

**ENVIRONMENTAL EXPOSURE AND PUBLIC HEALTH CONCERNS OF MUNICIPAL SOLID WASTE
DISPOSAL IN DAR ES SALAAM, TANZANIA**

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ABSTRACT

Increased quantities and nature of solid waste has led to the need for proper disposal landfill to avoid environmental and health impacts. This study assessed problems of dumpsite in Dar es Salaam with the aim to improve the environment, health and the socio-economic status of the inhabitants. Data were collected by questionnaire, interview, field observations and laboratory analyses. Results showed that 79.6% of respondents had basic knowledge on solid waste, 72% and 98% had understanding of risks on exposure and environmental impacts of poor disposal, respectively. Identified environmental problems include odour, fire eruption, dust, water contamination, litter and pest outbreak. Groundwater was slightly acidic with pH range of 5.67-7.40, high COD range of 127-659 mg/l, iron range of 0.09-1.09 mg/l and coliform level beyond WHO and Tanzania limits for drinking water. Health problems include injuries, diarrhoea, skin and respiratory diseases, and malaria. In order to attain sustainable development, measures should be taken to reduce negative human impacts and enhancing ecosystem services, at least to develop the site by putting cells, leachate and gas management mechanisms, daily soil cover, fence and waste scavenging plan.

Keywords: Environment, Solid waste, Disposal, Dumpsite, Landfill, Sustainable development

INTRODUCTION

Decision making around the disposal of municipal waste is complex and becomes more difficult in developing countries. The only safe solution is to dispose in a way that environment is not affected. This requires significant investments from the already squeezed budgets of governments, which continue to have other pressing priorities for spending (Pokhrel & Viraraghavan, 2005). In most of developing countries municipal solid waste management services take third chance in municipal priorities after water supply and sanitation. Large amount of waste in many urban centres are disposed of by depositing in land. This method has been the prime means of waste disposal since the evolution of man (Medina, 2011). As from the late nineteenth century, the volume and hazardous nature of wastes generated has increased considerably, and has led to the need for disposal to land specifically allocated for the purposes of disposal landfill to avoid environmental impacts and health hazards. Environmental impacts arise from pollution associated with incineration, landfill, and recycling of waste. Health hazards arise from some air pollutants, from waste not disposed of to controlled outlets, from poorly managed waste sites, and from possible groundwater contamination by leachate from landfill sites. Health hazards are, by and large, relevant to developing countries where disposal practice is often primitive (Jha, Singh, Singh & Gupta, 2011).

In Tanzania waste is simply disposed of by open dumping. This method is a primitive stage of landfill development, abandoned in developed countries but it remains to be predominant waste disposal option in most of the developing countries owing to their low initial costs and lack of expertise and equipment. The disposal sites are selected on the basis of their closeness to the collection areas rather than their technical and environmental suitability (Kurian, 2002). The majority of these areas are normally peri-urban, areas which are neither rural nor urban but an interface where there is less provision for various urban services and ecological services of unpolluted air and fertile land. In most cases open dump accommodate the entire solid waste collected within the city that include waste from industrial, agriculture, domestic and medical. On the contrary, while avoiding high costs of modern landfills, cumulative effects of indiscriminate disposal of all types of wastes poses adverse effects of the quality of environmental resources, placing at risk both human health and the environment at large (Sessa, Giuseppe, Marinelli & Angelillo, 2010).

Section 11 of the Tanzania's National Environmental Policy (NEP) 1997 and National Management Act (EMA), 2004 have identified environmental pollution as one of the key problems that call for urgent attention (Vice President's Office, 2008). Proper disposal of waste and protection of the environment is also among the prerequisite for the achievement of the Millennium Development Goal (MDG 7), which calls for environmental sustainability by integrating the principles of sustainable development into country policies and programmes, and reverse of environmental pollution processes as well as loss of environmental resources (United Nations Summit, 2010). However, like many developing countries, Tanzania is still facing environmental problems of diverse nature and some of which are growing day by day (Mato, 2002). The establishment of dumpsites close to urban areas becomes increasingly evident that community at peri-urban areas is at great risk of hazard due to dumpsite either through direct exposure or through dispersive air, water and soil. In many cases, the peri-urban communities are dominated by low income earners that rely of resources from rural areas and cities in constructing their livelihood and sustenance (Ikem, Osibanjo, Sridhar & Sobande, 2002). The Millennium Development Goal also sets eradication of extreme poverty and hunger as its first goal (MDG 1), whereby economists and activists consider epidemic diseases as crucial factors in and consequences of extreme poverty (United Nations Summit, 2010). Lacks of adequate waste disposal systems aggravates poverty due to loss of income because of illness,

