



Original Research Article

Household Solid Waste Management Survey in Benin City Agglomeration, Edo State, Nigeria

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ABSTRACT

A survey of 200 residences was undertaken in Benin City, Edo State, Nigeria. The objectives were to identify and document residential waste management practices and recommend appropriate strategies for improving the management process. Stratified random sampling procedure was used to identify households and well-structured questionnaires administered. Data obtained were then analyzed qualitatively. The results showed that seven methods are used for household collection and storage. Of these, baskets and bags are most frequently used while in-house composting was the least. Half of the residents practice modest recycling, although 8% of the households dump their waste on bare ground and burn them openly. Haulage and final disposal are mostly done monthly, while 36% of the households manage their wastes independently. The infrequent collection coupled with relatively high number of households independently managing their own wastes may explain in part the littering of neighborhood streets in Benin City. The harmonization of waste management by the waste management board with respect to collection, haulage and final disposal is recommended. Also, increasing the collection frequency to reduce waste overflow and dispersal, provision of standard community bins for storage and legal means for discouraging independent disposal and open burning are recommended.

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1. INTRODUCTION

Worldwide, solid waste generation has steadily increased as a result of global changes associated with population, consumption and industrial development. The world cities generate about 1.3 billion tonnes of solid waste per year and this volume is expected to increase to 2.2 billion tonnes by 2025 (Ayanshola, 2013).

Thus, the importance of waste collection, transfer and disposal remains and the need for long-lasting solutions.

Nigerian cities and towns have continued to grapple with the reality of how best to manage the growing municipal solid waste stream as population grows. Although various private and public waste managers exist, most of the city streets remain littered with assorted waste thus rendering the urban landscape unsightly (Ogboi and Okosun, 2003). This situation is however not unconnected to the changing consumption patterns resulting from increased income as the method of handling solid waste greatly determines its impact on the local and global environment (Ogwueleka, 2003; Ludwig et al., 2003). Furthermore, solid waste management structure in most municipalities is rather weak and ineffective in Nigeria (Isah and Okorie, 2007).

Improperly disposed solid waste have been implicated in greenhouse gas emission and thus climate change, soil and water pollution, blockage of drains, deterioration of the built environment, nuisance; and loss of tourist income. In terms of unquantifiable costs, improperly managed solid waste usually results in downstream costs higher than what it would have initially cost to manage the waste properly (Ayanshola, 2013).

The United Nations (UN) reports on developing countries concluded that endemic diseases such as gastrointestinal diseases, diarrheal diseases, anemia, trachoma, chronic infections and parasitic diseases are due in part to poverty, unsanitary environment and the inappropriate distribution of health resources among various regions of several socio-economic groups, coupled with limited government resources (UNDP 1997). High management costs, lack of linkages between stakeholders and low coverage challenge is attributed to increasing solid waste generation and stage-wise understanding of the factors that affect solid waste management (Aremu, 2013). Ogboi and Okosun (2003) reported that residents of Onitsha and those of other Nigerian cities such as Benin City, Lagos, Ibadan, Kano, Enugu, dump their refuse indiscriminately along the streets, roads, in open spaces, market places, front of residential buildings and drainage system. This results in an unsightly mountain of refuse that have become a common feature of the Nigerian urban landscape. Waste generation, collection, transportation, sorting, treatment, and disposal are the main processes within municipal solid waste (MSW) management system (Zhang et al., 2013). While an ideal treatment and disposal processes may require various management options such as source reduction, curbside recycling, material recovery, waste-to-energy, sanitary land filling and composting (Turan et al., 2009), illegal dumping and littering of refuse along streets is still common place in many Nigerian cities (Ike et al., 2018).

Benin City, the Edo State capital in Nigeria, known worldwide for its rich cultural heritage has been experiencing rapid rural-urban migration and influx of displaced citizens from Northern Nigeria as a result of insurgency in recent times. In fact, Balogun, and Onokerhoraye (2017) reported that population and spatial growth of Benin City are faster than the pace of infrastructure provision and that the lag between the growth of Benin City and infrastructure provision is impacting negatively on the quality of lives of the residents and threatens the sustainability of urban environment. Such a rapid growth leads to rapid increase in solid waste generation. With the exception of a few major streets swept daily within the urban agglomeration during week days, most neighborhood in Benin City streets remain littered with solid wastes thus rendering the landscape insightful (Ogboi and Okosun, 2003). The objectives of this study therefore were to survey and document residential waste management practices in Benin City and to recommend appropriate strategies for improving the solid waste management process.

