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Evaluation of Solid Waste Management Practices in Kakamega Municipality, Kakamega County

E. K. Kanda and K. Cheronu

Abstract— Solid waste management is a challenge, particularly in the developing countries. This is aggravated by increased urbanization, population growth and economic development which have increased the rates of solid waste generation in urban areas. The solution to effective solid waste management is the adoption of the 3 R's (reduce, re-use and recycle) which is the bedrock for integrated solid waste management (ISWM). The main aim of this study is to determine the extent of adoption of ISWM practices in Kakamega Municipality of Kakamega County. The study adopted a descriptive research design. Random sampling was used to select a hundred different enterprises within Kakamega Municipality. The research instruments used were questionnaires and Key Informant Interviews (KII). The validity and reliability of the questionnaires were tested using Pilot study conducted on different sets of respondents in the area. The quantitative data was analysed using SPSS 26, while thematic analysis was used to analyse the qualitative data. 85.7% of all the enterprises sampled were commercial with a smaller proportion being educational (7.2%) and health (7.1%). Eighty nine percent of the enterprises had a small number of workers (1-50), with a large proportion (46%) of these enterprises having an age of 5-10 years and an average waste generation rate of 0-10 kg day⁻¹. Most of the enterprises had information on recycling, but this did not influence their choice regarding recycling of waste. Although the study revealed useful information regarding behavioural aspects of small enterprises towards waste disposal, preliminary findings show that inertia could be a key factor hindering sustainable solid waste disposal practices.

Keywords— composting, sanitary landfill, solid waste recycling, solid waste re-use, source separation.

I. INTRODUCTION

SOLID waste management is a challenge, particularly in the developing countries. This is aggravated by increased urbanization, population growth and economic development which has increased the rates of solid waste generation in urban areas [1]. Kenya, like other developing countries is experiencing increased urbanization more than the general population increase [2]. This poses serious problems in terms of solid waste management.

The integrated solid waste management (ISWM) involves the adoption of sustainable waste management approaches in a hierarchical form with waste reduction being the most desirable option followed by re-use, recycling, resource recovery, incineration and landfilling being the least desirable [3]. The 3R's of reduce, re-use and recycle are important components of IWSM which need to be promoted in order to ensure environmental sustainability. However, this is hardly the case in Kenya, for example, in Kisumu city, the national and County

government do not have programmes of reducing household waste generation, especially in informal settlements [4].

The benefits of solid waste re-use and recycling are the creation of employment through opportunities in waste collection, processing, distribution and marketing. As explained by Kinyanjui [5], recovery of recyclables in solid waste is a low-skill job with relatively free entry and low capital requirement. Recycling is the preferred option, if it is possible to recycle some of the waste, to energy production options such as incineration or anaerobic digestion for organic wastes [6]. Recycling is influenced by sociopsychological, technological, legislation or policy and economic factors [7]. These factors affect directly or indirectly the efficiency of recycling programmes.

The efficiency of solid waste recycling is dependent on the effectiveness of source separation. Source separation basically involves sorting the waste streams into various fractions/components that include organic wastes and inorganic wastes such as glass, plastic, metals, among others at the point of generation. In municipal solid waste management, the efficiency of source separation is largely influenced by household behaviour rather than government led initiatives [7]. According to Zhang et al. [8], individuals act or fail to separate their wastes at source based on their personal beliefs about the environment.

Source separation and recycling helps in minimizing the amount of wastes to be ultimately disposed of in a landfill. It also facilitates re-use and recycling initiatives since it is easier to manage than mixed wastes. Re-use of solid waste in Kenya is done informally at household level where items such as plastics, paper and card boards are used and sold informally to waste recyclers after they are no longer required while organic wastes are sometimes picked or bought by farmers for making compost [9]. Recycling and re-use in Kakamega County is very low as indicated in the Kakamega County Integrated Development plan (KCIDP) of 2018-2022 [10]. Kinyanjui [5], attributed the low re-use and recycling of inorganic wastes among households in Thika to inadequate information about recycling and inaccessibility to buying points/locations. Generally, in low income countries, recycling is facilitated by informal players which are driven by the market value of the recyclables [11]. Recycling in developed countries mostly utilize kerbside recycling approach where the wastes are collected and sorted for processing while in developing countries, the recycling is

K. Cheronu, Department of Agricultural and Biosystems Engineering, JKUAT (corresponding author phone: +254722800474; e-mail: kcheronu@agr.jkuat.ac.ke).

