Determinants of Households Willingness to Participate In Solid Waste Separation for Reduce, Reuse and Recycle: The Case of Dar es Salaam

Joel Monella & Vincent Leyaro*

Abstract

Using households as units of analysis, and Dar es Salaam as a case, this study employs the logistic regression model to investigate and assess factors that determine households' willingness to participate in wastes separation for reuse and recycle. Analysis based on descriptive statistics established that out of 450 households, most respondents (60%) are not aware of wastes separation and sorting for reduce, reuse and recycle. Of those who aware, only a few engaged in wastes separation and sorting for reduce, reuse and recycling; and even for these, the sorting is only limited to plastics bottles (more than 70%). Regression results find that households' willingness to participate in domestic waste separation and sorting for reuse and recycle is influenced by array of factors, including: education, household's level of income, wards handling status, incentive in terms of monetary and peers influence—all these are statistically significant. To enhance higher levels of household participation in wastes separation and sorting there must be stronger stakeholders' participation and involvement in issues of waste collection and management in urban areas; and proper channels for enhancing knowledge and awareness about waste collection and management. More importantly, wastes separation at source is critical to effectively implement the 3Rs initiative, which is today perceived as solutions to challenges of managing wastes as well as offering income to material sorters, generate employment and promote industries and local artisans who utilizing reuse and recycled materials.

Keywords: solid wastes, recycle, urban Africa, Dar es Salaam

1. Introduction

Managing solid wastes is one of the main challenges facing most urban areas in the world. The challenges are even worse in developing and low-income countries, like those mostly found in Africa, due to rapid urbanization; where the capacity to provide adequate basic services such as water and sanitation facilities, transport infrastructure and waste collection and management are in poor state, and even lacking in most of areas (UNCHS, 2001). Like in many other urban areas, urban areas in Tanzania are no exception to the challenges of solid wastes management. According to United Nations Report (2010), Dar es Salaam—with a population estimated at 4.36 million that accounts for 10% of the total Tanzania Mainland

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population—is the fastest growing city in Africa (UN-HABITAT, 2010; Population Census, 2012).

Rapid urbanization in most of urban areas in Africa has been mainly due to the rural-urban migration, especially of youths in search for jobs and better life. Labour is attracted to urban areas because of low agricultural productivity in rural areas that has failed to absorb the growing population. This has increased pressure on informal sector in urban areas, hence effective unemployment rises and/or the fall of average earning to accommodate the growing labour supply (Leyaro *et al*., 2013). Consequently, rapid urbanization has brought with it many problems, which include: poor infrastructure and congestions, poor cities planning and mushrooming of slums/squatters, lack of housing, shortages of food, water and energy, and the challenge of creating employment for an increasing labour force.

Mushrooming of unplanned suburbs (slums and squatters) in towns and cities has further worsened the challenges of solid wastes management. In Tanzania, for instance, low and irregular earnings in the informal sectors in urban areas has forced urban dwellers, especially youths with their families, to live in unplanned suburbs with low and poor standards of living; unable to pay for basic services including proper wastes management. This is a serious problem because studies have shown that more than 70% of city dwellers in Tanzania live in informal and unplanned settlements with very poor access to basic social services, including poor solid wastes management systems. Conditions in these informal settlements (squatters and congested slums) are worsened by poor sanitation and drainage system, poor wastes collection and disposal practices such as wastes burning, illegal wastes disposal in water bodies that leads to waterborne diseases such as cholera, typhoid and other social hazards (Kyessi & Mwakalinga, 2009; Sawio, 2008; Kironde & Yhdego, 1997). Due to lack of proper wastes collection and disposal, only 40% of solid wastes in Dar es Salaam is collected; while the big chunk, about 60%, is left uncollected and is roughly disposed into drainage ditches, streams and by the roadside (Lyeme, 2008; DMD, 2011; Breeze, 2012).

Solid wastes management (SWM) implies the collection, storage, transportation, processing, treatment, reuse, recycling and final disposal of wastes (Rouse, 2008). The separation of solid wastes is a critical starting point to enhance the 3Rs initiatives approach of ***reduce***, ***reuse*** and ***recycle*** activities that depends very much on willingness to participate in wastes separation at generation points (Banga, 2013). When all kinds of wastes are mixed up in a single storage facility without separation in the first place, and then transferred to designate areas for disposal, it then becomes very difficult to recover them for reduce, reuse and recycle. As households are the main generators of wastes, contributing to over 50% of the total collected wastes in Dar es Salaam, the key question this study is to examine what determines and influence households' willingness to participate in wastes separation for reduce, reuse and recycle.[1] Thus understanding households'

[1] Separation activities include sorting and separating waste in different bins depending on their type, designing recycling programs that suit them effectively, placing bins on proper place and at right time to enhance collection and so forth. The participation of households at their respective locations

behavioral factors (and determinants) that influence their involvement in solid wastes separation for reduce, reuse and recycle are important first in implementing the 3Rs imitative approach as well towards both reducing the austerity of poor wastes disposal and tapping the many benefits of wastes management.

Base on consumer's random utility theory, where consumer chooses from different alternatives, the main objective of this study is to establish and assess determinants of households' willingness to participate in wastes separation for reduce, reuse and recycle, and to provide recommendations for improving solid wastes management in Dar es Salaam. In particular, the study aims to assess households' awareness and willingness to participate in wastes separation, and factors that enhance higher participation rates for the separation for the 3Rs. Besides this introduction section, section two looks at the state of solid wastes management and its challenges in urban Tanzania, particularly Dar es Salaam; while section three reviews empirical studies in the region that have looked on the wastes separation for reduce, reuse and recycle. Section four deals with the analytical framework, approaches and data used. Descriptive statistics and main results are in section five, while section 6 concludes and give implication of this study.

2. State of Solid Waste Management in Cities and Urban Areas

2.1 Overview of Solid Wastes Management

A World Bank study on the status of world cities by Hoornweg *et al*., (2012) shows that cities across the globe generate about 1.3 billion tons of solid waste per year, which is expected to increase to 2.2 billion tons by 2025. In lower income and poor countries, that situation is expected to be even worse given scarce resources in terms of budget allocation and low capabilities and inefficiencies in addressing solid waste management challenges regarding collection and disposal. Generally high income countries are in better position to carry management operations than the least developed and poor countries as shown in Table 1.

Cognizant of the challenges and negative effects that solid wastes have across cities and urban areas, hence the pressing need to address them, the global community have a taken a number of initiatives, including a number of conferences and summit to address solid waste management challenges. What follows are some of the initiatives that have focused on addressing solid wastes management challenges, and how Tanzania have attempted to accommodate the suggestions.

