



Health Hazards Associated with Operations of Medium-Scale Dual Purpose Kerosene Vendors Using Motorized Pumps with Aboveground Storage Tanks in Ilorin Metropolis, Kwara State, Nigeria

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This work was carried out in collaboration among all authors. Author MLI designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Author HOS proofread the first manuscript and managed the analyses of the study. Author ANI assisted in data collection. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: The use of Dual Purpose Kerosene (DPK) as a means of cooking and power supply in Nigeria cannot be overemphasized especially among the over 70% of Nigerians living in poverty. It is a highly hazardous product and the adverse environmental health effects from the use of this product remain widespread. Thus, due to the scarcity of epidemiological studies, potential harm and risks of kerosene, the present study was carried out.

Aim and Objectives: This study aimed at evaluating the environmental health hazards associated with operations of medium-scale DPK vendors using motorized pumps with aboveground storage tanks (ASTs) in Ilorin metropolis and as such estimate the numbers of medium-scale DPK vendors,

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identify their locations using the Geographic Information System (GIS) tool and assess the likely environmental health hazards associated with the operations of these DPK vendors.

Methodology: Purposive sampling technique was deployed in this study and data was collected using a structured questionnaire and handheld Germin (GPSmap® 78) GPS.

Results: The study revealed that about 76 medium-scale DPK vendors with ASTs are found in Ilorin metropolis with 48(63.2%) found in Ilorin West LGA, 18(23.6%) in Ilorin South and 10(13.2%) in Ilorin East. Over 80% of the DPK vendors have their ASTs in close proximity to major roads, 68.4% in close proximity to residential buildings, 30.3% in close proximity to a water source and 7% reported the incidence of kerosene spillage. The test of association between the operations of medium-scale DPK vendors and associated environmental health hazards was found to be significant at ($p < 0.05$); while ArcGIS 10.4 software was employed in showing the spatial distribution of the DPK vendors within Ilorin metropolis.

Conclusion: Conclusively, this study shows the activities of the DPK vendors causes high environmental health hazards which directly impact both environmental health and health of the population

Recommendations: Stringent enforcement activities by the Environmental Health Officers (EHO's) on adherence to stipulated setbacks from buildings and major roads; massive enlightenment on the various health hazards associated with DPK vendors operations; and government, through the state assembly, should enact laws to curb the uncontrolled proliferation of medium-scale DPK vendors in Ilorin metropolis and storage of toxic and flammable substances.

Keywords: Aboveground storage tanks; dual purpose kerosene; environmental health hazards; geographic information system; Ilorin metropolis; kerosene.

1. INTRODUCTION

In Nigeria, tens of millions regularly use kerosene, adverse environmental health effects remain widespread much of the time given the mixed results from various studies. Adverse environmental health effects rising mortality and morbidity often associated with fire hazards from kerosene explosions, destruction of properties, burns, compromised vision, indoor air pollution, asthma and the disproportionate exposure of infants and women to the risks of recurrent kerosene hazards. With hospital emergency cases involving complications from kerosene hazards on the rise, adulterated products in the face of loose regulations and mass poverty have surged over the years [1].

On Thursday 28th of June, a kerosene tanker exploded in Lagos, Nigeria, setting more than 50 cars on fire during rush hour in the megacity. At least nine people died. A similar explosion at the same area in 2010, had killed no fewer than 15 persons, including an infant and also inflicted 18 others with varying degree of injuries, with over 20 cars burnt [2]. Barely four hours after the Festac incident of last year, six persons, including three soldiers were burnt to death in Iwuru in Biase Local Government Area (LGA) of Cross River State when a tanker laden with petroleum including kerosene products crashed and exploded along the Calabar-Ikom highway.

Hospital emergency cases involving complications from kerosene hazards are constantly on the rise, due to the fact that adulterated products in the face of loose regulations and mass poverty have surged over the years [1]. Despite Nigeria being the sixth largest producer of crude oil among members of the Organization of Oil Producing Exporting Countries (OPEC), petroleum products, especially kerosene, are not always available. Surprisingly, kerosene is more readily available through sub-dealers and retailers than at licensed pump stations despite the product being subsidized [3]. According to Merem et al. [1], factor such as corruption is responsible for the product not been readily available at the licensed pump stations as these stations sells to middle men thus increasing the demand-supply chain thus leading to scarcity of the product. Such retailers/vendors who sell Dual Purpose Kerosene (DPK) through installed tanks can be found at almost every nook and crannies of Ilorin metropolis and their activities seem non-regulated. Indiscriminate installation of kerosene tanks at close proximity to residential areas and at close proximity to one another is a potential environmental health hazard.

Merem et al. [1] laid emphasis on the issues, the trends, factors and impacts using mix scale techniques of GIS and descriptive statistics to map and track the hazard trends of DPK

spatially. Preliminary results from their study using descriptive statistics reveal kerosene hazards in the form of fatalities through household explosions as well as health and environmental risks. Just as impact analysis identified pollution threats, the GIS mapping pinpointed the spatial dispersion of the risks and elements associated with kerosene hazards. All the identified hazards were attributed to several elements from ineffective policy to economic conditions, the reports offered several remedies consisting of the need for education and enlightenment campaign, coupled with improved emergency response to fire hazards and the strengthening of policy.

