

An Assessment of the Adequacy of the Methods Of Domestic Solid Waste Management in Kisii Town, Kenya

Mecheo O. Naftal, PhD

Urban Environmental Governance Management
Wangari Maathai Institute- University of Nairobi Kenya

ABSTRACT

Urban domestic solid waste is increasingly being generated in many urban centres including middle sized towns. In many urban areas in developing countries there's a growing need and awakening for meeting the waste disposal for the ever increasing population. This paper examines and analyses the varied treatment and disposal methods of domestic solid waste employed in Kisii town. The specific objective of the study include: to assess the adequacy of the available management systems of handling domestic solid waste (DSW) in Kisii town. A mixed methodology approach was taken into consideration. A sample of 110 households was obtained using the multi stage stratified sampling method. Data collection methods of the sampled size involved the use of questionnaires to 110 householders and direct interviews to 2 county officers in charge of DSW and observation integrated with photography. Data analysis was carried out using methods such as use of tables and graphs through SPSS. The results indicate that the storage facilities are inadequate for the residents, the collection times are not only insufficient but also irregular, the transportation means employed are limited, and disposal and treatment of the DSW is limited to mainly open dumping at the overfilled Nyambara dumpsite. In conclusion, the management methods of the DSW are inadequate and pose severe health risks to the residents of Kisii. It is recommended that, for effective domestic solid waste management adequate bins should be provided in the town, collection should be regular and indiscriminate in all estates, recycling, re-use, reduce and energy recovery should be introduced to move from challenges to opportunities. Finally, an integrated model of integrating CBOs and private groups in management of DSW is suggested to ensure sustainable solid waste management.

Keywords: Assessment, adequacy, domestic solid waste management, Kisii town, Kenya.

INTRODUCTION

Solid waste is produced in all residential areas with human inhabitation. The management of the waste thus has become a critical problem to different counties and towns especially in developing countries. In many urban areas in developing countries there's a growing need and awakening for meeting the waste disposal for the ever increasing population (Foster, 2011). This may remain as one of the most crucial, expensive and even difficult duties of many urban authorities such as counties currently in Kenya and in particular Kisii town.

With the exponentially increasing urban population, most towns have been incapacitated in their ability to manage domestic solid waste which accounts for 70% of the total garbage or the solid waste generated in the towns. It has been noted that households generate more solid

waste than the local authorities in most county headquarters as in the case of Kisii town, than the town's authorities can handle (Habitat, 1987).

Inadequate resource mobilization, has greatly affected the effectiveness of household solid waste management in most developing nations' towns. This case is replicated in Kisii town where the county and the municipality are not injecting adequate efforts to manage the solid waste. Thus inadequate resource mobilization and allocation creates a situation of poor solid waste management in the town (Nath, 1993).

Poor management of the wastes observed in many towns in developing countries is attributed to the inefficient and irregular collection, not separating the generated waste, poor storage, transportation and disposal. This challenge has been observed in relation to the solid waste management organization and structures in the municipal and county's ability in managing the wastes (Kiplagat, 1999).

Inadequate use of technology to enhance waste minimization through energy extraction so that energy can be generated from the waste is evident in many towns in developing countries. Also the significance of recovery and reduction of solid waste is lacking. This could enable the use of alternative means to manage the domestic solid waste generated in the urban areas (Oluchiri, 2002).

The inadequacies of proper water supply and sanitation measures have adversely affected the hygiene of the towns in many developing countries; such that the residents dispose their refuse along and near the water sources (Ongore et al, 1996). Kisii town also experiences critical problems in the water supply, the sanitation measures and a poor sewerage system this has contributed to the residents indiscriminately disposing their solid wastes along the river courses such as the areas near Daraja Mbili market and near the bridges at Nyanchwa residence. These suggest a need for a well-planned policy by the county on these areas so as to contain the solid wastes.

The constraint that come up in public and private partnership in garbage removal in developing countries have hindered the effective and efficient domestic solid waste in many urban areas as evidenced in Kisii municipality (Layton, 1986). These challenges of garbage collection entail low priority ascribed to the service to citizen by authorities, budget crisis, and few legal barriers that discourage private sectors; unwillingness for the consumers to pay for the services limiting the service to high income residential who can afford to pay for the services; leaving the low income residential areas with heaps of uncollected wastes (Layton 1986).

There are inadequate solid waste management systems due to poor architectural designs of refuse and laxity in the enforcement of building by laws; in various counties and towns in Kenya. This has led to the indiscriminate methods of waste management in the towns. For example the disposal method in most towns is the use of open landfills as in the case of Kisii town. Also the storage of the domestic solid waste before they are collected in most towns in developing countries leaves much to be desired (Mbugua, 1980).

There has been a cycle of lack of sufficient resources in most county headquarters in Kenya and in most towns in developing countries; a situation prevalent in Kisii town which severely limits

a range of options to the towns. This situation limits the collection, transportation and the disposal of the solid wastes generated within the town by the households and other sources, thus the management of the household wastes often consume up to half of the budgets of the towns (Adam, 1995).

In comparing the slum areas and the expensive residential areas of high income earners; the county authority is more effective in collection, transportation and disposal of solid waste in the high affluent estates as compared to the services provided to the slum dwellers (Algak, 1995). This disparity is evident currently in Kenyan towns and is predominant in Kisii town. A proper more inclusive waste management strategy is required which will accommodate and cater for the low income earners. This will enable the provision of services to the tax payers regardless of their level of income and their residential areas, (Kibwage, 1996).

Domestic solid waste management in middle-sized towns such as Kisii has become a vital problem to local authorities and municipal authorities especially in developing countries. Consequently, UNEP (2006) observed that the impact of solid wastes in urban environments has become more and more intractable. For example it's estimated that more than 5 million people die annually in urban areas worldwide from diseases related to inadequate waste management systems (UNDP, 1991).

Most towns especially the county headquarters in Kenya as in the case in many developing countries heavily over- rely on imported equipment and technologies in the management of household solid wastes,(UNEP,2015). This over- reliance evidenced in Kisii town has led to the slow development especially on the management of solid waste (household) generated within the town by its residents. Therefore, there is need to develop a comprehensive alternative ways to manage the domestic solid waste in the town (Nath, 1993).

