

People's Awareness And Practice On Technologies For Sustainable Solid Waste Management In Mbeya City, Tanzania

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Abstract: *This study examined the awareness people have on sustainable technologies for solid waste management, and whether some do dare to incorporate the knowledge they have in the management the waste just at the source. A sample of 103 households from six selected wards in Mbeya city was made where as one respondent from each household was involved in the study. The author used questionnaire to collect information from the respondents. The findings revealed that majority of the respondents do not sort the solid waste they generate as they are also not using any technology like composting for sustainable management of waste. Though most of the respondents (92.2%) were aware of the composting technology, they lack an in-depth knowledge about the technicalities for composting. Thus, none of them have ever used it in managing the waste, despite of their high interest to use the compost fertilizer. Public perception on solid waste management system is characterized with irregularity and inefficient collection system which make most of respondents (88.3%) in the city dissatisfied. It was therefore found that despite of many people being aware of composting technology, they lack an in-depth knowledge on the technicalities for composting organic solid waste. However, they are highly interested to use the organic fertilizer produced from the organic materials. Sensitization of Mbeya city residents on the sorting and composting should be done to achieve the goal of sustainable waste management and create employment opportunities for youths.*

1.0 Introduction

Solid waste management can be defined as a discipline associated with control of generation, storage, collection, transfer, processing and disposal of municipal solid waste in a way governed by the best principles of public health, economics, engineering, aesthetics and other

environmental considerations (Daskalopoulos, 1999, and Mlozi, 2011).

Solid waste management is one of the critical problems in most of the cities in developing countries. The problem is aggravated by urbanization which is on the rise in Africa. The crisis is expected to continue in the future if not intervened as the rate of waste generation keep on increasing in line with the population expansion (UNH, 2010). Of great concern is the inability of infrastructure and lack of facilities to cope with the rate of solid waste generation. In developing countries studies show that, one to two thirds of the solid waste generated in most urban areas is not collected as a result of poor infrastructure (Zurbrugg, 2003; Sinha and Enayetullah, 2000a). Hence, individual/group knowledge towards solid waste generation and disposal is critical in the effort to address the current solid waste management challenges in Mbeya city.

Mbeya city is one of the rapidly growing cities in Tanzania, whose population is about 2,707,410 with the annual growth rate of 2.7% (URT, 2012). Increase in population size not only put pressure on resource use, but also make the sanitation system complex. The complexity in sanitation attributed by poor collection systems and infrastructure, and inadequate hauling facilities, the situation which leads to the accumulation of large heaps of municipal solid waste in the designated secondary collection points of the city (Sharholly et al., 2007). Solid waste management (SWM) which covers production, storage, collection, transportation and final treatment or disposal it is a major problem in many urban areas (Mbuligwe, 2005; Okot-Okumu & Nyenje 2011) Mbeya city being a case. Mounting heaps of refuse on major roads and highways reduce the public confidence on the ability of the city council to successfully manage the solid waste. According to MCC (2008/9) annual report shows that the solid waste generated daily was about 167 tons and the generation rate

per person per day is 0.5kg (Gidde et al., 2008) where as the population size was about 337,109 people. Out of the total amount generated only 74tons equivalent to 44.3% was collected and disposed per day (Mlozi, 2011). Such low achievement was attributed by inadequacy of facilities, as there were only 2 skip-masters, where as, only one was operational. In additional to that, there were four (4) side-loaders and two (2) tippers (MCC, 2009).

This situation calls for the requisite to integrate various methods in the solid waste management so as to reduce the amount of waste to be transported for the final disposal. The main technological options available for treatment and disposal of MSW are composting, vermicomposting, anaerobic digestion, incineration, gasification and pyrolysis, plasma pyrolysis, production of Refuse Derived Fuel (RDF), also known as pelletization and sanitary landfilling or landfill gas recovery (Asnani, 2006). Not all the identified technologies can be equally applied every where. The suitability of the technology at a place depends on a number of factors (Asnani, 2006) such as origin and quality of waste, toxic content in waste, marketability of the resource from the waste like compost fertilize, the investment cost needed and the practicability of the selected of the technology. Moreover, among other factors which can influence the applicability of the technology to a place will not only depend on the level of knowledge and skills a community has, but also the attitude of the towards developing environmentally friendly community waste behavior (Ehrampoush and Moghadam, 2005).