2. MATERIALS AND METHODS

Fifty households were sampled in each of the four Local Government Areas (LGAs) of Benin City agglomeration in Edo State, Nigeria (Egor, Ikpoba-Okha, Ovia North-East and Oredo) (Figure 1) using a

multi-stage random sampling procedure. Ten neighborhoods within each LGA were randomly selected initially and five residences within major streets in each neighborhood.

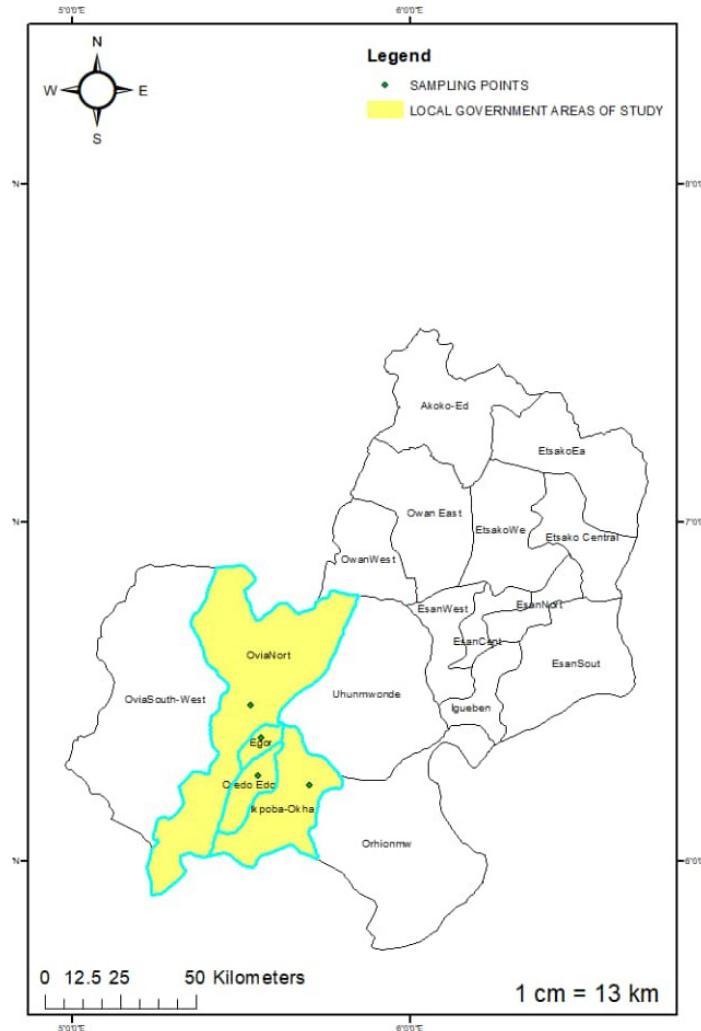


Figure 1: Map of Benin City showing the four local government areas (in asterisks) surveyed

Following the selection, well-structured questionnaires were administered to an adult per residence; the elements of the questionnaires are summarized in Table 1. Methods used for domestic solid waste collection and storage prior to final haulage and disposal by waste management or sanitation authorities, sorting and recycling practices, frequency of waste collection, fees paid, as well as personal opinion of the residents on the disposal services were also assessed. In addition to the questionnaire administered, the methods used for collection and storage in each resident was physically verified, classified and documented. Data obtained from the survey were collated and analyzed using percentages and graphical methods.