E. K. Kanda, Department of Civil and Structural Engineering, MMUST (e-mail: kandaedwin@gmail.com).

carried out by low-income individuals who scavenge the waste at transfer stations or dump sites and sold to recycling shops or middlemen [12, 13].

Recovery of resources from solid wastes should be encouraged from a policy perspective in developing nations as it contributes to the development of organized solid waste management through reduction of the quantities for disposal [14]. This can be achieved by sorting the wastes at collection points [9, 14]. However, there is minimal source separation of wastes in Kenya at household, commercial, institutional, and industrial areas [3]. Mukui [15] reported that only a quarter of households in Nyeri town practice source separation of solid wastes. Similarly, Munala and Moirongo [16] found that source separation of wastes is rarely practised in Kisumu city. Therefore, there is need to determine the source separation and recycling practices in Kenyan towns and understand the factors influencing the recycling initiatives. This study, thus, aimed at determining the status of source separation and recycling of solid waste in Kakamega municipality in Western Kenya. Kakamega municipality was chosen because it is the headquarters of Kakamega County and it is the second most populous (projected population of 2.2 Million by 2020) County in Kenya after the capital, Nairobi [10]. This study would help in identifying the status of source separation and recycling in Kakamega Municipality which is useful in planning sustainable solid waste management options in the County. The findings can also be correlated to towns or Counties with similar characteristics.

II. MATERIALS AND METHODS

A. Study Area

Kakamega Municipality which consists of Kakamega urban and peri-urban area have a projected population for 2020 as 91,502 and 29,313, respectively (KCG, 2018). This population represents a triple increase from the 2009 values.

B. Sample size and sampling techniques

Random sampling was used in this study. The study focused on commercial, health and institutional enterprises. A total of 140 Questionnaires were administered to owners or workers in business enterprises, educational and health institutions. Key informant interviews were conducted from key personnel in charge of public health/environmental sanitation in County Government/Municipality.

C. Data analysis

The data from the questionnaires was analysed using SPSS 26 (IBM, USA) and results presented in graphical form. Interaction of different categorical variables was assessed at 95% confidence intervals.

III. RESULTS AND DISCUSSION

A. Waste generation and handling practices across different enterprises

Enterprise characteristics

Majority of the enterprises were dealing with commercial

activities (94.6%) while Health and Educational institutions were the minority (Table 1). Kakamega municipality is fast growing due to devolution and as such, businesses are growing rapidly which means increases in commercial solid wastes. The average cost of solid waste collection was KES 200 and KES 1675 for commercial and Educational institutions respectively as shown in Table 1. Sibanda, Obange and Awuor [17] found solid waste management fees for institutions in Kisumu city to be as high as KES 7000 per month. The possible explanation for the high solid waste management cost in Kisumu compared to Kakamega is that the former is a city with large quantities of solid wastes generated.

Table 1. Categories of enterprises

Category	Proportion (%)	Cost paid for solid waste collection (KES Per month).
Commercial	94.6%	201.5
Health	85.7%	16.67
Educational	100.0%	1675

Relationship between enterprise size, waste output and age

Majority of the commercial, educational and health enterprises were between 5 – 10 years old which can be attributed to the formation of the devolved system of government as established in the Constitution of Kenya in 2010. The number of employees working in the enterprises increased with the age of the firms (Fig. 1).

