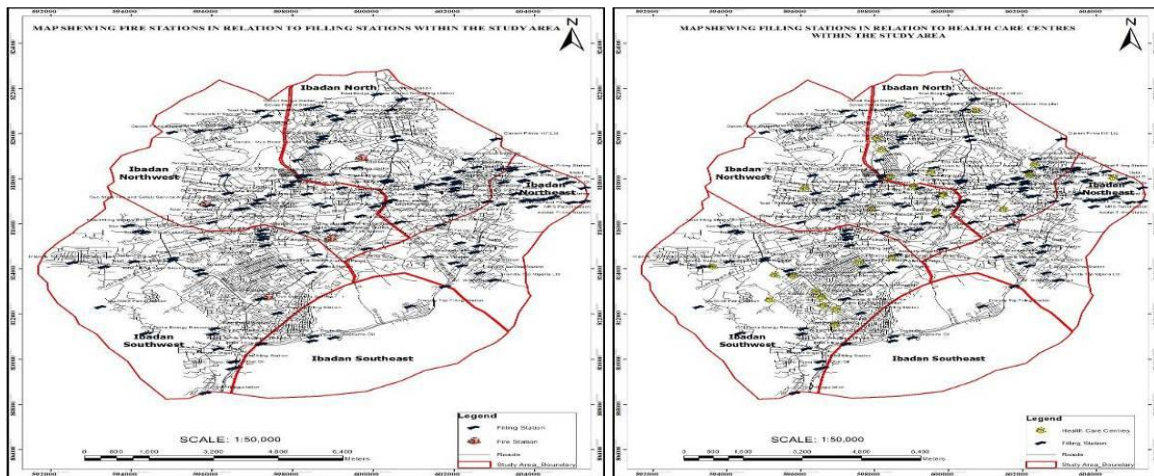


Fig. 3: Filling stations in relation to fire service stations and filling station in relation to Healthcare Centers

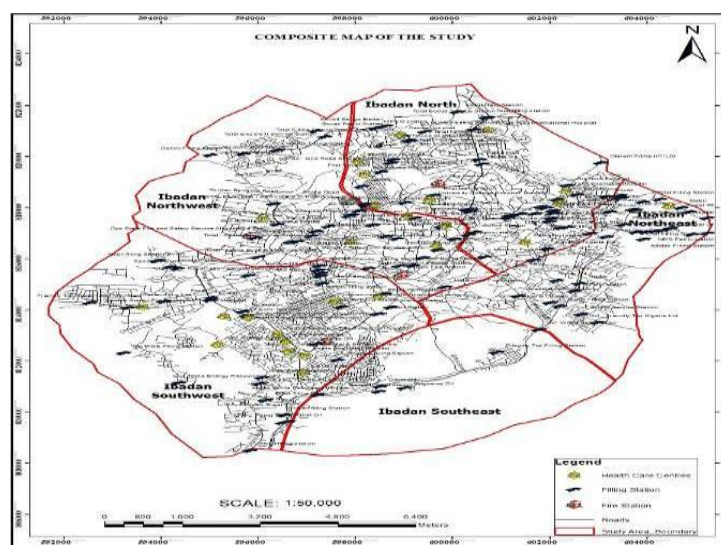


Fig. 4: Fire Stations in relation to Filling Stations and Healthcare Centers within the study area

From figure 4 above, the number of fire stations present within the study area

was four. Two in Ibadan Northwest local government area i.e. one in Mapo Hill and

the other one in Aleshinloye along Jericho road. Only one in Ibadan North local government along Queen Elizabeth State Secretariat road. Also, only one in Ibadan Southwest along Molete road. There was no fire station in Ibadan Southeast and Ibadan Northeast. The one in Molete in Ibadan Southwest will be serving Ibadan Southeast while the one in Mapo at Ibadan Northwest will be serving Ibadan Northeast in case of emergency off fire outbreak. For safety and emergency response, each of the local government area needs to have fire service station within their neighbourhood.

Buffering Analysis

Buffering is a spatial process used to determine the spatial nearness of various different geographic features to one another. Buffer zone areas are shown with single or multiple polygons surrounding the features. For the purpose of this study, the buffering analysis was carried out to know the nearness/proximity of the filling/service stations to one another and to know if they conform to the service area for the fire service station. Also, the healthcare centers that are of high, moderate and low vulnerable to fire in case of fire outbreak from the filling stations.

