

A Spatial Disparity Analysis of Fire Station Distribution in Lagos, Nigeria

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Abstract:- The spatial extent at which world cities have sprawled outside their original boundaries, has shown the limitations urban facilities have in meeting with the increased demand and service area. This has led to the question of spatial justice and equity with respect to access to these amenities. But the case for developing cities like Lagos is more drastic, where new sets of questions are emerging all together with a predominance of uneven location and distribution of public services and facilities. The study examined the spatial distribution of fire service facilities in Lagos, to highlight the disparity in their distribution. Using web mapping API query, descriptive analysis and correlation analysis, the study proceeded to establish a relationship between the income characteristics of settlements and the spatial location and distribution of fire service facilities in Lagos. The result showed that there exists a strong correlation between the affluence level of neighbourhoods and the location of fire stations in Lagos. The study recommended the need for social equality and evenness in the distribution of fire services facilities in Lagos, to promote even development and services availability across the city, thus erasing social inequalities and evening out spatial differences.

Keywords: public facilities, fire stations, spatial distribution, income levels, inequality

I. INTRODUCTION

Cities of the global south suffer from an unevenness in the location of public facilities, with city municipalities often focusing more on the affluent neighbourhoods and neglecting the makeshift sprawls, ghetto suburbs or the derelict old city center. Optimal distribution of social, economic, cultural, and sanitary facilities in the city is thus lacking and new sets of differences are emerging all together with a predominance of socio-economic inequality enunciated by the location and distribution of public services and facilities in the city; with varying level of accessibility to these facilities by the rich and poor. As a result, the perceived cosmopolitan outlook of global cities has not translated to a socio-physical and socio-economical synthesizes of people, the location and distribution of public amenities, nor services delivered by both government and private businesses; with income doing more to separate people and communities than geography, language or cultural differences.

Lagos provides a useful case study for the disparity in location and distribution of public facilities in many cities of the global south. This unevenness is even more enunciated with the growth of class settlements in the city. Lagos follows a pattern with a clear distinction, distribution and separation of residential areas according to income level. This has led to

the development of three major settlement classes in the city; the highbrow areas, the old city areas, and the sprawls. These settlement class then to play a major role in the location, distribution and availability of public services in Lagos. Municipal and private developers have worsened this spatial inequality, by almost certainly locating urban services in settlement areas that have a rich populace with the poorer neighbourhoods often considered only when it is a foreign backed project or there are political votes to secure. The continued occurrence of this has led to several problems and weaknesses in terms of policy coordination between increase in the population size and physical development of the city from an urban services location and distribution perspective. This problem derives from the inappropriate location of some urban services like malls, highways, parks, trade centers, hospitals, recreational facilities, bus parks, etc. Thus, resulting in even more problems and difficulties for citizens such as shortage of public services, inaccessibility to these services, congestion of different services centres, and general citizens' dissatisfaction with the resulting livability problems in the city.

The study exemplifies contemporary challenges cities of the global south face and Lagos provides a good case study for this study as one of Africa's largest and most diverse metropolitan center. Using the distribution fire service stations, the study provides a case study that exemplifies contemporary challenges world cities face with respect to uneven public service distribution. These challenges cannot be viewed in isolation as difficult questions and complex considerations hold significant influence over their occurrence and the ability and willingness of policy makers to adopt the smart regulations needed to address them. This study is thus timely and offers insightful contribution to managing the integration of urban communities, erasing social inequalities, and promoting social inclusion.

Literature Review

As policing urban growth and development sustainably becomes an important issue for policy makers and planners alike, many scholars have carried studies to examine and explain the rise, growth and the dearth of cities since World War two. Alig and Healy (1987) noted that cities have changed since this time from cohesive urban economies and societies into disorderly places characterized by fragmenting relations. The city aggravates this as seen in the imbalances

between urban areas and various urban sectors in benefiting from available services and facilities (Lorestani, 2016).

Anderson & Pomfret (2005) stated that just as inequalities exist between individuals they also do exist amongst spatial units, and there is a plethora of scholarship on the disparity in the spatial distribution of urban services or public facilities. In an analysis of the Sharifi (2006) equates this with social justice with the need for a fair distribution of facilities and resources amongst different urban district and equal access to them. Sharifi’s view develops on David (1997) work which focused on the issue of equitable distribution of resources, as a strategy for social justice, wherein the optimal allocation of resources with the most suitable combinations to address inequalities is sought. Other scholars such as Hugget (1996) highlighted the importance of the urban managers being aware of the need for equity in the spatial distribution of social benefits in order to reduce spatial inequalities. Corbacho and Osorio(2012) examined travelling distance to health facilities in the US and Caribbean and noted that spatial access to these public services is dampened by distance. Spatial distance was also considered a mitigating factor the effective use of health facilities (Currie & Reagan, 2003; Buchmüller, Di Bari, & Plümacher, 2005) and schools (Kondylis & Manacorda, 2012).

