

DISTRIBUTION AND PERCEPTION OF THE RISK OF ILLEGAL SOLID WASTE DUMPSITES IN MINNA, NIGER STATE, NIGERIA

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ABSTRACT

Rapid urban economic growth and urbanization are the main culprits, which besides bringing higher standards of living have also brought high generation of waste. This research therefore, aims at analyzing the spatial distribution and perception of the risks of illegal solid waste dumpsites in Minna town, Nigeria. Administration of questionnaire, Administrative map of the study area, Global positioning system, (GPS), buffer analysis using ArcGis 10.3 was used to compute the standard distance between dumpsite and residential houses as set by the world bank (200m) and land use map were the materials and methods used for the study. Also, descriptive statistics were combined in analyzing the data. The buffer constructed showed that 77.0% of the dumpsite falls within the buffer zone, while 23.0% fell outside the buffer zone. The findings further revealed that all the 77% residents whose houses fell within the buffer zone were victims of diseases, proliferation of insects, air pollution, bad odour and dirty street, while the remaining 23% of the residents whose houses fell outside the buffer zone are also affected with air pollution, and bad smell from the dumpsites, but mainly when wind is blown in their direction. The result from the perception of the respondents showed that four (Bad odour, proliferation of insects, dirty street and air pollution) out of the nine items of risks posed by the solid waste dumps to the residence are seen to be very serious. It was recommended that Strict measure or punishment should be talking to any one coughs dumping refuse in gutters or area not designated dump. And also Inhabitant of the area should be enlightened on the effect and negative implication of poor waste management system.

Introduction

Rapid urban economic growth and urbanization are the main factors which besides bringing higher standards of living, have also brought problems related to the growth of dense and unplanned residential areas, environmental pollution, dearth of services and amenities, solid waste generation, and growth of slums (Chris 2003). Activities create wastes and the way these wastes are handled can pose risk to the environment and to public health (Chris 2003). In urban areas, especially in the rapid urbanizing cities of the developing world such as Indonesia, Jamaica, Nepal and Burkina Faso among others, problems and issues of Municipal Solid Waste Management (MSWM) are of immediate importance. United State Environmental Protection Agency (USPEA 2008) defined solid waste as a form of household garbage, leftover food and other wastage that include old household items such as paper, plastic waste in the form of kitchen equipment or any other products that are consumed during everyday activities.

The concept of solid waste management has been explain by Peter, Karl and Jurg (1996) defined solid waste as refuse from household, non-hazardous solid waste from industrial commercial and institutional establishment, market waste, yard waste and street sweepings. It is actually difficult to present the complete meaning of the term "solid waste" in a single definition. In a broader perspective waste can be defined as items which are no longer in use and are not expected to be in future (Kurian, Nagendram and Palanivelu, 2001). Jilani (2002) defined solid waste as the collective name for all the component parts of solid waste both domestic and industrial which may be found in human environment. There are however, other technical descriptions of the term "solid waste" which include the following.

According to Arinsola (2004) solid waste can be defined as non-liquid material arising from domestic, trade, commercial, agriculture, and industrial activities and public services. The two important types of solid waste are municipal solid waste and hazardous solid waste.

According to USPEA (2008) Solid waste management is the proper disposal and management of the garbage that is generated by the various industries, human settlements, institutions and other places where activities of production and consumption of products and services take place.

Butu *et al* (2014) observed that Municipal solid waste in most cities contains human excreta, animal excreta, hazardous chemical pollutants and sharp object which can facilitate the spread of disease and injury particularly among children playing near waste dumpsites and employees in waste management sector.

According to Sandra (1995) in Nigeria, open or uncontrolled dumping is largely practiced and consequently, causing pollution, foul odour, breeding ground for rodents and mosquitoes, which has a very great negative impacts on public health and wellbeing, it also affects the quality and sustainability of the environment as well as the efficiency and productivity of the economy.

