Solid Waste Management Practices in High Density Suburbs of Zimbabwe: A Focus on Budiriro 3, Harare

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Abstract

The disposal of solid waste is a major environmental challenge in most developing countries including Zimbabwe. Empirical data on people's perceptions and attitudes towards solid waste and its associated environmental and public health risks are critical for developing sustainablesolid waste disposal practices. To date, such empirical information has been lacking, particularly in developing countries such as Zimbabwe. To address this knowledge gap, a case study was conducted in Budiriro, a high-density suburb in Harare. The objective of the present study was to investigate people's perceptions and attitudes on the nature of solid waste, environmental and health risks associated with solid waste, and waste disposal practices including recycling. To achieve this, structured questionnaires were administered to 156 randomly selected households within the suburb. From this research work, gender, marital status, religion, level of education and age were the main factors influencing peoples' perceptions and attitudes towards solid waste management. The research findings also revealed that organic solid waste constituted the larger proportion (28%) of the waste generated in Budiriro 3 with a percentage increase of 8.This study further revealed the low levels of knowledge on solid waste disposal technologies among households, and factors motivating solid waste recycling at household level in a typical high-density suburb in Zimbabwe. In the light of these findings, it is recommended that education and awareness need to target changing human attitudes and thinking towards solid waste as the basis for good solid waste management. The study thus provides practical recommendations for solid waste management in high-density suburbs of Zimbabwe and a proposal for further research.

Introduction

Solid waste management constitutes one of the most serious health and environmental problems facing governments in most developing countries that include Zimbabwe (Bandara *et al.*, 2007, Jerie 2006, and 2011, Bhatia, 2003; Chinamo, 2003 and Tanyanyiwa *et al.*, 2011). Studies by Chinamo (2003) in Dar salaam, Tsiko *et al.* (2012) and Musademba *et al.* (2011) in Zimbabwe highlighted that, poorly managed dumpsites often produce bad odours and also contaminate ground and surface water, and release greenhouse gases (GHGs) from rotten organic matter (Rodic, 2010; Chikobvu *et al.*, 2011; Chifamba, 2007). These affect human health and contribute to climate change. Studies have shown that solid waste releases gases such as methane and carbon-dioxide which result in enhanced greenhouse effect.

In many developing countries that are experiencing economic difficulties, the problems associated with solid waste production and management are not addressed until they pose a serious threat to advancement. Zimbabwe has not been spared of the problems as its urban councils, municipalities, rural district council and institutions have become known for poor waste management (Chikobvu *et al.*, 2011; Taru *et al.*, 2005; Musademba *et al.*, 2011).Recycling, burning and burying of waste, open space dumping and uncontrolled piles of garbage are examples of waste management practises in most urban areas that include residential suburbs in Zimbabwe. All the alternatives used are a source of environmental pollution. As observed by Folmer *et al.* (2000) and Ackerman (1997), burning is not an effective way of solid waste management, and it can lead to the contamination of soil and water when washed off by overland flow (Tevera, 1991). To minimise environmental pollution arising from solid waste, there is need for a detailed understanding of the sources, quantities and nature/type of the wastes (Bandara *et al.*, 2007 and Rushton, 2010).

In order to minimize environmental pollution arising solid waste, the disposal of solid waste is now governed by the Environmental Management Act (EMA) Statutory Instrument (SI) 6 of 2007 **CAP. 20:27**, which prohibits the disposal or discharge of effluent and solid waste in undesignated areas. SI 6 of 2007 also prohibits the discharge or disposal of any waste whether generated within

or off site, in such a manner that it causes environmental damage or ill-health to any person. In spite of the presence of the EMA statutory instrument, environmental pollution arising from solid waste management has continued unabated leaving many wondering whether individuals are aware of such an act.