Perhaps, Ofose (2012) study of the spatial distribution of health services in Eastern Ghana came the closest to addressing the objectives of this study; noting that the interactions between economic agents and increasing returns that can be created by dense agglomerations and interactions explains the reason why public facilities and unevenly

distributed. Madu (2007) opined that the spatial variation in availability and access to infrastructure equates the spatial disparities in living standards both within and between regions and localities, as the richer regions get richer and more developed while the poorer areas slip further into underdevelopment (Madu, 2007). Anderson and Pomfret (2005) study in Tajikistan, Central Asia showed considerable inequalities in the provision of public services in Central Asia, as the most isolated region, had poor roads, low quality and inadequately heated schools, and low availability of water, sewer and garbage disposal system and the wealthier regions were well off.

In Nigeria, most of the study carried out have focused entirely on the spatial distribution and access to schools (Inobeme & Ayanwole, 2009). Fabiyi & Ogunyemi, 2015; Ismail, Jaro, Wankata,&Maiwada,2016) and health facilities (Okafor, 1987;Onokerhoraye, 1999; Ajala, Sanni, & Adeyinka, 2005;Atser& Akpan, 2009; Nwakeze & Kandala, 2011; Adeyinka, 2013;Ujoh & Kwaghsende, 2014). None have been carried out to examine the distribution of fire services stations in Nigeria nor has any of the forgoing literature focused on settlement class as a determining factor affecting the disparity of fire stations in a settlement area. This gap in literature has necessitated the examination of the spatial distribution of fire facilities in the city of Lagos. This case study evaluation is a novel approach that is critical for any meaningful response to the developmental challenges in the study area.

II. MATERIALS AND METHODS

2.1. Study Area



Figure 1: Map Showing the Study Area

Source: Adapted from Hello Maps (2019)

Lagos State covers an area of 3,577.28 square kilometers (Lagos State Lands Bureau and Surveyor General Office, 2016). It is bordered to the north and east by Ogun State, to the west is the international border Nigeria shares with the Republic of Benin, to the south is the Atlantic Ocean (Figure 1). With a projected population of 23 million people (Lagos Bureau of Statistics, 2015) and a population density of approximately 6,871 residents per square kilometer in the metropolitan area (World Population Review, 2018), the Lagos metropolis is by far the largest city in Africa. Of the 20

local government areas (LGAs) in Lagos State, the National Bureau of Statistics (2007) classifies 16 LGAs as within the metropolitan area while 4 LGAs are classified as sub-urban LGAs. The metropolitan area of Lagos comprising of Lagos Island, Lagos Mainland, Victoria Island, Lekki, Apapa, Festac Town, Satellite Town, Ebute Meta, Surulere, Ikeja, Ikorodu, Ojo, Ijora, Ikoyi, Egbeda, Ikotun, Ajeromi-Satelite, Oshodi and Yaba (Figure 2); is home to one of the densest concentration of people in Africa.