increased spending on health care, and deprive the poor's capability to live in a safer environment (World Bank, 2001). The anticipated problems to the peri-urban community around the dumpsite include the tension between vulnerability and resilience as measures of relative well being in the face of urban environment. This means a society striving for sustainable development consequently needs sustainable waste disposal systems.

DISPOSAL OF SOLID WASTE IN DAR ES SALAAM

Dar es Salaam city is growing rapidly in terms of population and size, and volume of solid waste that must be disposed of has also increased tremendously in recent years. Consequently the quality of the city environment in particular waste disposal sites has become a problem of growing concern to the people and the authority. For about 50 years, solid waste disposal in Dar es Salaam has been crude dumping in periphery areas of the city, particularly abandoned gravel or sand quarry, valleys or river sites (Dar es Salaam City Council, 2011). Selections of these areas have been based on the closeness to the city rather than their environmental suitability. Wastes have been tipped in a haphazard fashion, and have been sources of negative environmental implications. The conditions of dumpsites have been unacceptable from an environmental and public health point of view. These problems together with community complain made some of the dumpsites to be relocated or closed by court orders before the planned time. For instance after the closure of Tabata dump which was established in 1965, dumpsites were relocated several times in 1990's and 2000's (Dar es Salaam City Council, 2011). Table 1 shows different areas that dump in Dar es Salaam has been reallocated from 1992 to 2007. In all the areas the major reason for the dump closure and reallocation was either court order or community protest. The sustainability challenges of all these sites were due lack of application of scientific principles, imprecise identification of environmental risks and lack of stakeholders' cooperation. This means the problem was to find out what the community would go through or experience before deciding the lands to be used for solid waste dumping and more importantly what would be conservation techniques for the area for sustainable development.

Table 1 Current and former dumpsites in Dar es Salaam city

Dump	Location	Time operated and reason for closure
Tabata	Along Mandra road on the way to Ubungo, Tabata ward, Ilala.	Operated from 1965 to 1992. Closed by court order
Kunduchi	Abandoned gravel quarry at Kunduchi on the way to Bagamoyo	Operated for few months in 1992. Community protest.
Mbagala	Mzinga river valley within the area used for car washing.	Operated for few months in 1992. Community protest.
Vingunguti	Along Msimbazi river valley near livestock market and abattoir, Ilala.	Operated from 1992 to 2001. Closed by court order.
Mtoni	Along the gulf of Indian ocean at Mtoni kwa Kabuma, Temeke.	Operated from 2001 to 2007. Community protest
Pugu Kinyamwezi	Pugu ward in former sand quarry along the way to Chanika, Ilala.	Current in operation since 2007.

