SPATIAL DISTRIBUTION OF SOLID WASTES DISPOSAL IN JIMETA METROPOLIS OF ADAMAWA STATE

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Abstract
Solid waste disposal in cities has become a major environmental problem to which Jimeta metropolis is not an exception from this environmental degradation. One of the challenges faced in monitoring, locating and securing of facilities is lack of up-to-date maps. This study therefore aimed at mapping the spatial distribution of solid waste disposal sites within Jimeta metropolis. Global Positioning System (GPS) survey and Geographic Information System (GIS) were employed to carry out the spatial database tasks. The GPS coordinates acquired from the field were used for geo-referencing and digitization was performed using AutoCAD Land Development and Arc GIS 9.2 versions, which gave the digital map showing the locations of the Solid Wastes Disposal Sites. The study revealed three major disposal sites within the study area to include legal designated waste disposal sites, thrown into the drainage and gutters, and open dump in any available land. The later being the dominant method of wastes disposal and in recent years, it has been the major cause of flooding in the metropolis where lives and properties worth millions or naira were lost. It is recommended that similar research be carried out to determine suitable sites for solid wastes disposal. This will help to avert environmental pollution, health hazards and epidemic that may occur as a result of wastes disposal.

Key Words: Waste, Disposal, Hazard, Degradation and Environmental.

Introduction

The growth of human population coupled with increased economic activities in towns and cities result in high rate of solid waste generation. A fundamental attribute of solid waste is that it is inevitable as almost every human activity involves the generation of waste in solid, liquid, semi-solid or containerized gaseous form (Simeon, 2001). Thus solid waste means any garbage, refuse, sludge from a wastewater treatment plant, water supply treatment plant, or air control facility and other discarded materials resulting from industrial, commercial, agricultural operations and from community activities (Simeon, 2001). It is the unwanted products of development related activities such as industrialization and urbanization and other domestic refuse.

Throughout most of history, the amount of waste generated by humans was insignificant due to low population density, and low societal levels of the exploitation of natural resources. Common waste produced during pre-modern times was mainly ashes and human biodegradable waste, and these were released back into the ground locally, with minimum environmental impact. However, some civilizations do seem to have been more profligate in their waste output than others.

The growing concern for environmental issues and the goal of sustainable development has moved the management of solid waste to the forefront of public agenda and discussion. Legislation and regulation had been introduced in local and national levels to guide waste management. Techniques for appropriate waste treatment and disposal have become a major environmental problem to which Jimeta metropolis is not an exception.

The ability of digital mapping to manipulate

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both spatial and attribute data from specific geographical location makes it possible to create a realistic perspective of an area and the opportunity to view the effects of future actions. This unique ability provides the opportunity to analyze and combine large sets of spatial and attribute data into useful information, offering new perspective and fresh approaches to problem solving. The geographic information system (GIS) is a computerized tool for capturing, storing, checking, integrating, manipulating, analyzing, and displaying data which are spatially referenced to the earth (Kufoniyi, 1998, and Ndukwe, 2001). It is normally considered to involve partially referenced and structured digital database and appropriate application software. The digital mapping was therefore used to carry out the analyses of sites location for solid waste disposal in the area of study.

Digital mapping of solid waste disposal sites in Jimeta metropolis is one of the solutions to environmental degradation. This study focuses on addressing the problem by exploring digital mapping potentials as a decision support system based on site selection criteria. Therefore, the study is designed to map the various solid waste disposal sites in Jimeta metropolis, showing their spatial distribution within the metropolis to enhance the visibility and accessibility on the map.

Problem of the Study

One of the major factors militating against the achievement of sound environmental management system in Jimeta metropolis is the indiscriminate disposal of solid waste at the collection depots by the general public. This is because there is no clear policy on the mode of solid waste disposal. What presently exist is uncompleted buildings, undeveloped plots of lands, street or access road, gutters or drainage systems, burrow pit and open space in the outskirt of the town are used by the public and sanitation officers to dump wastes.