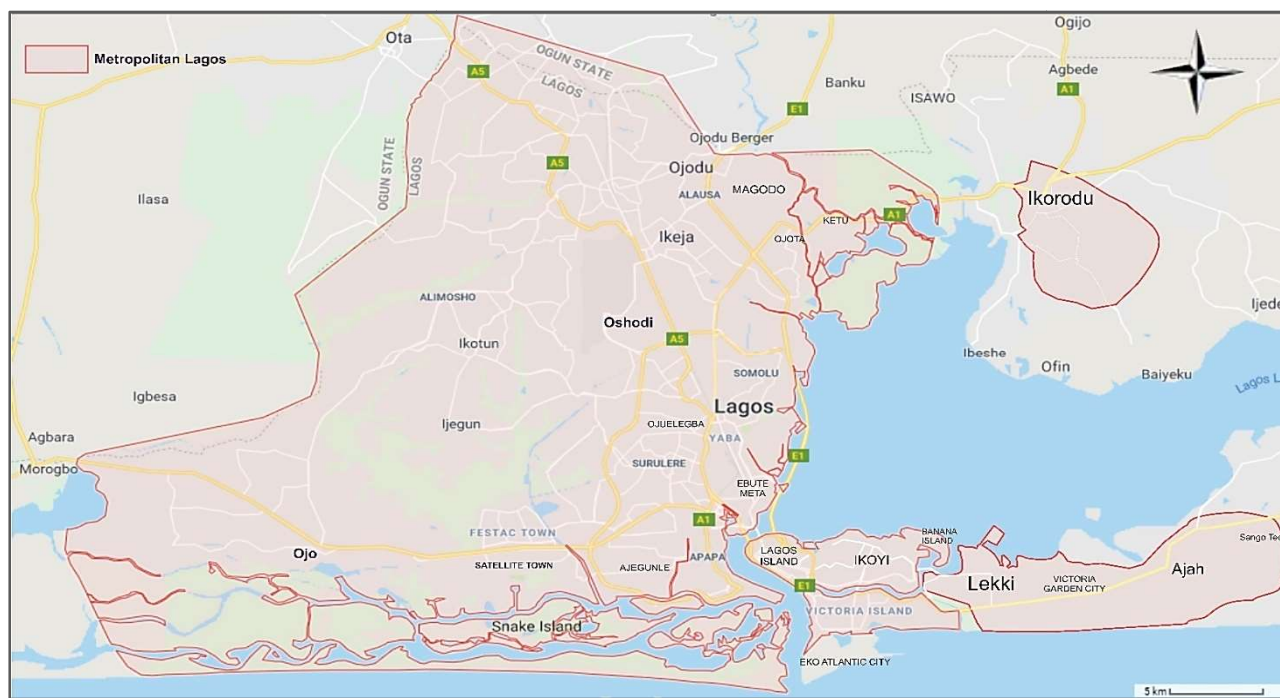


Figure 2: Map Showing the Metropolitan Area of Lagos

Source: Adapted from Google Maps (2019)

The state is situated on a densely built-up land area of about 18,558 Hectares with over 50% of the land used for residential purposes (Table 1). The Lagos State Summit of 2001 places the metropolitan area of Lagos to currently occupy close to 90% of Lagos State. This high level of urbanization and dense population has led to immense pressure on land, with the city continuously sprawling to make room for new migrants.

Table 1: Land Use distribution in Lagos

Land Use	Hectares (in Use)	Percentage (%)
Residential	9,669	52.1
Transportation	3,340	18
Institutional and Special Use	2,784	14
Industrial	1,448	7.8
Commercial	1,021	5.5
Open Spaces	52	2.8
Total	18,558	100

Source: Lawanson (2012)

This has led to differential settlement growth with the poorer populace settling in fringe settlements (Ojo, Ikorodu) or crammed neighbourhoods in the old city district (Yaba, Ebute Meta, Oshodi, Ijora, and Ojuelegba). Well off residents reside in the better planned neighbourhoods on the Island (Lagos Island, Ikoyi, Victoria Island and Lekki) or on the mainland (Apapa, Ikeja, Surulere, Amuwo Odofin). This distribution reflects the differential distribution of residents of the Lagos metropolis according to some income indicators such as socio-economic characteristics such as income of household, type of accommodation, monthly rent, quality of buildings, availability of housing facilities, inaccessance of crime .Lagos however typifies an unusual pattern, with most public facilities and urban facilities located in the medium to high income residential areas of Lagos.

2.2. Methodology

This study is largely based on secondary data. Spatial data and geo referenced information were sourced from Google Maps and Hello Maps, and statistical data were

obtained from works by Agboola (2015) and Owolabi (2017) on the study area. Google Earth was relied upon for visualized data on the live blood of each cities such as circulation and location of public services from which spatial maps were generated. Data of urban services and public facilities in the study area was obtained from simple online query using Web mapping API of mainstream map service providers. A key variable of the user population that was considered for this study, is socio-economic status and this matches the

settlement they reside and their proximity to available public facilities. Lagos is observed to follow a pattern with a clear distinction, distribution and separation of residential areas according to income level. This has led to the development of three major settlement classes in the city; the high-income highbrow areas, the medium income planned settlement area, and the low-income old city areas and the sprawl neighbourhoods (Figure 3). These were the basic unit of the analysis for this study.