Table 1: Elements of questionnaire administered

Questions	Options
Demographic	Name, age, sex
Residential type	Single family, multiple family, commercial, Combination
Location	Local Government Area, neighborhood, street
Waste collection for final disposal	Yes, No
Regularity of collection	Regular, irregular
Frequency of collection	Weekly, monthly, bimonthly, others
Waste collector for final disposal	Local Government, State Government, Federal Government, private
Waste sorting/recycling	Yes, no, sometime
MSW burning	Yes, No
Collection fee/assessment	Amount (NGN); Too high, High, Fair, Low, too low
Solid waste in-house collection/storage methods	Physically evidence provided and classified: bag, basket, drum, concrete fence dumpster, compost heap, surface dump, others

3. RESULTS AND DISCUSSION

3.1. Household Solid Waste Disposal Methods

The result of this survey showed that residents in Benin City agglomeration commonly use seven major solid waste collection/disposal methods in their homes. The methods include: baskets (made of plastic or Palm fronds), bags (made of plastic or jute), concrete fenced dumpsters (open without roof or doors and roofed with doors), non-perforated drums (made of metal or plastic), perforated drums, compost heap and open dump (Figures 2).

Baskets and bags were the most frequently used collection/storage methods by nearly half (46%) of the residence surveyed, while in-house compost pits were the least (4%) (Figure 3). A similar study in Lafia, Nasarawa State (Ogah et al, 2014) showed that plastic materials and metal buckets were preferred unlike our study. Assorted drums and concrete fence dumpsters of different construction are preferred by 40% of the households. The popular community bins made of plastic materials with wheels and cover preferred in most major metropolitan areas of the world was infrequently used in the Benin City residences surveyed, while surface dumping within homesteads was observed to be surprisingly high and practiced by 8% of the residences surveyed. Of these methods, composting as a form of recycling appears to have the greatest economic potential in view of the ease of biodegradation unlike plastics. Furthermore, other methods of local collection such as drums without lids, concrete dumpsters and baskets invite insects, rats and other vermin that may be human disease vectors-unlike the community bins that is both rat and insect-proof. In addition, wastes collection is done monthly in majority of the residences with less than half of the subjects reporting irregular collection and final disposal by the various sanitation departments or waste managers.



Figure 2a: Plastic basket



Figure 2b: Perforated plastic drum



Figure 2c: Non-perforated drum



Figure 2d: Bags (Plastic)



Figure 2e: Fence dumpster



Figure 2f: Surface dump



Figure 2g: Compost heap

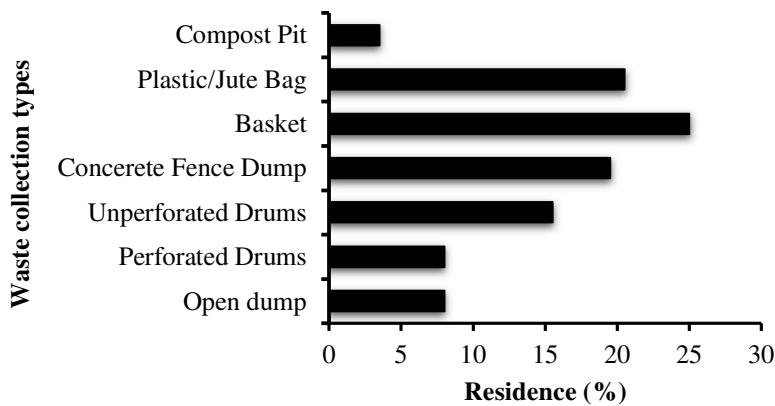


Figure 3: Frequency of use of major in-house solid waste collection/disposal methods in Benin City agglomeration

3.2. Solid Waste Sorting and Recycling

With respect to sorting and recycling, half of the subjects polled claimed that they sometimes sort their waste at home before putting them out for haulage i.e. they remove or separate objects such as metals, plastic bags etc for reuse (Figure 4). Twenty percent of the respondents sort their waste always before disposal and 30% do not sort before disposal. This result shows that a majority of the residents do practice some modest recycling of their household wastes, thus reducing natural resource consumption. However, the low frequency of composting by residents is noteworthy particularly because a major portion of the solid waste disposed in Nigerian cities are known to be biodegradable (Ike et al., 2018); therefore, recycling them through conversion to compost for sale or use for home gardening will be most environmentally and economically viable options. There is thus the need to sensitize and teach residents how to recycle their biodegradable solid wastes.

