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Analysis of socio-economic and housing characteristics In some selected slum area in Lagos State Metropolis, Nigeria using Geographical Information System

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Abstract

This study aims to evaluate the socio-economic and housing characteristic of residents in the slums of Lagos Metropolis. A multi-stage sampling method was used, whereby systematic and simple random sampling procedures were adopted. Data was collected using a valid questionnaire and face-to-face open interviews with household residents in Bariga, Oworonshoki, Makoko, and Iwaya slums. The obtained data were subjected to descriptive statistics using statistical package for social science version 20 and Geographical Information System based Multi-Criteria Decision Analysis. Results of the socio-economic characteristic of residents showed that 32.5 % had no formal education, out of which 39.5 % of the respondents were business persons while 77.0 % are in the low-income class. Housing characteristics revealed that 32.0 percent of the respondents were owner-occupier while 27.0 % are rental-tenant. About 30.0 percent of the houses occupied by most of the respondents were built from 1981 to 1995, and 30.5 percent had lived in the slum for more than ten years. Most of the respondents occupied one-room apartments (73.0 %), and about 58.5 % of houses are built with concrete. This study suggests that a comprehensive approach to slum upgrading is necessary by engaging local governments in partnership-based planning, community participation, and infrastructure improvement; this can be achieved by improving the security of tenure through regularization of land rights and improving the provision of basic services, incentives for community management, access to health, education and new housing areas should be built. Thus, the approach should be carried out to consider the needs and desires of the urban poor.

Keywords: Slums, Settlements, Socio-economic peculiarity, Housing, Urban planning, GIS.

1. Introduction

Housing is among the major determinants of a city structure that profoundly influences the community's health, efficiency, social behaviour, satisfaction, and general welfare (Omole, 2010). Furthermore, adequate shelter has always been the major consequential need for human existence (Oladapo, 2006). Hence, the provision of appropriate housing, especially for the urban poor, constitutes a major constraint to the growth of most African countries and developing nations at large (Lawanson, 2005). More so, in the sub-Sahara African region, countries are faced with the shortage of urban infrastructure deficiency, good housing, urban poverty, growing urban populations, and prevalence of informal housing practices (Habitat International Coalition, 2006). Omole (2010) notes that most of the housing conditions-related problems found most especially in Lagos, Nigeria, resulting largely from inadequately planned land use and non-secure land tenure, poor construction, weak development control, and cultural lifestyles of the inhabitants, and low level of socio-economic attributes.

Moreover, Cohen (2006) discovered that socio-economic factors affect societal organizations, such as the nature of work, demographic structures, people's lifestyles, and the choice better to understand the pattern and trends of urban change. Furthermore, International Housing Coalition (2007) reported that the urban population is escalating among the sub-Sahara African countries, whereby about 75 and 99 percent of urban residents in most African cities live in squalid slums of ramshackle housing. UN-Habitat (2003) ascertain that slum expansion is fuelled by an emulsion of rapid rural to- urban migration, spiraling urban poverty, the inability of the urban poor to access affordable land for housing, and insecure land tenure. However, Owoeye and Omole (2012) documented that the environmental conditions faced in slums manifest themselves in various forms such as overcrowding, the emergence of unsanitary housing, and the general deterioration in the environment's quality. World Bank (2008) reported that slums result from unrealistic regulatory frameworks and ill-conceived policies.

Slums are found to arise from failed policies, bad governance, corruption, inappropriate regulation, dysfunctional land markets, unresponsive financial systems, and a fundamental lack of political will (Chang, 2009). Although, cities are struggling to accommodate their rising

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populations and address the multidimensional challenges like infrastructure and urban sprawl developments (Soyinka et al., 2016). Hence, slumming conditions have become a global concern and one key factor driving rapid urbanization (Davis, 2004). United Nations Human Settlement Program (UNHSP, 2003) projected that the global number of slum dwellers would have increased to about two billion in the next thirty years. Rahman et al. (2010) reported that the poor's environmental conditions lead to the decay of inner cities and the growth of shantytowns, especially in the peri-urban areas. These living conditions in slums are usually unhygienic and contrary to all planned urban growth norms. They are vulnerable to all forms of pollutions such as air pollution, noise pollution, traffic congestion, and surface water pollution. Therefore, this study examines residents' socio-economic attributes and housing characteristics around slum settlements within Lagos metropolis to determine the contributing factors responsible for poor environmental conditions in the slums.

2. Materials and Methods

2.1. Study Area

The study was carried out in four selected slums within Lagos Metropolis, Nigeria, around Longitudes 3 ̊249 'E and latitudes 6 ̊279 'N with a coastline of approximately 180 km (Odunuga et al., 2012). The state has a total land area of 3577.28 km2, out of which 22 percent is wetland and a population density of approximately 5926 persons per km2 (Oshodi, 2013). Lagos state population is estimated to be 24.5 million in 2015 (UNHSP, 2003) and 29 million by 2020 (Lagos Water Corporation, 2011), with a growth rate of 3.2 and 8 percent (World Bank, 2013). The state's geology consists of coastal plain sands and a tidal flat with alluvium (BRNCC, 2012), while vegetation is a tropical rainforest zone, consisting of mangrove swamps, freshwater swamps, lagoons, and creeks. Relief occupies a low-lying topography of 1– 4 % slope, an elevation of 0–2 m above sea level (Awosika et al., 2000) represented by the dendritic drainage system of river Ogun, Adiyan, and Ossa (Idowu and Martins, 2007). The state is ranked 15th globally in terms of the population vulnerable to coastal flooding because over 70 percent of its population live in unplanned settlements such as slums (Adelekan, 2010), this is not surprising as only 45.2 percent of its built-up areas are connected with drains (Nwigwe and Emberga, 2014), and only less than 30 percent of the existing drains are maintained (Aderogba, 2012). There is two distinct climatic seasons experience in the state; dry and wet (rainy). It also experiences high air temperatures ranging from 30.0 ˚C to 38.0 ˚C (Adejuwon, 2004). Figure 1 presents the map of the study area indicating the sample locations.