The result of all these is that, common infections associated with poor sanitary and waste disposal condition cannot be avoided. The indiscriminate disposal of solid waste causes ground water and surface water pollution and also when the dump refuses are burnt, it pollute the air thereby contributing to green house effect. Uncontrolled and unattended disposal of open dumps leads to blockage of drainage systems and gutters resulting to flooding within the environment. In addition, constant burning of solid waste cause air pollution and constituting a fire hazard to other properties. Although the state government tried to locate solid waste disposal sites, environmental criteria for such sitting were not followed because the ministry of environment does not have in full the criteria to achieve that. It becomes pertinent to show at a glance, the existing waste disposal sites with the aim of achieving a friendly environment.

Purpose of the Study

Considering solid waste disposal as a menace, the study aimed at mapping spatial distribution of solid waste disposal sites in Jimeta metropolis through the following objectives:

- Ø Digitizing the existing analogue map of Jimeta metropolis.
- Ø Conducting a GPS survey to obtain the coordinates of solid waste disposal sites.
- Ø Producing a digital map of the solid waste disposal sites.

Study Area

Jimeta, the headquarter of Yola North local government area of Adamawa state was established in 1912 by British Colonial Administration as part and model town to

carter for the increasing influx of people into the town. Yola North is bounded in the north by Song Local Government, in the east by Fufore, in the West by Demsa and in the South by Yola South Local Government Areas of Adamawa State (Figure 1). It is located between latitudes 09^0 16? N and 09^0 30? N and longitudes 12^0 18? E and 12^0 34? E of Greenwich meridian.

The population of the study area was 141,724 in 1991. With the growth rate of 2%, the population was 198,247 based on the 2006 census (Edan, et al 2013). The land use arrangement in the study area is that of mixed urban setting. These include among others, health, residential, institutional, administrative, commercial, recreational and industrial services.

The residential land use areas are of three (3) categories, the high density, medium density and low density. The high density residential areas include wards like Rumde, Nassarawo, Jambutu, Shinko, Luggere and Limawa wards. The medium density areas comprises of Bekaji, Damilu, and Demsawo wards, while the low density areas are Karewa, 80 housing unit, Legislative quarters, Old GRA and Dougirei wards.
The Institutional Land use comprises of education, law and defense. Educational land use includes schools like Adamawa State Polytechnic, Federal College of Education (FCE) Yola and many Secondary Schools, while law and defence include Law Courts, Military Barracks, Police and Civil Defence stations.

Under the Services of land use, there are two categories of land use. The first is the public transport and utilities such as Motor Park. While the second category is the land use for mixed commercial and industrial areas which are market, business premises along Bishop Street, Mubi road, etc.

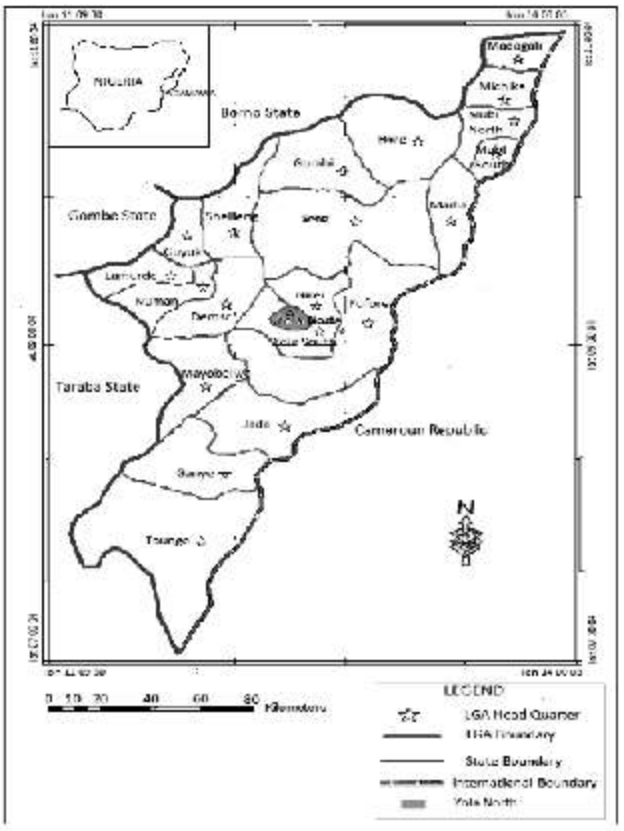


Fig. 1 Digitized Map of Adamawa Showing Yola North L.G.A.

