Chapter 1

Solid Waste Management in African Cities – East Africa

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1. Introduction

This chapter analyses solid waste management trends in East African cities from the colonial time to the present, where the cities have moved from the purely centrally controlled systems monopolised by the urban authorities to the current mixture of both public and private systems in varying combinations, that involve many actors(service providers) serving the different urban communities. The main challenges associated with this transition in solid waste management systems are described and compared among the major cities.

In most developing countries it is the urban authorities that are responsible for waste management. Waste management is one of the most visible urban services whose effectiveness and sustainability serves as an indicator for good local governance, sound municipal management and successful urban reforms. Waste management therefore is a very good indicator of performance of a municipality.

Information for the preparation of this chapter came entirely from publications and reports on waste management in Urban Councils of the East African Community (EAC) Countries of Kenya, Tanzania and Uganda. The chapter will examine the management of solid waste from the source to final disposal and will describe and compare waste management in East African cities. This chapter will also examine E-wastes which is becoming a significant management issue in East African urban centres.

2. Trends in solid waste management in East African cities

Waste management in urban centres of East Africa has for a long time been centralised (Liyala 2011), with the use of imported refuse truck (Rotich *et al*., 2006; Okot-Okumu & Nyenje 2011) that collect wastes from sources or transfer point and deliver to designated

waste dumps. Municipal solid waste management (MSWM) system in East Africa has changed from the colonial days in the 40s, 50s and early 60s when it was efficient because of the lower urban population and adequate resources (Okot-Okumu &Nyenje 2011) to the current status that displays inefficiencies. The centralised waste management system has evolved into the current management mixtures that include decentralised as well as the involvement of the private sector.

The storage, collection, transportation and final treatment/disposal of wastes are reported to have become a major problem in urban centres (ADB 2002; Kaseva & Mbuligwe 2005; Okot-Okumu & Nyenje 2011; Rotich *et al.,* 2006). The composition of wastes generated by the East African urban centres is mainly decomposable organic materials (Table 1) based on the urban community consumption that generates much kitchen wastes, compound wastes and floor sweepings (Oberlin, 2011; Okot-Okumu & Nyenje 2011; Scheinberg, 2011; Simon, 2008; Rotich *et al*., 2006). This calls for efficient collection system to avoid health, aesthetics and environmental impacts. The global trend of increased use of electrical and electronic goods is also evident in EAC where E-waste is becoming a significant threat to the environment and human health in EAC urban centres (Blaser & Schluep, 2012; NEMA 2010 & UNEP, 2010; Wasswa & Schluep, 2008).

Waste composition (%)	Dar es Salaam	Moshi*	Kampala#+	Jinja	Lira	Nairobi*
Biowaste	71	65	77.2	78.6	68.7	65
Paper	9	9	8.3	8	5.5	6
Plastic	9	9	9.5	7.9	6.8	12
Glass	4	3	1.3	0.7	1.9	2
Metal	3	2	0.3	0.5	2.2	1
Others	4	12	3.4	4.3	14.9	14
kg/cap/day	0.4	0.9	0.59	0.55	0.5	0.6
Percent collection	40	61	60	55	43	65
Population	3,070,060	183,520	1,700,850	91,153	107,809	4,000,000
Population paying for collection (% of total population)		35	ND	ND	ND	45

ND= Not determined
+ KCC, 2006; #NEMA 2007;*Scheinberg et al., 2010

Table 1. Composition of solid wastes generated in East African urban centres

2.1. Solid waste characteristics, generation rate and household management

Waste generation rates of the urban centres in this study are shown in Table 1. Waste sources are households(residential), commercial premises, markets, institutions, industries and health care facilities (Table 2) as illustrated by the case of Uganda, which is similar to other EAC urban centres (Kaseva & Mbuligwe 2005; Liyala 2011; Oberlin 2011; Rotich *et al.*, 2006; Scheinberg 2011). Residential areas or households are the major contributor of wastes followed by markets and commercial areas respectively (Kaseva & Mbuligwe 2005; Kibwage

Solid waste streams	Contribution in weight %	Waste characteristics Comments	Comments
Domestic (Residential)	52 -80	Major: food wastes. Minor: paper; plastic; textiles; glass; ceramics; ashes; leather; compound wastes	Waste quantity increasing with population increase -E-waste is emerging as significant - Wastes collection by: urban councils; private companies, NGOs and CBOs
Markets[a]	4 -20	Major: vegetable wastes (leaves, stalks), spoilt fruits Minor: damaged packaging materials (e.g., sacks, bags, paper, timber)	Markets in all municipalities - Number increasing - Waste collection: urban councils and private collectors
Commercial (excluding markets)	3.7-8	Major: packaging materials; food wastes; scrap metals Minor: glass, hazardous wastes (e.g. contaminated containers, batteries and cleaning textiles)	Shops, hotels, restaurants, offices, open pavement trading - Mobile open air traders - Increasing business - Increasing waste volumes - E-wastes has become significant Waste collection: urban council and private collectors
Institutional (e.g. Government and private-Ministries, Educational establishments, sports facilities, clubs)	5	Major: food wastes, stationery Minor: packaging (e.g., cardboard, paper, plastics)	- Expanding in numbers with population increase - E-wastes has become significant Waste collection: mainly by private companies.
Industrial (manufacturing)	3	Various types depending on industry (e.g., decomposable wastes from food industries, non-degradable such as broken bottles and plastic containers	Production wastes: by-products and damaged items - Broken bottles: recycled or dumped - E-wastes has become significant - Plastic: recovered, re-used, recycled or dumped - Scrap metals: recycled or dumped - Recycling plants available in the EAC