PUGU KINYAMWEZI DUMPSITE

Pugu Kinyamwezi dumpsite located in Pugu ward, Ilala Municipality is the current main dumping site for most of the solid waste from Dar es Salaam city. With an estimated population of 14,652 residents, Pugu ward has markedly urban characteristics, with people of divergent ethnic origins and of social and economic status. Trade and agriculture are the most important economic activities. Trade is mainly limited to small scale petty traders in the informal sector occupies almost 50% of the ward's population. Small shops and market stands are a common sight and ensure the distribution of consumer goods to all the sub-villages in the area (Environmental Resources Consultancy, 2004). The area is absolutely strategic for development and city growth, and presents excellent conditions for the expansion of human settlements and social economic activities. The dumpsite is approximately 20 km from the city centre and lies at latitude 6° 51' 41" S and longitude 39° 07' 02" E, and covering an area of approximately 75 hectares. Surrounding the dump are Mgeule, Viwege and Kigogo informal settlements (Figure 1). The site was previously used as sand quarry and then afterward turned into waste disposal site, which has been in operation since 2007 after the closure of Mtoni dumpsite. The initial aim was to construct and operate the place in a sanitary manner, which could receive solid wastes as well as wastewater but this was not finally possible due to lack of funds and other preparatory measures (Dar es Salaam City Council, 2011). Environmental impact assessment (EIA) was conducted and suggested that the site to be first geared up with designed cells, full leachate management, full landfill gas management, daily soil cover, a final soil cover and a compaction process, fence with a gate, daily record of the volume, type and source of waste, and waste scavenging plan (Environmental Resources Consultancy, 2004). Currently between 1,200 to 1,600 tonnes of waste generated and collected from various locations in Dar es Salaam are deposited on a daily basis into the dumpsite and what initially was to be sanitary landfill has given rise to mountains of garbage. Dumping at the site is unrestricted and industrial, agricultural, domestic, commercial, institutional, medical and other special wastes (yard wastes, batteries and electronic) are seen scattered all over the dumping site.