Methodology

Data

- GPS coordinates of road junctions in Jimeta metropolis
- Street Guide Map of the study (Jimeta)

Software

- Corel draw 12
- AutoCAD Land Development GIS software.
- Arc GIS 9.2 version

Hardware

- Laptop computer (specification 40 GB HDD, Pentium IV processor and 516 MB RAM). Scanner
- Hewlett Packard Deskjet 9600 series.
- Promark 3 Dual frequency Global Positioning System (DGPS) receiver

Data Acquisition

A GPS survey using Promark 3 Dual

frequency Global Positioning System (DGPS) receiver was conducted to obtain geographic coordinates of solid waste disposal sites in the study area. An analogue street guide map of the study area which was used in generating the map of solid waste disposal was obtained from Adamawa State Ministry of Lands and Survey, Yola.

Geo-Referencing

The street guide map of Jimeta was scanned into the computer. The map was scanned in bits as the raster input using scanner and merged Corel Draw 12 for further processing. Geo-referencing was done by the used of tie-points. Three features were sought for, and used as tie-points because of their ease of identification. The features include road junctions, and cross points of roads and rivers (i.e. culverts and bridges). The geo-referenced map portrayed information as to where the area represented on the map fit on the surface of the earth.

Digitization

Digitization was carried out to create spatial data from existing hard copy map and documents. The geo-referenced raster image of the street guide map of Jimeta metropolis was digitized using Arc GIS 9.2 by the process of onscreen digitization. Road network of the study area was digitized as line features, while the solid waste disposal sites were digitized as point features. The exact locations of the disposal sites were identified by using tool in AutoCAD Land development (Figure 2). By using the measure tool, the spatial location of a particular disposal site was marked.

Results Presentation

Table 1 shows the Universal Transverse Mercator (UTM) coordinates of the solid waste disposal sites observed by Promark 3 DGPS receiver. These coordinates were used in identifying the location of the disposal sites as shown in figure 2. Figure 2 is the digitized street guide map of the study area. Table 2 gave an insight on the number of solid wastes disposal sites per ward. The magnitude of solid wastes disposal sides in each ward of the metropolis was finally displayed in a bar chart format as shown in figure 3.

Table 1. The Coordinates of Solid Waste Disposal Sites in Jimeta Metropolis

S/ No.	Site	E (m)	N (m)
1	Jimeta by pass Doubeli	221012.8702	1027383.0524
2	Jimeta by pass Doubeli	220240.3190	1027483.7310
3	Jimeta by pass Doubeli	220015.5293	1027503.6384
4	Old town Kashim Ibrahim Road	221634.7222	1026604.2142
5	Old town Kashim Ibrahim Road	221644.2514	1026733.7231
6	Olusegun Obasanjo Road Upper NEPA old GRA	220736.4203	1025300.3850
7	Olusegun Obasanjo Road Upper NEPA old GRA	220788.7017	1024739.1002
8	Abdulahi Bashir Road 80 housing unit	221107.0758	1021872.1113
9	Bature Army Barracks Road Malamre Karewa	220342.3912	1022008.8801
10	Bature Army Barracks Road Malamre Karewa	219374.9132	1021772.2031
11	Legislative Quarters Road Malamre	218680.6280	1023247.3904
12	Legislative Quarters Road Malamre	218854.2138	1023739.0007
13	St. Augustine catholic church Bekaji	218703.5727	1024522.7703

