



Solid Waste Management Practices at Egerton University, Njoro Campus and the Community Around

J. M. Kariuki^{1*}, B. Soi¹, A. N. Mutio¹ and D. N. Kinyanjui¹

¹*Department of Environment Studies and Resources Development, Chuka University, Kenya.*

Authors' contributions

This work was carried out in collaboration between all authors. Author JMK designed the study, performed the statistical analysis, wrote the protocol and wrote first draft of the manuscript. Authors BS and ANM managed the analyses of the study and author DNK managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JSRR/2018/36174

Editor(s):

(1) Dr. Masafumi Tateda, Department of Environmental Engineering, Graduate School of Engineering, Toyama Prefectural University, Japan.

Reviewers:

(1) Aminu Umar Kaoje, Usmanu Danfodiyo University, Nigeria.
(2) Kamal A. R. Ismail, State University of Campinas, Brazil.

Complete Peer review History: <http://www.sciedomain.org/review-history/25507>

Original Research Article

Received 16th August 2017
Accepted 4th July 2018
Published 11th July 2018

ABSTRACT

Aim: The purpose of this study was to characterise existing solid waste management practices in the study area.

Study Design: The study was a cross-sectional survey

Place and Duration: It was carried out between January – May 2009 within Egerton University, Njoro campus and the community around it, all within Njoro division.

Methodology: The sample comprised 220 respondents that were drawn from tenants, farmers and the business community. A semi-structured questionnaire was used to gather quantitative data which was analysed using frequency tables by the Statistical Package for Social Sciences software.

Results: The study established that use of open dumpsite as the final disposal option was done within the University as well as for the community around the university. Open dumps and waste pits near living areas were fairly common outside the university but very rare within the University. Whereas waste collection was common in the university, it was rare outside the University. Waste

*Corresponding author: E-mail: makqarix@yahoo.com;

burning was fairly common outside the university with more than 70% of the business people and the tenants burning their waste whereas tenants and students within the University never burnt their waste. Waste minimisation practices like shopping with a durable bag were practiced by over 50% of the respondents. Waste separation, practiced by 36% of the respondents was not practiced for environmental reasons but to extract materials that were still useful.

Conclusion: waste management within the university was better due to the presence of waste collection and centralised disposal which were lacking in the community outside the university.

Keywords: Solid waste; recycling; reuse; waste separation; waste disposal; Egerton University.

1. INTRODUCTION

Solid waste management is a challenge globally but more so in most of the developing world where basic practices like effective collection, transportation and disposal are yet to be perfected. In Kenya, waste management sector is besieged by many problems, for instance it is recognised that waste collection in most urban areas is low [1-3], waste segregation at source is rarely done, recovery of recyclables is done informally and disposal sites are poorly sited, unfenced and without daily compaction and covering of the waste [4].

Guerrero, Maas and Hogland reported that in 30 cities in 22 developing countries, waste is disposed in open dumps without leachate treatment, protection by a bottom layer, gases treatment and other important infrastructures but also the cities suffer from the illegal disposal of waste in rivers, lakes, oceans, drainage channels, empty lots and roadsides [5]. Oteng-Ababio avers that in the low-income high-density areas, in the developing countries, waste is often dumped in gutters, drains and streams [6]. Furthermore, in Africa 47% of the waste is openly dumped, 9.2% openly burned and 8.4% disposed of by other unhygienic methods [7]. Mbiba reveals that due to the inadequate waste collection in the cities of Eastern and Southern Africa some households dispose of waste by burning of plastics, burying of organic wastes in backyard gardens or various forms of illegal dumping and even though the fraction of organic waste is quite high, there is limited waste composting [1]. In Gambia for instance, about 90% of waste is disposed by open dumping [8].

The study area is an upcoming urban centre whose growth in population is fuelled by the increased enrolment in Egerton University. The

purpose of the study was to evaluate the existing waste management practices within and around Egerton University, Njoro campus.