The solid waste generated in Mbeya City, about 57% composed of organic materials from daily food remains, the fruits peels, vegetables, grasses and plant trimmings from gardens (Mgimba and Sanga, 2016). This indicates the potentiality of the solid waste being managed through composting and resource recovery technology as strategies to reduce the amount of solid waste to be transported for the final disposal. Also, it will initiate organic agricultural production through the use of organic fertilizer recovered from the solid waste through composting. Composting is a microbial based aerobic process which is now consider as an environmentally sound way to reduce organic waste in towns and produce organic fertilizer for agricultural production (Gautam et al., 2010). The technology is very suitable for organic biodegradable fraction of municipal solid waste with high content of celluloses materials (Asnani, 2006).

2.0 Methodology

2.1 Description of the Study Area

Mbeya City is situated in the south western part of Tanzania along the Tanzania Zambia (TANZAM) highway and the Tanzania Zambia Railway line (TAZARA). It is located within Mbeya District, lying between latitudes 8°50' and 8°57' South of the equator and between longitudes 33°30' and 35°35' East of the Greenwich meridian and borders. Mbeya City is the headquarters of Mbeya region and is conveniently accessible by road and railway from Dar es Salaam (830km North East). Administratively, Mbeya City is divided into two divisions namely lyunga and Sisimba which are further subdivided into 36 and 181 hamlets.

Mbeya City Council is situated at an elevated land along the slopes of Mount Mbeya ranges at an altitude rising from 1600 to 2400 meters above sea level. The city is characterized by moderate climate, with the mean annual rainfall of 1200 mm received between November–May which is accompanied with mean temperature ranging between 110C – 250C.

2.2 Data collection

To fulfill the research objectives, the researcher identified six wards basing on their location in the city. The mode of life of the people in these wards is almost identical such that demarcation of wards based on the household economic status is even more complex (Mgimba and Sanga, 2016). In assessing the level of awareness people in Mbeya city have towards the application of technologies for sustainable solid waste management, the researcher made a sample of 103 respondents. These were randomly sampled from the identified wards as shown in table 1.

Table 1: The Household Sampled

Ward	Population size in each ward	Number of Households in each ward	Household sample size in each ward
Nsalaga	18993	4522	23
Iganzo	14414	3432	17
Ilongba	34021	8100	41
Sinde	7014	1670	8
Forest	6649	1583	8
Ghana	4885	1163	6
Total	85976	20470	103

The collection of data was based on interview schedule, interviews and direct observation, which focused on the awareness of people on; household sorting of solid waste, application of compost fertilizer and recycling. The collected raw data from the field were processed and analyzed through Portable PASW Statistics Version 18 Software. The study was based on the cross-sectional research design and descriptive statistics used to depict the people's attitude towards sustainable solid waste management.

3.0 Results and Discussion

3.1 Demographic characteristics of the Respondents

Among the respondents involved in the study 58.3% were females and 41.7% were male. This shows that there was adequate representation of either gender in the population as the number of female in the whole population also exceeds that of males (URT, 2012). These findings correspond with those in a study by Kipkoech (2014) where 55.5% of the respondents were females. This might be contributed by the fact that females are the one who takes care of the family and engage in indoor economic activities while males are away from their home for various income generating activities. Moreover, in Tanzanian societies it is a responsibility of women to; prepare food, do the domestic maintenance, make home cleaning, and do laundry. Such distribution of responsibilities makes women and men have different view on solid waste management. Thus, it is important for both sex to have adequate representation in the study.

3.2 Sorting Practice of Solid waste

The management of solid waste supposed to start at the sources where the generator could reduce, reuse or reduce them before entering the solid waste management stream. Among other treatments people at household can do, is sorting of the waste into different categories. This simplifies the handling of solid waste in the whole process of their management. Compostable or recyclable wastes are to be isolated right at their source of generation. The findings revealed that 85.4% of the respondents do not sort the solid waste they generate (Table 2). This might be because of lack

of awareness on other technologies for solid waste treatment like composting or recycling which could necessity them sort the waste just at the source. Moreover, there is no any effort made by the city authority to make sure generators take responsibility of separating the solid waste before carrying to the disposal site. Waste sorting behavior among individuals influenced by education and the enforcement effort made by the authority (OECD, 2008). The residents do keep the mixed solid waste in plastic bags or containers which are then carried to the side road on the day a transfer truck passes to pick for transporting to the disposal site.

Table 2: Do you usually sort the solid waste you generate into their categories?