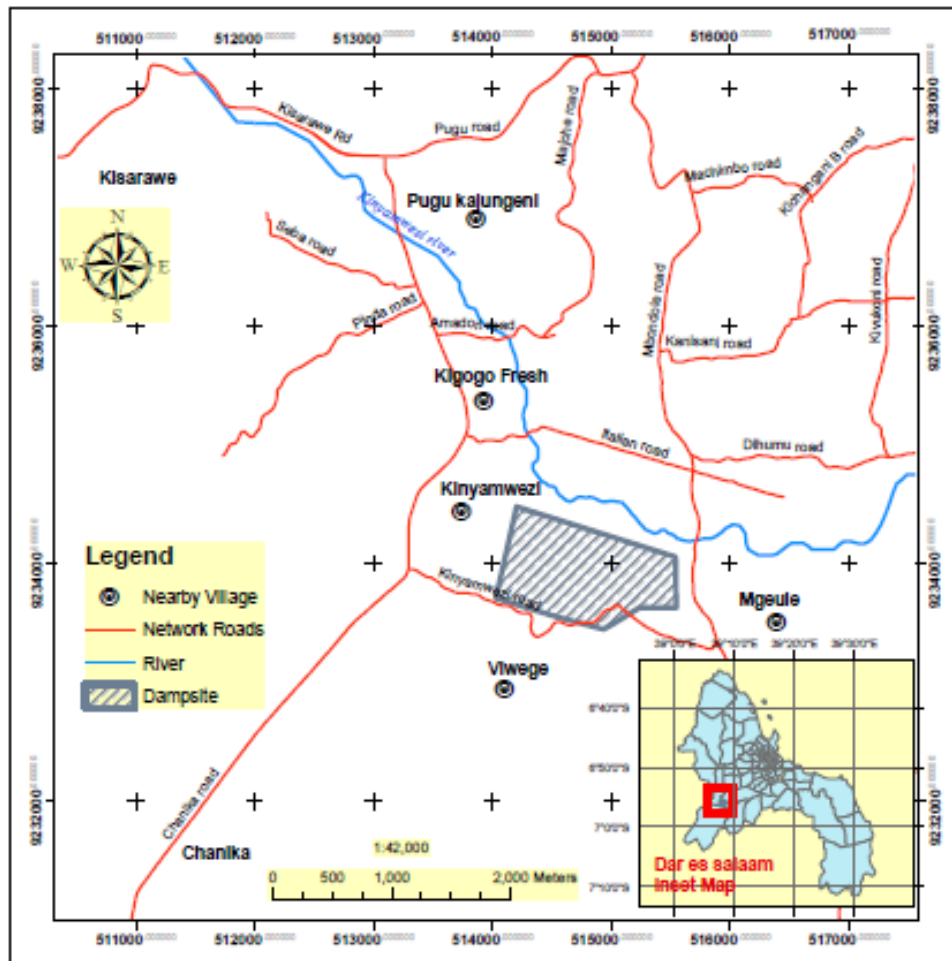


Figure 1 Location of Pugu Kinyamwezi dumpsite and neighbouring suburbs

METHODOLOGY

The study was conducted between March and May 2012. Site reconnaissance was done to get an overall picture of the existing situation on the site before commencement of the study. Data for this study were collected from a wide variety of sources to present a description of the phenomenon or the experience from the perspectives of the respondents. Instruments used included a questionnaire guide, an interview guide, field observation and sample collection. The questionnaire contained both close and open ended questions in order to solicit information. The questionnaire focused on the community understanding of solid waste, environmental and health impacts associated with poor management of solid waste, as well as residents concerns on the existing solid waste disposal operation. Identification of stakeholders was based on the location, role and relevance of an organization, village, group or individual to Pugu Kinyamwezi dumpsite. An issue raised by one individual was crosschecked by discussing it over with other group members. Water samples for measurement of groundwater quality were collected from four boreholes surrounding the dump. The samples were analysed for physical, chemical and microbial parameters at the laboratory of the School of Environmental Science and Technology, Ardhi University.

RESULTS AND DISCUSSION

Reaction to the project

The decision to use sand quarry at Pugu Kinyamwezi as the dumpsite for solid waste of Dar es Salaam city caused community controversy. Open dumpsites were once most common means of municipal refuse disposal, but with the introduction of more complex products into the waste stream, increased urbanization and population growth, increasing public awareness of environmental issues, including the current focus on sustainability and global climate change, the use of open dumps are no longer acceptable (Nissim, Shohat & Inbar, 2005). With understanding of environmental impacts and community outcry in former dumpsites at Tabata and Mtoni, the surrounding community at Pugu ward, realized that environment and public health would deteriorate if the dump is positioned in their neighbourhood. Table 2 depicts results on community awareness on the aspects of poor municipal solid waste disposal. Most respondents had basic knowledge (79.6%) on municipals solid waste disposal compared to those with an appropriate knowledge and not responded. 72% of the respondents demonstrated an understanding of the general risks of exposure to solid waste. They were able to identify some risks such as possible respiratory infection as a result of emissions from burning waste, injuries from sharp objects, skin diseases and diarrhoea particularly for children who are attracted to the site to scavenge for discarded items. The community worry for their children that would be the most affected was also reported in the environmental impact assessment report, which was conducted when the plan was to establish sanitary landfill (Environmental Resources Consultancy, 2004). Twenty eight percent (28%) of the respondents showed either inadequate understanding or did not respond to the question of the general risks to poor solid waste disposal. For environmental impacts of poor municipal solid waste disposal 98% of respondents were aware and showed sufficient understanding and identified environmental damage which result from the dump such as contamination of water, air pollution, spread of garbage by wind, scavenging animal, pests and diseases. Since Pugu has no piped water supply from outside sources, most residents depends on locally constructed shallow wells, therefore contamination of local sources of water which are used for domestic and agricultural activities was the biggest fear raised by residents during environmental impact assessment survey (Environmental Resources Consultancy, 2004).

Table 2 Awareness of residents on aspects of municipal solid waste disposal

Awareness variables	Categories	Results (%)
Concept of municipal solid waste	Basic knowledge	79.6
	Appropriate knowledge/Don't know	20.4
Health impacts of poor municipal solid waste disposal	Adequate knowledge	72
	Inadequate knowledge/No answer	28
Environmental impacts of poor municipal solid waste disposal	Aware	98
	Unaware	2
Public concerns on the existing municipal solid waste disposal methods	Yes	82
	No	18

The present situation

At present, solid waste dumping site at Pugu Kinyamwezi present hazards to the surrounding community. Waste is neither placed systematically nor covered with earth and compacted in thin layers as required for sanitary landfills (Hazra & Goel, 2009). The filling operation becomes critical during rainy season when the dump is inaccessible to heavy hauling. Also surface run off mixed with leachate run out of the dump and eventually reaches surrounding water bodies, which are used for various human activities including domestic use. Figure 3 shows uncontrolled leachates spread within the dump. There is no control on the entry, as a result children and others scavengers go through the dump to collect items they can play or sale. This waste picking can have serious effect on health and safety of the children and other scavengers because it is conducted in unorganized, hazardous and unhygienic way. Also free range livestock and other domestic animals from the nearby residence enter the dump and feed on the garbage (Figure 4). Their presence is of concern because germs and chemicals the livestock are regularly exposed can be accumulated in their bodies through several processes and finally enter the food chain at high concentrations capable of causing a serious health risk to human who consume their meat and other livestock products.