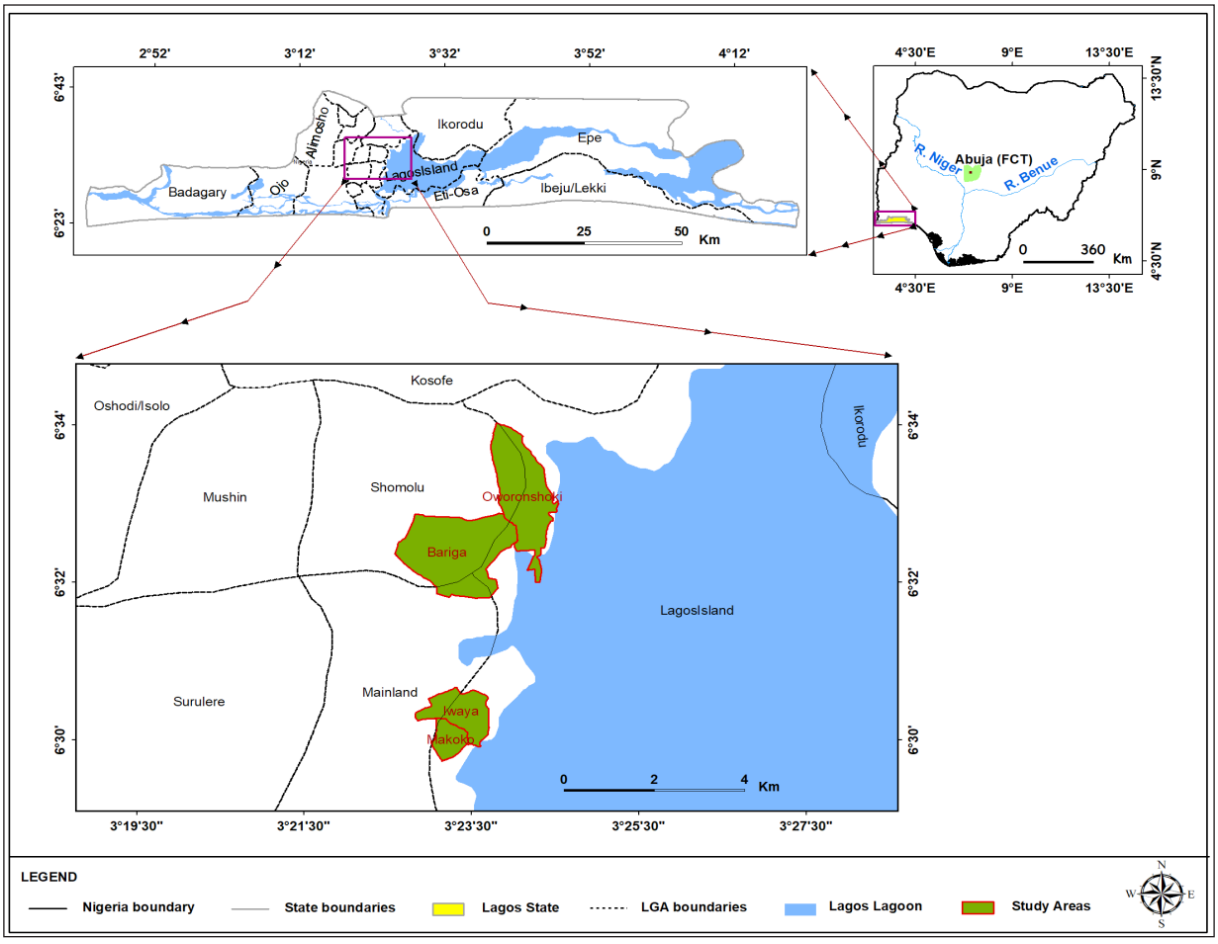

Figure 1. Location map of the study area.

2.2. Research Approach and Design

Primary and secondary data were used. Primary data were derived from a field survey of the slum settlement. In contrast, secondary data includes relevant literature such as books and journals, internet materials, land use maps of the study area, documents from community participation, and government agencies.

2.3. Sampling Location

A total of four selected slum settlements were designated for this study in the Lagos metropolis. These slums were randomly selected from the list of slum settlement identified by officials of the Lagos state environmental protection agency (LSEPA) after excluding settlement that is not closed to the coastal area. The aim is to target slums that are located close to the coastal area. The names of the slums are Bariga, Oworoshoki, Makoko, and Iwaya.

2.4. Survey

A multi-stage sampling procedure was employed in selecting the study area. A descriptive survey design was also adopted because it allows the establishment of unique characteristics of the inhabitants and developing a detailed picture and intensive knowledge of the study area. More so, a reconnaissance survey of the study area was also carried out. A systematic sampling method was used in selecting the houses; the first house was randomly selected and the subsequent house at an interval of the fifth house. Simple random sampling was used in selecting a household head. In a situation where the household head was not available, the wife or a grown-up child was chosen.

Moreover, this field survey study was designed and administrated to different slums located around the Lagos metropolis' coastal areas. The questionnaire was pre-tested to assure reliability and validity issues. Hence, a pilot survey was conducted in early July 2015 because it provides useful information regarding the study in processes, resource management, and scientific evidence (Van Teijlingen et al., 2001). Hill (1998) also suggested 10 to 30 participants for pilots in survey research. Therefore, this study makes use of 10 to 40 participants by using the formula stipulated by Berenson et al. (2006);

$$n = \frac{Z2\ XS2}{D2}$$

n = is the minimum sample size

z = is the value of the distribution function (for normal distribution z = 1.96 while for alpha = 0.05)

s = is the population standard deviation

d = is the acceptable standard error of the mean (the standard error of the mean is estimated as the sample standard deviation divided by the square root of the sample size).

Furthermore, the preliminary fieldwork conducted also sought the household's agreement to participate in the study. Trained interviewers visited more than 250 individual households and obtained the necessary information from a responsible adult. Two hundred (200) households out of the original list of 280 agreed to participate in the survey representing a response rate of 71.4 %. Seventy households out of 280 who agreed to participate were chosen from each slum location in Lagos metropolis. They were provided with questionnaires containing detailed questions about residents' socio-economic characteristics, physical characteristics of residential buildings, and the availability of basic amenities.