In highlighting the extent of kerosene hazards in Nigeria, there is an opportunity for resource managers and decision-making to build from it and design proactive measures to mitigate future disasters for the safety of citizens [1]. Indiscriminate siting of aboveground storage kerosene tanks, overpopulation of vendors in the business, and unrestricted operations and activities of the DPK vendors may cause accumulation of kerosene toxic wastes, the release of vapour, fire explosions and various environmental hazards. Long term exposure of people to kerosene has been known to cause various health hazards such as toxicity through inhalation of kerosene vapour, respiratory irritations, dermatitis and irritation to the eyes, among others [4].

As at present, there is no dearth of information on the activities of kerosene vendors; and where present, results are sparse and literature are scarcely available [5]. With the continuous environmental degradation and health hazards occurring as a result of various activities of man, this study is justified with the rationale to assess the environmental health hazards associated with the numerous DPK vendors operating in a densely populated environment such as Ilorin. The primary aim of the study is to evaluate the health hazards associated with operations of medium-scale DPK vendors using motorized pumps with aboveground storage tanks (ASTs) in Ilorin metropolis.

1.1 Research Questions

- i. What is the total number of medium-scale DPK vendors operating within Ilorin metropolis?

- ii. What are the spatial locations of the medium-scale DPK vendors operating within Ilorin metropolis?
- iii. What are the likely environmental health hazards associated with operations of these medium-scale DPK vendors?

1.2 Objectives of the study

- i. Estimate the number of medium-scale DPK vendors using motorized pumps with ASTs in Ilorin metropolis.
- ii. Identify the locations of these medium-scale DPK vendors operating within Ilorin metropolis using GIS tool.
- iii. Assess likely environmental health hazards associated with the operations of these DPK vendors.

2. METHODOLOGY

2.1 Study Area

The study was conducted in the three (3) Local Government Areas of Ilorin; namely: Ilorin East, Ilorin West, and Ilorin South. Ilorin, the state capital of Kwara State is located on latitude 8°30' and 8°50'N and longitude 4°20' and 4°35'E of the equator. Ilorin city occupies an area of about 468sqkm and it is situated in the transitional zone within the forest and the guinea savannah regions of Nigeria. It is about 300 kilometers away from Lagos and 500 kilometers away from Abuja the federal capital of Nigeria [6]. The geology of Ilorin consists of Pre-Cambrian basement complex with an elevation that varies from 273m to 333m in the West having an isolated hill (Sobi hills) of about 394m above sea level and 200m to 364m in the East. Oyegun further asserted that a large part of Ilorin town is laid by sedimentary rock, which contains both primary and secondary laterites and alluvial deposits [7]. The major river in Ilorin is Asa, which flows in the North-South direction dividing the plain into two, Western and Eastern parts. The Eastern part covers those areas where the GRA is located while the core indigenes areas of Ilorin fall under the Western part.

2.2 Study Design

The study design used is a descriptive cross-sectional study to evaluate the health hazards associated with operations of medium-scale DPK vendors using a motorised pump with aboveground storage tanks in Ilorin metropolis for the purpose of mitigating associated adverse effects.

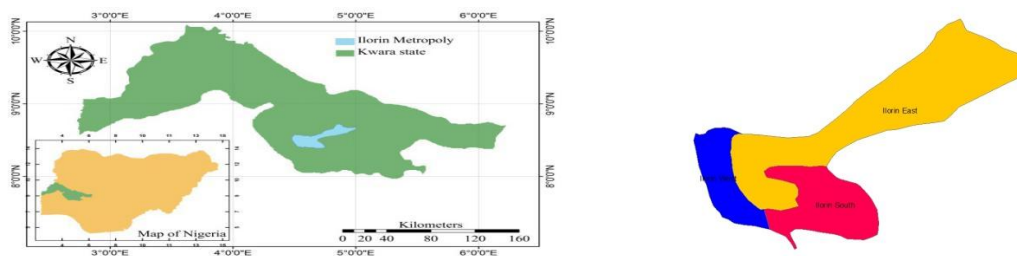


Fig. 1. Map showing Kwara state with an indication of the study area

2.3 Sampling

The sampling technique consisted of all medium-scale DPK vendors using a motorised pump with aboveground storage tanks within the three Local Government Areas of Ilorin metropolis. These medium-scale DPK vendors using motorised pumps which were classified by using their storage facility methods. This was based on either an Aboveground Storage Tank (AST) or Underground Storage Tank (UST) using purposive sampling method, all the DPK vendors which met the inclusion criteria was studied.

2.4 Inclusion Criteria

Respondents included in this study were; salespersons and owners of the medium-scale DPK vendors using motorized pumps with aboveground storage tanks.

