



Market Town Household Solid Waste Management: A Case Study of Embu, Kenya

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ABSTRACT: Household solid waste management directly impacts human health and the environment. Globally, increasing quantities and complexity of household solid waste has become a menace in many market towns. The aim of this study was to establish the status of household solid waste management in the market town of Embu in Kenya. The objectives were to identify the methods used by households to manage solid waste and to establish the factors that influenced the households' choice of solid waste management method. A survey design was deployed and questionnaires were used in data collection. Data analysis was done using the Statistical Package for Social Sciences software. 37% of the households discarded their solid waste in open places, 32% burnt and 24% recycled it. About 8% households reused the solid waste. Employment, education and access to waste collection services were the major factors influencing household solid waste management strategy. Sustainability of household solid waste management depended on awareness on health and environmental benefits of improved household solid waste management, reduction in household solid waste generation and establishment of a household solid waste management policy for Embu market Town. It was concluded that the current practices for household solid waste management are inadequate. High level of unemployment and low education level hinder proper household solid waste management. Awareness on the health and environmental benefits and policy could improve household waste management in the market town.

DOI: <https://dx.doi.org/10.4314/jasem.v24i1.15>

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Dates: Received: 30 November 2019; Revised: 20 December 2019; Accepted: 23 December 2019

Keywords: Recycling, Solid waste, Environmental impact, Sustainability

Solid wastes are unwanted by products of human activities whose management directly impacts human and environmental health (Leton and Omotosho, 2004). Growing quantities of complex solid waste are discarded globally (Vergara and Tchobanoglous, 2012). The problem of household solid waste management is worse in small market towns compared to large metropolis largely due to unavailability of commercial service providers (Adzawla *et al.*, 2019). Thus a serious challenge to authorities managing waste as low income countries rapidly urbanize (Adzawla *et al.*, 2019).

Market towns produce varying quantities of wastes ranging from 5.4 Mega Tonne day⁻¹ in Sojitra, India (Pamnani, 2015); 15 Mega Tonne day⁻¹ in Gampola, Sri Lanka (Wijerathna *et al.*, 2013); 24 Mega Tonne day⁻¹ in Rangpur, Bangladesh, (Rakib *et al.*, 2014); 42 Mega Tonne day⁻¹ in Bawku, Ghana (Douti *et al.*, 2017); 59 Mega Tonne day⁻¹ in Chiapas, Mexico (Aguilar *et al.*, 2017) and 88 Mega Tonne day⁻¹ in Jimma, Ethiopia (Getahun *et al.*, 2012). The quantities produced are determined by the population, urbanization level and lifestyles. These wastes are related to negative environmental impacts such as

clogging drains, increased soil erosion, soil and water pollution and negative human health effects.

Effective solid waste management techniques depend on local waste attributes. Waste attributes differ with socioeconomic, climatic and cultural variables as well as institutional capacities (Vergara and Tchobanoglous 2012). Unsustainable solid waste management methods are used in most market towns. For instance, open dumping and burning in Ongata Rongai, Kenya (Gitau, 2018) and Grahamston, South Africa (Godfrey and Oelofse, 2017); open dumping in Manzini Swaziland (Abul 2010) and Borama in Somalia (Abdirahman, 2015) and landfilling in Chandigarh, India (Rana *et al.*, 2015). These unsustainable methods contribute to soil, water and air pollution (Modak *et al.*, 2010). Sustainable waste management strategies include waste reduction, recycling, recovery or treatment (Seadon, 2010). Examples include composting in Juja Kenya (Mwangi *et al.*, 2017).

Most market towns such as Embu are characterized by high population growth rate resulting in increased generation of household solid waste. These include

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Jimma in Ethiopia (Aguilar *et al.*, 2017); Lamu, Kenya (Monyoncho, 2013); Minna, Nigeria (Adeoye *et al.*, 2016); Paradeep, India (Patra and Harichandan, 2015) and Illam, Nepal (Rai *et al.*, 2019) with annual population growth rates ranging from 1.4% to 3.9%. The aim of the present study was to establish the status of household solid waste management in the market town of Embu. The objectives were to identify the methods used by households to manage the solid waste and the factors influencing the choice of methods.

MATERIALS AND METHODS

Study Area: The study was done in Embu market town in Kenya. The town is located 120 km Northeast of Nairobi and on the South Eastern slope of Mount Kenya. The town receives an average annual rainfall of 1120 mm and average temperatures of 20.2° C. Population of Embu Town is 41,092 (Kenya National Bureau of Statistics, 2018).

Study Design: The survey design (Ponto, 2015) with stratified random sampling procedure was used to select households and in data analysis. The sample population was calculated using Equation 1 (Yamane, 1967).

$$n = N/1 + N(e)^2$$

Where; N = Population size, n = Sample size,

$$e = \text{Error rate (0.05)}$$

An initial sample size of 400 was determined. However, due to financial constraints, 60 respondents were selected. However, only 40 respondents responded thus giving a response rate of 67%. This return rate was acceptable being above the 60% return rate recommended by Amin, (2005) for analysis and reporting. Data was collected using a questionnaire comprising open and closed-ended questions.

Data Analysis: Responses in the questionnaire were assigned numerical values. Coding, entering and data analysis was done using IBM SPSS Statistics for Windows (IBM Corp, 2017).

RESULTS AND DISCUSSIONS

Methods used by households in Embu town to manage the solid waste: Solid waste in Embu town was managed as shown in Figure 1. About 37% of the households discarded their solid waste in open places, 32% burnt and 24% recycled it. About 8% households reused the solid waste. Burning and open waste disposal were the most preferred household waste management methods (Figure 1). These methods were common in households in areas where waste collection

by the County government of Embu was inaccessible or poor. Some of the areas had steep slopes limiting access of waste collection trucks. However, these methods are ineffective posing health and environmental hazards due to air, water and soil pollution (Kalesanwo *et al.*, 2013). For instance, burning wastes results in air pollution from smoke.