This sample size (70 households out of the total 280 households) gives a 95 % confidence level with a margin of error of 5 % using the formula suggested by Cochran (1963);

$$\text{Sample size} = \frac{Distributionof\ 50\ \%}{\frac{((MarginofError\ \%)Squared}{\square}{ConfidenceLevelScore)Squared}}$$

Finite Population Correction:

$$\text{True Sample} = \frac{SamplesizexPopulation}{Samplesize(Population-1)Squared}$$

Population = 1,000

$$\text{Sample size} = \frac{0.5\ x\ (1-0.5\ ))}{\frac{((0.05)2}{\square}{(1.96)2}}$$

$$\text{Sample size} = \frac{0.25}{((0.025512)2}$$

$$\text{Sample size} = \frac{0.25}{((0.00065077)2}$$

Sample size = 384.16

$$\text{True Sample} = \frac{384.16\ x\ 1000}{384.16\ +1000-1}$$

$$\text{True Sample} = \frac{384160.3024}{1383.1603}$$

True Sample = 277.7409 (True sample size was rounded up to the nearest whole number).

Table 1. Sampling source and population Estimation.

Slum locations	Estimation of population	Pilot survey	Total number of questionnaire per location
Bariga	250	10	70
Oworoshoki	250	10	70
Makoko	250	10	70
Iwaya	250	10	70
Total	1,000	40	280

More so, the true sample size was rounded up to 278, but in other to get an equal number of questionnaires per location, 70 questionnaires were distributed. However, the survey was conducted for six months: the month of October to March from 2015 to 2016. Coordinates were recorded at each sampling site using the Garmin GPS device (GPSMAP 76CSX model).

2.5. Statistical Analysis

The data obtained were subjected to descriptive analyses (frequency, percentage, and chart) using the social sciences statistical package (SPSS version 20.1). The advanced analysis employed in this study is Geographical Information System

(GIS) based Multi-Criteria Decision Analysis (MCDA) Arc Map 10.1 to analyze the questionnaire's information and produce a spatial analysis of the study area.

2.6. Spatial Analysis of the Study Area Using Multi-Criteria Analysis (MCA) in GIS

The methodology used in data collection (Figure 2) incorporated those of Abbot (2000); Karanja (2010), and Tyler (2011), whereby data collected consist of two main parts: capturing the social information from the communities using a questionnaire and capturing the spatial information using GIS. Households were interviewed across the settlement while social information was subsequently recorded in a spreadsheet. The spatial information was derived from satellite imagery of the settlement, sourced from the global land cover facility (GLCF), and questionnaire data were integrated into GIS software for the evaluation. Ascertaining the key issues of low-income settlements based on measurements includes using the following:

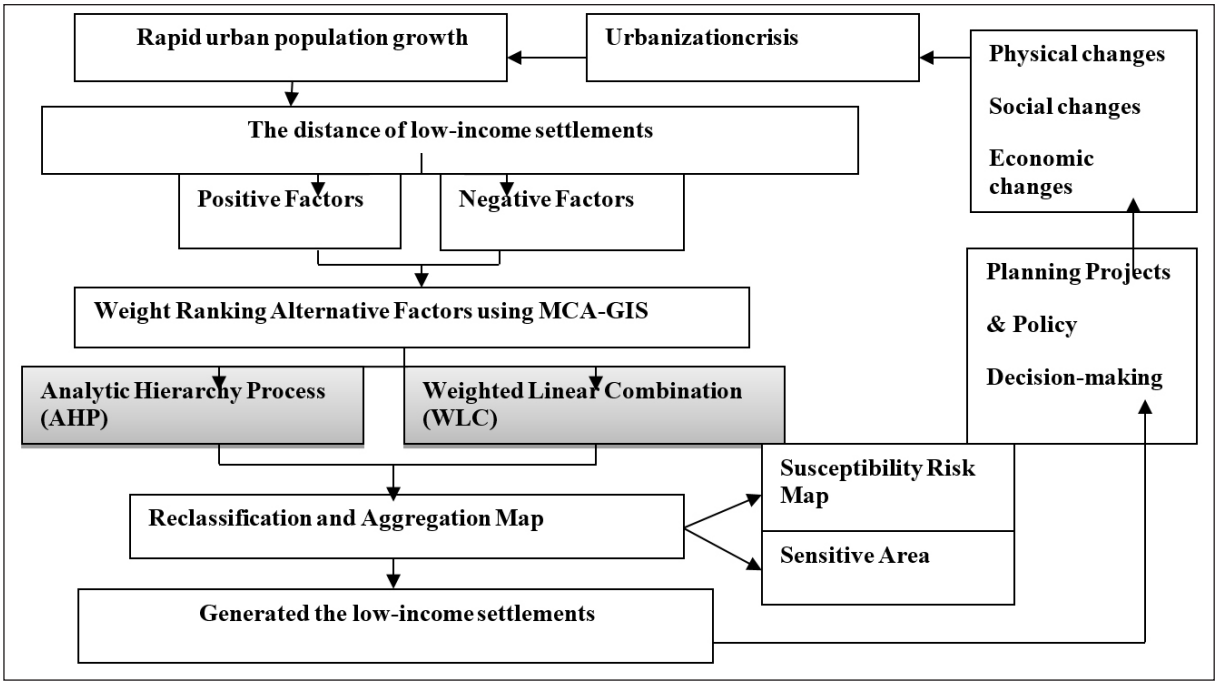

Figure 2. GIS-based spatial decision-making procedures (Shummadtayar et al., 2013).

2.6.1. Analytical Hierarchy Process (AHP)

For measuring individual participant data, Saaty (1977) reported that the AHP could be derived by taking the principal eigenvector of a square reciprocal matrix of pair-wise comparisons between the criteria and dealing with the relative importance of the two criteria involved in determining suitability for an individual with the size of areas recommended for prioritization (Malczewski, 1999).

