Journal of Sustainable Development in Africa (Volume 11, No.2, 2009)

ISSN: 1520-5509

Clarion University of Pennsylvania, Clarion, Pennsylvania

ANALYSIS OF DOMESTIC SOLID WASTE MANAGEMENT SYSTEM: A CASE OF SAKUBVA HIGH DENSITY SURBURB IN THE CITY OF MUTARE, MANICALAND PROVINCE, ZIMBABWE

By

I.O. Manyanhaire

Geography and Environmental Studies, Zimbabwe Open University, Zimbabwe

E. Sigauke and D. Munasirei

Geography and Environmental Studies, Africa University

ABSTRACT

The study analyzed the domestic solid waste management system in Sakubva High Density Suburb of the City of Mutare. One hundred heads of households participated through answering a pretested questionnaire, which was triangulated with field observations, interviews, and secondary data sources, such as maps and official documents. The solid waste management system comprised generation, storage, collection, transfer, transport, and disposal following two basic waste streams. One was the formal and the other was informal. The system was characterized by inconsistency, inadequacy, irregularity, and a number of environmental-health impacts were associated with the malfunctioning system. In light of the ineffectiveness of the system, the study recommended that the council, community, and other important stakeholders come up with all-inclusive strategies towards an adequate, well-designed, and sustainable solid waste management plan for the city.

Key Words: Waste, Solid waste, Generation, Handling, Collection, Disposal

BACKGROUND TO THE STUDY

Domestic solid waste management has emerged as a dominant urban environmental issue that has attracted academic, economic and media debates, and has over the years developed into an independent discipline. However, despite this formidable growth in content and general awareness, the waste management system in the third world city has either crumbled or is non-existent altogether. The theoretical approach to the subject identifies seven major components of the solid waste management system. These are waste generation, storage, collection, transfer, transport, processing, and disposal (Tevera *et al*, 2002).

Waste generation includes activities in which materials are identified as no longer of any value and so are either thrown away or gathered together for disposal (Theodore and Theodore, 1996). In the late 1990s, it was estimated that each person in the world generated 200 kg of solid waste per year (UNCHS, 2001) and this was forecasted to increase with the growth in population. At a more regional study by Mukuka and Masiye (2002), a similar trend was revealed that there was a quasi linear relationship between population growth and waste produced in Lusaka, Zambia. A more alarming example was also found in Indonesia's region of Jabotatek, which includes Jakarta, where population growth was fast and waste generation rate was estimated at 50,000 m^3/day or 7 million tons per year (Otten, 1996). The rate of increase in the quantity of waste generated in relation to the population size can only worsen urban environmental issues and planning as a whole.

In low income cities of India, it has been estimated that 15.62% of domestic waste is vegetable matter, 4.35% is paper, 0.55% is rubber and leather, 0.62% are plastics, 4.00% are rags, 0.40 % wooden paper, and 0.62% are metals (Bhatia, 2003). These figures are somehow different from the African scenario as represented by findings from Chirundu, Zambia where 10% of household waste was paper, 7% plastic, 6% metal, and 72% was food waste (Masundire and Sanyanga, 1999). Therefore, components and amounts of waste generated vary for different towns and cities. A number of determinants account for the type of waste generated. These include consumption patterns, as well as lifestyles. Sanyanga and Masundire (1999) found that Kariba and Victoria Falls had the same population size of 30,000. However, due to greater consumptive lifestyle and higher per capita income, Victoria Falls generated five times as much waste than Kariba. It is essential to note that waste generated also varies according to levels of economic development, seasons of the year, and public attitudes.

Once waste is generated at the household level, it has to be handled in a manner that facilitates easy disposal. Waste handling and separation involves activities that are associated with the management of waste until they are placed in storage containers for collection (Tchobanoglous *et al*, 1993). Waste storage involves the management of wastes until the generator places them in a suitable container for collection. Storage containers include black refuse bags, hard plastic bins, skips, metal bins, informal bags, and bulk containers. Waste receptacles differ in shape, size, and materials, which they are made of. They also differ in durability; for example, metal bins have a life span of about five years and carry waste ranging from hot ash to glass. A study by Masundire and Sanyanga (1999) revealed that in areas, such as Kasane (Botswana), Livingstone (Zimbabwe), and Chirundu (Zambia) there were too few litterbins, thus, people ended up sharing bins resulting in over spilling of the bins. Lack of refuse storage containers in overcrowded towns and cities resulted in prevalence of odors, housefly infestation, and visual pollution produced by exposed and decomposed garbage.