World Summit on Sustainable Development: In its Agenda 21, the United Nation Environment Program (UNEP) advocated that environmentally sound waste management must go beyond the mere safe disposal or recovery of wastes. Programs embodied in the Agenda 21 include: minimizing wastes, maximizing

will enhance households to enjoy the multi-dimensional benefits accruing from recycling and ultimately improve solid waste management and their livelihood.

environmentally sound waste reuse and recycling, promoting environmentally sound wastes disposal and treatment, and extending wastes service coverage. The emphasis of the summit is that all countries to well integrate the four programs to ensure a comprehensive and environmentally responsive framework.

Table 1: Solid Waste Management in D*ifferent Income Groups*

Activity	**Low income**	**Middle income**	**High income**
Source reduction	no organized program, no public awareness	discussion are presented but rarely implemented	Greater emphasis of 3Rs (Reduce, Reuse and Recycle)
Municipal solid waste generating rate (kg/capita/day)	0.6-1.0	0.8-1.5	1.1-4.5
Collection overall rate	sporadic and inefficiency below 50%	improved services between 50%-80%	very formal above 90%
Recycling	informal (waste pickers) unregulated markets for recycled products	formal and informal regulated market and open dump	high level of technology sorting and processing
Disposal of waste practice by generators	open dump, burning, in water bodies and along roads	controlled sanitary landfills, CDM projects	well monitored, sustainable sanitary landfills system
Examples of relevant Countries	India, most Africa and South America cities	Malaysia, Costa Rica, Venezuela	US, UK, Tokyo, Sweden Germany

Source*:* Author's construction from Hoornweg *et al*., (2012)

Millennium Development Goals (MDGs)*:* Goal Seven (7) among the 8 MDGs as adopted by United Nation General Assembly in 2000 concerns 'Environmental Sustainability'. Again, the goal targets is to integrate the principles of sustainable development into country's policies and programs, reverse loss of environmental resources, achieve significant improvement in lives of at least 100 million slum dwellers and to halve the proportion of urban population living in slums with poor states of wastes by 2020.

The G8 summit initiative on 3R's*:* In June 2004, the G8 Summit launched the '3R Initiative'. This initiative aimed at building a global recycling-oriented society through promoting the three R's, namely: reduce, reuse, and recycle. As far as foreign aid to third world countries is concerned, cooperation in areas such as capacity development, raising public awareness, and the implementation of recycling projects is being sought through this initiative.

Solid Waste Management Regulations in Tanzania*:* As a signatory to several global and regional conventions and treaties, Tanzania has also ratified a number of conventions with relevance to environment and sustainable development. For instance, it is not lagging behind in implementing Agenda 21 of World Summit on Sustainable Development as it committed itself in the preparation of the following: the National Conservation Strategy for Sustainable Development (NCSSD); the National Environmental Action Plan; convening of a national workshop in March 1993 to translate Agenda 21 into a national agenda; the preparation of the National Environmental Policy (NEP); enacting the Environmental Protection Act (EPA); and capacity building program planning for sustainable development at central and local government in line with issues of wastes management.
Tanzania has also reviewed a Solid Waste Management Regulation Act in 2009 that specifically focuses on solid waste management issues, and understanding of the essential linkages between environment and development covered by the National Environmental Policy of 1997. The overall aim of the regulation is to ensure improvement of the roles of authorities to regulate, guide and supervise environmental management goals. Moreover, Tanzania enacted the Environmental Management Act in 2004 that provides for the establishment of a National Environment Management Council (NEMC) to coordinate environmental issues at the national level. The role of NEMC is to act as the leading technical advisory, co-coordinating and regulatory agency, which is responsible for protection of environment and sustainable use of natural resources.

Out of these summits and regulations, it is clear that solid waste management is a global agenda. It follows that all countries should adhere to the stipulated efforts to address waste challenge. Since the focus of this study is Dar es Salaam city, the next section focus on waste generation, collection and disposal in Dar es Salaam, and initiatives with regard wastes separation for reduce, reuse and recycle.

2.2 Solid Wastes Generation, Collection and Disposal in Dar es Salaam

Solid Waste Generation

Sources of solid wastes generation in Dar es Salaam are mainly residential places, commercial and market places, industries, public and private institutions such as healthcare, educational establishments, sports facilities, etc; and other like street sweepings, public park wastes, construction wastes, etc. Of these groups, as shown in Fig. 1, households records the highest share of wastes generation, ranging from 52–80 % (Okot-Okumu, 2012). Others account only for a small share.

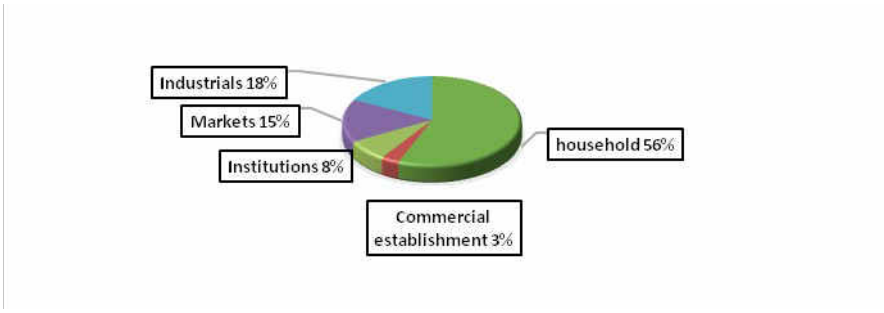

Figure 1: ***Waste Generating Sources and their percentage in Dar es Salaam***
Source*:* Author's modification from Kaseva and Mbuligwe, 2005

Rapid urbanization and increasing population growth in Dar es Salaam, as noted earlier, are the main factors behind increasing solid waste generation by households. Also contributing to this are industrial and other activities that have not been matched with increase in the capacities in collection and disposal services due to budget deficits and other inefficiencies. In 2006, Dar es Salaam city generated 3,350 tones of solid waste at the rate of 0.815kg/cap/day, which is estimated to increase to over 12,000 tons per day by the year 2025. Given the observable and estimated trend, it follows that if stakeholders fail to find a workable solution to the existing challenges, then the future state of the Dar es Salaam city will be in jeopardy (Mkwela & Banyani, 2008). Table 2 decomposes further the composition of wastes in Dar es Salaam by the type of wastes materials.