The current practice in waste management in most residential suburbs of Harare is the collection of waste from sources of generation and dumping without proper segregation (Mubaiwa, 2013; Chikobvu *et al.*, 2011; Masocha, 2004). The accumulation of heavy metals such as cadmium, zinc, copper and lead within waste disposal sites (Chifamba, 2007 and Masocha, 2004). If such waste is disposed in areas designated for farming, it could lead to detrimental effects on crop production since the heavy metals are known to suppress the growth of plants (Nyamapfene, 1991). Mismanagement of solid waste also contributes to the contamination of ground and surface water and the release of greenhouse gases (methane and carbon dioxide) which affects human health and contribute to climate change respectively (Mangizvo, 2010, Tsiko *et al.*, 2012). In Zimbabwe, there is paucity of data on the nature and quantity of solid waste coming from individual households. Such data could be useful for the sound management of solid waste in residential areas. While solid waste management practices have been investigated in several studies, up until now, data on quantified solid waste and people's perceptions on solid waste management has been lacking. The focus of this research is therefore to determine the nature and quantify solid waste produced at household level in Budiriro 3 and its management. This study was undertaken in Budiriro, a high density suburb in Harare. Harare, the capital city of Zimbabwe with an estimated population of 2 098 199, and this constitutes 16.2% of the total population in Zimbabwe (ZIMSTAT, 2012). Budiriro is one of the densely populated suburbs in Harare and Budiriro 3 suburb houses 1000 stands and approximately 750 informal houses fitted in open spaces within the area.

Methodology

This study focused on the 1000 legal residential stands in Budiriro from which a total of 278 stands was drawn for sampling using Krejcie's method of

determining sample size (Krejcie *et al* 1970 and UAB, 2003). In the article "Small Sample Techniques," the research division of the National Education Association (2003) published a formula for determining sample size. From a population (N) of 1000 households 156 households were sampled and the recommended sample size is 278 (Universal Accreditation Board, 2003). The main qualitative research instruments which were used included open ended questionnaires, formal discussions with key informants (interviews) and field observations (groundtruthing). A sample of residents from Budiriro 3 was drawn randomly from the total population to answer questionnaires. Field measurements were carried out to determine the types and quantities of waste generated per household using a balance, garbage bins and sacks at the temporary collection point and estimate the number of full bins collected on daily basis. These measurements were undertaken for two weeks per month for three consecutive months for consistency. An arbitrary number 'ten' for sample size was selected for these measurements. The ten houses were selected randomly from the total of 156 for these measurements and no formula was used to determine this number. The waste was segregated into biodegradable and non-biodegradable and then further sorted into different units like food and vegetable waste, plastics and scrap metal following a classification by (UN-Habitat, 2006).Interviews were used to solicit information from key informants on the current generation, collection and disposal methods of solid waste as well as environmental health risks associated with poor solid waste management in Budiriro. Key informants included the Director of Waste Management for Harare City, Environmental Management Agency official, City council representative, councillor, residents chairman and health department representative.

Results and discussion

Organizational structure of waste management in Harare

 In the City of Harare, the waste management (cleansing) division falls under the department of amenities which employs a total of one thousand and sixty-four workers (1064). The department falls under the directorate of an amenities director under whom is the waste management manager. The toxic waste inspector, cleansing superintendent and the transport supervisor report

directly to the waste management manager according to this hierarchy. The cleansing inspectors report directly to the cleansing superintendent and there are 33 cleansing supervisors who report directly to cleansing inspectors on queries, issues, comments and even work progress from the 142 public toilets and 646 street cleaners. The transport supervisor is responsible for consolidating reports from the 46 heavy vehicle drivers, one transport clerk and 17 light vehicle drivers and forwards them directly to the waste management manager so that progress and way forward is mapped.

Types and amounts of waste generated

Results obtained on waste quantities calculated as average percentages by month for November, December and January are shown in Table 1. Generally the results show an alternating trend in waste quantities produced even though the highest averages are recorded in December.

Table 1: Quantities of waste generated by month calculated as average percentages in Kg/wk.