2. MATERIALS AND METHODS

2.1 Study location

The study was carried out in Njoro Division of Njoro District and covered communities living in Njoro and Mukungugu sub-locations of Njoro Location (Fig. 1). Njoro Division lies between longitudes 35°28'E to 36°10'E and latitudes 0° 13'S to 1° 10'S which is to the South-west of Nakuru town and cover 313.6 km² [9]. The nearest urban centre to the University is Njoro which is only five kilometres away and Nakuru town, the fourth largest town in Kenya, is about 25 Km away. The study population was 50,750 persons and 13,048 households [10].

2.2 Research Design and Sampling

This research design was a cross section survey and the sampling frame comprised the population within Egerton University and the neighbouring villages namely Mukungugu, Beeston, Mwigito, Eriithia, Njokerio and Ng'onde. The sample was made up of tenants, farmers and business people. Within the University the sample included students, resident staff and members of business community. The sampling unit for tenants and farmers was households whereas for business enterprises it was individual businesses. The sampling design was stratified random. When sampling university students, the sampling was for the halls of residence and for rooms within the selected halls. Only one tenant in every estate was the subject of the survey but in areas with detached housing units each house was treated as a unit whether it had one or

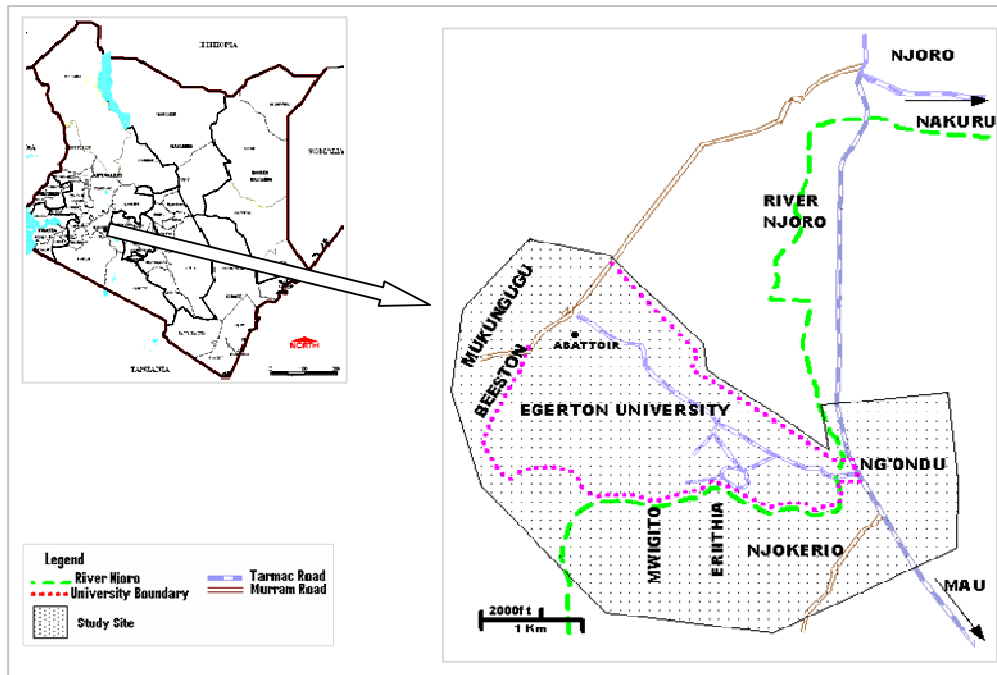


Fig. 1. Location of the study area

more tenants. The subject of the study was the household head of every third house in each plot. The businesses comprising hotels, groceries, posho mills, butcheries, retail shops among others, were sampled proportionately. The sample size used was 220 composed of 80 businesses, 80 tenants, 30 farmers and 30 students. The sample size was based on the recommendations by Kathuri and Pals [11] that in survey research a major subgroup of the sample could be adequately represented by 100 cases and a minor subgroup by 20-50 cases.

2.3 Data Collection and Analysis

Structured questionnaires were used to collect data on a wide variety of factors of interest that included the existing waste management practices, attitudes on existing practices, constraints to proper management and socio-economic information. Data were analysed using the Statistical Package for Social Sciences (SPSS). The analysis was achieved by descriptive statistics.