Figure 3 Uncontrolled leachate accumulated within the dump



Figure 4 Livestock feed on dumped waste

Table 2 shows that 82% of the respondents from three settlements (Kinyamwezi, Mgeule and Viwege) agreed on complaints or concerns from residents around the dump relating to methods of solid waste disposal. The most frequently reported concerns include fire eruption, water contamination, dust, odour, scattered litter and pest outbreak. Figure 5 display variations of response in which water contamination and odour were highly reported at Viwege, while pest outbreak, odour and fire eruption were reportedly high at Kinyamwezi settlement. According to the respondents, they get difficulty of breathing during the burning of solid waste and the foul smell from decomposing waste. The average percentage respondent was high for odour (89.40), followed by fire eruption (84.5%), dust (80.6%), water contamination (78.3%), scattered litter (70.6%) and pest outbreak (62.2%) was the least. The least reported cases of pest outbreak could be due to the series of fumigation conducted by Dar es Salaam City Council. Incidence of fire eruption, both natural and manmade, is commonly during dry season where explosive gases are full and easily erupt. Among the EIA recommendations not adhered, was to have in place gas collection mechanism prior to the start of disposal operation (Environmental Resources Consultancy, 2004). During site observation, smell of methane gas was easily felt, signifying that the gas was present and any triggering action like fire onset by scavengers in search of recoverable would initiate the fire. The frequency and trend of fire eruptions in the site is irregular and when onset can take up to three months before setting down. The major environmental and health problem linked with fire is smoke nuisance from burning refuse, which the community complaints to suffer from respiratory disease, dizziness, headaches, chest pains and eye irritations. Smoke from burning solid waste is reported to cause short-term, as well as potentially more serious diseases, such as cancers and heart disease in the long term. The smoke commonly contains particulates, carbon monoxide, carbon dioxide and other contaminant gases, including low levels of dioxins, all of which can be hazardous to health (Environmental Protection Agency, 2010).

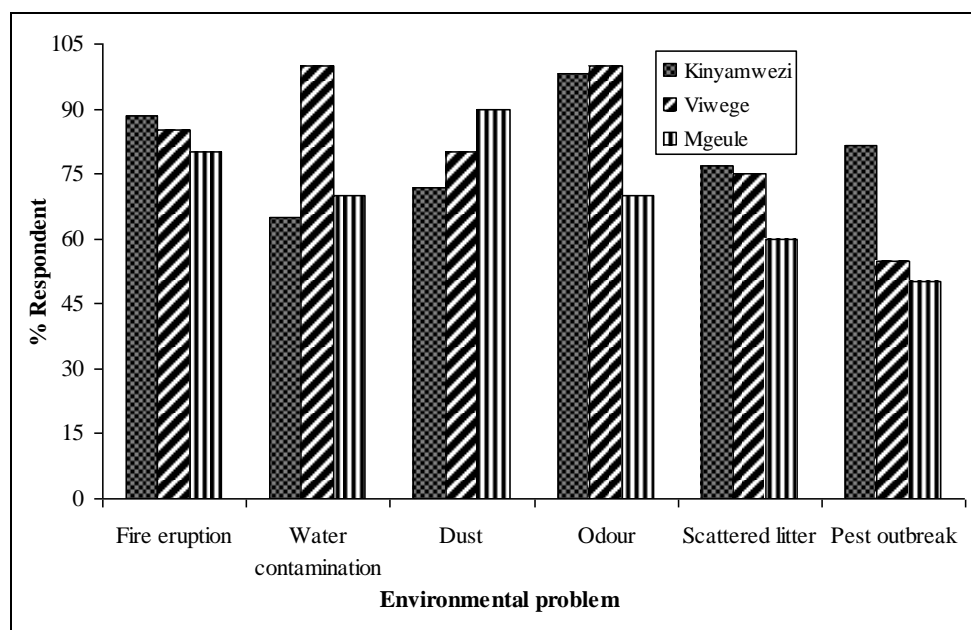


Figure 5 Distribution of respondents on environmental problems in three settlements surrounding the dumpsite