Waste collection, transport, and transfer have also presented a number of challenges in the third world city. These range from lack of waste removal equipment, personnel, finance, and above all, lack of commitment by management. Skip vehicles, tractors, trailers, and trucks are used to collect waste. The collection system in most developing countries is grossly inadequate and local authorities are blamed for inefficient and unreliable domestic waste collection with 30-50% of domestic waste generated left uncollected (Hardoy, 1997).

In Tanzania, Dar es Salaam City Council failed to provide adequate solid waste collection services for the fast growing population (Majani, 2002). It was estimated that the city was generating around 1,400 tons of domestic solid waste daily, yet Dar es Salaam City Council was capable of collecting between 30-60 tons of this amount. In Kinshasa, the Democratic Republic of Congo household waste collection was undertaken in a few residential areas and in the rest of the city waste was put on roads, illegal dumps, in storm water drains, or buried in open pits (United Nations Development Programme, 1996). These examples reflect the erratic nature of the waste collection system in most African countries.

Various constraints account for the inadequacies in the provision of an effective domestic solid waste management. Insufficient equipment, such as collection trucks, is a drawback in domestic waste collection in developing countries. In Zimbabwe, the Ministry of Local Government Rural and Urban Development (MLGRUD, 1995) mentions that the major problem with collection is inappropriateness and shortage of vehicles for collection. In 1999, the Harare City Council failed to collect refuse because only 7 out of its 90 trucks were operating. This was due to insufficient funds for training personnel and equipment maintenance (UNCHS, 2001). This has been compounded in recent years by the critical shortages of fuel and foreign currency.

In the traditional approach to solid waste management, the local authorities are responsible for disposal of domestic solid waste. However, there is a growing tendency towards illegal disposal of waste by residents mainly due to the fact that local authorities are failing to execute their duty of waste collection. United Nations Environmental Programme (1999) pointed out that between 20-80% of solid waste in African cities is disposed by dumping in open spaces, water bodies, and surface drains as a result of inadequate infrastructure. Residents also resort to open burning where materials are simply set on fire and left to burn and to burying waste. Johannessen (1999), United Nations Centre for Human Settlement (2001), and Masocha and Tevera (2003) in their studies found that in Africa open dumpsites are poorly engineered. Lack of leachate management, no registration of users, no control of tipping, and lack of compaction of waste characterize them. Poor siting of the dumpsites has resulted in soil contamination, surface and ground water pollution, and disease outbreak.

Incineration is another method of disposal and it involves passing the waste through a chamber at high temperature with an adequate supply of oxygen to oxidize all organic material. Its advantage is that it requires less land than landfills. Incineration disposes 99.999% of organic waste if properly carried out at 1200˚C temperature and ambient oxygen. Combustion in an incinerator reduces volume by 90% and weight by 75% and ash uses about a third as much landfill space as solid waste itself does (Hill, 2004). Energy recovered from the process can be utilized for electricity generation. Although incineration appears to be an extremely attractive option, the high financial start-up and operational capital required to implement incineration facilities is a major barrier to successful adoption in developing countries (United Nations Environmental Programme, 1996). A large portion of that cost goes to the environmental hazard mitigation components, including emissions (Rand *et al*, 2000). Additionally, specific technical expertise and related general repair and maintenance technology are often absent in developing nations' scenario. Incineration in Africa would be infeasible if the waste stream is indeed 70% wet-basis petruscible organic content. Under these conditions, incineration is likely to be energy-consuming rather than an energy-producing option. There is environmental-health problems associated with incineration. When conditions are not optimal, incineration volatilizes many compounds, such as dioxins, sulfur dioxide and carbon monoxides, which are potentially harmful to human health, atmosphere, plants, and animals.

Land filling is the most prevalent form of ultimate waste disposal and involves placing the waste in compacted layers in a lined pit or mound with appropriate leachate and landfill gas control. It is a method used for disposal of residuals from previous processes and for materials that are not recoverable and have no further use. Land filling eliminates the problem of odors and minimizes environmental damage. However, it should be done in a proper and responsible way, as it can create a lot of pollution, especially to ground and surface water. The safe and effective operation of landfills depends on sound planning, administration, and management system (Tchobanoglous *et al,* 1999). This is naturally the main constraint in developing countries. Additionally, human resources, coupled with absent enabling policies, limit the extent to which landfills can be built, operated, and maintained at minimum standards of sanitary practice.

