Household Waste Management in Lubumbashi, Democratic Republic of Congo

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Abstract

Introduction: Household waste management is a multidimensional challenge faced by urban authorities, especially in developing countries like the Democratic Republic of Congo (DRC). This study aims to describe the socio-demographic characteristics of the respondents as well as the management of household waste in the municipality of Katuba in Lubumbashi, DRC.

Methods: This is a cross-sectional descriptive study. We conducted a survey with cluster survey of households in the municipality of Katuba during the period from April 1st to May 31st, 2019.

Results: A total of 152 households were surveyed. The mean age of the respondents was 35.4 ± 13.2 years (range: 18 and 79) and 42.8% of them were between 20 and 30 years of age. One hundred and thirty-two (86.8%) respondents were female. The use of bins was present in 82.2% of households. Waste sorting was practiced by 11.2% of the households; waste recovery was insufficiently practiced (3.9%). Household waste was transported by rickshaws (small carts) in 94.1% of cases and waste disposal was done once a week in 73.7% of cases. Sixty-seven point one percent of the respondents were aware of the dangers due to the presence of waste.

Conclusion: Sorting and disposing of household waste poses real problems in Katuba municipality. However, people are aware of the dangers associated with waste. Better involvement of city councilors in the management of household waste would be a solution.

Keywords: Household waste; Management; Lubumbashi

Introduction

Waste management is the organized and systematic channeling of waste through the channels to ensure that it is disposed of with attention to acceptable guarantees of public health and environment [1]. However, adequate management cannot be achieved without a well-designed waste management plan. According to Rossel and Jorge, waste management planning strategies should advocate the avoidance of waste generation, the use of cleaner technologies, the promotion of recycling and recovery of waste, using an appropriate treatment for waste generated and proper disposal of the waste [1,2]. The challenge of managing household waste has become a priority for governments around the world. Globally, there is a growing awareness of environmental planning and management as the growing population and accelerated urbanization have led to an increase in the generation of household waste [1]. Some developed countries, such as Germany, United States and Japan, have successfully managed waste. There is a shift from a landfill-based waste management system to a more integrated system. Integrated waste management is considered to be the key to the success of household waste treatment [3,4]. Waste separation is an essential component of an integrated waste management system [5]. Although progress has been made on the separation of global waste sources, there is still a large gap in the reduction and recycling of household waste compared to many developed countries. Several major factors limited the practical application of the established systems: (i) the sorting method was not well defined and the residents were easily confused by general concepts such as recyclable and non-recyclable materials, combustible and non- combustible materials; (ii) recovery became difficult once recyclable materials were mixed with high water content waste; and (iii) there was a lack of compatible facilities for the treatment of separate waste [4]. In many cities (with rapidly growing) in developing countries, the treatment