2.5 Exclusion Criteria

All DPK sales point located within petrol stations due to the fact that their storage facility method is underground storage tanks.

2.6 Data Collection

Three methods of data collection were used in collecting data from our respondents:

- i. Face to face Interviews with the DPK vendors salespersons and owners on the awareness of the health hazards associated with the vending of kerosene.
- ii. Observational checklist was used to collect data on the availability of safety equipment and the use of personal protective equipment related to the occupational health and safety of DPK vendors operations.
- iii. Global Positioning System (GPS) and Measuring Tape

2.7 Data Analysis

Prior to data entry, and during the data collection period, the completed data was captured in Excel. The observational data was categorized for analysis. All numerical data were analyzed using descriptive statistics. The spatial coordinates gotten with the aid of GPS was displayed on the map with the aid of Arc View GIS software. The result was presented using tables, frequencies, charts and maps.

2.8 Ethical Approval and Consent

Permission to conduct this research was obtained from the Director, Ministry of Environment Kwara State, before visiting the DPK vendors. The purpose and nature of the study were explained to each respondent after which written consent was sought and obtained. Each of the respondents was assured of the confidentiality of the information he/she may divulge.

3. RESULTS

Table 1 presents the descriptive statistics based on local governments, age, sex, gender, tribe, religion, educational status, position, marital status and year of establishment. It was revealed that 10(13.2%) of the vendors are located in the eastern part of Ilorin metropolis; while a greater proportion 48(63.2%) were located in the western part of Ilorin. The age distribution shows that majority 58(76.3%) of the respondents were in the age group 21-40 years, 12(15.8%) were in the age group 10-20 years and 6(7.9%) were in the age group 41-60 years. There was more of the females 56(73.7%) than the males 20(26.3%). This could be one of the reasons why more females are involved in fire incidents. From the nationwide coalition of kerosene disasters, the ratio along gender lines reveals that there are more female victims than males at hospital emergency wards all through 1984 to 2001 in all

states. The breakdown at Ilorin across gender in the same year showed more females at 40 (61.5%) than the males who were outnumbered by 25 (38.5%) with many of the victims drawn from over half a dozen communities in the Ilorin area of Kwara state [8]. All of the respondents were of Yoruba tribe. Majority 62(81.6%) were Muslim, 13(17.1%) were Christians. Twenty

seven (27) (35.5%) had secondary education, 25(32.9%) had tertiary education, 21(27.6%) had primary education while 3(3.9%) had non-formal education. 46(60.5%) of the respondents were owners of these DPK ventures while 30(39.5%) of the respondents were salespersons. Twenty-seven (27) (35.5%) of the respondents were single while 49(64.5%) were married.

Table 1. Demographic characteristics of the population studied

Variable	Characteristics	Frequency	Percent (%)
Local Government	Ilorin east	10	13.2
	Ilorin south	18	23.6
	Ilorin west	48	63.2
	Total	76	100.0
Age	10-20years	12	15.8
	21-40years	58	76.3
	41-60years	6	7.9
Gender	Male	20	26.3
	Female	56	73.7
Tribe	Yoruba	76	100.0
Religion	Islam	62	81.6
	Christianity	13	17.1
	Traditional	0	0.0
	Others	1	1.3
Educational status	No formal education	3	3.9
	Primary	21	27.6
	Secondary	27	35.5
	Tertiary	25	32.9
Position	Owner	46	60.5
	Salespersons	30	39.5
Marital status	Single	27	35.5
	Married	49	64.5
Year of establishment	2007	2	2.6
	2009	1	1.3
	2010	1	1.3
	2011	1	1.3
	2012	4	5.3
	2013	9	11.8
	2014	17	22.4
	2015	19	25.0
	2016	15	19.7
2017	7	9.2	

Table 2. Total number of DPK vendors operating in the various LGAs in Ilorin

Variable	Characteristics	Frequency	Percent (%)
Local Governments	Ilorin east	10	13.2
	Ilorin south	18	23.7
	Ilorin west	48	63.2
	Total	76	100.0

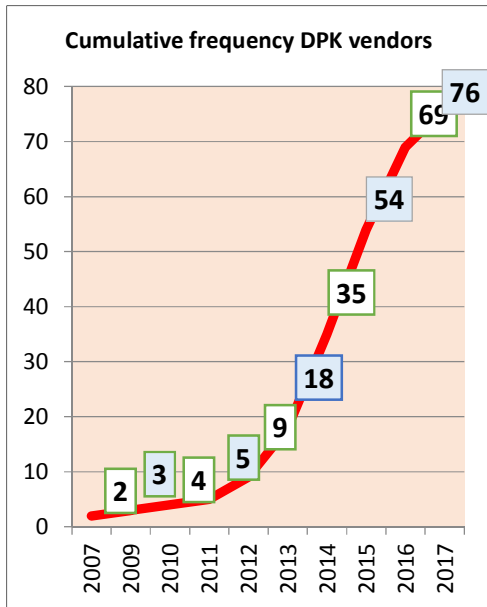


Fig. 2. Ogive graphical representation of year of establishment and frequency of the various DPK vendors operating within Ilorin metropolis