Alternative methods, which include waste reduction, waste reuse, waste recycling, and private sector participation, can be used as a means of achieving an improved domestic waste management system (Yap, 1999). These methods are based on the need to adopt an integrated solid waste management system. Modern integrated solid waste management encompasses the control of generation, storage, collection, transfer, transport, processing, and disposal of waste in a manner that is in accord with the best principles of public health, economics, engineering, conservation, aesthetic, and environmental considerations (Tchobanoglous *et al*, 1993). In developing an integrated waste management plan, it is necessary to select appropriate techniques, technologies, and management programs for each of the elements.

A study by Masundire and Sanyanga (1999) showed that Kariba was the only town, out of the 8 studied, which had a significant recycling program. At the dump, a group of women collected paper before burning the rubbish. It was estimated that 80% of the paper dumped was collected for recycling. However, recycling is not yet very significant in Africa. Recycling plants are very few and far from disposal sites, thus, making it less profitable to recycle goods due to transport costs incurred in traveling to the recycling plants. Recycling has a number of benefits in that it alleviates future resource shortages, reduces energy demand, cuts pollution, saves water, and decreases solid waste disposal and incineration. Recycling provides employment, especially in countries where social security systems are inadequate or non-existent.

In the 1990s, privatization gained foothold as a potential solution to improving solid waste management particularly collection. Private sector participation reduces control, ownership, and/or activity in provision of waste collection service (Cointreau–Levine, 2000). The advantage of the private sector is that their operations are motivated by transparency, accountability, competition, and the need to fulfill certain requirements as set out in the contract (Furter, 2003). An example where privatization has been a success is in Dar es Salaam where the private contractor performed well in the ten wards it was supposed to collect. It collected 75% of the domestic solid waste generated (Tevera *et al*, 2002). The private contractors have more efficient service than the local authorities and also respond quickly to new market forces. Moreover, the private contractors have technical and financial resources to buy the necessary equipment. Although some arrangements with the private sector have been successful, there are some cases of failure that have been recognized (United Nations Centre for Human Settlement, 1996). In Mombassa, Kenya when solid waste collection was privatized on the mainland, only higher income households and formal business could afford the prices charged by private contractors. Low-income settlements were no longer served and the municipality had no option but to collect the refuse that was now being dumped along roadsides (Rakodi *et al*, 2000). In Zimbabwe, the Harare City Council contracted out waste management services to private contractors in 1997 hoping that improved services to residents could be offered. However, it did not work out as expected (Tevera *et al,* 2002). Limited financial resources and negative public attitudes made it quite controversial whether privatization, which worked for developed countries, could be adapted in poor cities.

In the context of the crushing scenario observed along the entire waste management system, it became necessary that a critical review of the waste management system in the city of Mutare be conducted with a view to unravel the dynamics of the solid waste management system at a local level. Sakubva has experienced an increase in population over the years and certainly the challenges associated with this phenomenal growth in population.

STUDY AREA

The City of Mutare is located 265 km from Harare on the eastern border, with Mozambique in Manicaland Province of Zimbabwe (Figure 1). Mutare is located in the very heart of the best timber growing area in the country. Timber resources range from softwoods (such as pine) and hardwoods (including mahogany and mukwa), and also has a wide variety of quality agricultural produce (particularly fruits and vegetables including bananas, grapes, oranges, tomatoes, mangoes, avocadoes and apples). In 1982, the City of Mutare had a population of 7,500 people which grew to 11, 376 in 1992 and currently 170,466 (Central Statistical Office, 2002). Sakubva alone has a total population of 62, 419.

METHOD AND MATERIALS

The research was a descriptive survey of domestic solid waste management in Sakubva high-density suburb. Data were obtained through the use of questionnaire, interviews, and field observations supported by secondary data collection methods, which involved extensive review of public documents that included waste records.

A sampling frame, consisting of all the 39 sections of the suburb with a total housing stock of 5,327 was sourced from the Housing and Community Services Department. A stratified sampling method was then used to select targeted houses. This was selected from the 6 conveniently sampled sections determined by their high rates of illegal waste dumping, high population density, and the number of houses. The areas selected were Chitungo, Chineta, Mawonde, Mazhambe, Muchena, and National Housing Board (NHB). A sample size of 5% was used to come up with the number of houses to be interviewed in each stratum. Systematic sampling was then used to select the 100 houses from which each of the household head was issued a copy of a questionnaire. Field observations, with the aid of a checklist were used for ground truthing on domestic solid management problems in Sakubva. Calculations of mean/average and waste generated were used. The average number of people per residential stand and average number of days taken to fill waste receptacles were calculated. The data was then summarized into tables and figures for easy of analysis and presentation.

