

The Primary Solid Waste Storage Gaps Experienced By Nairobi Households

¹Afullo Augustine and ²Frank Odhiambo,

Abstract

This study identifies and analyses the solid waste management service gaps and situations in these different socio-economic setups. The objectives of this study were: (i) To assess households' current bin types; (ii) To assess households' desired bin types; and (iii) To identify the bin gaps experienced by households. A total of 430 households were selected through stratified sampling from dwellings with different social status, as represented by estate to give the quantitative data. The qualitative methods such as key informant interviews, observation surveys, and secondary data were also used. All the 8 divisions in Nairobi were represented, in a ratio proportionate to households from slums, low income, and middle income estates. There is a bin gap of about 15% households needing bucket; 26% excess plastics; and a deficit of 12% households needing but short of metal bins; and a 6% deficit of the 5-10 litre bins; a 13% excess of bins less than 5 litres; 1.6% deficit of 10-15 litre bins, and 14 % deficit of households needing bins larger than 20 litres. 30% of households have heavy to very heavy bins. Entrepreneurs should improve availability of storage bins of correct specification (size, material and make) as preferred by various households. Correct specifications of garbage bins should be designed to satisfy these household needs.

Key Words: Household Storage, Solid Waste Management; Garbage Bins

Introduction

Nairobi city faces huge solid waste management (SWM) challenges. Many of its residential estates are littered with garbage. Many researchers have found out that solid waste (SW) collection among Nairobi households (HHs) is less than 25%, the bulk of which is done in upper income areas, and often managed by private garbage management firms. The littering in low income and slum estates, where at least 75% of the entire city population resides, has been attributed to the informal nature of the estates, insecurity and the impassability of the narrow pathways (JICA, 1998). However, researches indicate the residents of the low income and slum estates also aspire to have an improved SWM system. There may be insufficient data to inform a more productive service delivery, with wrong packages of services being delivered to the HHs, indicating lack of information on the demand side of the services. This is supported by presence of lots of literature on the economic, social, entrepreneurial and engineering aspects of solid waste in Nairobi, most of which deal with supply driven aspects.

Solid waste management is a chain comprising primary storage, primary collection, secondary storage, secondary collection, processing, and disposal. The most challenging stage of SWM in the city estates has been primary collection, whereby households do not deliver all wastes to the designated points from where they can be collected. This research was conceived upon a realization that there could be barriers to the HHs depositing the wastes in the right places. Thus this study aimed at identifying gaps existing at primary (household) SW storage which could have a bearing on the HHs' ability to manage their wastes better at source. The current level of and the desired level of SWM service among Nairobi HHs remain as glaring research gap. The existing information on SWM service to HHs, as has been noted in JICA (1998), is rather old and may not be very useful in improving service delivery to Nairobi residents more than a decade after it was done. This is in view of the fact that demand for services change very fast, yet demand driven approach to service delivery remains the best. This research is an attempt to fill the solid waste collection demand gaps, as well as update any related information on SWM services in Nairobi. This study aims at identifying solid waste storage challenges faced by Nairobi HHs. The specific objectives were to; assess HHs' current bin types; assess HHs' desired bin types; and identify the bin gaps experienced by HHs. As such the study questions were: (a) what type of bins do

Nairobi HHs currently uses? (b) What type of bins do Nairobi HHs desire to use and (c) is there a difference between the existing and the desired bin specifications among the Nairobi HHs?

Literature Review

Nairobi is a varied city, with rapid urbanization amidst deteriorating economic, environmental and health conditions, with features and facilities of a modern city on one hand, and extreme pockets of poverty and destitution on the other hand (Ikonya, 1991; Gathuru, 1990; and GoK, 1985). For instance, it has Kibera, Mathare and Korokocho as major slums, among others, where about 2 million residents live yet occupying only 5% of the municipal residential land (JICA, 1998; GoK, 1994a, 1994b). Kibera prides in being the largest slum in Kenya and sub-Saharan Africa, with more than 25% of the Nairobi population confined in only 250 hectares of land (GoK, 2003 and WSP, 2005). The spatially divided internal structure is based on land uses and income levels (Mitullah, 2003). The city is littered with lots of garbage, the bulk of which comes from residential sites. The kind, level of solid waste management (SWM) service desired by, as well as the service gaps experienced by HHs remain unclear, making it extremely difficult to improve service delivery. This study identifies and analyses the SWM service gaps and situations in these different socio-economic setups (Figure 1). This research aims at understanding and, where necessary, updating the service gaps within HHs with a view to improving SWM in Nairobi.