2.6.2. Weighted Linear Combination (WLC)

Measures the different scales so that all factor maps will be positively correlated with suitability (Figure 2). A linear scaling method was applied, typically using the minimum and maximum values as scaling points for standardization. Factors were combined, followed by a summation of the results to yield a suitability map (Anagnostopoulos, 2009).

3. Results and Discussion

3.1. Socio-Economic Characteristics of Residents

The respondents' socio-demographic characteristics (Table 2) showed that gender (female) were 54.0; 58.0; 60.0, and 56.0 % for Bariga, Oworoshoki, Makoko and Iwaya, respectively. And about 46.0 % (Bariga), 42.0 % (Oworoshoki), 40.0 % (Makoko), and 44.0 % (Iwaya) accounts for male gender across the slums. The high values recorded for females across the slums could be attributed to the assertion that men have the right to marry more than one wife, making females dominant in the settlement.Marital status of the respondents revealed that 52.0; 52.0; 34.0 and 36.0 (Bariga, Oworoshoki, Makoko, Iwaya) percent were still single and about (Bariga) 20.0 %, (Oworoshoki) 28.0 %, (Makoko) 44.0 % and (Iwaya) 48.0 % were married while others 28.0; 20.0; 22.0 and 16.0 percent were either widow or widower. Hence, most of the respondents who are still single could be due to the living conditions because even the married ones among the respondents are complaining about their poor marriage life and how they could not afford two square meals per day.

The educational level of the respondents depicts that 20.0 % (Bariga), 12.0 % (Oworoshoki), 62.0 % (Makoko), and 28.0 % (Iwaya) had no formal education, which means that they cannot read or write. About 38.0; 54.0; 4.0; and 26.0 percent (Bariga, Oworoshoki, Makoko and Iwaya) attended tertiary institution and 8.0; 14.0; 30.0; and 28.0 percent had primary education certificate while 34.0 % (Bariga), 20.0 % (Oworoshoki), 4.0 % (Makoko) and 18.0 % (Iwaya) stopped at the secondary school education. The implication of the low level of education of the people in the area weakens the importance of a healthy environment whereby the majority of the respondents are poor, and their low monthly income depicts a high level of poverty among the respondents (Ayoola and Amole, 2014). Therefore, it can be deduced that residents in the slum area will be living below the minimum environmental standards

Common occupations of the respondent are businessmen and women (20.0; 22.0; 8.0 and 32.0 %) at Bariga, Oworoshoki, Makoko and Iwaya respectively; apart from the civil servant that constituted 42.0 % (Bariga), 46.0 % (Oworoshoki), 6.0 % (Makoko) and 16.0 % (Iwaya). About 36.0; 26.0; 4.0 and 30.0 percent were student while 2.0 %, 6.0 %, 10.0 % and 22.0 % are pensioner, this shows that the occupational and income distributions are closely related. Hence, the nature of occupation determines their level of income. More so, occupation characteristics portray the settlements as typical slum emerging areas with sprout growth from rural-urban migration.

Concerning the monthly income range, respondents in Bariga (64.0 %), Oworoshoki (76.0 %), Makoko (82.0 %), and Iwaya (86.0 %) were within the low-income range, and about 32.0; 24.0; 18.0 and 14.0 percent were in the middle-income range while only 4.0 % (Bariga) of the respondents can boost of being in the high-income range (Table 2). This study shows that the poorer residents are the low-income earner, so they prefer staying in the slum area because of cheaper livelihood. Lawanson and Olanrewaju (2012) also documented that about 70 % of the 17 million Lagos metropolis residents are considered poor and can only survive by participating in informal activities.

Table 2. Socio-Economic Characteristics.

Demographic Characteristics	Bariga		Oworonshoki		Makoko		Iwaya		Total Freq	Total (%)
	Freq	%	Freq	%	Freq	%	Freq	%		
Gender										
Male	23	46.0	21	42.0	20	40.0	22	44.0	86	43
Female	27	54.0	29	58.0	30	60.0	28	56.0	114	57
Marital Status										
Single	26	52.0	26	52.0	17	34.0	18	36.0	87	43.5
Married	10	20.0	14	28.0	22	44.0	24	48.0	70	35
Others	14	28.0	10	20.0	15	22.0	8	16.0	43	21.5
Educational Level										
No Formal Education	10	20.0	10	12.0	31	62.0	14	28.0	65	32.5
Primary Education	4	8.0	7	14.0	15	30.0	14	28.0	40	20
Secondary Education	17	34.0	10	20.0	2	4.0	9	18.0	38	19
Tertiary Institution	19	38.0	23	54.0	2	4.0	13	26.0	57	28.5
Occupation of Respondents										
Businessperson	10	20.0	13	22.0	4	8.0	16	32.0	79	39.5
Civil Servant	21	42.0	23	46.0	3	6.0	8	16.0	55	27.5
Student	18	36.0	11	26.0	2	4.0	15	30.0	46	23
Pensioner	1	2.0	3	6.0	5	10.0	11	22.0	20	10
Monthly Income Range										
Low	32	64.0	38	76.0	41	82.0	43	86.0	154	77
Middle	16	32.0	12	24.0	9	18.0	7	14.0	44	22
High	2	4.0	-	-	-	-	-	-	2	1

Source: Field Work, Lagos Metropolis slums 2015/2016.

3.2. Residential Building Characteristics

Figure 3a shows that about 32; 14; 31, and 23 percent of the respondents in Bariga, Oworoshoki, Makoko, and Iwaya were owner-occupier. The values recorded for owner-occupier tenancy status are not surprising because most of the respondents occupy land space without land tenure certification to erect buildings and structures.

The common tenancy status among the respondent (Figure 3b) is the rental tenant accounting for 24 % (Bariga), 27 % (Oworoshoki), 25 % (Makoko), and 24 % (Iwaya), respectively. The findings from this study confirm the assertion reported by the FNG-National Housing Policy (2004) that the most predominant form of tenure in many Nigerian cities is rental accommodation, providing over ninety percent of the country's housing sector (Olanrewaju, 1997). Hence, Ogunleye (2011) also ascertained that a significant proportion of low-income people in developing world cities live in rental housing.

