INCIDENCE ANDLANDUSE CHARACTERISTICS OF PETROL FILLING STATIONS IN OGBOMOSO TOWNSHIP, NIGERIA

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Abstract
The continual increase in the incidence of Petrol Filling Stations (PFSs) in Nigerian urban centers, and its intrusion of into residential and commercial hubs requires the intervention of landuse planning. It is against this background that this study investigates the incidence and landuse characteristics of PFSs in Ogbomoso Township. To achieve this, an inventory of PFSs in the Ogbomoso Township was made, where 48 PFSs were identified. Thereafter, a ring of 50 meters radius was delineated around each identified filling stations, and landuse characterization of the delineated area was done. Also, the road characteristics of abutting road to the PFS were obtained. To model the incidence of PFSs, another 15 rings of 50 meters radius were randomly delineated in areas without PFSs. Pearson Product Moment Correlation analysis was used to investigate the relationship between the incidence of Petrol Filling Stations (IPFS), Commercial Landuse Area (CLA), Residential Landuse Area (RLA) and Road Characteristics Index, while Multiple Regression Analysis was used to calibrate the relationship between IPFS, RLA, CLA and RCI. The study discovered that, out of the 48 identified PFSs, 89.6% are functional and 10.4% are not functional. With r= -0.755,p=0.000; there is a strong negative relationship between IPFS and RLA, thus indicating the gradual replacement of residential areas for PFSs. To predict the incidence of PFSs in any area in Ogbomoso town, the model PFSs= -0.734RLA – 0.518CLA – 0.093RCI was calibrated. The study concluded that with sustained economic growth in Ogbomoso Town, there will be an increase in incidence of PFSs and its continuous intrusion into residential and commercial hubs. It therefore recommended development control and introduction of incentives for reuse of abandoned PFSs.

Key Words: *Landuse Planning, Petrol Filling Stations*

Introduction

Petroleum Filling Stations (PFSs) are installations used for the sale and dispensing of petroleum products, or other related fuels for automobiles and mechanized engines. It includes part or whole of the land, building or equipment for such services. The increase in the incidence of PFS in Nigeria, since 1980s with its causative factors, among others, include increase in automobiles, economic prosperity, access to land, and lack of enforcement of urban planning laws (Ambituuni *et al.*, 2014). Meanwhile, the flammable characteristics of PFS necessitate the need for its specialty in locational choice, design, construction, installations and maintenance (Ahmed *et al.*, 2011, Mishelia, 2015). An otherwise, which can cause accidents, fire outbreak, air pollution, and other related environmental hazards. However, with increasing landuse densities in towns and cities, and its associated increase in population and transportation demand, the incidence of petrol filling stations and its demand for prime locations within the urban fabric keep increasing (Ahmed *et al.*, 2014). Further this variant of landuse, because of its ability to pay for locational prices; dislodge less competitive landuses, such as residential landuses, in prime locations and central places. Hence, most of these filling stations are located in central places (Mshelia *et al.*, 2015).

The Location of PFS in central places usually without adherence to both planning and safety regulations have led to the outbreak of disasters in many areas. This has attracted various socioeconomic implications which, among others, include loss of lives and properties, displacement of town value and degradation of its aesthetics. Of particular note is the sitting of some of these facilities, without observing adequate set back to roads, under power cab1es, beside streams, road intersections, U-Turns and adjoining land uses (Ambituuuni *et al.*, 2014). Some of the PFS are even located in close proximities to each other as observed in the findings of Blamah *et a1.* (2012), where petrol station were linearly aligned along Abuja-Keffi road without much reference to planning standard of a distance of 400 m away from each other. These can unsurprisingly result in multidimensional environmental effects, among which include, fire outbreak, accidents and pollution of all sort. The influx of informal activities around these facilities also poses significant danger especially pertaining to crime and violence. United Nations accounted that between the year 1970 and 2000, there is a high incidence of death tolls and economic losses in relatively more concentrated geographic areas (ISDR, 2009), thereby suggesting an inseparable human influence in disaster creation. Meanwhile human activities are expressed in landuse, and there is somehow a way of predicting the emergence of these landuses

Several research attempts have been directed at predicting the occurrence of a particular type of landuse or other other (Moril and Dormitizer, 1979; Das and Sakar, 2019). Predicting the incidence of a type of landuse will arm the urban planner with proactive decision making. Such may include prevention the landuse emergence through the control of its underlying factors. It may also influence policy directions in the preparing for such landuse, by providing facilities, especially if the occurrence of such type of landuse is inevitable. The emergence of landuses, without the existence and enforcement of policy guidelines, and absence of facilities

has influenced the negative impact of such facilities (Sarin, 1982). For instance, in many occasions, PFS has been associated with fire disaster because of its improper placement and lack of planning, (Ahmed *et al.*, 2011).