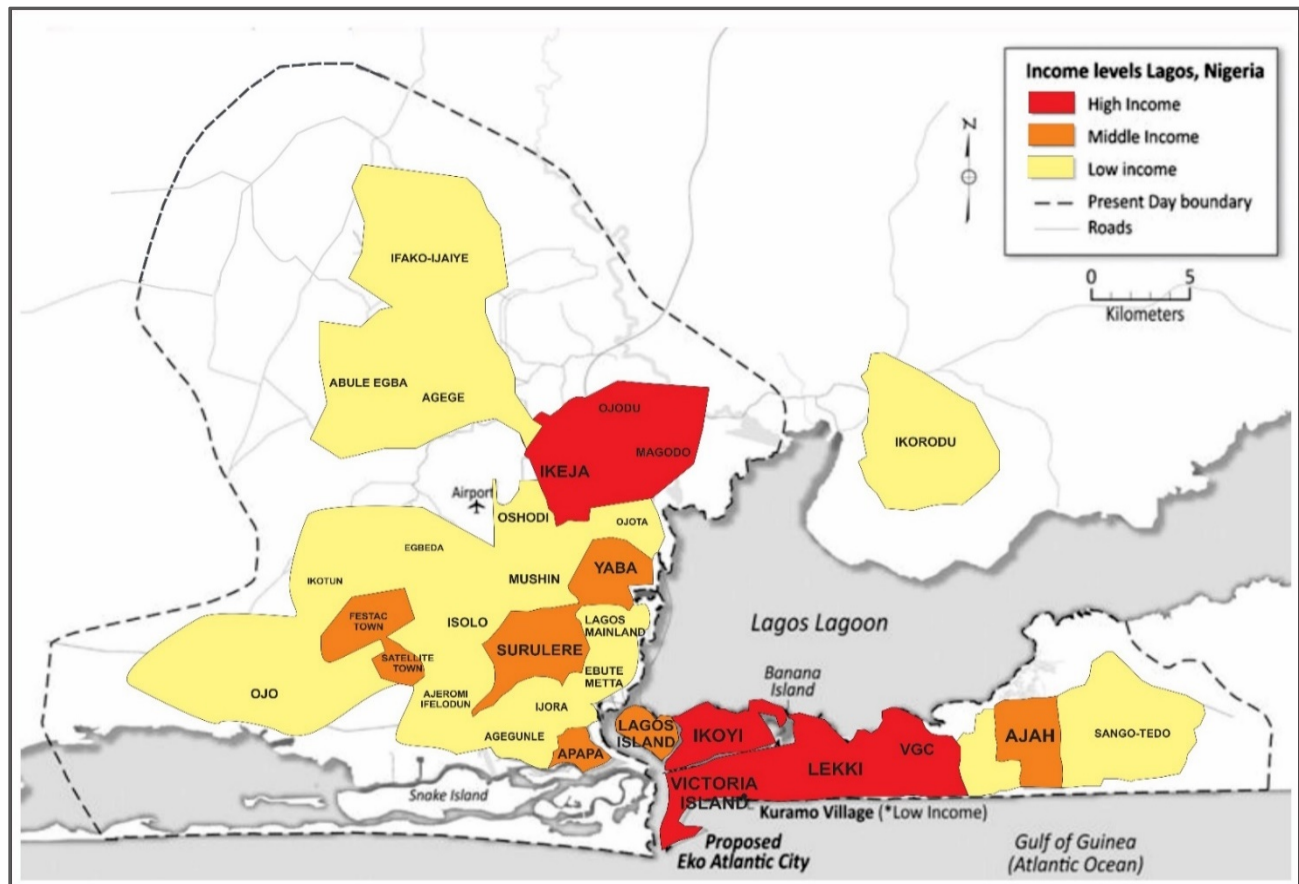


Figure 3: Map Showing the Settlements Distribution according to Income Level in Lagos

Source: Adapted from Agboola, 2015(2019)

2.2.1. Method of Data Analysis

The method of data analysis used for reducing and organizing data was comparative-analytical and public facilities and urban services constituted the sample population in the settlement classes identified in Figure 3. First was to identify and locate the existing fire stations using the Google and Here Map web mapping API across the study area to get the existing spatial distribution characteristic. Next was to overlay the location of these fire stations and services with the settlement distribution map. This is followed by an

assessment of catchment areas which is defined how each settlement class attracts the location of fire stations. A correlation test was performed to statistically test the relationship between income levels and the distribution of public facilities and urban services in the study area.

2.2.2. Web API Query

This involved the use of internet map hosting websites such as Google Maps and Hello Map to extract information on the location of the study variables.