Healthcare(hospitals, clinics, drug shops)	1	Major: domestic type of wastes Minor: hazardous(e.g., anatomical, contaminated materials, sharps)	Major hospitals treats own hazardous wastes. - Clinics dump with other wastes - Domestic: collected by private companies. E-waste is becoming significant
Others	11-11.4	Examples: street sweepings, public park wastes, construction wastes	collected by: Urban council and private companies

[a] Merchandise for urban markets comes along with enormous amounts of wastes (e.g. leaves, stalks, grass, sacks, and branches) from the countryside. (Source: Okot-Okumu & Nyenje 2011; Oberlin 2011).

Table 2. Solid waste streams and the estimated contribution to the urban waste load

2002; Oberlin 2011; Okot-Okumu & Nyenje 2011). Densely populated urban zones (e.g. slums) have low income households with waste generation estimated between 0.22 and 0.3 kg/cap/day. Solid waste generation by the higher income households is estimated between 0.66 and 0.9 kg/cap/day on average (Kaseva & Mbuligwe 2005; Kibwage 2002; Oberlin 2011; Okot-Okumu & Nyenje 2011; Oyoo *et al*., 2011; Scheinberg 2011).

Overall waste generation rate for EAC urban centres vary on average between 0.26 (low income) and 0.78 (high income) kg/cap/day (Kaseva & Mbuligwe 2005; Kibwage 2002; Oberlin 2011; Okot-Okumu & Nyenje 2011; Oyoo *et al*., 2011; Rotich *et al.,* 2006; Scheinberg 2011). Similar waste generation rates have been reported for developing countries of other regions of the world (Achankeng, 2003; Supriyadi *et al.,* 2000; Vidanaarachchi *et al.,* 2006). Low income urban communities generate lower waste volumes because they buy little and are less wasteful in consumption. In contrast the higher income groups have higher disposable income and purchase larger volumes of consumable goods, that have high waste portions and also practice a more wasteful consumption pattern (EWAG, 2008; Okot-Okumu 2008; Scheinberg *et al.,* 2011).This observation is consistent with what has been reported by other authors (Hina Zia & Devadas V, 2007; Scheinberg, 2011; Passarini *et al.,* 2011; Supriyadi *et al.,* 2000). Low income urban community spend most of their disposable income for purchase of food items most part of which are consumed and little disposed, while the higher income groups purchase a variety of goods some with associated wastes in form of non-consumables (e.g. packaging, containers, etc.).Total waste generation by the urban councils generation rate is associated with national GDP per capita as illustrated in Scheinberg, 2011. Therefore developing economies such as countries in Africa and Asia have lower waste generation rates (≤ 1.0 kg/cap/day) compared to developed economies (> 1.5 kg/cap/day) as reported by IPCC 2006 and Scheinberg, 2011.

The quality of the urban council wastes can be illustrated by a study done in Uganda in preparation for the composting project (NEMA 2007) that indicated pH (5.7 – 6.9); moisture content (50–75%); Relative humidity(75-155%);volatile solids (66-79%); decomposable organic carbon (DOC 74-86%). Study (NEMA 2007) done in Uganda indicate methane emission potential

from such urban wastes to vary between 0.9 and 4.12 Gg/yr. The high decomposable biowaste contents and the optimal moisture content (for aerobic decomposition) of the solid waste make it suitable for composting (Chakrabatrti *et al*., 2009; NEMA, 2007; Kumar 2006). Composting is being practiced in more than 11 urban councils of Uganda under the Clean Development Mechanism (CDM) pilot project promoted by the World Bank (NEMA 2007; Kumar 2006). In Dar es Salaam composting was initiated by women CBO (KIWODET) operating in Kinondoni (Oberlin & Sza´nto´ 2011). The KIWODET composting project was suspended because of land use pressure and negative consumer attitude. Oberlin & Sza´nto´ (2011) argue that even though successful composting can arise from local community capacity, lack of municipal integration and support leaves such technically viable initiatives vulnerable to external factors. Aerobic composting is apart from economic benefits that may accrue are environmentally important because it eliminates GHG emission that would occur during waste decomposition at dumpsites or landfill (NEMA, 2007; Kumar 2006). EAC countries should consider composting as an option for the implementation of an integrated approach to solid waste management.