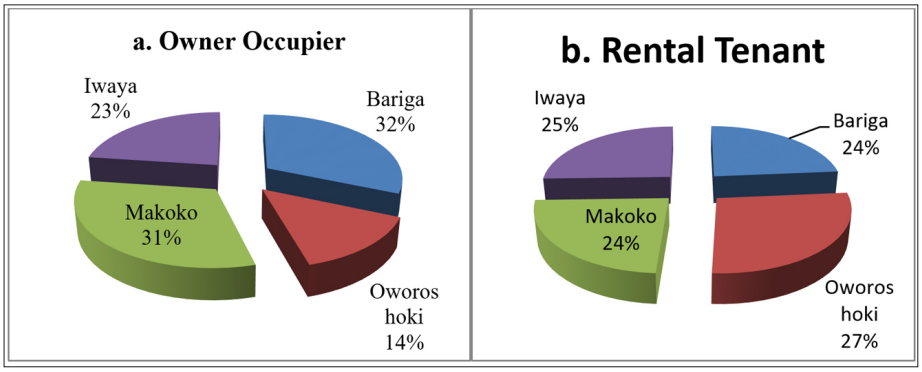

Figure 3 a. Owner-occupier tenancy status. b. Rental-tenant tenancy status.
Source: Field Work, Lagos Metropolis slums 2015/2016

The age of most building occupied. showed in Table 3 revealed that 2.0; 6.0; 14.0, and 18.0 percent of the buildings were built from 1960 to 1976 in Bariga, Oworoshoki, Makoko, and Iwaya, respectively. Hence, 24.0 %, 10.0 %, 36.0 % and 26.0 % of the houses were constructed from 1977 to 1980, followed by 2.0 % (Bariga), 48.0 % (Oworoshoki), 38.0 % (Makoko) and 32.0 % (Iwaya) built from 1981 to 1995. About 34.0 % (Bariga) of the houses are built from 1996 to 2010, and 38.0; 36.0; 12.0, and 24.0 percent were erected from 2011 up to date. These signify that buildings increase in the slum settlement, which gives rise to poor environmental conditions in the slum.

Concerning the duration of occupancy, 16.0; 12.0; 18.0 and 18.0 percent of respondents reported that they have lived in the slum for 1 to 4 years and about 6.0 % (Bariga), 28.0 % (Oworoshoki), 36.0 % (Makoko), and 22.0 % (Iwaya) revealed that they had stayed in the slum for 5 to 7 years. Although 28.0; 20.0; 42.0, and 32.0 percent had lived for about 8 to 10 years, followed by those who lived for 11 to 15 years (22.0; 22.0 and 14.0 %) respectively. Hence, most of the respondents in Bariga (28.0 %), Oworoshoki (8.0 %), Makoko (20.0 %), and Iwaya (8.0 %) had lived in the slum for 16 years and above. These results revealed that the populations of the slum dwellers are increasing daily due to rural-urban migration.

Most of the respondents' common accommodation unit is squatting with friends and families, which constitute 6.0 %, 10.0 %, 2.0 %, and 4.0 % (Bariga, Oworoshoki, Makoko, and Iwaya), respectively. About 42.0; 64.0; 96.0 and 90.0 percent occupied one-room apartment. More so, 30.0 %, 12.0 %, 2.0 % and 4.0 % of the respondents occupied two rooms apartment. Hence, 16.0 % (Bariga), 10.0 % (Oworoshoki) and 2.0 % (Iwaya) are occupying three room's apartment while 6.0 % (Bariga) and 4.0 % (Oworoshoki) occupied four rooms apartment (Table 3). Generally, most slum dwellers are in the low-income range, which corroborates with the assertion that they cannot afford a comfortable apartment. NBS (2009) reported that the Nigerian Government Urban Survey in 1970 shows that 70 % of Lagos households lived in one-room housing units. By 2007 the figure had marginally risen to 72.3 percent.

Table 3. Physical Characteristics of Buildings.

Physical Characteristics of Buildings	Bariga		Oworonshoki		Makoko		Iwaya		Total Freq	Total (%)
	Freq	%	Freq	%	Freq	%	Freq	%		
Age of Building Occupied										
1960-1976	1	2.0	3	6.0	7	14.0	9	18.0	20	10
1977-1980	12	24.0	5	10.0	18	36.0	13	26.0	48	24
1981-1995	1	2.0	24	48.0	19	38.0	16	32.0	60	30
1996-2010	17	34.0	-	-	-	-	-	-	17	8.5
2011 till date	19	38.0	18	36.0	6	12.0	12	24.0	55	27.5
Duration of Occupancy										
1-4yrs	8	16.0	6	12.0	9	18.0	9	18.0	32	16
5-7yrs	3	6.0	14	28.0	18	36.0	11	22.0	46	23
8-10yrs	14	28.0	10	20.0	21	42.0	16	32.0	61	30.5
11-15yrs	11	22.0	11	22.0	-	-	7	14.0	29	14.5
16yrs and above	14	28.0	4	8.0	10	20.0	4	8.0	32	16
Accommodation Unit Occupied										
Squatting	3	6.0	5	10.0	1	2.0	2	4.0	11	5.5
One-room apartment	21	42.0	32	64.0	48	96.0	45	90.0	146	73
Two rooms apartment	15	30.0	6	12.0	1	2.0	2	4.0	24	12
Three rooms apartment	8	16.0	5	10.0	-	-	1	2.0	14	7
Four rooms apartment	3	6.0	2	4.0	-	-	-	-	5	2.5

Source: Field Work, Lagos Metropolis slums 2015/2016.

