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Patterns and correlates of solid waste disposal practices in Dar es Salaam city, Tanzania

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This study examines the patterns and correlations of solid waste disposal practices among households in urbanized and populated Dar es Salaam city in Tanzania. The Tanzanian Household Budget Survey (HBS) data covering many households' characteristics was used. Multinomial Logit (MNL) model was applied to examine the underlying correlates of choosing ways to dispose garbage. About 35% of the households used rubbish bin, and approximately 24% used throwing out option. MNL estimation suggest that distance, home ownership, household expenditure proxy for income, age, proportions of family members and education were statistically significant in influencing the choice of ways to dispose garbage in the city. This study suggest to policy makers to rely much on policies that will reduce poverty and raise households' income. And the city to increase the supply of waste containers on streets, the number of municipal vehicles for garbage collection and to ensure there is regular collection.

Key words: Solid waste, garbage, waste disposal, waste management, Multinomial Logit model.

INTRODUCTION

Urbanization introduces society to a new, modern way of life, an improved level of awareness, new skills and learning process. However, when the rate of urbanization gets out of control, it poses a big challenge to governance, and institutional capabilities become inadequate and ineffective. In the context of solid waste management (SWM), urbanization plays part in increasing the rate of waste generation (Amuda et al., 2014). Further, it can be taken as a problem especially when the governing bodies fail to cope with the amount of waste generated. Globally, it is not only urbanisation but also rapid population growth, which can lead to an enormous increase of solid waste generation per unit area. The increase in population, the rapid economic growth and the rise in community living standards accelerate municipal solid waste (MSW) generation in developing cities (Minghua et al., 2009). The population growth rate is contributed by factors like increasing birth rates, immigration and transient population. While the world's urban population grew very rapidly (from 220 million to 2.8 billion) over the 20th century, the next few decades will see an unprecedented scale of urban growth in the developing world. This will be particularly notable in Africa and Asia where the urban population will double

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between 2000 and 2030, that is, the accumulated urban growth of these two regions during the whole span of history will be duplicated in a single generation. By 2030, the towns and cities of the developing world will make up 80% of urban humanity (UNFPA, 2007). Specifically, Dar es Salaam and other cities like Kampala, Nairobi, Antananarivo and Addis Ababa already rank among the 31 fastest growing cities and urban areas in the world; of which, Dar es Salaam is the ninth city (Dubbeling and Pasquini, 2010).

According to United Nations Centre for Human Settlements (UNCHS, 1991), management of solid waste and other environmental infrastructures is a major problem facing developing countries. The health and environmental implications associated with SWM are mounting in urgency, particularly in the context of developing countries (Marshall and Farahbakhsh, 2013). For a country that has paid little attention to the issue of SWM, it becomes imperative to recognize the extent of the problem and its growth magnitude (Goel, 2008). It should be noted that the problem of managing solid waste is caused by poor waste collection, storage and disposal leading to subsequent pollution and environmental degradation (Ramachandra and Bachamanda, 2007; Thomas-Hope, 1998). The treatment and disposal of MSW is a worldwide concern especially in highly urbanized cities (Lu, 1996). And these problems or concerns are more in developing countries and have remained a challenge due to changing economic trends and rapid urbanization.

Likely, the practice have changed nowadays, but in 1994 for example, around 30-50% of residents in most cities in developing countries did not get proper SWM services and most of the time, their disposal practices were unsafe (Cointreau-Lavine, 1994). While the government authorities in many countries are major stakeholders who actually provide the SWM services, UN-Habitat report in 2006 shows that SWM in developing countries consumes 20-40% of municipal revenue and less than 20% of urban solid waste is collected and disposed of properly (UN-HABITAT, 2006). In Dar es Salaam for example, there were increased solid waste generation and only less than 50% of that amount is collected and disposed of at the dumpsite (WHO, 2004; World Bank, 2012). Failure by the local authorities to collect waste, results in urban dwellers dumping it at open sites as well as peri-urban areas which are health hazards and cause pollution (Gonzenbach and Coad, 2007). In fact, the uncollected solid waste have been left to household's decision, which are likely to be dumped in open spaces, valleys, roadsides, drainage channels or can be buried, burnt and the like. The uncollected wastes, which are dumped inappropriately, in turn can either produce insects, parasites and bacteria that spread diseases such as cholera and dysentery, or block the drainage channels as well as pollute the surface and groundwater. Both inadequate collection and unmanaged disposal, therefore, bears several adverse consequences on human health and environment.

Globally, a number of studies have assessed the factors associated with solid waste generation (Abel, 2007; Afroz et al., 2010, 2011; Ajani, 2008; Jadoon et al., 2014; Sivakumar and Sugirtharan, 2010; Sridhar et al., 1985), also in Tanzania in particular (Kaseva and Gupta, 1996; Kaseva and Mbuligwe, 2005; Oberlin, 2013). But few studies (Abebaw, 2008; Oguntayo and Obayelu, 2013; Tadesse et al., 2008; Tadesse, 2009) have assessed the factors associated with solid waste disposal practices in Africa. In Dar es Salaam city, however, there is no empirical work examining the households' correlates in choosing ways to dispose garbage. This study therefore attempts to fill this gap and expand the scope of knowledge on solid waste disposal in Dar es Salaam city. Specifically, the study identifies the most used solid waste disposal practices in the city and explores the underlying correlates of residential choice on solid waste disposal alternatives.