Bulk density of the waste varies between 180 and 310 kg/m^3 comparable to wastes from other African countries (Palczynski, 2002) that are typical of low income countries. Little is known of waste from urban agriculture that has emerged and this together with poor sanitation in the peri-urban areas (Asomani- Boateng & Haight, 1999; Okot-Okumu, 2008) pose high risk to human health.

Household wastes are stored in bins by the affluent and in sacks, plastic bags, cut jerry cans, cardboard boxes by the low-income households, and a large percentage of domestic waste storage containers (e.g. sacks, polythene bags and boxes) used by the poorer urban community are dumped with the wastes(Figure1). There is no sorting as such, but households separate components of wastes considered of value such as vegetables and food leftover (*for animal feeds – used at source or sold, sometimes given free*), plastic bags (*reuse*), bottles- plastic/glass (reuse *and sale*), tins (*reuse and sale)* and scrap metals (*for sale)* are separated by some households from waste that is usually stored mixed. Sorted/separated wastes are either reutilised at source or sold to itinerant buyers who afterwards sell them to middlemen who supply recycling industries. Waste separation also takes place at transfer stations (e.g. bunkers, skips, road verges,), on transit to the landfill and at the landfill or dump sites.

(a) (b) (c)

Figure 1. Waste containers disposed with wastes (A)- plastic jerry cans in in Soroti, Uganda (B) – sacks, plastic bags and cardboard boxes disposed with waste in Kampala, Uganda *(A&B are photos by author, 2010)* (C)- wastes in plastic bags in Dar es Salaam Tanzania *(source: Simon , 2007).*

2.2. Waste transfer stations

The generated wastes are transported to transfer points (Skips, bunkers, standby trailers, open lots see Figs 2 and 3 mostly by the waste generators (e.g. households, commercial premises, market traders) themselves or hired (informal) labour, before collection by urban council workers or private operators. Industries, large institutions (e.g. educational, hospitals), shopping malls, large markets have their own transfer stations served by skips , bunkers, trailers and other waste containment facilities.

(a) (b) (c)

Figure 2. (A) Skip amidst wastes in Lira, Uganda(2006) (B) community managed skip at a collection point in Kamwokya, Kampala Uganda (2005)*(A&B photos by author,*) (C) A skip in Mwanza, Tanzania *(source: Ishengoma 2007)*

(a) (b)

Figure 3. Waste transfer points/methods: (A) -A bunker in Makerere, Kampala Uganda (*(photos by author, 2009); (B)* - a tractor trailer in Dar es Salaam, Tanzania (source*: Simon, 2007*)

2.3. Waste collection and transportation

Three main methods of wastes collection can be identified as the informal primary or pre-collection phase mainly from households to community collection points (e.g. skips, bunkers or open roadside) mostly by households, hired labour. The secondary phase collection is from community transfer points to final disposal sites or landfills and is mostly by formal institutions like urban councils and private operators. Private operators mostly collect wastes directly from generating sources (door to door). Typical waste management scheme in East African urban centres is illustrated by Figure 4. Private operators collect waste at negotiated fees with the individual clients. Industries and shopping malls in most cases

contract private waste collectors to pick wastes from their premises, while community markets and hospitals still rely mainly on urban council collection. Other collection modes take the form of a "summon to bring" system, where a truck is parked at a location and a horn (hooting) summons people to deliver wastes to the truck.

The frequencies of household waste collection vary between low-income and high income groups. The high-income groups dispose waste often 3 times a week that is determined by the frequency of collection by most contractors of 2-3 times a week similar (Kaseva & Mbuligwe 2005; Okot-Okumu & Nyenje 2011).

Much time is spent collection as on waste is manually loaded onto trucks by urban council workers. Percent of waste collected vary between 35 and 68, which is comparable to other urban councils in developing countries (Vidanaarachchi *et al.*, 2006; Palcznki, 2002; Supriyadi *et al.,* 2000; Scheinberg, 2011). The introduction of private operators has increased solid waste collection levels compared when it was dependent entirely on the urban councils (Kaseva & Mbuligwe 2005; Oberlin 2011; Okot-Okumu & Nyanje 2011). However most of these reported collection efforts only apply to wastes that have reached community collection points (Transfer points).