Mohammed (2004) stated that Minna, Nigeria being among the cities in the world is faced with solid waste disposal problems. The researcher also noted that the implication is serious when a city is growing rapidly and the wastes are not efficiently managed. Igoni Ayotamuno *et.al* (2007) stated that the problem of solid waste management in Minna town is not different from other urban areas in Nigeria where poor waste disposal leads to illegal waste dumpsites

leading to aesthetic and health hazards. Also, an observation of the residential areas in Minna by the researcher reveals that some open spaces and some drainage channels serve as dumpsites which are left unattended to causing air pollution, bad odour, flooding, and breeding ground for rodents and mosquitoes and also used for open defecation and playgrounds for children.

According to Anthony (2011) the problems associated with solid waste generation and disposal have been the focus of considerable environmental attention during the last quarter of the twentieth century as communities all over the world have begun to recognize its hazards. Arthur (2010), stated that in developing countries, millions of people live without a waste system, wide spread dumping of waste in water bodies and uncontrolled dumpsites aggravates the problem of generally low sanitation, which poses serious threat to the surrounding environment and health risk to the population by contaminating drinking water and soil.

Butu and Mshelia (2004) assessed municipal solid waste disposal and its effect on the environment in Kano metropolis, Nigeria. Questionnaire was used to determine the highest heaps of solid waste on the major streets and open spaces. The study showed that soil, air and water pollution in the study area were caused by pathogenic and chemical elements from these heaps of solid waste that dot some of the major streets and open spaces.

Butu, *et. al* (2014) studied municipal solid waste generation, disposal and effects on the environment in Kura, Nassarawa state. The researchers found out that population growth and unplanned urban expansion results to unorganized house to house or street to street collection of solid waste and concluded that solid waste dumpsites serve

as hideouts for rodents and snakes which are dangerous to health.

Mohammed (2014) appraised solid waste management system in Minna, Niger State. The study found out that the improper management of solid waste was as a result of population growth and insufficient facilities for waste management. The study also showed that management of solid waste in the study area are not effective. In Minna, little effort has been made towards waste management.

Attention has been paid to solid waste research, but that towards population exposure to the hazards posed by poor disposal, areas under constant threat of hazards and distribution of waste dumps is highly limited. This leaves a gap in knowledge which forms the focus of this study. It is the belief of this research that a better understanding of the location and distribution of disposal points and their relationships to household and the environment are important for a better management of the solid waste.

Thus, it becomes necessary to analyze the spatial distribution and perceptual implication of illegal municipal solid waste dumpsites on the environment in Minna, Niger state using Geographic Information System (GIS). The research covered waste dumps situation as at 2016.

The objectives of this research are to determine the location, proximity, distribution of solid waste dumpsites and the perception of the residents on the dumps.

The Study Area

Minna the capital of Niger State is located between Latitudes $9^{\circ} 36'$ and $9^{\circ} 61'$ North of the Equator and Longitudes $6^{\circ} 33'$ and $6^{\circ} 55'$ East of the Greenwich Meridian (Maxlock, 1979). Minna urban area consists of two Local Government Areas, Chanchaga and Bosso spanning, from Maikunkele in north-east and

Chanchaga in the South-eastern part of Minna, (see Figure 1) The study covers Minna town in Niger State which consist of twenty-four (24) neighbourhood they include, Bosso town, Shango, Sauka Kahuta, Barkin Sale, Kpakungu, Minna Central, Tudun Fulani, Chanchaga, Bosso Estate, Tayi Village, Bosso Extension, Tunga, Tudun Wada North, Tudun Wada South, Makera, Sabon Gari, Maitumbi, Nassarawa, F-Layout, Nigeria Army Barrack,

Fadipe, GRA, Dutsen Kura Hausa and Dutsen Kura Gwari.

Minna is about 145 kilometres by road from Abuja the Federal Capital Territory of Nigeria. It covers about 76,363km² and it is located in the middle belt of Nigeria. Minna town is bordered by Shiroro Local Government Area to the North, Shiroro and Paikoro to the East, Paikoro and Katcha Local Government Areas in the South and Wushishi and Gbako to the West (MaxLock, 1979).