Type of waste	Percentage waste generated in (Kg/wk)								
	08-14 Nov 2012	22-29 Nov 2012	Average	08-14 Dec 2012	22-29 Dec 2012	Average	08-14 Jan 2013	22-29 Jan 2013	Average
Vegetables ***	21.9	18.5	20.2	15	25.1	20.05	31.8	23.4	27.6
Paper**	3.8	7.1	5.45	4.8	2.3	3.55	5.3	6.8	6.05
Cardboard & egg trays	17.9	10.7	14.3	14.2	13.9	14.05	14.8	16.6	15.7
Plastics	14.8	22.9	18.85	17.1	22.8	19.95	16.3	14.7	15.5
Bones	10	12.4	11.2	14.3	19.5	16.9	9.3	13.6	11.45
Glass	4	9.2	6.6	4.9	8.4	6.65	3.7	8.5	6.1
Textiles	4.2	1.3	2.75	4.9	0.4	2.65	2.4	4.6	3.5
Ablution*	14.8	17.5	20.2	24.8	7.2	16	15.9	11.3	13.6

*: including diapers; **: including tissue paper, newspaper, book sheets; ***: including crop, fruit and food scrap.

Organic waste constitutes the largest proportion of the total waste generated in Budiriro3 with a percentage increase of 8%. Vegetable waste including

crop, fruit and food scraps at 20% in November and December and 28% in January represents the largest proportion of organic waste generated. Ablution waste and plastics are also examples of inorganic waste that require extended attention in as far as disposal is concerned because of their adverse health and environmental impacts. In the month of November, plastics and ablution waste generated averaged was 18,9% and 20% respectively. In December the waste averaged 19.9% and 16% for plastics and ablution respectively and 15.5% and 13.6% in January.

Results in Table 1 show either a slight increase or decrease in waste quantities and this was attributed to changes in household size and maybe consumption pattern during festive seasons. In November, the general trend represents low quantities of waste as compared to high volumes in December and a decline again in January. The assumption is that December is a busy month with people preparing for Christmas hence people tend to spend more on purchasing items for the festivities. In January, the majority of residents migrate in and out of town for a new season hence waste generated (paper, cardboard and egg trays, vegetables and textiles) are likely to be increased or decreased. For example textiles, cardboard and egg trays, increased by almost 1%, paper by almost 2% and vegetables have also a percentage increase of 8%. Plastics and ablution wastes decrease by 4%, bones almost 6% and glass1%. Organic waste increases whilst inorganic waste is decreases when results for the three months are compared. The reason attributed to this observed difference is that some people undertake indoor recycling of plastics scrap metals and rags hence reduce inorganic waste.

Inferential statistical tests of significance using ANOVA showed that there were no significant differences ($P > 0.05$) in waste quantities generated in Budiriro when comparing quantities by month or by days within a month. Although the average household size in Budiriro 3 was 9, it has no impact on the variations. However, significant variations would be expected when comparing high density and low density suburbs where there would be significant variations in terms of individual earnings.

Waste Collection

The waste management system in Budiriro involves generation, storage, collection and disposal. Single and multiple-families in Budiriro use black

plastic paper bins (70%) and hard plastic bins (8%) for waste collection at household level. Some of the receptacles used include sacks (5%), cardboard boxes (10%), mealie-meal plastics (5%) and metal tins (2%). These bins are collected once-a-week through door to door collection according to the Harare City Council's plan. One plastic paper bin is provided per household per month by the city council. However, study results revealed that 80% of the respondents noted that bins are collected once-a-month or are never collected, and this contradicts with what is on the Harare City Council's master plan. Sometimes the plastic paper bins are torn before they are replaced at the end of the month. This has forced residents to use cardboard boxes and mealie-meal plastics which quickly filled up and overspill resulting in illegal burning and open space dumping. Masocha (2004) notes that the inconsistencies in solid waste collection in high density suburbs, result in the dumping of waste and this has led to excessive accumulation of heavy metals in the soil and as well as visual pollution.