Disaster related to PFS is really a growing challenge, and has attracted various research interests in its conceptualization, incidence, causes, prevention and management (Buckle, 2005; Britton, 2005; Alexander 2005, Mshelia, 2015). Yet in Nigeria, the relationship between the incidence of PFS and landuse characteristics has not been so explored. The proliferation of PFS, like other usually incompatible uses, in virtually every segment of the urban space especially those close to residences has been observed to pose a serious threat to land use classification and planning (Sarin, I982; Tipple, l993). It also affects environmental planning; as such tend to create a level of disorderliness, wastes and other environmental impacts within the urban enclave. More unfortunately are the inadequacies associated with agencies in charge of fire management in Nigeria, which have been reported to operate with inadequate staff, absence of water hydrant, fire lane reserved for fire appliances etc.

Planning is a proactive activity and as such requires a forecast of the emergence of an activity, PFS in this instance, within the urban enclave. This requires landuse characterization and baseline studies. It is therefore necessary that an inquiry be made into the incidence and landuse characteristics of petrol filling stations in Ogbomoso, Nigeria. This is with the aim of proffering recommendations that will guide in planning related decisions for such type of landuse in the town, and other towns with similar characteristics.

Study Area

Ogbomoso, the second largest town in Oyo State, Nigeria, is located on latitude of 10'N and longitude 4 degree 10'E of the globe. It is 105 km Northeast of Ibadan, 58 km Northwest of Oshogbo and 57 km Southeast of Oyo. Ogbomosho land covers roughly 3547.89 sq km land area, and its population has grown from approximately 645,000 in 1991 to an estimate of about150000 people. Influenced with the presence of a university, college of education, theological seminary, and two university teaching hospitals, Ogbomoso is witnessing a rapid population growth and urbanization. These have influenced an increase in the demand for petroleum products, and consequently PFS.
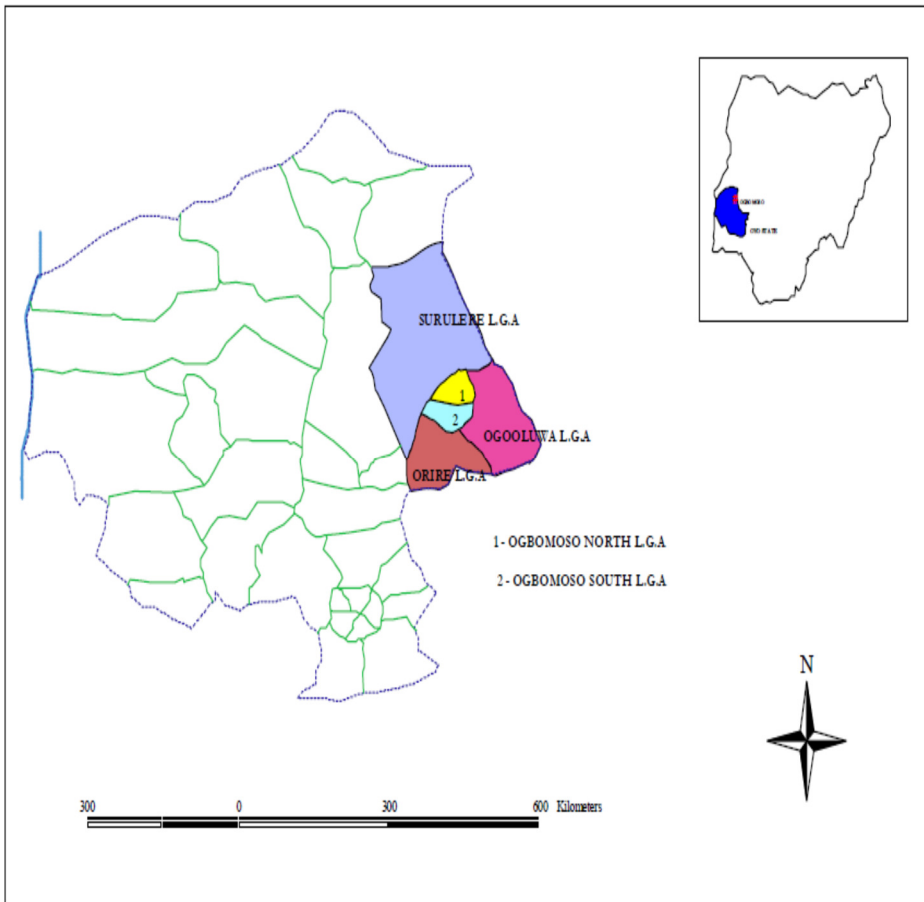
Fig. 1: Map of Ogbomoso
Source: Adapted from GIS laboratory, LAUTECH, Ogbomoso, Oyo, State (2019)