Inadequate supervision of the workers and also poor maintenance of vehicles are the major problems for solid waste management the towns, (Otieno, 2010). The work of the county workers in terms of collection of the waste is shoddy in most towns in the developing countries. These are evident in Kisii town such that the workers of the county are minimally supervised resulting in shoddy work in terms of collection, transportation and the disposal of the waste. Otieno, also it is noted that the maintenance of the vehicles which are used to collect and transport waste is rarely done surmounting to the breakdown of many vehicles thus the reason behind the uncollected waste in most parts of the town. This necessitates the need for a proper management of the domestic solid waste in Kisii town (Munuve, 1990).

Administrative and financial problems have hindered the efficient solid waste management on the Kisii town. Budgetary constraints in the municipality and the county have greatly contributed to the inadequacy of systems of managing the waste in the town (Agevi 1991). Also, municipalities in Africa spend as much as 70% of their budget on garbage management as noted by Agevi a figure that leaves minimal budgetary allocation for the development of the towns in other sectors.

The manner in which garbage is disposed of in urban areas poses a health hazard to the people living in the surroundings of the dumping site. A replica in Kisii town has been noted as the

domestic solid waste is disposed within the town. Thus garbage dumping sites should be located far from inhabited areas (Kalendu 1995).

The lack of equipment such as: bins in major collection points, vehicles and tractors for transportation and treatment equipment lead to the municipality ineffectiveness in handling solid waste, (Nyakaana, 1996). Kisii town to a great extent lacks equipment such as bins, collecting polythene bags, sorting out bins, vehicles and tractors and even digesters and disposal sites such as closed landfills. This has adversely affected the management of domestic solid waste management in the town. The inadequacies of the equipment have also contributed to the uneven collection, sometimes uncollected, poorly collected and unsafe disposal of the domestic solid waste in the town.

The scarcity of disposal sites in many urban municipalities which results in vehicles criss-crossing town centres to the few available disposal sites to dispose the refuse is evident in Kisii town. The main disposal site in Kisii town is Nyambara; this is the only disposal site for the whole town though lately the dumping site has been grabbed by private developers, rendering the town without a dumping site. The limited disposal sites in the town for refuse disposal has encouraged the vehicles and tractors transporting the household solid waste to criss cross the town thus dropping some of the wastes in the town and even causing discomfort to the urban people who engage in various day to day activities. This necessitates the need for effective and efficient managing the domestic solid wastes in the town (Omondi, 1998).

The reasons for the deteriorating state of solid waste management in most urban centres are that: most municipalities are led by politicians who adopt systems from other places without considering differential conditions, institutional circles problems, fragmentation of responsibilities, failure by the county authorities to coordinate the waste management and also failure to coordinate between ministries a prevalent case in Kisii town (Kayongo, 1997). Kayongo also, observed that health problems in urban areas can be caused by solid waste if precautionary measures are not taken in time because solid waste cause long- term pollution of air, land and water. Effects such as explosive gases are generated, contaminates water bodies, acid rains prevail from air pollution.

These inadequacies are common in many big towns/cities in developing countries. This study sought to establish the inadequacies associated with middle sized town such as Kisii to bring to knowledge the challenges of managing DSW in these towns which are developing which in most cases have not been dealt with.

METHODOLOGY

The study area

Kisii town is geographically located on Latitude: 0° 41' 0 S and Longitude: 34° 46' 0 E. The town is a driving distance of 309 km (192 mi) from Kenya's capital city of Nairobi, located east-southeast, on Class B3 all-weather road. It lies at an altitude of 1,700 m (5,577 ft) above sea level on the slopes of Kisii highlands. Kisii town is the county headquarters of Kisii County in the Nyanza region western Kenya. The town covers 8 km² (3 sq mi) and it has recently expanded rapidly to cover a peripheral extent of 29 km² (11 sq mi), a total of 37 km² (14 sq mi). Kisii receives frequent relief rains and enjoys a highland climate (KMC, 2010). The location of Kisii town on the highlands facilitates the growth of a vast vegetation cover making the region

produce a lot of food crops and vegetation which form the large part of the domestic solid waste generated in the varied residential areas of the town. The rapid expansion of the town has resulted in the creation of more residential estates such as Ufanisi, Getare, Milimani and Nyanchwa which have enhanced the stratification of the residential areas and also contribute tremendously to the generation of domestic solid waste putting pressure to the existing solid waste management systems.

Figure 1.1: A map showing location of Kisii town in Kenya and its various estates.

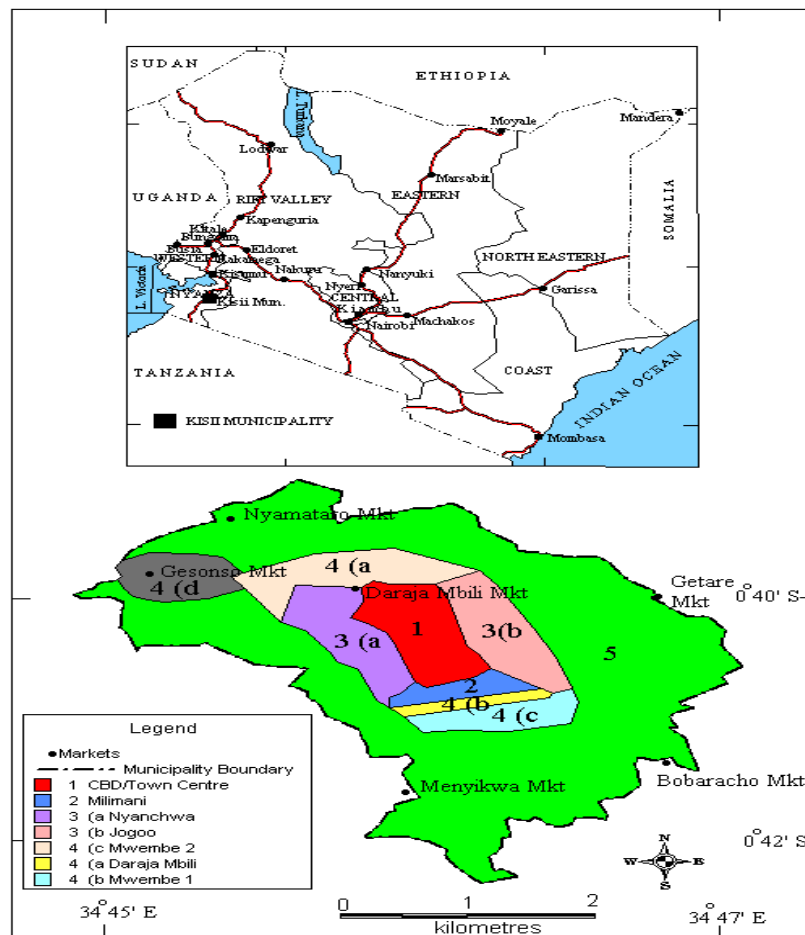


Figure 1: Map of Kisii Municipality
Source: Kisii Topographical Sheet 130/2 G.O.K (1991)

Research Design

For the study to meet the set objectives, the researcher took into consideration a household descriptive survey design, which covered selected residential estates within Kisii town. Kisii town has been chosen as one of the rapidly growing county headquarters in Kenya.