METHODOLOGY

Data type and source

The study used household budget survey (HBS) data, which was collected by the Tanzania National Bureau of Statistics (NBS). The data collection began on January 2007 in all 21 regions of mainland Tanzania. The fieldwork continued for 12 months and was completed by December 2007. The nature of the data enables household level analysis. The data set is the latest of its kind in Tanzania. The sample was based on a revised national master sample developed out of the 2002 national census data. The HBS data for year 2007 had a sample of 447 clusters (villages) and 10,466 households; of which 152 clusters and 3,541 households are from Dar es Salaam. Basically, three main areas were considered separately: Dar es Salaam, other urban areas and rural areas. This study used specifically the Dar es Salaam information, given the nature of the study. The HBS collected information on a range of individual and household characteristics. One main household questionnaire, together with a diary recording household consumption, expenditure, and income over a calendar month were used.

Theory and model specification

Theoretical framework

In consumer theory, consumers consume goods or services in order to optimize the utility they gain from such consumption. However, consumers cannot have everything they wish or want to have but their choices are constrained by various factors like income. A particular household as a consumer is faced with a different consumption bundles. It is assumed not only that the household has preferences on those consumption bundles, but also the household associates some level of utility with the choice to participate in any of the available alternative choices. Furthermore, it is assumed there is no ordering regarding the given alternative choices.

The households, in this study, are assumed to derive some indi-

rect (unobserved) utility in choosing ways to dispose their garbage. The assumption of not ordering the alternatives makes the random utility model to be applicable under this scenario, in which the utility obtained from each alternative is a linear function of the observed characteristics plus an error term (Verbeek, 2004). The true utilities of the alternatives are taken as random variables, thus the probability that the alternative is chosen is defined as the probability that it has the greatest utility among the available alternatives. The household is assumed to choose an alternative with the highest level of utility.

From the decision maker's perspective, the best alternative is simply the one that maximizes net private benefit at the margin. In other words, household "*i*" will choose solid waste disposal method *j* if and only if $u_{ij} > u_{ik}$, for $k \neq j$. The utility derived from the choice of a waste disposal alternative is expressed as a function of socio-economic, environmental and demographic factors plus a random component. Let u_{ij} denote the utility derived by the household "*i*" by choosing alternative "*j*" to dispose his garbage:

$$u_{ij} = \beta_j x_{ij} + \mu_{ij}. \quad (1)$$

Where, β_j is the parameter for alternative j, x_{ij} is the observed variables influencing the choice of alternatives to derive utility, μ_{ij} is the random error term reflecting basically random choice behavior, unobserved characteristics, and measurement or specification error and $\beta_j x_{ij}$ is the deterministic or observed portion of the utility.

Multinomial logit (MNL) model

In describing the behavior of consumers when they have a variety of goods with a common objective of consumption, the multinomial model seems to be used in many literatures (Abebaw, 2008; Chuen and Jamal, 2009; Tadesse et al., 2008; Tadesse, 2009). The choice of the model was based on its ability to perform better in discrete choice studies with alternatives which cannot be ranked (Judge et al., 1985; McFadden, 1974). It is widely used in decision study involving multiple choices. The main limitation of the MNL is the independence of irrelevant alternatives (IIA) property; which states that the ratio of the probabilities of choosing any two alternatives is independent of the attributes of any other alternative in the choice set (Hausman and McFadden, 1984). The IIA test was done and the test suggested that the IIA assumption hold for the data in this study.

The nature of dependent variable is qualitative 'Y' taking more than two options, $Y_i = j$, j = 0, 1… m. In this study, the values of "Y" represent the alternative ways to dispose garbage. Furthermore, assuming that the errors (μ's) from Equation 1 are identically and independently distributed, there is probability that a household chooses alternative "j" can be explained by MNL model (Greene, 2003). The MNL is actually an extension of the Binary Logit Model. Let P_j (for j = 0, 1, 2...) be the probabilities of alternative choices. The probability that a household chooses one type of disposing garbage is restricted to lie between zero and one. The probability of an individual "i" to choose the alternative "j", also taking j=0 as a base category, will be:

$$P_{ij} = P(Y_i = j) = \frac{\exp(\beta_j x_{ij})}{\sum_{j=0}^{j} \exp(\beta_j x_{ij})} = \frac{\exp(\beta_j x_{ij})}{1+\sum_{j=1}^{j} \exp(\beta_j x_{ij})} \quad (1)$$