Fig. 2 shows the cumulative frequency graphically represented by an Ogive. From this, it was discovered that 2(2.6%) of the DPK vendors were established in 2007, 1(1.3%) was established each in the year 2009, 2010 and 2011 respectively, 4(5.3%) was established in the year 2012, 9(11.8%) was established in the year 2013, 17(22.4%) in the year 2014, 19(25.0%) in the year 2015, 15(19.7%) were established in the year 2016 and 7(9.2%) were

established in the year 2017. It is of great importance to note that from the year 2012 to 2017, the establishment of DPK vendors increased sporadically as it coincides with the scarcity of the product in the filling stations nationwide and the high cost of kerosene in the country. According to Oduwole et al. [3], kerosene is more readily available through sub-dealers and retailers than at licensed pump stations. This point is further emphasized by Merem et al. [8] who revealed that during this period, the nation devoted more than \$5billion annually for the imports and subsidy of paraffin coupled with massive corruption in the petroleum industry which made kerosene unavailable in the fuel stations.

Table 2 shows the distribution of the DPK vendors across the three local governments in Ilorin metropolis, data from the field survey revealed that there are 76 DPK vendors operating within Ilorin metropolis. Ten (13.2%) are located in Ilorin east, 18(23.7%) are located in Ilorin south and 48(63.2%) are located in Ilorin west. The high percentage of the DPK vendors being found in Ilorin west local government can be attributed to the social-economical status of the population of the people that dominated the area. According to 2006 census, Ilorin west has the largest population of residents in comparison with the other two local governments that make up Ilorin metropolis with about 395,735 people. Most of the residents in this area are local farmers, traders, weavers of fabrics popularly known as "aso oke".

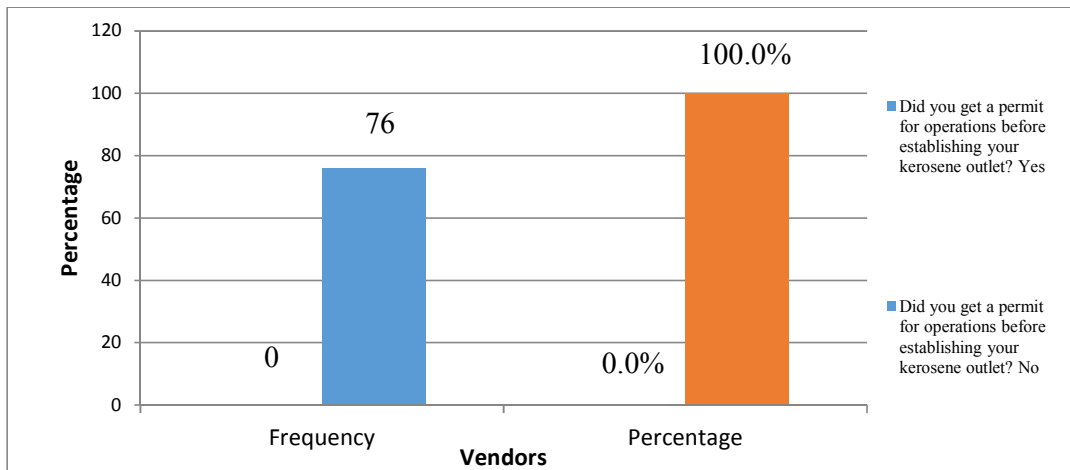


Fig. 3. Graphical representation of frequency distribution of vendors that got permission before starting operations

Results from Fig. 3 revealed that 100% of the DPK vendors did not get permission before starting their ventures which clearly indicates that their activities are not regulated thus DPK aboveground storage tanks can be installed indiscriminately within Ilorin metropolis which is in contrast with the study by Brighton (2013) that aboveground storage tanks (ASTs) are regulated in Pennsylvania by Storage Tank Program.

Results from Table 3 and Figs. 4 to 6 reveals likely environmental health hazards associated with the operations of these medium-scale DPK vendors, about 5(6.6%) of the DPK vendors had case of spillage/leakage of kerosene from their tanks and the pipes that connect the tanks with the dispensing pumps- although it looks insignificant but one of the principles of environmental health sciences, the precautionary principle stipulates that caution should be exercised in matters that could be deleterious to health even if no incidents/accidents have been

reported. Fifty two (52) (68.4%) of the DPK vendors have their tanks situated at place less than 5m to residential buildings, 16(21.1%) have their tanks situated at distance between 5-10m to residential buildings while 8(10.5%) have their tanks situated at distances greater than 10m to residential buildings. Sixty one (61) (80.3%) of the DPK vendors have their tanks situated at place less than 5m to major road, 12(15.8%) have their tanks situated at distance between 5-10m to major road while 3(3.9%) have their tanks situated at distances greater than 10m to major road. Eleven (11) (14.5%) of the DPK vendors have their tanks situated at place less than 5m to water sources, 12(15.8%) have their tanks situated at distances between 5-10m to water sources while majority 53(69.7%) have their tanks situated at distances greater than 10m to water sources. A similar study which was conducted by Samuel [9] on the distribution of filling stations in Kaduna.

