Research Article

Solid Waste Management Practices in the Informal Sector of Gweru, Zimbabwe

Steven Jerie[1] and Daniel Tevera[2]

[1]Department of Geography and Environmental Studies, Midlands State University, Gweru, Zimbabwe
[2]Department of Geography and Environmental Studies, University of the Western Cape, Robert Sobukwe Road, Bellville 7535, South Africa

Abstract
Full-Text PDF
Full-Text HTML
Full-Text ePUB
Full-Text XML
Linked References
How to Cite this Article

Abstract

This paper contributes to the debate on the role of the informal sector in solid waste management by examining the effectiveness of informal sector solid waste management practices in transforming waste into nonwaste in the city of Gweru in Zimbabwe. The study focused on 589 informal enterprises that were surveys using questionnaire interviews and focus group discussions with key informants. Analysis of solid waste management in the informal sector of Gweru has revealed that large amounts of waste are generated indicating poor material efficiency in the enterprises, especially in food market areas where huge amounts of biodegradable material and vegetable wastes are generated and disposed of haphazardly. Analysis of the key factors that include solid waste generation rates, collection frequencies and transportation, waste minimisation, and reduction practices showed that the current waste management system is unsustainable in the long run. The municipality of Gweru needs to provide more resources for financing, training, and manpower to enable effective provision of an environmentally friendly solid waste management system in the city, including the informal sector.

1. Introduction

Urban solid waste management is considered to be one of the most serious environmental problems confronting developing countries [1] and the city of Gweru in Zimbabwe is no exception. Economic implosion in Zimbabwe has resulted in high levels of unemployment estimated at 80% [2–5]. This has led to the growth of home industries in Gweru and around the city centre and high density suburbs such as Mkoba, Monomotapa, Mambo, Ascot, and Senga. Solid waste generation in these suburbs is very high given their spatial extent and population. This is putting much pressure on the waste disposal system in place and as a result a lot of waste is left uncollected creating a health hazard. The aim of this paper is to examine the solid waste management practices in the informal sector of Gweru, the third largest city in Zimbabwe.

Waste management refers to the collection, transport, recovery, and disposal of waste, including the supervision of such operations and after-care of disposal sites. It concerns itself with the existing amount of waste, trying to minimize the human-waste or environment-waste interface and to minimize potential impact. Waste management should concern itself not only with final disposal of waste but also with the whole cycle of waste creation, transport, storage, treatment, and recovery and does so to minimize pollution. According to the waste management pyramid, the waste management strategies need to be based on prevention measures and measures such as recovery and disposal are secondary. Waste minimization measures include waste prevention, internal recycling of production waste, and source-oriented improvement of waste quality and reuse of products for the same purpose. Also external recycling, sorting of waste, reuse for another purpose, and energy recovery are included as waste management measures. Waste management is also viewed as the control of waste-related activities with the aim of protecting human health and the environment and resources conservation. Waste related activities include waste-creating processes, waste handling processes, and waste utilisation. This paper examines the waste management practices in the informal sector of Gweru with the aim of determining whether these practices have helped to reduce environmental contamination in the city.

Collection costs have been estimated to represent about 50 to 70% of the total cost of solid waste management, ziment, depending on the disposal method Tchobanoglous et al. (1993) [6]. Refuse collection is a difficult and expensive aspect of solid waste management in developing countries [7] and accounts for 70% to 90% of costs in developing countries [8, 9]. However, in most developing country cities, such as Addis Ababa (Ethiopia) and Ibadan (Nigeria), efficient refuse collection is complicated by poor roads and heneral access problems which make house-to-house collection difficult and expensive. Even in those areas where house-to-house collection is practicable, lack of collection vehicles makes the process irregular and unreliable. Refuse character and availability of trucks affect frequency of collection. The solid waste generated in African cities is largely organic and exhibits relatively high moisture content. Its odour attracts flies and rodents and this is why collection should be frequent and regular [6, 10]. Separating urban solid waste into classes such as paper, glass, plastics and metal at the source is a very efficient way of collecting waste because it makes recycling, reutilisation or energy recovery a lot easier [11]. It is important to have an appropriate system of selective collection at source. Selective collection is the point of contact between generators and disposal operators. Therefore, the model of collection must strike a

balance that satisfies both parties [12].