In order to carry out the design effectively, the researcher recognizes the need to classify the town's residential areas into distinct environmental neighborhoods according to income levels of the residents. This catered for differential respondents' perceptions and activities on the research subject. Therefore, this entailed the division of the area into different major zones of residential/environmental areas using the multi- stage sampling method.

The researcher issued 110 questionnaires to the residents in the three sampled estates in Kisii town and 2 in depth interviews were conducted to county officers in charge of public health, town planning, waste collection and environmental management with a view of having reliable and valid findings. The officers that interviewed were purposively picked from the county department in charge of solid waste management in the town to improve on the level of accuracy and relevance of the information collected.

Study population/ Sampling criteria

Kisii town has more than 20,000 households in all estates currently (KMC, 2010). Using the multi-stage sampling three estates were chosen by dividing the entire study area into different major residential areas based on the environmental indicators as the structures of the existing households such as: the levels of income and the prevailing environmental conditions of the residents.

Consequently, the residential zones were stratified as high income residential (HIR), middle income residential zones (MIR), and low income residential zones (LIR). This was done in collaboration with the county authorities who helped in this classification since their determination was more precise. This facilitated the selection of the households that were interviewed. Using the most populous estate in the category three estates were selected as follows: Nyanchwa, Jogoo and Mwembe which have more than 300, 600 and 800 households respectively.

The three residential classifications estates were selected from the existing estates namely: Menyinkwa, Gekomu, Nyanchwa, Jogoo, Mwembe, Campus, Gesonso, Daraja Mbili, Nyamataro, Bonubi, Egesa, Bochura, Omosocho, Milimani and Getare among others. The table below shows the selection of the estates according to the income levels.

Table 3.1: A table showing the sampled estates in Kisii town

Low Income Residential Estates	Middle Income Residential Estates		High Income Residential Estates
★ Mwembe	Menyinkwa	Campus	Milimani
Daraja Mbili	★ Jogoo		Nyamataro
Bonubi	Gekomu	Omosocho	★ Nyanchwa
Bochura	Getare	Egesa	Gensonso

★ Sampled Estates

Different number of households were systematically selected after a Kth household has been randomly selected based on each estate's total number of households according to the county statistics which were provided by the county and town administration statistics department.

Figure 3.1: A map showing the sampled estates.

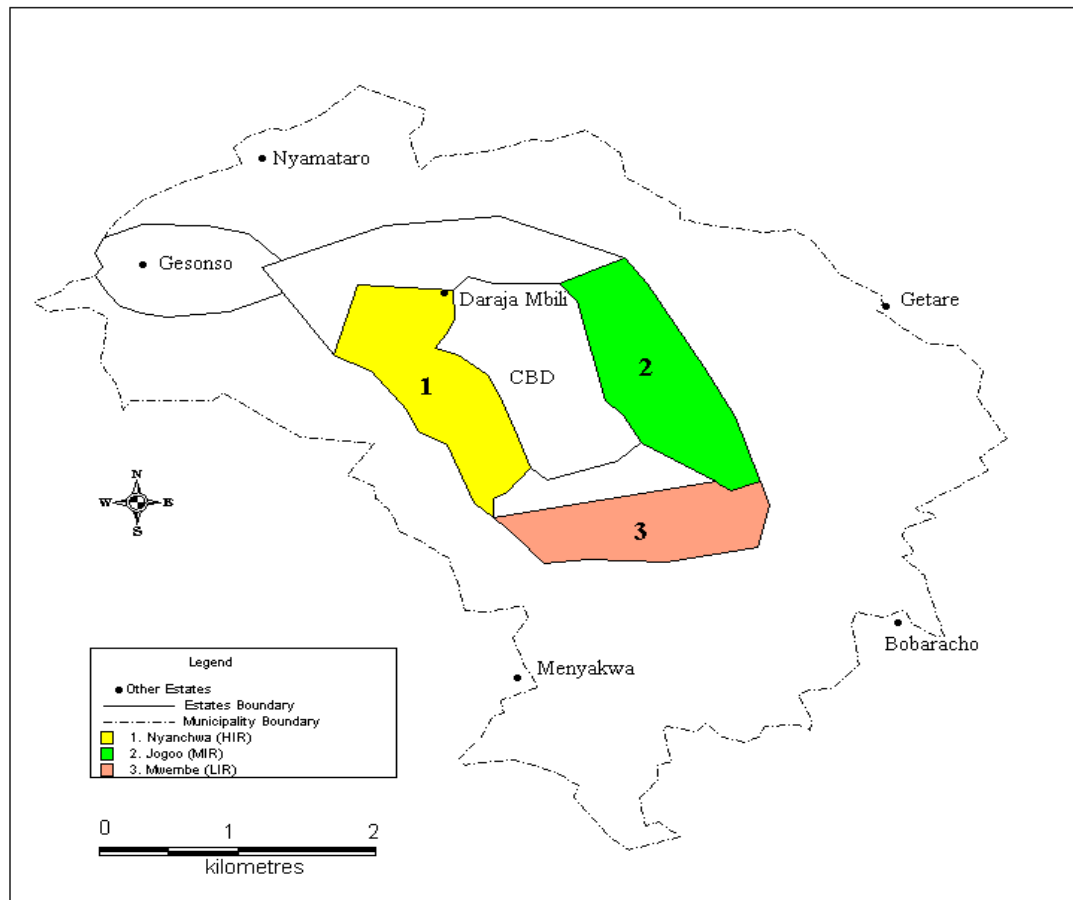


Figure 3: Map of Kisii Municipality showing the three sampled Estates (KMC, 2010)

Sampling procedure

The sampling procedure used by the researcher largely depended on the research design. Whereby, questionnaires were issued to the residents in the identified areas and estates, also interviews targeted Kisii county staff as in depth informants.