Where, P (Y_i= j) is the probability of choosing the alternatives to dispose garbage; j is the number of ways to dispose garbage in a choice set (j= 0,1,...j); X_{ij} is a vector of the explanatory variables of i^{th} household in choosing alternative j; β_j is a vector of the estimated parameters associated to the alternative j. Simply by writing in odds ratio will be:

$$\frac{P_{ij}}{1-P_{ij}} = exp(\beta_j X_{ij}) \quad (3)$$

By applying natural logarithm both sides plus the error term, the equation can now to be used to estimate the coefficients as:

$$\text{In}\left[\frac{P_{ij}}{1-P_{ij}}\right] = \beta_j X_{ij} \quad (4)$$

The estimates from Equation 4 are presented in Table 3. These estimates are simply the natural logarithm of relative odds/odd ratios. The sign of the estimated coefficients β_j shows the direction of households' choice. A positive estimated coefficient implies an increase in the likelihood (probability) that a household chooses the alternative to dispose garbage and vice-versa. Furthermore, marginal effects $\frac{\partial P_{ij}}{\partial X_{ik}}$ as partial derivatives, were computed from Equation 4 for easy interpretation. For instance, the partial derivative with respect to k^{th} – predictor is presented as:

$$\frac{\partial P_{ij}}{\partial X_{ik}} = P_{ij}\ (\beta_{jk} - \sum_{j=0}^{j} P_{ij}\ \ \beta_{jk}) \quad (5)$$

The estimates from Equation 5 are presented in Table 2. Ideally, Equation 5 shows the variation of the probability of household "*i*" to choose alternative "*j*", when one of the explanatory variable, that is, "*k*" changes keeping other variables constant. The signs of the marginal effects (Table 2) and respective coefficient estimate (Table 3) may be different, as the former depend on the sign and magnitude of all other coefficients.

There are number of variables affecting the random utility maximization choice directly and indirectly. On literatures, the choice of an alternative way to dispose garbage is influenced by socio-economic, demographic and structural factors. Household behaviors are critical to the successful attainment of desired targets for MSW management practice (Chen, 2010). In this study, the MNL model is written in such way that the dependent variable is the alternative ways to dispose garbage, with different explanatory variables such as socio-economic, demographic and structural factors (Table 1).

RESULTS AND DISCUSSION

Descriptive statistics

This study uses disposal as a dependent variable in categorical form. The variable captures the various ways employed by Dar es Salaam residents in disposing their garbage. Specifically, it includes the rubbish pit inside compound, rubbish pit outside compound, rubbish bin, throwing out and other options. As long as the main focus

Table 1. Summary statistics of all variables.

Variable	Description	Mean	SD.	Min.	Max.
disposal	Waste disposal alternatives	2.909	1.152	1	5
exp_adeq	Monthly expenditure per adult equiv. (TZS)	52,989	41236	1,440	607,135
gender	=1 male, 0 female (household head)	0.767	0.423	0	1
agehead	Age of the household head (years)	40.07	12.59	18	97
distmins	Walking distance to main road/ transport (mins)	10.09	17.36	0	630
pr1	Proportion of family members with (<15years)	0.247	0.227	0	1
pr2	Proportion of family members with (15-30years)	0.338	0.318	0	1
pr3	Proportion of family members with (30-65years)	0.333	0.306	0	1.3
pr4	Proportion of family members with (>65years)	0.019	0.094	0	1
hhsize	Household size	3.750	2.398	1	22
occup1	=1 if household head is paid employee,	0.444	0.497	0	1
occup2	=1 if household head is self -employed	0.437	0.496	0	1
occup3	=1 if household head is in agricultural works	0.060	0.237	0	1
pmale	Proportion of males at the household	0.525	0.295	0	1.5
pfemale	Proportion of females at the household	0.477	0.296	0	1.7
educ0	=1 if household head has no education	0.058	0.234	0	1
educ1	=1 if household head has primary schooling	0.610	0.488	0	1
educ2	=1 if household head has secondary schooling	0.189	0.392	0	1
educ3	=1 if household head has post-secondary	0.108	0.311	0	1
educ4	=1 if household head has a university degree	0.035	0.183	0	1
tenure	=1 if household own a home, 0 otherwise	0.375	0.484	0	1
kinondoni	=1 if is Kinondoni municipal, 0 otherwise	0.408	0.492	0	1
ilala	=1 if is Ilala municipal, 0 otherwise	0.251	0.434	0	1
temeke	=1 if is Temeke municipal, 0 otherwise	0.341	0.474	0	1

of this study is to do household level analysis, the household related features are of major concern. Table 1 summarizes the descriptive statistics of the variables used in the analysis.

In Table 1, about 3,541 households were interviewed in Dar es Salaam city. Out of that, about 77% were male-headed household, with mean monthly expenditure per adult equivalent of Tanzanian Shillings (TZS) 52,988.45 (44.16 USD), and average household size of 3.7 members. The average age of the household head was 40 years. Only 37.5% out of households in the city own their homes which show that many household heads in the city does not own their homes. Furthermore, many households have family members aged between 15 and 65 years, which implies that majority are in the working age category. The average proportion of family members who are males was 0.53; whereas, on occupation, the majority are paid employees (44%) and self-employed (44%). Table 1 also shows that majority (61%) of the household heads can read and write, as they have attained primary school education; while, 6% only who cannot read and write have not been to school. Relatively small percent (4%) have attained a university education. The walking distance to access public transport (in terms of time) was 10 min on average. And among the three municipalities in Dar es Salaam city, about 41%, 34% and 25% of the households are from Kinondoni, Temeke and Ilala municipality, respectively.