Numerous bilateral and multilateral external support agencies (ESAs) are engaged in supporting municipal SWM in low-income countries. Source separation is considered one of the most effective in SWM, and its introduction must be done in a pragmatic and incremental manner, preferably beginning with pilot activities to assess and encourage the interest and willingness of users to participate. Local collection systems should be designed in collaboration with the communities concerned (Schübeler et al, 1996). This is the demand responsive approach (DRA) to service delivery. Liyayi (1988) states that before a national solid waste policy for a city can be constructed, checking the following is a prerequisite: (i) Relative net benefit of household separation of wastes versus machine separation; and (ii) Optimal (local and regional) organization. These demand determination of measurements of impact of user charges for SWM on generator behaviour and systems costs, especially on

¹Department of Public Health, Kenyatta University, Department of Public Health, Nairobi, Kenya afullochilo@yahoo.com

²Water, Engineering and Development Centre, Loughborough University, Kenya

waste generation, littering, propensity to separate wastes, resource recovery and distribution of income. It recommends the use of information and attitude changing techniques as methods of increasing acceptance of changes in resource allocation that lead to increase efficiency in resource use. The effectiveness of WM depends on people's identification with the SWM system. The character of SWM tasks, coupled with the technical and organizational nature of appropriate solutions, depends greatly on the country's economy in general and on the economic situation in the particular area of a city (hereafter called estate). The level of economic development is an important determinant of the volume and composition of wastes generated by residential and other users (Schübeler et al, 1996).

At the same time, the effective demand for WM services is also influenced by the economic context of the estate. The level of economic development is a determinant of waste generation and the demand for SWM services. This research takes into account the economic disparities and realities in different parts of Nairobi, and recognises the need for various SWM options in various estates. This demand responsive approach (DRA) is likely to help create demand driven. Besides SWM, municipal governments are responsible for the provision of the entire range of infrastructure and social services. Needs and demands for SWM must therefore be weighed and addressed in the context of the needs and relative priorities in all sectors and services (Schübeler et al, 1996). A public articulation of demand is required to express the full value of SWM to society. Under conditions of limited resources and extensive waste management needs, trade-offs between alternative goals and objectives are inevitable. Society may have to choose between, for example, a more extensive coverage of collection services as opposed to higher environmental standards of waste disposal, or between improved WM as opposed to the upgrading of another infrastructure sector (Schübeler et al, 1996). The Undugu Society of Kenya, for instance, is providing the lead in waste recovery and reuse at the Dandora Rescue Centre's waste paper group project (Wachira, 1994), an initiative which can be better facilitated if the generators of wastes cooperated fully with the waste handlers. The cooperation, however, also depends on whether the waste generators have any bottlenecks which may hinder their support to service providers.

Study Area

Nairobi city is the area of study. It is the administrative and commercial capital city of Kenya, which is one of the East African Countries. It is located at the equator at 6000ft above sea level, covers an area of 684 km², rendering it the smallest province in Kenya. Nairobi is administratively divided into divisions of Mathare, Westlands, Starehe, Dagoreti, Langata, Makadara, Kamunji and Embakasi (Figure 1 and Table 1). There is a general disparity of incomes as well as population densities in Nairobi. The people living in the western suburbs are generally the more affluent while the lower and middle-income elements of society dominate the eastern suburbs.

Methodology

This study used both primary and secondary data. Primary data were collected through the use 430

SWM service options that are tenable. People's attitudes influence not only the characteristics of waste generation, but also the effective demand for waste collection services, and thus their interest in and willingness to pay (WTP) for collection services (Schübeler et al, 1996). Improved waste handling patterns can hardly be maintained in the absence of practical waste disposal options. Private sector waste collectors may be contracted directly by willing individual waste generators (Schübeler et al, 1996). More often, they operate under contractual agreement with municipal authorities, with the latter retaining responsibility for user fee collection. This arrangement ensures more equitable service access. In Nairobi, they are most effective in SW collection. When private enterprises rely on user charges, they have little incentive to provide services in low-income estates where revenue potentials are weak (Schübeler et al, 1996). The latter therefore continue experiencing the garbage crisis. However, an assessment of their WTP may help develop options that they can afford. The authority to enforce bylaws and regulations and to mobilize the resources required for SWM is conferred upon local governments by higher government authorities.

pre-tested questionnaires; transect walk, observation survey, 12 key informant interviews and 6 focus group discussions. Secondary data were from records. The questionnaires, administered to households by 10 research assistants, were distributed through stratified sampling as per the socio-economic grouping and in proportionate to estate population. This method was used to acquire at least 80% of the information collected. The study population was the household, the sample size of which was calculated using the Mugenda, and Mugenda (1999) formula, which gave 400 households, but adjusted upwards to 430 for better representativeness. This calculation assumed 95% Confidence Interval, a collection level of 25% (thus representing p); and a Z value of 1.96. This was distributed across the eight administrative divisions of Nairobi, as shown in the sampling plan in table 1 (GoK, 2001).

