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Perceived Environmental Risks and Challenges of Urban Waste Management in Planned and Unplanned Settlements of Dodoma Municipality in Tanzania

I.J.E. Zilihona, H.K. Mayaya, G. Mnyone and J. Nkonoki
Department of Environmental Planning, Institute of Rural Development Planning,
P.O. Box 138, Dodoma, Tanzania

Abstract: The problem of waste management in planned and unplanned settlement is currently a common phenomenon in developing countries. Of importance is to understand the best mechanisms through which such wastes can better be managed. It is on such basis this study aimed at analysing the perceived environmental risks and challenges of urban waste management in planned and unplanned settlements of Dodoma Municipality in Tanzania. In soliciting the required information, a total of 226 respondents of which 200 are from household level and the remaining 26 as key informants were involved in the study. The data generated were analysed through the use of descriptive statistics, multiple responses, cross tabulation and sometimes of combination of the above data analysis techniques. The study established that despite the commonality in the problem of waste management in Dodoma Municipality, there are some differences in terms of sources, types and composition of wastes between planned and unplanned settlements. Furthermore, the study revealed that epidemic diseases, blockage of water drainage systems, air pollution and environmental dirtiness are among the perceived environmental risks associated with poor waste management. The study also established that efforts and initiatives to deal with the problem of generated wastes encounter managerial, technical and awareness challenges and hence reducing their effectiveness. It is on the basis of the study findings, this study concludes that the problem of wastes in the municipality will continue to pose more environmental risks and hence the need to scale up its waste management efforts by investing on waste management infrastructures, awareness creation, promotion of stakeholders involvement and capacity building among waste management institutions and stakeholders.

Key words: Urbanisation, environmental risks, waste management, planned settlement, unplanned settlement, stakeholders involvement

INTRODUCTION

Urbanization is defined as the proportional change between the human population living in rural areas and that living in urban areas. Such changes are caused by both migration and natural increases (Miller, 2001). Worldwide, the trend shows that majority of the population are moving from rural to urban areas. For instance in 1990, the average population of the world's 100 larges cities was 5 million inhabitants compared to 2.1 million in 1950 and less than 200,000 in 1800 (UNCHS, 1996). Regarding the world population, it has more than doubled in 49 years whereby the world population was 2.5 billion in 1950 as compared to 6 billion in 1999. It is expected that the world population will be 8 billion in 2028, 9 billion in 2054 and 10-15 billion in 2100.

In Tanzania, between 1980 and 1997 the urban population grew at a rate of 10% per annum. The above growth is mostly attributed by rural-urban migration. For instance, a city like Dar es Salaam alone receives about 100,000-300,000 people a year. According to the national census of 2002, there is a clear indication of the increase of the urban population in Tanzania. Currently, 30% of the total population in Tanzania is living in urban areas as compared to 6.4% in 1967 (URT, 2008).

In absolute numbers, the urban population of Tanzania as a whole changed from 787,000 in 1967 to 7.9 million in 2002 (URT, 2008). Unfortunately, majority of these rural-urban migrants land in unplanned and un-serviced areas characterized with poor environmental conditions that endanger their life and health as indicated by the growing number of people with water and airborne diseases. Most of such health risks results from anthropogenic activities that have polluted cities in various ways (UNCHS, 1996, 2001; United Nations, 2010).

Corresponding Author: I.J.E. Zilihona, Department of Environmental Planning, Institute of Rural Development Planning, P.O. Box 138, Dodoma, Tanzania

As noted in URT (2008), a number of outbreaks of diseases such as cholera are linked to poor management of wastes. Hence, the need for waste management strategies so as to deal with environmental and health challenges associated with poor management of urban wastes. In developed countries, the population increase ended up in throwing out enormous volumes of garbage and the countries are said to have records in the business of recycling. For example, the Netherlands recycle 50% of their paper; Swedish cities recycle 80% of their aluminum cans and France has have >100 composting plants producing 800,000 tones of compost a year (Girardet, 1996). Contrary to the developed countries in the developing countries, the dumps and landfills are rapidly stilling up and new waste management sites are both expensive to manage and scarce.