SOLID WASTE MANAGEMENT SYSTEM IN SAKUBVA

Mutare City Council operates a solid waste management system, which includes generation, storage, collection, transportation, and disposal (Figure 1). The waste system flows into a formal and an informal or illegal waste stream. The formal involves a scenario, whereby once solid waste is produced on site; it is temporarily stored in waste bins or any other suitable containers or at transfer points awaiting collection. The municipality’s solid waste management section collects the wastes from the temporary storage facilities and transports them to its specially designated dumpsite. The second stream is illegal and it accounts for solid wastes that do not find their way into the municipal solid waste collection system. Some of the wastes are illegally buried in the ground, or burnt at source or dumped in open spaces, streams, or roadsides. Both streams have leakages that have direct and indirect impacts on the biophysical and social environments. A better understanding of the linkages and the shortcomings of the system can only be achieved in the context of the analysis of every stage of the waste stream.

The rate of waste generation in Sakubva was 0.80 kg per day and the total amount of waste produced was 49.9 tons. The waste components found in Sakubva included food residue, paper, plastics, metals, glass, textiles, rubber, and wood (Figure 2). The types of waste generated were comparable to the composition of waste in many developing countries, for example in Chirundu, Zambia, food waste, paper, and plastic constituted 85% of the solid waste stream. It was the same scenario in Lagos, Nigeria where it constituted 60% petruscible wastes and Jakarta, Indonesia where it was about 82% (Cointreau, 1982; Masundire and Sanyanga, 1999). Plastics, glass, and other synthetic material are non-biodegradable wastes that were also generated in Sakubva. Such type of material is difficult to deal with in terms of sustainable disposal, as they demand sophisticated, capital-intensive management techniques, which the council could not afford, given financial and technical shortcomings. However, such type of waste can be recycled and residents can earn a living from recycling activities.