3. RESULTS AND DISCUSSION

3.1 Study Population

Most of the farmer respondents were female whereas most of the students and tenants were males. The farmers had the highest

proportion of respondents with the lowest level of education and had the highest mean age. The mean monthly incomes were higher within the university (Shs 30,000) as compared to outside the university (Shs 6,666) [12].

3.2 Storage, Collection and Disposal of Waste

A majority of the respondents stored their waste temporally before taking the waste out of their households (77%). There were a variety of apparatus used to store the waste: waste bins by 43% of the respondents, buckets (16%), plastic bags (2%), sacks (8%) and cartons (8%). The rest (23%) did not use any form of containers and hence took the waste to disposal site immediately.

Within the University, 80% of the tenants had waste bins, 6.7% used buckets and 6.7% used plastic bags (Table 1). Of tenants outside the University, 22.8% did not have any type of waste receptacle, 75% had waste bins, 2.3% used plastic bags. All the business people within the University had the bins. Of business people outside the University 56.5% used waste bin while the others used buckets, sacks and cartons.

All the University students (100%) had waste bins whereas a majority of the farmers had no waste bins. Mbiba similarly found that in low income areas many resident use alternative containers like sacks instead of the conventional waste bin while others dispose their waste immediately without storage [1].

From the households, 57% of the respondents removed their wastes from the households daily, while 11%, 10% and 17% did so twice, thrice and once a week while 5% did it once or less in two weeks (Fig. 2).

From the point of generation of waste (household/business), the waste is taken to various places. For those living within the university, the waste was placed outside from where it would be picked (35.5%) which was done mainly by students (Fig. 3). Another

practice by a large proportion of respondents within the university was taking the waste to a transfer point (43.5%), which was mainly done by resident staff. Practices that were present but practised by a small proportion of respondents within the university were waste dump in compound (3.2%), waste pit in compound (8.1%) and waste pit outside the compound (3.2%).

Within the university waste was collected for a majority of the respondents. This was done for all the respondents who placed the waste outside for collection, into a larger container and who took it to a transfer point. In the student hostels, one large waste container was placed within halls of residence whereby most hall of residence had more than 20 student rooms each with about 3 students (Plate 1). Several halls of residence used a common waste transfer point.

Table 1. Containers uses for temporary storage of waste

Containers	Within University			Outside University		
	Business (%)	Tenants (%)	Students (%)	Business (%)	Tenants (%)	Farmers (%)
Waste bin	100	80.0	100.0	56.5	75.0	30.0
Bucket	0	6.7	0	13.0	0	0
Plastic bags	0	6.7	0	0	2.3	3.3
Sack	0	0	0	11.6	0	0
Carton	0	0	0	17.4	0	0
None	0	6.7	0	1.4	22.8	66.7