The identification of suitable sites and methods of waste disposal is one of the major challenges facing many urban authorities today [6, 13–16]. This is exacerbated by the NIMBY (not in my backyard) syndrome whereby no one wants the dumpsite in his or her backyard, but all the same want the waste removed and dumped somewhere else [17, 18]. Landfills represent the dominant alternative for municipal solid waste disposal in most parts of the world [15, 19]. In many emerging economies, municipal solid waste disposal by sanitary landfill is regarded as the most cost-effective method to protect human health and the environment. In South Africa, almost all collected municipal solid waste is land-filled [19]. Similarly, over 80% of municipal solid waste generated in China is landfilled. Landfilling provides the cheapest and most convenient method of waste disposal today when operated efficiently [15, 19].

Waste in many developing countries is ideal for conversion into organic fertiliser, and economic factors favour composting in those countries where food production is of great importance [20–22]. Refuse composting converts the fermentable organic content of refuse into a soil conditioner. In the poorest countries very simple screening and manuring can produce good results considering the economic realities which the populations face. The Harare City Council at one time operated a composting plant just less than one kilometre from the former Mabelreign drive-in-cinema [10]. This converted refuse free from nonbiodegradable material into organic manure. Operations at the plant slowed down largely due to costs, as manure is bulky and hence expensive to transport. As in composting, modern incineration is not common in the developing countries because the refuse has a low calorific value [6]. The operation of huge urban incinerators without coupling them with heating and power generation is too expensive for most developing countries.

2. Methodology

A number of key stakeholders involved with the solid waste management Gweru sector were identified for interviews on solid waste management practices in the informal sector. These included public institutions and government ministries, waste management service providers, and their clients as well as nongovernmental organisations and some local doctors specialising in occupational safety and health and epidemiology. In the Ministry of Local Government, Rural and Urban Development, two officials involved with urban development were interviewed formally using structured interview guides. The Gweru City Council is directly involved as a waste management service provider and five interviews were conducted with the physical planner, the Amenities Division Manager, the Senior Health Environmental Officer, the Cleansing Supervisor, and the city chemist. Interviews were also conducted with the Education and Publicity and the Planning and Environmental Impact Assessment officers of the Environmental Management Agency. The National Social Security Authority's Principal Factories Inspector was also interviewed on issues pertaining to occupational safety and health in the informal sector. Chairpersons of the informal sector enterprises in each of the spatial locations are key in providing in-depth information on issues relating to solid waste management that include generation, collection disposal, and options for an environmentally sustainable waste management system and these were interviewed.

Questionnaire surveys were used to achieve the immediate objectives of the research and to gather data on the informal sector of Gweru. The study population for questionnaire surveys comprised all the 589 organised informal sector enterprises in Monomotapa low-income high density suburb, Shamrock Park medium-income, medium density suburb, Mkoba low-income high density suburb, Ascot low-income high density suburb, Kudzanai market, and Kombayi market. Focus was on these areas because of the large concentrations of informal enterprises that include retail, service, repair, manufacturing, and construction activities. To gather data on critical areas of solid waste management in the informal sector, the design as recommended by Oppenheim [23, 24], and Baker [25] was used so as to reduce ambiguity or bias. The questionnaire covered aspects of the objectives to investigate issues concerning informal sector enterprise waste generation and disposal practices, availability and type of waste disposal services, and perceptions of informal sector operators. The questionnaire administered to the home industry operators aimed at collecting information on the quantity and type of waste produced, waste collection, and disposal practices and the enforcement of legislation. The instrument was divided into appropriate sections to allow for the systematic collection of data from the enterprises in the different spatial locations of Monomotapa, Shamrock Park, Mkoba, Kudzanai, Kombayi Market, and Ascot. The survey questionnaire was semistructured, containing both open-ended and closed-ended questions. Interviews were for the purpose of gathering information on the waste management system in Gweru's home industries, occupational safety, and health problems associated with solid waste management, planning for waste management in informal enterprises, environmental impact of waste produced in the home industries. The interviews targeted policy makers and planners in the organisations dealing with waste management.