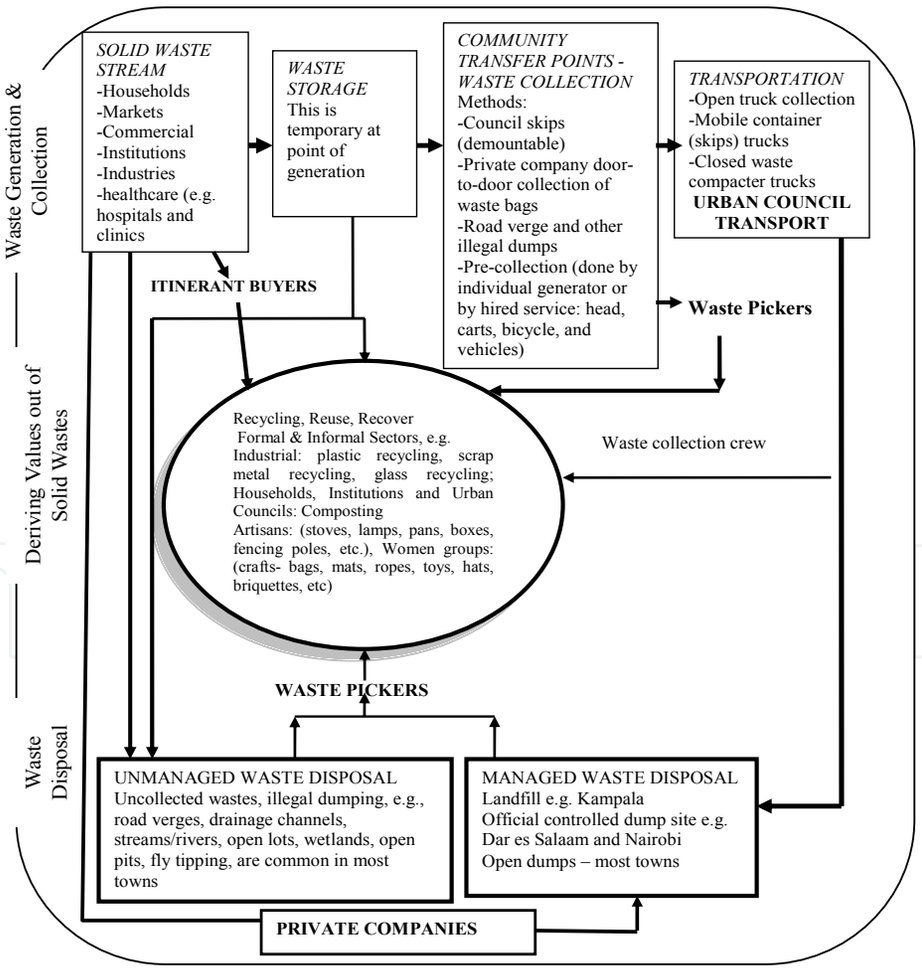

Figure 4. Typical waste management scheme in EAC urban centres (*source: Okot-Okumu & Nyenje 2011 with modifications)*

This means a higher percentage of urban solid waste do not reach the legal disposal points but end up in the environment. Open dumping is the most common waste disposal methods in urban areas (Oberlin 2011; Okot-Okumu & Nyenje 2011). Where skips and waste bunkers are too far the communities dump wastes indiscriminately and some disposal points are often overflowing with uncollected wastes (Figure 2). The use of skips has been terminated in many parts of Kampala since 2002. Skips were found to be linked to lack of cleanliness and most urban residents were dissatisfied with its use (Katusiimeh *pers comm*). The current operating systems in Kampala are open ground disposal and in the remaining skips. Communities without access to transfer stations resort to open disposal methods which include burning, burying, using of wastes as animal feeds and indiscriminate disposal. There is rampant littering caused by the indiscriminate disposal of wastes in storm drainage channels, road verges and open lots. The carelessly disposed wastes block storm water drains causing floods and also cause health hazards and poor aesthetic.

Institutions like universities, schools, hospitals and business complexes are often served by the private companies, while those not served transport their wastes individually to community collection points. The urban poor receive very low to no waste collection services due to inaccessible roads, unplanned facilities and neglect by the urban councils. Waste collection in East African urban centres is not based on the total amount of waste generated but rather on the level of income of the service area (Kaseva & Mbuligwe 2005; Okot-Okumu & Nyenje 2011). Satisfaction level for waste collection is higher for private operators compared with the urban councils. This can be attributed to the low waste collection frequency causing nuisance to communities. In most urban areas only a small fraction of the wastes generated daily is collected and safely disposed. For example in the cities 45% (Rotich *et al.*, 2006), 43% (Okot-Okumu 2008; Okot-Okumu & Nyenje 2011) and 30% (Oberlin, 2011) are collected for Nairobi, Kampala and Dar es Salaam respectively. Collection of solid wastes is usually concentrated in the city centres and high income neighbourhoods and even then these are irregular. Common collection and transport modes are covered compressor trucks, open trucks and trailers. Wastes on transit are often uncovered causing littering, odour and aesthetics problems (Fig 5).