To distribute the households per divisions above among estates, Stratified random sampling method was used to help achieve the desired representation from various sub groups in the city. The identified sub groups included the high income, medium to high income, medium income and, low-income groups, which were identified from the socio-economic status as represented by housing development (estates). The high income group is excluded because they represent a very small population, have established and operational SWM system, experience least SWM problem, and accessibility to their residences to administer the questionnaire would be difficult. Researches indicate that levels of SWM service, and household satisfaction with the same in the high income states is near optimal at 78% (JIKA, 1998). The low income and slum groups need improved SWM services most because of service gaps, experience the worst garbage menace, face the worst environmental and health hazards, are likely to be involved in the livelihood initiatives and opportunities existing in SWM and are likely to benefit most from an improved SWM sector (see Tables 2 and 3).

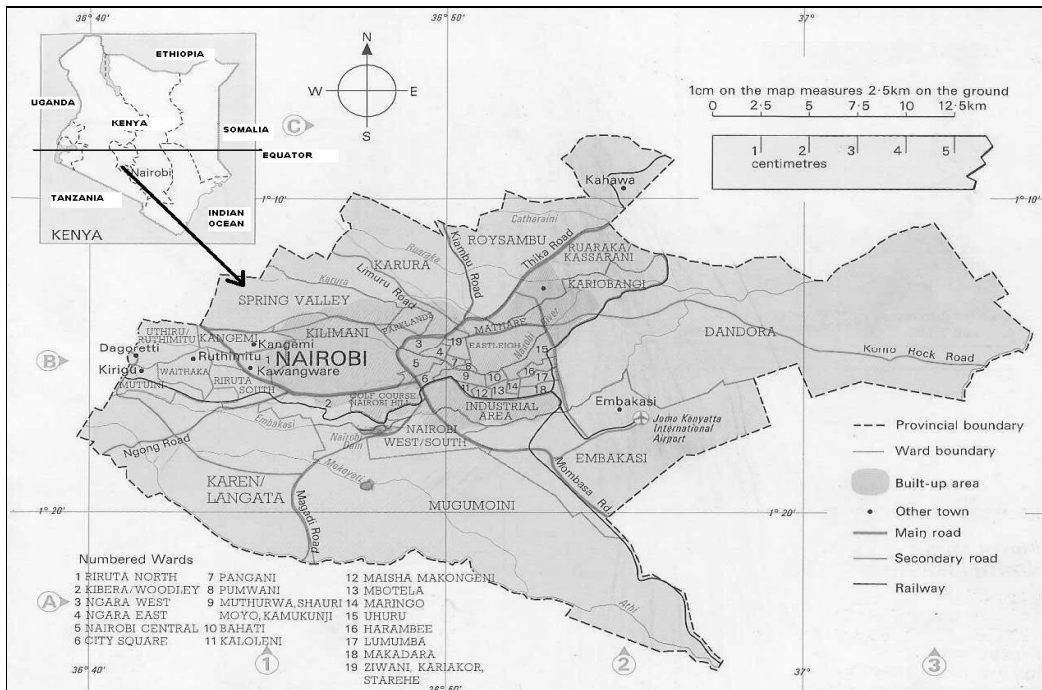


Figure 1: Map of Nairobi showing the administrative divisions and estates

Table 1: The households' distribution in Nairobi province, by Divisions.

Division	Westlands	Kamukunji	Dagoreti	Langata	Starehe	Makadara	Mathare	Embakasi	Nairobi
No of HHs ¹	61,258	54,801	73,670	89,086	69,958	58,032	109,149	133,472	649,426
% of HHs	9.5	8.4	11.3	13.7	10.8	8.9	16.8	20.6	100
Estimated population (000)	160	190	250	390	115	220	570	250	2,210

HH Means Households

Table 2: Household sampling plan

Division	Calculated minimum No. of HHs studied	Adjusted No. of HHs studied per division	Estates represented	Socio-economic Class of estate	Sample size
Westlands	38	40	Kangemi	Lower Middle	40
Pumwani / Kamkunji	34	40	Eastleigh south	Lower middle	40
Dagoreti	45	50	Riruta /Satelite	Middle	50
Kibera / Langata	55	90	Langata Kibera	Middle-high Slum	40 50
Starehe	43	40	Mathare	Slum	40
Makadara	36	40	Makongeni	Low	40
Kasarani	67	50	Korokocho	Slum	50
Embakasi	82	80	Kayole / Komarock	Low Lower middle	60 20
Total /Nairobi	400	430			430