Waste disposal sites were also observed in order to gather data on the standards of maintenance as well as environmental quality in the informal sector enterprises or nearby communities. In the course of field observation, photographs were taken of waste scenes such as waste storage containers, transportation, and disposal of the waste. It was also helpful to participate in the waste collection tours with waste labourers as they went about their work in the informal sector enterprises and other parts of the city of Gweru for comparison. This exercise assisted in gaining first-hand information on the situation in the study areas including sold waste disposal habits of the enterprise operators, level of waste disposal services available, collection, transportation and disposal of waste, and safety, health, and environmental problems associated with solid waste management.

3. Results and Discussion

3.1. Generation, Collection, and Disposal of Solid Waste

Significant quantities of solid waste are generated in the informal sector of Gweru especially in market areas that focus on retailing of vegetable and food products and the industrial sectors involved in manufacturing and construction. The major components of the waste stream include food and vegetable wastes at Monomotapa, Ascot, and Mkoba (51%, 29%, and 18% of total weight, resp.), metals at Shamrock Park, Monomotapa, and Mkoba (36%, 31%, and 19% of total weight, resp.), and paper at Mkoba, Ascot, and Kudzanai (11%, 11%, and 9% of total weight, resp.). Solid waste generated in the retail sector is dominated by biodegradable waste in the form of food and vegetable waste as well as long-term biodegradable (incinerable) wastes such as paper, textiles, rubber, and leather products. The biodegradable waste stream dominates in the market areas of Kudzanai and Kombayi where it constitutes an average of 57.1% of waste generated in these areas. In the market areas located in Ascot and Mkoba, the biodegradable fraction comprises 31.6% and 20%, respectively, of the waste generated in those areas. It is important to note that biodegradability is a vital biological characteristic of the organic component of solid waste. Establishing biodegradability of solid waste is essential because the majority of environmental and health problems associated with waste generated in the enterprises are caused by the biodegradable components especially when the collection and disposal systems are inefficient.

3.2. Vehicle and Equipment Performance Standards

The city of Gweru has only two compactors that are currently being used for waste collection. The cleansing superintendent emphasised the inadequacy of the waste collection fleet when he noted that "the two trucks are not able to service all the settlements taking into account the

increasing population of Gweru as well as the mushrooming informal sector as well as the shrinking of the formal sector and associated retrenchments." A tractor is also used by the city council for waste collection, but it normally breaks down and this normally results in delayed collection in areas normally serviced such as the informal enterprises close to the city centre such as the markets. The Gweru City Council faces high vehicle breakdown rates because of poor road conditions and inadequate maintenance of vehicles. As a result of stringent budgets, the limited financial resources are committed to maintaining collection vehicles. Maintaining an adequate inventory of spare parts has posed problems for the local authority when makes of vehicles imported from different sources are being used. This scenario has resulted in the refuse removal section of the Gweru City Council having inadequate equipment which does not perform efficiently. Some of the vehicles used for refuse removal are old and are constantly breaking down. In some cases the local authority had bought unsuitable vehicles such as the Bedford trucks with very high down times because they were not designed to transport waste. This, together with the maintenance of some of the older vehicles, has pushed the repairs and maintenance budget of the Gweru City Council. The maintenance cost of aged equipment takes up between 30% and 40% of the total expenditure on waste management. The capacity of some of the vehicles used such as tractors is too small for the wastes it has to carry, for example, that generated at Kudzanai.

3.3. Frequency of Collection and Time Spent on Collection

The collection frequency rates of solid waste generated in the city of Gweru are shown in Table 1 indicating that it is expected that waste is collected daily in the city centre and market areas and at least once a week in the residential areas, industrial areas, hospitals, and schools and colleges. The frequency of solid waste collection in the enterprises is not adequate to effectively remove all the waste. In the market areas such as at Kudzanai and Kombayi heaps of uncollected solid waste are evidence of the inadequacy in waste collection frequencies. The erratic collections are not in line with the World Health Organisation stipulation that solid waste should not be left standing in market areas for more than 48 hours. As many as 96% of the enterprise operators interviewed indicated that the waste collection services were erratic and inadequate. It was also observed that the movement of waste collection crews is so rapid in the enterprises to the extent that some of the bins are not completely emptied and some of the waste is strewn all over the ground. The rapid movement of collection crew is prompted by the need to complete a shift quickly and the absence of a monitoring system by the city authorities.