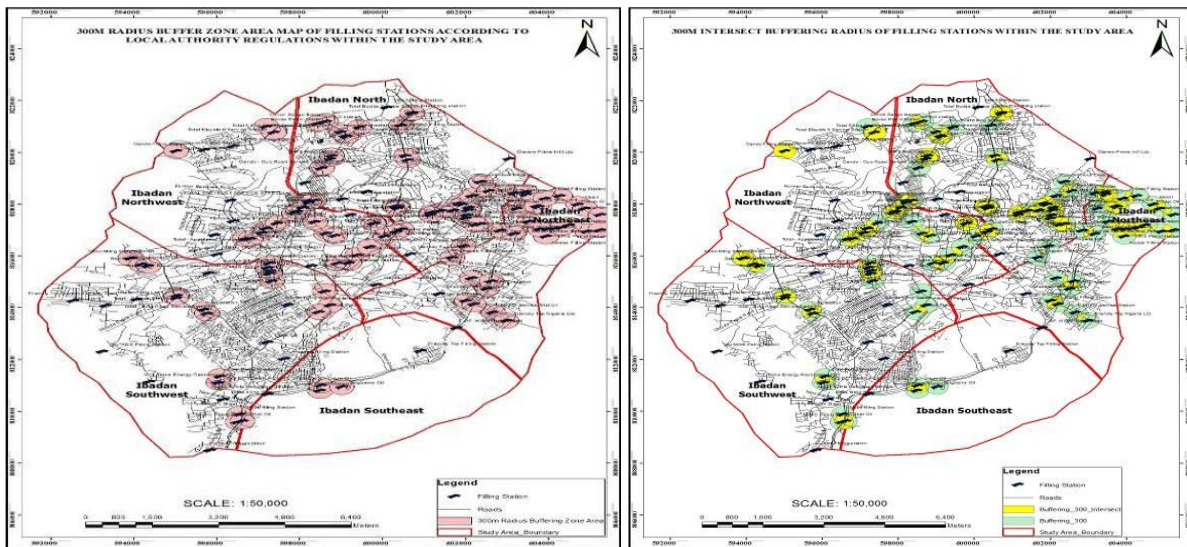


Fig. 5: 300m Buffer and buffer intersect by the local authority

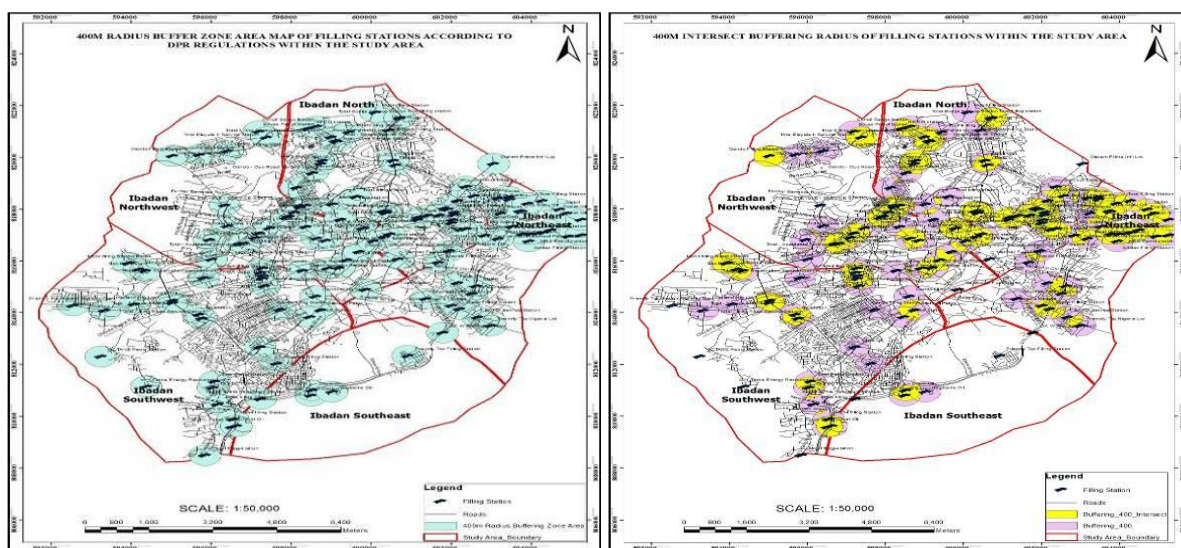


Fig. 6: 400m Buffer and buffer intersect by the DPR

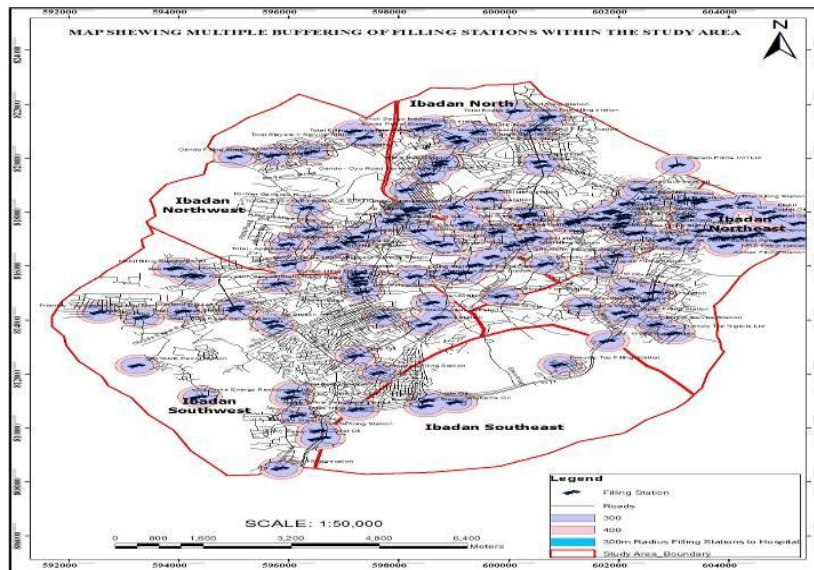


Fig. 7: Multiple buffering 300, 400 meters Radius of filling stations within the study area