Table 2: *Composition and Weight of Waste in Dar es Salaam*

S/N	Waste material	Weight
1	Kitchen waste	9%
2	Plastic	16%
3	Paper	8%
4	Textile	5%
5	Grass/wood	10%
6	Metal	5%
7	Glass	2%
8	Leather and rubber	6%
9	Stones and ceramic	6%
10	Others	3%
	Total	**100%**

Source: DCC, 2004

Solid Waste Collection
There are different waste storage practices, with the more affluent households using big dustbins containers; while sacks, plastic bags, cut jerry cans and cardboard boxes are mainly used by the less affluent ones. There is no sorting as

such, but households separate components of wastes considered of value – e.g., plastics, food leftovers, plastic bags, bottles, plastic tins and scrap metals—the rest of waste is usually stored mixed. Waste separation also takes place at transfer stations where pickers search for materials worthy for resell. The rest is moved on transit to landfill or dump sites where sorting is also done.

The solid waste management performance in Dar es Salaam city has been relatively better following privatization of collection and disposal services by the Dar es Salaam City Council (DCC) to NGOs and CBOs groups from 1994. The DCC adopted concession methods other than contracting and outright sale to privatize the services, which involves handing private operators tasks to provide solid waste collection and transfer to dumpsite, as well as collecting refuse charges from waste generators on behalf of the DCC (JICA, 1996). Before this move, DCC had failed in providing efficient and reliable refuse collection services. For instance, in 1992 only 2-5% of Dar es Salaam solid waste was collected (ILO, 2004). The collapse of the solid waste management by the DCC led to the city experiencing unhygienic conditions, including bad smells around accumulated large mounds of garbage, along streets roads, in open spaces, at market places, and in the aged systems of drain (Majani, 2000). Planned areas were the only ones mainly served with refuse collection services, with a few unplanned settlements—which consists of more than 70% of urban populations—was being served with informal collection agents (Halla, 2002).
Despite the existing challenges on waste management in Dar es Salaam, the privatization of waste management services has led to improved daily refuse collection of total generated waste from 12% in 1994 to 40% in 2007, creating employment and income opportunities to people engaged in collection and disposal of wastes, especially youths who would otherwise be unemployed (Kaseva & Mbuligwe, 2005). It is worth noting that the privatization of solid waste management by DCC has led to the absence of systematic assessment of the extent to which the strategy has benefited the poor in terms of access to waste services.

The curve for waste generation Fig. 3 is clearly above collection levels. This is mainly due to the increasing annual growth rate (5.6%) of the city population in 2012, compared to 4.3% in 2002. In 2011, DLAs estimated that about 4,200 tons per day of solid waste was being generated in Dar es Salaam (Breeze, 2012). Fig. 3 shows that approximately 41% of the generated waste is collected in Kinondoni. This was the highest amount, compared to 39% in Ilala and about 27% in Temeke.

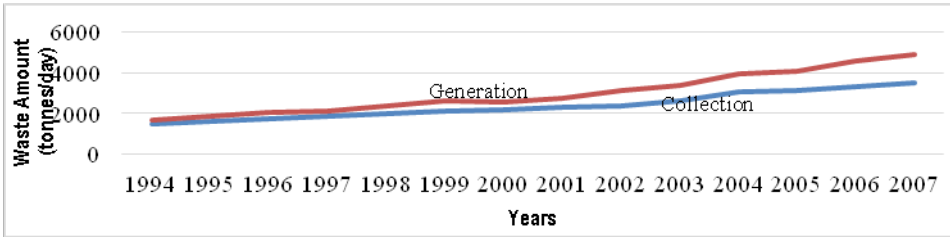

Figure 2: ***Dar es Salaam City Waste Amount and Trend 1994-2007***
Source*:* Author's own construction from Dar es Salaam city report, 2009

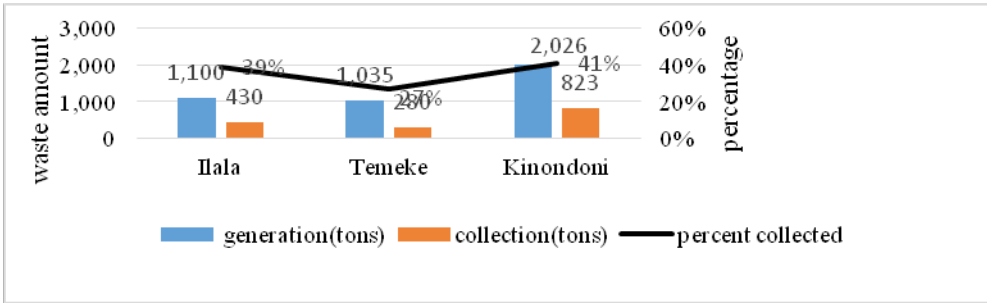

Figure 3: ***Dar es Salaam Municipals Waste Generation and Collection***
Source: Author's own construction from DMD project, 2011

Private companies and CBOs still face challenges to maximize the goal for improving waste management in Dar es Salaam. A failure of the concession method has been a result of both poor financial capacities of the private agents to meet contractual obligation and constraints from the government to provide supportive structures like roads, and proper urban land use planning (Gary & McCubbins, 1996). The absence of proper locations for waste transfer and treatment, poor routing systems and charge non-compliance by low income earners need to be properly addressed. Currently, collection system in Dar es Salaam operates in the following ways: door to door, community bins, curbside pick-up, self-delivered, and contracted or delegated services. As per privatization approach of solid waste collection services from 1994, these waste collection designs are classified into primary and secondary collection designs.

On average, only 40% of the generated waste in Dar es Salaam is collected, of which less than 10% is collected by three municipalities, 24.4% by private contractors, and 5.5% through recycling by municipal authorities. The rest (about 60%) is illegally dumped in open places, along roads, in water bodies, and so forth (Kaseva & Mbuligwe, 2005).

Solid Waste Disposal

Solid waste disposal in Dar es Salaam is done both formally and informally. There are disposal practices by households and by waste collectors. Households with enough space, especially in affluent localities, practice waste burying, burning, and at times compost a large fraction of their waste; while other households hand it to waste collectors who are responsible for arranging final disposal operations. The use of waste collectors, waste burying, compositing and pits at peripheries are considered as acceptable ways, whereas illegal dumping in streets, rivers valleys and unnecessary burning are considered as unacceptable ways as they expose the public to health hazards that may, for instance, lower the quality of life for urban residents and other living organisms in their habitats (Mkwela & Banyani, 2008).