In Dodoma region, about 25% of urban population living in urban areas depends on formal business and formal employment. These activities lead to generation of enormous number of waste products most of which are inadequately managed and hence threatening the health, survival and sustainability of human activities. In additions >75% of housing in the area is in unplanned, un-serviced and/or hazardous area. Most of those houses do not conform to building regulations requirements on security, health and building materials. In Dodoma town, for instance, both planned and unplanned settlements were supposed to have adequate waste management services and infrastructures. Unfortunately, these services and infrastructures are either lacking in some neighbourhoods or not functioning resulting in poor environmental conditions that consequently leads to health threats. Therefore, this study aims at analysing the perceived environmental health risks and challenges of urban waste management in planned and unplanned settlements of Dodoma Municipality in Tanzania. Specifically, this study aims at putting into limelight the nature of wastes generated in the area, the perceived health and environmental risks of generated wastes, waste management strategies and challenges involved in waste management in Dodoma Municipality.

MATERIALS AND METHODS

The study area: Dodoma urban district covering an area of 2576 km^2 is one of the five districts in Dodoma region. Other districts include Mpwapwa, Kondoa, Kongwa, Bahi and Chamwino. The district lies between latitudes 004° and 007° South of the equator and between longitudes 035° and 037° East of the Greenwich Meridian. Furthermore, the district lies between the altitudes from 830-2000 m above the sea level characterised by a semi-arid climate with a bimodal rainfall 400-600 mm per annum. The district experiences temperatures ranging between 10 and 35°C which is varying according to altitude and season of the year. Administratively, the district is divided into 4 divisions, 30 wards, 39 registered villages and 70 registered Mitaa. The municipality was selected for this study based on the fact that larger amount of wastes generated through various economic and household chores remain unattended. For instance, the generation of solid wastes amounts 75 tones day^{-1} while the capacity of the municipality to collect the same is only 55 tones day^{-1} (73%) (URT, 2008). Such phenomenon creates a cause of alarm in particular on matters pertaining to waste management in the area.

Data collection and analysis: In achieving the study objectives both primary and secondary data were collected. Primary data were collected from 226 respondents of which 200 were from households and the remaining 26 respondents included governmental officials and other key respondents. The major primary data collection techniques were focus group discussions, observation and interviews using both questionnaires and checklists. On the other hand, secondary data were gathered from different documentary sources such as pamphlets, manuals, books and progress reports among others. Furthermore, the study applied both probability and non-probability sampling in selecting the respondents. In respect to probability sampling, the simple random sampling method was used while in non-probability sampling; the purposive sampling method was applied. Through purposive sampling, total of 26 leaders and executive officers were selected from the two wards; while, through random sampling a total of 200 respondents from households of which 100 respondents from each wards (Chamwino and Majengo) were selected.

The collected data were edited, coded and classified prior to analysis. Data analysis involved the use of descriptive statistics whereby the findings were presented into simple frequency tables. The data were also analysed by using multiple response in a situation where several responses or measurements were recorded for a single question. In addition, cross tabulation was used during data analysis for the purpose of comparing the similarities of the findings across Dodoma Municipality in particular the two wards (Majengo and Chamwino) involved in the study. It should be noted that during the analysis those who did not report anything to some of the questions do not appear in frequency or cross tables in the multiple response case. In such cases, the base on which percentages were calculated in some cases may not be in

the entire sample but rather in the total number of responses. In addition, after the analysis the data were presented in the form of text or tables. In the case of secondary data, content analysis was used to in extracting out the underlying themes of the documents reviewed (Kothari, 2004; Bryman, 2008).

RESULTS AND DISCUSSION

Nature of wastes in Dodoma Municipality: In explaining the nature of wastes in Dodoma Municipality the focus is on the types, sources and composition of the generated wastes. Regarding the types of generated wastes in Dodoma Municipality, the finding shows that residents produce two major types of wastes namely solid and liquid wastes. However in the course of waste production, 4 and 1.5% of all 200 respondents produce only solid and liquid wastes, respectively. The remaining, 94.5% of the 200 respondents produce both liquid and solid wastes (Table 1). Hence, majority of the respondents in Dodoma Municipality and in particular in Majengo and Chamwino ward produce both solid and liquid wastes as compared to those producing either solid or liquid wastes only. In the two wards, respondents producing either solid or liquid wastes only have specialized activities such as trading and tailoring and therefore justifying why majority in that category are from Majengo ward which is located in the Central Business District (CBD). Furthermore, using observation as a method of data collection, it was revealed that Dodoma Municipality lacks the mechanisms to sort out wastes during collection and transportation and disposal of wastes. However, proper sorting of wastes could assist in better management of wastes (Crous, 2010) and therefore decelerating the processing, treating and using wastes for other purposes.