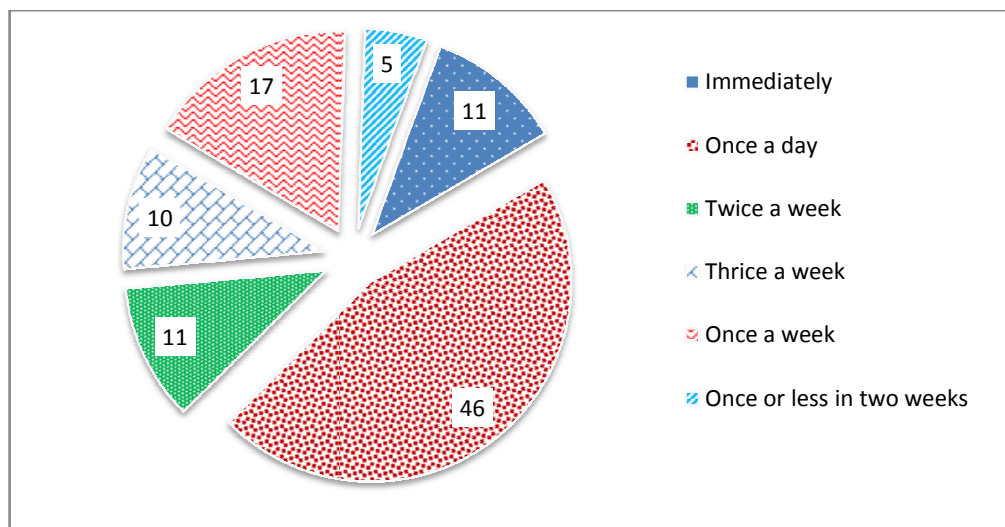


Fig. 2. Frequency of emptying waste container

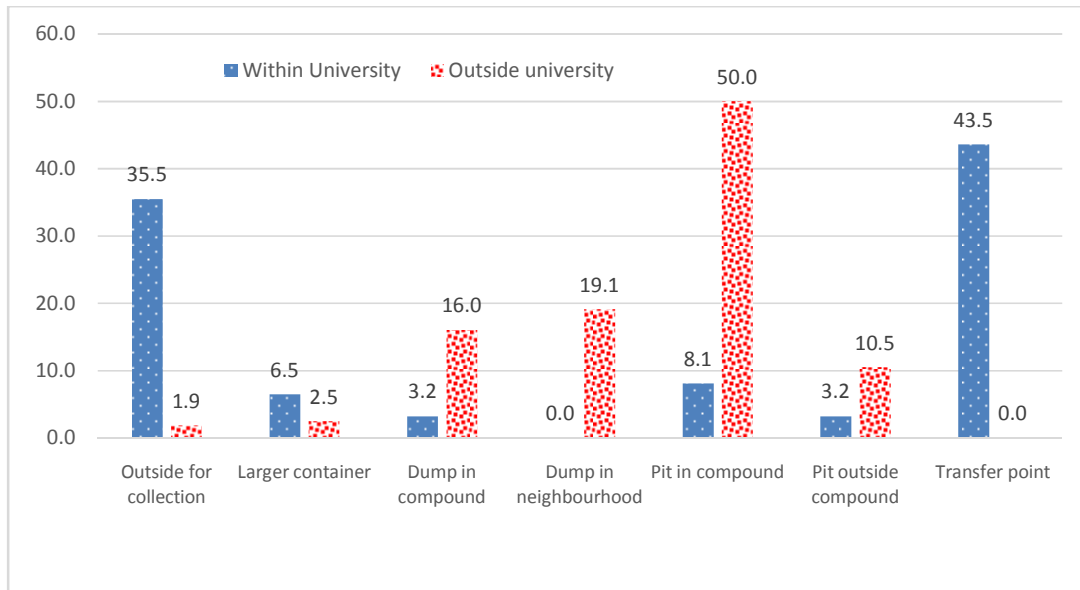


Fig. 3. Where waste is taken from the household



Plate 1. A large waste container serving a hall of residence (a) and a transfer point serving several halls (b)

On the other hand, for the community outside the university, the practices used by most of the respondents were dumps and waste pits. For instance, pits within the compound were used by 50% of the respondents whereas pits outside the compound were used 10.5% whereas dumps within the compound were used by 16% whereas those outside the compound were used by 19.1% (Plate 2). Waste collection was rare for this community outside the university and was only reported by less than 2%.

3.3 Waste Disposal and Disposal-Site Management Practices

Waste pits and dumps were used as permanent way of waste management, that is rarely was waste removed for further disposal but other practices were carried out to minimise the waste

and lengthen the use of the site for disposal. Within the University there was a waste collection service that served most of the University population whereby waste was taken for disposal to a single dumpsite located within the university but away from the built-up area. However, a small population within the university was not served by waste collection services probably due to low population density and in this case, the residents used waste pits and dumps.

On the other hand, for the community outside the University, waste was rarely collected for disposal. In the rare occasions that waste was collected, it was taken to dumpsite at Ng'onde which used to be a quarry in the past, near Kwa-Wright centre and next to Ndarugu river.



Plate 2. A waste dump with waste overflowing to a nearby river (a) and an improved waste pit with raised stone walls (b) at Njokerio centre



Plate 3. Egerton University open dumpsite

When the waste was taken from the house/business many practices were carried out at the transit or disposal point. Within the university most of the waste was collected for disposal at a common dumpsite (Table 2). On the other hand, where waste was not collected, it was burned or buried. Sometimes after a pit

filled up after burying, the pit was prepared again for use after digging up the decomposed waste whereby any plastics would be burned and the rest used as compost manure. Practices like burning, burying and removal for use as manure were for more common outside the university than within the university.