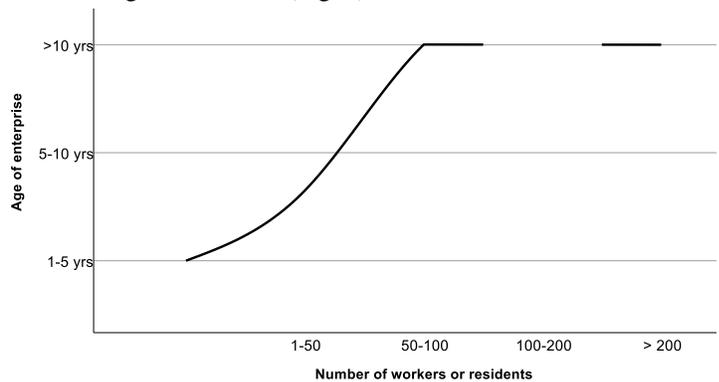


Fig. 1 Relationship between Age of enterprises and the number of workers

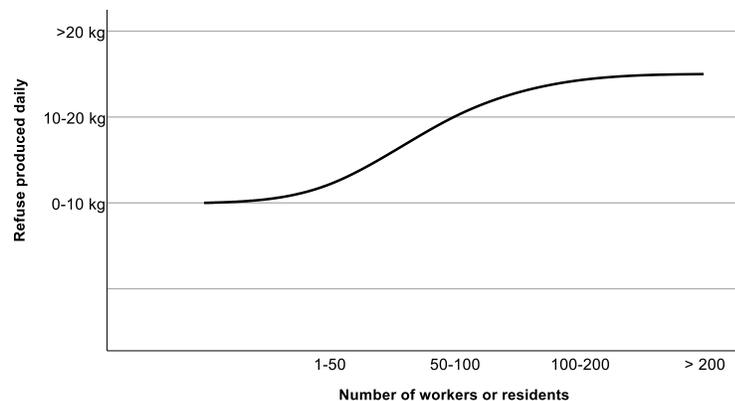


Fig. 2 Relationship between solid waste generation rate and number of employees

The quantity of solid waste generated increased exponentially with increase in the number of workers and the age of the enterprise (Fig. 2). The number of workers in an enterprise is a measure of the size of the organization and consequently the amount of wastes generated.

Waste generation and handling practices

Organic waste (food and paper/carton) forms the second and third largest bulk of waste generated respectively (Fig. 3). The mixed waste formed a significant bulk (60%) of the waste generated, and therefore sorting of waste within enterprises should be a first line approach in improving the outcomes of waste management practices. Mixed wastes in this study included solid wastes which were not categorized and were found lumped together in the collection container. This study has demonstrated that a significant proportion of the enterprises do not practice sorting of waste at point of generation as will be discussed in the following sections of this study. Sorting of solid waste at source is important if re-use and recycling is to be effective.

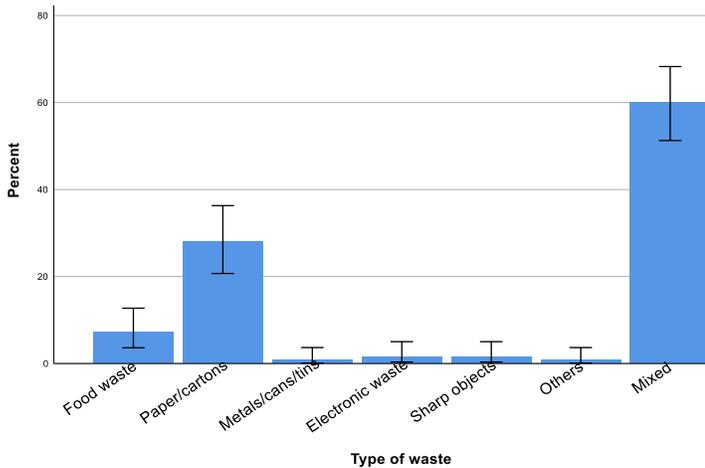


Fig. 3 Types of solid wastes generated in Kakamega Municipality

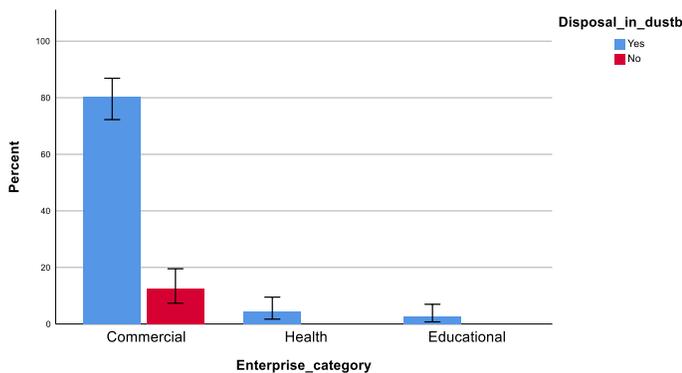


Fig. 4. Waste collection in Kakamega Municipality

All health and educational institutions and majority of commercial enterprises collect and dispose their wastes in dustbins within their premises (Fig. 4). About 15% of commercial enterprises do not dispose their wastes in bins (Fig.

5) and thus this should be a focus of solid waste management strategies such as awareness campaigns.