of household waste has become a key political issue. Policies and regulations aimed at good waste management, ranging from specific waste control at household level to integrated waste reduction efforts in municipalities and across the economy, have been implemented with mixed results [6]. Good solid waste management involves the sequential hierarchy of source reduction, reuse, recycling and safe disposal [7]. It would be impossible to understand and manage waste effectively if management does not take into account the generation of waste. In order to maintain good waste management, we need not only precise data on the generation of waste, but also information on people's behavior and attitude towards household waste [8]. Efforts to reduce household waste at source and through various techniques such as recycling, reuse and composting determine the optimal waste management scheme [6]. It is stressed that environmental damage does not only result from the amount of waste generated (from consumption and production), but also from the way in which waste is disposed of [6]. Unlike developed countries, dumping in open areas, roads and valleys has been widely used in many cities in developing countries. Many studies have looked for the determinants of various behaviors and attributes on household waste recycling practices [9-11]. However, there is a gap in the literature on the factors responsible for disposing of solid waste from households, especially in cities in developing countries. Although all these studies focus on the behavior of recycling, this study highlights the behavior of households according to the choice of alternative methods of waste disposal. Although an understanding of economic and social behavior of households is essential to improve the management of solid household waste, these studies in the Democratic Republic of Congo (DRC) are not available. Empirical studies on the impact of the economic and social status of households and the attributes of household waste and environmental concerns on solid waste disposal practices are needed to improve solid waste management at the household level in the DRC in general and in Lubumbashi city in particular where the issue of environmental management is relevant. One of the biggest challenges facing urban authorities is the collection of household waste. These difficulties are reflected in an accumulation of household waste, creation of many wild dumps, stagnation of wastewater and rainwater in many neighborhoods and lack of strategic awareness of the population. Katuba municipality, the largest in Lubumbashi city, is not spared from this situation. Like all other municipalities, Katuba has experienced a population explosion in recent decades. Currently, according to estimates from the municipal statistical office, this municipality has about 319,274 inhabitants. In the DRC, waste management in general and that of household waste in particular represents a major and crucial problem. In addition, the absence of functional structures for the collection and disposal of household waste in the municipality leads to uncontrolled and uncontrolled dumping in streets and in watercourses of Katuba neighborhoods. This study aims to describe socio-demographic characteristics of the respondents as well as to describe the management of household waste in the municipality of Katuba in Lubumbashi (in DRC) as to identify the problems and future prospects.

Materials and Methods

Study setting

Katuba municipality is located in Haut-Katanga Province in the Democratic Republic of Congo and more precisely in the city of Lubumbashi. This municipality (the largest in the city of Lubumbashi) has experienced a population explosion in recent decades. Currently,

according to estimates from the municipal statistical office, the municipality has about 319,274 inhabitants. The municipality of Katuba is limited: To the north by the Lubumbashi river, to the east by the Katuba river and the Lubumbashi river, to the south by the Katuba river and to the west by the Katuba river.

Study design

We conducted a cross-sectional descriptive study from April 1st to May 31st, 2017. It concerned households in Katuba municipality, where a convenience sample was drawn. We selected households, within which adults were interviewed. Avenues were considered to be clusters. The selection of these avenues was done by simple random, using sketches of the municipality for identification. These households were selected because of 10 households per avenue and 17 avenues throughout the municipality. A total of 170 households had been interviewed, of which 18 had refused to answer the questionnaires, which corresponds to a response rate of 89.4%. Thanks to a pretested and validated questionnaire, we had collected data by interview. A team of 10 interviewers was recruited and trained before going down to the households in order to administer the questionnaire which consisted of the following parts: Socio-demographic characteristics of the respondents (age, sex, level of education, occupation), related parameters with household waste management (use of waste bins, waste storage method, waste reusing/recycling, waste dumping, waste transportation, rate of evacuation, recovery), knowledge of dangers due to the presence of waste as well as proposals of the respondents concerning waste management (payment method for waste collection costs, sale of recyclable waste, waste separation method).

Data collection

For our data collection, different techniques were used including documentary analysis, free observation and structured interview. Field visits made it possible to have a general overview of the state of unsanitary conditions in our study environment, to observe the living environment of populations in order to immerse ourselves in the realities of daily life in Katuba municipality. Surveys and interviews carried out made it possible to deepen the research and provide elements of answers to certain questions related to the management of household waste. This method made it possible to collect information from population. To do this, we used a questionnaire on the management of household waste. The questionnaire survey targeted heads of households, but the choice was made for those who do housework. The choice of households was random.

Data analysis

The study focused on a sample of 152 households. The data entry and processing were done on Epi Info version 7.2 software. Analysis and interpretation used the calculation of proportion, mean and standard deviation.

Results

Table 1 shows socio-demographic characteristics of the respondents. 132 (86.8%) respondents were female. The mean age was 35.4 ± 13.2 years (range: 18 and 79 years) and 42.8% of the respondents were between 20 and 30 years of age. 62.2% of the respondents had a secondary education level, 18.4% had a primary school certificate and 15.8% were university graduates. 65.7% of the respondents were unemployed and 21.7% were merchants. Table 2 shows parameters related to waste management. 82.2% (125/152) of the respondents said they use trash cans of various kinds (bucket, bag) to store their solid household waste. Regarding the storage mode, 88.8% of

Table 1: Socio-demographic characteristics of the respondents.