Table 2. Waste management practices after collection/removal from house/business

Respondent	Practice									
	% Collected/ removed		% Burning only		% Burning and burying		% Burying		% Nothing	
	W.U	O.U	W.U	O.U	W.U	O.U	W.U	O.U	W.U	O.U
Business	81.3	11.4	18.8	74.3	0.0	4.3	0.0	7.1	0.0	2.9
Tenant	66.7	3.3	0.0	77.0	0	3.3	13.3	4.9	0	11.5
Student	100	0	0.0	0.0	0	0	0	0	0	0
Farmer	0	0	0.0	40.0	0	56.7	0	0	0	3.3

Where: W.O = Within University, O.U = Outside University

When asked who was responsible for waste management at the disposal site, about 57% of the respondents reported being solely responsible. About 29% of the respondents revealed that landlords were whereas 5% reported that the practices were done by a private company (or individuals paid to do so) and a similar percentage (5%) by a neighbourhood group (Fig. 4).

3.4 Waste Prevention, Separation, Reuse and Recycling

Of all the respondents, 54% reported going shopping with their own bags or re-using plastic bags. The largest proportion (34%) of those who carried their shopping bag was to avoid the expense of buying another bag. The respondents who deliberately chose to use their own bag in order to avoid generating plastic waste was 14%. Of the others, 3% used their own bags because they were stronger and 2% because they were more convenient.

The majority of the respondents (64%) did not separate their waste into different categories before disposal. Of the 36% who reported separating their waste, the separation was not due to environmental concerns or existence of any policy guidelines. The majority extracted a waste stream was useful e.g. food remain by farmers, tenants and hotels either for own use as animal feed or for sale to farmers. Only a single household was observed to separate all the different waste streams before the waste

was collected for disposal. This particular household was only unique by the fact that the spouse of the respondent was a foreigner and insisted on separation because it was part of their upbringing in their home country. Good as separation by this household was, the was still mingled up during collection. Babaei et al. indicated that 1.7% of respondents in a survey in Abadan, Nigeria practiced source separation with women’s participation being more than three times that of men [13]. In Mombasa, there was no formal waste separation program but a majority of households were ready to separate wastes, 83.3% in low-income areas, 81.8% in middle-income areas and 91.4% in low-density high-income areas [1].

Reuse was reported for various types of waste materials with reuse of plastics being reported by the largest proportion of respondents (Fig. 5). Plastic cans, plastic bags and plastic bottles were reported as being reused by 43.9%, 43% and 41.2% respectively. Reuse rates for waste paper, wood, food, vegetables and animal waste were all above 20. The rates are much higher for some respondents than others for instance; reuse of food wastes among farmers was virtually 100. Farmers did not dispose any food waste as any remains were used as animal feed. Similarly, Palczynski noted that in households in low-income peri-urban areas, like the study area, resource recovery begins with the reuse of plastic bags, bottles, paper, cardboard, and cans for domestic purposes, extending their useful life [14].