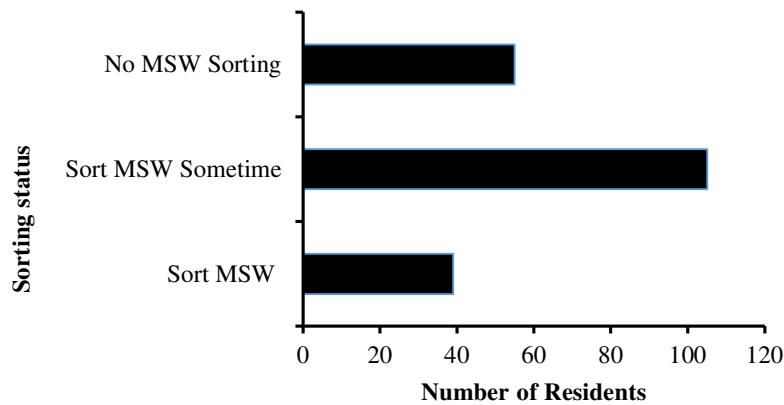


Figure 4: In-House municipal solid waste sorting status in Benin City metropolis, Edo, Nigeria

3.3. Solid Waste Haulage and Final Disposal

Household wastes once collected are usually hauled for final disposal by environmental sanitation departments of the four local or state government areas of Benin City agglomeration, and in some cases, private contractors. The result of this survey showed that only 60% of the residents use this service, while 36% of the subjects interviewed claimed that they do not subscribe to any municipal disposal services at all (Figure 5).

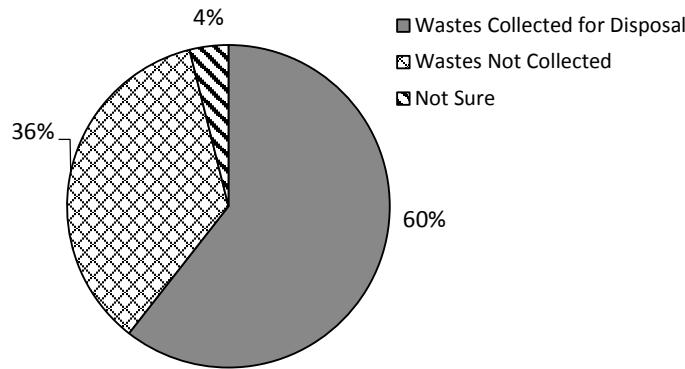


Figure 5: Residential waste collection and final disposal by sanitation authorities in Benin City Metropolis, Edo, Nigeria

The implication of this is that they either manage their wastes within their residences or transport them elsewhere for final disposal legally or otherwise. Such actions may be contributing to the unpleasant littering in many streets in Benin City agglomeration. With respect to the frequency of collection of solid waste by the various waste managers (Figure 6), monthly collection was the most common.

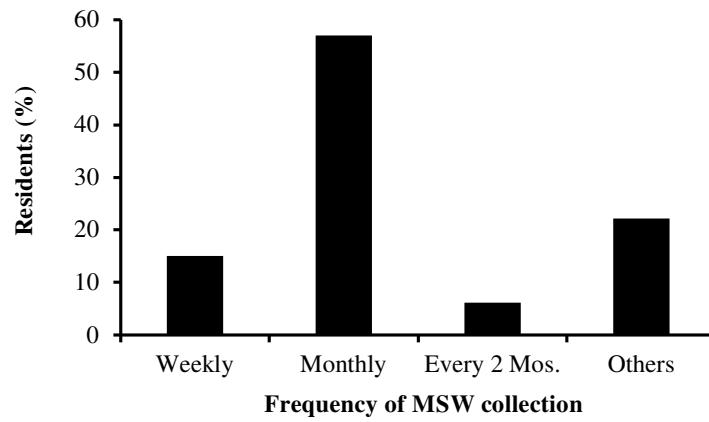


Figure 6: Frequency of residential MSW collection in Benin City agglomeration

3.4. Solid Waste Incineration

Residents who do not use the services of the sanitation companies were asked whether or not they burn their waste on site from time to time. The survey showed that about half of them (52.5%) do burn their MSW

while others do not-as indicated in Figure 7. Those who do not burn theirs may probably be dumping them outside their homes legally or otherwise. Adogu et al. (2015) reported a similarly poor waste management habit of open burning amongst more than 60% of the residents in the Nigerian City of Owerri, Imo State.