(a) (b)

Figure 5. Waste transport: (A) - overloaded open truck (the sacks contain sorted plastics) in Kampala, Uganda *(photos by author, 2010)* and (B) - a skip conveying truck in Kampala Uganda *(photos by author, 2005)*

NGOs and CBOs are also participating in waste collection, recycling and disposal in the urban councils (Tukahirwa 2011; Oberlin 2011, Okot-Okumu & Nyenje 2011; Liyala 2011). NGOs and CBOs focus mainly on the less privileged urban communities where they serve more than half the population compared to urban councils and private companies combined. CBOs are much more well established in Dar es Salaam and Nairobi compared to Kampala where they focus mainly on the urban poor solid waste management (Tukahirwa 2011).There is also the informal waste collection by waste picker (also known as 'scavengers') who salvage from public bins, disposal sites and along streets; itinerant waste buyers who buy or exchange (barter) items from households such as bottles, plastics and old newsprints for mostly fruits and vegetables (in Kampala). There are also waste buying kiosks for scrap metals and plastics. The informal waste collectors operating in urban councils deal directly with households, markets and other establishments. It is reported (Wang, *et al.,* 2008) that even though these informal practices have positive contribution to urban waste management, they also bring about social problems[1]. Barter systems could be explored by urban councils for the poorer zones of the municipalities to reduce the negative impacts solid wastes and eliminate cheating while at the same time improving on community nutrition (Okot-Okumu & Nyenje 2011). The public-, private- and informal sectors can all work together with the community to improve solid waste management (Chakrabrati 2009; Liyala 2011; Oberlin 2011; Okot-Okumu & Nyenje 2011; Tukahirwa 2011). The community can be involved more effectively through CBOs that are already working with them in waste management projects.

Wastes of value such as plastics, cardboards and scrap metals separated stating at source, at transfer points, on transit and at disposal sites. Some of the separated wastes are sold to artisans and women groups who convert them into goods such as hats, bags, necklaces, baskets, door rugs, mats and seedling cups that are sold to the community as crafts (Fig 6).

Urban councils in many African countries concentrate on waste collection with other aspects of the waste stream having little attention (Achankeng, 2003; Kasenga *et al*., 2003). Solid waste collection in itself is very much below satisfaction as reported by many authors (Kaseva & Mbuligwe 2005; Okot-Okumu & Nyenje 2011). The collected waste is often disposed indiscriminately without concern for human health impacts and environmental degradation that includes soil, surface and ground water pollution. Indiscriminately dumped wastes in places such as open lots, roadsides and drainage channels is known to cost about 2-3 times per ton the cost of communal collection as noted by Anjum and Deshazo (1996) quoted by Kaseva & Mbuligwe (2005).

2.4. Final disposal of waste

Almost all waste disposal sites in EAC urban councils are in what are considered wasteland like old quarry sites or valleys close to wetlands that are not prioritised for other uses as is

[1] Problems of waste pickers are nuisance and social disruption. Itinerant waste buyers sometimes cheat on price, quality and weight or recyclables and in some cases stealing. Informal waste collectors compete for zones allocated to formal collectors causing financial losses to contracted collectors.

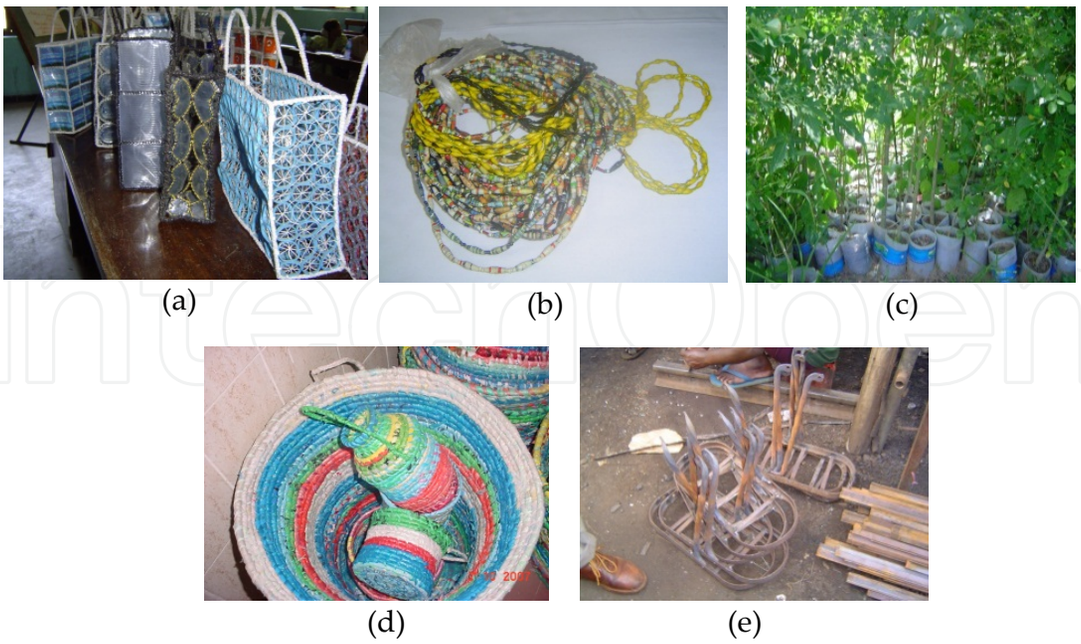

Figure 6. Recycled wastes (A)-bags; (B) - necklaces; (C) –tree seedling in plastic cups, (D) - hats and baskets, all from plastic wastes and (E) - bicycle carrier from scrap metals.