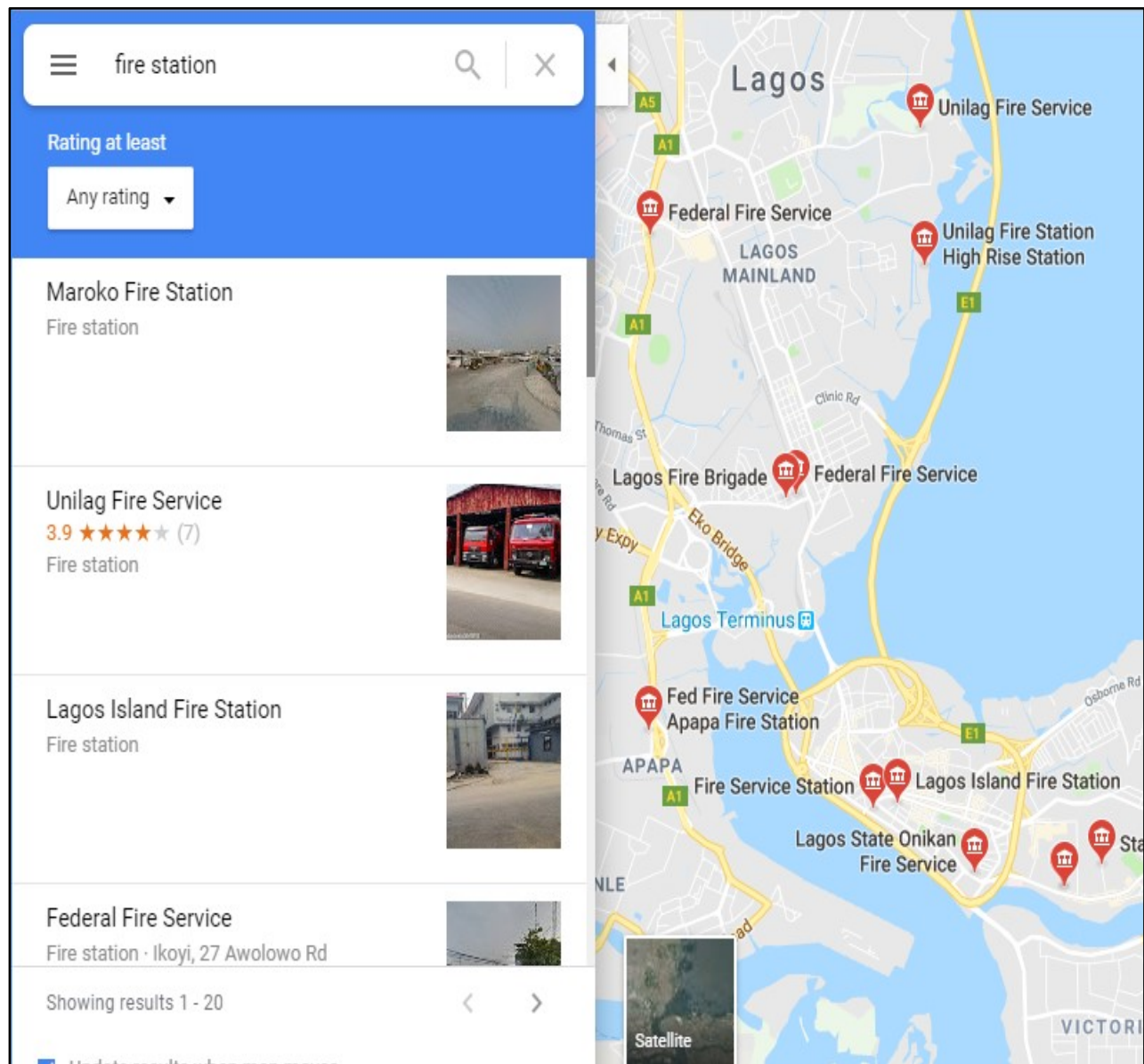


Figure 4: Sample Map Query of the Distribution of Police Stations in the study area

Source: Authors' Analysis (2019)

Using the search button on these maps' platforms, public hospitals, police stations, fire stations, shopping malls, cinemas, and theatres were inputted and their location on the maps could be easily obtained. To check for accuracy, live google earth feeds were used to check their location and environment together with official website check of these institutions to confirm their existence and functions. Figure 4 shows snapshot of web query of fire stations in the study area using google earth. Irrelevant results were filtered out of the

search results to ensure only the desired results were returned. After obtaining the location of the selected variables, they were interpolated on the income level map based using the Google Earth and Corel Draw X8 applications.