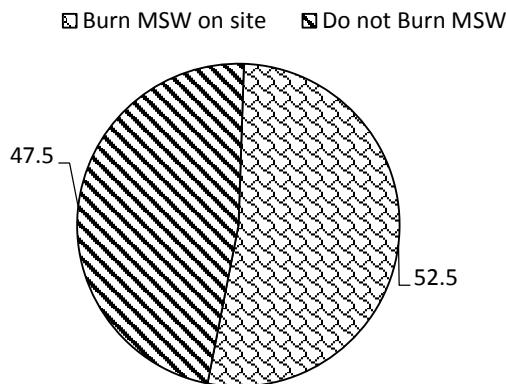


Figure 7: On-site municipal solid waste burning status in Benin Metropolis, Edo Nigeria

Burning of solid waste contributes to global warming as well as air pollution. Because plastic is dominating most solid wastes these days, burning them releases various carcinogenic gases which are unhealthy to people living nearby and should be discouraged. Open burning is cause of CO, CO₂, SO, NO, PM₁₀ and other pollutant emissions that affect the atmosphere (Wiedinmyer et al., 2014).

3.5. Regularity and Frequency of Solid Waste Haulage

Table 2 shows the opinion of respondents based on regularity of collection of Municipal Solid waste by all four LGAs in Benin City agglomeration. Majority of the residents (42.5%) claimed that the sanitation department was regular in the pickup of their solid wastes, whereas 32.5% of the households reported that pickup was irregular and 25% reported that it was irrelevant to them probably because they manage their wastes themselves. With respect to frequency of MSW haulage by sanitation department however, the results showed that MSW collection and haulage is done mostly (60%) once per month in Benin City by the various public and private waste managers. This collection frequency is low relative to those of most major metropolitan areas in western nations or Abuja, the Federal Capital Territory where waste collection is done weekly (Kadafa, 2017). Inconsistent and low frequency of collection can lead to overflow of the collection containers and thus littering, and transport of the wastes away from disposal site by wind, water, rodents etc.

Table 2: Regularity of MSW haulage and disposal

Response	Oredo	Ikpoba-Okha	Egor	Ovia-North East	Total	Percentage
Yes	19	22	20	24	85	42.5%
No	16	14	21	14	65	32.5%
Not applicable	15	13	11	11	50	25%

3.6. Collection Fee Assessment

Subjects were asked to rank the monthly fees paid for the service provided by the waste collectors in the survey. Figure 8 shows the ratings in the four LGAs of Benin City metropolis. A majority of the subjects rated the monthly fee paid as fair. However, about half of the residents do practice some modest form of

recycling by sorting their wastes before putting them out for final haulage and disposal by the respective sanitation departments.

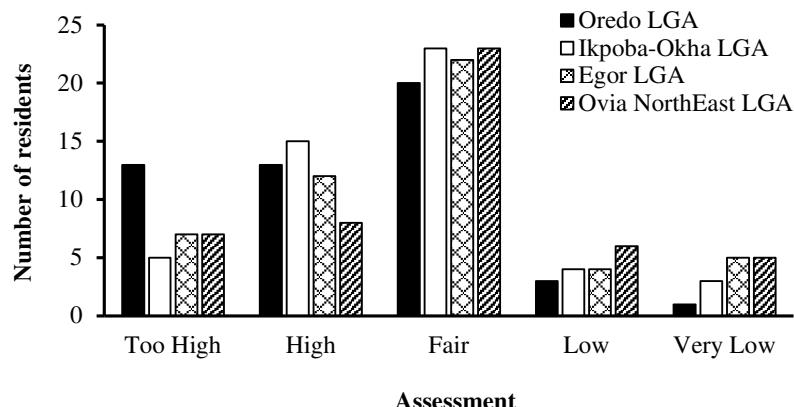


Figure 8: Municipal solid waste collection fee assessment by residents in four Local Government Areas of Benin City Metropolis, Edo State