Research Methodology

The study, an exploratory and applied research, utilized two types of data. These are primary and secondary data. Secondary data utilized for the study include maps obtained from the Geographic Information System Laboratory of Ladoke Akintola University of Technology, Ogbomoso. Primary data utilized for this study were obtained with the aid of questionnaire administration and direct measurement. To determine the number of questionnaire to be administered, an inventory of all PFS in the town was made, where 48 PFS were identified. For all the identified PFS, a ring of 50 meter radius was delineated,

and landuse use characterization of the delineated area done. To predict the incidence of PFS, 15 additional rings with non-incidence of PFS were randomly delineated, and landuse characterization of the area was also done. Obtained landuse information includes landuse type, area of landuse within the delineated area, year of establishment of PFS, functionality of PFS. Obtained data was subjected to both descriptive and inferential statistics. Pearson Product Moment Correlation was used to evaluate the relationship between the incidence of PFS and landuses, while multiple linear regression was used to calibrate the

relationship between landuses and incidence of PFS.

Result and Discussion

This section discus the findings made in the study area. The section is broadly divided into three, these are: incidence of PFS in Ogbomoso Township, landuse characterstics of PFS in Ogbomoso Township, and predicting the future.

Incidence of PFS in Ogbomoso Township

As at the time of this survey, there are forty-eight (48) Petrol Filling Stations (PFSs) in Ogbomoso Township, out of which 89.6% are functional, while 10.4% are non-functional. Also, 50% of the PFSs constructed about 16 years ago, are not functional, thus indicating poor maintenance of such filling stations. These non-functional filling stations are nearly abandoned and are used as automobile workshops, car ports for selling of cars and garages for picking up of passengers. Some of the nearly abandoned PFSs are bushy, with thatched roof and decaying structures. At nights, these category of PFSs are usually deserted, and, as such are hideout for criminals, insane patients, and joint for smoking of hemps. Unfortunately, because the PFS are located at prime junctions within residential and commercial hubs, residents and passerby becomes victims of various crimes and attacks. These are results of the hardships associated with conversion of lands that were once used for commercial purpose to other landuse(s) with relatively low rate of economic returns. Despite that, these landuses cannot afford the cost of such land, land speculators, because of their expected return on land, tends to keep the land until there is a buyer to acquire it at an anticipating price. Unfortunately, not only the infrastructure

on the land will be decaying, but such land attracts informal activities, and harbour crimes.

As evidenced in Table 1, 45.8% of the PFS in the study area were built less than 5 years ago, 31% were constructed about 6 to 10 years ago, while 10.4% and 4.3 % were constructed in 11-15 years, and 16 - 20 years ago respectively. From this statistics, it is deducible that the number of PFS constructed between 6- 10 years ago tripled those that were constructed within 11-15 years ago, while the numbers of those constructed within 5 years ago is about 150% of those constructed within 6-10 years ago. One may therefore conclude that era of PFS boom in Ogbomoso Township started about 6 -10 years ago. This period was the era of strong political relevance of the town, where an indigene of the town was the state governor. This brought development and economic prosperity to both the town and her indigenes. Members of the town not only held key political offices but had access to Government and all its benefits, which include winning of tangible contracts. It was during this era that a general hospital in the town was upgraded to the status of a teaching hospital, a private radio house was established, while shopping malls and other enterprises were constructed. Also, major roads linking the town to other towns were upgraded; new major roads were constructed, while existing internal roads were either renovated or dualised. These among other factors such as peace, security could have influenced the increasing incidence of filling stations in the study area.