Table 1: Municipal solid waste collection frequencies for Gweru.

About 24% of all the enterprises revealed that they stored waste in their premises for 1-2 days before placing it at the curbside for collection, 30% for as long as 3-4 days and 46% for up to a week or more. The length of time the waste is stored within the premises of the enterprises is determined primarily by the collection frequencies by the city council of Gweru which on average is expected to be once a week. Those enterprises that store waste within their premises for 1-2 days are essentially those that are located close to the city centre at Kudzanai market and Kombayi market and in areas where collection is expected to be undertaken daily due to the perishable nature of commodities sold here such as vegetables. Enterprises in other areas such as Monomotapa, Ascot, Shamrock Park, and Mkoba store waste within their premises for longer periods because the collection frequencies may be erratic despite the fact that the waste is expected to be collected once a week. The implication of this is that, with more waste not being collected timeously, the enterprises resort to open dumping. In turn the open dumping manifests wastage of resources that could have been recovered for other uses that include energy generation.

3.4. Cost of Waste Collection

Currently, the city council does not know how much it costs them to remove a unit of solid waste. It is the treasurer's department that determines the amount to be paid per enterprise or household as an income generating activity for council as a whole rather than relating it to the actual cost of the service. The absence of reliable information makes it impossible for the Gweru City Council to compute the average vehicle cost per kilometer. The objective of an efficient service needs to be the minimization of solid waste costs and the maintenance of an adequate and regular service. According to council officials, on average 40%–70% of the total expenditure incurred in solid waste management was spent in collecting and transporting waste to disposal sites. The acquisition of inappropriate equipment and vehicles such as compactors by the city council resulted in inadequate maintenance due to the need for costly imported spare parts. Improved compatibility between each of the three stages of storage, collection, and transport is essential to ensure efficient operation.

3.5. Waste Collection and Disposal Facilities

In the informal enterprises that generate relatively large quantities of solid waste such as those at Kudzanai market and Shamrock Park skips are used as temporary waste disposal and storage sites. One huge skip is located at the main market and bus terminus at Kudzanai and outside the main entrance to Shamrock Park industrial site and at Monomotapa. There are, however, many factors that needed to be considered in the location of the skips. Firstly, the surrounding community should have been consulted to curtail any negative impacts of waste and there should have been agreement on how to deal with the impacts. At Kudzanai market, Shamrock Park, and Monomotapa there were no consultations made with the neighbouring residential areas regarding the potential impacts of the solid waste. Questionnaire surveys in the enterprises revealed problems such as odours from rotting waste, smoke from burning waste, and rodents as potential health hazards. Another problem with skips is that they are not monitored for any illegal dumping. Each enterprise has the task of carrying waste from its premises using card board boxes, sacks, plastic bags, and dishes, for dumping in or outside the skips. Most of the enterprises indicated that they dumped their waste inside the skips although observations indicated that some illegal dumping was taking place in the backyards and the open spaces around the informal enterprises. Wood shavings, paper, cardboard boxes, plastics, and tyres were also seen burning with huge amounts of smoke emanating from the area.

The dumping sites are also exposed to animals such as dogs, cats, and other rodents and these scatter the waste during scavenging activities. Table 2 shows the most common waste disposal methods in the informal sector enterprises of Gweru and these were derived from a total of 589 questionnaire responses.

Table 2: Methods of solid waste disposal used in the informal enterprises (%).

The data in Table 2 reveals that there are five main methods for solid waste disposal used in the informal sector enterprises because of inadequate and inefficient collection and these are open dumping, burning, open dumping and burning, incineration, and landfilling. The most common method used to dispose the waste is through open dumping of waste by 383 (65%) out of the total of 589 enterprises and burning of waste is the second most popular method of disposing the waste as reported by 131 (22%) of the enterprises. The factors that were cited as influencing open

dumping of solid waste are summarised in Table 3 and these include lack of solid waste disposal facilities (50% of the enterprises), the nonexistence of penalties for dumping, lack of enforcement of legal deterrents by way of penalties (25% of the enterprises), inadequate information on waste disposal and management in general (22% of the enterprises), and the desire to save on disposal costs as shown in Table 3. A total of 292 (50%) respondents identified absence of municipal solid waste management facilities as the key factor responsible for open dumping of waste in the informal sector enterprises. The enterprises that reported that lack of facilities promoted open dumping of waste included the service sector (63% operators), the retail sector (50%), the repair sector (49% operators), the manufacturing (45% operators), and the construction sector (39% operators). In confirming the problems associated with collection and disposal of solid waste generated in the informal sector enterprises, the Education and Publicity Officer in the Environmental Management Agency noted the following.