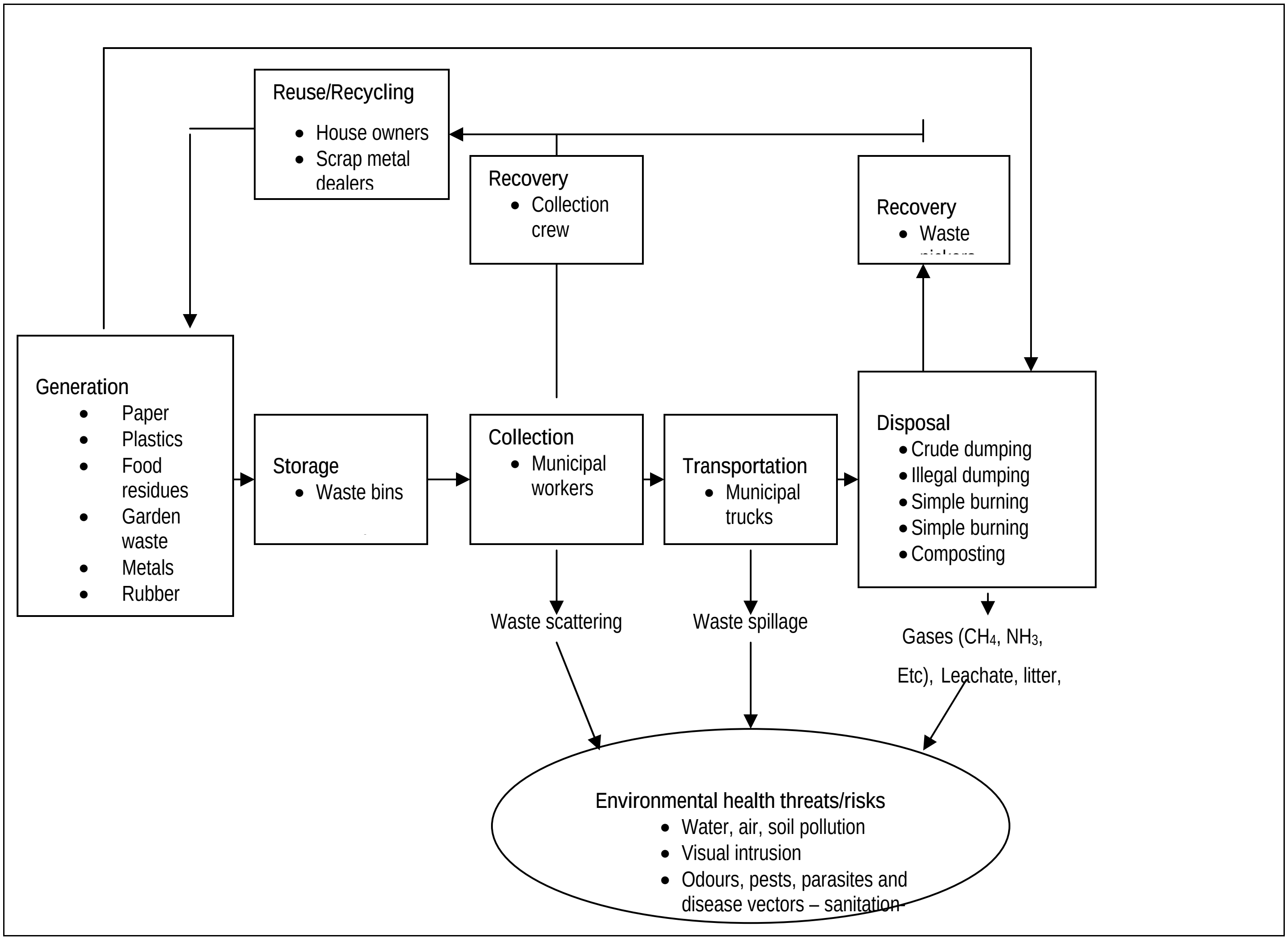

Figure 1: The Components of Solid Waste Management System in Sakubva

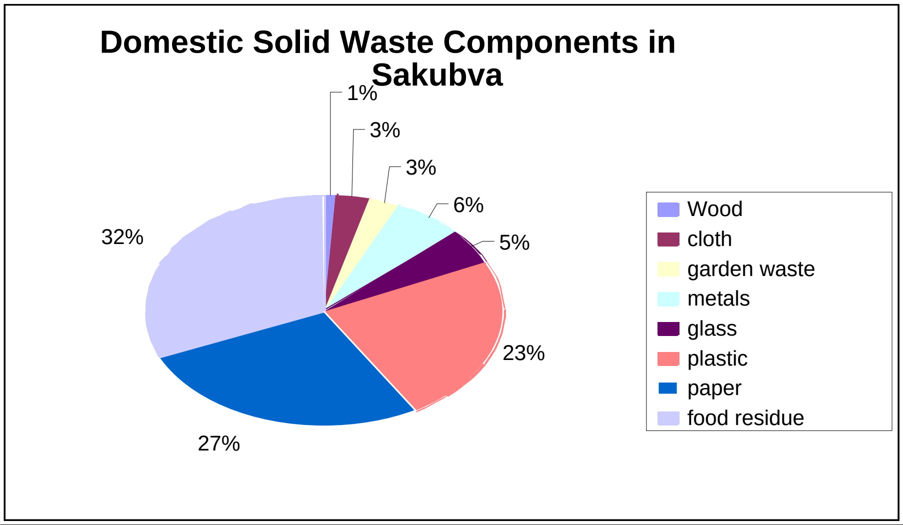

Figure 2: Types of Domestic Solid Waste Generated in Sakubva

WASTE GENERATION, HANDLING, AND STORAGE

The second functional component in the domestic solid waste management system was waste handling and storage (Figure 1). The residents used different methods of handling and storing waste generated in Sakubva (Figure 3).