Recent times have witnessed more incidences of filling stations, and possibly more intrusion of PFS into urban hubs in the study area. However, with the increasing trend of the incidence of filling

stations in the Ogbomoso Township, its current number, the improving socioeconomic condition of the town and its urbanization rate, it will not be out of place to conclude that there will be more establishments of filling stations at alarming numbers in the town, except for government intervention with the aid of development control. The concern here is not really about the number of filling stations but the landuse implication of their locational characteristics and their potential disaster impact. The continual establishment of filling stations, at the sight of poor management, will increase the chances of fire disaster. Also, with the eventual nonfunctional and abandonment of these filling stations, as evidenced in existing nonfunctional ones, there is tendency of increased abandoned structures.

Table 1: Incidence of PFS in Ogbomoso Township

			Year of Establishment					Total
			Less than 5 Years	6 – 10 years	11- 15 years	16-20 years	21 years and above	
Functionality	Functional	Count	21	14	5	1	2	43
		% within functionality	48.8%	32.6%	11.6%	2.3%	4.7%	100.0%
		% within year of establishment	95.5%	93.3%	100.0%	50.0%	50.0%	89.6%
		% of total	43.8%	29.2%	10.4%	2.1%	4.2%	89.6%
	Not functional	Count	1	1	0	1	2	5
		% within functionality	20.0%	20.0%	0.0%	20.0%	40.0%	100.0%
		% within year of establishment	4.5%	6.7%	0.0%	50.0%	50.0%	10.4%
		% of total	2.1%	2.1%	0.0%	2.1%	4.2%	10.4%
Total		Count	22	15	5	2	4	48
		% within functionality	45.8%	31.2%	10.4%	4.2%	8.3%	100.0%
		% within year of establishment	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of total	45.8%	31.2%	10.4%	4.2%	8.3%	100.0%

X^2=11.695; p=0.005

Landuse Characteristics of PFS in Ogbomoso Township

This section discusses the landuse characteristics of the PFS in Ogbomoso Township. This was done to picture the landuse fabric around PFS in the study area. It is evident in Table 2, that the predominant landuses around PFS are residential and commercial landuse. This is as about 81% of the landuses at the right side of the PFS are residential development. Similarly 52.1%, 66.7% and 68.8% of the landuses at the rear, front and left sides of the PFS are residential landuses. From the foregoing, one may infer that filling stations are located within residential hubs. This situation though alarming, reflects the impact of land transition in urban areas, where existing buildings, at prime locations, within

residential hubs are displaced for entrants of new landuses such as PFS that can bring higher return on land. This situation may raise few questions on the urban planning of urban areas and development control. Some of these questions are: Is there no masterplan guiding developments in the urban areas? Is there no zoning plan for various landuses in the urban area? If yes to these previous questions, why then are they not religiously followed, as evidenced in the transitional nature of landuses in the urban areas? Another major landuse type around PFS is commercial landuses which account for 47.9% at the rear, 20.8%, 21.3% and 18.5% at the front, left and right sides of the PFS.

Table 2: Landuse Characteristics of PFS in Ogbomoso Township

	Rear	Front	Left Side	Right Side
Residential	52.1	66.7	68.8	81.3
Commercial	47.9	20.8	31.3	18.5
Industrial	0.0	2.1	0.0	0.0
Receational	0.0	4.2	0.0	0.0
Institutional	0.0	6.3	0.0	0.0
Total	100.0	100.0	100.0	100.0

Predicting the Incidence of PFS in Ogbomoso Township

As a result of the foregoing, an attempt was made to predict the incidence of PFS in an area of Ogbmoso based on its landuse characteristics. To achieve this, 14 additional areas that are without PFS were randomly selected, and a ring of 50m radius delineated, where a landuse characterization was done. Since access is vital to the location of any activity, especially PFS, the route characteristics of the abutting road was measured. Variables considered for the regression analysis were: Residential Landuse Area (RLA) measured as area used for residential development within the defined ring, Commercial Landuse Area (CLA) measured as area used for commercial development within the defined ring, Road Characteristics Index (RCI) (measured as the product of road distance from the closest junction; road condition, where 1 was allotted to untarred and 2 to tarred; and Road Type where, 1 was allotted to minor and 2 to major) and Incidence of Petrol Filling Station (IPFS).