often the case in developing countries (Johannessen & Boyer 1999). The disposal sites are therefore in most cases located in environmentally sensitive areas in lowlands areas such as wetlands, forest edge or adjacent to water bodies. They often do not have liners, fences, soil covers and compactors as is in most developing countries (Johannessen & Boyer 1999). In Uganda, Kampala city has upgraded its waste dump at Kitezi to a sanitary landfill (Fig 7). The landfill was funded by the World Bank and has been managed since 1999 by private companies. Though built to standard with a leachate treatment plant, there is some leachate leakage before the treatment plant and this is polluting the surrounding environment with heavy metal (Skoog 2004).

Waste dump sites receive mixed wastes of various origins that include domestic, industrial, medical and commercial wastes. The waste dumps pose real hazard to workers, waste pickers and stray animals that visit the sites. Most of the waste workers do not wear proper protective gears. Major problems from solid waste disposal sites include pollution from leachate, odour, vermin, attraction of scavengers and poor accessibility. Wastes are often dumped at easily accessible points on the way or close to the dumping sites causing serious pollution and aesthetic impacts.

The openness of landfill sites provides free access to waste pickers to sort valuable items for sales. Waste pickers work under no clear control and do not follow any safety and health regulations. Waste collection workers also pick out wastes of value en route to the landfills and sell them to middlemen. The major wastes picked are plastics (e.g. jerry cans, bottles, plates, and basins) and paper and cardboard. Formalisation of waste pickers groups can make them more effective, make them follow health and safety regulations and protect them against exploitation. Achankeng (2003) argues that as the waste pickers get more organised

(a) (b)

Figure 7. Waste disposal: (A) - The Kitezi landfill in Kampala where waste pickers can be seen at work (B) – the impact of indiscriminate disposal on Nakivubo channel, Kampala (wastes washed from the catchment floating on storm water).

through formalisation of operation conflicts with formal collectors ensues especially regarding areas of operation. Achankeng (2003) reports such conflicts in Cameroon and quotes Kamel (2001) for such conflicts in Cairo. Such conflicts however could be avoided if urban councils formalise all waste operation activities and set clear rules of operation whereby zones of operation and all other requirements are strictly adhered to. This is only possible for waste pickers if organised in formal groups that can be legally registered, monitored and supervised as reported in studies by Mbeng *et al*., (2009) in Cameroon and Nzeadibe (2009) in Nigeria.

The private sector is to some extent involved in waste recycling of items such as plastics, paper and cardboard. This apart from providing source of livelihood to the waste pickers is helping in removing wastes that could have ended in the environment causing pollution and aesthetics impairment.

2.5. E-wastes in East Africa urban centres

There is no comprehensive data on electronic wastes in EAC urban councils even though it forms a significant component of disposed waste as regards risks to the environment and the urban community. A study by Wasswa & Schluep 2008 indicates that 2,000 tons of e-wastes were generated mainly from computers in Uganda in 2007. There is no formal e-waste management in Uganda and formal recyclers do not exist. For Kenya e-wastes generated were 11,400 tonnes from refrigerators, 2,800 tonnes from TVs, 2,500 tonnes from personal computers, 500 tonnes from printers and 150 tonnes from mobile phones (NEMA & UNEP010). Although Kenya has developed guidelines for e-waste management (2010), e-waste management is still largely handled by the informal sector (*Jua Kali*). Tanzania produces between 2,000 and 3,000 tons of e-waste annually and there is no formal recycling. Feasibility studies were carried out for piloting e-waste management in Tanzania and Uganda (Blaser & Schluep 2012; Wasswa & Schluep 2008). Results indicate difficulties in achieving any profitable venture because of the low quantities of e-wastes generated currently. In all the three countries there is no clear disposal mechanism and large stocks of

e-wastes are being held in storage by consumers. However recycling options for parts from e-wastes such as plastics, metals (ferrous, aluminium and copper) do exist and should be explored. Recycling options for printed wiring boards, CRT tubes and hazardous fractions (e.g. PCBs, mercury, batteries) do not exist

3. Solid waste management challenges

All the EAC countries have policy, legal and institutional framework for waste management where urban councils are charged with the tasks to manage urban wastes (Liyala 2011; Oberlin 2011; Okot-Okumu & Nyenje, 2011; Tukahirwa, 2011). The duties and responsibilities are spelt out in a number of pieces of national legislations mainly in the area of public health, environmental management, urban planning and local governance (Kaseva & Mbuligwe 2005; Liyala 2011; Oberlin 2011; Okot-Okumu & Nyenje 2011). The urban councils are responsible for the implementation of these instruments including ordinances and bye-laws. In the (EAC), environmental policymaking remains largely a function of the central government, but implementation of policies and legislation is devolved to the Local Governments (Liyala 2011; Oberlin2011; Okot-Okumu & Nyenje 2011; Tukahirwa 2011). The existing laws on waste management are not being effectively enforced (Liyala 2011; Oberlin 2011; Okot-Okumu & Nyenje 2011; Simon 2007), which may be attributed to inherent weaknesses of the laws themselves. The informal sector and the community therefore operate with little or no regulation at all.