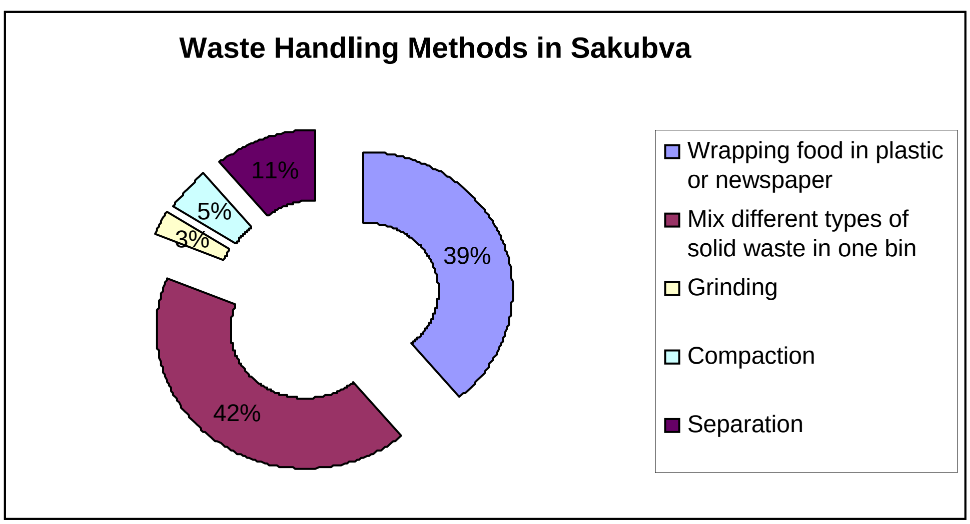

Figure 3: Waste Handling Methods in Sakubva

Waste handling is a fundamental component in solid waste management, although it was viewed as dirty work and time consuming by most residents. There was limited knowledge of the benefits associated with the separation of wastes through the recovery of reusable and recyclable materials from the waste stream. Besides, most residents had only one bin where they mixed all types of waste and could not afford to buy more than one bin for the separation of waste. Manual compaction is another method of waste handling used. It was done so that more waste could fit in one bin. Manual grinding was done to particularly food waste and it was flushed into the sewage system. The solid waste that was not reused, recycled, or composted was placed in waste receptacles waiting for either collection by municipality or for illegal dumping.

Residents used different types of waste receptacles, which were either formal or informal (Figure 4). Hard plastic bins were used by 60% of the residents, 17% used sacks, 9% cardboard boxes, 4% metal bins, and 1% bulk containers. The waste receptacles differed in type, shape, size, and nature of material they were made of and on average were filled in 7 days. Informal waste receptacles, such as mealie bags, cardboard boxes, and sacks have limited capacity and, hence, filled up quickly resulting in over-spilling. The lack of appropriate refuse storage containers resulted in prevalence of odors, housefly infestation, and visual pollution produced by the exposed and decomposing garbage. In Sakubva, the average number of people per residential unit was 8. This figure was above the national mean of 6 persons per household unit. Overcrowding, whereby in many cases several individuals and families reside at one residential unit, worsened the problem of waste storage. Refuse generation per unit residential stand was, therefore, greater to the extent that the garbage bins failed to cope with the refuse generated. This resulted in residents resorting to dumping excess refuse at undesignated sites, burning, and burying leading to observable environmental-health problems that included visual intrusion.