As summarized in Table 3, with r= 0.292; p=0.020; there is a significant positive correlation between RCI and RLA, thus indicating that there is a relationship between the incidence of residential landuse and road characteristics. Hence, in the study area, residential landuse development tends to be encouraged with improved road characteristics. However, there seems to be a stronger relationship between commercial landuse area and road characteristics, as about 17.2% of the factors associated with the location of commercial landuses can be traced to road characteristics. Also, with r=0.415, p=0.001, a strong positive correlation between CLA and RCI is reported. However, with r= -0.755, p= 0.000; there is a strong statistically significant negative correlation between IPFS and RLA thereby indicating that as areas used for residential development reduces, incidence of Petrol Filling Station

increases, hence suggesting PFS intrusion into residential areas, for the displacement of residential landuses. Similarly, there is a statistically significant negative correlation between the incidence of PFS

and CLA, (r=0.548, p= 0.000) which indicates that PFS is also a major contender for space with other commercial landuses.

Table 3: Correlation Summary

		RLA	CLA	RCI	IPFS
RLA	Pearson Correlation	1	-.011	.292[*]	-.755[**]
	Sig. (2-tailed)		.930	.020	.000
	N	63	63	63	63
CLA	Pearson Correlation	-.011	1	.415[**]	-.548[**]
	Sig. (2-tailed)	.930		.001	.000
	N	63	63	63	63
RCI	Pearson Correlation	.292[*]	.415[**]	1	-.522[**]
	Sig. (2-tailed)	.020	.001		.000
	N	63	63	63	63
IPFS	Pearson Correlation	-.755[**]	-.548[**]	-.522[**]	1
	Sig. (2-tailed)	.000	.000	.000	
	N	63	63	63	63

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

Table 4a - 4c shows the result of regression analysis modeling the relationship between IPFS and all of RLA, CLA and RCI of areas around PFSs in Ogbomoso Town. According to the Tables (Table 4a and 4b), the F-ratio of 153.227and p-value of 0.000 indicates that the joint relationship between RLA, CLA and RCI is statistically significant. Moreover, with the correlation coefficient (R) of 0.941and coefficient of determination (R^2) of 0.866, as shown in Table 4.a, it is evident that 86% of incidence of PFS is accounted for by the landuse characteristics of the area. The remaining 14% can be related to other factors not covered in this model. To determine the relative contribution of each of the independent variable (RCA, RLA and IPFS), reference was made to their coefficients (as shown in Table 4d).

From the table, the following predictive model can be calibrated:

$Z = -0.734Y1 - 0.518Y2 - 0.093Y3$

Where Z is the IPFS; $Y1$ is RLA; $Y2$ is CLA; $Y3$ is RCI

With the disappearance of the constant, a, as the standardized coefficient was used, the result of regression coefficient implies that a unit increase in RLC will lead to a change of 0.734 in IPFS, while a unit change in CLA will cause a change of 0.518 in IPFS. Furthermore, for a unit change in the RCI of the roads in the study area, PFS will change by 0.093. It is observable that, out of the three variables, only RCI, is not statistically significant (p= 0.074).

Table 4a: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.941[a]	.886	.880	.14844

a. Predictors: (Constant), RLA,CLA,RCI

Table 4b: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	10.129	3	3.376	153.227	.000[b]
	Residual	1.300	59	.022		
	Total	11.429	62			

a. Dependent Variable: IPFS
b. Predictors: (Constant), RLA, CLA, RCI

Table 4c: Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	2.238	.053		42.412	.000
CLA	-2.029E-005	.000	-.518	-10.602	.000
RCI	-1.778E-005	.000	-.093	-1.820	.074
RLA	-2.659E-005	.000	-.734	-15.798	.000

a. Dependent Variable: IPFS

Conclusion and Recommendations

From the foregoing, it can be concluded that there are presently 48 PFSs in Ogbomoso Township, located at prime areas within commercial and residential hubs. The observed incidence of the PFSs, which has tripled within the last 5 years, may increase with sustained socioeconomic balance. This has grave implications on landuse and environmental planning, to manage these, the following recommendations are proffered:

1. Planning Authority in the town under the aegis of Oyo State Ministry of Physical Planning and Urban Development should promote development control by discontinuing the granting of developmental approvals to PFSs in residential and commercial Hubs. Similarly, construction of PFSs in areas with existing PFSs should be discouraged. Also, existing PFSs should be audited for compliance with planning standards for the establishment of such landuse type.

2. Developer with aim of flaunting new PFSs should be encouraged to take over existing non-functional PFSs. Such encouragement could be in form of waivers for permit fees.

3. To ensure night safety at PFS, PFS operators should be encouraged to employ the service of night guards and CCTV at their stations. To also promote multi-activities at PFSs, especially at night, ATM galleries should be encouraged.

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