Figure 4 shows that most respondents' buildings are block and cemented surface (36 and 18%) for Makoko and Iwaya, respectively. About 72 (Bariga), 72 (Oworoshoki), 16 (Makoko), and 74 (Iwaya) percent occupied buildings built with concrete. Hence, 28%, 28%, 30%, and 8% of the respondents occupied mud and cemented surface buildings while only 18% (Makoko) stayed in wooden and board steel surface buildings. This study's findings corroborate with Olotuah (2005), who reported that 75% of the dwelling unit in Nigeria's urban centres are substandard, and the dwellings are sited in slum areas.

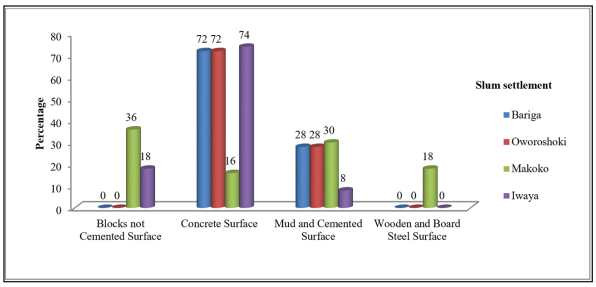

Figure 4. Types of buildings occupied by the respondents.
Source: Field Work, Lagos Metropolis slums 2015/2016.

Household size of most respondent showed in Figure 5 revealed that 26 (Bariga), 32 (Oworoshoki), 4 (Makoko), and 34 (Iwaya) percent accounts for 1 to 2 persons per room and about 6; 14; 2; and 14 percent accounted for 3 to 4 persons per room. Hence, 48 %; 36 %; 40 %, and 36 % for Bariga, Oworoshoki, Makoko, and Iwaya consist of 5 to 8 persons per room while 20; 18; 54 and 16 percent constitutes nine persons and above per room. This study's results conform with Oshodi (2010), who reported that living conditions are worse among poor households living in informal settlements with an occupancy ratio of 8 to 10 persons per room.

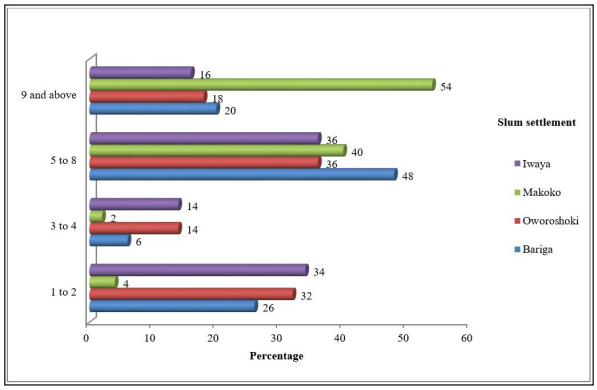

Figure 5. The household size of the respondents.
Source: Field Work, Lagos Metropolis slums 2015/2016

3.3. Availability of Basic Amenities

Table 4 shows that electricity availability in the slum settlement accounted for 100% (Bariga), 100% (Oworoshoki), 100% (Makoko), and 96% (Iwaya), respectively, while only 4.0 % (Iwaya) of the respondents complained of unavailability of electricity. Hence, 60.0; 58.0; 70.0 and 74.0 percent of the respondents had access to toilet facilities, while 40.0%, 42.0%, 30.0%, and 26.0% (Bariga, Oworoshoki, Makoko, and Iwaya) do not have toilet facilities in their houses, this implies that the respondents who do not have access to toilet facilities make use of public toilets. Most of the respondents (22.0; 32.0; 86.0 and 70.0%) in Bariga, Oworoshoki, Makoko, and Iwaya do not have waste disposal methods; they usually dump their generated waste in an open dump while 78.0%; 68.0%; 14.0%, and 30.0% of the respondent had access to waste disposal methods whereby they dump their generated waste inside a pit before burying the waste. This finding also conforms with Ackleman and Anderson (2008), who documented that basic infrastructures' unavailability causes widespread environmental damages.

Table 4. Basic Amenities Availability.

Availability of Amenities	Bariga		Oworonshoki		Makoko		Iwaya		Total Freq	Total (%)
	Freq	%	Freq	%	Freq	%	Freq	%		
Electricity										
No	-	-	-	-	-	-	2	4.0	2	1
Yes	50	100.0	50	100.0	50	100.0	48	96.0	198	99
Toilet facilities										
No	20	40.0	21	42.0	15	30.0	13	26.0	69	34.5
Yes	30	60.0	29	58.0	35	70.0	37	74.0	131	65.5
Waste disposal method										
No	11	22.0	16	32.0	43	86.0	35	70.0	105	52.5
Yes	39	78.0	34	68.0	7	14.0	15	30.0	95	47.5

Source: Field Work, Lagos Metropolis slums 2015/2016.

Figure 6 depicts the medium of water provision across the study area. Private water provision constitutes about 60; 42; 18 and 26 percent for Bariga, Oworoshoki, Makoko, and Iwaya, respectively, while 22 %; 16 %; 42 %, and 24 % accounts for public-private provision, this means that the residents contributes money in constructing central borehole for the community. Hence, government water provision consists of 18 % (Bariga), 42 % (Oworoshoki), 40 % (Makoko) and 50 % (Iwaya) respectively. The implication of this is that most of the respondents use the water provided by the government. The results from this study corroborate with the United Nations (2010). Who reported that a sustainable water supply is increasingly difficult in urban areas due to population growth and urbanization, poor management, and ageing infrastructure.

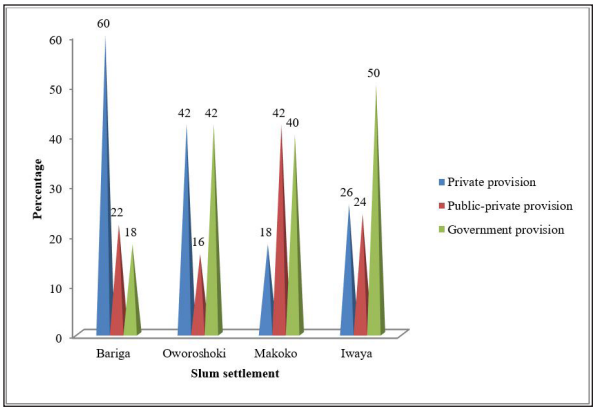

Figure 6. The medium of water provision in the study area. Source: Field Work, Lagos Metropolis slums 2015/2016.