Variable	Number (n=152)	Percentage
Age		
<20 years	8	5.3
20-30 years	65	42.8
30-50 years	60	39.5
>50 years	19	12.5
Sex		
Female	132	86.8
Male	20	13.2
Education level		
None	5	3.3
Primary	28	18.4
Secondary	95	62.5
Higher	24	15.8
Occupation		
Unemployed	100	65.7
Employee	19	12.5
Merchant	33	21.8

Table 2: Parameters related to household waste management.

Variable	Number (n=152)	Percentage
Use of waste bins		
Yes	125	82.2
No	27	17.8
Waste storage method		
Waste sorting	17	11.2
Waste mix	135	88.8
Waste reusing/recycling		
No	146	96.1
Yes	6	3.9
Waste dumping		
Discharge	78	51.3
Incineration	42	27.6
Waste landfill	32	21.1
Waste transportation		
Rickshaw	143	94.1
Minivan	6	3.9
Wheel barrow	3	2
Rate of waste collection		
Once a day	16	10.5
Once a week	112	73.7
Twice a week	14	9.3
Three times per week	10	6.5

respondents mixed garbage and only 11.2% sorted waste by separating biodegradable from non-biodegradable. Nearly 4% of the households recycle their household waste; some used kitchen debris as a source of food for poultry and pigs, and a small minority used waste to control erosion and flooding. In contrast, 96.1% of households did not give a value to their household waste. 27.6% of the households disposed of

Table 3: Knowledge of dangers due to the presence of waste and proposals of the respondents regarding waste management.

Variable	Number (n=152)	Percentage
Dangers due to the presence of waste		
Known	102	67.1
Unknown	50	32.9
Method of payment for waste collection costs		
With water and electricity costs	36	23.7
Individually	115	75.6
Other	1	0.7
Sale of recyclable waste		
Never	130	85.5
Some times	18	11.8
Often	4	2.6
Waste separation method		
Food waste, dry and harmful	56	36.8
Recyclable *vs.* non-recyclable	55	36.2
Recyclable, harmful and other wastes	41	27

their waste by incineration, 21.1% by landfill and 51.3% by discharge which was the most common method of disposal for households in Katuba municipality. 143 (81.6%) respondents said that they used the rickshaw (small local carts) to collect waste, 6 (3.9%) used a pickup truck (minivan) and 2% used their wheelbarrow to dispose of the waste. As for the rate of waste disposal, 73.7% of the respondents said they dispose of waste only once a week and 10.5% said they do it every day. 102 (67.1%) respondents declared that they were aware of the dangers due to the presence of waste in environments such as diseases such as cholera, typhoid fever and gastroenteritis (Table 3). 75.6% (115/152) of the respondents said that individual payment method (that is, each one deals with waste management individually) is the most reasonable way to collect the money, and 23.7% said they would be better off collecting the money along with the costs of water and electricity. 130 (85.5%) respondents said that they never preferred to sell recyclable materials to collectors.

Discussion

Socio-demographic characteristics of the respondents

The majority of the respondents in our study are women (86.8%). The 20 to 30 years age group was dominant (42.8%) and the mean age was 35.4 ± 13.2 years (range: 18 and 79 years). 62.5% of the respondents have attained secondary education level. 21.7% were merchants and 16.4% were employees. Sujauddin et al. [12], in his survey on the management of household waste in Chittagong (Bangladesh), found a mean age of the respondents of 43.14 years and that their education level was on average the secondary level. He also noted that almost 56% of the respondents were tenants [12]. In our study, 15.8% of respondents were of university level. A study in Colombo (Sri Lanka) showed that 36% of the respondents had a university education level [13]. Xiao et al. [14], in their survey carried out in the city of Xiamen (China), noted that about half of the respondents (51%) were women, 77.7% of the respondents were between 25 and 60 years old and 70.2% had completed more than 9 years of study. In Surabaya (Indonesia), Dhokhikah et al. [15], found that 67.3% of the respondents were female, 70% were between 35 and 65 years old and 39% had a university level.