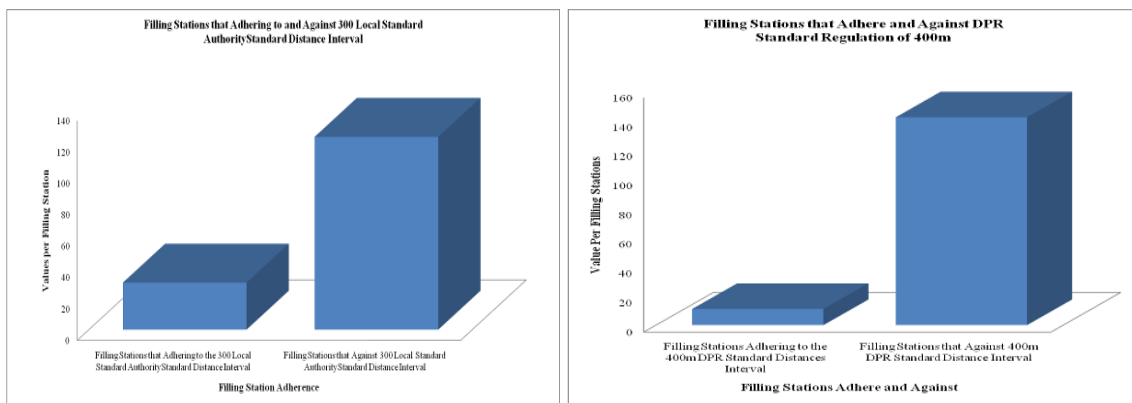


Figure 8. Variation of filling stations that adhere and against the local authority standard and DPR in the Study Area

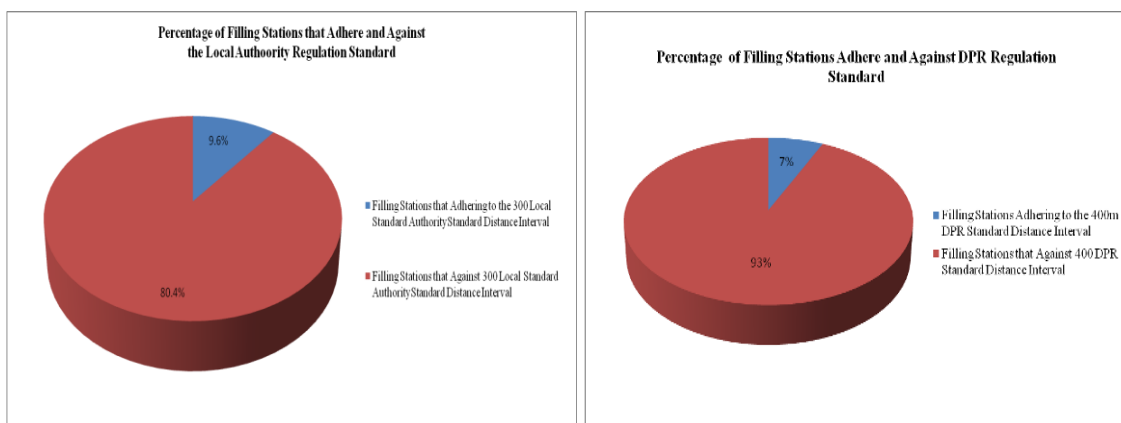


Figure 9. Percentage of filling stations adhere and against the local authority standard and DPR in the Study Area

Figure 5 and 6 was used to determine the number of filling stations that adhere and against the local authority standard and DPR. 300m standard was specified by the local authorities as minimum distance interval between two Filling stations along the same route. A total of 153 filling stations are within the study

area from the field observation. 30 (9.6%) are within the local authority standard interval while 123 (80.4%) against the local authority standard distance interval which implies that larger percentages against the standard regulation (Figure 5-9). The DPR specified a standard minimum distance interval of 400m between two filling

stations along the same route. The result of the 400m filling station buffering showed that only (7%) filling stations on the same axis adhere to 400m standard regulation while the remaining while the remaining 142 (93%) against (Figure 5-9) and this make the result look similar to the result

obtained by [30]. The results also showed that 49 (32%) filling stations had their dispensing pumps at least 15m to the road as specified by Department of Petroleum Resources (DPR), Nigeria and the result look similar to the result obtained by [30, 23].

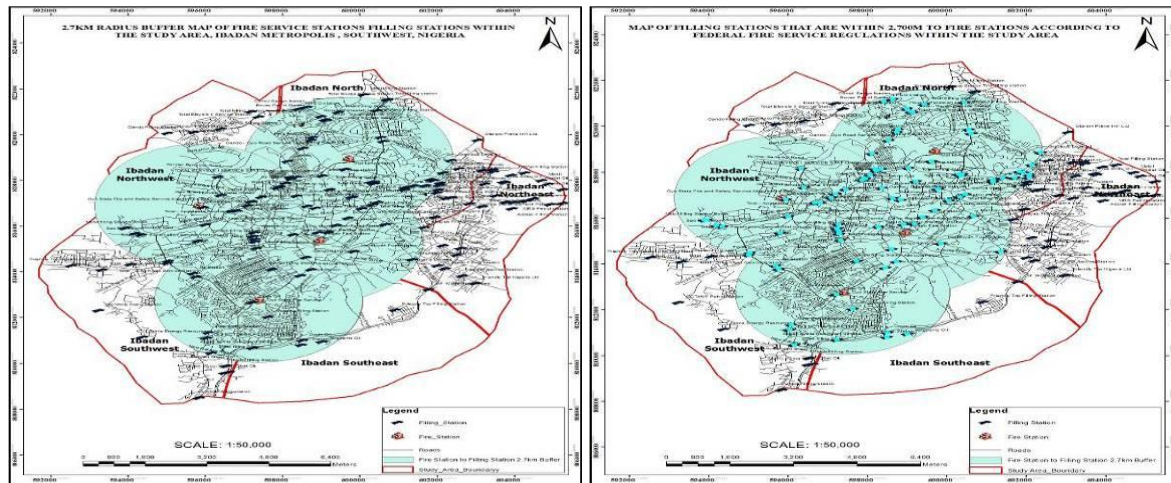


Figure 10. 2.7km radius from fire stations to filling stations and numbers that conform to filling stations standard

Federal Fire Service stipulated 2700m (2.7km) radius to filling stations [32]. Figure 10 showed that 93 filling stations representing (60.8%) out of 153 are within a radius of 2.7km to fire stations while the remaining 60 (39.2%) are far (Figure 10). Far distant of the fire service stations to filling stations during fire outbreak may lead to loss of lives and properties. From the study, it showed that not all the filling stations under the study area are within the fire service area.