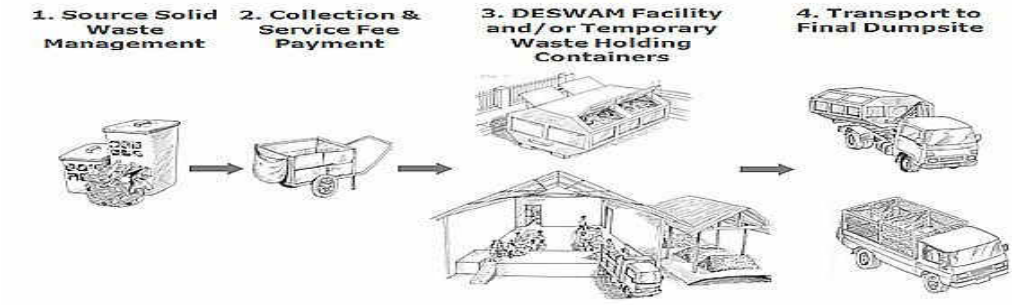

Figure 4: ***An Illustration of Waste Storage, Collection, Temporary Transfer and Disposal Points***

Source: Author's own construction

The dumpsite at Pugu Kinyamwezi, 30km from city center, is the current final dumpsite for solid waste in Dar es Salaam city. The dump started operation in 2009 to date after the closer of previous dumps, which due to poor management had led to discomfort to people residing near the dumps. These were Tabata (1961-1991), Mbagala (1992), Vingunguti1 (1992-2001), and Kigogo (2007-2009). The Pugu Kinyamwezi dumpsite is projected to serve the city for ten years (UN-HABITAT, 2010). Operations in the dumpsite include waste spreading, covering waste with soil material, and fumigation.

Thus, although there have been a number of efforts to address wastes management challenges in Dar es Salaam—including stakeholder collaborations, encouraging informal sector participation, and development of technological innovations for material recovery and recycling—little has been done to overcome these challenges to date (Lyeme, 2008). The level of recycling in Dar es Salaam is still very low: it is estimated that only around 200–750 tons are recycled per day,

which is about 5–18% of total collected wastes stream (Breeze, 2012).[2] Associated with recycling activities are waste reduction and reuse approaches, which are considered as sustainable approaches to urban solid waste management since they bring benefits to participating community. These benefits include: reducing pollution; improved health; promotion of recycling entrepreneurial and compositing activities through readily available sorts; income generation to individuals, especially poor urban dwellers through selling of some sorted wastes; and income even to the government from taxes.

3. Empirical Review of Literature

A good number of studies have looked at the challenges of solid wastes management in developing world and Africa (Banga, 2013; Abbot et al. 2013; Oladeyede et al. 2010; Mona, 2010; Budak & Oguz, 2008; Lyeme, 2008; Billitewski, 2008; Kamara, 2006; Jenkins *et al*., 2000; Oskamp et al. 1991; Ebreo, 1990; De-Young, 1988). Generally, studies have focused on aspects of demographic attributes such as age, gender, income and household size, awareness and attitude, economic incentives, the role of government and contextual factors. In Tanzania, the focus of most studies has been on technical issues of waste generation, collection and disposal as the primary aspects indicating the magnitude of solid waste challenges to the management authorities in urban centers.

Banga (2013) employed a logistic regression approach to assess domestic solid waste separation and recycling in urban Kampala City of Uganda. It is a cross sectional study of 500 households from five administrative units covering low, medium and high income groups, which are obtained through stratified sampling technique. Among the determinants, gender and education level were also found to explain separation behavior in Kampala. For the case of gender, females were willing to separate waste than males at 5% significance level, while education was negatively related to separation behavior at 10% significance level; implying that people with higher education probably earn higher income enough to afford paying for refuse charges. Income was found to be negatively related to waste separation significantly at 10% significant level. The study further recommended for intensive awareness campaign and increased accessible classified waste collection centers in all residential urban Kampala since awareness also significantly influenced household waste separation behavior.

On the other hand, a material specific analysis study on determinants of household's participation in solid waste recycling behavior by Jenkins et al. (2000) revealed social-economic variables of household's income, family size, age and educational

[2] The solid waste generation in Dar es Salaam increased from less than 2,000 tonnes per day in 1998 to approximately more than 4,200 tons in 2012, with waste generation rate of 0.93 kg/cap/day is a threat to the City Council authority and it has kept getting worse (Breeze, 2012).

level as the main determinants of household participation in solid waste recycling behaviour. The use of ordered probit regression model found the relationship of household income, education and household size to be positive and significant.

A similar positive influence of education and income was found by Kamara (2006) from a study on household participation in domestic waste disposal and recycling in the Tshwane Metropolitan area of South Africa. A random representative sample of 46 household was selected with a combination of low, medium and high income groups from which a thorough descriptive analysis was done. The study found out that higher income earners sorted waste more than the medium and low income groups. Education also influenced higher participation. The study recommended the strengthening of environmental education not only in schools, but also through formal and informal outreach programs.

Assessing household participation in recycling program, Budak and Oguz (2008) found out that the variables of education, household income, household size, number of adults, and mean age had no significant role in influencing participation in recycling activities. This particular study used logistic regression for 224 randomly selected household from a pilot source separation and recycling project area in Turkey using face-to-face interviews based on pre-tested questionnaire. Significant positive relationships were found in the variables of knowledge about recycling program, living in apartment with refuse service and house ownership, with knowledge showing the most statistically significant relationship at $p<0.001$. A similar result of no significant influence for variables age, sex, education and income on household participation in recycling programs is revealed by Oladeyede et al. (2010).

De-Young (1988) explored the difference between recyclers and non-recyclers on waste sorting and recycling activities. Households were asked to hand out sorted recyclable materials for collection over a three-month period. Using a survey instrument, 200 households were administered with a questionnaire focusing on a five point Likert scale of pro-cycling attitude toward recycling, frugality (satisfaction derived from recycling), extrinsic motivation, triviality of recycling programs, and perceived difficulties in carrying out recycling. A descriptive study using a two way Anova analysis found that recyclers and non-recyclers were not different in terms of attitude on recycling as they both described it to be a good idea. Similarly, the two groups were indifferent in terms of the degree which they derive personal satisfaction, extrinsic motivation, and the degree which they view recycling as a trivial activity.
However, the higher score for non-recyclers was on perceived difficulties; suggesting that the role of awareness of materials sorting, storage and points for assistance was very crucial to promote higher participation of households on recycling. The study advocated that authorities work on other aspect rather than

the notion that non-recyclers had a bad attitude on recycling. On the contrary, studies by Oskamp et al. (1991) and Vining and Ebreo (1990), found a positive correlation between attitude and recycling behavior resource.