Table 3: Reasons cited for dumping solid waste (%).

"There are inadequate waste collection and disposal facilities that have been put in place by Council in the form of skips and metal or plastic bins. Look, areas such as Kudzanai market generate large amounts of waste in a single day and this does not match with the few bins that have been provided as receptacles for collection. The enterprise operators have nowhere to dispose of their vegetable and food waste as well as other types of waste such as cardboard, paper and plastic due to the rapid filling of the few disposal bins provide by the Gweru City Council. Such open dumping of waste is improper and can result in a number of environmental and health hazards."

The respondents held several views regarding the prevalence of open dumping. A total of 152 (25%) of the respondents reported that the Gweru City Council lacked the will to enforce penalties for open dumping of solid waste as stipulated by the Gweru City By-Laws. 127 (22%) of the respondents were of the view that the main reason for open dumping of waste in Gweru was the absence of timely information on sustainable disposal options and a small number (3%) of the respondents attributed waste dumping to the need to maximise profits by saving costs. These factors have resulted in the undesired dumping of solid waste.

All in all, the challenges experienced in the collection of waste in the informal sector of Gweru are similar to those experienced in other urban settlements in Zimbabwe. Waste is bulky and can be poisonous when not handled properly and can affect the health of workers and residents and can also damage the vehicles used for transportation and disposal of waste. The subcontracting of refuse collection services to private contractors in Gweru has failed because waste collection as a business is less profitable when compared with the investment made and this leads to inefficiency and dishonesty by the contracted companies. The economy of Zimbabwe heavily relies on agriculture and industrial manufacturing with different seasons being associated with particular types of waste and there is thus need for the waste authorities to ensure that the waste collection equipment is suited to different seasons. This in turn poses challenges of having several types of waste removal fleet since the council is already experiencing challenges in deploying an adequate number of vehicles and containers resulting in waste being collected after a long time or in some cases not being collected at all.

3.6. Analysis of Waste Minimisation and Recycling Behaviour

The extent to which solid wastes can be reduced recovered and recycled needs to be an integral part of any solid waste management system. The first step needs to be the reduction of waste at the point of generation. Included here are returnable bottle deposits and containers such as glass, metal, and plastic and not food jars, plastic and paper cups, liquor bottles, and so forth. In the informal enterprises significantly more enterprises reported recycling as the most friendly method of managing solid waste with waste minimisation (waste prevention/source reduction) as the second most preferred option (Table 4).

Table 4: Environmentally friendly methods of managing waste in the enterprises %.

In the informal sector enterprises, 191 (32%) respondents indicated that they would source-reduce waste and 296 (50%) of the respondents indicated that they would prefer to recycle waste and hence a total of 487 (82%) respondents were considered the potential "reducers-recyclers" in the informal sector of Gweru. Waste minimisation is the most dominantly preferred in the service sector (57%) and it is the second most dominant way of managing waste in the retail enterprises (35%), the repair (20%), the manufacturing (26%), and the construction (25%) enterprises. On the other hand recycling dominates as a preferred method of waste management in construction (70%), repair (68%) manufacturing, and retail enterprises (45%).

The most common methods for the source reduction of solid waste unknowingly employed by the informal operators were the reuse of waste materials (as well as the repair and reuse of things that had been damaged). The other methods involved in source reduction take into account the attitudes of the enterprise operators in their decision whether to buy particular raw materials. The most important aspects considered include the durability of the raw materials, whether the products' package can be reused, possibilities for reusing the products, amount of packaging included with the raw materials, and whether the raw materials are from renewable resources. With the exception of the third, fourth, and fifth methods discussed above, percentages of enterprise operators for all other methods differed significantly among the enterprises. As an example, among all the methods, reusing waste materials was the greatest with the same importance in Monomotapa, Shamrock Park, and Mkoba and the least important at Aswcot.

