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Review of Municipal Solid Waste Management: A Case Study of Nairobi, Kenya

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ABSTRACT : *Solid waste management (SWM) is a major public health and environmental concern in urban areas of many developing countries. Nairobi's solid waste situation, which could be taken to generally represent Kenya's status, is largely characterized by low coverage of solid waste collection, pollution from uncontrolled dumping of waste, inefficient public services, unregulated and uncoordinated private sector and lack of key solid waste management infrastructure. Solid waste generated on daily basis is 4,016 tonnes as predicted by Allison (2010). The collection rate is as low as 33% (JICA, 2010) which leaves about 2,690 tonnes uncollected (almost equal to the total daily waste generation as predicted by JICA (1998)). Apart from Nairobi City Council (NCC), the body that has the primary responsibility for the provision and regulation of SWM services in the city, other actors have come into play such as private companies and community based organizations among others. The models of operation of these actors are not well understood. Effective coordination among these actors is also absent and regulation of the private companies by the city council is only beginning to emerge. According to Mwangi, 2007, analysis of total costs incurred by various actors and amount of waste collected per month showed that CBOs had the least fixed cost of operation as compared to private companies. Further, the CBOs had the lowest cost per tonne of waste collected as compared to other operators who showed almost twice this amount. These suggest that solid waste management is very expensive and CBOs are the cheapest operators of solid waste. Therefore, CBOs should be left as the waste operators in the low income areas where the residents are unable to pay a lot of money for waste management due to their low operating costs. Due to their relatively high operation costs, the private companies are more suited to operate in the high income areas and CBD where the residents or the owners of building are able to afford for the services. However, private enterprises are primarily interested in earning a return on their investment and may not be efficient due to the complexity of their operations outlay especially when proper coordination and SWM models are lacking.*

KEY WORDS: *Actors, Efficiency, Models and Solid Waste Management*

I. INTRODUCTIONS

Solid Waste Management (SWM) is a major public health and environmental concern in the urban areas and many developing countries. The situation in Africa, particularly in the large urban towns is severe. The public sectors in many countries are unable to deliver services effectively, regulation of the private sectors is limited and illegal dumping of domestic and industrial waste is a common practice. Local authorities charged with the responsibility of providing municipal services have found it increasingly challenging to play this role (UNEP, 2010). Nairobi's solid waste situation, which could be taken to generally represent Kenya's status, is largely characterized by low coverage of solid waste collection, pollution from uncontrolled dumping of waste, inefficient public services, unregulated and uncoordinated private sector and lack of key solid waste management infrastructure. Solid waste generated on daily basis is 4,016 tonnes as predicted by Allison (2010). At the local level, Nairobi City Council is the body that has the primary responsibility for the provision and regulation of SWM services to the city of Nairobi. NCC delivers its SWM services through the Department of Environment (DoE) under the cleansing section, one of its three units (JICA, 1998). Until the mid 1970s, the cleansing section collected over 90% of the waste. As years went by, there was a decrease in the number of waste collection vehicles due to lack of appropriate maintenance (Gicheha, 1990). On the other hand, the expansion of industrial and commercial sectors resulted in increased urban migration, improved standard of living and technological advancement which in turn led to increased waste generation. In mid 1980s, NCC collected only 20% of the municipality's solid waste, leaving about 290,000 tonnes of solid waste at the Dandora open dumpsite, located about 7.5Km from the city centre, from industries, institutions, commercial establishments, and high-income residential areas (Esho, 1997, UN-HABITAT, 1998). In the 1998 JICA study, NCC estimate that over 60 private companies registered under the Company Act were participating in waste collection.