Monetary incentive—through paying less for individuals that sort their waste—may have an influence in promoting sorting behavior. Mona (2010) and Billitewski (2008) show that economic incentives through charging less refuse fees to individuals who sorted waste, compared to those who did not sort, motivated people to sort waste. Abbot et al. (2013), however, show that it is personal satisfaction, driven by personal altruistic values and beliefs for positive behavior, rather than an influence of monetary rewards that determined recycling behavior.

Using Mixed Integer Programming (MIP) model, Lyeme (2008) designed an optimization of solid waste management system in Ilala, Dar es Salaam that resulted in reducing municipal transport costs from TAS 14,000,000 to 10,969,252 per day. To attain these advantage however the study advocated for capacity reforms among solid waste management stakeholders. The institutional reforms, management designs and arrangements concern stakeholder collaborations, development of technological innovations for solid waste management, enhancing informal sector participation through knowledge provision; and composting, incineration, conversion to bio-gas and related activities

4. Empirical Strategy, Approach and Data

4.1. Theoretical Framework

From economic theory, just as a consumer is faced with different consumption bundles to choose from, so is a household faced with a choice of whether or not to get involved in wastes separation. This study supposes that household chooses whether or not to sort wastes before final disposal depending on the utility to be derived from such a choice. Since the choices are not ordered, an individual can randomly make a choice given his/her own reasoning. This gives rise to the use of random utility theory, which asserts that utility derived from a particular choice is a linear function of two components: observed component and unobserved component (Verbeek, 2004).

A rational individual is expected to make a choice that derives the highest utility given its cost and benefits. This is to say household i will choose a practice j of storing waste if and only if $U_{ij} > U_{ik'}$ for $k \neq j$. Utility derived from whether or not separating waste before disposal is in this respect a function of household social-economic characteristics plus a random component presented as follows:

$$U_{ij} = \beta X_{ij} + \mu_{ij} \qquad (1)$$

where is observed variable influencing choice of practice, β is parameter, and μ_{ij} is unobserved random component.

Having a random component in the utility function simply means that we cannot ascertain an exact values of utility, thus we need to give the probability estimates of a certain event happening, hence we use probability models. Given the choice variable, the dependent variable in the study is binary, taking values $Y = 1$ if household is willing to participate in separation of domestic solid wastes, and $Y = 0$ otherwise; hence we use a binary qualitative model. The probability of the choice can be formally written as:

$$P_i(j) = P_r(U_{jh}) \geq U_{kh} \quad (2)$$

and

$$P_i(k) = 1 - P_i(j) \quad (3)$$

where j is willingness to separate wastes, k is willingness not to separate wastes, and h is the household.

4.2 Estimation Technique

For a qualitative response study like this, three approaches may be used. These are Linear Probability Models (LPM), Logit Model (LM), and Probit Model (PM). However, the validity of LPM has been criticized on the basis of non-fulfillment of strict assumptions for linearity, which include: non-normality of disturbances μ_i's; heteroscedastic variance of disturbances μ_i's; non-fulfillment of $0 \leq E(Y_i/X_i)$ and Constant Marginal Effect (CME) change of probability (Banga, 2013; Achapan, 2012; Budak and Oguz, 2008; Kirakozian, 2014). Despite the fact that most of the problems in LPM are surmountable by applying relevant statistical measures, the fundamental problem with the LPM is that of constant marginal effect change of probability. It is this problem that gave rise to alternative approaches to LPM, which are logit and probit models. The probit model is not so much different from the logit model: the main difference is that the probit model assumes cumulative normal distribution (Gujarati, 2004). This study adopts the use of the logit binary model due to its comparative mathematical simplicity, and the fact that it has been widely used in most empirical work associated with households' willingness to participate in domestic wastes separation for recycling.

The Logit Model

Logit model assumes a cumulative logistic probability function which can be represented by:

$$P_i = E(Y_i = \frac{1}{X_i} = \frac{1}{1 + e^{\beta_0 + \beta_1 x_i}} \quad (4a)$$

or

$$P_i = \frac{1}{1+e^{-z_i}} = \frac{e^{z_i}}{1+e^{z_i}} \quad (4b)$$

where $Z_i = \beta_0 + \beta_1 X_i$, and if P_i is the probability that a household is willing to participate in domestic waste separation for recycling then $(1 - P_i)$ is the probability that a household is not willing to participate in domestic waste separation for recycling. Hence:

$$1 - P_i = 1 - \frac{e^{z_i}}{1+e^{z_i}} = \frac{1}{1+e^{z_i}} \quad (5)$$

where $P_i/1 - P_i$ is the odd ratio in favor of household's participation in domestic waste separation for recycling. Applying the natural logarithm on the odd ratio equation results into:

$$L_i = \text{In}\frac{P_i}{1-P_i} = \text{In } + e^{z_i} = Z_i = \sum_{i=1}^{k} \beta X_i \quad (6)$$

L_i is called the logit, hence the name logit model, whose odd ratio is not only linear in X_i, but also linear in the parameters. Therefore, inserting variables to specification (6) give us the binary model:

$$Y_i = \text{In}\left[\frac{P_i}{1-P_i}\right] = \alpha + X_i'\beta + \mu_i \quad (7)$$

where P_i is the probability that household participate in domestic waste separation activities, X_i are a range of the explanatory variables that captures the factors that can influence households willingness to participate in the sorting and separation for reduce, reuse and recycle.

4.3. Data Sources and Sampling Framework

This study makes use of micro-survey data where, given resources and time constraints, Dar es Salaam and wards underneath were chosen purposively to allow for rich, medium and poor neighborhoods (10% of all wards were chosen, which is the same as 11 wards).[3] A random sampling was applied in each ward to obtain at least one street, making a total of 11 streets; and in each street a random sampling technique was used to obtain households as a unit of analysis.

[3] This include Mikocheni, Mbezi Beach and Kijichi as more affluent areas, Tabata Segerea, Mianzini and Ubungo as affluent and Vingunguti, Mwananyamala, Miburani and Gongo la Mboto as less affluent areas.

On average, 50 households were sampled for each ward, making out a total sample of around 450 households.