Experience drawn from various areas worldwide show that industrial areas, residential areas, commercial areas, institutional areas, construction and demolitions sites, socioeconomic services and processing activities are the principal sources of wastes (UNESCAP, 2002). In Tanzania, the main sources particularly in urban areas mostly characterized by high population growth and concentration of social economic activities, the main sources of wastes include municipal wastewater, industrial effluent, leachate from dump sites, agricultural activities, gaseous emissions from industrial establishments and transportation activities (URT, 2008). However in Dodoma Municipality, the main sources of generated wastes in Dodoma Municipality are residential areas, institutions such as hospitals, commercial areas such as shops, bars and hotels; agriculture in particular, urban agriculture such as livestock keeping. Table 2 presents the sources of wastes in Dodoma Municipality with special focus on specific sources such as small industries, wastewater, livestock shed, domestic wastes (emanating from uncontrolled waste wastewater, remains from shops and markets including butchers) and to a small extent institutions such as hospitals.

Table 1: Distribution of wastes by types of wastes produced in Dodoma Municipality

	Responses and percentages within wards		
Type of wastes	Majengo	Chamwino	Total
Solid	7 (7)	1 (1)	8 (4)
liquid	2 (2)	1 (1)	3 (1.5)
Both solid and liquid	91 (91)	98 (98)	189 (94.5)
Total	100 (100)	100 (100)	200 (100)

Table 2: Distribution of respondents by sources of wastes in Dodoma Municipality

	Responses and percentages within ward		
Sources of wastes*	Majengo	Chamwino	Total
Small industries	8 (8.2)	13 (13)	21 (10.6)
Uncontrolled waste/dirty water	80 (81.6)	78 (78)	158 (79.8)
Remains from shops	38 (38.8)	65 (65)	103 (52)
Livestock shed	3 (3.1)	14 (14)	17 (8.6)
Remains from markets	22 (22.4)	1 (1)	23 (11.6)
Hospitals	1 (1)	0 (0)	1 (0.5)
Kitchen wastes	38 (38.8)	6 (6)	44 (22.2)
Bar	3 (3.1)	0 (0)	3 (1.5)
Total	98 (49.5)	100 (50.5)	198 (100)

*Dataset based on multiple responses; values in parentheses are persentages

According to the findings as shown in Table 2, uncontrolled waste/dirty water ranks higher (79.8%) as compared to other sources of wastes in the municipality. This is due to the fact that in Dodoma Municipality; infrastructures for handling the problem of waste water are not well developed therefore drawing strong attention among respondents. Other sources of wastes in Dodoma Municipality apart from wastewater are the wastes caused by the remains from shops (52.0%), kitchen wastes (22.2%) and remains from markets among others.

Further analysis of sources of wastes shows that the extent to which waste sources are perceived by respondents differs from areas located in the CBD such as Majengo ward and areas located outside the CBD. While, some of the sources of wastes such as waste water is almost the same between Majengo (81.6%) and Chamwino (78.0%) ward, others sources are differs substantially in the two areas. For instance, remains from shops are more concentrated in Chamwino ward (65.0%) as compared to Majengo ward (38.8%). Probably, this is due to the fact that most of the items from shops including their packaging material such as boxes and plastic bags in the CBDs are purchased by people from the inner and outer suburbs where there is a high concentration of people. In addition, bars as sources of wastes in Dodoma Municipality are concentrated in Majengo ward (3.1%) as compared to Chamwino ward (0.0%). Observation findings have revealed that most people in Dodoma Municipality have the trend of commuting from their residential areas

in the inner and outer suburbs to CBDs for social gathering and refreshments after working hours and therefore, generating more bar wastes such alcohol cans and juice containers among others in Majengo ward. Furthermore, there is a high concentration of sources of wastes such as livestock shed (14.0%) and small industries (13.0%) in Chamwino ward located outside the CBD as compared to 3.1 and 8.2% of livestock shed and small industries, respectively in Majengo ward located in the CBD. The above trend is based on the fact that activities such as livestock keeping and small industries are rarely undertaken in the CBD due to lack of space, noise annoyance and nature of activities among zones of urban areas as explained by Burgess Model (Concentric Zone Theory) in 1925 (Carter, 1995).