These are business oriented operations in open and unregulated competition providing services to whom and where they like and collecting tariffs directly from the customers. They remain uncontrolled and operate without any institutional or legal regulation.Public private partnership in SWM in Nairobi started in 1997 when NCC contracted garbage collection and streets, roads, lanes and market sweeping and transportation of the waste to Dandora dumpsite on a daily basis in the Central Business District (CBD) to Kenya Refusal handlers (generally called handlers). This improved the collection from 40% to 90% in the CBD but delays in payments interfered with operations (UNHABITAT, 1998). In 2001, the collection of waste from communal collection areas and transportation to Dandora dumpsite was contracted out in other parts of the city. In 2004, the existing waste management districts were revised to 9 divisions according to the constituency boundaries apart from Central Business District that was curved out from Starehe Division. The contractors were then distributed into these divisions. More than 13 contractors have been engaged and allocated into the various divisions by NCC. The Divisional officers are responsibly for guiding these contractors on the routes to follow during waste collection and transportation to the dumping sites. It is the responsibility of the waste generators to transfer the waste to the collections sites. In the low income and unplanned settlements in the city, Community Based Organizations (CBOs), inkling charitable organizations, welfare societies, village committees, self-help groups and residential (or neighborhood) associations (RAs) are providing useful services at about Kshs. 100 – 300 per month whilst at the same time creating employment for about 3 – 4 days per week. These services include waste compositing, collection and transportation of solid waste, collection, storage, trading and recycling of waste component such as plastics and glass.

The aim of this paper is to provide a comprehensive review of SWM Practices in Nairobi with objectives: to identify the critical problem areas by an objective assessment of the state of practice and to recommend suitable measures for improvement in the current practices.

II. CURRENT STATUS OF SOLID WASTE MANAGEMENT

Solid waste management is a fundamental prerequisite in ensuring sustainable environment. Rapid urbanization, industrialization, population growth and increased waste generation have transformed solid waste into a major public health and environmental concern in Nairobi city. Solid waste management is tough and very expensive especially tough to the urban poor who cannot afford the services and hence left to deal with waste disposal on their own. NCC which is mandated on solid waste management on the other hand is unable to deliver quality services to all the residents.

2.1 Sources, Composition and Generation of Solid waste

Composition of waste is determined by various factors which include population, level of income, sources, social behavior, climate, industrial production and the market for waste materials (Baldisimo, 1988). The current municipal solid waste generated on daily basis in Nairobi is 4,016 tonnes as predicted by Allison (2010). The composition of waste generated has been evolving with years. Table 1 shows a summary of the evolving solid waste composition in Nairobi;

Table 1: Nairobi evolving solid waste composition

Waste Type	**Percentage Composition**			
	MoLG & FARID 1985 (Cited in Kibwage, 1996)	**JICA, 1998**	**ITDG, 2004 (Cited in Bahri, 2005)**	**UNEP/CCN/NTT, 2009**
Organic	78	58	61.4	50.9
Paper	10.2	17	11.8	17.5
Plastic	4.1	12	20.6	16.1
Glass	3.8	2	0.7	2.0
Metals	1.9	3	0.6	2.0
Other	2	8	4.9	11.4

Source: Solid waste Management in Nairobi: A situation analysis. Report for City Council of Nairobi, 2010

The evolving trend of Nairobi's solid waste composition shows a decrease in organic waste and increase in paper contents over the years. This can be attributed to the changing lifestyle of the Nairobi residents of packaged goods consumption. 'Other' waste content which includes textiles, wood and ash seems to be increasing over the years due to population increase and the increased rate of urbanization. Organic matter

remains the highest content over the years with an average of 62.1% as shown in the summary of the physical composition of municipal solid waste composition in Nairobi in Fig 1.