The cooking methods shown in Figure 7 revealed that 22; 4; 6, and 22 percent of the respondents in Bariga, Oworoshoki, Makoko, and Iwaya use fuelwood for cooking because they believe it is cheaper than gas or kerosene. This result agrees with Gwatkin et al. (2000), who reported that people using and exposed to fuelwood are higher in South Western Nigeria's low-income settlement. About 16%; 16%; 54%, and 26 % use coal for cooking, which is the most common cooking method among the slum dwellers. Although 20% (Bariga), 46% (Oworoshoki), 16% (Makoko) and 40% (Iwaya) uses kerosene stove for cooking. Thus, the respondent reported that the kerosene stove is affordable and economical. Hence, 2; 18; 18 and 6 percent of the respondents use electric stoves once electricity is available Hence 40%, 16%, 6%, and 6% (Bariga, Oworoshoki, Makoko, and Iwaya) uses gas stove for cooking. Although most of the respondents reported that it is expensive to maintain, but it aids fast cooking. The findings from this study conforms with Olufemi et al. (2012), who ascertained that urban areas, especially the low-income settlement, use multiple cooking methods than the rural areas.

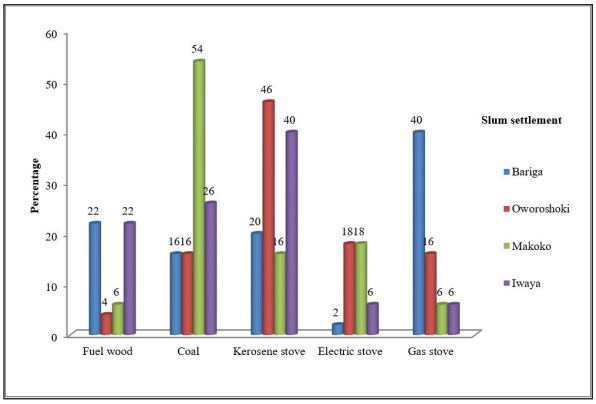

Figure 7. Methods of cooking of the respondents. Source: Field Work, Lagos Metropolis slums 2015/2016.

Figure 8 shows the means of transportation around the study area. Hence, 18 percent of the respondents in Makoko make use of canoe as means of transportation, and about 12 % (Bariga), 22 % (Oworoshoki), 60 % (Makoko), and 44 % (Iwaya) use the footpath. However, 12; 22 and 18 percent of the respondents use motorcycles while 38 %, 34 %, and 38 % use commercial buses. Hence, 50 and 32 percent of the respondents in Bariga and Oworoshoki use tricycles popularly known as Keke Napep. These findings could be attributed to the assertion that low-income dwellers are faced with a high level of poverty. More so, Samuel and Silvester (2002) reported that the cost of urban infrastructure and services (transport and others) has become unaffordable to most urban slum dwellers due to widespread poverty and low-income levels.

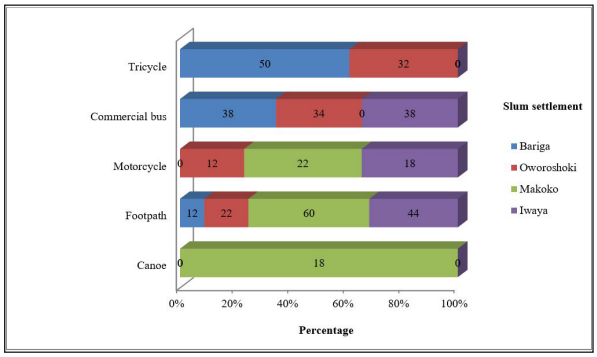

Figure 8. Means of transportation of respondents. Source: Field Work, Lagos Metropolis slums 2015/2016.

4. Spatial Analysis of the Study Area Using Multi-Criteria Analysis (MCA)

4.1. False Composite Colour (FCC) and Classified Image Of 1984

Figure 9a depicts the False composite colour image of 1984. The classification used for the map was the bare ground represented by grey colour and the built-up area represented by the red colour. In contrast, the blue colour represents the water bodies. Thus, as in the period (1984), the rate of urbanization is at the lowest peak.

Figure 9b shows the classified image of 1984. Hence, the different land cover and land use types used for the map classifications were vegetation/wetland, which represents the green colour, the built-up area represents the grey colour. In contrast, water bodies represent the blue colour. Generally, as of this period, the urban areas have started witnessing an increase in development; this confirms the assertion made by Shummadtayar (2013), who reported that spatial analysis provides representative information about settlement natural and human-made features.

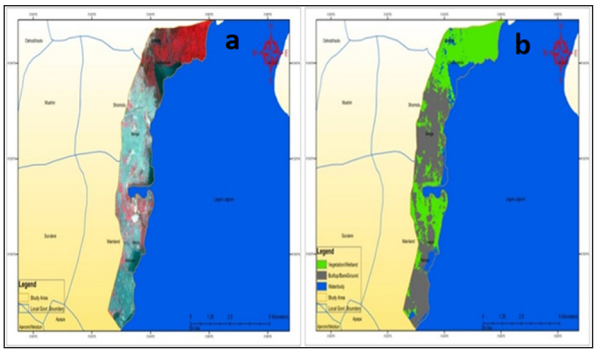

Figure 9. a. False composite image of 1984. b. Classified image of 1984. Source: Field Work, Lagos Metropolis slums 2015/2016.

4.2. False Composite Colour (FCC) and Classified Image Of 2014

The false composite color image of 2014 showed in Figure 10a revealed that the urbanization process takes a higher dimension, whereby most urban areas are witnessing changes in land use and land cover types. Hence, the bare ground represents the grey colour, and the red colour represented the built-up area, while the blue colour represents the water bodies on the map. Figure 10b shows the classified image of 2014. The vegetation/wetland is represented by green color. The built-up area represents grey color, while water bodies represent a blue color on the map.