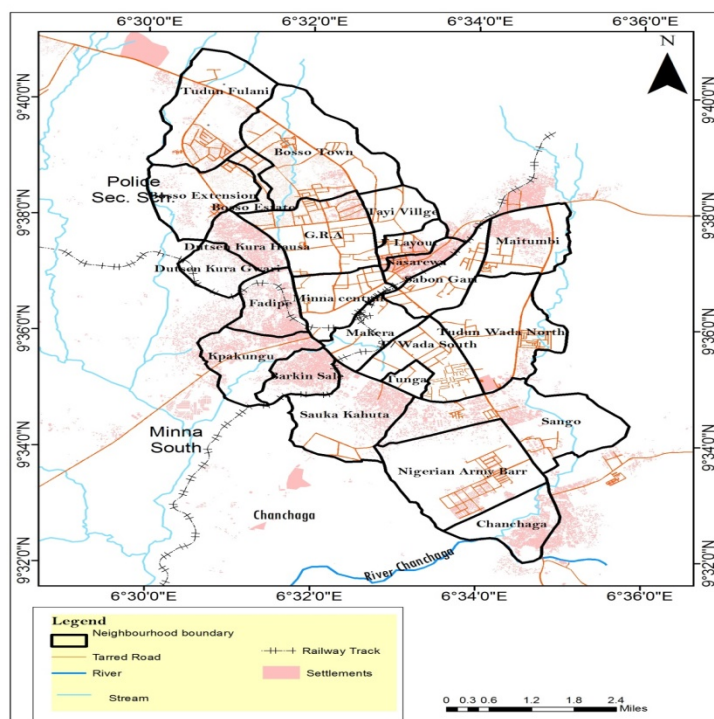


Figure: 1 Minna Metropolis

Source: QuickBird Images, 2013

Minna metropolis has area coverage of approximately 86.2 square kilometres. According to the 2006 National Population Census, Chanchaga and Bosso Local Government Areas had a population of 234,619 people (Niger State Planning Commission, 2012). The population of Chanchaga and Bosso was estimated to about 296,496 by 2016. There are three major

ethnic groups (Nupe, Gbagyi and Hausa) in the State. Other minor tribal groups include – Kadara, Koro, Baraba, Kakada, Ganagana, Dibo, Kambari Kamuku, Pungu, Dukkawa, Gwada and Ingwai. Though the area is mainly Gwari settlement, it has since become heterogeneous in terms of people of various and diverse ethnic religious and cultural

background (Niger State Planning Commission, 2012).

There are different types of economic activities in Minna metropolis. The main commercial zone in Minna area is Mobile, and is known as Central Business District (DBS). Being the state capital, virtually all the banks have their presence in Minna. Trading activities also take place along the major roads and all the streets. The main market of the town is the Central market (daily) and Gwari market (weekly). The major industries include chanchaga clay products, Minna juice, food processing industry, bakeries and Julius Berger Construction Company.

Materials and Methods

Reconnaissance Survey was carried out in Minna, and to different neighborhoods in order to get acquainted with the study area and observe general location and distribution of the dumpsites in the study area.

A Quick Bird 2013 Imagery of Niger State with resolution of 1m was used to map out Minna town, Geographic coordinates of illegal dumpsites were acquired from fieldwork by the use of Global Positioning System (GPS 76S), Data on the potential risk

posed by the spatial distribution of illegal dumpsites to the environment in the area was acquired through the use of questionnaire and record of dumpsites were from Niger State Development Board (NSUDB), Niger State Environmental Protection Agency (NISEPA), Niger State Task Force on Environment (NSTFE).

Questionnaire was used to capture the views of the people on the potential risks posed by the illegal dumpsites. The questionnaire consists of 17 items and it was divided into three sections. Section: A composed of demographic characteristic of respondents, section: B composed of waste management and section: C composed of effects of dumpsites on residential buildings.