Although categorically, there are three principal groups of wastes (solid, liquid and gaseous), their composition differs much depending on the source, nature of wastes and income of the country. Whereas higher income countries wastes comprises more of packaging material and recyclable wastes, lower income countries have less commercial and industrial activities and therefore produce less wastes which are more organic and have high water content (United Nations, 2010). Municipal wastes, industrial wastes, building construction wastes, residential wastes and special wastes from hospitals, chemical processing plants and slaughterhouses, for instance, differ in their composition, harmfulness and usefulness. Some of the wastes are hazardous, toxic and some produce bad smells. As far as the case of Dodoma Municipality is concerned, solid wastes comprises kitchen wastes (68.7%), plastic bags (58.1%), used paper or/and boxes (40.9%) and ash (31.3%) form a large part of solid wastes generated as opposed to hospital wastes (1.5%) and industrial remains (4.5%) and charcoal remains (7.6%). Despite the above generalisation in terms of composition of solid wastes in Dodoma Municipality, further analysis revealed some differences on the composition of solid wastes among the two wards within the municipality. For instance in Majengo ward, the problem of ash (53.5%), used bottles/cans (21.2%), dust (13.1%) and charcoal remains (11.1%) have been mentioned as major components of solid wastes; while, plastic bags (67.7%), used paper or/and boxes (52.5%) were mentioned by more respondents in Chamwino ward than in Majengo ward. Wastes such as kitchen waste, torn cloths, industrial wastes and hospital wastes are almost equally distributed across the two wards.

The above differences on the composition of solid wastes are due to the nature of activities such as businesses and transportation, sources of energy used, ability to immediately dispose wastes and distance from the CBD. For instance, high rate of transportation activities, high use of charcoal and availability of businesses like bar are the major causes for ash, dust and charcoal remains in Majengo ward than in Chamwino ward. While, distance from the CBD may be the reason for plastic bags and used study or/and boxes to dominate in Chamwino ward since the materials are used as carriage of various commodities from the market or shops located in the CBD. Experience from around the world show that economic development and changes in lifestyle contribute significantly in affecting the composition of solid wastes (United Nations, 2010). The above have been reported in China (Kunming town in Yunnan province) whereby changes in economic development and lifestyle has reduced the percentage of ash in municipal solid waste from >50% in 1997 to <25% in 2004. Also, study and organics are the leading components of solid wastes in USA and Netherlands cities as compared to plastics, metal and glass in developing country cities (United Nations, 2010) since their technological advancement play a critical role in recycling, incinerating and facilitating re-use of wastes. However in developing countries, the failure to properly manage solid wastes is attributed by lack of equipment, low priority given to solid waste services by municipalities and inadequate financial resources (URT, 2008).

In terms of the composition of liquid wastes in Dodoma Municipality the findings as per respondents' opinions indicate that wastewater is largely composing of bathing (71.4%), kitchen (60.4%), washing (50.5%) and toilet (45.3%) liquid wastes. In addition, it also contain industrial (1.0%), oil (2.1%) and mopping (3.1%) waste water. Based on the analysis of the composition of liquid wastes in Dodoma Municipality, focusing on responses percentagewise within wards, the perceived composition of bathing, industrial and oil is almost the same in both Majengo and Chamwino wards. However, there are differences in the perceived composition of washing, kitchen, toilet and mopping wastewater between Majengo and Chamwino wards (Table 3).

Through observation, it was revealed that such differences are due to the differences in housing qualities

Table 3: Distribution of respondents by types of liquid waste produced in Dodoma Municipality

	Responses and percentages within ward		
Type of liquid waste*	Majengo	Chamwino	Total
Bathing liquid wastes	69 (73.4)	68 (69.4)	137 (71.4)
Washing liquid wastes	54 (57.4)	43 (43.9)	97 (50.5)
Kitchen liquid wastes	41 (43.6)	75 (76.5)	116 (60.4)
Toilet liquid wastes	50 (53.2)	37 (37.8)	87 (45.3)
Industrial liquid wastes	1 (1.1)	1 (1)	2 (1)
Oil	2 (2.1)	2 (2)	4 (2.1)
Mopping	6 (6.4)	0 (0)	6 (3.1)
Total	94 (49)	98 (51)	192 (100)

*Dataset based on multiple responses; values in parentheses are persentages

(e.g., floor), settlement planning and availability of permanent wastewater infrastructures (septic tanks). For instance in the case of wastewater from mopping, all houses in Majengo had floors made up by cement or tiles which require mopping so as to maintain their cleanliness as compared to Chamwino ward particularly in unplanned settlement whereby some of the houses do not have floor therefore requiring sweeping rather than mopping. Following discussions with the focus groups and careful analysis of data it was noted that liquid wastes in unplanned neighbourhoods like Chang'ombe in Chamwino ward are directed to open spaces, house compounds and roads. Moreover in Chang'ombe neighbourhood, most household digs a hole in the small space available and direct all liquid wastes into unprotected holes a system locally known as kutapisha. The respondents further reported that sometimes the holes collapse a situation which increases bad smell to nearby households.