3.7. Products from the Recycling of Solid Waste

The most commonly recycled materials at Monomotapa and Shamrock Park include ferrous metal from tin cans and scrap metal from old vehicles and nonferrous metals such as aluminium, copper, and lead. Heavy metals such as zinc, mercury, and silver are also recovered from vehicle and household batteries while automobile and truck tyres and road building materials are recovered from tyres for recycling. Recyclable construction and demolition wastes in Monomotapa and Shamrock Park have been a source of soil, asphalt, concrete, wood, dry wall, shingles, and metals for builders and have in some cases constituted up to 25% of the building and construction material. The materials recovered from recycling differ significantly between the enterprises mainly involved with manufacturing and construction (Monomotapa and Shamrock Park) and those mainly concerned with retailing, repair, and service functions at Kudzanai market, Kombayi market, Ascot, and Mkoba.

4. Conclusion

Analysis of solid waste management in the informal sector of Gweru has revealed that large amounts of waste are generated indicating poor material efficiency in the enterprises. This situation is characteristic of the market areas such as Kudzanai and Kombayi markets where huge

amounts of biodegradable food and vegetable wastes are generated and dumped haphazardly. The major causes of the solid waste problem in the informal sector can be traced to the lack of urgency in dealing with the waste management problem by both the central government and the city authorities. This is mainly due to the nonexistence of a waste policy that provides a framework for the planning and organisation of waste management activities as well as the weak enforcement of legislation that makes reference to environmental management and solid waste management. There is clearly lack of public education on issues that deal with environmental management by the various institutions mandated with this task and these include the Environmental Management Agency (EMA) that falls under the Ministry of Environment and Natural Resources, the Ministry of Local Government, the Ministry of Education Sport and Culture, the Ministry of Health, the National Social Security Authority (NSSA), and various nongovernmental organisations such as Environment Africa.

There is a marked dearth of solid waste management data in as far as the informal sector of Zimbabwe is concerned. Creating a data base for the informal sector of Gweru could encourage other local authorities and the central government to encourage research on the generation rates of solid waste with regard to the various sectors of the local economies, the collection, and disposal practices as well. Data on the characteristics of solid waste generation would assist in the planning of appropriate strategies to manage the waste. Education is vital in raising awareness on environmental management issues and especially solid waste management. This is an area in which the Environmental Management Agency under the Ministry of Education could play a part through its education and publicity department.

In order to prevent or minimise waste generation in the informal sector of Gweru, there is need to control the enterprise activities undertaken thereof. This can be done by adopting an integrated approach, one that integrates waste management activities into the waste management system of Gweru. There is need to fully integrate the informal sector into the solid waste management system of the city of Gweru and also prioritise the waste management strategies following the order presented in the waste management hierarchy. This means educating the informal sector enterprise operators on the merits of waste prevention, waste reduction, reuse, and recycling as well as composting and energy production from waste. In this study, it has been observed that the bulk of waste generated in the market areas comprises organic waste and hence composting could be a vital solution for preventing waste from ending up in the least desired disposal option, the landfill. The success of a programme of selective collection lies in the participation of citizens which determines the type and amount of materials to be collected.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

Acknowledgments

References

1. A. H. Sinha and M. M. Enayetullah, The formal and informal sector linkages in waste recycling: a case of solid waste management in Dhaka City [M.S. thesis], 2000.

2. S. Hanke, Zimbabwe Earns Second Place in Hyperinflation History, John Hopkins University, Baltimore, Md, USA, 2009.

3. T. Kairiza, Unbundling Zimbabwe's Journey to Hyperinflation and Official Dollarization, GRIPS, Tokyo, Japan, 2009.

4. Financial Gazette, Dollarisation of Zimbabwe's Sickly Economy, Financial Gazette, Harare, Zimbabwe, 2009.

5. L. Mambondiani, Zimbabwe Should Admit Dollarization, The Zimbabwe Times, Harare, Zimbabwe, 2008.

6. G. Tchobanoglous, H. Theisen, and S. Vigil, Integrated Solid Waste Management Issues, McGraw Hill, New York, NY, USA, 1993.