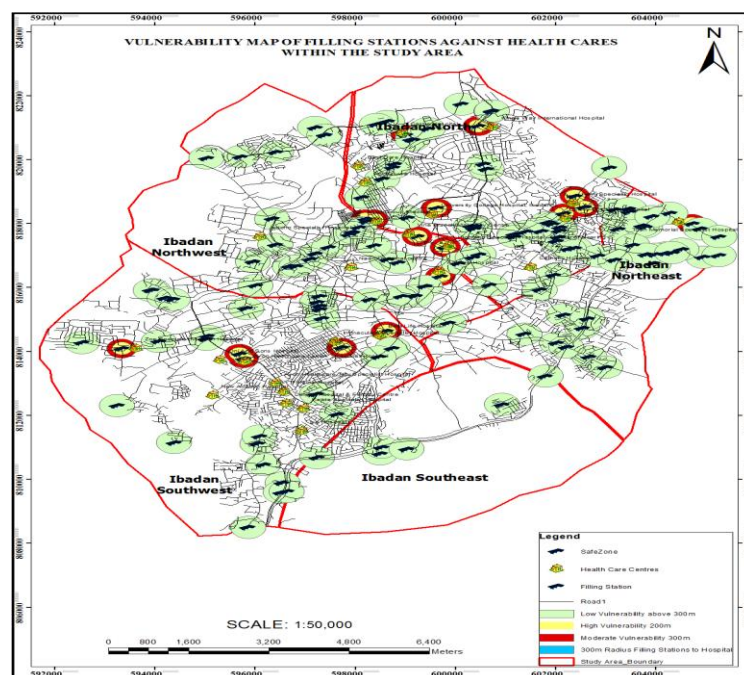


Figure 11. 200m, 300m and above 300m radius health care centre's vulnerable to filling stations fire outbreak

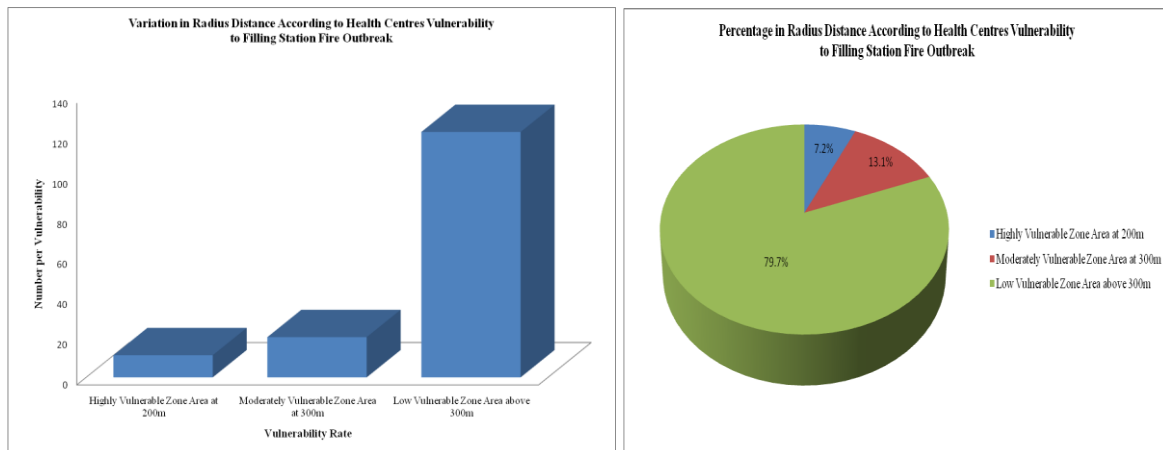


Figure 12. Variation and percentages in health care vulnerable zone area to filling station fire outbreak

DPR stipulated a distance of at least 100m from the health care centers [28]. For the purpose of this study, the vulnerability of filling stations to healthcare centre’s are classified as low, moderate or even high. 11 (7.2%) filling stations out of 153 are within 200m radius to the health care centers which may in turn endanger the lives of patients as well as loss of properties in case of occurrence of fire outbreak. 20 (13.1%) are within 300m radius and this reduce the rate of vulnerability by 9 (5.9%) and radius above than 300m lowers the risk to 122 (79.7%) (Figure 11-12).

Routing Network Analysis

Route network shows a set of interconnected lines that makes up a set of features through which the resources can flow. Determining the shortest distance between two locations in road networks is an issue that can be solved by different map services and commercial navigation products [45]. Therefore, the classic solution for generating th shortest paths is Dijkstra’s algorithm [46]. In this study, analysis based on the best route, alternative route and direction, in case of any obstacle along the best route network were carried out. It was done to determine the best route to take by the fire fighter in case of emergency response to the place of hazard during sudden fire outbreak from filling/service stations. For this study, routing analysis was done to determine the best and alternative route from the nearest fire stations to the filling stations within each of the local government area within the study area (Figure 15). Figure 13 & 14 shows the routing analysis from the two NNPC Mega Stations that are within the study area, one near Bashorun Bridge along Iwo Road, and the second one along challenge old-Lagos road.