The above findings reflect the actual situation in most urban areas in developing countries. In Rwanda, the expansion of unplanned residential areas has led to problems in handling liquid wastes and most of the drains in the cities are inappropriate and consist simple channels made by people (ROR, 2009). Furthermore, the National Bureau of Statistics as cited in URT (2008) point out that 80% of pit latrines and septic tanks used by most urban poor are substandard and offensive and frequently overflow especially during the rains, contaminating water sources and increasing health risks in the neighbourhoods. As a matter of fact, the management of liquid wastes is poor in developing countries. For instance in Tanzania, out of 18 cities/municipalities/towns only 9 has sewerage systems (URT, 2008). In Kenya, of the 174 local authorities, only 32 have some form sewage collection and disposal infrastructure (Kenya Republic, 2003). Despite the above shortage of sewerage systems in most cities and municipalities, the existing sewerage systems cover very small part of the municipalities.

Perception of residents on the effects of wastes: Through interview and discussion with residents in Dodoma Municipality, it has been possible to understand perception of the residents on the negative effects of solid and liquid waste generation. The findings in Table 4 indicates that the major effects of uncollected or poorly managed wastes as per the residents perceptions are epidemic diseases (87.0%), air pollution (34.5%), blockage of clean and wastewater drainage systems (34.0%) and environmental dirtiness (27.5%). Other perceived negative effects of solid and liquid wastes are drying of water sources (2.0%), piercing/cutting (1.0%) and fire outbreak (0.5%).

Table 4: The perceptions of residents on effects of wastes

Perceptions of residents on the effects of wastes*	Responses and percentages within ward		
	Majengo	Chamwino	Total
Epidemic diseases	84 (84)	90 (90)	174 (87)
Drying of water sources	3 (3)	1 (1)	4 (2)
Blockage of water drainage systems	57 (57)	11 (11)	68 (34)
Air pollution	46 (46)	23 (23)	69 (34.5)
Fire outbreak	1 (1)	0 (0)	1 (0.5)
Environmental dirtiness	19 (19)	36 (36)	55 (27.5)
Piercing/cutting	2 (2)	0 (0)	2 (1)
Total	100 (50)	100 (50)	200 (100)

*Dataset based on multiple responses; values in parentheses are persentages

Further analysis of the negative effects of solid and liquid wastes across Majengo and Chamwino wards indicates that the problems of air pollution and blockage of water drainage systems are more predominant in Majengo ward than in Chamwino ward. This is due to the fact that in Majengo ward, there are so many activities which can easily lead to air pollution and blockage of water drainage system than in Chamwino ward. In addition, the problem of epidemic diseases such as cholera and diarrhoea are almost equally distributed across the two wards although the problem is more predominant in Chamwino ward (90.0%) than in Majengo ward (84.0%). According to the discussion with local residents and health practitioners, cases of cholera outbreak and incidences of patients being admitted at Kwa Habiba Health Centre where cholera cases are attended has been reported in Dodoma Municipality. However, all the above problems are due to poorly developed waste collection and disposal technologies and infrastructures such as sanitary land filling, compositing, incineration and sewerage system in the municipality.

The findings from Dodoma Municipality on the negative effects of poorly managed municipality wastes as pointed out by residents are similar to the experiences from other countries in east Africa and India. For instance in Uganda where only 41% of wastes are disposed off properly, the remaining wastes (59%) is disposed improperly into road sides, natural water courses and in sanitary drainage systems leading to blockage of the systems (NEMA, 2004). In Kenya, particularly in unplanned settlement of Kibera in Nairobi, unmanaged wastes including sewage are distributed everywhere and therefore affecting the scenery of the area. In addition, residents of Kibera slums irresponsibly throw away plastic bags used for toilets (nicknamed as flying toilets) which consequently lead to the outbreak of epidemic diseases (UNDP, 2006). In the slums of Karachi (India), the problem of untreated effluent has made waterborne epidemic diseases a common phenomenon in the area (UNDP, 2006). As pointed out in Zake (2008) and URT

(2008), improper disposal of wastes leads to land degradation and disease epidemics like cholera, dysentery and diarrhoea. Considering such effects, it is important to manage wastes for productive activities such as the use of used beverage cans in making paraffin candles.