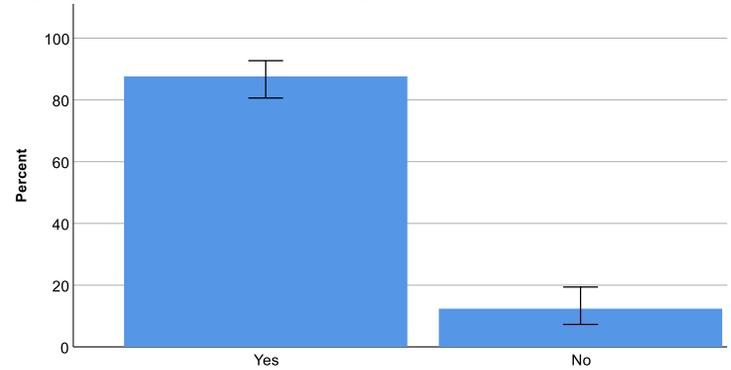


Fig. 4 Solid waste collection and disposal in bins among enterprises in Kakamega Municipality

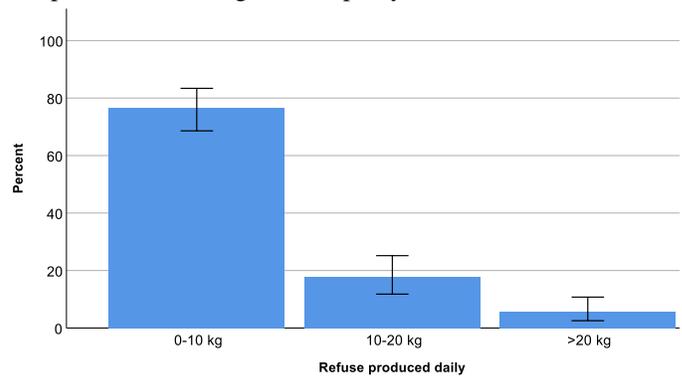


Fig. 5 Solid waste disposal in dust bins among enterprises in Kakamega Municipality

The average quantity of solid waste generated in Kakamega Municipality was 8.2 kg/day (Fig. 6). A significant number of organizations generate waste in small quantities. This could be attributed to a significant proportion of the enterprises being small organizations with a small group of employees.

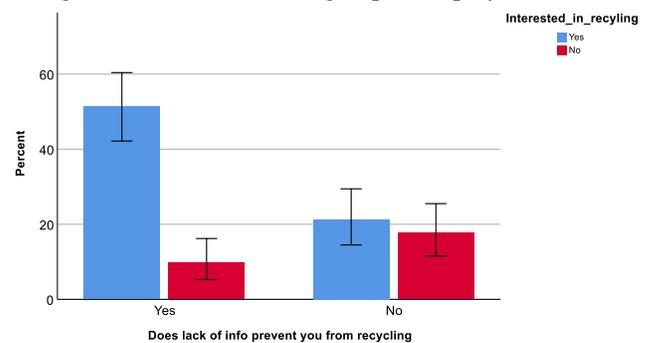


Fig. 6 Solid waste generation rate in Kakamega Municipality

Majority of enterprises do not throw their solid wastes in the bush, as indicated in Fig. 5. Most enterprises collect their waste within their premises despite them being willing to pay higher amounts to other organizations for waste collection services. Therefore, services or frequency of collection of waste by external organizations (county and private organizations), should be improved to limit the occurrence of improper waste management/disposal practices

Solid waste collection frequency is a good indicator of efficiency of solid waste management practice as it indicates the level of awareness on those concerned on the importance of maintaining a clean environment [18]. County staff accounted for the organization that collected waste most frequently (daily) compared to both private and self (Fig. 7). This is a plus for the solid waste management service delivery in the Municipality and it prevents the hazards associated with uncollected refuse littering the streets such as flies, odours and un-aesthetic environment. From key informant interviews, it was established that the County Government of Kakamega has contracted a private firm to handle solid waste collection services in the Municipality. This can be used as a case study on private-public partnerships (PPP) in solid waste management.