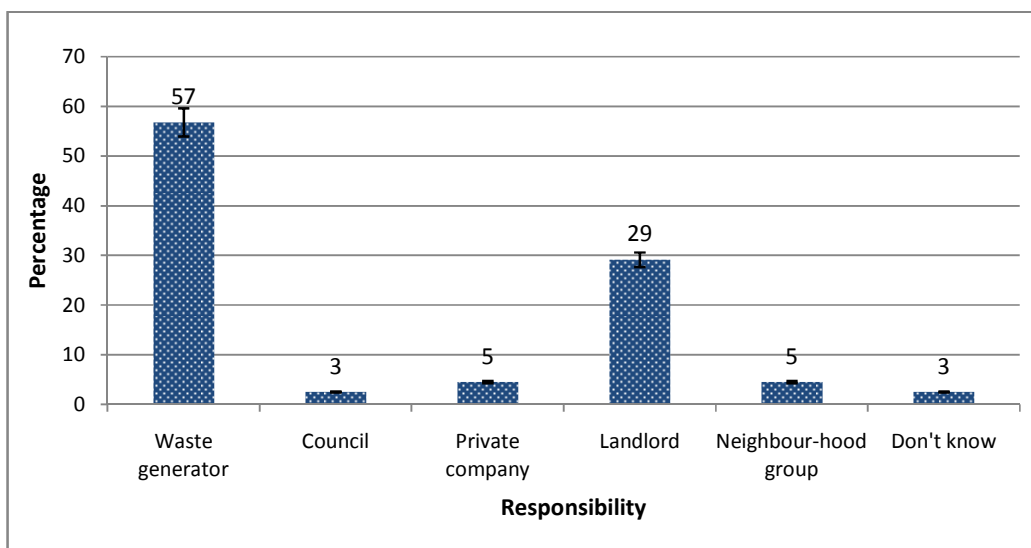


Fig. 4. Responsibility for waste management practices at the disposal site

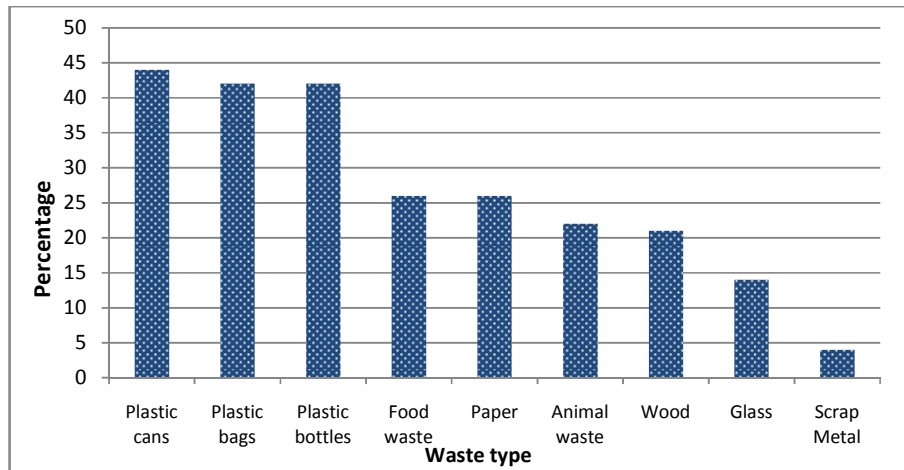


Fig. 5. Percent waste reuse in the study area

In this regard, it was also recorded that even businesses facilitated diversion of waste from the dumpsite. In most businesses that generated food wastes like hotels, butcheries and groceries, it was established that food wastes were sold or given to farmers. Wastes from hotels were mostly sold to chicken and pig farmers while grocery wastes were sold to dairy farmers. Other wastes that were recovered for sale included scrap metals, some types of plastics, papers and wet batteries. Guerrero, Maas and Hogland noted that commonly recycled materials in communities include plastic, paper, metal, glass, organic, battery, electric and electronic [5]. On the other hand, Wilson observed that materials like plastics, paper, cardboard, aluminium, steel, other metals, glass and textiles were recovered in Karachi but mostly for sale [15]. One of the reasons, given for recovery of waste materials in the study area was for use as fuel whereby, some respondents revealed that plastics were widely used as fuel for cooking due to a shortage of woodfuel. Recycling activities in the community where new products were made from waste materials were very rarely encountered during the study. However, some materials were recycled into other products, for instance, textile waste was made into fireless cookers or pillows. Similarly, Dhokhikah, Trihadiningrum and Sunaryo found that recycling activities are sometimes practiced by a few members of the community, reporting that in eastern Surabaya only 5% of the respondents were involved in creating of unique handcrafted goods [16].

Recovery of materials for use or recycling was chiefly due to financial reasons. The majority

(62%) recovered useful materials to avoid the expense of buying a new one. A further 10% stated that continued use of waste materials was necessary as it did not make sense to throw it away while it could still serve the purpose. Only 17% stated clearly that their concern about generating more waste was the reason for continued use of materials that would otherwise have been discarded. This is in line with other findings that note that for low income people, involvement in sustainable waste practices is usually economically motivated, while for higher income people the majority do so due to their sense of social responsibility in the community [17].