The sample size was 110. This was calculated according to Yamane's formula

$$n = \frac{N}{1 + N(e)^2}$$

Where n- is the required sample size

N- is the population size

e- is the error margin

In this case N was 1700 and e was 0.09

$$\text{Hence } n = \frac{1700}{1 + 1700(0.09)^2} \quad n = 110$$

The sample size of 110 made up 6.5% of the households of the sampled estates.

Table 3:2: A table showing the sampling procedure of the questionnaires used

Estate Class	Estate Name	Target household population	Sample size
LIR	Mwembe	800 *0.65	52
MIR	Jogoo	600*0.65	39
HIR	Nyanchwa	300*0.65	19
TOTAL		1700*0.65	110

Methods of data collection

Both primary and secondary data collection methods were employed for the research study. Primary methods of data collection used involved the collection of raw data from the field. Questionnaires, interviews, measurement, use of photographs and direct observation were used.

The use of multiple techniques was aimed at ensuring that accurate and reliable data was collected. Since the major consideration in the research was to obtain data; that would allow accurate descriptions of situations or relationships between certain variables, information adequacy and efficiency is required. (Busha and Harter, 1990). Therefore, reliance on multiple data techniques usually provides better results.

Questionnaires were the preferred data collection tool since they gave firsthand, comparable, reliable and accurate data for one to achieve the research objectives, research questions and the research hypotheses (Babbie, 2004).. A questionnaire covering a wide range of issues on household solid waste management was administered to man or woman of the house depending on their availability at household level as shown; in appendix I, and another to the county/ municipal authorities as shown in appendix II.

Data Analysis

After data had been collected, the raw data was systematically organized through coding to facilitate analysis. This was done by converting data to numerical codes representing attributed or measurements of variables. Statistical Package for Social Sciences (SPSS) program was used (descriptive statistics and tables) as an analytical tool to produce the result required for the interpretation. However, some data obtained from interview schedules, observation and photographs were presented directly. Various inferences were made from the analysis for the purposes of verifying and testing to confirm the research question.

In analyzing the data, descriptive were employed, where tables were used to summarize the scores of variables of solid waste generated in the varied residential estates, percentages were also used to gauge the proportions of waste generated and the responses given.

Methods of data presentation

The data was presented using tables, figures, photographs and calculated percentages. Also, explanations of the study finding were made so as to make valid conclusions.

RESULTS AND DISCUSSION

Adequacy of the Available Management Systems of Handling DSW

Storage

The results from the questionnaires indicated that DSW is stored in self- purchased polythene bags, self- purchased bins, plot provided bins and county provided bins. It was noted that the self- purchased polythene bags and bins make a large percentage in storage of DSW. The results also indicate that the county's distribution of bins is inadequate in all the estates with the lowest percentages. The table below shows the percentages of the storage methods available in the estates.

Table 4.1: A table showing the methods of storage of DSW in the estates

Methods of storage of DSW in Estates	Estates		
	LIR (%)	MIR (%)	HIR (%)
Self- purchased polythene bags	53.3	46.7	52.4
Self- purchased bins	33.3	40.0	37.6
Plot provided bins	10.1	0.0	3.3
County provided bins	3.3	13.3	6.7
TOTAL %	100	100	100

It was also, noted that in Kisii town unlike other towns the MIR areas suffer most in terms of provision of bins/skips by the county. The bins provided in MIR are few such that DSW is collected in open spaces and at roadsides as indicated by the plate 4.11 below.



Plate 4.11: DSW stored/dumped by the roadside at Jogoo

The photograph above is a clear indication of inadequacy of storage materials provided by the county. This results to indiscriminate waste storage/dumping leading to bad odors, sight sore and environmental degradation.

Further, the results indicated that unlike HIR and LIR where the county provided bins/skips are large of 8 tonnes in MIR the skips are small of 4 tonnes hence inadequate considering the generation of DSW as shown by plate 4.12 below.



Plate 4.12: A 4 Tonnes skip at Jogoo

This disparity in allocation of adequate bins/skips may be attributed to inadequate mapping by the county management to establish places of need.

Collection

In collection of the DSW from the estates, the questionnaire responses indicated that: the collection was irregular not daily as expected to be as shown in table 4.2 below.

Table 4.2: A table showing the % of collection of DSW in the estates

Collection of DSW Rates in Estates	LIR	MIR	HIR
Daily	1.3	2.7	30.0
1- 3 days	58.7	39.3	46.6
4 – 6 days	26.7	51.3	20.7
Over a week	3.3	13.3	6.7
TOTAL %	100	100	100

Also, the responses eluded that in all estates the waste was collected after a week. This poses a health hazard to the residents. The results further showed that waste is mainly collected 2 – 6 days after it has been disposed by the residents in various estates. However, it was noted that collection was more frequent in high income residential areas unlike other estates and the middle income resident estates suffered more uncollected waste for long times. The results deduced from the table indicate a disparity in collection of DSW in the various estates and show the inadequacies of the methods employed in the management of waste in Kisii town. The plate 4.13 below shows uncollected in MIR for a period of 6 days.



Plate 4.13: Uncollected DSW along the road at Jogoo

This implies that the DSW is collected more regularly in the affluent estates followed by the least affluent due to its high rate of generation as observed above and the middle class residents suffer the effects of the uncollected DSW. It was noted that in Kisii town like in other towns collection is more effective in affluent estates than the less affluent estates. Quite unique to Kisii town collection in MIR is poor than in LIR. This is attributed to the county focusing on reducing the effects of DSW in LIR such as disease outbreaks for example cholera which is commonly associated with LIR areas; thus ignoring the need for regular collection in MIR. This shows enormous disparity considering the population of the varied estates.

Transportation

In transportation of DSW, the results indicated that transportation is carried out in all the three estates that were sampled due to their proximity to the town and to the dumping site. Therefore the 80% of HIR, 100% of MIR and 100% LIR in Kisii town experience the same method of DSW collection; except 20% of the residents of Nyanchwa who through their landlords have organized self -transport by hiring people with hand pulled carts (*mkokotenĩ*) transport the DSW to either the common tractor collection points or even to the common dumping site at Nyambara.