Table 3: Socio-economic classes of Nairobi estates

Socio-economic class	Slum	Low Income	Lower middle income	Middle-High income
Estates representing	Kibera, Korokocho and Mathare	Eastleigh, Kawangware and Komarock	Makongeni and Kayole	Langata and Riruta
Household sample size	140	100	100	90
% Representation	32.6	23.2	23.2	20.9

Results and Discussion

This sub-section presents and discusses the specification (size, shape/type and material) of bin used by households, as well as the specifications of bins they desire to use. The Nairobi HH bins are made of plastic, metal, woven or carton. The plastics may be thin (jwala) or heavy. On the average, 60% of Nairobi HHs would like to have plastic bins, 17% would like to have metal bins, while 1% would like to have woven waste bins (Figure 2). About 22% non-response is attributed to the estates already under private firm waste collection such as Komarock (50%), Riruta (92%) and Langata (67.5%). Their non-response could be attributed to the fact that already, they are satisfied with the level of service they get (figure 3), and thus the majority feels they need not make further suggestions (figures 4 and 5).

However even the few HHs contributing to the low response overwhelmingly chose plastic bins. The rest of the estates registered at least 70% preference to plastics, with Makongeni recording the lowest (70%), and Kawangware registering the highest (97.5%), while Eastleigh has 100% preference for metal bins. In socio-economic grouping, plastic bins were preferred by 83.6% of slum HHs, by 79% of lower middle HHs, 45% of low income HHs, and only 16.7% of middle-high income HHs (Figure 4). In low income estates, the ratio of plastic: metal preference is 1:1. The demand for woven material and cartons is negligible, with a range of 0% to 2.9%. Thus there is more than 20% service gap in plastic

bin use than desired. Many HHs (85.8%) use plastic containers while only 60% would like to have it, while 5.3% use metallic bins while 12% desire it. This leaves a bin gap of 26% excess plastics; and a deficit of 12% HHs needing but short of metal bins.

The bin types applicable to Nairobi households are the drum, bucket or thin plastic (jwala). Among Nairobi households, 61.4% prefer bucket bin in the slum with jwala scoring a distant second with 19.3%; 52% in prefer the bucket bin in low income households, with jwala scoring a close second of 41%; 23% of lower middle households prefer the bucket bin, with jwala coming a close second at 22%; 52.2% in middle-high income households prefer bucket bins, with jwala coming a distant second at 17.7% (figures 5 and 6). The majority of Nairobi households seem to prefer a bucket bin (48%), 23.5% prefer jwala and 12.6% prefer a drum. Only 2.1% can do without a bin.

On the average, there is 30% more jwala than is desired; and at least 15% deficit of bucket bins. Jwala prices are relatively cheap and affordable to even the poor slum dwellers. It is worth noting that even when the price of jwala was low, still at least 30% of HHs using it do not seem to like it. The dislike, coupled with the latest Kenya Government policy and tax on thin plastics (jwala), it will become more expensive, and is unlikely to be an option for many, given its low durability relative to its high price. This research was done before the new Kenya government policy on jwala, and it would be interesting

to assess the impact of the tax on the households' preferences. Among Nairobi HHs, 57.4% store their waste in thin plastic (Jwala) while only 23.5% prefer plastics, depicting use of an undesired material. On the other hand, only 34.4% of HHs use bucket out of the 48.4% who prefer such bin. Thus there is a bucket bin gap of 14% HHs.

The most used container size is the medium sized 5-10 litre bins used by 32.3%; while small bins of <5 litres bins are used by 21.6%; 10-15 litre bins by 20.5% and large bins of ≥ 20 litre bins by 13% of the Nairobi residents (figures 7 and 8). However, the majority of households in the slums use 5-10 litre bins, low income households use 10-15 litre containers; lower middle income group uses 5-10 litre containers and the middle-high income households tend to use <5 litres containers. The medium to high income HHs desire the small containers, perhaps because their wastes are collected more regularly and they feel no need for larger containers. Their next currently most used bin size is ≥ 20 litres. This could be partly because the level of collection service is likely to be higher (e.g. door to door service), where the HHs members do not have to handle the containers, and all responsibility rests with the collector (crew).

The residents may therefore not be aware of, and do not care about the burden of carrying the heavy load. This is not unexpected because many high income earners in Kenya operate outside the reality zone. There is also lack of contact with the collection service providers, as the collection is done during the day when the majority of the household members are at work. Even those at site at the time of collection do not have to be involved, since the door-to-door service means the service provider plays all collection roles, including picking the bin from the yard. This varies from the kerbside where the household members carry the full bin to the kerb, or to a block collection where households carry the bins to waiting vehicle, thereby making them involved, and are likely to be more sensitive to the size and weight of the full bin. Tchobanoglous et al, (1993) states that heavy household bins compromise households' ability to deposit wastes at designated points.