As mentioned earlier, there are five alternatives or ways of disposing garbage employed by the study. Specifically, the “other alternative" includes options like thrown inside compound, informal waste pickers and burning, which in most cases are environmentally unfriendly. The five alternatives used in this study were basically taken as presented in the structure or design of the 2007 Tanzanian HBS questionnaire. In terms of proportion, Figure 1 presents a clear distribution of the five ways to dispose garbage in Dar es Salaam city.

Patterns on SWD practices

Figure 1 clearly shows the majority of the households in Dar es Salaam city use rubbish bin as their most preferred way to dispose waste, with about 35% of the households. The less preferred alternative with almost 6% of the households was the use of other category to

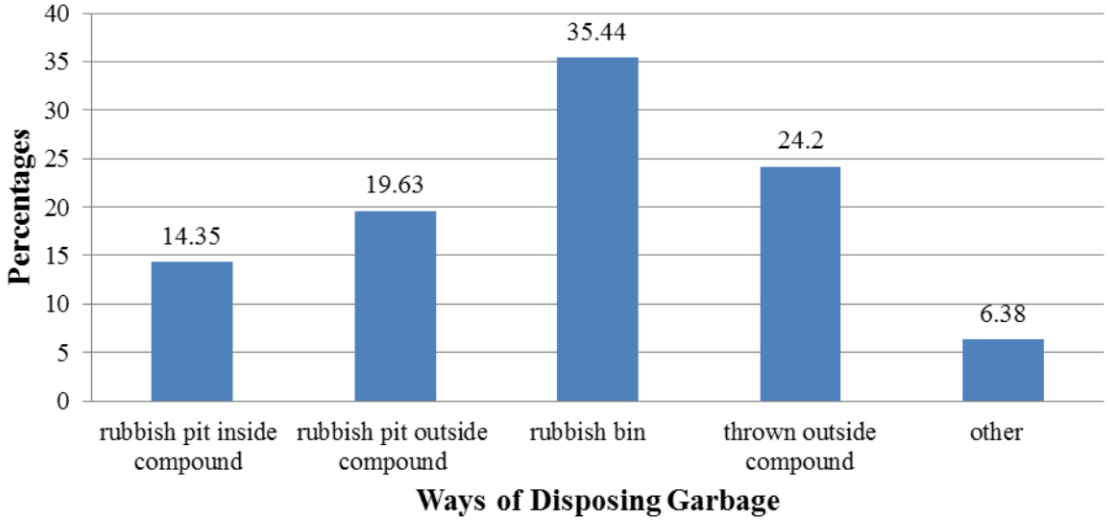

Figure 1. Ways of disposing garbage graphically.

dispose waste apart from the four recognized in the study. study. And the proportions for the rest ranged between 35% and 6%. As far as SWM is concern, those households who cannot afford to buy the rubbish bins were ideally supposed to use the rubbish pit rather than throwing or unrecognized alternative. In this case, the likely reason for not using the rubbish pit might be the shortage of land since the city is almost congested with unplanned settlements in most parts. This is evident in the Tanzania population census for 2002, which reveals about 356,286 people were living in Dar es Salaam in 1967 and it was estimated to be 2.5 million with a 4.3% annual growth rate in 2002. In the latest 2012 Census, Dar es Salaam was found to have a population of 4.4 million accounting for 10% of the total Tanzania Mainland population (Tanzania Census, 2013). The population density again, in 2002 and 2012 was 1,793 and 3,133 persons per square kilometre, respectively, in Dar es Salaam. This limits the land availability for rubbish pit establishment.

MNL and marginal effects estimation

Both the MNL model and marginal effects were estimated to identify the determinants of households' choice on solid waste disposal practices in Dar es Salaam city. The marginal effects basically describe the marginal impact of a certain individual or household characteristics on solid waste disposal choice, and are evaluated at the mean of each characteristic. They also indicate the change in probability of falling in a particular alternative of disposing garbage over a unit change in the given explanatory variable at the mean values, keeping all other explanatory variables constant. All these estimations were done through econometrics software -STATA version 13. The marginal effects are presented in Table 2, and it was found that some of the variables do not have any significant marginal effect on ways to dispose garbage, although their coefficients were significant in the general MNL estimation (Table 3).

The results show that, the household expenditure positively and negatively influence the choice of rubbish bin and rubbish pit outside compound, respectively, as ways of disposing garbage in Dar es Salaam city. The significant influence, however, is small in margin terms almost negligible as it shows that a unit increase (1 USD) in household expenditure increases the likelihood of using rubbish bin and reduces the likelihood of using rubbish pit outside compound for solid waste disposal by less than 1% in both alternatives, respectively (Table 2). With expenditure as a proxy for household income, those households with higher income are likely to buy the rubbish bins for proper waste disposal. The influence of income on waste management in this study is consistent with other studies, for example Chen (2010), Tadesse et al. (2008) and Tadesse (2009).