In order to ascertain the possibility of groundwater contamination, groundwater samples from four boreholes adjacent to the dump were analysed based on physical, chemical and microbial indicators (Table 3). The pH range shows that groundwater were near neutral to slightly acidic (5.67 – 7.40). pH level for W1, W3 and W4 were within the normal pH range for groundwater (6 – 8.5), pH levels for W3 and W4 were also within the accepted limits for drinking water quality

as per Tanzania Standard limits and WHO guidelines. The low pH level in water normally increase the availability of metal ions in water as the metal would dissociate from substrate and complexes (Adhikari, Ghosh & Ayyappan, 2006). It is also an indication of high level of iron, this was evident in the study as high level of iron was in W1 and W2 compared to W3 and W4. The source of iron in the studied groundwater is associated with solid waste through leachate that has infiltrated some aquifer. Fecal coliform and total coliform exceeded recommended permissible Tanzania limits for non-chlorinated drinking water quality TZS 789:2003 (Tanzania Bureau of Standards (TBS), 2003). The detection of coliform in groundwater reflects anthropogenic inputs particularly faeces of man and other warm blooded animals. COD value range of 127-659 mg/l was high for natural groundwater system. Low levels of NO₃-N and NO₂-N in a situation with high organic pollution is an indication of low bacterial activity. These results are evident that there is infiltration of leachate into the surrounding environment and subsequent contamination of the land and water (Chattopadhyay, 2009).

CONCLUSION

Findings of this study indicate that despite the attempt to improve solid waste disposal sites in Dar es Salaam city, the sites still have negative impacts to the environment, public health and socio-economic status to the peri-urban community and thus limit sustainable development. The disposal situation is expected to deteriorate further as Dar es Salaam city experiences rapid urbanization, in which housing developments are increasingly encircling the existing dump and the environmental degradation associated with the dump is direct affecting the population. This study recognized landfill as a valuable and sustainable method of waste disposal in any waste management system. The study suggests that as efforts are being made to establish sustainable landfill in Dar es Salaam city, temporary measures should be taken to the current dumpsite to avoid further problems. This can be achieved through putting in place cells, leachate and gas management mechanisms, daily soil cover, fence and waste scavenging plan. Also prevention, re-use and recycling should be promoted over disposal. This means waste materials should not be landfilled if an alternative option is available that is practically, economically and environmentally more sensible.

Table 3 Groundwater quality at Pugu Kinyamwezi dumpsite

Parameter	W1	W2	W3	W4	TZS
	655318 S, 3907349 E	655463 S, 3908196 E	655464 S, 3908197 E	655552 S, 3908039 E	789:2003 ^a
Temp. °C	29.9	29.0	28.8	28.8	
pH	6.10	5.67	6.50	7.40	6.5-9.2
Fe (mg/l)	0.28	1.09	0.09	0.13	0.3-1.0
NO ₃ -N (mg/l)	0.50	0.10	0.30	0.50	1
NO ₂ -N (mg/l)	0.01	0.01	0.01	0.01	1
NH ₄ (mg/l)	2.58	2.95	1.76	1.65	2
Turbidity (NTU)	12.80	62.90	8.62	4.73	5-25
SO ₄ (mg/l)	105.00	70.00	65.00	175.00	200-600
Cl (mg/l)	108	340	218	587	200-800
COD (mg/l)	127	572	659	422	
PO ₄ (mg/l)	0.30	0.20	0.23	0.16	
Faecal Coliform (count/100 ml)	54	99	80	71	0
Total Coliform (count/100 ml)	104	134	126	113	0

^aTanzania recommended standard (Tanzania Bureau of Standards, 2003)

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