

Solid Waste Management Strategy Gaps Experienced By The Residence of Bauchi (Traditional) Walled city, Bauchi Metropolis, Nigeria

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ABSTRACT: Municipal solid waste management is ultimately the responsibility of the municipal authorities in most African urban centers. However these municipalities collect only between 50-60% of their total waste generated. Most of its ends up in open dumps, wetlands and so on. Solid waste collection and disposal in Bauchi old city remained the most serious challenge facing the Bauchi state environmental protection agency (BASEPA). The old city surrounded by the town wall (GANUWA) is the most densely populated part of the metropolis which prior to the year 1999, was characterized by major waste dump sites called Bingi, found in every ward within the walled city. This paper examines the solid waste generation, collection and disposal processes, problems, challenges and environmental impacts posed by the waste management service provisioning in the traditional walled city of Bauchi. Waste characterization study, questionnaires, observations, oral interviews, and direct visits to the sites formed the methodology of the research. The study recommends the need of an articulated solid waste management framework for the households in the traditional city.

keywords; Bauchi traditional walled city, solid waste generation, solid waste collection, Solid waste disposal.

INTRODUCTION

Municipal Solid Waste (MSW) generation in developing countries exceeds collection capacities, due to rapid population growth in the urban areas. In Nigeria, 25 million tonnes of Municipal Solid Waste (MSW) are generated annually (Ogwueleka, 2009). The Nigerian minister of environment on March 2nd, 2013, admits that about 3 million tonnes of waste littered the streets of Nigerian urban centers uncollected. Nigerian Television Authority (NTA, 2013). Studies by Medina (2002), Ogwueleka (2009), showed that about 70-90 % of these uncollected wastes are generated from households and little fraction from commercial establishments. According to (Onibokun *et al.*, 2000; Ogwueleka, 2009, Nabegu, 2010) these wastes are not collected by municipal collection systems largely due to improper management strategies, fiscal

irresponsibility, equipment failure, and or lack of adequate waste management budgets. In most cities of Africa solid waste management is the responsibility of the municipal government (Mugagga 2006, Simon, 2008 & Ogwudeka 2009). The service is non-rivalled, without diminishing the benefits to anyone else (Cointreau, 1994).). Solid Waste Management is an important facet of sustainable development for any country and global initiatives greatly support the prioritizing of SWM. (Ndum, 2013).

Unfortunately, most administration in developing countries failed to provide waste management service to a large section of their population (Cointreau, 1994; Chegaill, 1996; Bolaane & Ali. 2004 & Simon, 2008). Akinsulire, (2005), observed that recent events in major cities of African countries have shown that the problems of waste management has become a monster that has thwarted most efforts by international, federal and states governments as well as city authorities and professional alike. Also, (Bovea *et, al.*, 2010 & Zurbrugg *et, al.*, 2012), cited in Cherian and Jacob, (2012), highlighted that waste management is a complex process that requires a lot of information from various sources such as factors on waste generation and waste quantity forecast. Households solid waste generation and management are generally unknown to government officials especially the responsible agencies. According to (Napoleon *et al.*, 2011; Ukpong and Udopia, 2011) there is a general paucity of data on key waste variables such as generation rates, composition, densities, storage and transport. Also, Cherdasitirkul (2012) stated that it is hard for government of developing nations to deal with MSWM issues because of lack of information and adequate data collection. However, good and proper municipal solid waste management is critical to the health and well-being of urban residents (World Bank, 2003). Heaps of refuse garbage which are common sights in most of our urban centers threatens the health of nearby inhabitants, destroying the entire ecosystem and aesthetic qualities of most

urban centers. In Bauchi metropolis, municipal solid waste management poses a serious environmental problem. The fast growing population as a result of the influx of migrants from neighboring states due to the relative security enjoyed by the town has with it corresponding increase in quantities of domestic solid waste and boost of economic activities. This constitutes an enormous challenge for the Bauchi state environmental protection agency (BASEPA). According to BASEPA (2013), about 492,750 metric tonnes of waste is generated annually in Bauchi and its environment. . Afron *et, al.*, (2009), cited in Amalu and Ajake, (2014), also reported that, empirical analysis using macro economic data indicates that the capita generation of solid waste is at least 0.3-0.4 kg/day even for the poorest people. There is, therefore the need for the authorities to improve their strategies for managing domestic solid waste both in the technological and managerial dimensions. Solid waste in Bauchi is characterized by inefficient collection system, inadequate coverage of the collection methods and improper disposal alternatives. Significant portions of the metropolis do not have access to proper solid wastes services. There is also lack of data at all levels. From the households, sub-ward, wards, districts, up to municipal level. Available data's are scattered or unorganized and are generally unreliable. The result is that growing amount of household waste remain uncollected exacerbated by Illegal and indiscriminate disposal of waste which caused health risk and destroyed the aesthetic qualities of the town. This study therefore seeks to establish the solid waste management deficiencies in the old Bauchi town(traditional walled city) of Bauchi metropolis.