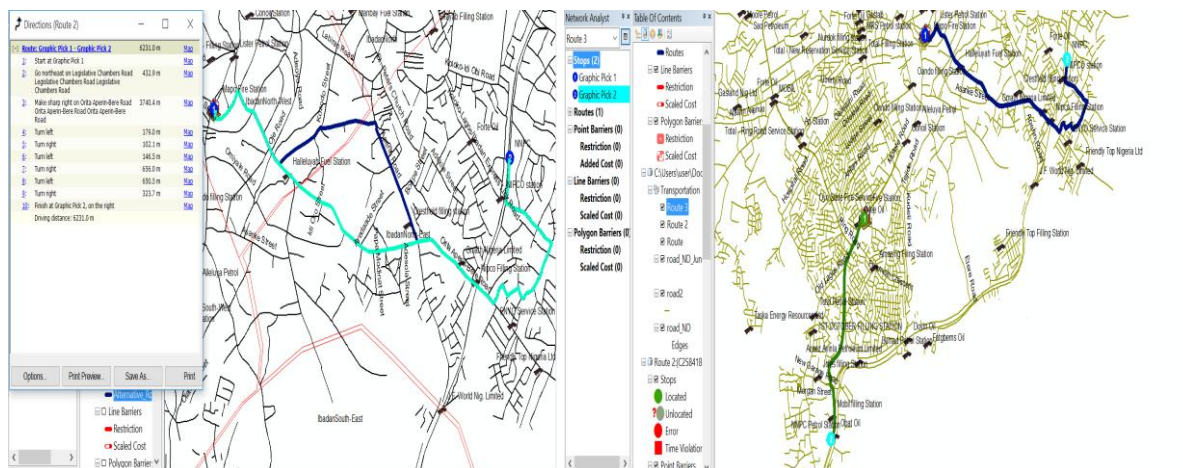


Figure 13. Best and alternative route from Mapo fire service station to NNPC near Bahorun bridge along Iwo-Road

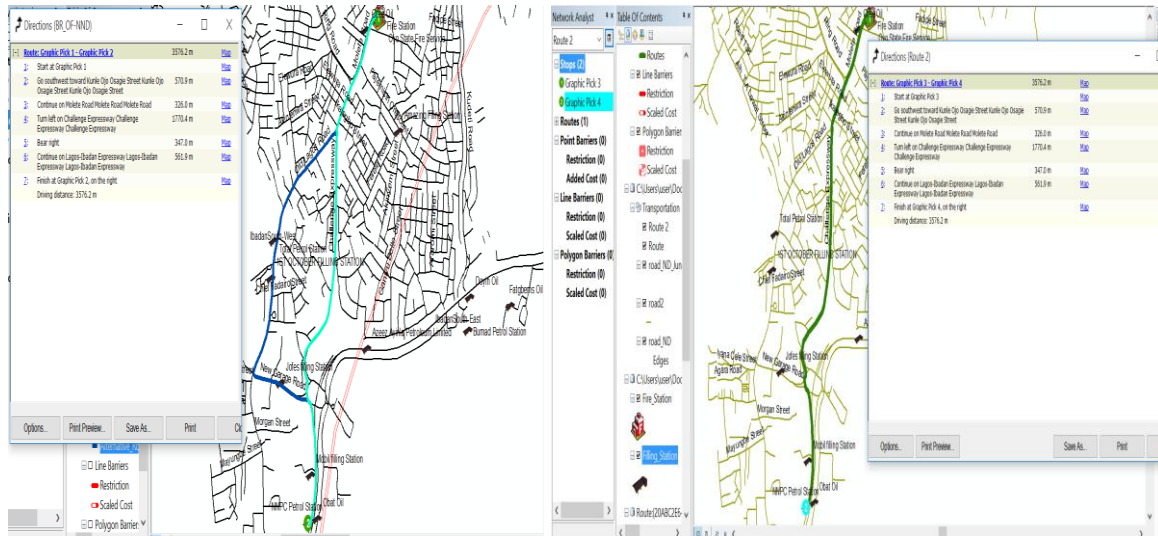


Figure 14. Best and alternative route from Molete fire service station to NNPC along challenge/old-Lagos road