Waste management strategies in Dodoma Municipality: During the past 2 decades, Dodoma has been growing as the national capital. The establishment of the national capital in Dodoma has led to rural-urban migration mainly caused by slow performance of agricultural sector in rural areas. In addition, the establishment of various academic institutions (universities and colleges) and government institutions such as the parliament and ministries has made Dodoma an area of attraction to temporally and permanent migrants. The large influx of people from rural and from elsewhere to Dodoma Municipality and the natural increase in population have in turn, increased generation of both liquid and solid wastes in the area and hence creating the need for proper management of wastes. The rationale behind waste management includes the reduction of wastes and their effects on human health or local aesthetic (UNCHS, 1996, 2001). However, effective management of wastes so as to promote the health of people and the quality of the environment requires properly laid down strategies. It should be noted that the development of strategies depends on government policies and laws, local knowledge, affordability and culture of people (United Nations, 2010). In addition, it also depends on the capacity of agencies responsible for waste management in terms of staff, facilities, funding and infrastructures (UNCHS, 1996).

According to the earlier findings, some of the strategies used in waste management are the use of a decentralized system where by individuals at household level are involved in collecting and dumping wastes (36.8%); use of environmental groups (28.5%) and use of paid garbage collectors (27.8%) (Table 5). Other strategies are formulation of environmental committees (8.3%), connection to central sewerage system (4.2%), home incineration/burning (2.8%) and to a small extent, the use of fines (0.7%) as part of the economic disincentive.

Table 5: Distribution of respondents by waste management strategies

	Responses and percentages within ward		
Waste management strategies*	Majengo	Chamwino	Total
Environmental committee	6 (7.5)	6 (9.4)	12 (8.3)
Environmental groups	32 (40)	9 (14.1)	41 (28.5)
Paid garbage collectors	35 (43.8)	5 (7.8)	40 (27.8)
Home incineration/burning	1 (1.3)	3 (4.7)	4 (2.8)
Individuals collecting and dumping wastes	10 (12.5)	43 (67.2)	53 (36.8)
Fines	1 (1.3)	0 (0)	1 (0.7)
Connecting to central sewerage system	6 (7.5)	0 (0)	6 (4.2)
Total	80 (55.6)	64 (44.4)	144 (100)

*Dataset based on multiple responses; values in parentheses are persentages

Across wards, paid garbage collectors (43.8%), environmental groups (40.0%), connection to central sewerage system (7.5%) and fines (1.3%) are commonly used in Majengo ward as compared to their counterpart in Chamwino ward where collection and dumping of wastes by individuals at household level (67.2%) and home incineration/burning (4.7%) are mostly used. According to the earlier findings, most of the strategies involve individuals at household level, paid waste pickers and environmental groups. However, some of these strategies are dangerous to human health. For instance, burning of wastes at home may lead to the occurrence of respiratory diseases especially to women and children (UNCHS, 1996).

Apart from the above mentioned strategies, the involvement of various stakeholders is one of the most widely approach in waste management. The involvement of stakeholders is paramount in identifying responsible institutions, opportunities and incorporating stakeholders' inventiveness in solving problems and sustaining solutions related to solid waste management. In addition, involvement of a wide range of stakeholders lowers the operational costs of which most municipalities can not afford (Collins *et al*., 2006; URT, 2008). In Dodoma Municipality, various stakeholders are involved in waste management activities (Table 6).

The findings in Table 6 shows that the key stakeholders involved in waste management as per the perception of residents in Dodoma Municipality are environmental groups (59.4%), the government (45.1%), individuals at household level (35.4%) and private sector (5.7%). Furthermore, an analysis across wards shows that environmental groups are widely involved in waste management in Majengo ward (80.5%) as compared to Chamwino ward (56.7%). This is because Majengo ward is characterized by business and office activities as it located within the CBD, therefore attracting environmental groups to operate in the area. Consequently, the role of individuals is more prominent in Chamwino ward (38.0%) as compared to Majengo ward (32.2%) because of lack of waste management infrastructures and wide use of waste pits at home (Table 7).