Waste management is poorly financed because it is not a prioritised activity in all urban councils. Funds for the operation of the urban councils are mainly from external sources (over 50 %) like the central government and donors in the form of grants (Liyala, 2011). This means fiscal autonomy has not been realised by the EAC urban councils as observed by Okot-Okumu & Nyenje (2011). The central governments do not adequately cost-evaluate the decentralised environmental management functions implemented by the urban council (Okot-Okumu & Nyenje 2011). National priorities usually differ from environmental management activities causing low remissions in these sectors by the central governments. The study by Liyala (2011), of Kisumu (Kenya), Mwanza (Tanzania) and Jinja (Uganda) clearly illustrates the solid waste management financing dilemma. It is difficult to solve the dilemma because urban council local revenue sources are limited and locally raised revenues are in some cases as low as 3% of the total annual local authority budgets. In Kenya and Tanzania the community pay for waste management, while in Uganda there is unwillingness to pay although in all these countries, Local Governments are by law (Local Government Acts) are given the powers to charge fees for waste services (Liyala 2011). The problem is compounded by the inability by a large percentage or urban community to pay for waste collection services due to low income levels in the EAC region. Therefore households not served by waste collection have developed their own waste management systems. The most common household waste management methods identified are waste burning and backyard burying or indiscriminate open dumping (Liyala 2011; Oberlin, 2011; Okot-Okumu & Nyenje 2011; Simon, 2007). Waste composting is still small-scale and insignificant, often by households and mostly for individual household gardens, while

anaerobic biogas production is limited and in the homes or farms of high-income people in peri- urban or rural areas. These are informal setups that are not easy to assess or control. Composting and anaerobic biogas production are therefore often on individual basis and insignificant. Uganda is however piloting composting in eleven urban councils that have scored different levels of success (NEMA 2007; Okot-Okumu & Nyenje, 2011). In Tanzania KIWODET composting activities demonstrated that successful composting initiatives can arise from local capacity (Oberlin & Sza´nto´, 2011). The main problems of the composting project are sorting which is not done at source but on delivery of wastes, mixed wastes of all categories increasing health risk to workers and lack of market for the compost. Some authors (Matete & Trois, 2008; Mbeng *et al.,* 2009; Mbuligwe & Kasenga, 2004; Rotich *et al.,* 2006;Wang *et al.,* 2008) have identified recycling, composting and biogas production as feasible options with social, economic and environmental benefits by reducing amounts of waste disposed, saving the environment and generating income for communities the lack of municipal integration and support leaves composting, which is technically viable, to be strongly vulnerable to external factors (Oberlin & Sza´nto´, 2011).In East Africa these innovative methods for waste management remain un-researched denying interested individuals among the urban communities information on such projects.

An integrated approach to solid waste management involving a mix of centralised urban council-controlled conventional methods with decentralised innovative decentralised alternatives such as 3Rs; composting and anaerobic biogas production can help to attain sustainability in waste management. This is the preferred approach in the region after the realisation by the EAC governments that the solid waste management monopoly by the urban councils is not succeeding to meet expected results, and the outcome is the acceptance of a holistic approach to solid waste management in the EAC that involves the community, private collectors, CBOs, NGOs and the informal sector working together under a decentralised arrangement (Okot-Okumu & Nyenje, 2011; Liyala, 2011; Tukahirwa *et al.,* 2010; Simon, 2008). Mbeng *et al*., (2009) identified information as critical for the success of 3Rs, composting, waste prevention and waste minimisation in urban councils since most communities lack vital knowledge for effective implementation of these methods of waste management.

Some authors (Liyala 2011; Oberlin 2011; Tukahirwa 2011) identify common causes for poor waste management services as the inadequate policy and legislation, lack of political will, lack of public commitment, lack of technical capacity, poor financing. A different group of authors think it is seldom technical (Scheinberg 2011) but rather politics, economics or institution (Wilson *et al.,* 2010)

Little investment has been made in MSWM research, resources and human capacity development. The only coordinated major research that has been done on waste management in EA cities is the one under PROVIDE where some of the MSc and PhD research results have already been published (Liyala 2011; Oberlin 2011; Simon 2007) .