A REVIEW OF MUNICIPAL SOLIDWASTE MANAGEMENT IN BAUCHI

Over the years, Bauchi metropolis, the capital of Bauchi state, north-east Nigeria, has witnessed various approaches to solid wastes management, (Ogwueche, 2013; Bogoro, 2012), but the problems has been one; inefficient solid waste management system. Recent population explosion

and uneven urbanization patterns in Bauchi compounded the problems. These coupled with lack of strategies, technical and institutional inefficiencies and effectiveness continue to worsen the situation. Some of the solid waste management options that have been carried out in the past without success to solve the problem of refuse disposal in Bauchi metropolis include monthly environmental sanitation programme, operation keep Bauchi clean, street cleaning exercises and mobile courts on environmental sanitation. Notable efforts by the state government dates back to the late 1990s, the era of new democratic dispensation in Nigeria to 2006. The operation that facilitates the total evacuation of heaps of refuse dumps (Bingi) within the old-walled city Bauchi by the state agency, (BASEPA). These file of refuse are either left burrow pits, and or left-over spaces within the old-city, and were found in almost every ward and sub-wards within the residential areas in Bauchi town. Notable ones were; the

- i. Malashe at Wunti converted to a mosque (wunti street)
- ii. Jakara around Ilelah-central market converted shopping complex and a Bank building
- iii. Bingin Galadima now a residential area (Jahun District)
- iv. Bingin Sarki at Tura, now a primary school building
- v. Bingin Kwara at Wunti, now a residential area.(wunti street)
- vi. Kan Garke at Malam Goje
- vii. Ganjuwa at Jahun/Ganjuwa now residential area.(Gwabba sub-ward)

However, following the evacuation of these wastes dumps, owners of the plots reclaimed (usually through inheritance) and developed their plots. As an alternative to these dumps sites, the government provides masonry bins and wheel containers (Roro) in some locations within the metropolis. These facilities were grossly inadequate and received low frequency of evacuation by the state agency. These resulted to unhealthy attitudes of illicit and indiscriminate disposal of

refuse in public drains, public spaces, uncompleted building sites, vacant plots and so on. During raining days, these wastes were washed away and blocked drains causing flooding and contamination of well waters in the affected wards and districts.

The years 2007-2013, the state government admits the incapacitation of the state agency in adequate waste management, thereby entered into Public Private Partnership (PPP) with Cosmopolitan cleaners and National Union of Road Transport Workers (NURTW) Tipper Branch Bauchi. The two partners in collaboration with the Bauchi State Environmental Protection Agency (BASEPA) and Bauchi State Commission for Youth and Women Rehabilitation and Development (BASYWORD) sweeps and collects waste daily on some major streets, and fortnightly and monthly in other parts of the metropolis. The process required households and other commercial outfits to dump or disposed their wastes daily at undesignated points along the streets for collection, with no supervision monitoring or involvement of household heads, or wards heads in the process. However, the collection became sporadic, irregular and sometimes absent in some cases. Consequent upon these, the unattended and accumulated wastes harboured scavengers, domestic animals and birds patronizing these waste dumps, spreading it on the streets. Also residents who receive fortnight and monthly collection disposed their wastes at night on vacant plots and public drains.

MATERIALS AND METHODS

Study area

The ancient city of Bauchi surrounded by the town wall (Ganuwa) is the most densely populated part of the metropolis. It houses the emirs palace, the central mosque, main market, and the prison yard. It was from this name “Bauchi” the state got its name Bauchi state. The name which was believed to be derived from the name of the settler “Baushe” whom the first emir Yakubu

met when he founded the town. The “Ganuwa” was said to be built by the emir to fortified the town against invaders. The emir was a disciple of the re-known Islamic scholar who founded Islamic caliphate in Sokoto, Usman bin Fodio.