In the household, the respondent chosen was someone who was responsible for wastes management and had knowledge of other household characteristics, including income. In most cases female spouses were purposely chosen as respondents. In their absence, we chose an adult member involved in wastes management. Thus female respondents make about 81.6% of the total sample. Of the total, 47.3% of respondents had a primary education, and 20.9% had a tertiary education. This is despite that fact that 78.7% of the households were male-headed, and only 21.3% were female-headed. Of the women, 74.7% were married, 10.2% were singles, and 7.8% were widows. Most families had an average of 4.9 members, which is more or less equivalent to the national average of 4.8 members. Interestingly, the study confirmed that about 70.2% of the resident household heads were not born in Dar es Salaam, with approximately 93.4% coming from rural areas. A questionnaire was administered to each household to get the required information. Table 3 presents the key variables used in this study.

Table 3: Description of variables, their definition and expected signs

Variable	Description	Expected sign	Mean	Std. Dev.	Min	Max
Age	Age of respondent engage in waste issues	[+]	34.084	11.438	18	73
Education	Respondent education (years of schooling)	[+]	11.829	5.957	0	21
Gender	1=Respondent is male, 0 otherwise	[-]	0.1844	0.388	0	1
H-Size	Number of adults and children feeding from the same household	[+]	4.9311	2.192	1	15
Income	Average monthly expenditure	[+/-]	13.368	1.1632	10.6	17.09
Handling	1=Good waste handing in the ward as perceived by respondent, 0 otherwise	[+/-]	0.6067	0.489	0	1
Awareness	1=Aware of waste separation, 0 otherwise	[+]	0.4444	0.497	0	1
Peers	1=Peer participation has influence on household, 0 otherwise	[+]	0.9822	0.132	0	1
Incentive	1=Monetary incentive, 0 otherwise	[+]	0.0667	0.249	0	1
Districts	Dummies for Ilala, Temeke, Kinondoni being reference category	[+/-]	0.3333	0.472	0	1

Source: As for Table 1

5. Empirical Results and Discussion

This section presents the main findings, starting with descriptive and data analysis, followed by regression results. The regression results enhance and compliment what we have in descriptive statistics, so the two enhance and compliment each.

5.1 Descriptive Statistics and Data Analysis

Waste disposal and management practices among households

The descriptive statistics began by exploring what has been the pattern of wastes collection and disposal in Dar es Salaam as shown in Figure 5 and Table 4. Figure 5 clearly shows that most households (78.4%) use waste collectors for solid waste disposal. However, households combined more than one way to dispose waste, depending on the circumstance like inability to pay for refuse disposal fees, or delays in collection. About 21.1% of respondents, especially those with enough space area, disposed wastes in their backyard by burrying or burning them. Non-conventional wastes disposal are also evident, where 7.3% disposed their solid domestic waste along streets and in informal dumps, 0.9% along rivers, and 0.4% in valleys (*'korongo'*).

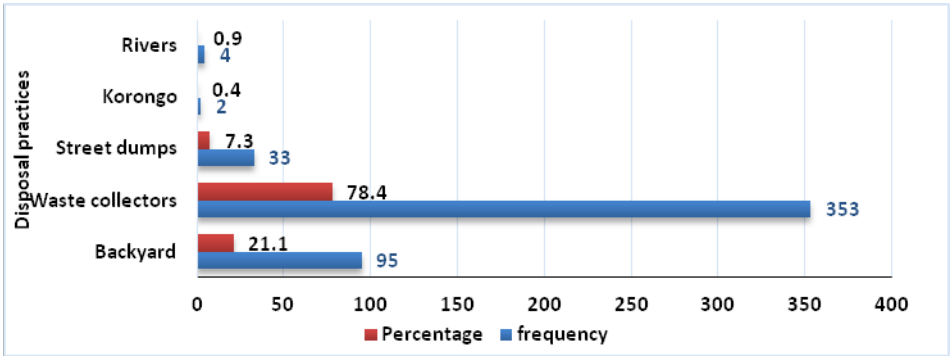

Figure 5: *Waste Disposal Practices by Households in Dar es Salaam*

Source: Author's construction from survey data, 2014,

Note: Multiple answers were allowed hence total% exceeds 100

Table 4 shows that around 60.7% of the respondents perceived waste management practices as being relatively better compared to previous times; while 39.3% said that the services had not improved, and were getting worse. The more affluent wards like Mbezi Beach, Kijichi and Segerea were well-served with collection services, while some of less affluent wards like Vingunguti and Mwananyamala claimed that the situation had worsened.

Table 4: Perception on Wastes *Management among Wards*

Ward	No	Percent (%)	Yes	Percent (%)	Total
Vingunguti	41	82	9	18	50
Gongo la mboto	18	36	32	64	50
Segerea	11	22	39	78	50
Ubungo	21	42	29	58	50
Mwananyamala	29	58	21	42	50
Mikocheni	7	30.4	16	69.6	23

Miburani	22	44	28	56	50
Kijichi	9	18	41	82	50
Mianzini	19	38	31	62	50
Mbezi beach	0	0	27	100	27
Total	**177**	**39.3**	**273**	**60.7**	**450**

Source: As for Table 1

When queried about the main reasons behind poor wastes management, 87% of the respondents said this was due to poor tools and equipment used, which are either few, outdated or of poor quality to adequately meet the capacity of transferring waste from residential areas to the designated landfills. This situation applied to both formal and informal waste collectors. Others (nearly 13%) attributed the poor services to poor infrastructure, especially in densely populated areas. Also, there were others (12.4%) who attributed poor wastes management to delays in waste picking, 11.3% on unaffordable fees, and 7.3% on people's ignorance to observe health rules, ending up dumping waste anyhow and anywhere (Figure 6).

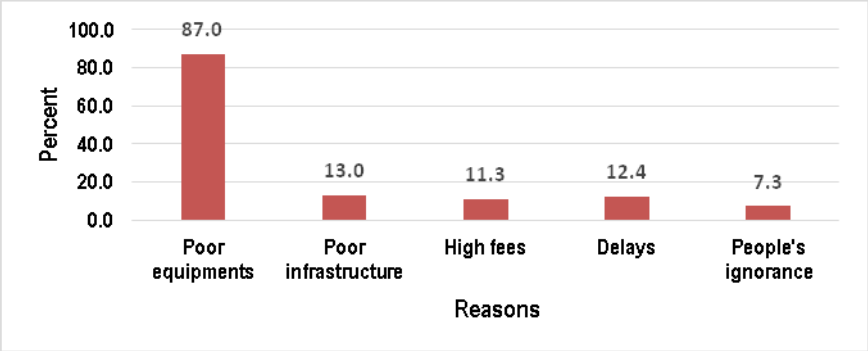

Figure 6: ***Reasons behind Poor Waste Management within Municipal Wards***

Source: As for Figure 1

Waste Separation for Reduce, Reuse and Recycle

Respondents were asked about their level of awareness on waste separation and recycling, including whether they had ever heard or seen any reused and recycled products. They were also asked about the practices of waste separation into different bins, and the specific sources of such information. Out the 450 respondents, 61.8% reported to have seen recycled and reused products, while 38.2% had never seen these products. As Fig. 7 shows, plastic material was the mostly known recycled product (70.9%). Plastic bottles were reused mainly for packaging of locally made soft drink, and collected for recycling by private dealers. Other mentioned products were paper products (20.5%) which were used as wrapping materials and for charcoal lighting in some places; 19.1% had seen sandals product from used car tires, and the rest reported to use the recycled waste for locally made cooking stoves, biogas, ladies accessories, candles and saucepans.