In the past the Harare City Council provided plastic bins for household waste, but these were, however, used for other purposes such as storing water for domestic use due to the perennial water problems bedevilling Budiriro annually. Skips have also been provided at market places or shopping centres to cater for large quantities of waste generated and are emptied during the night shifts for improved efficiency in waste management. The distance from these skip bins deters residents from using them. To address the crisis bedevilling the amenities department in management matters (Williams, 2012), greater Harare was subdivided into eight zones headed by the zone manager who report on the overall operations of the zones on a daily basis for easy management.

The Harare City Council has a total of forty-seven refuse compactors to ensure that each of the city's 46 wards is serviced and twelve of these were received on the first of January 2013 from a private company in a bid to improve refuse collection (Williams, 2012). Some of the vehicles and solid waste receptacles used include front end loaders, skip trucks and skip bins, tipper trucks, skid steers as well as tractors. Highfields, Glen Norah, Glenview, Budiriro, Willowvale industrial area, Lochinvar, Southerton, Southerton industrial area,

Ardbennie industrial area and Workington industrial area have been allocated eight refuse compactors to cater for waste collection. Currently, only four refuse compactors operational and this has led to proliferation of illegal waste dumps within these communities due to fuel shortages and financial constrains to service them regularly.

Waste Disposal

Open space waste dumps are the prime breeding sites for houseflies, mosquitoes, rodents and other vectors for communicable diseases like cholera, dysentery, typhoid, malaria, fever and diarrhoea. Toxic smoke from burning waste causes acute respiratory infections and the odours are an environmental nuisance. Leachate from the dumpsites pollutes the ground water source (Saungweme *et al.*, 2012; Masocha, 2004) for the residents, for example in Glenview a neighbouring suburb to Budiriro, nine people died after drinking contaminated borehole water last year. Investigations made revealed that the contamination was from leachate from sewage leaks and leachate from waste dumps around the area and this has led to the clearing of these dumpsites by city of Harare. In addition, papers and plastics blown by wind from these dumpsites result in distortion of the aesthetic value of the suburb and the surrounding environment.

The use of plastic papers for bins has proved to be ineffective in solid waste management in Budiriro. Although they are cheap and easily available to the residents and light to lift up, they are not strong to hold more waste or scrap metals and bottles hence they tear off easily. Plastic containers/bins are the best option for household solid waste because of their durability. However, reports in Lagos have indicated that 89% of the city council workers especially those who load the trucks have been reported to have musculoskeletal disorders as a result of lifting these heavy bins. Residents were then advised to separate all biodegradable materials for composting as a way of reducing weights and up until now, the idea is still working. This strategy can be borrowed by residents in Budiriro for an improved waste management system in their local area.

Respondents were also asked to identify disposal methods suitable for certain types of solid waste. Results revealed the following methods: composting

for kitchen waste, landfill for electronic and construction waste, recycling for paper, poly-waste, bottles and cans and incineration for diapers. Although incineration and landfills are all over capacity, they are regarded as the best methods to dispose of solid wastes in large amounts such as those that cannot be composited or recycled. However, suppose City Council intends to locate an incineration plant or landfill for solid waste disposal in Budiriro, there are various factors to be considered essential and 90 respondents (58%) suggested that the most ideal site should be identified by experts in this field. This means that experts would choose an appropriate area that will reduce conflicts induced from air pollution. The study results also indicated that although people produce solid waste, they are much concerned about their health statuses. This is so because about 39 respondents (25%) have selected "any open space downwind of major buildings" as their important factor so that they are free from effects of toxic smoke produced.

Environmental health problems associated with solid waste generated in Budiriro 3

Some of the environmental problems associated with poor solid waste management identified by respondents were disease outbreaks, water pollution, odours, ecological disruption and resource depletion, toxic smoke and poor visibility. . Findings of this study also indicated that knowledge about the causes of climate change is still limited amongst the residents but they can easily identify effects of climate change in their area. Similar studies by Mangizvo (2007) and Banjo *et al*. (2009), have traced the causes of climate change to poor solid waste management in the urban environment; yet, people are still producing more and more waste.