In respect of the above, the high income households where the burden must be borne by the members themselves such as in block and kerbside collection methods tend to prefer the smaller containers, again indicating a sense of selfishness and lack of stamina to carry even 5-15 litre containers among such residents. The smallest container size is second most popular in the slums because the HHs members who collect the waste to relatively far and insecure unofficial dumpsites are largely children, whose ability to carry larger loads is relatively low. The low income estate use 10-15 litre containers, followed by 5-10 litre containers. The lower middle group uses the 5-10 litre containers, followed by 10-15litre size. In all, considerations of convenience tend to dominate in HH selection of bin size.

The majority (27.7%) of Nairobi HHs prefer a 5-10 litre bin; 27.2% like large bins of ≥ 20 litres; 22.1% prefer bins of 10-15 litres, and only 8.6% prefer bins less than 5 litres. Of these, the majority (56%) in Riruta prefer a bin of <5 litres, the only estate with preference for smallest bin size. Other than Kawangware, which registers a 15% HHs preference for the smallest bin, all the other estates register at most 5% for the same. On the other hand, 80% of Eastleigh, 34% of Korokocho and 17.5% of Langata

HHs prefer a bin of ≥ 20 litres. This is not unexpected in Langata and Eastleigh where there exists prominent private garbage collection firms, making the HHs least concerned about the weight of the full bin since a non-household member is likely to handle it. In Korokocho, the HHs have no bins, but seem to be concerned about the long walk to dumpsites. Thus they would rather use larger containers which they do not have to empty so frequently. 38.3% on Households in Kayole, 45% in Komarock, 38.3% in Kawangware and 25% in Mathare prefer the 5-10 litre bins. 37.5% in Makongeni and in 52% in Kibera prefer the 10-15 litre bins. In terms of socioeconomic groupings, the modal bin size for the slum is 10-15 litre, low income is 5-10 litre, lower middle is 5-10 litre and middle-high income classes of HHs is <5 litres. On the average, the ratio of preference for the 5-10, 10-15, >20 and <5 litres among Nairobi HHs is almost 3:3:3:1 (figure 8). About 14% never responded to the question, perhaps with an imagination that it would be tantamount to committing oneself to it, and may be asked to buy what they have stated they prefer. On the average, there is at least 30% surplus of bins less than 5 litres; a 10% surplus of bins 5-10 litres; just enough of 10-15 litre bins; and at least 20% deficit of the large bins in excess of 20 litres. These findings concur with Ali (2003) and Ali et al, (1999) who state that presence of the right specifications of bins can facilitate SWM.

The design (size and structure) of a settlement greatly influences the character and urgency of waste management needs. In quite low-density semi-urban settlements, some form of local or even on-site solution to the management of organic solid wastes may be more appropriate than centralized collection and disposal. In urban areas, the physical characteristics of a settlement including such factors as density, width and condition of roads and topography need to be considered when selecting and/or designing waste collection procedures and equipment such as containers and vehicles (Schübeler et al, 1996). Comparing bin use against preference, there is a 6% deficit of the 5-10 litre bins; 13% excess of bins <5 litres; 1.6% deficit of 10-15 litre bins, and 14 % deficit of HHs needing bins ≥ 20 litres.

The size of bin has an implication of its weight at the time of emptying. A large bin will be relatively heavier at emptying, depending on frequency of emptying, which is also determined by distance to disposal site, and who does the emptying. Households in Nairobi tend to be very sensitive to size of bin if the emptying is done by a member, while they don't care if the emptying is done by a non-household member. In the former case, they chose smaller bins, while in the latter case, they do not care about the size, as long as what they have serves them sufficiently between collection times. In cases where the disposal point is far, households prefer large bins. This is to reduce the frequency of emptying, which then is done by adult members of the family, preferably men. This shows a gender aspect of waste management at household level in Nairobi. There is 6% deficit of the 5-10 litre bins; a 13% excess of bins <5 litres; 1.6% deficit of 10-15 litre bins, and 14 % deficit of households needing bins larger than 20 litres. This means a deficit of 21.6% for larger containers, and a surplus of 13% for the small, cheaper, containers. Households are largely unable to purchase larger containers due to lack of funds.

The majority of Nairobi HHs (39.5%) rate the weight of their waste bin as average. However, 23%

consider them heavy, 22.6% consider them light, 7.2% consider it very heavy and 6.7% consider it as very light. These have serious implications on whether the wastes end up in the right place, and health and safety of those handling the full bins. Within Estates, 65% in Eastleigh, 65% in Langata, 85% in Komarock, 52.5% in Makongeni describe the weight of their full waste bin as average, while 50% in Mathare, and 90% in Korokocho describe their as light. These cases all represent modal % of HHs in the various estates. The Mathare and Korokocho cases are typical slums where HHs find very little to eat, and therefore almost nothing to dispose of. The non-motorised collection systems provide an advantage of being usable in relatively narrow corridors common in low income residential areas, but provide challenges of health and safety since the contact with the filthy, rotting, and contaminated garbage poses a hazard to the handlers (Afullo, 2004).