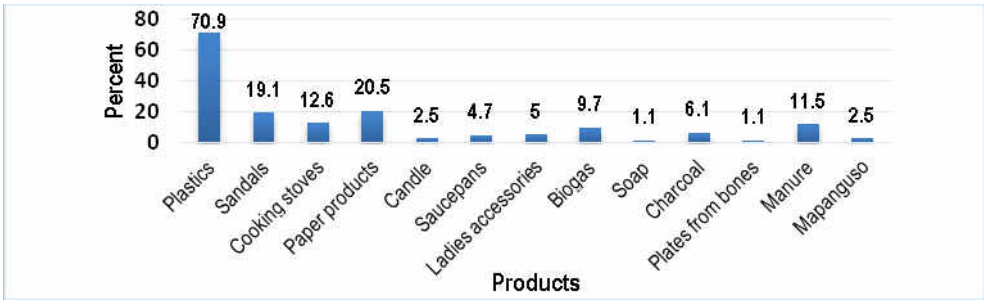

Figure 7: ***Awareness on Reuse and Recycle Products from Wastes***
***Source*:** As for Figure 1

Still, a large proportion of people (about 55.6%), had no a prior knowledge of waste separation. Education played an important role for those with awareness (44.4%), as the most of aware respondents were those with tertiary education (61.7%), compared to those with vocation training (59.5%), or with secondary education (43.2%), or with primary education (34.7%). When asked whether they engaged in wastes separation, nearly 63.8% of the respondents said they had never practiced it; while 36.2% said they had. Of the practicing respondents, only 65.4% had known the benefits of doing so, while 15.3% knew nothing. The main practice for most was the process of separating plastic bottles by keeping bundles; the latter involve door to door plastic collectors.

As shown in Figure 8, the main reasons for the practice were: to aid proper disposal by setting aside plastic bottles while mixing other waste for collection and burning (81.6%); monetary incentive, especially for those who sold plastic bottles and metal materials to itinerant buyers, and food remains to animal keepers (18.4%). Few were doing it to get manure (14.7%) for gardening at their places. The rest did it for environmental reasons – mainly to avoid air pollution (17.8%).

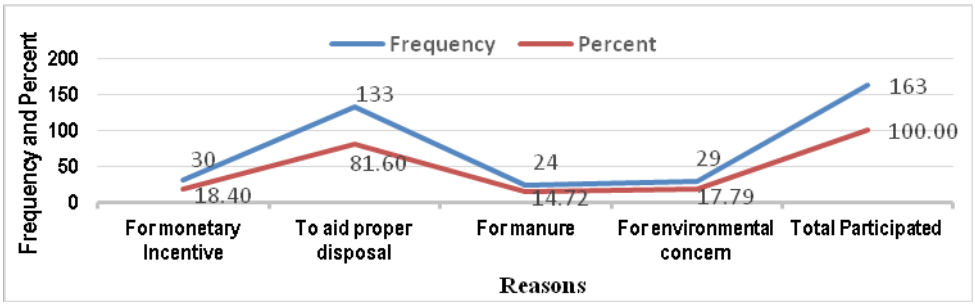

Figure 8: ***Reasons for Practicing Waste Separation***
Source: As for Figure 1

Willingness to participate in wastes separation

When asked whether or not they are willing to participate in domestic waste separation, 70.67% of respondents were ready to participate in the programs, while 29.33% were not ready for different reasons (Table 5). Some of the reasons for not willing to participate include lack of enough time to do so by (68.2%), lack of reliable market for sorted waste materials (47.7%), and difficulties in affording separate waste bins (30.3%). Results also showed that prior awareness on waste separation had no significant effect on respondent's participation on domestic waste separation as only 46% of those who had prior knowledge were willing to participate.

Table 5: Willingness to Participate in Waste Separation

	Frequency	Percent
No	132	29.33
Yes	318	70.67
Total	450	100.00

Source*:* As for Table 5.1

Respondents were asked on what should be done to promote their participation in domestic waste separation. Table 6 shows that 95.6% were ready to participate in domestic waste separation. 54% that required a reliable market for sorted wastes while 41.1% perceived provision of separate bins as a good strategy. 26% called for the establishment of waste collection center nearby, while 15.6% suggested enforced laws and order for compliance. Others are presence of door to door buyers to promote higher participation on waste separation and if neighbors practice it 5.6% and 5.1% of respondents respectively.

Table 6: *Reasons to enhance Participation to Waste Separation and Recycling*

Reason	Respondents	Percent
Awareness	430	95.6
Market for sorted waste	243	54
Provision of separate bins	185	41.1
Other people do it	23	5.1
Near collection centers	117	26
If it is mandatory	70	15.6
Door to door buyers	25	5.6
Total observation	**450**	**100**

Source: As for Table 5.1

When asked on the means to enhance a mass awareness, 31.3% of respondents recommended local government's campaign to be the main means of raising awareness about waste separation, compared to 30.9% and 27.8% who suggested television and radio, respectively. Other means of raising awareness like using peers (relatives and friends), posters, house to house informants, newspapers and internets were the least preferred, as these were recommended only by 10% of all respondents on average.

5.2. Econometric Estimation Results

As practice, several diagnostic tests are applied to logistic regression to ensure that our results are plausible and robust. To test for multicolinearity, both pair-wise multicolinearity test and tolerance and variance inflation factor were used. To test for model specification Hosmer–Lemeshow test of goodness of fit were used. All tests satisfy that the model is correctly specified. Tables 7 present a correlation matrix, where, when the pair wise correlation is very low, it implies that there is no danger of multicolinearity.