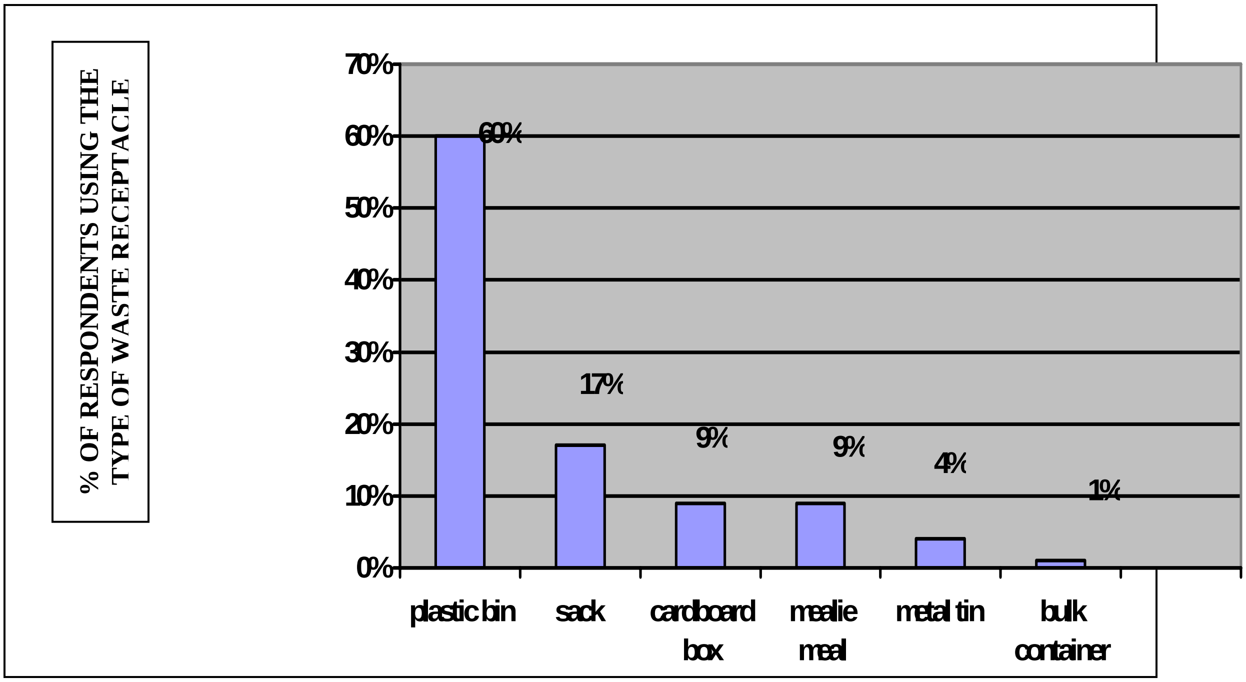

Figure 4: Types of Waste Receptacles Used by Sakubva Residents

WASTE COLLECTION, TRANSFER, AND TRANSPORT

In Mutare, waste management is administered under the provisions of the Public Health Act (1957) as amended and in accordance with the ruling by-laws. Refuse is classified into fours main classes. Class A consists of household garbage and non-bulky light refuse. Class B is all refuse of a heavy bulky nature, which cannot be handled in portable receptacles provided for Class A refuse. (This include bricks, sand, stone, garden rubbish, and hedges.) Class C was stable litter and manure and Class D, the carcasses of dead animals. It is the responsibility of the Council to remove Class A refuses, but the waste generator has to pre-pay for the service. Owners of Class B refuse can either remove their waste or dispose it under strict council conditions at the Council's landfill site or hire the Council to do it for them. Class C refuse is removed on request by the generator but a fee has to be charged. Class D is the responsibility of the Council but the owner is charged.

Waste collection consumed 20% of the waste management budget for Mutare City Council. Constraints, such as fuel shortages, shortage of waste collection vehicles, limited human resource, and financial constraints limited the capacity to provide adequate waste management services. The City Council was able to collect only 40% of all the waste generated by residents in Sakubva. This fell within the range of estimates provided by Hardoy (1999) who stated that 30–50% of domestic waste generated is left uncollected. Mukuka and Masiye (2002) gave a very low estimate of the percentage of waste that the Lusaka City Council was able to collect (less than 10%).

WASTE DISPOSAL

Residents used disposal methods that included burning (19%), burying (19%), and dumping in open spaces (38%), rivers (2%), and drainage basins (Figure 6). This can be attributed to poor waste collection systems and the residents' attitude towards solid waste. Open burning emits pollutants in the atmosphere, such as carbon monoxide, oxides of sulfur and oxides of nitrogen. These pollutants result in detrimental effects to health and the environment. The Mutare City Council forbade the illegal disposal methods used by residents. Mutare (Public Health) by-laws 1957 as amended to prohibit depositing refuse in a pubic place and burning refuse without permission of the Council. Burning refuse resulted in a fine of $500,000 ($500 revalued) during the time and depositing refuse in a public place had a fine of $125,000 ($125 revalued). This amount was a pittance given the hyper-inflationary environment the country was operating under. Thus, illegal dumping in monetary terms was cheaper, yet costly from an environmental perspective.

Although some operations were properly carried out, a visit to the landfill site revealed that not all standards were adequately met. The landfill site is poorly sited, it is located near streams and rivers, and there was no monitoring of runoff. This has resulted in leachate contaminating nearby rivers and streams. Water sampling is not done for nearby streams and rivers, thus, posing danger to ecosystems. However, Mutare City Council has plans for relocating the landfill site to a proper site, which fulfill requirements of the Environmental Impact Assessment policy.

CONCLUSION AND POLICY IMPLICATIONS

The solid waste management system in Sakubva system constituted waste generation, waste handling and storage, waste collection, transfer, transport, and disposal. The components of the system were characterized by waste leakages that led to environmental health problems. Constraints, such as fuel shortages, shortage of vehicles, shortages of manpower, limited financial resources, and weak institutional arrangements have resulted in an erratic and ineffective domestic waste management service. It was essentially characterized by inadequacy, inefficiency, irregularity, and inconsistency. Thus, domestic solid waste has become a menace to urban environments, a leading contemporary environmental and socio-economic challenge that face urban areas in the 21^{st} Century. Sustainable waste management seems unattainable for numerous municipalities. Waste dumped on roadsides, streets, drainage systems, and waterways are common sights. Given such a sad state of affairs there is a need to adopt strategies to improve the domestic solid waste management system.

In order to develop appropriate waste management strategies, the council has to be aware of the environmental impacts of waste; this can be achieved through working with local universities. There is also a growing realization that communities themselves can be the drivers in waste management, departing from the traditional way when they were viewed as ratepayers and the councils as service providers. Community Based Solid Waste Management has contributed in the improvement of waste management elsewhere and, thus, can be adopted. The people can contribute in the identification of waste problems, proposal of workable solutions, and formulation of locally understood policies of waste management.

Recycling is an effective way of minimizing problems of solid wastes at generation point, transit and disposal, and ultimately reduces waste disposal cost. The waste recycling activities are also justified on both economic and environmental grounds because they can help save resources, protect the environment, and contribute to sustainable development. The success of any policy has to do with a broad based public education program detailing the advantages of adopting waste minimization strategies along the whole stream. Such an education program will ultimately reduce council risk to litigation, as overall environmental performance and conformity improves. In this regard the design of an operational environmental management system for public authorities will go along in reducing pollution through commitment to continual improvement of the waste management system.