III. RESULTS AND DISCUSSIONS

Findings

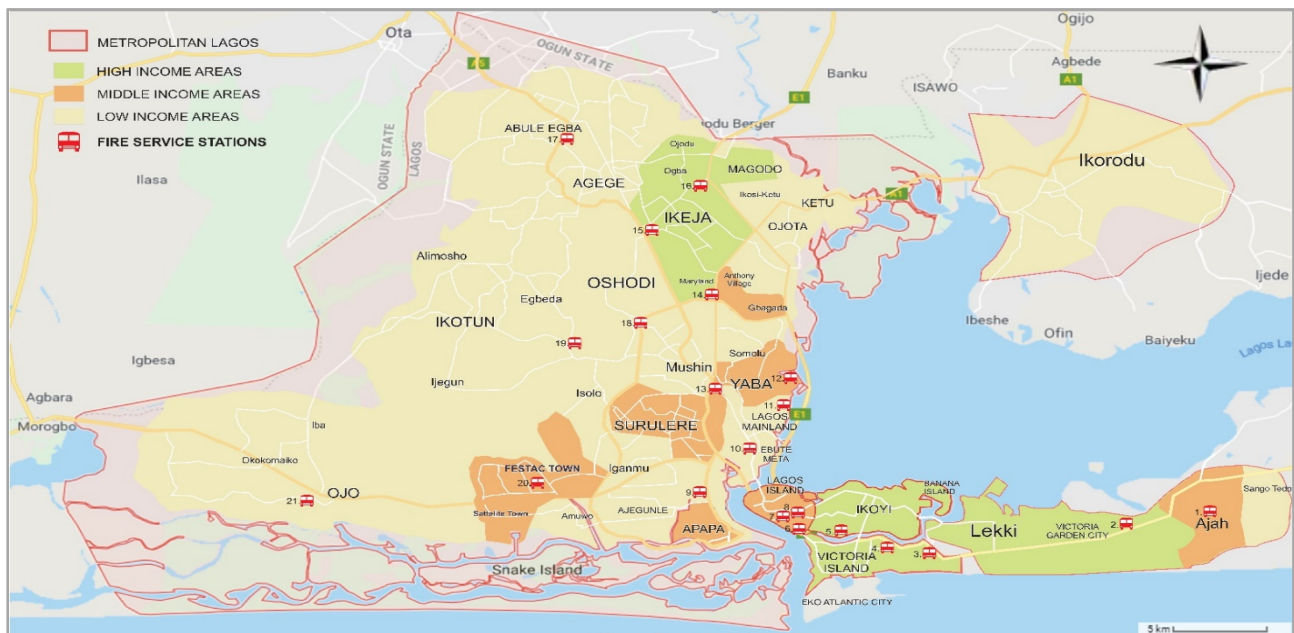


Figure 5: Map Showing the Distribution of Fire Stations in the Lagos Metropolis According to Catchment Areas

Source: Authors’ Analysis (2019)

Figure 5 shows the result of the map query of fire service stations located in the study area. The importance of an equitable distribution of fire services in a city like Lagos cannot be overemphasized. However, it was observed that

not all the catchment areas studied had fire service stations located in them.

Table 2: Map Query Result of Fire Service Stations in the Lagos Metropolis According to Catchment Areas

No.	Name of Fire Service Station	Catchment Area	No.	Name of Fire Service Station	Catchment Area	
1.	Lekki Phase 2 Fire Station	AJAH		NONE	KETU/OJOTA	
2.	Chevron Fire Station	LEKKI/VGC	17.	Agege Fire Station	AGEGE/ABULE EGBA	
3.	Maroko Fire Station	VICTORIA ISLAND	18.	Isolo Fire Station	OSHODI/MUSHIN/ISOLO	
4.	Victoria Island Fire Station		19.	Ejigbo Fire Station		
5.	Federal Fire Service	IKOYI	20.	Festac Fire Station	FESTAC/SATELLITE TOWN/AMUWO	
6.	Onikan Fire Station	LAGOS ISLAND	21.	Ojo Fire Station	OJO	
7.	Lagos Island Fire Station		NONE		NONE	IKOTUN
8.	Federal Fire Service		NONE		NONE	IKORODU
9.	Apapa Fire Station	APAPA				
	NONE	AJEGUNLE				
	NONE	IGANMU				
	NONE	SURULERE				
10.	Ebute Metta Fire Stations	EBUTE METTA/				
11.	UnilagHighRise Fire Station	LAGOS MAINLAND				
12.	Unilag Fire Station	YABA/				
13.	Yaba Fire Station	SOMOLU				
	NONE	GBAGADA/ ANTHONY VILLAGE				
14.	Illupeju Fire Station	IKEJA/MAGODO/ MARYLAND				
15.	Ikeja Fire Station					
16.	Alausa Fire Station					