14	St. Augustine catholic church Bekaji	218589.0172	1024611.2205
15	Gimba Crescent Bekaji	218721.4531	1024640.0276
16	Gimba Crescent Bekaji	218987.8777	1024556.6651
17	Fire service	219615.3198	1025460.3765
18	Fire service	219607.5688	1025442.2209
19	State low-cost Hospital Road	220094.7662	1025504.5550
20	State low-cost Hospital Road	220204.6500	1025322.4311
21	Hospital/ Mubi Road junction	220379.0800	1025010.2144
22	Upper Lugere round about	219678.7235	1025985.6917
23	Bauchi street Nasarawo	219649.0722	1026810.6010
24	Mubi Road Nasarawo	219902.4494	1026972.0933
25	Wurokuturu	218660.1079	1027221.1287
26	Geriyo Road Jambutu	217718.9166	1027471.2673
27	Near Geriyo Road Jambutu	217772.2870	1027540.1471
28	Near Geriyo Road Jambutu	217644.0030	1027417.6500
29	Near Geriyo Road Jambutu	217545.4125	1027450.0111
30	Jambutu	217178.7110	1027591.2870
31	Jambutu	217048.4767	1027292.0666
32	SPY Jambutu	216915.4105	1027421.2901
33	Jambutu	216768.8820	1027405.7200
34	Jambutu	216517.1448	1027499.0155
35	SPY Jambutu	216454.2233	1027756.3041
36	SPY Jambutu	216290.0119	1027797.9041
37	SPY Jambutu	216740.3675	1027115.3674
38	Demsawo	217503.2263	1026527.8712
39	Local G. Clinic Damilu	216512.4114	1025608.1335
40	SUBEB Primary school Damilu	216470.1955	1025754.4749

Table 2. The Distribution of solid waste Disposal sites and their percentages.

S/No.	Name of Ward	Number of Sites	Percentage (%)
1	Doubeli	3	7.5
2	Old Town	2	5.0
3	Old GRA	2	5.0
4	80 housing unit	1	2.5
5	Bature	2	5.0
6	Karewa	2	5.0
7	Bekaji	4	10.0
8	Fire service	2	5.0
9	State low-cost	3	7.5
10	Upper Luggere	1	2.5
11	Nasarawo	2	5.0
12	Wurokuturu	1	2.5
13	Jambutu	12	30.0
14	Damsawo	1	2.5
15	Damilu	2	5.0