4. CONCLUSIONS AND RECOMMENDATIONS

Waste practices in the study were not environmentally sustainable for instance open dumping which was fairly common outside the university. In this regard, there is a need for promotion of environmental awareness to enhance reuse and recycling, discourage open dumping and promote better methods of disposal and management of disposal areas. This can be done by encouraging the use of waste pits rather than open dumping, fencing of disposal areas to prevent spreading of waste by wind, composting of waste and separation of hazardous waste like electronic waste from the general waste.

There was no organised waste management in the community around the university. Therefore, a community approach to waste management should be encouraged. This can be achieved by promoting the formation of waste collection and

recycling groups, the formation of the waste management committee to come up with a guideline on waste management in the area and community policing on waste management.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Mbiba B. Urban solid waste characteristics and household appetite for separation at source in Eastern and Southern Africa. *Habitat International*, 2014;43:152-162.
2. United Nations Environment Programme. Selection, Design and Implementation of Economic Instruments in the Solid Waste Management Sector in Kenya: The Case of Plastic Bags; 2005. Available:www.unep.ch/etb/publications/EconInst/Kenya.pdf on 24.09.16
3. Rotich KH, Zhao Y, Dong J. Municipal solid waste management challenges in developing countries – Kenyan case study. *Waste Management*, 2006;26:92–100.
4. National Environment Management Authority, Kenya. The National Solid Waste Management Strategy. NEMA: Nairobi; 2014.
5. Guerrero LA, Maas G, Hogland W. Solid waste management challenges for cities in developing countries. *Waste Management*. 2013;33:220–232.
6. Oteng-Ababio M, Arguello JEM, Gabbay, O. Solid waste management in African cities: Sorting the facts from the fads in Accra, Ghana. *Habitat International*. 2013;39:96-104.
7. Oteng-Ababio M. Missing links in solid waste management in the Greater Accra Metropolitan Area in Ghana. *Geo Journal*. 2011;76:551–560. DOI:10.1007/s10708-010-9363-9
8. Sanneh ES, Hu AH, Chang YM, Sanyang E. Introduction of a recycling system for sustainable municipal solid waste management: a case study on the greater Banjul area of the Gambia. *Environ Dev Sustain*. 2011;13:1065–1080. DOI: 10.1007/s10668-011-9305-9
9. Republic of Kenya. Nakuru District Development Plan, Government Printer, Nairobi; 2000.
10. Kenya National Bureau of Statistics. Population Statistics for Nakuru District. Nakuru Office: Nakuru, Kenya; 2007.
11. Kathuri NJ, Pals DA. Introduction to educational research. Educational Media Centre: Egerton University, Njoro, Kenya; 1993.
12. Kariuki JM, Moturi WN, Shivoga WA, Kingori IW, Kilonzi CM. Demand for, awareness on and constraints to proper solid waste management in Njoro Division, Nakuru, Kenya. *Journal of Scientific Research & Reports*. 2016;11(2):1-10. Article no. JSRR.25844. ISSN: 2320-0227
13. Babaei AA, Alavia N, Goudarzia G, Teymouric P, Ahmadi K, Rafieef K. Household recycling knowledge, attitudes and practices towards solid waste management. *Resources, Conservation and Recycling*. 2015;102:94–100.
14. Palczynski. Study on solid waste management options for africa. african development bank. Sustainable Development & Poverty Reduction Unit: Abdijan, Côte de Ivoire; 2002.
15. Wilson DC, Araba AO, Chinwah K, Cheeseman CR. Building recycling rates through the informal sector. *Waste Management*. 2009;29(2):629-635.
16. Dhokhikah Y, Trihadiningrum Y, Sunaryo S. Community participation in household solid waste reduction in Surabaya, Indonesia. *Resources, Conservation and Recycling*. 2015;102:153–162.
17. Permana AS, Towolioe S, Aziz NA, Ho CS. Sustainable solid waste management practices and perceived cleanliness in a low-income city. *Habitat International*. 2015;49: 97-205.

© 2018 Kariuki et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:

The peer review history for this paper can be accessed here:
<http://www.sciencedomain.org/review-history/25507>