This indicates that transportation of DSW is good in the county unlike storage and collection. The transportation is 100% in both MIR and LIR except in the HIR where transportation by the county is 80%. This is an indication of good management. Though the inadequacy noted is the openness of the tractor transport which drops litter along its trail also bad odor whenever it crosses a given area. Further, the number of tractors and compacters/ lorries used by the county is small and there is need to increase their numbers so that they can reach all estates daily.

Disposal

In disposal of DSW the results indicated that in LIR/ Mwembe estate, 98.6% of the residents collect their DSW and dispose it to the nearby county provided bins. In areas where the county

bins are far the residents dispose their DSW in personal polythene bags which are placed at night by the roadside to be collected by the county personnel into the county provided bins during the next day. The results from questionnaires show that, 1.4% of Mwembe estate residents dispose their wastes by the use of personal polythene bags which are later collected by the county government for disposal.

In MIR/Jogoo, 93.3% of the residents dispose their DSW in the county designated areas whether there are county bins or not, these specified places are the official collection sites of the county. However, due to inadequacy of bins, several disposal centres for the residents have cropped up. Up to 5.3% dispose their waste using personal polythene bags which they place by the roadside at night to be collected later by the county government. A paltry 1.4% of the residents of Jogoo dispose their DSW in home dug pits within the residential areas depending on the landlord organization. This method though is inadequate since these home dug pits get overfilled within a short time leading to unhygienic conditions in the estate.

In HIR/Nyanchwa, 83.3% of the residents dispose their wastes in personal provided bins. The wastes in this estate are disposed in a large wheeled bin within the estate provided by the landlord. The caretaker or a person is assigned by the landlord empties these bins to the county provided bins or sometimes transport them directly to the county dumpsite. This has led to reduced overdependence on the county provided bins for the disposal of DSW in this estate. However, 16.7% of the residents especially those who are near the county provided bins, dispose their DSW there. The landlords resorting to using self- purchased bins proves that the county provided bins in Nyanchwa are inadequate.

In disposal of DSW at the Nyambara dumping site it was noted that the dumpsite is overfilled, invaded by scavengers and private developers who are constructing thus reducing the size of the dumpsite as shown on plate 4.14 below. Also, the location of the dumpsite in the CBD is a challenge in occupying important space for meaningful infrastructural development in the town bearing in mind that the town is located in a highly populous region with minimal space and adverse land fragmentation. Also, the dumpsite has provided adverse effects to the nearby level six/ county referral hospital and the road alongside the dumpsite.



Plate 4.14: A section of Nyambara dumpsite under construction and scavenging birds

The following factors according to the interviews were identified to be leading to solid waste management problems in Kisii town: inadequate qualified personnel, poor coordination by the county government officials, lack of adequate equipment evidenced by two tractors (only one in good condition), two compacters and two lorries to serve the whole town, inadequate disposal site since the Nyambara site has been overfilled and the newly acquired Etor dumpsite has not been put into use, as shown on appendix I.

Lack of initiative by the county to provide sensitization/create public awareness to educate the residents on proper waste management policies/methods, laziness of the workers who don't do their work effectively such as leaving behind some waste during collection, wastes falling off while being transported, irregular collection of the waste among others, a rapidly increasing population in the town thus increasing the generation of DSW, and rapid expansion of the town have all led to development of new estates whose wastes management has not been captured by the county administration, as depicted in appendix I.

Data from the questionnaires indicated that, the residents feel that the disposal methods employed by the county government are not good for the town and the following alternatives were suggested by questionnaire respondents for the improvement of the waste management systems in Kisii town. These alternatives include: the need to recycle waste, separation of wastes at generation, re-using some of the wastes, separation of wastes during disposal, incineration to generate energy and burn more waste completely, use of landfills due to scarcity of land to be used as dumpsites, avoid burning since it pollutes the environment, dumping the waste away from town and far from homesteads/public places, decomposing of biodegradable wastes to make manure, aquatic food, make fertilizers and make biomass energy.

Summary

The storage systems available are inadequate since an average of 80.6% of the residents in HIR, MIR and LIR store their DSW in self-purchased bins and polythene bags whereas, a paltry 19.4% store their DSW in county provided bins and skips. Therefore, there is need for provision of more storage materials (bins and skips) for the wastes generated in households.

The collection methods also proved inadequate due to irregularities in estates such as Mwembe (LIR) and Jogoo (MIR) as opposed to Nyanchwa (HIR), where the collection was regular. There is need for intensified and regular collection in all estates indiscriminately. This should be done daily to enhance clean and safe estates for residence.

Transportation methods involved by the county are good though limited to the use of two compacters, use of county tractors and limited use of hand pulled carts (*mkokoteni*). This methods can be improved since the tractors are uncovered resulting to dropping the DSW along their trail and bad odors in the town whenever they criss-cross the town. The compacters are few hence need to increase their numbers. The use of hand pulled carts is only limited to HIR due to a few private organizations. Therefore, there is need to encourage and involve more private groups and CBOs.

Disposal of DSW is done at two levels: at the households and beyond the estate. At the households residents dispose their wastes in three ways: disposing in bins/skips/self-purchased bins and polythene bags, also by burning and disposing in estate dug pits. Beyond

the estate disposal is done by the county dumping the DSW in the Nyambara dumpsite located in the CBD.

The figure 5.1 below is a suggested model on adequate measures/systems of managing DSW in urban areas. Whereby resources are purchased for use then they become waste after use. Segregation should be done at the households (source) before they are disposed in various bins at estates collection points. The DSW should be collected by county, CBOs and private groups and transported to relevant places depending on the type of waste such that re-usables are transported to cleaning agents, recyclables to recycling plants, organic to composting pits, combustibles to incinerators to generate energy for recycling plants and the non-combustibles to land-fills.

Figure 5.1: Suggested Model for DSWM.