Parameters related to waste management

The study shows that only 11.2% of the respondents practiced sorting or separation of waste. This rate was 53.5% in Xiao's study [14]. According to Hu et al. [3], integrated waste management is considered to be the key to the success of household waste treatment. Waste separation is an essential component of an integrated waste management system [5]. Waste separation increases the quality of compost and recyclable materials, and optimizes incineration [4,16]. Warunasinghe's study found that combustion (44%), composting (16%) and incineration (10%) were the methods of disposing of household waste [13]. In Goudiry (Senegal), waste sorting was carried out by 30% of households, with predominant manual separation (54.2%) [17]. Recycling waste can help eliminate and minimize it [1]. Our study reports that the recovery of household waste was only known and practiced by 3.9% of the respondents. According to Kofoworola, putrescible waste can be transformed into organic fertilizer or soil conditioners by composting [1]. This is an option that should be promoted in any municipal government solid waste management program. The use of landfills as a method of waste management is widely practiced around the world. But our study shows that only 21.1% of the respondents used landfill. In addition, with regard to waste dumping, it is possible to minimize waste thanks to the practice of incineration [1]. Incineration is practiced by 27.6% of our respondents. In Goudiry (Senegal), the most used disposal procedures were display in vacant lots (40.2%), the use of relay depots (21.2%) and rejection behind the palisades (18.1%) [17]. According to the respondents, the municipality of Katuba does not have a solid waste collection service from households. This finding is contrary to that noted by Tadesse in Mekelle (Ethiopia) who found that the municipality is responsible for collecting and transporting solid waste to open landfill sites [7,18]. This service for the collection of solid waste from households by the municipality of Mekelle is mainly carried out using two main methods: Door-to-door collection services by tractor-trailers and collection services using common containers at fixed points [7,18]. There are a few informal waste collectors whose participation in the collection and disposal of waste remains very limited and conditioned on the payment of fees. Waste disposal is carried out by rickshaws (paid, private and informal) in 92.8% according to the respondents. Although the boom in population of the municipality experienced an excessive increase in solid waste, the waste management system remains largely traditional and with an acute shortage of human capital and material for the management of household waste [1]. We noted in our series that rickshaws (small and locally made carts) were the primary means of transportation, collection and disposal of waste (94.1%) to dispose of waste; the van and the wheelbarrow were used respectively by 3.9 and 2.0% of the respondents. In Faye's study, household waste was transported by manual traction in 74.1% and by animal traction in 6.4% [17]. Although 78.3% of respondents said that they dispose of waste in a dump, we find that other households have no choice but to dump their waste on the ground, on the edges of the streets and in open areas (ravines). Tadesse, in his study, had found that despite the fact that there are containers available from the municipality in the city of Mekelle, households continued to dump their waste in the open areas and on the roadsides around the containers [7]. Although 78.3% of the respondents said they dispose of waste in a dump, we find that other households dump their waste on the ground, on the edges of streets and in open areas (ravines). Tadesse et al. [7] had found that despite the fact that there are containers available from the municipality in Mekelle, households continued to dump their waste in the open areas and on the roadsides around the containers. In Lagos (Nigeria), facilities for waste collection and management are absent or grossly insufficient [1]. The effect of this is that most people dump their household waste in the streets, around street poles and next to embankments along the roads [1]. Consequently, disfigured landscapes, air pollution and partially obstructed roads are observed. To strengthen waste management in the municipality of Mekelle, Tadesse et al. [7,18] noted that there is a tractor-trailer system where members of the van crew unload the waste from bins and household containers into the trailers. Despite these two systems, they points out that these solid waste collection services are irregular and poor [7,18]. This observation has been made in several developing countries as noted in an analysis of the literature on the management of household waste made by Guerrero et al. [19].