Table 6: Distribution of respondents based on stakeholders involved in environmental management

	Responses and percentages within ward		
Stakeholders*	Majengo	Chamwino	Total
Environmental groups	66 (79.5)	38 (41.3)	104 (59.4)
Government (central and local)	37 (44.6)	42 (45.7)	79 (45.1)
Private sector	3 (3.6)	7 (7.6)	10 (5.7)
Individuals	27 (32.5)	35 (38.0)	62 (35.4)
Total	83 (47.4)	92 (52.6)	175 (100)

*Dataset based on multiple responses; values in parentheses are persentages

However, the role of government(central, local and environmental committees) is almost equally appreciated by residents from the two wards.

Based on the findings as shown in Table 6, the identified stakeholders have different interests and roles in waste management in Dodoma Municipality. According to the discussion with key informants and residents, the following (Table 8) are the interests and roles of environmental groups, government, private sector and individuals as key stakeholders in waste management. The involvement of other stakeholders rather than depending on government alone as service provider is crucial in addressing waste management issues in urban areas. This is due to the fact that the government alone can never effectively address waste management issues due to financial constraints, inadequate skilled human resources, inadequate institutional capacity, poor enforcement of laws and regulation and insufficient or/and lack of reliable data on waste management for informed decision making (URT, 2008). Sometimes operating waste management infrastructures is too expensive for the government and other agencies dealing with wastes to afford (Collins *et al*., 2006). Therefore, such gaps can easily supplement by environmental groups, private sector and individuals at household level trough awareness campaign, provision of skilled staff and facilities and direct and indirect involvement in waste management activities (Joseph, 2006; Wilson *et al*., 2006).

Experience from other municipalities and cities worldwide shows that incinerators, landfills, central sewerage systems, public-private partnerships, privatization and use of waste pickers are the key strategies in waste management (UNCHS, 2001; Mwangi, 2002). For instance in urban areas such as Dar es Salaam and Moshi Municipality, privatization of waste collection in Central Business District has been used as strategy for solid waste management (UN-HABITAT and UNEP, 2004; United Nations, 2010). In addition, Moshi Municipality also uses fines to compliment other waste management strategies (Ondigo, 2010). Therefore, the current use of various strategies in Dodoma is very critical in addressing the problem of wastes in the municipality. However, the municipality should put in place the necessary liquid and solid waste infrastructures in the area so as to reduce the environmental challenges including health concerns associated with poor waste management.

Table 7: Distribution of respondents by places for dumping the generated wastes

Places for dumping generated wastes*	Responses and percentages within ward		
	Majengo	Chamwino	Total
Waste collection points	26 (26)	19 (19.4)	45 (22.7)
Waste storage equipment	66 (66)	16 (16.3)	82 (41.4)
Municipal dumping site	7 (7)	21 (21.4)	28 (14.1)
Along river valley and roads	1 (1)	0 (0)	1 (0.5)
Incinerator	1 (1)	1 (1)	2 (1)
Waste pits at home	20 (20)	58 (59.2)	78 (39.4)
Total	100 (50.5)	98 (49.5)	198(100)

*Dataset based on multiple responses; values in parentheses are persentages

Table 8: Roles and interests of key stakeholders involved in waste management in Dodoma Municipality

Stakeholders and their interests	Roles
Environmental groups	Collecting, transporting and disposing wastes
Cleaning the environment	Awareness creation through training and meetings
Generating income through waste collection, disposal and re-use	Coordinating environmental management activities in their area of operation
Government (central and local)	
Addressing sanitation issues within the municipality	Enforcing laws and regulations on waste management
	Formulating and enforcing waste management bylaws
	Contracting private sector in waste management
	Providing facilities and other resources for waste collection and disposal
	Awareness creation through training and meetings
	Financing major projects such construction and management of sewerage systems in the municipality
	Allocating spaces for waste management infrastructures
	Supporting and providing technical backstopping to environmental groups, committees and residents in their efforts to manage wastes
Private sector	
Cleaning the environment	Collecting, transporting and disposing wastes
Generating income out of wastes	Recycling of recyclable wastes such beverage cans to kerosene lamp (koroboi)
	Awareness creation through training and meetings on the effects of wastes and waste management options
	Supporting and providing technical backstopping to residents in their efforts of managing wastes
Individuals	
Living in a clean environment	Proper storage of wastes at household level
Making a living from wastes	Separation of domestic wastes, especially those using kitchen wastes for feeding livestock
Reducing the potentiality of waste related diseases	Reducing the bulkiness of wastes through burning or burying
	Re-using some of domestic and non-domestic wastes for storage (plastic bags, bottles) and irrigation (wastewater)
	Supporting and working with other stakeholders in cleaning and managing wastes
	Offering waste picking services (especially those who are not in groups)