Most importantly, as at this period, there is an increase in a built-up area with buildings extending towards the lagoon and several changes due to urban city expansion processes and the quest for development. Similarly, researches have shown that multi-criteria analysis is good for the decision-making process. These confirm the assertion stipulated by Temiz and Tecim (2009). They reported the combined use of GIS and multi-criteria decision methods (MCDM) for forestry management in Izmir, Turkey, which allows forest managers to visualize solutions proposed by MCDM and better understand the problem they confront in the study area.

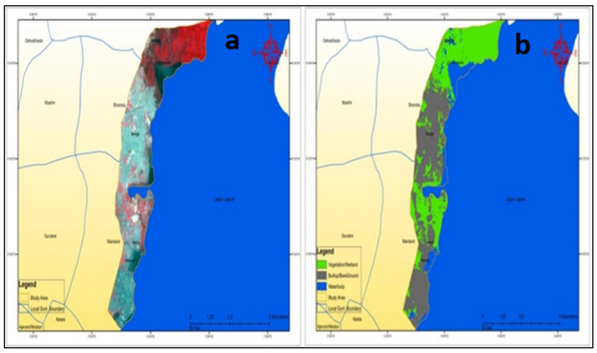

Figure 10. a. False composite image of 2014. b. The classified image of 2014. Source: Field Work, Lagos Metropolis slums 2015/2016.

4.3.1. Socio-Economic Characteristics of Residents Survey

Figure 11a shows that few of the respondents belong to the high-income earners in Bariga. In contrast, most of the respondents are still on the moderate-income level across the study area, represented with green colour on the map. In contrast, the other areas of Makoko, Iwaya, Bariga, and Oworoshoki, represented with red colour belong to the low-income earners; this implies that people prefer to live in slum settlements with a cheaper and affordable livelihood.

Figure 11b depicts that Makoko and Bariga settlements are faced with poor underdeveloped slums while Iwaya and Oworoshoki are among the poorest slum settlements in this study. Although few parts of Bariga had a little developed area, most of the slum settlements in this study need government intervention by partnering with the private sector to upgrade the settlement. More so, there is a notion that multi-criteria analysis is suitable for urban susceptibility environmental criteria used in evaluating and eliminating long-term effects of the informal settlement. Hence, thus conforms with Liu et al. (2007), who carried out a study using these methods by integrating GIS and multi-criteria analysis in the Hanyang lake area located in Wuhan city China where a comprehensive method is used in analyzing the suitability of future land use according to specified requirements, preferences, and predictions that were uncovered in Liu et al., 2007 research work.

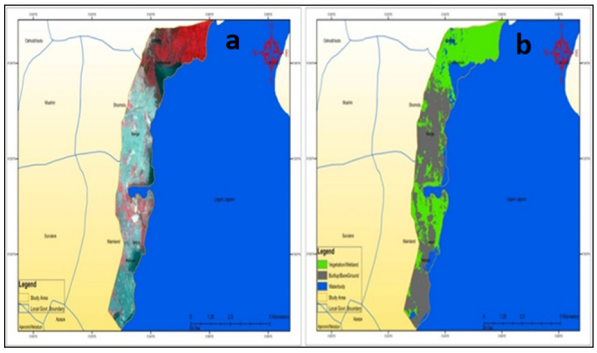

Figure 11. a. Monthly income range. b. Undeveloped areas. Source: Field Work, Lagos Metropolis slums 2015/2016.

4.3.2. Residential Building Characteristics Survey

Building types shown in Figure 12a revealed that Iwaya and Bariga had more cemented surface buildings than the other slum settlement. In contrast, block and cemented surface buildings are found across the study area. The mud buildings are found in Makoko, Iwaya, Bariga, and Oworoshoki, respectively. Generally, the building types found across the slum settlement are of substandard quality due to the poor living standard among the slum dwellers.

Figure 12b shows that the house structures are of low quality across the study area marked with yellow colour on the map. The green colour represents areas with moderate housing structures in Makoko, Iwaya, Bariga, and Oworoshoki respectively is still part of the sentence before adding full-stop. this means that most of the houses had little availability of basic amenities. Hence, the areas that are represented with red colour signify areas with high quality of housing structure. The high level of poor housing quality could be attributed to the lack of security of tenure.

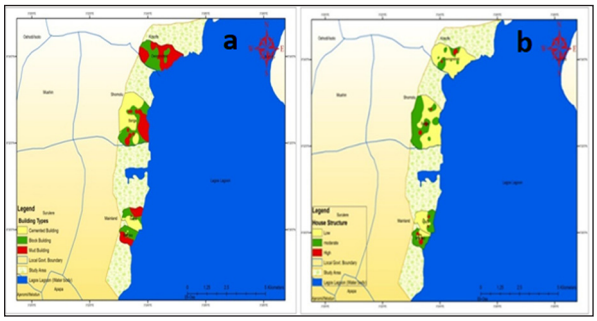

Figure 12. Figure 12. a. Building types. b. House structures. Source: Field Work, Lagos Metropolis slums 2015/2016.

5. Conclusions

This study concluded that poor housing conditions and lack of good financing schemes in upgrading the settlements contribute to the high rate of slum dwellers living in substandard houses that gives rise to unhealthy living conditions. The amount of infrastructural facilities

available in the informal settlements is grossly inadequate, while some are not available. Hence, the poor environmental conditions characterized by numerous problems such as overpopulation and inadequate basic amenities increase the socio-economic problems and pose serious threats to the slum dwellers' long-term livelihood. However, most of the challenging problems faced by low-income people could be solved using Geographical Information System (GIS) based Multi-Criteria Decision Analysis (MCDA) for calculating the simplify situations of alternative factors using Analytical Hierarchy Process (AHP) for weighting the measure of individual participant data and Weighted Linear Combination (WLC) on the socio-economic and housing characteristics in the low-income settlement. Conclusively, the informal settlement should not be considered an anomaly but rather as the necessary response. They represent the desires and needs of the poor to have access to the urban environment. Attempts to eradicate them will fail until these underlying issues of poverty and inequality are properly addressed.

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