Available population census figure showed that Minna had a population of 234,619 in 2006. Using the national growth rate of 2.8 percent the projected population for 2016 is 296,496. This was achieved using the projection formula:

$$P_n = P_i (1+r/100)^n$$

Where P_n = Future Population

P_i = Base Year Population (2006)

r = Growth Rate (2.8%)

n = Projected Period (2006-2016 = 10 Years)

Table 1: The Neighbourhoods in the Study Area, their Population and the proportion of Respondents sampled

S/no.	Neighbourhoods	2006 Population	Estimated Population as at 2016	No of Questionnaire administered to Respondents
1.	Bosso Town	43,856	57,804	76
2.	Shango	6,494	8,559	11
3.	SaukaKahuta	4,274	5,633	7
4.	Barkin Sale	5,862	7,726	11
5.	Kpakungu	17,775	23,428	31
6.	Minna Central	19,496	25,696	34
7.	Tudun Fulani	5,083	6699	9
8.	Chanchaga	23,236	30,626	41
9.	Bosso Estate	5,083	6699	9
10.	Tayi Village	1,417	1,868	2
11.	Bosso	6,012	7924	10

	Extension			
12.	Tunga	6,494	8,559	11
13.	Tudun Wada North	6,494	8,559	11
14.	Tudun Wada South	4,274	5,633	7
15.	Makera	6,604	8,704	11
16.	SabonGari	6,604	8,704	11
17.	Maitumbi	17,775	23,428	31
18.	Nassarawa	4,274	5,633	7
19.	F – Layout	6,604	8,704	11
20.	Nigeria Army Barrack	4,274	5633	7
21.	Fadipe	4,274	5,633	7
22.	GRA	4,274	5,633	7
23.	Dutsen Kura Hausa	6,604	8,704	11
24.	Dutsen Kura Gwari	6,604	8,704	11
	Total	234,619	294,893	384

Source: Niger State Bureau of Statistic (2011) and Author's Analysis, (2016)

Bosso and Chanchaga Local Gornvement Area therefore have a total projected population of (296,496) as shown in Table 1.A total of 384 respondents were sampled for the study based on Krejcie and Morgan (1972) sample size selection table, where it is stated that given a population size above 99999, sample size of 384 is appropriate.

The population size of each location is shown in Table 3.1. The proportion of questionnaire administered in each neighbourhood was calculated using Krejcie and Morgan formula, $n/N \times Q$

Where n = Population of each neighbourhood

N = Total population of the neighbourhoods

Q = Total number of respondents

The 384 questionnaire were proportionally distributed according to the population of each neighbourhood, while the questionnaires were systematically administered within each of the neighbourhoods based on the population size to the household at interval of three (3)

houses, lastly the responses from the questionnaires were analyse using simple percentage

A high resolution QuickBird was used to capture the satellite image of the area. This image was imported into ArcGIS 10.0 environment and geo-referenced in order to define its existence in physical space. This was done by projecting the map to Universal Transverse Mercator (UTM) projection system with World Geodetic System (WGS) 84 datum, for easy distance measurement, subsequently, digitization of land uses types and identification of the neighbourhoods was carried out in the study area using Arc GIS.

To identify and map the solid waste illegal dumpsites in the study area, GPS receiver was used to get the geographic coordinates. The coordinates were then imported from Microsoft Excel into Arc GIS environment and then overlaid on the land use map of the study area. A point – in –

polygon overlay was carried out to show the spatial distribution of illegal solid waste dumpsites in the area.

To determine the proximity of the illegal dumps to residence and other facilities, buffer zones of 200m was developed on the overlaid dump site map of the study area, the buffer create a clear demarcation of the set buffer distance, Near table was also used to automatically generate a table showing the

distance between each dump site to the residential houses, this is in accordance with World Bank Standard (World Bank, 2004). According to Dikshit, Padmavatti, and Das (2000), a domestic solid waste dumpsite must be situated at a far distance away from biophysical habitats, such as water, wetland, critical habitat and well to reduce the risk of contamination from dumpsite.