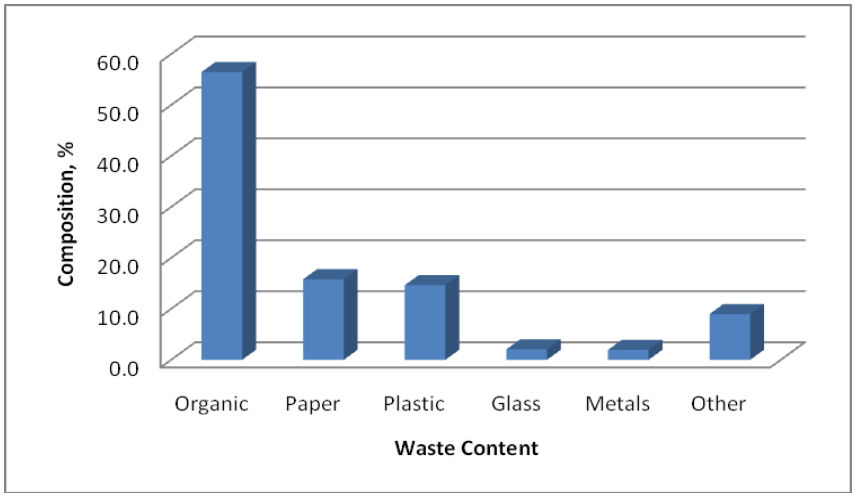

Figure 1: Physical composition of MSW in Nairobi

2.2 Collection of Solid Wastes

The collection rate of MSW in Nairobi City is as low as 33% (JICA, 2010) which leaves about 2,690 tonnes uncollected (almost equal to the total daily waste generation as predicted by JICA (1998)). The total solid waste reuse and recycling in the city is about 100-150tons/day (Allison, 2010) which is approximately equivalent to 3.7% of total waste generated. With the assumption that collection of recyclables/reusables happens before final collection, uncollected waste reduces to 2,540 tonnes per day. This could be assumed to be largely disposed-off in inappropriate ways such as burning and illegal/indiscriminate dumping either by collectors or due to non-collection.

2.3 Treatment and Final Disposal of Solid Wastes

Besides the Kayole temporary dumpsite (located 13 km from the city centre, started in 2009 and has a capacity of 930,000m^3), Nairobi's Dandora dumpsite is the only site which is operational. It is an open site where all the waste collected from the city is dumped off and is located at approximately 7.5 km northeast of Nairobi city. It covers approximately 46 ha but only 2 ha belong to the NCC whereas the rest is privately owned (JICA, 2010). Dandora dumpsite has a capacity of about 1.8 million m^3 and about 220,000 tonnes had been disposed off at the site by 2009 (JICA, 2010). With the rapid population growth rate and urbanization among other factors, the dumpsite is almost full to its capacity. There are over 70 illegal dumpsites scattered throughout the city where most private waste collectors dump collected waste. This coupled with the unmanaged Dandora dumpsite and uncollected waste make solid waste management in the city a challenge.

2.4 Actors in Solid Waste Management

In Nairobi, waste management stakeholders include Nairobi City Council (NCC), Ministry of Environment, Water and Natural Resources, Ministry of Lands, Housing and Urban development, Non-governmental organizations (NGOs), Community Based Organizations (CBOs) and the private sector. The National Government is responsible for establishing the institutional and legal framework for municipal SWM and ensuring that county governments have the necessary authority, powers and capacities for effective solid waste management. County government through the NCC is generally responsible for the provision of solid waste collection and disposal services. CBOs in most cases arise in the low-income residential areas where solid waste is commonly dumped onto nearby open sites, along main roads or railways, or into drains and waterways, as a source of employment as well as to upgrade local environmental conditions. NGOs operate between the private and governmental realms and they have a strong presence in the city's informal settlements. Private sector includes a wide range of enterprise types varying from informal micro-enterprises to large business establishments. They may be contracted directly by individual households, neighbourhood associations or business establishments.