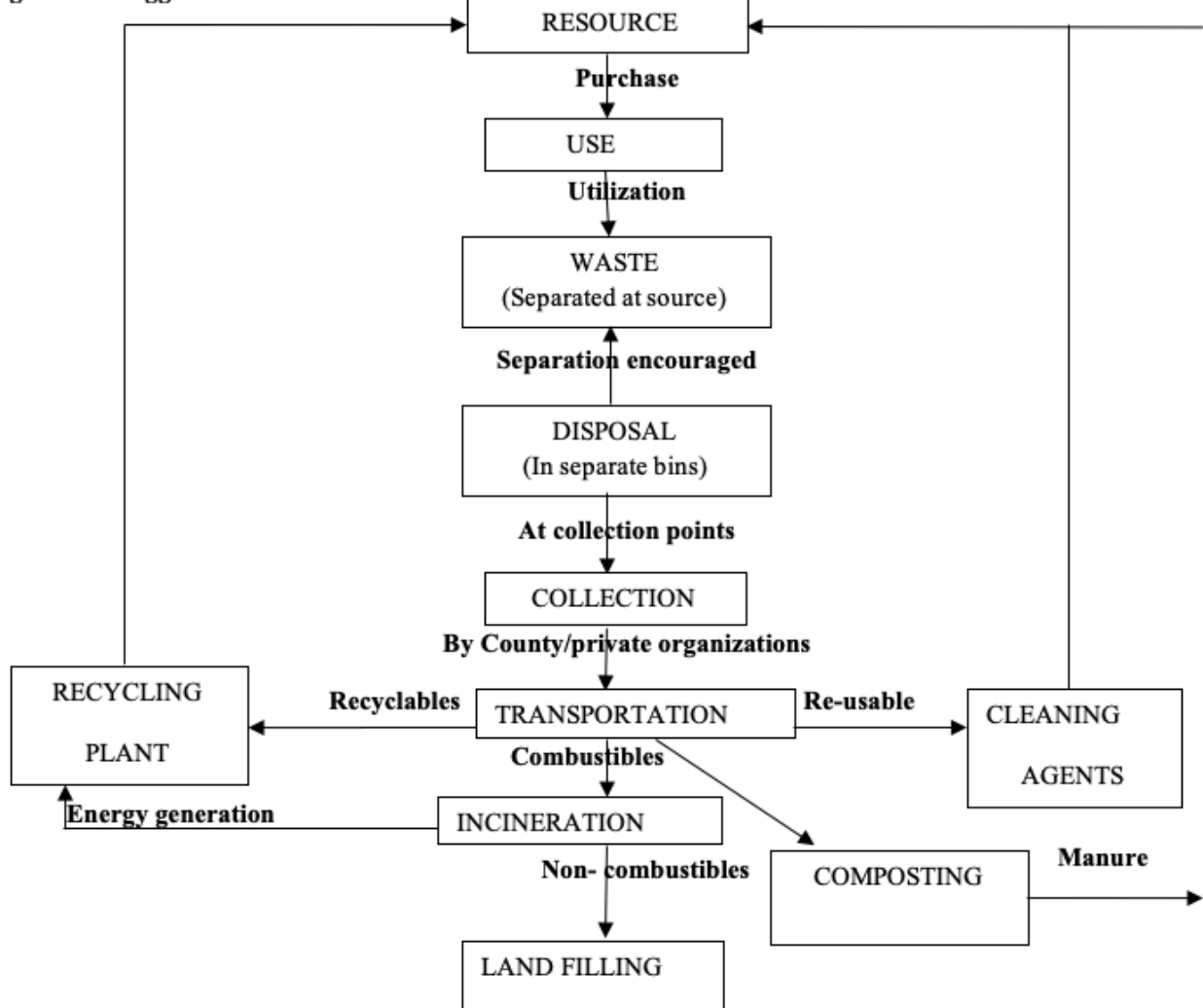


Figure 5.1: Suggested Model for DSWM
Own Source 2017

Conclusion

In conclusion, the management methods of the DSW are inadequate and pose severe health risks to the residents of Kisii. It was noted that the methods of storage of DSW does not match

the extensive generation rates, the collection cycles in the estates is inefficient, transportation measures put in place by the county government are not adequate and the disposal methods employed are also ineffective for the residents. Therefore, there is a dire need of an integrated DSW management plan in the town.

Recommendations

These management systems of handling DSW are inadequate hence the following recommendations are necessary. The study noted that the available management systems of handling DSW that is storage, collection, transportation and deposition are inadequate. Therefore it is recommended that one: the county government should provide adequate bins and skips for the storage of DSW before it is collected and transported.

The county government should purchase more compacters and covered tractors/trailers to ensure effective collection and transportation of the DSW in the town without affecting other not involved persons through bad odor. Also, in transportation, more trips per day should be enhanced to enable wider reach of all areas of the town and for effective collection of the waste from the residential areas. Further, the private group/s also need to be encouraged and strengthened in partnership with the county management in transporting DSW for effective management.

Also, the county government should embrace proper disposal methods which are environmentally friendly and avoid burning and dumping of the DSW. They should use and incorporate re- use by establishing sterilization/ cleaning plants and re-packaging centres for water bottles.

The county government through the environmental department should increase the personnel especially the collectors of garbage and provide them with protective equipment for handling various types of wastes. The personnel should further undergo necessary training to equip them with the skills for the job. Also, there is need to incorporate private organizations and CBOs in the collection for effective and more frequent collection.

In addition, the environmental department should encourage and work with private groups/ CBOs and individuals involved in DSWM practices in the town. This will help in reaching all parts of the town especially where the roads are impassable to tractors and compacters.

Further, it is recommended that recycling centres/plants should be established to put into use used bottles, polythene papers, tins, glass and other wastes so as to reduce their bulk in the town. Digesters and compost pits should be developed to utilize organic wastes such as food remains to make organic manure to be sold and used in farms. Digesters should also be used to generate biomass energy which can be used to provide energy for small scale use. Incineration plants should also be established to burn combustibles and energy generated to be used in recycling plants to enhance sustenance of the plant and provide cheap energy source.

Finally, it is recommended that the county government should purpose to increase the budgetary allocation to the environmental department from 5% to enhance the efficient running of the department.