Results and Discussion

Distribution of illegal solid waste dump sites in Minna Town

Table 2 below presents a total of 116 illegal solid waste dumpsites and their proportion in each neighbourhood.

Table 2 Number of Illegal Solid Waste Dumpsites per Neighbourhood

S/N	Neighbourhood	Number of dumpsites	Proportion of illegal Dumpsites (%)
1	Makera	1	1.1
2	Sango	3	3.1
3	Minna Central	1	1.1
4	SabonGari		
5	SaukaKahuta	6	5.1
6	Bosso Estate	1	1.1
7	Barkin Sale	10	9.0
8	Bosso Extension		
9	Kpakungu	7	6.0
10	Bosson Town	43	37.1
11	Tudun Fulani	2	2.1
12	Tayi Village	4	3.0
13	Tunga		
14	Maitumbi	4	3.0
15	Nassarawa	5	4.0
16	F-Layout	1	1.1

17	Nigeria Army Barrack		
18	Fadipe	5	4.0
19	Duten Kura Hausa	6	5.1
20	Dutsen Kura Gwari	4	3.0
21	Tudunwada North	5	4.0
22	Tudunwada South	4	3.0
23	G.R.A	5	4.0
24	Chanchaga	3	3.1
Total		116	100

Source: Author's Analysis, (2016).

Table 2 shows the total number and the proportion of illegal solid waste dumpsites in each neighbourhood. It shows that the highest proportion (37.1%) of illegal dumps is found in Bosso Town, Barkin Sale (9.0%), Kpakungu (6.0%), SaukaKahuta (5.1%), Dutsen Kura Hausa (5.1%) and the least is found in Makera (1.1%), F-Layout (1.1%), Minna Central (1.1%), Bosso Estate (1.1%) and SabonGari, Bosso Extension, Tunga, Dutsen KuraGwari, Nigeria Army Barrack, have no illegal dumps, this may be attributed to probably compliance of the inhabitant of the mentioned area to the organisation responsible for waste management. Neighbourhood with higher number of illegal dump site such as Bosso, Barkin and

Kpakungu among others may be attributed to high population growth couple with poor waste management habits of the inhabitants.

The spatial location of illegal dumpsites in the neighbourhoods is presented in Fig 2.

During the survey the locations of the dumps showed that there are serious negative implications of the dumps on residence in the area. Some of the dumps were inside drainages (see Plate I) thereby obstructing the free flow of water and this could lead to flooding which is common during rainy season. A good number of dumps were within and adjacent residential structures. The one that is located at Makera is in contact with the wall of the residential houses of the people.



Plate I: Dump in drainage in Chanchaga.