There are over 120 private companies licensed by NCC and more than 140 informal private companies that are estimated to be participating in waste management (Ngau & Kahiu, 2009). An analysis of total costs incurred by various actors and amount of waste collected per month showed that CBOs with the least cost of operation (at zero waste collection) at KShs 7,355 as compared to private companies which showed over 5 times this amount KShs 40,608 and NCC over 200 times Kshs 1,617,462. Further, the CBOs had the lowest cost per tonne of waste collected as Kshs. 865 compared to other operators who showed almost twice this amount. These figures suggest that solid waste management is very expensive and CBOs are the cheapest operators of solid waste (Mwangi, 2007). Therefore, CBOs should be left as the waste operators especially in the low income areas where the residents are unable to pay a lot of money for waste management due to their low operating costs. Due their relatively high operation costs, the private companies are more suited to operate in the high income areas and CBD where the residents or the owners of building are able to for the services. However, private enterprises are primarily interested in earning a return on their investment and may not be efficient due to the complexity of their operations outlay especially when proper coordination and SWM models are lacking. Despite the sprouting of private companies, CBOs, RAs and other actors currently involved in solid waste management in Nairobi, the models of operations of these actors are not well understood. Effective coordination among these actors is absent and regulation of the private companies by the NCC is only beginning to emerge.

1. Existing Institutional and Organizational Framework on SWM

At the national level, Ministry of Environment, Water and Natural Resources has the main responsibility of SWM. The Ministry of Health and the Investment Promotion centre (IPC) play a minor role (JICA, 1998). Nairobi County Government has control over all the operations and activities within the city whereas Ministry of Lands, Housing and Urban development controls all the urban development, housing and lands activities. Ministry of Environment, Water and Natural Resources comprises of the National Environmental Management Authority (NEMA), the ministry's environmental coordinating body and National Environmental Agency Plan (NEAP) which has been responsible for formulating environmental policies and drafting the Environmental Management coordination Act (EMCA) among other departments (JICA, 1998). MoH has the general responsibility under the Public Health Act to deal with health hazards arising from the problems with solid waste. However, it has no specific legislation on the regulation and management of hospital waste apart from when the hospitals or clinics are being set up. At the local level, Nairobi City Council has the primary duty of care for the provision and regulation of SWM services to the City of Nairobi. NCC delivers its SWM services through the Department of Environment (DOE). However, these do not carry any monitoring of SWM activities that is waste generators or private collection companies other than some inspection of its own collection and disposal activities (JICA, 1998).

2. Existing Legal Framework on SWM

Legal framework concerning solid waste at the national level are very few and scattered through a number of Acts and NCC's bylaws (JICA, 1998). There is no categorization in these legislations which was enacted to cover municipal waste only. The legislation is also deficient in setting and defining standards and conditions covering a number of aspects on SWM, particularly concerning operational aspects. For example, there is no by-law or central government regulation defining standards for collecting, treating and transporting SW or proper management of sanitary landfills. There is also no legislation on waste reduction or recycling. The EMCA (1999) provides the framework for the coordinated management of the environment. The Act deals with waste management including standard setting, disposal site licensing, control of hazardous, industrial and hospital waste. Under the Act, responsibility for the storage, treatment and collection of hospital, industrial and hazardous wastes will be the generator. However, final disposal of all types of wastes remain the responsibility of local governments. These laws are not followed. Consequently, lack of systematic approaches to hospital, industrial and hazardous wastes disposal has resulted to these wastes being mixed with the municipal waste in collecting bins at roadsides and disposed of similarly. Some of these wastes are simply buried without any appropriate measure. There is an urgent need that the solid waste management law should legislate. The laws should be legislated to include activities concerned with the waste management; what part citizen; enterprise and government should take of responsibilities. The laws should also include sanctions to the law breakers concerning solid waste management.