Source: Authors’ Analysis (2019)

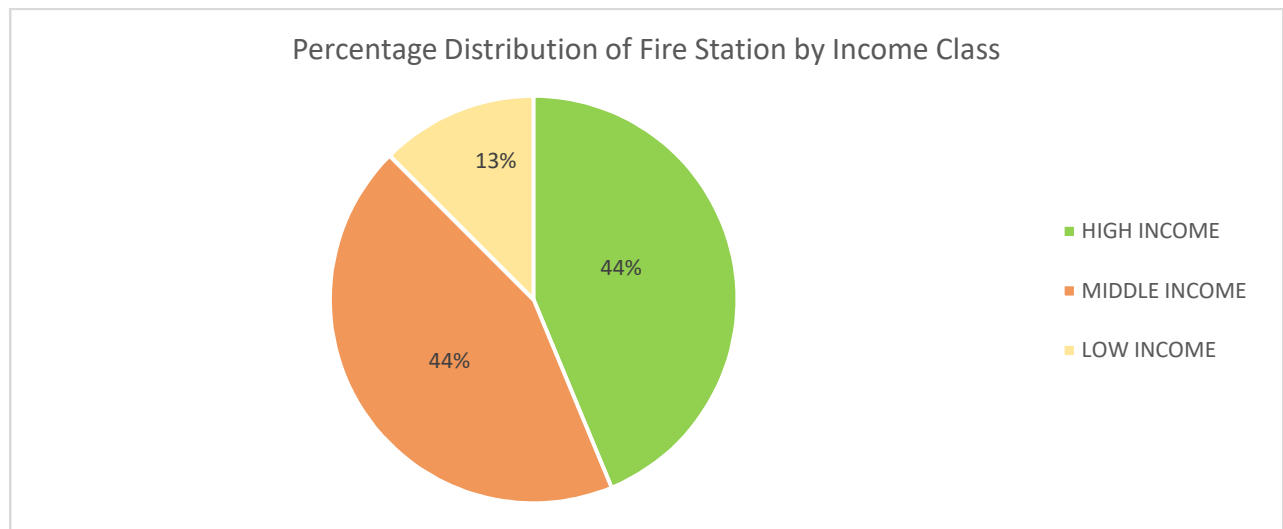


Figure 6: Pie-Chart Showing the Distribution of Fire Service Stations in the Lagos Metropolis According to Income Class

Source: Authors’ Analysis (2019)

From Table 2 and Figure 6, it can be noted that there is a disproportionate concentration of fire service station in well-off neighbourhoods. 88% of fire service stations located in the study area, are concentrated in high- and middle-income neighbourhoods. Low income catchment areas accounted for only 12% of the fire stations located in the study area. Lagos Island and Ikeja/Magodo/Maryland catchment areas had 3 fire stations each, while low income neighbourhoods such as Ikorodu, Ikotun, Ketu/Ojota, Iganmu and Ajegunle had none. This spatial inequality in the location of fire service in the study area, depicts a lack chronic lack in low-income communities in Lagos of adequate fire fighting services provided by the government. Neighbourhoods as remote as

Ikorodu and Ikotun lack fire fighting stations and would have to rely on neighbouring communities in case of emergencies. This is more troublesome, if the quality of the fire service stations is taken into consideration. Many of the available fire service stations located in the middle- and low-income catchment areas are ill-equipped, with some lacking basic equipment’s such as vehicles and water. Thus, providing insufficient for their catchment area and other areas that do not have a fire service station.

From the forgoing analysis, it can be deduced that the distribution of public facilities and urban services relates closely with the income class characteristics of the catchment areas.