The age of the household head had significant marginal effect only in using rubbish bin ($p<0.05$). So, one-year increase in the age of the household head increases the probability of choosing rubbish bin by 0.4% (Table 2). Therefore, as the age of the household head increases, the likelihood of using rubbish bin also increases. Consistently, the other findings (Abebaw, 2008; Oguntayo and Obayelu, 2013) show a significant effect of age on waste management. Whereas, the marginal effects of distance on choosing rubbish pit both inside and outside compound were found to be positive and statistically significant ($p<0.05$). Both inside and outside rubbish pit were more likely to be chosen by households staying far from the main road. However, the expectation

Table 2. The marginal effects after MNL estimation.

Variable	Description	Rubbish pit inside compound	Rubbish pit outside compound	Rubbish bin	Throwing outside compound	Other alternatives
exp_adeq	Monthly expenditure per adult equivalent (TZS)	0.00000006	-0.0000007*	0.0000009*	-0.0000002	0.00000004
gender	=1 male, 0 female (household head)	0.013	0.029	-0.013	-0.028	-0.002
agehead	Age of the household head (years)	-0.001	-0.001	0.004**	-0.002	-0.000
distmins	Walking distance to main road/ transport (minutes)	0.003**	0.003**	-0.005	-0.001	0.001
pr1	Proportion of family members with (<15years)	-0.075	0.039	-0.121	-0.044	0.049
pr2	Proportion of family members with (15-30years)	-0.035	0.002	0.069	-0.044	0.008
pr3	Proportion of family members with (30-65years)	0.026	-0.040	0.03	-0.038	0.022
pr4	Proportion of family members with (>65years)	0.103	0.121	-0.356**	0.119	0.013
hhsize	Household size	-0.002	-0.001	0.002	-0.000	0.001
occup1	=1 if household head is paid employee,	-0.013	0.074*	-0.044	-0.008	-0.009
occup2	=1 if household head is self -employed	0.006	0.044	0.008	-0.041	-0.017
pfemale	Proportion of females at the household	0.005	-0.013	0.065	-0.083*	0.026
educ1	=1 if household head has primary schooling	-0.029	0.043	-0.004	-0.034	0.025
educ2	=1 if household head has secondary schooling	-0.041	0.078	0.016	-0.069	0.017
educ3	=1 if household head has post-secondary	-0.031	0.091	0.053	-0.121***	0.007
educ4	=1 if household head has a university degree	0.094	-0.064	0.131	-0.153***	-0.008
tenure	=1 if household own a home, 0 otherwise	0.131***	0.002	-0.107***	-0.026	-0.001
kinondoni	=1 if household is in Kinondoni municipal, 0 otherwise	-0.035	-0.153***	-0.039	0.093	0.134***
ilala	=1 if household is in Ilala municipal, 0 otherwise	0.026	-0.095*	-0.098	0.149**	0.069*

*Significant at 10%; **significant at 5%; ***significant at 1%; predicted probabilities for each outcome: rubbish pit inside = 16.9%, rubbish pit outside = 21.1%, rubbish bin = 32.7%, thrown outside = 21.9% and other = 7.3%. Also, 1 USD = 1200 TZS in 2007/2008.

was, as distance increase a particular household decides to throw garbage outside, considering that the households is "interior" in terms of accessibility which hinders the vehicle to pass and collect garbage. This expectation is supported by other authors (Oguntayo and Obayelu, 2013; Tadesse et al., 2008; Tadesse, 2009). However, the significant margin term is small, since the probability of choosing rubbish pits both inside and outside compound increases by 0.3% for a unit increase in walking distance, that is, one minute (Table 2).

Looking on the education variable however, it seems to be consistent with *a priori* anticipation. Post-secondary schooling and university education negatively affected the alternative of throwing garbage outside, and very significant ($p<0.01$). Meaning that, as compared to no education, those with university education and post-secondary education are less likely to throw outside their garbage, but insignificant for lower education level. In margin terms, those with university education were less likely to throw garbage outside by 15% as compared to those with no education. Similarly, being in post-secondary schooling category reduced the likelihood of throwing garbage by 12% (Table 2). It means that as household head become educated, they tend to choose better ways of disposing waste, also those household head with high level of education like university education are likely to have higher income, and therefore can decide to live in more organized places and opt for better solid waste disposal practices. Consequently, the significant effect of education level on proper waste disposal was also observed in previous

Table 3. Multinomial logistic estimation.