III. CONCLUSION

Solid waste management (SWM) remains a major public health and environmental concern in Nairobi and Kenya in general. A summary of the conclusion from the review on present status of solid waste management in Nairobi are as follows:

- Rapid population growth rate, increased urbanization rate and current changing lifestyles of the Nairobi residents result to the evolving estimates of waste generation rates as well as characterization of the wastes generated
- SW collection rate is about 33% of the waste generated, recycling rate is about 3.7% hence leaving about 63% uncollected waste
- Dandora is the only operational official dumpsite of the city waste and its capacity is almost full. It's an open site and poorly managed hence becoming annoyance to the residents neighbouring it and the environment. It is not only security risk but also health risk
- Various SWM actors including private companies, CBOs and RAs are continuing to evolve and work towards SWM besides the NCC. However, proper the models and regulations of operations of these actors are not well understood
- There is a limited focus on control mechanisms on SWM which is adversely effecting on safety, health and the environment
- Regulations are inadequately enforced and SWM seem considered of low priority
- In some cases, hospital and industrial wastes which are highly hazardous are treated as ordinary waste
- Rising number of illegal dumpsites and the much uncollected waste throughout the city poses serious health hazards
- Recycling for resource recovery and community participation in SWM, and also on road side and rivers have positive contributory role
- A proper model on waste generation determination should be developed taking into account the evolving change in waste generation and characterization
- Public awareness should be created especially at the generators level so as to minimize waste generation and for the generators to embrace the importance of proper waste management
- Specific policies and regulations to solid waste management addressing all types of waste and with clarity of the roles and responsibility of each citizen should be developed
- Private sector involvement as well as other actors in SWM should be increased so as to improve the efficiency of SWM
- SWM monitoring system should be put in place to ensure adherence to SWM regulations/laws
- Dandora dumpsite and other illegal dumpsites should be rehabilitated. Integrated SWM involving sanitary landfilling technology should be adopted over open disposal
- Sanctions and penalties of waste mismanagement should be put in place and strictly followed
- Reduce, reuse, and recycle (3R) should be promoted

REFERENCES

[1] Allison Kasozi and Harro von Blottnitz, 2010. *Solid waste Management in Nairobi: A situation analysis. Report for City Council of Nairobi, contract for UNEP*

[2] JICA, 2010. *Preparatory Survey for Integrated Solid Waste management in Nairobi City in the Republic of Kenya*, Final Report

[3] JICA, 1998. *The Study of Solid Waste Management in Nairobi City*, Final Report

[4] Mwangi, Faith Wanjiru, 2007. *Evaluation of Optimum Solid Waste Management Model for Nairobi*, M.Sc. Thesis, University of Nairobi, Kenya

[5] Harro von Blottnitz and Peter Ngau, 2010. *Integrated Solid Waste Management Plan for the City of Nairobi*, Kenya For the City Council of Nairobi, contract for UNEP

[6] Gicheha Mwangi J, 1990. *Solid Waste Management in Nairobi Metropolis.* , M.Sc. Thesis, University of Nairobi, Kenya

[7] Esho Lawrence Saloon, 1997. *An Assessment of the Role of the Private Sector in Urban Infrastructure Service Provision*: A case Study of Solid Waste Management in City of Nairobi, MA Thesis, University of Nairobi, Kenya.

[8] Baldisimo J. M., 1988. Scavenging of Municipal Solid Waste in Bangkok, Jakarta and Manila. *Environmental Sanitation Reviews, December No. 26. Asian Institute of Technology, Bangkok*

[9] Ngau & Kahiu, 2009. *ISWM Secondary Data Report on Solid Waste Inventory in Nairobi: Report of the National Technical Taskforce (NTT) on Preparation of An Integrated Solid Waste management Plan for Nairobi*. Nairobi

[10] Gakungu, N. K., Gitau A. N., Njoroge B. N. K., Kimani M. W., 2012. Solid waste management in Kenya; A case study of public technical training institutions. *ICASTOR Journal of Engineering. 2012;5:3 (ISSN-0974-407X):127-138*.

[11] Khadhaka Liyali V, *Problems of solid waste management in the city of Nairobi*, M.A thesis, University of Nairobi, Kenya, 1988.