The efforts by the Central and Local Governments, international organisations such as International Labour Organisation (ILO), Non-Governmental Organisations (NGO) and

CBOs to train for awareness and capacity building for MSWM are not coordinated and are also discontinuous causing duplication of efforts, therefore have insignificant impacts on target communities. Even though urban councils contract private operators to collect wastes, the urban councils themselves are still the main waste collectors and the combined efforts of the urban councils with the private sector have not yielded the levels of success expected. This is evident by the common scenes of uncollected wastes on roadsides and in drainage channels, streams and wetlands in urban and peri-urban areas.

The problem of MSWM in East Africa is compounded by the rapid urban population growth caused by rural to urban migration overstretching resources. The rising urban population and increasing industrial activities means larger volumes of wastes that pose threat to public health and the environment since they are predominantly decomposable organic (Table 1) and E-wastes are also increasing in the waste stream. Zurbrugg (1999) noted that the problems of MSWM are of immediate importance in many urban areas of the developing world and waste management is known as one of the key issues in urban management aside from water and sanitation. Municipal wastes therefore constitute one of the most crucial health and environmental problem of African urban councils (Achankeng 2003; Adebilu & Okekunle 1989; Asomani-Boateng & Haight 1999; Kaseva & Mbuligwe 2005). It is evident from Kaseva & Mbuligwe (2005) for Tanzania, Rotich *et al.*, (2006) for Kenya and Okot-Okumu & Nyenje (2011) for Uganda that urban areas in East Africa have been experiencing serious solid waste management failures.

The prevailing attitude of the public towards waste collection and disposal or treatment is poor (Liyala 2011; Oberlin 2011). The urban communities generally do not participate in waste management responsibly and this is not helped by the inability of the urban councils to enforce existing waste management laws (Liyala 2011). Political interference caused by personal interests has in some cases obstructed opportunities to implement ordinances or bye-laws. Political interference weakens environmental management institutions and creates a community that is difficult to work with for environmental management (Okot-Okumu & Nyenje 2011).

There are also the negative factors of attitude and culture that have prevented in some cases the very important element of public participation as noted by some authors (Kaseva & Mbuligwe 2005; Palczynski 2002; Rotich *et al.,* 2006; Yhedgo 1995). The low standard of living (poor pay), education (high illiteracy levels) and the economy (low GDP per capita) are influencing factors that cause low levels of willingness to participate in public management matters. The combination of all these factors together with the urban council weaknesses that cause management failures have led to the accumulation of wastes in neighbourhoods leading to environmental degradation and threat of disease epidemics such as cholera, diarrhoea and parasites. Socio-cultural and attitude problems in waste management may be addressed gradually through public education to sensitise the communities, while economic issues can be addressed by providing livelihood opportunities (employment) within the waste management activities.

There is need to explore the opportunities for the 3Rs and composting in urban waste management among urban communities to minimise waste while at the same time providing social (e.g. clean and healthy neighbourhood) and economic (e.g. sale of recycled

or recyclable materials) benefits. To successfully adopt sustainable methods of waste management by the communities, Mbeng *et al.,* (2009) suggested making awareness programmes simple and accessible to change the mindset of urban residents to perceive waste as resources (goods) rather than something without value. To address community level waste problems pre-collection/ primary collection needs better organisation and strengthening by communities working together with urban councils and CBOs to chart the most suitable waste minimisation and collection methods. Integrated waste management approach that employs decentralised community based systems involving NGOs/CBOs targeting the peri-urban poor and the more centralised urban council and private operator systems that target the central business areas and the rich and middle class estates should be explored by the urban councils. Such systems can be promoted through community participation and education involving CBOs and the informal sector. There is need for political support for such initiatives of waste management strategies to succeed.

4. Conclusions

The demand for solid waste collection has steadily increased in the East African urban councils as urban population increase with the accompanying expansion of settlements mostly occupied by the peri-urban poor (in informal settlements) that receive little or no waste services at all. The waste collection and disposal levels are low in all urban councils in East Africa resulting in waste piles that cause environmental degradation and health hazard. Waste management is a decentralised function of urban councils but its funding is predominantly external and the urban councils do not prioritise waste management in their annual plans. These have combined to cause poor allocation of resources and ineffective solid waste management by urban councils.

The predominantly conventional waste management methods have failed because they do not effectively address local conditions such as culture, financing system, institutional framework, technical and human capacities, socio- political situation and waste characteristics. There is therefore need for urban councils to explore opportunities for innovative integrated approach for sustainable waste management such as the 3Rs, composting, anaerobic biogas production that involve all stakeholders including the community and the informal sector. The process from planning to implementation should be all inclusive to ensure consensus building for success. The role of the private sector, NGOs, CBOs and the informal sector should be strengthened to minimise waste in the environment while at the same time providing social and economic benefits to communities especially the urban poor. This requires long-term planning by the urban councils that involve all the stakeholders.

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