Variable	Description	Rubbish pit inside compound		Rubbish pit outside compound		Rubbish bin		Other alternatives	
		Coeff.	(SE)	Coeff.	(SE)	Coeff.	(SE)	Coeff.	(SE)
exp_adeq	Monthly expenditure per adult equivalent (TZS)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
gender	=1 male, 0 female (household head)	0.202	0.218	0.264	0.220	0.082	0.200	0.099	0.276
agehead	Age of the household head (years)	0.003	0.009	0.007	0.011	0.021**	0.009	0.006	0.012
distmins	Walking distance to main road/ transport (minutes)	0.023**	0.011	0.021**	0.010	-0.008	0.017	0.013	0.011
pr1	Proportion of family members with (<15years)	0.646	0.627	0.390	0.619	-0.168	0.520	0.881	0.803
pr2	Proportion of family members with (15-30years)	-0.009	0.483	0.211	0.481	0.409	0.445	0.313	0.682
pr3	Proportion of family members with (30-65years)	0.326	0.471	-0.015	0.452	0.267	0.398	0.474	0.735
pr4	Proportion of family members with (>65years)	0.066	1.267	0.029	0.942	-1.629	0.904	-0.367	1.558
hhsize	Household size	-0.012	0.044	-0.005	0.051	0.006	0.040	0.019	0.070
occup1	=1 if household head is paid employee,	-0.042	0.278	0.374	0.280	-0.099	0.263	-0.091	0.391
occup2	=1 if household head is self -employed	0.229	0.263	0.397	0.275	0.215	0.216	-0.041	0.409
pfemale	Proportion of females at the household	0.409	0.352	0.319	0.302	0.580**	0.279	0.742*	0.402
educ1	=1 if household head has primary schooling	-0.013	0.280	0.363	0.389	0.142	0.402	0.504	0.384
educ2	=1 if household head has secondary schooling	0.090	0.338	0.689	0.444	0.407	0.467	0.573	0.529
educ3	=1 if household head has post-secondary education	0.522	0.437	1.091**	0.450	0.872*	0.501	0.817	0.571
educ4	=1 if household head has a university degree	1.567**	0.647	0.762	0.687	1.461**	0.668	1.003	0.791
tenure	=1 if a household own a home, 0 otherwise	0.897***	0.197	0.129	0.232	-0.210	0.195	0.111	0.243
kinondoni	=1 if a household is in Kinondoni municipal, 0 otherwise	-0.639	0.429	-1.234***	0.384	-0.543	0.420	1.033**	0.471
ilala	=1 if a household is in Ilala municipal, 0 otherwise	-0.769	0.534	-1.112***	0.419	-0.933*	0.486	0.195	0.468
_cons	Intercept	-1.500	0.797	-1.083	0.668	-0.902	0.763	-3.602	1.201
Number of obs. = 3451; F(76, 76) = 3.26; Prob>F = 0.0000									

SE is linearized standard error; Reference category is the throwing out option; ***, ** and * indicate significance at 1, 5 and 10% levels of significance, respectively. Also, 1USD = 1200 TZS in 2007/2008.

papers in Africa (Abebaw, 2008; Oguntayo and Obayelu, 2013; Tadesse, 2009).

The effect of household occupation was positive and statistically significant for only the paid employee category ($p<0.10$) on choosing rubbish pit outside compound as a major means of solid waste disposal. It implies that paid employees are more likely to use the rubbish pit outside compound as compared to those who are engaged in crop farming and other agricultural activities. Being a paid employee increases the likelihood of adopting rubbish pit outside compound by 7.4% (Table 2). Oguntayo and Obayelu (2013) supports the finding on occupation level affecting proper waste disposal. This can be due to the fact that most of the employed people have attained education and acquired knowledge. Therefore, awareness of the negative environmental impacts can be realized through that knowledge; also through the earnings from, they can employ better ways of disposing garbage like the use of pit and bin.

Among the four proportions of family members according to age, it is only proportion of family members aged above 65 years that have statistically significant marginal effect in using rubbish bin ($p<0.05$). Suggesting that, a unit increase in proportion of family members aged above 65 years reduces the probability of using rubbish bin by almost 36% (Table 2). In other way, house-

holds with many younger members than elders prefer to dispose garbage properly. And perhaps because the old people other way, households with many younger members than elders prefer to dispose garbage properly. And perhaps because the old people are likely to be of less concern with environment as compared to the youths since the youths are still depending on the environment for some years to come. However, it has been observed earlier that the old household head contrarily prefers rubbish bin relative to the rest of the options. Similarly, the marginal effect of proportion of females at the household was statistically significant against throwing ($p<0.10$). In margin term, as the proportion of females at home increases, the likelihood of throwing out garbage decreases by 8.3% (Table 2). It is consistent with prior expectation as long as females are "traditionally" more sensitive with the surrounding environment at home as compared to males. The household size in this study was not significant as compared to other studies for example (Abebaw, 2008).

Furthermore, the marginal effect for home ownership variable was positive and statistically significant in using rubbish pit inside compound ($p<0.01$), while negative and statistically significant in using rubbish bin ($p<0.01$). Those who own a home were more likely to use rubbish pit inside compound than using rubbish bin as compared to those who does not own their home. In marginal impact, those who own their homes are 13% more likely to use rubbish pit inside compound, while reducing the likelihood of using rubbish bin by 10.7% (Table 2). The finding on home ownership was consistent with other studies, for example Oguntayo and Obayelu (2013) on SWM in Nigeria. As expected, those who own their homes are very conscious with the surrounding environment, which makes them to adopt better ways of disposing garbage. The use of a rubbish pit inside compound, also, might be attributed to the space availability at home place. On municipalities, as compared to Temeke municipality, the marginal effects on Kinondoni and Ilala gives a similar pattern in choosing rubbish pit outside compound and other alternative. As compared to Temeke municipality, the households in Kinondoni and Ilala are less likely to use the rubbish pit outside compound, but more likely to use other alternative. Also, households in Ilala are likely to throw their garbage as compared to household in Temeke.