7. City of Gweru, Annual Report, Gweru City Council, Gweru, Zimbabwe, 2011.

8. UNDP, The Informal Economy, SMEs and the Mining Middlemen in Zimbabwe, UNDP, Harare, Zimbabwe, 2010.

9. UNEP, Framework for Global Partnership on Waste Management, Note by Secretariat, 2010, http://www.unep.cr.jp.

10. D. S. Tevera, "Solid waste disposal in Harare and its effects on the environment: some preliminary observations," The Zimbabwe Science News, vol. 25, no. 1–3, pp. 9–13, 1991. View at Google Scholar

11. A. Gallardo, M. D. Bovea, F. J. Colomer, M. Prades, and M. Carlos, "Comparison of different collection systems for sorted household waste in Spain," Waste Management, vol. 30, no. 12, pp. 2430–2439, 2010. View at Publisher · View at Google Scholar · View at Scopus

12. P. L. González-Torre and B. Adenso-Díaz, "Influence of distance on the motivation and frequency of household recycling," Waste Management, vol. 25, no. 1, pp. 15–23, 2005. View at Publisher · View at Google Scholar · View at Scopus

13. S. Jerie, "Sound sanitary landfilling: a sustainable option for waste disposal in Harare and Gweru, Zimbabwe," OSSREA Bulletin, vol. 2, no. 3, pp. 78–87, 2005. View at Google Scholar

14. S. Jerie, "Landfill site selection in Gweru: a GIS approach," OSSREA Bulletin, vol. 4, no. 3, pp. 35–40, 2007. View at Google Scholar

15. J. Krook, N. Svensson, and M. Eklund, "Landfill mining: a critical review of two decades of research," Waste Management, vol. 32, no. 3, pp. 513–520, 2012. View at Publisher · View at Google Scholar · View at Scopus

16. D. S. Tevera, Waste Recycling as a Livelihood in the Informal Sector: The Case of Harare's Teviotdale Garbage Dump Scavengers in Harare. In Zinyama, University of Zimbabwe Publications, Harare, Zimbabwe, 1993.

17. S. Jerie, "Environmental problems in Gweru and Kwekwe, Zimbabwe: a focus on domestic solid waste management," UNISWA Research Journal of Agriculture, Science and Technology, vol. 9, no. 2, pp. 179–185, 2006. View at Google Scholar

18. A. Ray, "Waste management in developing Asia: can trade and cooperation help?" The Journal of Environment & Development, vol. 17, no. 1, pp. 3–25, 2008. View at Publisher · View at Google Scholar · View at Scopus

19. J. W. F. Morris and M. A. Barlaz, "A performance-based system for the long-term management of municipal waste landfills," Waste Management, vol. 31, no. 4, pp. 649–662, 2011. View at Publisher · View at Google Scholar · View at Scopus

20. L. Dahlén and A. Lagerkvist, "Methods for household waste composition studies," Waste Management, vol. 28, no. 7, pp. 1100–1112, 2008. View at Publisher · View at Google Scholar · View at Scopus

21. T. C. Nzeadibe, "Solid waste reforms and informal recycling in Enugu urban area, Nigeria," Habitat International, vol. 33, no. 1, pp. 93–99, 2009. View at Publisher · View at Google Scholar · View at Scopus

22. K. Parizeau, V. Maclaren, and L. Chanthy, "Waste characterization as an element of waste management planning: Lessons learned from a study in Siem Reap, Cambodia," Resources, Conservation and Recycling, vol. 49, no. 2, pp. 110–128, 2006. View at Publisher · View at Google Scholar · View at Scopus

23. A. M. Oppenheim, Questionnaire Design, Interviewing and Attitude Measurement, Pinter Publishers, London, UK, 1992.

24. D. A. de Vaus, Surveys in Social Research, Routledge, London, UK, 5th edition, 2007.

25. M. J. Baker, "Data collection-questionnaire design," The Marketing Review, vol. 3, no. 3, pp. 343–370, 2003. View at Publisher · View at Google Scholar

26. Gweru City Council, Waste Collection Frequencies, City Health Department, Gweru, Zimbabwe, 2013.