References

- Adam R. (1995), Taking Action on Environmental Goods for you and your Community. UNEP, Nairobi Kenya.
- Agevi T. (1992), Collection and Transportation of Solid Waste. Page 44-68.
- Algak.(1995), A Journal of Association of Local Government Authorities of Kenya.
- Arcot.R. (1992), Refuse Collection Vehicles for Developing countries. UNCHS Habitat, Nairobi Kenya.
- Babbie E. (2004), The Practice of social research. (10th ed.). Belmont, CA: Thomson Wadsworth.
- Busha C.H. and Harter S.P. (1990), Research Methods in Librarianship: Technology and information interpretations. New York academic press.
- Central Bureau of Statistics (CBS) Kenya.Population Census 2009. Nairobi: Government Printers; 2010.
- Cordoba J.C. 2003, On the Distribution of City Sizes.Rice University, 31 p.
- Davis J. (2004), "Corruption in Public Service Delivery: Experience from South Asia'a Water and Sanitation Sector." World Development, Elsevier, vol. 32(1), pages 53-71, January.
- Elkingto J. And Shopley J. (1989), Cleaning Up: US waste management technology and third world development. (Washington D.C World Resource Institute).
- EMCA (1999), G.O.K: Environmental Management Co-ordination Act, 1999.
- Engel, J. F. (2005), The practice of research in social work. (2nd ed.). Thousand Oaks. CA: Sage Publishing Entire Societies, 2005.
- Foster J.B. (2011), The Ecological Rift: Capitalisms War on the Earth. Monthly Review Press.p 544
- Gakungu N.K. (2011), Solid Waste Management in Kenya: A Case study of Public Technical Training Institutes, University of Nairobi. Nairobi.
- G.O.K (1991), Atlas of the Government of Kenya.
- G.O.K (1997-2002), Kisii Development Plan.Kenya Government Printers Nairobi.
- GOK (2007). Vision 2030: The Environment. Kenya Government Printers Nairobi. Government press Nairobi, Kenya.
- Habitat (1987), Global report on human settlements.Oxford University Press. New York.
- Habitat (2015), Environmental Management of Cities in Africa: Models for Environmental Management. Habitat, Nairobi, Kenya.
- Kalendu .N. (1995), Garbage Disposal: Algak Journal of association of local government authorities of Kenya.
- Kayongo C. (1997), Lack of Solid Waste Management: A dissertation hindrance to sustainable development in slums. A case study on Laini Saba and Soweto villages –Kibera.Catholic university Nairobi.
- KC. (2014), Kisii county: Environmental management policy guidelines : Government printers Nairobi.
- Kibwage J.K. (1996), Towards Privatisation of Household Solid Waste Management Services in Nairobi City. Mphil thesis. Moi University Eldoret Kenya.
- Kiplagat W.K (1999), Towards Sustainable Solid Waste Management: Alternatives for Eldoret. Mphil thesis Moi University Eldoret Kenya.
- KMC (2010), Kisii Municipal council: A guideline to town management, Longhorn publishers Nairobi.
- Kothari, C.R. (2004), Research methodology. Methods and techniques. (2nded). New Delhi: New Age International Publishers.
- Layton J. (2009), Eco- plastic: Recycled plastic. Science how stuff works. Retrieved 2014-06-09.
- Mbugua M.N. (1980), Refuse Collection and Disposal in the City of Nairobi Kenya: An investigation report dissertation B. Arch. University of Nairobi.
- Mugenda O. (1999), Research Methods, Analysing quantitative data. Act press. Nairobi.

- Munuve L.M. (1990), Refuse Collection: A criteria for effective collection: a Case study of Nyeri municipality dissertation. B.A University of Nairobi.
- Muthaura P.C.N. (1990), Refuse collection and Disposal in Meru municipality. B.A Dissertation.University of Nairobi.
- Nath K.J (1993), Urban Solid Wastes Appropriate Technology proceeding of water and waste engineering for developing countries (WEDC) conference Loughborough.
- NEMA (2003), State of Kitale Environmental Report. 2003 Nairobi page 1-25.
- NEMA (2010), State of Environmental Report. 2010 Nairobi 67-78.
- Nyakaana S.O. (1996), Waste Management in Developing countries- Towards Improving Solid Waste Management Capacity in Nakuru Municipality.Mphil thesis University of Nairobi.
- Oluchiri S.O. (2002), Energy Potential of Solid Waste in Eldoret municipality and Kisumu city. Mphil thesis Moi University Eldoret.
- Omondi .O. (1998), Assessment of the Generation and Management of Household Solid waste in Eldoret municipality.Mphil thesis, Moi University Eldoret.
- Ongore et al (1996), Waste management in Developing countries – Towards Improving Solid Waste Management Capacity of in Nakuru Municipality, 1996.
- Otieno.S. O. (2010), Urban planning and management in small and medium-size towns In Supplementary Issue, 23-48.
- Shibanda B.M.C. (1980), Planning for Basic Infrastructural service in Thika with specific reference to water, sewerage and solid waste disposal. Thesis M.A University of Nairobi.
- UNCHS (1998), Refuse Collection Vehicles for Developing Countries.UNCHS Nairobi.
- UNDP (1991), Effects of Urban Waste, Diseases and related deaths.Environmental report 1991.
- UNEP (2006),"Environmentally Sound Management of Solid Wastes and Sewage-Related Issues". United Nations Environment Programme.Retrieved 2011-02-23. 26, Issue 1, 2006, pp. 92-100.
- UNEP. (2015), Managing Urban Waste. International Environmental Technology Centre,
- Yamane T. (1967), Statistics; An introductory analysis, 2nd edition Harper and Row NewYork.

APPENDIX I: SLIDES 1 – 7 OF COUNTY STAFF RESPONSES

Questionnaire for county/ municipal staff

Good morning/ afternoon Sir/ Madam

I am Mecheo O. Nafial, a student at Moi university. I would appreciate if you spare some of your time valuable time to fill for me this questionnaire. This work is meant entirely for Academic purposes

Assessment of the generation and management of household solid waste in Kisii town.

PART A: Personal Details

Officer name.....

Department/ section..... Countryside

Rank in office..... Environmental management

Length in the office/rank.....

PART B: Organisation, Management and General Information

1. State the responsibilities of your department in domestic solid waste management in Kisii town.

i) To ensure garbage is collected from town with environs

ii) To locate the sites/containers where waste generation is high

iii) To ensure all wastes generated has been taken care of

2. Outline the current organisation structure of domestic solid waste management in Kisii town.

3. What structural changes have occurred in the past.

Only one route before - now 2 new vehicles (compactors) - new dumping site at Etoria - outside town

Slide 1

4. Do you have plans to change the current structure?
Yes ☒ No ☐

5. Is the county/ municipal authority currently working with any voluntary group/ private company in the provision of domestic waste management?
Yes ☒ No ☐ *don't pay to con*
✓ private groups & outside houses
Highly encouraged per zone

If yes give details
Zones - *Skp - 2* - *T. Daga* - *Bochers*
(20) - *Nyanchaga* - *B. D. Daga* - *B. D. Daga*
Nyanchaga - *Nyanchaga* - *Muraka* - *Suraka*

6. What efforts are made by the county/ municipal authorities to involve the general public to ensure the town is clean?
a) Creating awareness ☒ - *Training groups - one in a while* *Public health dept* *- Active*
b) Financial assistance ☐ - *Public* *Task to people* *patrolling* *accidents* *- Justice*
c) Technical assistance ☒ - *Patrolling groups* *- Know how* *- Categories of waste* *very clean*
d) Nothing ☐
e) Others specify.....