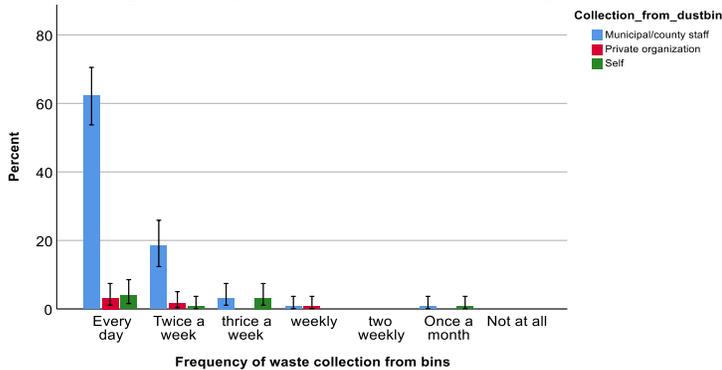
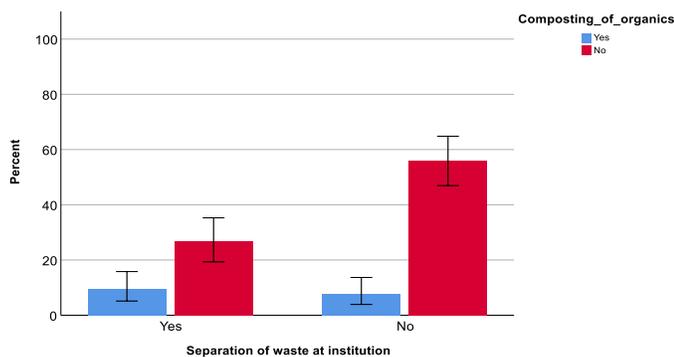


Fig. 7 Solid waste collection frequency in Kakamega Municipality

B. Attitudes towards recycling

Relationship between waste generation, sorting and composting

Source separation of solid waste is an important aspect of integrated solid waste management. In Kakamega municipality, majority (55%) of the enterprises do not sort their waste at the point of generation (Fig. 8). This brings about difficulties in managing the waste downstream. Similarly, composting of organics is only practiced by a minority of the enterprises. About 10% all respondents compost the organic fraction of the solid waste. The low practice of composting could be attributed to inadequate knowledge and marketing of the final product which is a challenge facing most cities and towns in sub-



Saharan Africa [19].

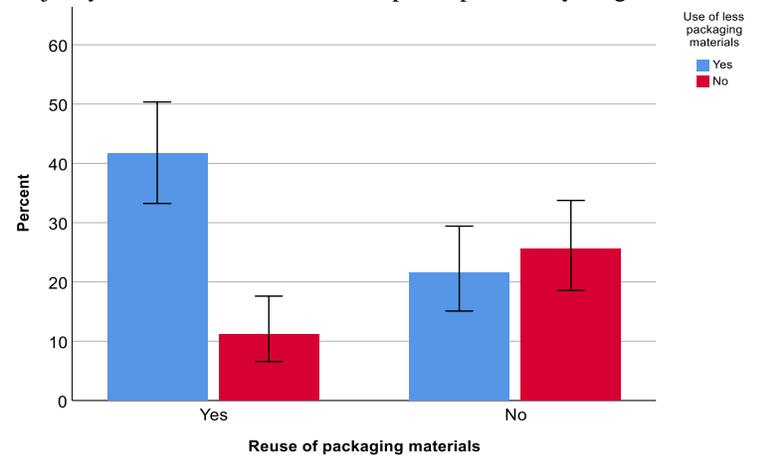
Fig. 8 Source separation of solid wastes and composting of

organics in Kakamega Municipality

Another possible reason why composting is rarely practiced is because the enterprises comprise urban dwellers with no gardens as found by [20] in Kikuyu municipality in Kiambu County in Kenya.

Perceptions towards reuse and reduction

A higher proportion of enterprises reuse packaging materials (Fig. 9). Waste reduction practice of using less packaging material is not well practiced by enterprises in the municipality. It appears that is easier to reuse packaging than use less packaging materials which could be attributed to most of the enterprises selling consumer goods which have been pre-packaged at manufacturer's level. Therefore, the practice of 'use less to dispose less' should be aimed at manufacturers of consumer goods. The findings of this study concurred with those found in Zimbabwe by Jerie and Tevera [21] where majority of the informal sector enterprises prefer recycling than



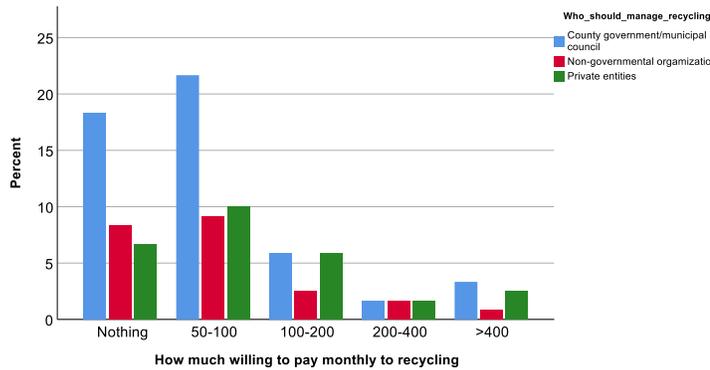
waste reduction practices.