Table 3. The likely environmental health hazards associated with the operations of these medium-scale DPK vendors

Variable	Characteristics	Frequency	Percentage (%)
Any case of spillage/leakage of kerosene	yes	5	6.6
	no	71	93.4
Any case of fire explosion incidence/accidence	yes	0	0.0
	no	76	100.0
Proximity to residential building	< 5m	52	68.4
	5-10m	16	21.1
	>10m	8	10.5
Proximity to major road	< 5m	61	80.3
	5-10m	12	15.8
	>10m	3	3.9
Proximity to a water source	< 5m	11	14.5
	5-10m	12	15.8
	>10m	53	69.7

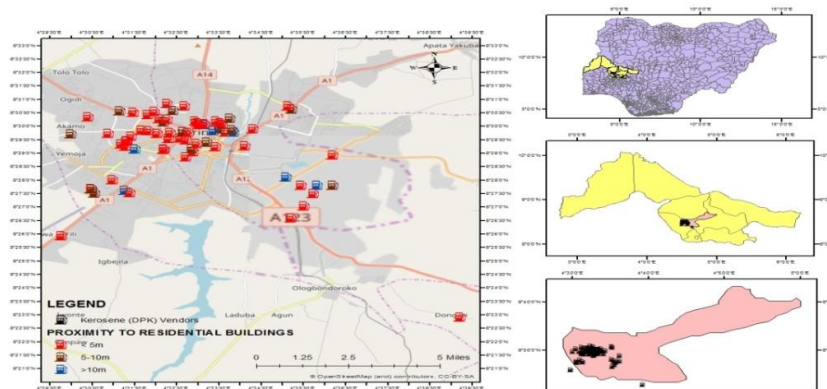


Fig. 4. Map showing the Installation of medium-scale DPK vendors' proximity to residential buildings

North revealed that 69.5% of the filling stations did not conform with the 15m setback thus can pose a serious environmental health hazard. Oloko-oba et al. [10] in a study conducted in Ilorin metropolis on the assessment of filling stations in Ilorin using geospatial techniques also revealed that 28.4% of the filling stations violated the distance from the edge of the road to the nearest pump which should not be less than 15 m as being stipulated by the DPR guidelines for the approval of construction and operations of a filling stations. Similarly, Mshelia et al. [11] revealed that the guidelines for sitting petrol stations have not been adhered by most of the petrol stations thereby posing serious threat on a residence in close range to them even though some of these petrol stations were situated much earlier than the residential houses close to them.

This study is corroborated with a study by Abdullahi [12] in Agege Local Government in Lagos State. Although, there is no written requirement for sitting of DPK sales point or ventures in the DPR guidelines thus this has created a loophole that has to lead to the indiscriminate sitting of DPK sales points all over Ilorin metropolis- which could result in numerous environmental health and health hazards to the DPK vendors and to the populace surrounding them. During the field study, it was discovered that majority of this DPK vendors uses a generator to power their motorized pump used in dispensing the product and this generator is placed close to the aboveground storage tank (ASTs) thus increasing the risk of fire explosion and further pollution of the air which constitute a major environmental health and health hazards respectively.

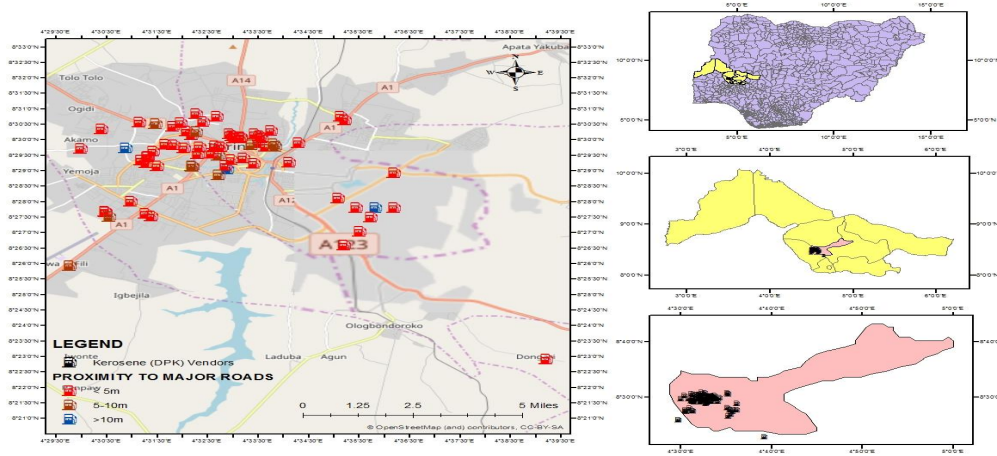


Fig. 5. Map showing the installation of medium-scale DPK vendors' proximity to major roads