7. How is the daily attendance of staff engaged in the provision of waste management services? *by name - daily - school* *colleges - alternative*

8. Would you say that the county/ municipal authority has the capacity of handling the management of solid waste to enhance environmental quality of the town?
Yes ☒ No ☐
If no why *Less staff*
a) Lack of personnel ☒
b) Lack of finance ☒
c) Lack of enough equipment ☒
d) Others specify.....

9. How do you assess the current status of solid waste management in Kisii town?
a) Very good ☐
b) Good ☒
c) Fair ☐
d) Poor ☐
e) Very poor ☐

10. Are there any problems in domestic solid waste management in Kisii town?

2

Slide 2

Yes ☒ No ☐

If yes what are the problems?
~~Disposal site - small~~ ~~Inadequate funds~~ ~~Problems~~
~~High garbage~~ ~~Few~~ ~~inadequate~~
 11. What are the measures the county government has taken to improve the situation?
~~Protecting drainage site~~
~~to have compound~~
~~to have a covered compound~~
~~Provision for donor funding~~
 12. What do you consider as the factor(s) leading to the problems in management of solid wastes in Kisii town?
 a) ~~Lack of awareness~~ ☒
 b) ~~Lack of finances~~ ☒
 c) ~~Lack of coordination~~ ☐
 d) ~~Lack of equipment~~ ☐
 e) ~~Lack of qualified/ committed personnel~~ ☐
 f) Others specify.....
 13. In your opinion what is the best way(s) to deal with the management of domestic solid waste in Kisii town.
~~Provision of a landfill site~~
~~Provision of an integrated D.S.W. unit~~
 PART C: Legislation
 1. What is the legal position of household solid waste management in the county government and public acts?
~~There are laws and enforced laws of public~~
~~and~~
 2. Have any by- laws or bills been enacted by the county government to regulate the domestic solid waste management in Kisii town?
 Yes ☒ No ☐ If yes, which ones?
 3

Slide 3

3. What legal constraints are currently hindering the management of domestic solid waste in Kisii town?

- *Jobs have been reduced - payments have been reduced - people are not being charged*
 - *Revenue losses prevent people from paying for the waste*

4. Are there private companies engaged in the provision of waste management?

Yes ☒ No ☐

If yes do the laws guide them?

Yes ☒ No ☐

PART D: Generation Of Household Waste

1. a) What are the types of household waste generated per day in the households?

Types of solid waste	Tick where appropriate
Plastics	☒
Food remains	☒
Bottles/ glass	☒
Tins	☒
Papers	☐
Polythenes	☒
Others specify	<i>chip boards, metal remains</i>

200 tons per day 3000 tons per week

a) Approximately in what quantity are they generated per week?

1-5 kgs [], 5-10 kgs [], 10- 15kgs [], 15- 20 kgs [] above 20 kgs []

50-100 100-150 150-200 200-250 250-300

PART E: Storage of Domestic Solid Waste

1. How is the household solid waste stored by individuals?

a) In self purchased bins ☒

Slide 4

b) In county provided bins []
 c) Others specify... polythene bags Cost = 8f

2. Give the specification of the storage facility in use currently?

Type	Capacity	Remarks on efficiency, compatibility, convenience and public health safety.
<u>Skips</u>	<u>3 tons</u> <u>4 tons</u>	
	<u>3 Tons</u>	<u>Efficient, convenient for trailers</u>

3. What criterion is used in the distribution of such containers?
 a) Income level of residents []
 b) Population density [✓]
 c) Distance to be covered []
 d) Frequency of collection []
 e) Others specify... Quantity / Rate of generation

4. What are the county future plans to improve storage facilities of domestic solid waste?
1. Purchase more skips for zone
2. More lorries & tractors
Do waste recycling (cost)

PART F: Collection of Domestic Solid Waste

1. What is the collection frequency in the high, medium and low income residential areas?
 a) High... Less generation Nyumbani

b) Medium... More generation Nyumbani

c) Low... Least generation Nyumbani

Give reasons for any differences
High income - use of structures to dispose their own waste
More waste generation

2. Are there any collection vehicle routes?
 Yes [✓] No []

5

Slide 5

If yes are they followed? *Compacted - not*
 Yes ☒ *Trucks CBP* No ☐
Truck use - not

3. Are there county/ municipal official collection sites?
 Yes ☐ No ☒

4. Which means of transport are used to collect the wastes?
 a) Vehicles ☐
 b) Tractors ☒
 c) Trucks ☐
 d) Others specify *Trucks & Compacted*

5. How many staffmans each collection trip in a single vehicle?
 a) Drivers *1*
 b) Supervisors *1*
 c) Loaders *6*

PART G: Transportation of Household Solid Wastes

1. a) Is the refuse properly covered while being transported to disposal sites?
 Yes ☒ No ☐

b) How frequent are collecting vehicles washed?
 i) Daily ☐
 ii) Twice a week ☐
 iii) Not washed at all ☐
 c) Others specify *Once a week*

2. a) What average numbers of refuse collection vehicles are on the field per day? *2*
 d) How many shifts a day do you use the vehicles to collect the refuse? *1*

3. How many days in a week are the vehicles transporting refuse from collection to disposal sites?
 a) Once ☐
 b) Twice ☐
 c) Daily ☒

Slide 6

d) Others specify.....

PART II: Disposal of the Refuse

1. What are the current disposal arrangements?
Dumping

2. Are the wastes separated before disposal for recycling
 Yes [] No [✓]

3. What disposal methods are used by the county/ municipal authority in dealing with domestic solid waste?
Dumping
Landfilling

4. What problems do the county/ municipal authority face pertaining waste disposals?
No Segregation of waste
inadequate space for dumping

5. What are the county's future plans in improving waste disposal?
costing
Recycling
Re-use

PART I: Budget

1. Are there any fiscal arrangements within the county budget for solid waste management services?
 Yes [✓] No []

If yes what percentage of total budget is reserved for such purpose... 5% of total budget

Thank you very much for your kind assistance. I might see you later if need arises for more help. May God bless you abundantly?

7

Slide 7