4. CONCLUSION

Most of the seven general methods used for collecting and storing household solid waste in Benin City agglomeration attract flies, rodents and vermin that may be disease vectors and should be discouraged while community bins that is seldom used and composting encouraged. The infrequent collection coupled with relatively high number of households independently managing their own solid wastes may explain in part the littering of neighborhood streets in Benin City. The four local government areas within Benin City agglomeration do not manage their solid waste in unison with respect to frequency of collection, and thus the need to harmonize their operations including the provision of guidelines for private waste managers for effectiveness, Surface dumping and burning of solid waste should be discouraged and replaced with composting-a form of recycling of biodegradable kitchen and yard wastes known for providing both economic and environmental benefits.

5. ACKNOWLEDGMENT

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6. CONFLICT OF INTEREST

There is no conflict of interest associated with this work.

REFERENCES

- Adogu, P.O.U., Uwakwe, K.A., Egenti, N.B., Okwuoha, A.P. and Nkwocha, I.B. (2015). Assessment of Waste Management Practices among Residents of Owerri Municipal Imo State Nigeria. *Journal of Environmental Protection*, 6, pp. 446-456.
- Ayanshola, A.M., Aremu, A.S., Jacob, S.O., Bilewu, S.O. and Salami, A.W. (2015). Evaluation of Municipal Solid Waste management system and willingness-to-pay for its improvement in Ilorin, Nigeria. *Journal of Technology*, 34, pp. 868-874.

- Aremu, A.S. (2013). In-town tour optimization of conventional mode of Municipal solid waste collection. *Nigerian Journal of Technology*, 32, pp. 443-339.
- Balogun, T.F. and Onokerhoraye, A.G. (2017). Spatio-Temporal Growth of Benin City, Nigeria, and Its Implications for Access to Infrastructure. *Journal of Geography and Geology*, 9(2), pp. 11-23
- Ike, CC, Ezeibe, C.C., Anijjiofor, S.C. and Nick Daud, N.N. (2018) Solid Waste management in Nigeria: Problems, Prospects and Policies. *Journal of solid waste Technology and management*, 44(2), pp. 163-171.
- Isah, E.C., Okorie, O.H. (2007). Environmental sanitation in an urban community in Benin city, Edo State, Nigeria. *Postgraduate Medical Journal*, 14(1), pp. 12-15.
- Kadafa, A.A. (2017). Solid Waste Management Practice of Residents in Abuja Municipalities (Nigeria). *Journal of Environmental Science, Toxicology and Food Technology*, 11(2), pp. 87-106.
- Ludwig, C., Hellweg, S. and Stucki, S. (Eds.). (2003). *Municipal Solid Waste Management: Strategies and Technologies for Sustainable Solutions*. BerlinHeidelberg: Springer-Verlag.
- Ogah, A.T., Alhassan, M.M., Medugu, N.I. and Mohammed, A.B. (2014). Household Solid Waste Management Methods in Lafia, Nasarawa State Nigeria. *Journal of Environmental Science, Technology and Food Technology*, 8(4), pp. 46-51.
- Ogboi, K. C. and Okosun, A.E. (2003). The Role of Scavengers in Urban Solid Waste Management in Nigeria. *Environmental Studies and Research Journal*, 2, pp. 85-92.
- Ogwueleka, T.C. (2003). Analysis of urban solid waste in Nsukka, Nigeria. *Journal of solid waste Technology and Management*, 29 (4), pp. 239-246.
- Turan, G.N., Coruh, S., Akdemir, A. and Ergun, N.O. (2009). Municipal Solid Waste Strategies in Turkey. *Waste Management*, 29, pp. 465-469
- United Nations Development Programme (UNDP). (1997). Human Development report on Developing Countries. UNDP, New York, pp. 23-17.
- Wiedinmyer C., Yokelson R.J. and Gullett, B.K. (2014). Global emissions of trace gases, particulate matter, and hazardous air pollutants from open burning of domestic waste. *Environmental Science and Technology*, 48, pp. 523-9530.
- Zhang, Y., Huang, G.W and He, L. (2013). A multi-echelon supply chain model for municipal solid waste management system. *Waste management*, 34, pp. 553-563.