Predicted probabilities

This section present and discuss the various figures for predicted probabilities across three explanatory variables. In particular, the explanatory variables include: age of the household head, distance to access public transport and the monthly expenditure per adult equivalent. The predicted probabilities were computed at different values of explanatory variable by keeping all other variables at their mean values.

Age of the household head

Figure 2 shows that the predicted probabilities for rubbish bin increase with the age of the household head. It starts to increase at small rate and later from the age of 40 years and above increases at a high rate. This demonstrates a clear positive relationship with age as age increases household head tend to use rubbish bin, consistently with findings in Table 2. While the predicted probabilities for throwing garbage outside seems to move against that for rubbish bin. It starts by decreasing at lower rate and then after 40 years, starts to fall sharply with age. This negative relationship between age and predicated probabilities for throwing means that as age increases, the predicted probabilities for throwing tend to decrease. Again, the predicted probabilities for using rubbish pit and other option decreases as the age of the household head increases, however, it is at a decreasing rate. It suggests that age of the household head has little effect or does not explain significantly the above alternatives as compared to the use of rubbish bin and throwing out option.

Distance to access public transport

Predicted probabilities for distance in Figure 3 has two sides in terms of direction that are clearly observed. These directions shows that the probabilities for some of the alternatives are increasing with distance in one pattern and the rest are decreasing in the second pattern. The probabilities of using rubbish pit in both ways are increasing with distance. These patterns support the earlier results in Table 2. In the figure however, the probabilities of using rubbish pit inside compound increases continuously as time to access public transport increases, while that for rubbish pit outside compound increases but later starts to fall down slowly as distance increases. Other pattern is for the probabilities of using rubbish bin, throwing and other which are decreasing with distance and was not significant in Table 2. These predicted probabilities are falling down sharply especially from 200 min onwards. But, the area before 100 min has predicted probabilities that are coming across 0.2 for almost all alternatives (Figure 3). This suggests that when the distance is short from the household to the main road, the probability of choosing ways to dispose garbage does not differ significantly.

Monthly expenditure per adult equivalent

In Figure 4, clearly there is a unique pattern, since it is only predicted probabilities for rubbish bin which increases with monthly expenditure per adult equivalent, but the rest seems to fall slowly approaching zero

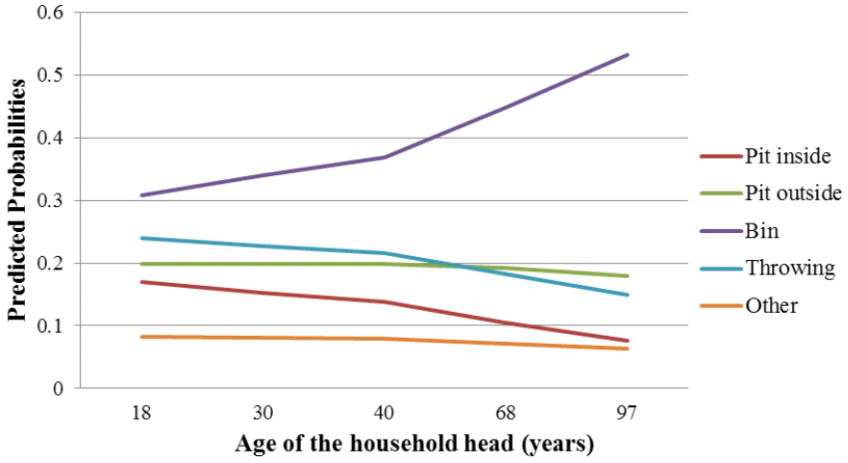

Figure 2. Predicted probabilities across various age levels.

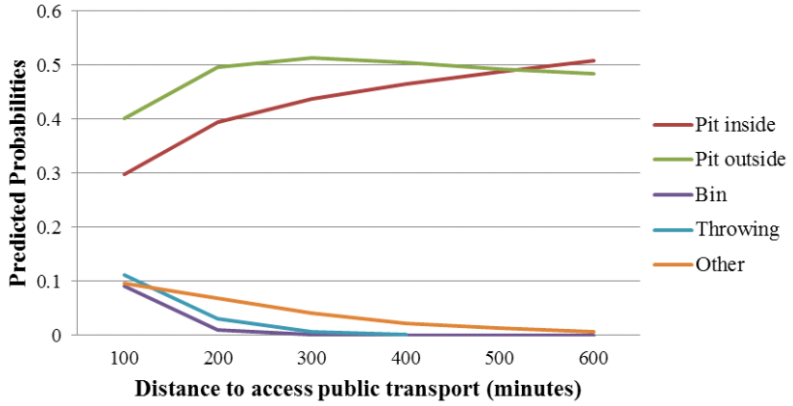

Figure 3. Predicted probabilities against distance to access public transport.