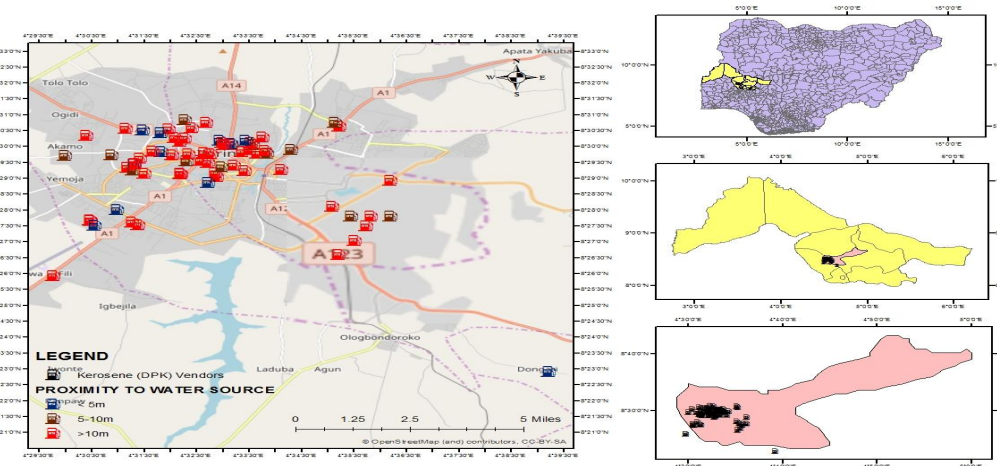


Fig. 6. Map showing the installation of medium-scale DPK vendors' proximity to water source

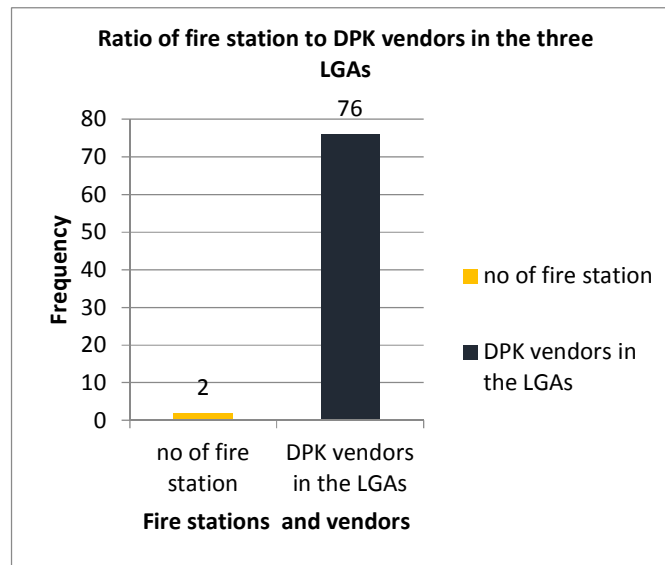


Fig. 7. Bar chart showing the ratio of fire stations to DPK vendors

Table 4. Ratio of fire stations to number of DPK vendors in the three LGAs

Variable	Frequency
No of fire station	2
Total DPK vendors in the LGAs	76
Ratio	1:38

Table 4 and Fig. 7 revealed that the ratio of fire station in Ilorin metropolis to a total number of DPK vendors operating in the three LGAs situated within the Ilorin metropolis, there are only 2 fire stations in Ilorin while there are 76 identified DPK vendors in the three LGAs in Ilorin. The ratio as shown in the third column of

Table 5. The basic safety precautions being practised by the DPK vendors

Variable	Characteristics	Frequency	Percentage (%)
Availability of fire extinguisher	yes	6	7.9
	no	70	92.1
Knowledge on the usage of fire extinguisher	yes	8	10.5
	no	68	89.5
Availability of bucket with sand	yes	13	17.1
	no	63	82.9
Availability of fire blankets	yes	10	13.2
	no	66	86.8
Presence of personal protective equipment	overall garment/apron	9	11.8
	face mask	1	1.3
	nose mask	1	1.3
	hand gloves	0	0.0
	no PPE	65	85.5
Reasons for not using PPE	availability	11	14.5
	convenience	15	19.7
	ignorance	47	61.8
	cost	3	3.9

the table was 1 to 38. This in addition to the revelation from table 4 shows that the disaster management facilities and enlightenment should in case a fire mishap occurs is grossly inadequate. This result is in line with the study conducted by Merem et al. [1] which stressed the need for improved policies on disaster management and improved emergency response to fire hazards.