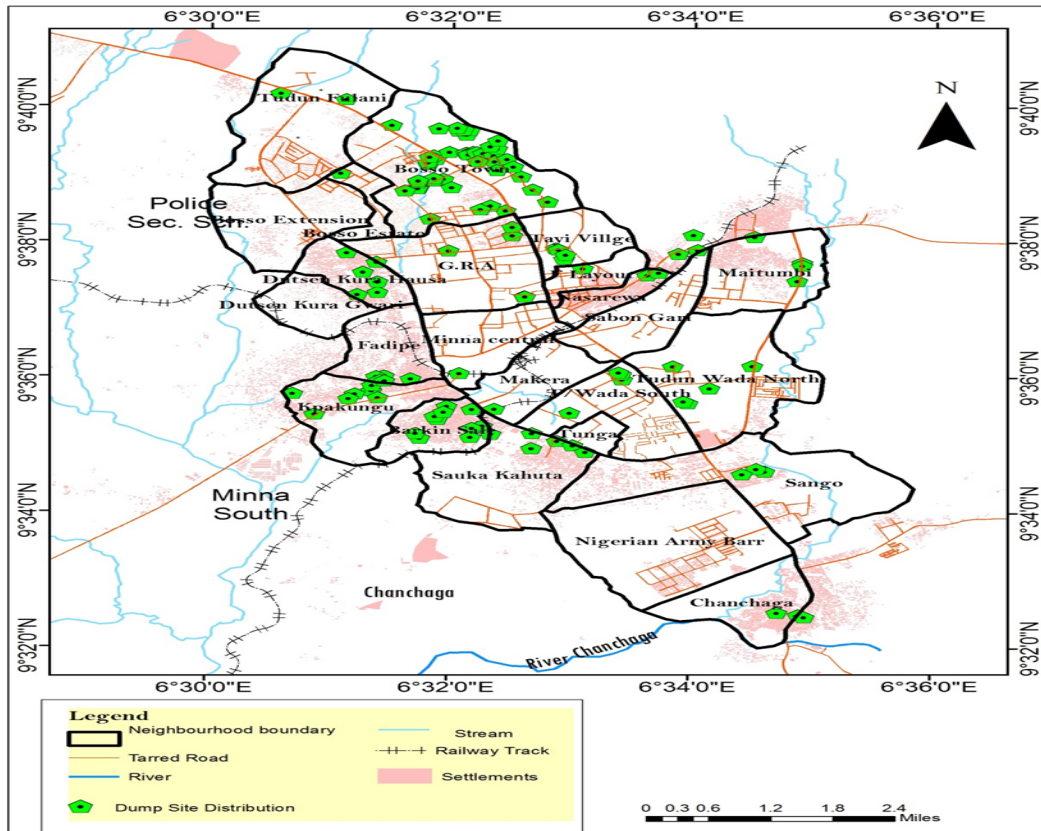


Fig. 2: Spatial Distribution of Illegal Dumpsite in Minna

Source: Author's analysis, 2016

Proximity of illegal solid waste dumpsites to residences

Buffer of 200m was generated around each of the illegal dumpsites. Table 3 shows the proportion of buffer of illegal dumpsites of less than and exactly or more than 200m. The result shows that (77%) of the dumps are less than 200m away from residences, while (23%) are more or exactly 200m away from

the residence. The distances of dumpsites can be termed either suitable or unsuitable from residential areas. The distance between the residential buildings to dumpsite can said to be unsuitable if the solid waste dumpsite is too close (<200m) to the residential buildings.

Table 3: Proportion of Buffer of Illegal Dumpsite that fell within 200m and outside 200m

Neighbourhood	Number of dumpsites	Illegal dump that fell outside 200m	Proportion of Illegal dump that fell outside 200m (%)	Illegal dump that fell within 200m	Proportion of Illegal dump that fell within 200m (%)
Makera	1			1	1.0
Sango	3			3	3.0
Minna Central	1			1	1.0
SabonGari					
SaukaKahuta	6			6	7.0
Bosso Estate	1			1	1.0
Barkin Sale	10			10	11.0
Bosso Extension					
Kpakungu	7			7	8.0
Bosson Town	43	21	78.0	22	25.0
Tudun Fulani	2			2	2.0
Tayi Village	4	2	7.0	2	2.0
Tunga					
Maitumbi	4			4	5.0
Nassarawa	5			5	6.0
F-Layout	1			1	1.0
Nigeria Army Barrack					
Fadipe	5			5	6.0
Duten Kura Hausa	6			6	7.0
Dutsen Kura	4			4	3.0
Gwari					
Tudunwada North	5	3.0	11.0	2	2.0
Tudunwada South	4	1.0	4.0	3	3.0
G.R.A	5			5	6.0
Chanchaga	3			3	3.0
Total	116	27(23%)	100	89(77%)	100