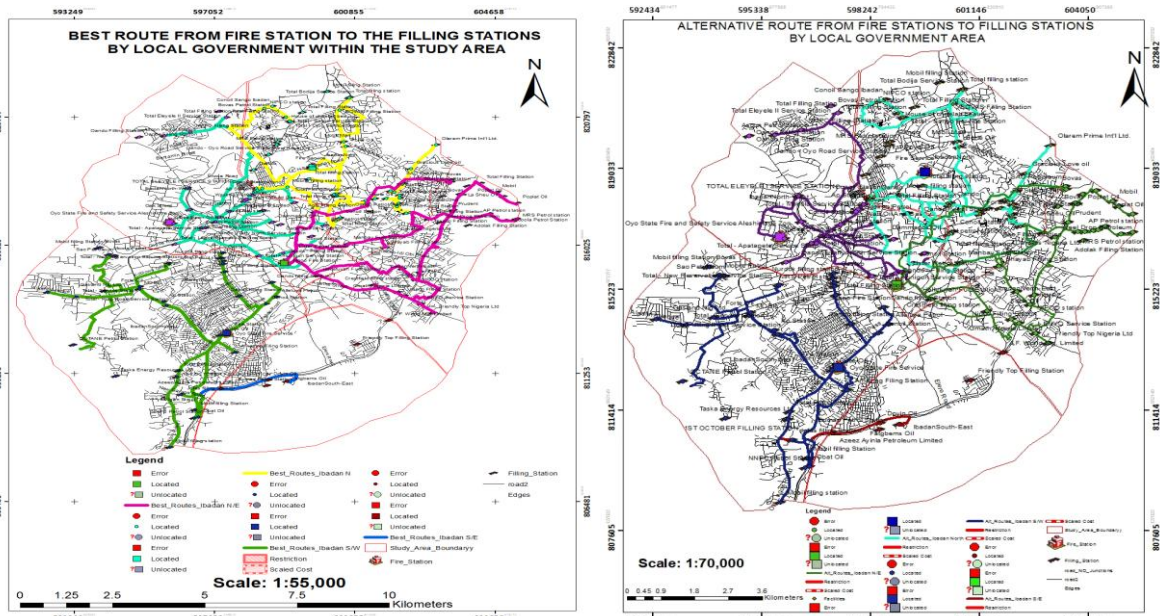


Figure 15. Best and Alternative Route per local government areas

From Figure 13, The deep blue colour showed the Best route with a total distance of 6231m and light blue (Alternative Route) with a distance of 7068m having a difference of 837m from Mapo fire station to NNPC Near Bashorun bridge along Iwo-Road, Ibadan but with best route lower than the alternative route and from Figure 14, deep blue colour showed the Best route with a total distance of 3576m and light blue (Alternative Route) with a distance of 4611m with a difference of 1,035m from Molete fire station to NNPC adjacent Ring road along Lagos- Ibadan Expressway but with the alternative route higher than the best route. Table 3 below described the analysis of best and alternative route from the closest fire station to filling stations.

Table 3: Best and Alternative Routes from Fire Service Stations to Filling Stations

From Fire Station to Filling Station	Best Route	Alter. Route	Diff.
Ibadan North Local Government			
Fire Service HQ, Secretariat to Mobil filling station Elizabeth street along Agodi Road	1227	6068	4841
Fire Service HQ, Secretariat to Oando filling station close R/A Sabo Road	1764	2021	257
Fire Service HQ, Secretariat to Conoil filling station close to R/A Sabo road	1939	2196	257
Fire Service HQ, Secretariat to Total Mokola service station Adekunle Fajuyi Road	1943	2200	257