The Bauchi emirate was sub-divided into eight districts comprising of over forty wards and one hundred and five sub-wards. Four out of the 8 districts that made the Bauchi metropolis; Bakaro, Warinje, Kobi and Jahun were within the old Bauchi city. They are characterized as areas of high density population and low income part of the metropolis. The areas were also characterized by overcrowding, lack of access roads and good drainages. The old city is the heart of the metropolis, located between $9^{\circ}00'$ and $9^{\circ} 30''$ north of the equator and longitude $10^{\circ} 25''$ and $11^{\circ} 20''$ east of the greenish meridian. It occupies a total land area of 3,604 hectares. According to Jos electricity Distribution Company (JEDC 2014), there are 33,339 households using both prepared and billing methods in the metropolis. The old city comprises about 2/3 of these households. According to the national population commission (NPC, 2014), Bauchi metropolis is a home to over 421,187 inhabitants.

Methodology

Purposive sampling techniques were applied in selecting wards within the districts and sub-wards within the wards. Wards and sub-wards along the streets and sub-wards within the inner part of the wards having poor access roads and narrows streets. 242 households were selected for the study. Face to face interview and direct observations were also applied in the study. These are to obtained data on municipal waste management and to understand existing solid waste management scenario, verify information on policy, legal frameworks and views regarding solid waste management.

waste characteristics study: - waste characterization study was combined with the structured households survey questionnaire, to obtain data on family size, current practices of solid waste management and other socio-economic characteristics of the respondents. The waste characterization study was aimed at; Estimating the percentage daily waste generation of the households and the relative proportions (percentage) of the waste composition. Direct waste sampling and analysis was the method used. It is time consuming and labour intensive but is detailed, accurate and informative when combined with factors affecting waste generation. Waste were collected in distributed target polythene bags at two to three days interval and taken to the waste sorting center. Contents of each bags were weighted and recorded. Calculation on the per capita waste generation was obtained by dividing the total amount of waste generated per household by number of household's members and number of days. The content was then emptied and spreads on plastic sheet and sorted into predetermined fractions, namely; garbage (organic) residues (ash, sweeping, ash) metal/aluminum, glass, paper, plastic, polythene and textiles. Each separated constituent was weighted separately. Calculations of the households waste composition was performed.

RESULTS AND DISCUSSION

Waste Generation and Composition; The mean household size in the studied sub-wards was found to be 10.6 persons per household. While the per capita waste generation varies from 0.22kg/cap/day to 0.34kg/cap/day obtained in the sub-wards of Kofar Wambai and Wunti streets respectively. The average per capita per day for old Bauchi town was found to be 0.27kg/cap/day. An earlier study by the author in 2015 found that 126.5 tons of solid waste is generated daily in Bauchi metropolis. The composition of the waste generated in the old Bauchi town indicated that garbage (organic) is 61.25 % residues (sweepings) 13.9 %, polythene 12.9 %,

paper 4.38 %, glass 0.99 %, plastics 2.55 %, metal 0.73 % and textiles 3.3 % respectively. Garbage which constitutes the bulk of the composition is biodegradable and mainly kitchen wastes. This is typical of most wastes from urban centers of developing countries. This fraction was observed to be as a result of the households consumption of unprocessed food or fresh food items. The implication here is that there is the need to evacuate the waste regularly to avoid foul smell and spread of diseases in the town. The finding also revealed the potential of the waste in terms of composting to produce organic manure. The volume of other constituents of the waste indicates economic significance when goes into circular economy in waste management.

Table 1: Per Capita Solid Waste Generation in the (traditional) Bauchi walled town

District	Ward	Sub-ward	Waste generation rate (kg/capita/day)	Average household size
Bakaro	Bakaro	Bakaro	0.30	10.7
	Tura	Tura	0.29	11.2
Warinje	Kofar wambai	Kofar Wambai	0.22	10.1
Kobi	Shekal	Shekal	0.24	12
	Wunti	Wunti Street	0.34	9.9
Jahun	Gwallaga	Gwallaga	0.26	9.8
	Jaja	Fadan Bayak	0.23	11
	Gwabba	Unguwar Gwabba	0.31	10.2

Waste Collection and disposal ;Waste collection process were of two types ; the waste collection along the major streets (Dual carriage ways) which involved daily waste disposal on road sides by the residence. The collection crew usually comprises of the pay loader and tipper or crewmen with shovels and a compactor truck. Waste is collected daily on these streets.