Major challenges for waste management in Dodoma Municipality: Management of wastes in most urban areas in developing countries is a big challenge to municipalities and city authorities. Some municipalities and city authorities lack s appropriate infrastructures and capacity for waste management (URT, 2008). Sometimes, waste management in cities or municipalities in developing country is very expensive (UNCHS, 2001). Such challenges increase the chances of uncollected and poorly managed wastes to cause health problems such as cholera and typhoid (Girardet, 1996).

Regarding the collection and disposal of wastes in Dodoma Municipality, the major problems as pointed out by respondents (Table 9) were lack of waste storage facilities (29.4%), lack of gloves and other equipments (24.4%), pilling of wastes at waste collection points (24.4%), distance to waste collection points and dumping points (21.7%), lack of knowledge on the use of certain equipments (18.2%) and lack of waste transportation facilities (16.1%). Other hurdles include high costs involved in collection and disposal of wastes (15.4%), citizens' irresponsible behaviours (8.4%) and lack of space for placing garbage pits (2.1%).

Furthermore, an in-depth analysis of the problems associated with collection and disposal of wastes in Dodoma Municipality across wards (Table 9) show that problems like lack of waste storage facilities, lack of knowledge on the use of certain equipments and distance to waste collection and dumping sites are more prominent in Chamwino than Majengo ward. On the other hand, lack of waste transportation facilities and pilling up of wastes are the top problems in Majengo as compared to Chamwino ward. The above findings on challenges involved in waste management in Dodoma Municipality are more or less similar to other municipalities in developing countries. Experience from various cities show that the process of waste management in most municipalities is hampered by lack of equipments, lack of infrastructures necessary for waste management process (UNCHS, 1996, 2001), distances from home to waste disposal points (Mwangi, 2002) and financial constraints (URT, 2008) among others. In turn, poorly managed wastes affect peoples' health and the aesthetic nature of the environment.

Table 9: Problems associated with collection and disposal of wastes in Dodoma Municipality

Problems in collection and disposal of wastes*	Responses and percentages within ward		
	Majengo	Chamwino	Total
Lack of waste storage facilities	8 (15.1)	34 (37.8)	42 (29.4)
Lack of gloves and other equipments	11 (20.8)	21 (23.3)	32 (22.4)
Lack of waste transportation facilities	13 (24.5)	10 (11.1)	23 (16.1)
Piling up of wastes	17 (32.1)	15 (16.7)	32 (22.4)
High costs involved in waste management	8 (15.1)	14 (15.5)	22 (15.4)
Lack of knowledge on the use of certain equipments	7 (13.2)	19 (21.1)	26 (18.2)
Distance to waste collection and dumping points	5 (9.4)	26 (28.9)	31 (21.7)
Lack of space for placing garbage pit	0 (0)	3 (3.3)	3 (2.1)
Citizens irresponsibility	5 (9.4)	7 (7.8)	12 (8.4)
Total	53 (37.1)	90 (62.9)	143 (100)

*Dataset based on multiple responses; values in parentheses are persentages

CONCLUSION

Despite the fact that various types of wastes from different sources are generated in Dodoma Municipality, their composition and management strategies are slightly different between the planned and unplanned settlement. In addition, the findings have revealed that such wastes pose great health and environmental risks. It is on the basis of such risks, various waste management strategies are in place. However, the process of waste management is hampered by lack of waste storage facilities, lack of gloves and other facilities' high waste management costs, lack of knowledge on waste management, poorly and inadequately developed infrastructures and citizens' irresponsibility hinders all efforts geared towards effective waste management. Furthermore, inadequate research, lack of appropriate technology, limited capacity among stakeholders and lack of partnership among and poor information flow among stakeholders hinders the intended strategies to curb the problem. Therefore, Dodoma Municipality should scale up its efforts to manage wastes since health and environmental risks posed by poor waste management are imminent.

RECOMMENDATIONS

Based on the findings, waste management is one of the environmental challenges which will continue to stir various health and environmental risks in urban areas. As per the findings and conclusion based on the experience from Dodoma Municipality, investment on waste management infrastructures, awareness creation, promotion of stakeholders' involvement and capacity building among waste management institutions and stakeholders are hereby recommended for future actions.

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