Table 5 shows the results of the evaluation of the basic safety precautions being practised by the DPK vendors. Majority 70(92.1%) of the vendors do not have fire extinguisher with only very few 6(7.9%) that had a fire extinguisher. On the assessment of their knowledge on the use of fire extinguisher, it was discovered that only 8(10.5%) had knowledge on the usage of fire extinguisher, majority 68(89.5%) do not which is in contrast with the study conducted by Afolabi et al. [13] where about 55.5% of the filling stations in Ife central LGA in Osun State had knowledge on the usage of fire extinguisher. On the further evaluation of other safety equipment, it was discovered that only about 17.1% had a bucket with sand and only 13.2% had fire blanket. The presence of Personal protective equipment (PPE) was also assessed. A very few 9(11.8%) had overall garment/apron, 1(1.3%) had a face mask, 1(1.3%) had nose mask and none had hand gloves. 65(85.5%) had no PPE. It was evident from the earlier result revealed in Table 5 where 59(77.6%) were not even aware of the hazards associated with the operations of medium scale DPK vendors thus it is important that there should be a rigorous enlightenment campaign on basic safety practices in order to prevent accidents and illness that arise from vending of kerosene. Many reasons were cited for not using personal protective equipment, 11(14.5%) gave their reason as availability, 15(19.7%) claimed it was not convenient, 47(61.8%) was discovered to be ignorant, 3(3.9%) claimed it was because of the cost of purchasing the equipment. It is pertinent that the Ministry of Environment through the Environmental Health Officers (EHOs) and Ministry of Health should enlighten the populace of Ilorin metropolis on the need to take safety precautions seriously as it was discovered during the field survey that some of these DPK vendors engages in the sales of Petroleum Motor Spirit (PMS) as black marketers. It was also

observed that some of the DPK vendors store the petrol in the same jerrycans and aboveground storage tank (AST) used in storing kerosene which can invariably lead to kerosene contamination. Kerosene contamination has been a chief culprit in the various instances of fire outbreaks in Nigeria (134 cases in February 2001, WHO Nigeria, 2001) [14]. The epidemiological study conducted by Musa et al. [15] concerning a recent kerosene tragedy reported in Ilorin in which 12(18.5%) deaths out of 65 cases of burns investigated was recorded while 2(23%) of the remaining 53 cases receiving treatment were at risk of death due to severe burns they sustained in which adulteration of the kerosene was a major factor identified as the cause of the mishap. Thus, appropriate precautions by kerosene suppliers and users, and health education can help prevent similar disasters in the future.

4. TEST OF HYPOTHESIS

4.1 Null Hypothesis (H_0) I:

There is no significant association between environmental health hazards and DPK vendors' operations.

4.2 Alternate Hypothesis (H_1) I:

There is a significant association between environmental health hazards and DPK vendors' operations (Table 6).

The test of the association between environmental health hazards of DPK and the operations of DPK vendors revealed that there is an association or relationship between the two variables (p values greater than 0.05). Therefore the null hypothesis which states that there is no significant association between environmental health hazards and DPK vendors' operations is rejected and the alternative hypothesis which states that there is a significant association between the environmental health hazards and DPK vendors' operations failed to be rejected. Thus, the perception towards the hazards that DPK vending can cause will determine how far or near to residential buildings, major roads and water sources that the DPK vendors will decide to site their DPK stations.

Table 6. Chi-square test of association between environmental health hazards and DPK vendors' operations

Do you think there are hazards associated with vending of kerosene?			Value	df	P value
Variable	Yes	No			
Any case of repair on the tank/dispenser					
Yes	4(23.5%)	11(18.6%)	5.199	1	0.006
No	13(76.5%)	48(81.4%)			
Proximity to residential building					
< 5m	10(58.8%)	42(71.2%)	6.413	2	0.004
5-10m	4(23.5%)	12(20.3%)			
>10m	3(17.6%)	5(8.5%)			
Proximity to major road					
< 5m	14(82.4%)	47(79.7%)	5.444	2	0.008
5-10m	2(11.8%)	10(16.9%)			
>10m	1(5.9%)	2(3.4%)			
Proximity to a water source					
< 5m	4(23.5%)	7(11.9%)	7.604	2	0.002
5-10m	1(5.9%)	11(18.6%)			
>10m	12(70.6%)	41(69.5%)			

5. CONCLUSION

It is concluded that the study shows a total of seventy-six medium-scale DPK vendors using a motorized pump with aboveground storage tanks (ASTs) were found to be operating in Ilorin metropolis as at the period of this study which ended February 2018. Worthy of notice is the sporadic increase in the proliferation of DPK vendors in Ilorin metropolis (a percentage increase of over 1500% within a decade and the indiscriminate citing of these DPK vendors close to the residential building (68.4%) and (80.3%) major roads which cause environmental degradation and environmental health hazards. This is of great concern as results from this study also revealed that only 2 fire stations serve the entire Ilorin metropolis, with 71% of DPK vendors not knowing the location and none(0%) of them has the fire stations emergency number in case of any fire mishaps.

The following recommendations are hereby suggested;

- The Environmental Health Officers in collaboration with Town Planning ministry should enhance their enforcement activities to ensure that proper set-backs are maintained so as to prevent indiscriminate citing of DPK stations near residential buildings and major roads.
- Promotion of public education on the dangers of DPK, basic safety practices,

use of PPEs, emergency toll lines through posters, the media and publicity campaigns by all stakeholders saddled with the affairs of environmental health, environment and health.