Informal discussions with the residents of Budiriro revealed that people are not aware of what really is referred to as hazardous or non-hazardous solid waste. Further investigations confirm that environmental campaigns and adverts on radios and television are the main sources of information regarding issues on solid waste management. Much still has to be done to increase awareness to both residents and non-residents in Budiriro so as to curb outbreak of epidemics and other environmental health hazards such as pollution (air, water and land). In addition to this, frequency of trainings and or campaigns on solid waste management should be increased to at least one

a month addressing safety and health issues in high density suburbs. According to questionnaire responses, 68% of the respondents stay close to illegal dumpsites but only 9% received awareness training in fighting cholera and typhoid outbreaks by UNICEF and Red Cross. Further analysis revealed that about 108 (69%) of the respondents were interested in further training in this subject so relevant institutions involved should prepare a schedule and relevant materials for these trainings before it's too late.

Eighty percent of the respondents do not use personal protective equipment/clothing (PPE/C) when handling solid waste and this puts at risk the waste workers. For those using some form of protection, only 4% use gloves and 16%plastics to protect themselves from contracting the most common waste related diseases such as cholera, typhoid, skin rashes, flue as well as allergies and burning eyes, congenital anomalies and still births and low birth weight. In this study, cholera, typhoid, allergies and burning eyes are ranked as the most dreadful health problems associated with poor solid waste management. This rank might have been influenced by the cholera and typhoid outbreak of 2008 which has caused vital deaths in Budiriro.

Solid waste management strategies

There are various waste management strategies that could be employed to address the waste management challenges in Budiriro. These include the four Rs waste management approach that is Reduce, Reuse, Recycle and Rethink. From this study, 75% of the respondents believed that waste can be turned into marketable products or used again for other purposes after the original use. However, mistakes generate new ideas. These strategies have reduced waste on landfill sites in most developing and developed countries but still waste is a problem in high density suburbs of developing countries (Mubaiwa, 2013 and Jerie, 2006) hence this has called for rethinking. Rethinking improved the waste management system and has been found to be effective in Harare, Zimbabwe whereby new dimensions in collaboration

and integration with private sectors to support community based projects in waste recycling and upcycling is peaking.

Reuse is taking a product or material at the end of its original use for the same or other purposes without processing the material. It is found in two forms that is *conventional reuse*, whereby the item is used again for the same function for example a broken water bucket can be mended and used again for storing water. *New-life reuse*is whereby the item is used for a different function for example old buckets can be used as flower pots. This strategy is not well understood by most of the residents in Budiriro 3 but is economical in that it saves money, time and resources by taking useful products and exchanges them without processing and in the same manner saving space in the sanitary landfill. More examples include door to door delivery of milk in refillable bottles, use of reusable plastic bags, rethreading of tyres.

Recycling is the breaking down of the used items into raw materials which are used to make new items (Spinardi *et al.*, 1998). Recycling is all well and good but if one wants serious eco-credentials, up-cycling is the way to go. As opposed to recycling, which requires much energy and transport resources to turn something into another thing of lesser value, up-cycling involves turning an unwanted object into something of equal or ideally greater value. For example one can make leather jewellery from worn out shoes and discarded meat bones. Women in the Philippines up-cycle tetra pouches to funky bags for Oxfam and handbags from old bicycle inner tubes.

In this study 76% of the respondents agreed that solid waste can be of economic/financial value while 24% of the respondents disagreed. The reason why some of the respondents disagreed is that people perceive things differently and this is why there is no consensus definition of what is called 'waste'. Those who agreed that 'there is money out of waste' would consider starting an income generation project based on solid waste in their community. Plastics & plastic bottles, cans and scrap metal are the top three solid materials they can recycle easily. The challenges that hinder residents to recycle waste are summarised in Table 2.