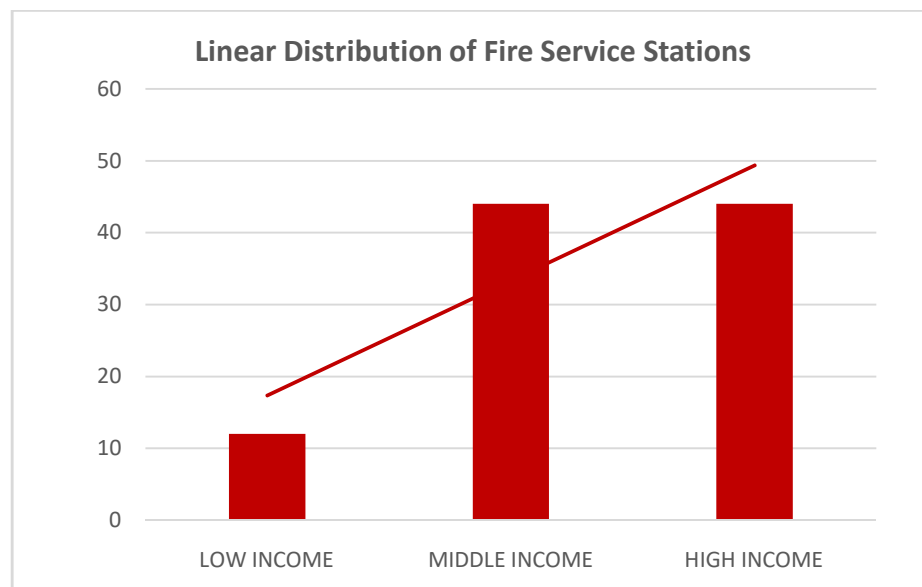


Figure 7: Chart Showing the Distribution of Fire Stations According to Income Class

Source: Authors’ Analysis (2019)

Figure 7 shows a significant relationship between the distribution of fire service stations across the catchment areas in the study area. The bar chart depicts a positive relationship between income and the availability of fire service stations in an area, with the trendline sloping upward from left to right. This shows that, the higher the income the higher the number of fire service stations available in a neighbourhood.

Furthermore, in determining the relationship between income class of the catchment areas (independent variable) and fire service stations (dependent variable), a correlation test was used to test the relationship and the result is shown in Table 3 below.

Table 7: Correlation Statistics between Income Class and Fire Station Distribution

<i>Variables</i>	<i>INCOME CLASS Correlation Coefficient</i>	<i>FIRE SERVICE Correlation Coefficient</i>
INCOME CLASS	1	0.80
FIRE SERVICE	0.80	1

Source: Authors' Analysis (2019)

On one hand, the correlation test shows a strong negative correlation between income class and distribution of fire stations (+0.80). As income class of the neighbourhood increased the number of fire stations increased. It thus can be deduced that, the concern for the wellbeing and safety of public infrastructure and life in a neighbourhood that government has, decreases as the affluence and the associated influence of neighbourhoods decreases. Similarly, fire services stations as with other public works and community services tend to locate in wealthy neighbourhoods because residents who live in these neighbourhoods are wealthier and pay more in tax and contributions that support fire departments, public works, community services, civic offices, etc. Equally, the location of fire stations in wealthier neighbourhoods in Lagos can be associated with the existence of a plethora of private estates that house both the wealthy and government officials. Poorer neighbourhoods seldom attract the attention of governments. In fact, when compared with the susceptibility of public infrastructure and life to fire disasters, the reality for low income areas is damning. Cases of arson and fire outbreak are more common in poor neighbourhoods than in the more affluent areas of the city. Crime as cynosures feature of these poor serviced neighbourhoods is rampant, and arson and burglary are common crimes that occur in these neighbourhoods. Looking at the spread and location of fire stations in Figure 5, one can observe clearly how inefficient the catchment distribution is. The distance between the fire stations and the major population centres in low income neighbourhoods are quiet far, resulting to loss of time in fire responses. Reported cases of fire outbreaks that were irredeemable, were due to poor fire service response, far distance from the fire hot spots and equally the unavailability of basic fire equipment like trucks, water tanks, and fuel.

IV. CONCLUSION AND RECOMMENDATIONS

The study has investigated the impact of spatial distribution of fire service stations. It has concluded that, the availability of fire stations varies with the income level of neighbourhoods in the city. In other words, neighbourhoods with an affluent resident population had more fire stations per square mile; while poorer neighbourhoods had fewer to none, all things been equal. A major obstacle to efficient fire response has been response time. This is usually associated with good road networks to transport fire service equipment to a fire outbreak faster. One problem being faced by the poorer neighbourhoods in Lagos is appalling nature of the road networks in these neighbourhoods. In some areas, they are non-existent and made up of mud tracks. Roads, when in good condition, are mainly concentrated in middle- to high income neighbourhoods. Therefore, it is of great necessity that government constructs better roads, in the low-income neighbourhoods that can supplement the location of fire stations in order protect and urban property. This will enhance general liveability across the entire city. When society is evenly serviced by public facilities, the improved standard of living of its citizens reduces crime rates which reduces government expenditure on renovation, reconstruction, or rehabilitation. Nevertheless, the purpose of government is to stabilize society, and as such the government must ensure that there is social justice in the location and distribution of public facilities.

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