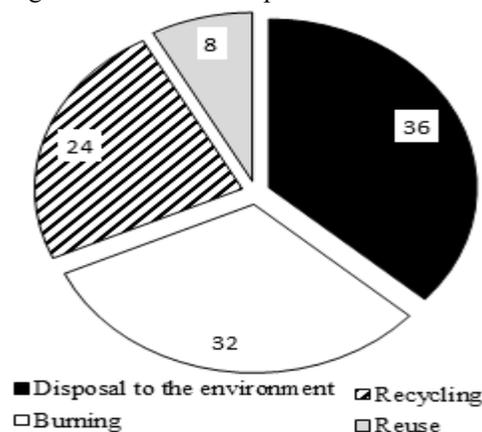


Fig 1. Solid waste management in Embu Town

Market towns have similar challenges of increased waste generation, overflowing dumpsites and pollution from inappropriate waste disposal (Sibanda *et al.*, 2017). Sustainable solid waste management is limited by inadequate funding and the poor attitude of the residents (Kalesanwo *et al.*, 2013). For example, in Gondar, Ethiopia, the municipality provides, waste disposal, transport and disposal services (Gedefaw, 2015). However, the services are not in pace with waste generation resulting in open dumping (Yoda *et al.*, 2014).

In the present study, late collection of waste led to scattering by wind, scavengers or children. In addition, lack of education on the dangers posed by improper solid waste disposal was responsible for respondents choosing ineffective disposal methods. This concurs with Fagariba and Song (2016) who reported ignorance and lack of basic education contributing to improper waste disposal. Similarly, in Ghana, poor education contributed to indiscriminate dumping resulting in flooding during the rainy season as the waste caused blockage of the major storm drains (Adeolu and Adeolu, 2014). Open burning and dumping were attributed to low education in Ibadan, Nigeria (Fredrick and Sentogo, 2018).

Factors influencing the choice of method used by households to manage solid waste: In the current study, education and income characteristics were the main factors influencing the households' choice of solid waste management method. Fifty percent of the

respondents had attained secondary school and 23% had primary school education. Twenty seven percent had attained tertiary education. The higher the education level of the respondents, the more insight they had regarding waste management. Income characteristics namely level and consistency determined the household's choice of waste management method. Fifty five percent of the respondents were casuals with low but regular income. Thirty eight percent were self-employed with irregular level and frequency of income. Permanently employed respondents were 7.5% and had relatively higher regular income. The respondents with a regular income could engage waste collection services either from the Embu County or from private waste collectors. Those on casual employment didn't prioritize waste collection services. Therefore, higher regular income earners disposed their household solid waste appropriately while low irregular earners disposed wastes indiscriminately in the open spaces.

Education administers knowledge, changes attitude as well as promotes skills development to transform societies in resource management, including waste management (Hoang and Kato, 2016). In the present study, education was a key factor in determining people's awareness of waste management with the more learned respondents being more knowledgeable on and employing sustainable waste management options. The findings concur with Zen *et al.* (2014), who found education an important factor in increasing environmental knowledge through methods such as reuse and recycling. Similarly Boateng *et al.* (2016) also found households with high education having a deeper understanding and adoption of sustainable waste management and recycling. These findings agree with those of Vassanadumrongdee and Kittipongvises (2017) and Ayuba *et al.* (2013) who found income a major determinant of choice of waste management options. Besides the level of income, the present study found that regular income encouraged respondents to contract solid waste collection and disposal services.

The present study also found that access to waste collection services determined the household's choice of waste management. Half the respondents had access to waste collection services. Inaccessibility of waste collection services led to poor waste management such as open dumping (Figure 1), open burning, and disposal to the environment. The situation in Embu compares to that of similar market towns such as Bawku in Ghana (Douti *et al.*, 2017) and Tha Khon Yang Municipality in Thailand, where irregularity in waste collection resulted in huge waste piles (Yukalang *et al.*, 2017).

Half the respondents in Embu town did not know any waste collectors. The other half who accessed the waste collection service only obtained the services once per week. This is similar to the situation in Nairobi city (Njoroge and Ndunge 2014) and KwaZulu-Natal, South Africa (Dlamini *et al.*, 2017). Similarly in India, waste collection services are ineffective due to insufficient budgets for municipal authorities responsible for solid waste management (Kumar *et al.*, 2017). A similar case was also reported in Sucre Municipality, Venezuela where solid waste collection is limited by inaccessible hilly areas, leading to overflow of garbage resulting in unsanitary conditions (Ramos and Ortega, 2012).

In the current study, households who could not access the services of waste collectors disposed wastes in different ways (Figure 1). The results of the present study agree with those of other authors. For instance, in Ngomongo Village of Korogocho informal settlement of Nairobi County, households without access to waste collection services dispose their waste by roadside dumping, burning and burying (Ochieng, 2016). A study by Fagariba and Song (2016) also found that in urban Accra, only 61% of households had access to waste collection services, the remaining 39% did not have access to waste collection services and dumped their wastes in bushes, holes, streets and gutters. Similarly, in Indian urban areas, waste collection is a challenge resulting in open dumping, which creates environmental and health hazards (Agarwal *et al.*, 2015).

Conclusion: The study concludes that waste is improperly managed in Embu town. For effective waste management in Embu Town, public awareness, waste minimization as well as the implementation of sustainable waste management strategies should be provided. This can effectively be provided by the County government of Embu that is responsible for this function. This provides an opportunity to conduct and implement research findings on sustainable waste management technologies.

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