Response	Frequency	Percent (%)
No	88	85.4
Yes	15	14.6
Total	103	100.0

The results almost match with those obtained by Lawuo et al., (2014) in their study which revealed that about 90% of the respondents declared that they do not sort the solid waste they generate. Further more, the results in this study can be partly attributed with the education level the household members have, as no one among the respondents with primary education do sort the solid waste at the source (Table 3). Among the respondents who do sort the solid waste at their home, at least 10.68% and 3.89% of the respondents with secondary and college education level respectively. The relatively low percentage of people sorting the waste, have a direct bearing on peoples' awareness of the relevance of waste sorting, hence participating in solid waste management. This might be contrary to the findings obtained by CED (2003) which shows that 70 % of the people in India were against separation of waste at source, because it was considered inconvenient. The findings may be indicative of a strong need to increase awareness raising efforts, about the importance of sorting in Mbeya city, which has to go concurrently with introduction of technologies for sustainable management of solid waste.

Table 3: Education Level with Sorting Solid waste Behavior

Levels of Education	Response			
	No		Yes	
	Frequency	Percent (%)	Frequency	Percent (%)
Primary Education	43	48.9	0	0
Secondary Education	17	19.3	11	73.3
College Education	28	31.8	4	26.7
Total	88	100.0	15	100.0

3.3 The Solid waste Collection Method Applied in Mbeya City

The study found two methods are commonly applied in the city in solid waste collection; the block collection and dump site collection methods were identified by the respondents. Block collection method is mainly practiced in area with well accessed roads, where the waste hauling trucks passes and stops for a short time at the designated stations in the street while alerting the residents to bring the waste kept in their houses. The findings shows that in the study area, this method has been widely adopted as about 79.6% of the respondents apply it in the management of solid waste as shown in Table 4. The method if properly operated is very convenient to the public as much of the waste remain owned by the generator hence reducing massive accumulation of waste at secondary collection points in streets.

Table 4: Solid Waste Collection Method

Response	Frequency	Percent (%)
Block Collection	82	79.6
Dump site Collection	21	20.4
Total	103	100.0

3.4 Public Perception on Solid Waste Collection System

The perception of the respondents towards the current solid waste collection system was captured through the questionnaire. Though there is great appreciation by the residents on the advantages associated with the application of block collection system in solid waste management in Mbeya city, majority of them need some improvement in its operation. The study found that 88.3% respondents were dissatisfied with the way block collection system operates. Only 11.7% showed satisfaction

with the system as indicated in table 5. Beside other things, irregular time in terms of several days a transfer truck passes in streets to pick the waste from the generators was mentioned by many respondents (57.3%) as the major reason for their dissatisfaction. This situation might be aggravated by the limited availability of working facilities like vehicles for hauling the solid waste, a problem currently faced by Mbeya city (MCC, 2009). Irregularity in collection of waste from the station not only discourages the generators from being keeping the environment clean, but also disrupts the smooth waste disposal operation leading to ineffective and inefficient waste management (Karija et.al., 2013; Longe et al.,2009).

Table 5: Perception on Solid Waste Collection Method

Response	Frequency	Percent (%)
Dissatisfied	91	88.3
Satisfied	12	11.7
Total	103	100.0

3.5 Application of Compositing Technology on Solid waste Management

Large proportional of the solid waste generated in Mbeya city composed of biodegradable materials (Mgimba and Sanga, 2016). Availability of such materials, it is a great opportunity for the residents in the city to produce products like organic fertilizer. Though such opportunity has not been used so far, the findings reveal that 92.2% of the respondents were aware about compositing of organic waste and showed willingness to use the technology not only to produce organic fertilizer but also as a way of reducing the cost for transporting the solid waste to the landfill for disposal (WaterAid, 2008). The results contrast with those obtained by Sichaaza (2009) where 68%

of his respondents did not know any thing about composting: only 38% of the respondents were aware about the technology but were unable to describe it correctly. Despite of the people's willingness to incorporate composting technology in the management of the solid waste there a number of factors which obstruct them from applying. The findings in table 6 relate to various factors inhibiting the residents from using composting technology in the management of solid waste. Lack of in-depth knowledge on how composting technology can be employed, is a major constraint among the people as 64.1% of the respondents admitted.