Fig. 9 Re-use and waste minimization practice in Kakamega municipality

Interest towards recycling and failure to recycle: The recycling gap

A higher proportion of enterprises (53%) are interested in recycling but lack of information on recycling prevents them from recycling (Fig. 10). Information on recycling clearly influences the interest in recycling and will nudge enterprises to actively undertake recycling practices as illustrated by the low re-use and recycling rate (Fig. 9). While dissemination of information on solid waste management is important, this is hardly the case in Kakamega Municipality. Curiously, the County Environmental Authority established under the Kakamega County Environmental Act, 2014 is mandated to offer training and disseminate information regarding proper solid waste management practices. Kinyanjui [5] found that 93% of respondents faulted Kiambu County of not availing information on importance of integrated solid waste management practices. Organizations/individuals are more likely to participate in recycling programmes when they get information on the benefits of recycling, how to separate the

waste and participation in the design of solid waste recycling programmes [22]. Therefore, the onus is on those tasked with solid waste management to upscale awareness programmes on importance of recycling as an integrated solid waste

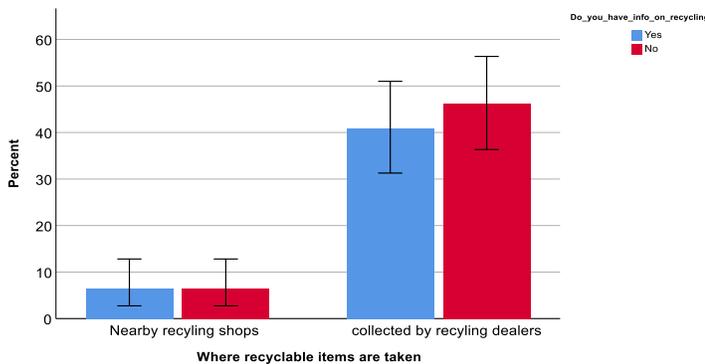


management practice.

Fig. 10 Availability of information on recycling and interest in recycling of solid waste

Perception towards the management of recycling activities

The recycling dealers take significantly higher recyclable materials than nearby recycling shops (Fig. 11). Majority of the wastes are not sorted at source and this probably explains the high percentage of recycling dealers as they would sort them for the valuables they require. Unsorted solid waste is an

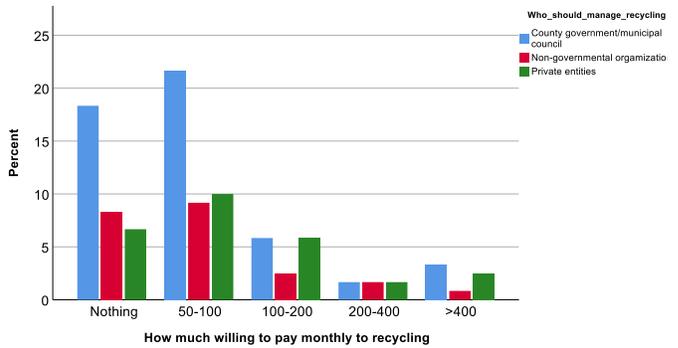


inconvenience for the enterprise owners to sell to nearby shops.

Fig. 11 Recycling practices in Kakamega county

The willingness to pay for recycling activities is necessary if integrated solid waste management is to be achieved. In Kakamega municipality, a significant proportion of the enterprises perceive the county government as the best choice for managing recycling practices, with most of organizations willing to pay little to nothing for recycling services (Fig. 12). Majority (22%) of the organizations are willing to pay between KES 50 and KES 100 per month for recycling programmes. This could be attributed to majority of the enterprises being relatively younger and smaller and therefore, do not have the necessary financial capacity to engage in environmental activities. The majority of organizations preferring the County government to manage solid waste recycling can be attributed to their positive perception on the collection frequency (Fig. 7)

done by the private firm contracted the County Government to



handle solid waste collection services.

Fig. 12 Willingness to pay for recycling programmes in Kakamega Municipality

IV. CONCLUSION

This study sought to evaluate the solid waste management practices in Kakamega Municipality. It was established that integrated solid waste management practices of waste minimization and re-use and recycling is still low in the municipality. This is attributed to inadequate source separation of solid waste which is compounded by the fact that most of the wastes generated are mixed. Recycling practices is hindered by lack of information on recycling. The County Government should invest in public private partnerships to manage recycling programmes such as training, awareness campaigns. Incentives should be provided to enterprises which practice waste reduction at source and also those which practice recycling.

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