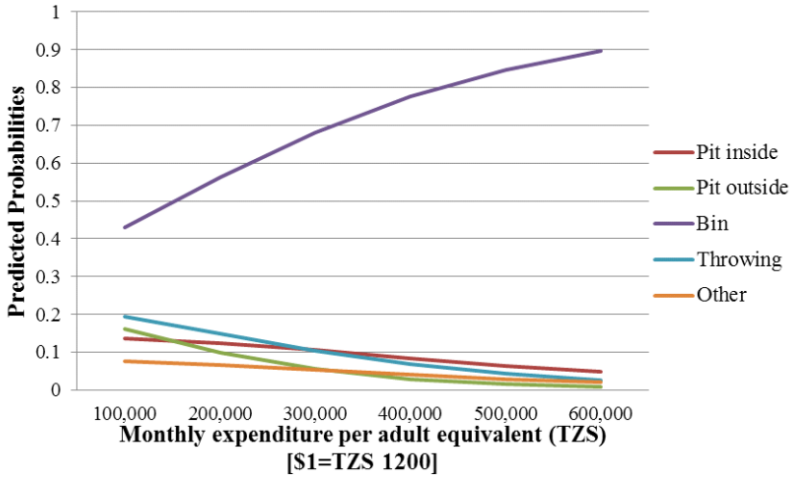

Figure 4. Predicted probabilities against monthly household expenditure.

predicted probabilities. In earlier results (Table 2), the expenditure variable was positively significant in using rubbish bin ($p<0.10$) and negatively significant in using rubbish pit outside compound ($p<0.10$). The predicted probabilities of using rubbish bin increases at a high rate towards one, while that for using rubbish pit inside compound, pit outside compound, throwing and other, stays below the predicted probability of 0.2. Among these, which are below 0.2, at least the curve for rubbish, pit outside compound falls down with significant rate before TZS 300,000 (250 USD). The trend of using rubbish bin is increasing with expenditure, since those with high income are likely and capable to buy rubbish bin instead of adopting other ways. Also, the household heads with high education level are likely to have high earnings (high expenditure), which make them to adopt better ways to dispose their garbage.

Conclusion and recommendations

The aim of the study was to analyse the pattern and correlates of choosing ways for solid waste disposal in Dar es Salaam city. This was done through ranking the given five ways to dispose garbage according to the usage frequency and to identify the influential factors in choosing ways to dispose garbage. By ranking the alternatives of solid waste disposal, the study found the rubbish bin to be used most, followed by the option of throwing garbage outside, the use of rubbish pit outside compound, rubbish pit inside compound and others.

This study went further to employ the MNL model given the nature of the dependent variable, which is in categorical form. In this case, the MNL has to capture the correlates of solid waste disposal practices. The proposed correlates were taken as explanatory variables during estimation, and the actual correlates were determined by statistical significance in marginal effects. The estimation results show that distance to access public transport and tenure increases the likelihood of using the rubbish pit inside compound. It was further identified that the probabilities of using the rubbish pit outside compound increases with variables like distance and occupation, while it decrease with the household expenditure and in Kinondoni or Ilala municipal. Again, the chances of using rubbish bin as a way for disposal was found to increase with the household expenditure and age of the household head, while it decreases with the proportion of family members above 65 years and tenure. Throwing garbage, however, was not chosen by the household heads with high level of education (like post–secondary and university education), also families with high proportion of females. Generally, the findings in this study are consistently with other studies on SWM practices (Abebaw, 2008; Chen, 2010; Oguntayo and Obayelu, 2013; Tadesse et al., 2008; Tadesse, 2009).

Given the findings summarized above, the study showed some suggestions that could be useful in one way or another to responsible authorities in improving the SWM in Dar es Salaam city. First of all, there is a need to improve policies that are designed to reduce poverty in general, since poor people who are living in urban areas (in informal settlements/squatters specifically) practices unsafe SWM. Also, there is a need to improve the schooling enrolments together with the completion rate. Alternatively, education can be offered through mass education, environmental seminars and several media advertisements on how to manage waste. Ideally, education can open up the residents' mind and change their attitude towards unsafe waste disposal. Furthermore, with the home ownership being significant determinant, government should create some incentives, which will attract households to build their houses instead of renting. Also, mortgage could be the best way to adopt, especially if the government could provide environment, which would encourage financial institution to venture into home financing. About congestion and unplanned settlements, the city authority through regional and urban planning department should take this into consideration, especially in new settlements where people are currently building their homes at high rate. This might reduce not only unsafe solid waste disposal, but also help the municipal vehicles to collect garbage properly. Finally, this study recommends the city to supply enough municipal waste containers on streets to increase the number of municipal vehicles for garbage collection and to ensure the regular collection. And more broadly, for sustainable SWM in urban areas, participation of the government, private sector and residents is required (Ezebilo and Animasaun, 2011).

Conflict of interest

The authors did not declare any conflict of interest.

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Appendix 1. Scaled map of Africa, Tanzania and Dar es Salaam city.