Table 2: Challenges faced by waste recyclers

Rank No.	Major challenge	Frequency response	Percentage response
1	Lack of knowledge	77	49%
2	Lack of benefits or incentives	44	28%
3	Ignorance	43	27%
4	Limited resources	41	26%
5	Distance from recycling bins	35	22%

As indicated in Table 2, lack of knowledge is the major challenge to waste recycling in Budiriro. This is because information on recycling in the media is not equally spread for the consumption of all. However, if it is spread, the assumption would be that everyone knows what recycling is, and its benefits of which that would not be the case. To some extent, limited resources such as fiscal and other equipment to carry out recycling projects are the main deterrents hence few poor residents end up scavenging for recyclable materials from dumpsites and public binsand send them to recycling centres where they are paid very few money to cater for their families. Sometimes recycling bins are placed a distant away from individual household therefore people find it difficult to carry their waste to these bins rather they mix their waste and wait for collection by city council or dump in open spaces at night. Ignorance is of no exception thus need for behaviour change programmes and environmental pressure groups.The findings of this study indicated that residents prefer recycling bins to be placed at every collection point or can be given per individual household if possible. However, due to financial challenges within the waste management department and the nation as a whole, it would be wise to increase the number of collection points maybe one in a suburb for ease of ease access within individual communities.

Conclusion and recommendations

This study revealed that solid waste quantities are ever increasing, but the problems faced by Harare City Council to render effective and consistent

solid waste collection and disposal services in high density suburbs remain unabated. The main challenges identified include lack of cooperation by some residents, inadequate transport and finance, and poor health care services. To address these challenges, the following recommendations could be adopted:

❖ An integrated waste management strategy must be fully implemented to ensure a radical change in solid waste management in Budiriro. The Harare City council must engage and integrate with other stakeholders and private companies to help push the waste log until they restore the glamour of the city. Otherwise the tourism exhibition day in December this year can be reached with no significant change in as far as waste management is concerned. This will tarnish the image of our country.

❖ The Harare City Council should come up with a waste management model for each constituency for example Budiriro or Mabvuku constituency so as to improve the waste management system of the city.Following this model, There should be twice-a-week collections of waste in high density suburbs since the once-a-week collections have proven to be inadequate and promote illegal dumping;

❖ Waste collectors need to be advised not to rapidly rush through the residential areas during collection as much waste is strewn all over the roads.

❖ NSSA needs to ensure adequate provision of Personal Protective Equipment or Clothing (PPE/C) to all public workers especially those in the waste management sector in a bid to minimise environmental health risks as well as safeguard their health from solid waste related diseases.

❖ EMA must come up with environmental pressure groups to encourage community actions in nature conservation. Environmental campaigns and fostering of environmental laws, policies and education have been practiced sometimes at full force but still poor waste management still knocks the doors. Environmental education and awareness must target at changing human attitude and thinking towards solid waste as the basis for good solid waste management.

❖ EMA to ensure that CBOs are spread in all high density residential suburbs and support their projects through educational campaigns and awarenesson environmental health threats associated with poor solid waste management. Projects based on recycling and reuse help reducing amounts of solid waste and delay the time of disposal thus saving landfill space.

❖ The Harare City Council must provide enough bins per household at least two per month and increase the collection frequency to avoid strenuous conditions. Clearing open space dumps by the municipality of Harare within the residential areas would be highly appreciated.

❖ Since most of the trucks and waste compacters are imported from other countries their maintenance would pose a challenge therefore, Harare municipality must increase refuse charges to keep in line with rising need for maintenance of equipment and transport. Alternatively, they can increase fines for illegal dumping of solid waste so that this would act as strong deterrents to illegal dumpers. By so doing, residents would opt to pay for collection rather than dumping everywhere hence improving solid waste management in high density suburbs.

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