Source: Author's Analysis, 2016

From Figure 3 it shows that most of the residences around the solid waste dumpsite fall within 200 metres to the dumpsite which implies that the residences within 200m buffers has poor waste management habit and are exposed to serious health risk. The proportion of dumpsites that fall within 200m buffer are Bosso town (37.1%), Shango (3.1%), Sauka Kahuta (5.1%), Barkin Sale (9%), Kpakungu (6%), Minna Central (1.1%), Tudun

Fulani(2.1%), Chanchaga (3.1%), Bosso Estate (1.1%), Tayi Village (3%), Tudun Wada North (4%), Tudun Wada South (3%), Makera (1.1%),Maitumbi (3%), Nassarawa (4%), F-Layout (1.1%), Fadipe, (4%), GRA (4%), Dutsen Kura Hausa (5.1%), with the total number of 89 dumpsites this is shown on table 3. Buffer of illegal dumpsites outside 200m from the residence is presented in Fig 3.

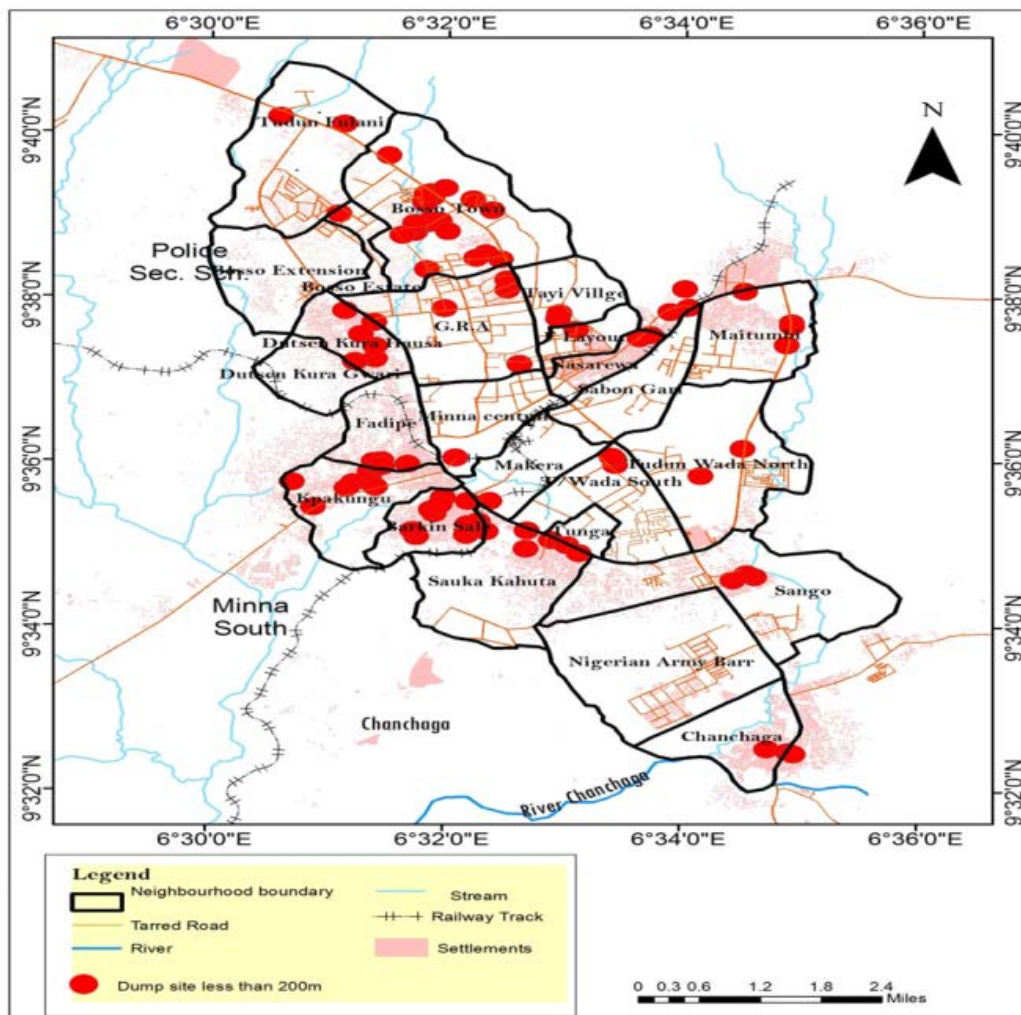


Figure 3: Proximity of dumpsites to residence (Less than 200m)

Source: Author's Analysis, (2016).