Fire Service HQ, Secretariat to Bovas service station Total Garden/Agodi Road	1986	5912	3926
Fire Service HQ, Secretariat to Bovas Station Total Garden/Agodi Road	2027	5871	3844
Fire Service HQ, Secretariat to Total filling station School of Nursing Road	2489	7116	4627
Fire Service HQ, Secretariat to Total fillin station Secretariat Agodi Road	3585	12413	8828
Fire Service HQ, Secretariat to Mobil filling station Oje market street	3741	5460	1719
Fire Service HQ, Secretariat to Conoil filling station along Irefin Oje street	3848	5567	1719
Fire Service HQ, Secretariat to BOVAS filling station Secretariat Agodi Road	4093	9769	5676
Fire Service HQ, Secretariat to Total filling station Queen Elizabeth Road	4629	6419	1790
Fire Service HQ, Secretariat to Total - Queen Elizabeth service station Queen Eliz. Road	4636	6427	1791
Fire Service HQ, Secretariat to Oando filling station along total Garden road	4637	6428	1791
Fire Service HQ, Secretariat to Total - Gaiser service station Queen Elizabeth Road	4724	6515	1791
Fire Service HQ, Secretariat to Total - UCH petrol filling station Queen Elizabeth road	4737	6528	1791
Fire Service HQ, Secretariat to Total Agodi service station Agodi gate road	4837	6873	2036
Fire Service HQ, Secretariat to Mobil - Mart filling station Secretariat-Agodi Road	5314	8495	3181
Fire Service HQ, Secretariat to NIPCO filling station Alaro street Sango-Eleyele Road	5624	16584	10960
Fire Service HQ, Secretariat to FO station Agodi-gate Bashorun Road	5702	7737	2035
Fire Service HQ, Secretariat to Oando Idi-Ape Lister service station Bashorun Road	5834	7870	2036
Fire Service HQ, Secretariat to Manbay fuel station Kosodo street	5975	6909	934
Fire Service HQ, Secretariat to Mobil filling station Along Ladoke Akintola Avenue	6234	8270	2036
Fire Service HQ, Secretariat to Total filling station along Iwo-Road	6341	8377	2036
Fire Service HQ, Secretariat to House of cheelah beauty service station Akufo Eleyele Rd.	6343	17303	10960
Fire Service HQ, Secretariat to Gracoius love oil along Bashorun Road	6419	8455	2036
Fire Service HQ, Secretariat to Ojoo service station Sano-Eleyele Road	6485	17445	10960
Fire Service HQ, Secretariat to Bovas filling station along Iwo-Road	6999	9035	2036
Fire Service HQ, Secretariat to Devatos Nigeria Limited along Idi-Obi Agungu Road	7312	8245	933
Fire Service HQ, Secretariat to Olarem prime int'l Ltd Bashorun Road	7534	9569	2035
Fire Service HQ, Secretariat to Sao filling station along Old-Ife road	8975	9908	933
Fire Service HQ, Secretariat to Total - Akran service station along Old-Ife Road	9087	10020	933
Fire Service HQ, Secretariat to Texaco filling station along Old-Ife Road	9441	10374	933
Fire Service HQ, Secretariat to Bigropet Nigeria Limited along Old-Ife Road	9518	10451	933
Fire Service HQ, Secretariat to Ola Sheu filling station along Adekunle street, Old-Ife Road	9541	10474	933
Fire Service HQ, Secretariat to Total filling station Adelakan Street along Old-Ife Road	9782	10715	933
Fire Service HQ, Secretariat to Bigropet filling station Odejayi street along Old-Ife road	9906	10840	934
Fire Service HQ, Secretariat to Oando petrol station Old-Ife Road	9932	10865	933
Total	215140	321724	106564
Ibadan Northeast Local Government Using Mapo fire service station			
Mapo Fire Station to CrestNelo filling station Orita Apeerin Road	3256	3309	53
Mapo Fire Station to Gmath Nigeria Ltd filling station Orita Apeerin Road	3677	4912	1235
Mapo Fire Station to Shayab filling station along Agungu Road	3758	4606	848
Mapo Fire Station to Forte oil Koloko Lagos-Ibadan Expressway	4180	5698	1518
Mapo Fire Station to Enyo service station Orita Apeerin Road	4460	5297	837
Mapo Fire Station to Nipco fuel station Koloko Lagos-Ibadan Expressway	4738	6255	1517
Mapo Fire Station to Friendly top Nigeria Ltd Orita Apeerin Road	4965	5803	838
Mapo Fire Station to NNPC along Ogbere Idi-Obi Road	6231	7068	837
Mapo Fire Station to Sao Petroleum along Iwo-Road	6952	7330	378
Mapo Fire Station to Total filling station along Old-Ife Road	6955	7803	848
Mapo Fire Station to Conoil petrol station along Iwo Road	7031	7409	378
Mapo Fire Station to Nafiu Badmus Petroleum Nigeria Ltd Old-Ife Road	7145	7993	848
Mapo Fire Station to Nafiu Badmus Petroleum Nigeria Ltd Old-Ife Road	7152	8000	848
Mapo Fire Station to Ap petrol station along Old-Ife Road	7370	8218	848
Mapo Fire Station to Unique Rock fuel station along Old-Ife Road	7491	8340	849
Mapo Fire Station to Bambol petrol station along Old-Ife Road	7703	8552	849
Mapo Fire Station to Agboola petrol station along Old-Ife Road	8229	9077	848
Mapo Fire Station to Wheel drop petroleum along Old-Ife Road	8432	9269	837
Mapo Fire Station to MRS petrol station Old -Ife Road	8575	9423	848
Mapo Fire Station to Prudent filling station Old-Ife Road	9002	9839	837
Mapo Fire Station to Oando SouthBound filling station Old-Ife Road	9642	10479	837
Mapo Fire Station to La sheu filling station along Old-Ife Road	9653	10490	837
Mapo Fire Station to World Oil Mega station along Old-Ife Road	9988	10825	837
Mapo Fire Station to Total filling station along Old-Ife Road	10428	11265	837
Mapo Fire Station to Mobil filling station along Old-Ife Road	11001	11838	837
Mapo Fire Station to Poplat Oil Old-Ife Road	11219	12056	837
Mapo Fire Station to Poplat Oil Old-Ife	11690	12527	837
Total	200923	223681	22758
Ibadan Northwest Local Government			
Aleshinloye fire service to Bee Deen Oil Aleshinloye Road	221	221	0
Aleshinloye fire service to Conoil filling station Kudeti Avenue Road	1215	2500	1285
Aleshinloye fire service to Total -Lagos bypass service station Railway, Dugbe	1415	4652	3237
Aleshinloye fire service to Dutum petrol station along railway, Dugbe	1719	3687	1968
Aleshinloye fire service toTotal Apatapete service station	1734	3365	1631
Aleshinloye fire service to total filling station Warden Street Dugbe/Abeokuta Road	1857	3646	1789