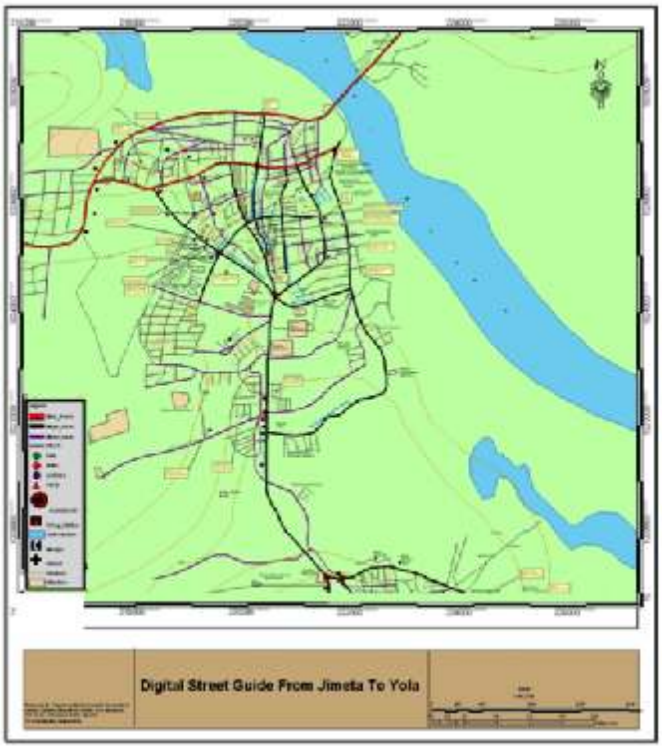


Fig. 2 Digitized Street Guide Map of Jimeta Metropolis

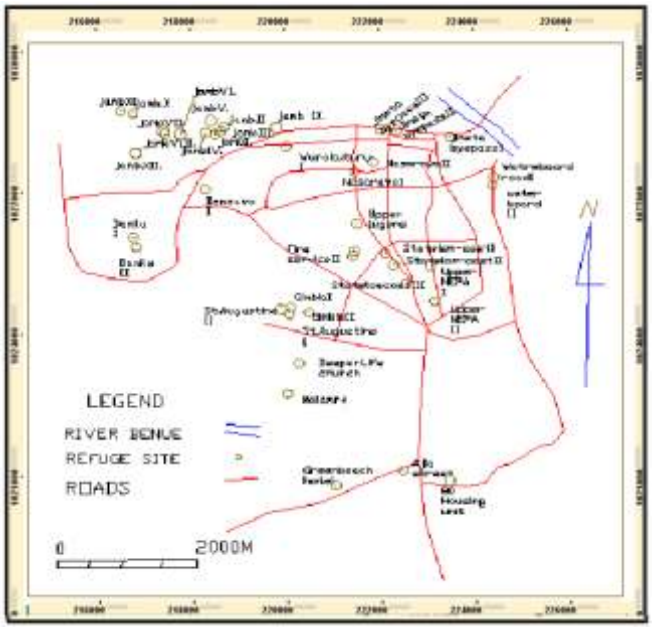


Fig. 3 Map of Jimeta Showing Solid Waste Disposal Sites

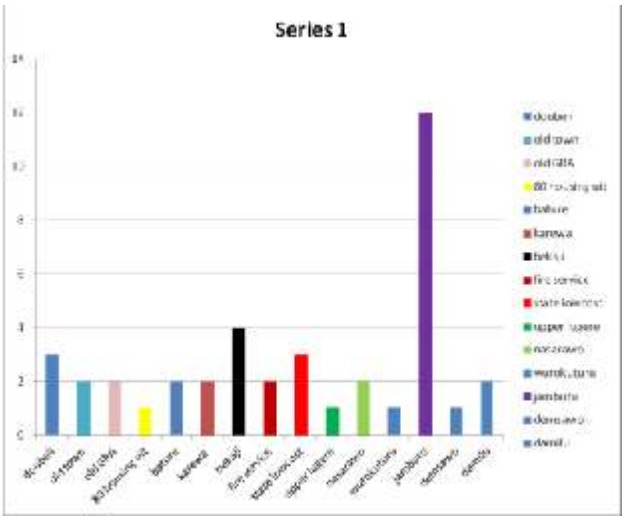


Figure 4: Bar Chart Showing Waste Disposal Sites Distribution

Analysis of the Results

The result obtained from the study shows that solid waste disposal sites are not evenly distributed within Jimeta metropolis rather, they are concentrated at the extreme of the town where development is still taking place, and the locations are along the access roads (Figure 3). The study revealed that there are a lot of solid waste disposal sites within the metropolis (Figure 3), and Jambutu Ward with the highest number of sites (Figure 4). This implies that Jambutu generates high rate of solid wastes and is the most populous ward in the metropolis. Table 2 and figure 3 give an insight on solid waste disposal sites in the area of study.

The study also revealed that cooking is the main source of refuse generation in the study area. These refuse (wastes) constitute food wastes, garbage and rubbish. It was discovered that the study area is characterized by three modes of disposal sites namely: Legal Designated Waste Sites, Thrown into the Drainage Systems and Open Dumping into available land. The method of open dumps dominated the area.

In developed countries, efforts are being

made to treat and recycle solid wastes. This is as a result of the global warning that piling up of solid waste posed a serious environmental threats or hazards as it will contaminate underground and surface water, soil and air and cause diseases to man and animals besides adversely affecting plants. On the contrary, Adamawa State Ministry of Environment and Cathen Nigeria Limited (a private establishment) are charged with the responsibility of evacuating wastes and dumping them in borrow-pits or farmlands as a supplement of fertilizer. The two agencies are not discharging their duties effectively because of inadequate funding, coupled with attitudinal behavior of the general public in respect of discharging the solid wastes. This left much to be decided as the piling up solid wastes have been the major cause of flooding in the metropolis where lives and properties worth millions or naira were lost.

Research Findings

- There is indiscriminate solid waste disposal in the study.
- Periodic evacuation of solid wastes, resulting to piling up.
- Ineffective waste management (recycling) practice constitutes severe hazards on humans and environmental degradation.
- Poor funding from government compound to this environmental hazards.
- The entire environment is characterized by offensive odor and air pollution, particularly in the immediate vicinity of the disposal sites.

Conclusion

From the findings, it is clear that waste management practice in the area is ineffective, thereby constituting severe hazards on human and environment. Un-even distribution of solid wastes disposal sites calls for an enhanced Master Plan for effective wastes disposal in line with the Environmental Protection Agency (EPA) standard. This will help to avert any epidemic that may occur from wastes disposal. The digital map of the wastes disposal sites produced can serve as a base map in forecasting future development. The study is therefore relevant for decision making and planning in the State.

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