However, 47.5% in Kawangware, 32% in Kibera and 37.8% in Kayole describe their full waste bins as heavy. Of greatest concern are Kibera, Kawangware, Kayole and to an extent Eastleigh and Makongeni estates where over 30% of full bins are considered as heavy to very heavy by the households. Mathare, Komarock, Korokocho and Riruta are very comfortable because not more than 10% of the HHs consider the full bins as heavy to very heavy (figure 9). The significant group to take care of their needs urgently is the 30% whose full bins are either heavy or very heavy, since handling such a heavy load poses a risk of contamination to the handlers.

In general, the level of satisfaction with solid waste collection service is low among Nairobi HHs (figures 10 and 11). The mean % of those satisfied is 24%, with only the middle-high income group registering above average

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The above is fairly satisfactory scenario since the burden of carrying heavy waste bins affects an insignificant minority in the above estates. If the weight of a full bin is relatively high, and the disposal site is far away, communities in slums have designed some innovative ways of collection, by using the non-motorised vehicles such as wheelbarrows. Such initiatives, if incorporated into an integrated SWM system, are likely to provide hopes of improved collection service in the slums and low income estates (Afullo, 2006; Afullo, 2004; Kibwage, 1996, 2002; and Kibwage and Momanyi, 2003).

level of satisfaction (78%). The low income group registers 24% satisfaction; the lower middle income group registers 18% satisfaction, while the slums register 2% satisfaction.

Conclusions

There is an excess but undesirable use of cheap plastic (jwala) and small bins in the market, and an unmet demand of metallic bucket bins of medium size (5-15 litres). There is an unmet demand for larger containers, and a surplus for the small, cheaper, containers. Households are largely unable to purchase large containers due to lack of funds, which also expose households to garbage handling hazards from emptying the heavy full bins. Therefore entrepreneurs should avail in the market less thin plastic (jwala) and more metallic bucket bins of medium size to meet the demand of households. More research is required on the willingness and ability of HHs to pay for their desired levels of service, and households' preferred bin specifications after the ban imposed by the Kenya government on thin plastics (jwala).

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Figure 2: % distribution of bin types the Nairobi households would like to use.

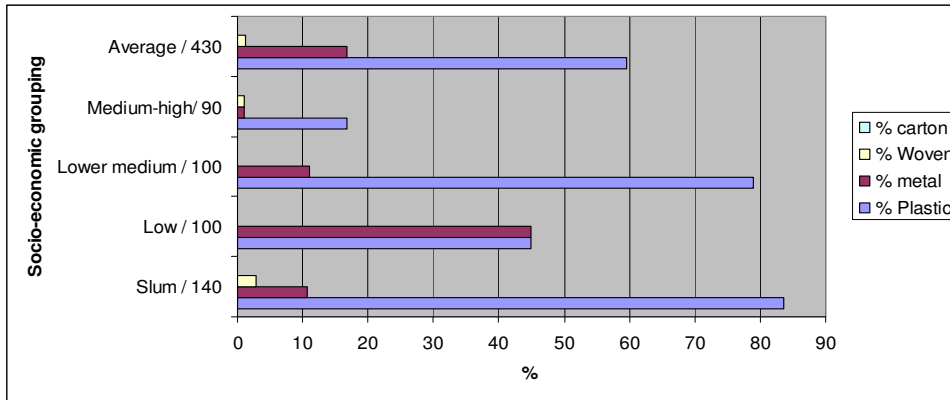


Figure 3: % distribution of service providers who collects solid wastes from Nairobi estates