The challenge in this process identified by this study is the non adherence to time schedules of disposal by the residence and the spread of the waste by animals and birds on the road before collection. This type of waste collection also creates traffic jams on the street in the day time. While collection on single lane roads and streets is done weekly or fortnightly. The residence dumped their waste on either a designated dump site or illegally in public area by the road sides or uncompleted building structures. In this process, the collection involved the use pay loaders and tipping trucks. In areas where the agency (BASEPA) kept a stationary wheel-container (RORO), the process involved towing of the roro with tractors to final disposal sites (open dump) This research found that the collection in these part of the town is grossly inadequate. The waste dumps were washed away by rain during rainy days or blown away by winds into drains thereby clogging the drains which result to flooding. The dumps usually became the breeding ground for rodents, rats, mosquitoes and flies which spread diseases.

Table 2;available equipment in BASEPA and its contractor (cosmopolitan cleaners)

Waste collector	Types of waste collection equipment (functional)			
	Compactor trucks	Open tipper	Pay loader	Tractor
BASEPA	2 nos	5 nos (6.5m ³)	1no	2nos
Cosmopolitan cleaners	4 nos	1 no (12m ³)	1 no	Nil
Total	6nos	6nos	2nos	2nos

Alternative waste disposal; The aftermath of reclaiming of plots of land (Bingi) or former dumps sites, the collection of waste within the old city became sporadic, irregular and insufficient in the sub-wards along the major streets with dual carriage ways, like Wunti street; in Kobi district, Kofar Wambai, Ran-road, and Kofar wase where residents were required to dump

their waste every morning by the road sides. The waste contractors using compactor trucks and a 5-6 men crew collect the waste using shovels and emptied into the compactor trucks or tippers. Collection was sometimes with pay loaders. While in the sub-wards with single lane roads, such as Fadan Bayak, Jahun, Dutsen Tanshi, the residents used communal open dumps, usually located as a child of circumstances along the roads to dump their waste. The collection in these sub-wards area is done, fortnightly and monthly using pay loaders and tippers. Observation and interviews revealed that due to inadequate waste collection services, the residents were forced to resolved to other alternative waste disposal options.

Three different illicit and illegal disposals were identified;

- dumping in public drains and water ways (plate 1)
- dumping at public places such as schools (plate 2)
- dumping of wastes along the roads infringing on the right of way R.O.W. (plate 3)

The environmental consequences of these waste disposal options are detriments to the health and wellbeing of the residence. Clogging of drains during rainy seasons, which cause flooding and blockage of water ways. The waters from the public drains channeled outside the town are used to irrigate vegetable farms along the water ways. Most of these vegetables are sold and consumed within the metropolis. There is the potential risk to the health of the inhabitants. The blocked drains became the breeding ground for mosquitoes that spread malaria. Also, during rainy days, the uncollected waste, became wet and increased in density which made the collection difficult especially using compactor trucks. The result are foul odors, from the uncollected waste. Water run-offs from the waste dumps overflows to wells in the affected sub-wards. The study also revealed that lack of inadequate waste collection, left the accumulated waste infringing on the right of ways, causing traffic havoc and becoming the breeding areas for domestic animals and

birds. The process of collection using both compactor trucks, pay loaders and tippers causes traffic jams in the town. The collection is also irregular as residents were not adhering to the time scheduled for collection. This resulted to continued appearance of waste dumps at any time of the day, portraying an ugly view of the major streets in the town.

The outcome of this study, suggest the need for further research on the water quality and safety of the wells in the affected sub-wards. This may not be unconnected with the recurrent and persistent outbreaks of diseases such as measles, cholera, malaria and typhoid's fever in the affected sub-wards. There is the need for the waste contractors to increase their capability and capacity of their waste collection fleets. Also alternative communal waste bins and collection facilities are recommended by this study. There is the need for the policy makers and the state environmental protection agency to develop a waste management framework or strategy that would conform with the size and structure of the settlement (the walled city). This has important influence on the urgency and character of the waste management.



plate 1;dumping in public drains & water ways



plate 2; dumping at public places such as schools



plate 3; waste dump infringing on the right of way

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