REFERENCES

Bhatia, H. S. (2003). Environmental Pollution and Control, Galgotia publication private Limited, New Delhi.

Central Statistics Office Report (2002). Government Printers, Harare.

City of Mutare Budget (2005 – 2006). City of Mutare, Mutare.

Cointreau, S. (1982). Environmental Management of Urban Solid Wastes in developing countries: Washington D.C.: Urban Development Department, World Bank.

Furter, L. (2003). Private sector has a role to play in Integrated Waste Management in Resource Volume 5, Number 3.

Government of Zimbabwe (1996). Urban Councils Act Chapter 29:15, government printers, Harare.

Government of Zimbabwe (1996). Public Health Act Chapter 15:09, Government printers, Harare.

Government of Zimbabwe (2002). Environmental Management Act Chapter 20: 27, government printers, Harare.

Government of Zimbabwe (1998). Water Act Chapter 20: 22, Government printers, Harare.

Hardoy, J. (1992). Environmental Problems in third World Cities, Earth scan, London.

Hill, M. K. (2004). Understanding Environmental Pollution, Cambridge University Press, UK.

Johannessen, L. M. (1999). Observations at solid waste Landfills in developing countries: Africa, Asia and Latin America. *Urban and Local government working paper Series No. 3*, World Bank, Washington D.C.

Majani, B. B. K. (2002). Urban Solid Waste Management in Dar es Salaam, Tanzania in Conyers, D., Matovu, G. and Tevera, (Eds) The challenges and New Innovations in Urban Solid Waste Management: Issues and Policy Options. Municipal Development Programme.IDRC.

Masocha and Tevera (2003). Spatial Patterns, Environmental threats and public health in Geographical Journal of Zimbabwe, *article title: Open waste dumps in Victoria Falls Town*: Numbers 33 / 34, Geographical Association of Zimbabwe, University of Zimbabwe, Harare.

Masundire, H. and Sanyanga, R. (1999). Waste Management in the Zambezi Valley: case studies from Botswana, Zambia and Zimbabwe in Yap, N.T.P.(1999) (Eds) cleaner Production and consumption in eastern and Southern Africa; Challenges and opportunities. University of Guelph. Weaver Press Series, Canada.

Ministry of Local Government Rural and Urban Development (MLGRUD) (1995). Zimbabwe Urban Solid Waste Management study, Ministry of Local Government Rural and Urban Development.

Mukuka, L and Masiye, G. (2002). Urban Solid Waste Management in Zambia in Conyers D. Matovu and Tevera. (Eds) The challenges and New Innovations in Urban Solid Waste Management: Issues and Policy Options. Municipal Development Programme.IDRC.

National Environmental Management Authority (2001). State of the environment Uganda 2000, National Environmental Management Authority, Kampala.

Otten, L. (1997). Integrated Solid Waste Management paper in Cleaner production and Consumption, Harare, Zimbabwe.

Tchobanoglous, G., Theisen, H., Vigil, S. (1993). Integrated Solid Waste Management: Engineering Principles and Waste Management Issue, Irwin McGraw-Hill, Boston.

Tevera, D. S. (1991). Solid Waste Management in Harare and its effect on the environment: Some preliminary observation, Department of geography, University of Zimbabwe, Harare.

Tevera, D., Conyers, D. and Matovu, D. (2003). Solid Waste Management Practices in Eastern and Southern Africa: The Challenges and New Innovations in Urban Solid Waste Management: *Issues and Policy Options Case Studies in Tanzania, Zambia, Zimbabwe*, International Development Research Centre, Canada.

Theodore, M. and Theodore, L. (1996). Major Environmental Issues facing 21st Century, Prentice hall, Upper Saddle River, New Jersey.

United Nations Centre for Human Settlement (UNCHS) (1996). An urbanizing world: Global Report on Human settlement, United Nations Centre for Human settlement, Nairobi.

United Nations Centre for Human Settlement (UNCHS) (2002). The state of the World's Cities 2001 Habitat, United Nations Centre for Human Settlement, Nairobi.

United Nations Environmental Programme (1996). International source Book on Environmentally Sound Technologies for municipal solid waste management, International technology Centre and Harvard Institute for International development, IETC Technical Publications Series, Issue 6, Osaka.

Yap, T. N. (1999). Cleaner production and consumption challenges and opportunities, South Africa.