PERCIVED EFFECTS OF DUMPSITES ON THE RESIDENTIAL BUILDINGS

All the risks posed by the dumpsites to the residents in the neighbourhood were scored by the residents who have experienced the risk posed by the dump site in one way or the other. The perceived effect of Dumpsites on the residential buildings is presented in Table 4.

Table 4: Types of risk Posed by dumpsites to the residents

Item	Flood		Bad odour		Fire outbreak		Water Pollution		Proliferation of insects		Injury		Dirty street		Air pollution		Disease outbreak	
	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%
Very serious	5	56.0	128	91.0	2	29.0	1	25.0	57	73.0	1	10.0	62	84.0	27	66.0	5	83.0
Serious			7	5.0					16	21.0	1	10.0	6	8.0	2	5.0	1	17.0
Moderate	4	44.0	5	4.0	3	42.0	2	50.0	5	6.0	7	70.0	6	8.0	12	29.0		
Not serious					2	29.0	1	25.0			1	10.0						
Not serious at all																		
Total	9	100	140	100	7	100	4	100	78	100	10	100	74	100	41	100	6	100

Source: Author's Field Survey, 2016

Table 4 showed that four (Bad odour, proliferation of insects, dirty street and air pollution) of the nine items of risks posed from the solid waste dumps to the residence are seen to be very serious. The highest score is obtained from bad odour (91%). Proliferation of insects (73%) and dirty street (84) and others are seen to be moderate to the residence in the neighbourhoods. Bad odour may lead to so many communicable diseases which strongly the health wellbeing of the residence in question and also to some extend proliferation of insect may lead to so many diseases causes by insect among which are malaria among others. The overall picture is that the people feel that the presence of the solid waste dumpsites in their neighbourhoods has a lot of risks on the residents.

Summary

Hundred and sixteen (116) illegal solid waste dumpsites were identify in the area. Buffer zones of 200m construction around the illegal dumpsites revealed that the proportion of dumps that are within 200m away from the residence is 77.0%, and the areas are affected by significant proliferation of insect, bad odour, dirty street, and air pollution these

areas includes; GRA, Tudun Fulani, Dutsen Kura Hausa, among others. While that of residence whose houses are outside 200 meters consist of 23.0%, these areas includes: Tayi village, Tudunwada North, Tudunwada South and Bosso Town. These areas are also affected by the air pollution and bad odour from the dumpsite, but mainly when wind blowntoward the areas direction.

The distance of the dumpsites to the residents also contributes to indiscriminate waste dumping

Findings from the perception of the respondents showed that proliferation of insects was highly rated (21%), while dirty street (20%), bad odour (37%) were rated second and air pollution (11%) was third. This shows that the dumps have a lot of effects on the residents. The study revealed that 95.0% of the respondents dump on illegal dumpsite because the legal dumpsites were too far from them.

Conclusion

It can be concluded that base on the 200m zone created from the dumpsite, significant number of dumpsite fall within the 200m. It was also observed that most neighbourhoods with higher human population generate

larger amount of waste, thereby making it very difficult to cope with the waste management system which leads to improper disposal of waste. This resulted to so many health implications. Dumping refuse in the gutters has been considered also as one of the careless habit of the inhabitant of the area thereby causing serious environmental challenges such as flooding.

Recommendations

- i. Government should provide dumpsite away from residential houses.
- ii. Strict measure or punishment should be talking to any one coughs dumping refuse in gutters or area not designated dump.
- iii. Inhabitant of the area should be enlightened on the effect and negative implication of poor waste management system.

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