Aleshinloye fire service to Bovas fuel station Koyejo Street Dugbe Road	1886	3518	1632
Aleshinloye fire service to Total Eleyele 1 service station Kudeti Avenue Road	2161	2551	390
Aleshinloye fire service to Emolaj Nigeria Ltd along Dugbe Road	2175	3806	1631
Aleshinloye fire service to Waskha Petrol station Sabo market road, Mokola	2767	4398	1631
Aleshinloye fire service to Bovas filling station Adekunle Fajuyi Road	2844	4475	1631
Aleshinloye fire service to Watt Oil and Gas Adekunle Fajuyi Road	2850	4482	1632
Aleshinloye fire service to AP filling station Adekunle Fajuyi Road	3051	4682	1631
Aleshinloye fire service to Oando-Egarton filling station Atewoda/Ire Akari Street	3246	4877	1631
Aleshinloye fire service to Total Amunigun service station Oba Adebimpe Road	3395	5631	2236
Aleshinloye fire service to Dammagok Oilalong idikan-Ayeye Road	3628	5260	1632
Aleshinloye fire service to Oando filling station Beere Road	4088	6096	2008
Aleshinloye fire service to Lister Petrol station Mapo-Molete Road	4433	6068	1635
Aleshinloye fire service to Total Filling station Yemetu Road	4727	6358	1631
Aleshinloye fire service to Conoil Labiran Road	4730	6362	1632
Aleshinloye fire service to Oando-Taffy North Service station	5226	6858	1632
Aleshinloye fire service to Total Filling station Oje street	5299	6930	1631
Aleshinloye fire service to Bovas filling station Yemetu Oja Road	5317	6949	1632
Aleshinloye fire service to Agip filling station Yemetu Oja Road	5335	6967	1632
Aleshinloye fire service to Halleluyah Fuel station Orita Apeerin-Bere Road	5380	7200	1820
Aleshinloye fire service to Total-Eleyele srevice station Sango-Eleyele Road	6710	7889	1179
Aleshinloye fire service to Ascon Petrol station Sango-Eleyele Road	7836	9015	1179
Total	95245	138443	43198
Ibadan Southest Local Government using Molete fire service station			
Molete fire station to Azeez Ayinla Petroleum Ltd Challenge/Lagos-Ibadan Expressway	3429	4417	988
Molete fire station to Doyin Oil along Challenge/Lagos-Ibadan Expressway	4763	5752	989
Molete fire station to Fatgbems Oil Eniayanfe layout Challenge/Lagos-Ibadan Expressway	6066	7054	988
Total	14258	17223	2965
Ibadan Southwest Local Government			
Oyo fire service Molete to Citee oil Olu Ayoola close Molete Road	1015	2400	1385
Oyo fire service Molete to Amazing filling station along Fajeminsi crescent	1048	1339	291
Oyo fire service Molete to Conoil station Molete Road	1527	4125	2598
Oyo fire service Molete to Alleluya petrol Molete Road	1904	4502	2598
Oyo fire service Molete to Total petrol station Old Lagos Road	1977	3362	1385
Oyo fire service Molete to 1st October Filling Station Old Lagos Road	2213	3597	1384
Oyo fire service Molete to Oando filling station Awolowo Road alon Lagos Bypass	2270	4399	2129
Oyo fire service Molete to Oando filling station Popo/Molete Road	2545	5143	2598
Oyo fire service Molete to Total - Ring Road service station along Ring road	2613	4494	1881
Oyo fire service Molete to AP filling station along Liberty Road	2806	4687	1881
Oyo fire service Molete to Jofes filling station along New Garage Road	3064	4081	1017
Oyo fire service Molete to Total filling station Awolowo Road Oke Ado market road	3290	5419	2129
Oyo fire service Molete to Mobil filling station along Ring Road	3557	4942	1385
Oyo fire service Molete to MRS filling station near Dapo Laoye street Awolowo Road	3581	5711	87
Oyo fire service Molete to NNPC Lagos-Ibadan Expressway	3576	4611	1017
Oyo fire service Molete to Obat oil along Lagos Ibadan-Lagos Expressway	3682	4700	1018
Oyo fire service Molete to Forte Oil Awolowo Road	3688	5817	2129
Oyo fire service Molete to Forte Oil Agbala Daniel Road along Aniyan Fagbemi Avenue	3691	5572	1881
Oyo fire service Molete to Nurdok filling station Awolowo Road	3812	5941	2129
Oyo fire service Molete to Gastab filling station Awolowo Road	3985	6115	2130
Oyo fire service Molete to Gasland Nigeria Ltd Agbala Daniel Church Road	4620	6235	1615
Oyo fire service Molete to Mobil filling station Old Lagos Road	4940	6325	1385
Oyo fire station Molete to Total New Res. station Kobiowu crescent Ring road	5199	7080	1881
Oyo fire service Molete to Total service station st. mary street Alaafin Avenue	5577	7202	1625
Oyo fire station Molete to Friendly top station and Mini mart Alaafin Avenue	6389	8014	1625
Oyo fire service Molete to Moore petrol station along Agabala Daniel Road	6397	7846	1449
Oyo fire service Molete to Octane petrol station along Zartech Road	7582	9207	1625
Total	96566	142866	44257
Grand Total	622,132	843,937	221,805

Source: Author

From Table 3, it showed that all alternative routes are longer than the best routes. The lowest and highest best route was 221m and 16,584m while that of alternative route was 221m and 17445m with the difference between the best and alternative routes of 861m.

CONCLUSIONS AND RECOMMENDATIONS

This study has assessed the fire stations response to filling stations fire outbreak and vulnerable health care centers in urban core area of Ibadan metropolis. GIS has been proven as a tool and technology that can effectively solve geographic

problems and serve as decision support system in solving environmental problems. The importance and the effective management of filling/service station globally cannot be overemphasized as it enhanced the socio-economic growth of humans' life and properties. The findings from this study have revealed that not all filling stations within the study area comply with the regulation standard stipulated by the local authority and DPR since only 35% filling stations adhered to the 300m local authority standard interval, 7.2% conform to the 400m by the Department of Petroleum Resources (DPR) regulation standard and only 32% was with their dispensing pump at least 15m to the road, then it can be concluded from their percentages that standard regulation were not properly followed in the study area. In terms of vulnerability between filling stations and healthcare centers in case of fire outbreak, the risk is low. The result of the fire station response to filling station in case of emergency indicates that more than half of the filling stations (60.8%) within the study area can receive quick attention. Therefore, the Local Authority Town Planning and the DPR Department should ensure that filling stations are well cited so as to conform to their stipulated regulation standard. Moreover, some of the filling stations that do not conform to the regulation standard, should be investigated and any filling station owner who contravene the regulation standard be sanctioned. For other people that want to go into the business of filling stations, inspection should be done by the concerned authority before approval and construction of such filling stations. Adequate provision should be made for a modern and well equipped fire service station in the study area and as well as the entire Ibadan metropolis to relieve to the existing ones and even more fire service stations should be established. Lastly, all filling stations should employ the use of modern anti-fire preventive control (Teckno control) in their filling stations and as well

as healthcare centers and other places of public assembly.

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