Conclusion

This study on management of household waste has shown that no specific system for classification, collection, recycling or disposal of household waste has been established in the municipality of Katuba. Residents of this municipality resort to street dumping or incineration. Sorting and disposing of household waste poses real problems in our setting. However, people are aware of the dangers associated with waste. Better involvement of municipality councilors in the management of household waste would be a solution.

References

1. Kofoworola OF. Recovery and recycling practices in municipal solid waste management in Lagos, Nigeria. Waste Manag. 2007;27(9):1139-43.

2. Rossel SA, Jorge MF. Cuban strategy for management and control of waste. In: Barrage A, Edelmann X, editors. Recovery, Recycling, Re-integration (R'99) World Congress. Switzerland: EMPA. 1999;287-90.

3. Hu D, Wang R, Yan JS, Xu C, Wang Y. A pilot ecological engineering project for municipal solid waste reduction, disinfection, regeneration and industrialization in Guanghan City, China. Ecological Engineering. 1998;11:129-38.

4. Zhuang Y, Wu SW, Wang YL, Wu WX, Chen YX. Source separation of household waste: A case study in China. Waste Manag. 2008;28(10):2022-30.

5. McDougall F, White P, Franke M, Hindle P. Integrated solid waste management: A life cycle inventory. London: Blackwell Science. 2001.

6. Choe C, Fraser I. An economic analysis of household waste management. J Environ Econ Manag. 1999;38(2):234-46.

7. Tadesse T, Ruijs A, Hagos F. Household waste disposal in Mekelle city, Northern Ethiopia. Waste Manag. 2008;28(10):2003-12.

8. Bisson K. Attitudes to waste. In: Bisson K, Proops J, editors. Waste in ecological economics, 2000. United Kingdom: Edward Elgar, Cheltenham; 2002;56-97.

9. Anwar AF, Koushki PA, Hamoda MF. Public opinion and siting solid waste landfills in Kuwait. Resources, Conservation and Recycling. 2002;35(4):215-27.

10. Ebreo A, Vining J. How similar are recycling and waste reduction? Future orientation and reasons for reducing waste as predictors of self-reported behavior. Environ Behav. 2001;33:424-48.

11. Li S. Recycling behavior under China's social and economic transition: The case of Metropolitan Wuhan. Environ Behav. 2003;35(6):784-801.

12. Sujauddin M, Huda SMS, Hoque AR. Household solid waste characteristics and management in Chittagong, Bangladesh. Waste Manag. 2008;28(9):1688-95.

13. Warunasinghe WAI, Yapa PI. A survey on household Solid Waste Management (SWM) with special reference to a peri-urban area (Kottawa) in Colombo. Procedia Food Sci. 2016;6:257-60.

14. Xiao L, Zhang G, Zhu Y, Lin T. Promoting public participation in household waste management: A survey based method and case study in Xiamen city, China. J Cleaner Prod. 2017;144:313-22.

15. Dhokhikah Y, Trihadiningrum Y, Sunaryo S. Community participation in household solid waste reduction in Surabaya, Indonesia. Resources, Conservation and Recycling. 2015;102:153-62.

16. He DW, Chai LY, Zhang CF. Implementation of municipal solid waste sorted collection in Chinese cities. Urban Environment and Urban Ecology. 2003;16:62-4.

17. Faye A, Badji F, Tal-Dia A, Fall IS. Évaluation de la gestion des ordures ménagères dans le district sanitaire de Goudiry (Sénégal). Revue d'Épidémiologie et de Santé Publique. 2005;53(4):464-532.

18. Tadesse T. Environmental concern and its implication to household waste separation and disposal: Evidence from Mekelle, Ethiopia. Resources, Conservation and Recycling. 2009;53(4):183-91.

19. Guerrero LA, Maas G, Hogland W. Solid waste management challenges for cities in developing countries. Waste Manag. 2013;33(1):220-32.