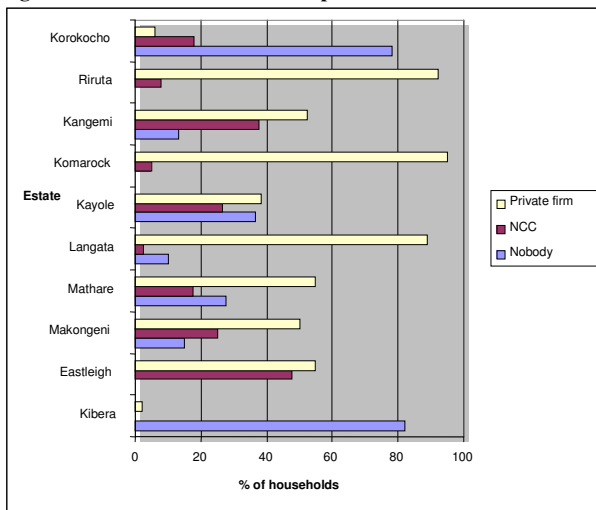


Figure 4: Material from which the Nairobi households' waste bins are made

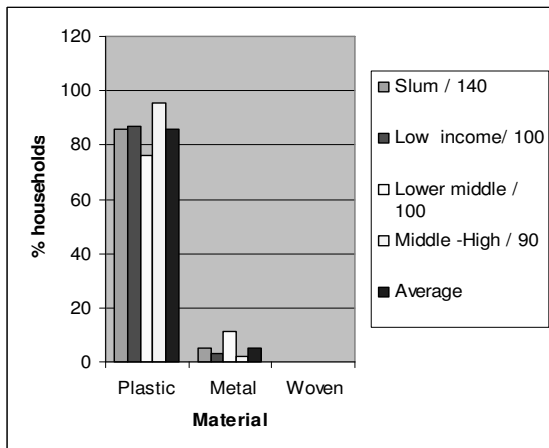


Figure 5: Distribution of preferred type of waste bins among Nairobi Households

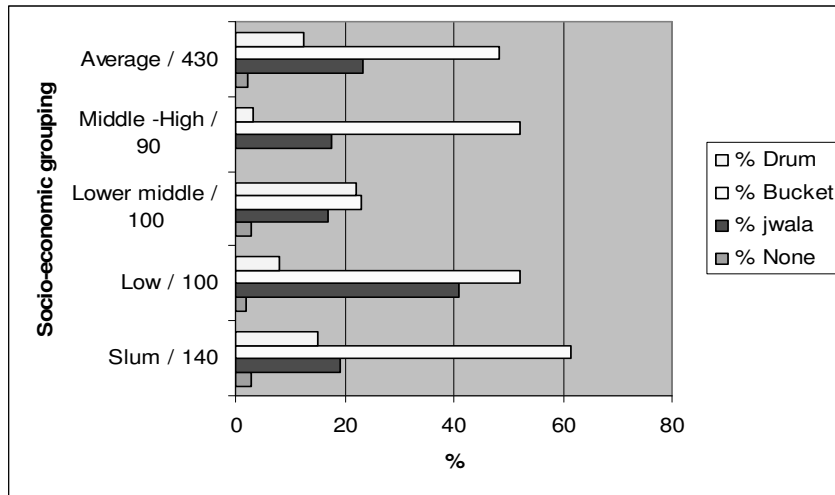


Figure 6: Distribution of waste bin types the Nairobi households are currently using

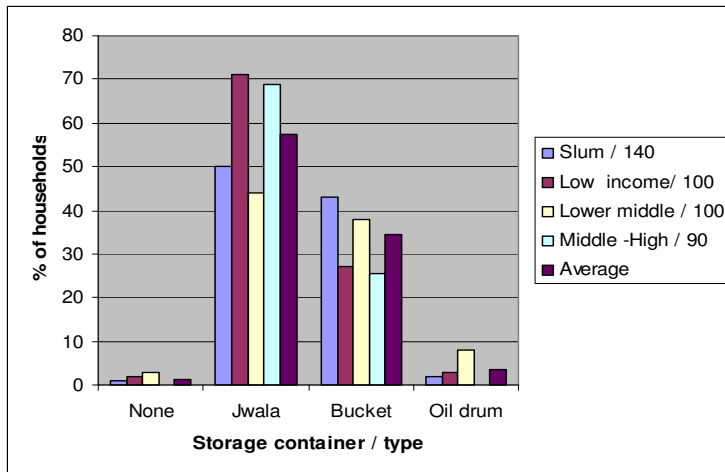


Figure 7: The distribution of size of waste bins desired by Nairobi Households

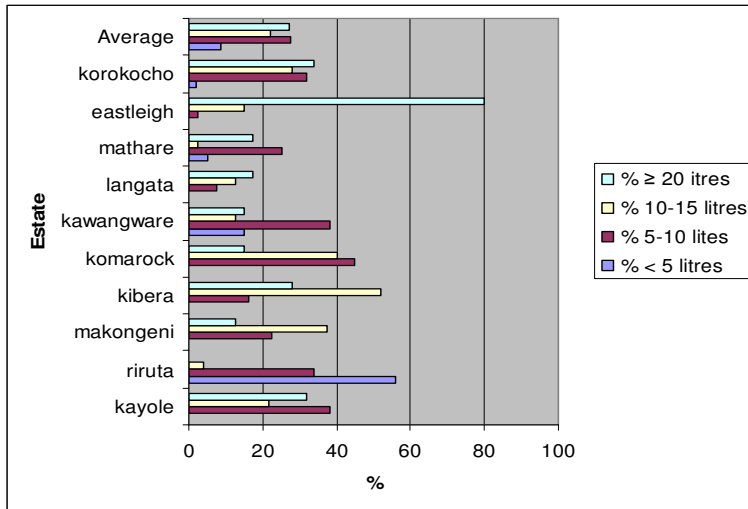


Figure 8: Distribution of the current size of waste bins used by Nairobi Households