- There should be the establishment of an agency which will be saddled with emergency/disaster preparedness, mitigation and relief with a toll-free emergency line like LASEMA in Lagos state.
- The Government through the State assembly should enact laws to curb the uncontrolled proliferation of medium-scale DPK vendors in Ilorin metropolis and storage of toxic and flammable substances.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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APPENDIX

Research questionnaire

School of Allied Health and Environmental Science, Department of Environmental Health Sciences, Kwara State University Malete.

Research topic: Health Hazards Associated with the Operations of Medium-Scale Dual Purpose Kerosene (Aboveground Storage Tank) Vendors in Ilorin Metropolis

(A) DPK VENDOR SPATIAL INFORMATION

1. Name of DPK Vendor:
2. Address: LGA.....
3. Status : Functional () Non- Functional ()
4. Latitude () Longitude () Elevation ()
5. Year of Establishment:

(B) SOCIO-DEMOGRAPHIC CHARACTERISTICS OF THE (OPERATOR)

6. Age: 10- 20yrs () 21- 40yrs () 41- 60yrs ()
7. Gender: M () F ()
8. Tribe: Yoruba () Hausa () Igbo () Others.....
9. Religion: Islam () Christianity () Traditional () Others.....
10. Educational status: No formal education () Primary () Secondary () Tertiary ()
11. Position: Owner () Salesperson ()
12. Marital status: single (), married (), widow (), divorced (), separated ()
13. Any formal Training on Vending of Kerosene: Yes () No ()
14. Hours of Sales (Exposure):

(C) INFORMATION ON THE DPK STORAGE TANK AND THE DISPENSER/ENVIRONMENTAL HEALTH HAZARD

15. Capacity of the Tank: <5000 litres () within 5000-10, 000 litres () > 10,000 litres ()
16. Did you get a permit for operations before establishing your kerosene outlet? :Yes () No ()
17. How long has the tank been installed: 0-20 yrs () 21 - 40 yrs () > 40 yrs ()
18. Nature of Tank: Rusted () Averagely Okay () Decent ()
19. Any case of repair on the Tank/ Dispenser: Yes () No ()
20. If Yes, How Often: Frequently () Occasionally ()
21. Any Case of Spillage/Leakage of Kerosene: Yes () No ()
22. If "Yes", (Describe):
23. Any Case of Fire explosion Incidence/Accidence: Yes () No ()
24. If "Yes" (Degree of Severity): Not Severe () Severe () Very Severe ()
25. How do you Refill your Tank: Independent () Major Marketers () Jerry cans ()
26. How often do you Refill your Tank: Daily () Weekly () Monthly () Quarterly () Annually ()
27. Proximity to Residential Building: <5m () 5- 10m () > 10m ()
28. Proximity to Major Road: <5m () 5- 10m () > 10m ()
29. Proximity to a Water Source: < 5m () 5- 10m () >10m ()

(D) OBSERVATIONAL CHECKLISTS ON AVAILABILITY OF SAFETY EQUIPMENTS /BASIC SAFETY PRECAUTION PRACTICE

30. Availability of Fire Extinguisher: Yes () No ()
31. Numbers of Fire Extinguisher:
32. Knowledge on the Usage of Fire Extinguisher: Yes () No ()

33. Date of Last maintenance of the Fire Extinguisher:

34. Availability of Bucket with Sand: Yes () No ()

35. Availability of Fire blanket: Yes () No ()

36. Presence of Personal Protective Equipment (PPE):

a). Overall garment/Apron ()

b). Face Mask ()

c). Nose Mask or Respirator ()

d). Hand Gloves (Nitrile Made) ()

37. Reasons for not using Personal Protective Equipment (PPE):

a) Availability ()

b) Convenience ()

c) Ignorance ()

d) Cost ()

e) Others (Specify):

(E) INFORMATION ON AWARENESS OF HAZARDS (SAFETY & HEALTH) ASSOCIATED WITH VENDING OF KEROSENE

38. Do you think there are hazards associated with vending of kerosene: Yes () No ()

39. What is/are your source of information: Radio (), Television (), Newspaper (), Friends/Family ()

40. If "Yes", what are these hazards?

a) Headache ()

b) Shortness of breath ()

c) Coughing ()

d) Nausea & Vomiting ()

e) Asthma ()

f) Dermatitis (Eczema) ()

g) Burns ()

h) Disorientation & Drowsiness ()

i) Catarrh ()

j) Others (specify)

(E) OTHER RELATED INFORMATIONS

41. Do you have a Fire Station close to your area: Yes () No ()

42. If "Yes" (Address):

43. Do you have the phone number of any Fire Station within Ilorin Metropolis:

Yes () No ()

44. If "Yes" (Phone Number):

45. Any Regulatory Institution/body regulating your activities/establishment: Yes () No ()

46. If "Yes", Name of Regulatory Institution/body:

47. What are their activities (Describe):

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