Table 6: Obstacles towards the Use of Composting Technology by the Residents in Mbeya City

Reasons	Frequency	Percent (%)
lack of knowledge /technology	66	64.1
Lack of space for composting infrastructure	15	14.6
Lack of financial capital	19	18.4
Poor accessibility to the waste collection points	3	2.9
Total	103	100.0

The results in table 7 reveals that, majority of the respondents (57.3%) still find disposing solid waste they generate to the landfill, is more convenient at their place. This might be due to the lack of knowledge on other methods for managing the solid waste. The knowledge on the technologies has great influence on the attitude and behavior of the community towards environmental sustainability ((Ehrampoush and Moghadam, 2005; Kumar, 2013).

Table 7: The method more suitable at the study area

Response	Frequency	Percent (%)
Composting	30	29.1
Reuse	5	4.9
Recycling	9	8.7
Disposal to the landfill	59	57.3
Total	103	100.0

3.6 People's Preference to Use Compost fertilizer

Table 8 shows that, among the respondents administered with the questionnaire 97.1% have an

interest of using the organic fertilizer which could be produced from composting of organic waste, either in crop production or gardening. The findings from this study imply that there is great market opportunity for the organic fertilizer which could be produced from the organic waste. It is an open chance for people in Mbeya city to use this opportunity of producing compost fertilizer as a means of reducing solid waste for disposing to the landfill. Reliable and effective marketing mechanism is an important factor for promoting project dealing with composting (Asnani, 2006). Although space can be an important constraint for all composting and sorting or recycling projects (CED, 2003), in the study site it is less important, respondents still find some ample places at which they can use to invest in such a project.

Table 8: Would You Like to Use Compost Fertilizer?

Response	Frequency	Percent (%)
No	3	2.9
Yes	100	97.1
Total	103	100.0

The results might be related to that of the study conducted by Bhattacharjee (2012) who assessed the farmers' attitude towards compost generated from solid waste. From that study it was found that about 90% farmers used compost in their agricultural field. The fertilizer has increased their crop yield for it supports plant growth, the reason which is in line with that given by the people study area.

3.7 By-Laws for Solid waste Management in Mbeya City

The By-Laws at a respective jurisdiction seeks to promote sustainable development and environmental justice through fair and reasonable measures for the management of solid waste within the municipality's jurisdiction. They promote participation of all municipal residents in the promotion of responsible citizenship by ensuring sound waste management practices within residential and industrial environments (STLM, 2008). It is therefore imperative for the residents to be aware of the legal frame work governing all practices of solid waste management in their respective area. Findings from this study showed that 69.9% of the respondents were aware of the by-laws applied in managing the solid waste in Mbeya City.

The findings contrast with those obtained by Lawuo et al., (2014) in their study about perseverance of poor solid waste management

system in urban areas, where only 38% of the respondents were aware about their existing by-laws related solid waste management in the area. However, that awareness has some correspondence with the education level of the residents as indicated in table 9. Among those who were not aware, 90.3% have primary education while none among those with college education was unaware of the city by-laws for solid waste management. This calls for deliberate effort to be made in disseminating education about the by-laws formulated to govern the solid waste management in the city, as about 49%(women) and 50%(men) of the population in Tanzania have only primary education (URT, 2011).

Table 9: Awareness on the By-Laws for Solid waste Management in Mbeya City

Levels of Education	Response			
	No	Percent (%)	Yes	Percent (%)
Primary Education	28	90.3	15	20.8
Secondary Education	3	9.7	25	34.7
College Education	0	0	32	44.5
Total	31	100.0	72	100.0

4.0 Conclusion and Recommendation

It is concluded that sorting of waste is widely not practiced by residents in Mbeya city, as it was confirmed by 85.4% of the respondents in the study. Therefore, it is imperative for the responsible authority to sensitize residents on the importance of separating the waste at the source. The sensitization process can go along with provision of education about the application of sustainable technologies for solid waste management. This study demonstrated that people in area of study are aware about composting technology. However, they do not apply it in waste management because of lacking sufficient knowledge on the technicalities for composting the organic materials. The city authority and other stakeholders should provide in-depth knowledge to youngsters in line with financial empowerment so that they can start composting project. The success in this will not only reduce amount of solid waste in management stream, but also will create employment opportunities among youths. The study also found that many people are more

interested to use organic fertilizer produced from organic through composting. 97.1% of the respondents would like to use such fertilizer for crop production or gardening if it could be available. This provides an assurance of the market for the compost that can be produced from compost project.

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