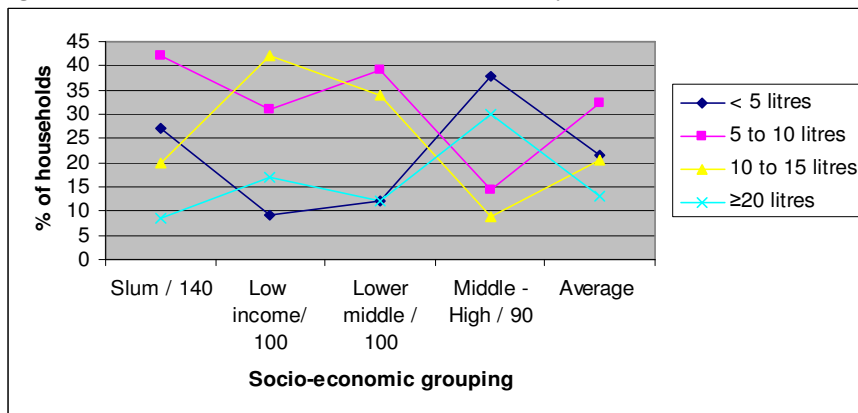


Figure 9: Distribution of perceived weight of Nairobi households' full waste bins

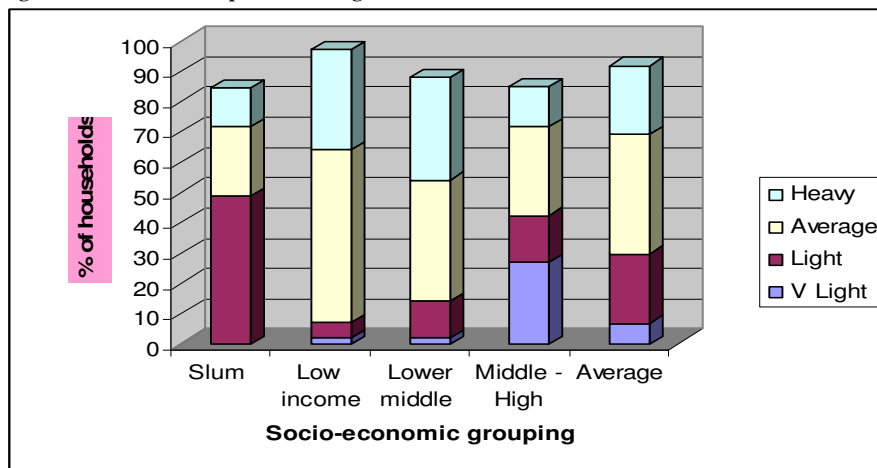


Figure 10: Net % of Nairobi households satisfied with the SWM service currently offered

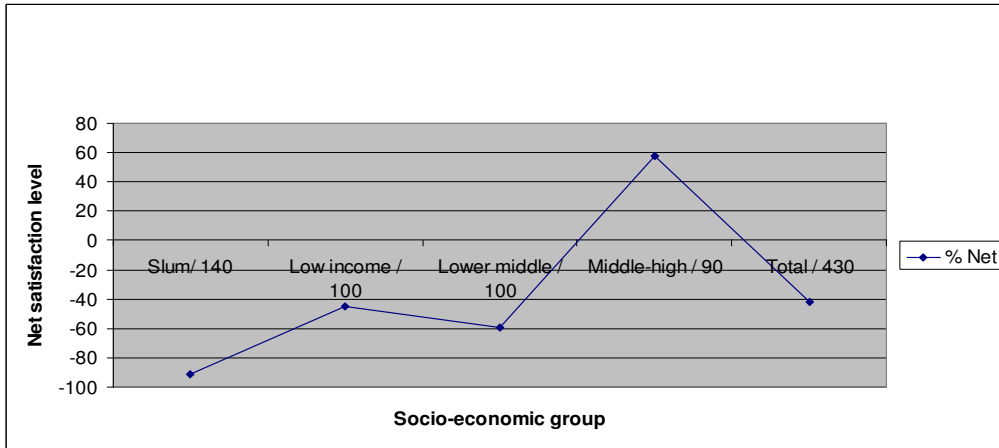


Figure 11: Nairobi household satisfied with the current level of SWM Service