Table 7*: Correlation Matrix of the Core Variables*

Variable	Age	Educn	Gender	HSize	Income	Handling	Awareness	Peers	Incentive	Ilala	Temeke
Age	1										
Education	-0.05	1									
Gender	-0.04	0.26	1								
H-Size	0.17	0.28	0.08	1							
Income	-0.02	0.56	0.2	0.348	1						
Handling	-0.05	0.15	0.07	0.072	0.24	1					
Awareness	0.01	0.22	0.12	0.03	0.14	0.13	1				
Peers	-0.01	-0	0.02	-0.02	0.07	0.06	-0.02	1			
Incentive	-0.02	-0.04	-0.1	-0.049	-0.1	-0.09	0.12	0.04	1		
Ilala	-0.14	-0.1	-0.1	-0.159	-0.22	-0.11	0.04	-0.1	0.2268	1	
Temeke	0.04	-0.07	0.03	0.07	-0.02	0.09	-0.14	0.06	-0.1512	-0.5	1

Source: As for Table 1

In Table 8, households' willingness to participate in domestic solid wastes separation in Dar es Salaam is analyzed using Logit Model with marginal effects estimates. Marginal effects estimate the marginal impact of a variable on the willingness to participate on waste separation at household level, indicating the probability of the dependent variable at the mean value of given explanatory variable, keeping other regressors constant.

Table 8: Logistic Regression and marginal effect (mfx)

Number of observation=450
LR chi2(10)=68.61
Prob > chi2=0.0000
Log likelihood = -237.996 and Pseudo R2=0.13

Participate	Coef.	Z stat	P>z	mfx=dy/dx
Age	0.013	1.21	0.227	0.002
Education	0.055**	2.24	0.025	0.01
Gender	0.544	1.63	0.103	0.094
H-Size	0.056	0.93	0.351	0.011
Income	0.274**	2.08	0.037	0.052
Handling	-0.811***	-3.28	0.001	-0.147
Awareness	0.189	0.8	0.423	0.036
Peers	2.994**	2.73	0.006	0.622
Incentive	2.759**	2.65	0.008	0.265
Ilala	0.066	0.23	0.817	0.012
Temeke	0.34	1.22	0.224	0.062
Constant	-6.89	-3.53	0	

Notes: *** and ** implies significance at 1% and 5% respectively.
Source: Model output, 2014

As shown in Table 8, the variables of years of education, log of household income, handling, peers group influence and incentives are statistically significant in explaining household's willingness to participate in wastes separation for reduce, reuse and recycle activities. Other variables such as age, gender of respondent, household size, awareness and the district dummies appear to have the right signs but are statistically insignificant. The effect of independent variables estimated in logistic regression in Table 8 is presented using the coefficient signs and p –value of each predictor variable while the interpretation and meaning of each significant predictor variable is presented using marginal effect in last column.

The marginal effects reveal that respondents with higher level of education have higher chances to participate in domestic wastes separation for reuse, reduce and recycle, which is significant at 5% level. The higher levels of education, in terms of many years of schooling, is expected to make people more knowledgeable and aware on wastes management issues and importance, hence more responsible and ready to adapt to better ways to improve wastes management. This is also in line with what we saw in the descriptive analysis, which showed that those with college and university level education were more aware of wastes separation and sorting practices compared to those in lower levels of education. One more year of schooling is expected to increase the likelihood of household's participation in waste separation by 1.05%. This is consistent with other studies that have looked on similar issue such as by Kamara (2006) and Jerkin et al. (2000).

Another variable that was found to be positively and statistically significant at 5% is the income level of a particular household. Households that earns higher income tend to consume more products than low income earners, thus producing more wastes. However, higher income earners are likely also to be more exposed to, and can access, a wide range of media for awareness compared to low income

earners. As a result, an increase in income by one unit increases household willingness to participate in wastes separation for recycling activities by 5%. Similar positive influence of income on waste management is confirmed in studies by Kamara (2006) and Jerkin et al. (2000).

On contrary, the status of waste handling in respective wards had a negative sign, and was statistically significant at 1% level. This suggests that households in areas that in well-served with wastes collection services are less willing to participate in waste separation for recycling activities. Possibly, these households are content with waste collectors' performance, as waste is timely collected and thus their environment is clean, and such they do not see the reasons to participate on wastes separation. In contrast, areas where wastes handling in inneficient, people are willing to participate in waste separation as they expect to reduce the amount of waste, maintain environment cleanliness, and get revenue from sorted wastes. The marginal effect estimate shows that an improvement in wastes handling in a ward reduces the probability of household participation in wastes separation.

A peer (neighbors, friends) involvement in domestic wastes separation/sorting for recycling has, as expected, a positive influence on neighbor households' to participate in solid wastes separation. In practice, people tend to adapt other people's ways of doing things, making it a social behavior. The marginal effect estimates show that peer involvement has a probability 0.62 of increasing household's participation in solid wastes separation. If mobilization is targeted towards increasing peers participation, then the effect can spill over easily to fellow neighbors, making it a social behavior. Incentives in the form of reduced payments or available markets for sorted wastes have higher chances to influence the behavior of household to willingness to participate in the wastes separation for recycling, as it is positive and significant at 5% level. Activities that do not give room to generate additional income may limit people involvement. Positive influence of monetary incentive in household waste sorting was also shown by Mona (2010), Billitewski (2008), and Reinchenbach (2008).

6. Conclusion and Implications

Given the challenges of wastes management that most cities and urban areas in developing countries are facing, this study set out to investigate and assess factors that determine households' willingness to participate in wastes separation for reduce, reuse and recycle in Dar es Salaam, Tanzania. Wastes separation and sorting at the point of generation is critical for the 3Rs initiative approach of waste ***r****educe*, ***r****euse* and ***r****ecycle* as one of solutions to wastes management challenges in most urban areas. Dar es Salaam, which according to UN-HABITAT is the fastest growing city in Africa with 4.6 million people was taken as a case study.

The descriptive statistics have established that most respondents (around 60%), are not aware of wastes separation and sorting for reduce, reuse and recycle. Of those who aware, only a few engage in wastes separation and sorting for reduce, reuse and recycling. However, even of these few sorting is only limited to plastics and bottles. Regression estimation find that households' willingness to participate in domestic wastes separation and sorting for reduce, reuse and recycle is influenced by array of factors, including age, education, gender, household size, income, handling, awareness, incentives, peers' influence, and district locations. Of these, education (captured by years of schooling), household level of income, wards handling status, incentive in terms of monetary rewards, and peers influence are statically significant in influencing household willingness to participation in wastes separation and sorting for reduce, reuse and recycle. But other factors—such as age, gender, household size and awareness as well as district location—though with right signs, were however statistically insignificant.

A number of important implications can be drawn from these findings to help enhancing wastes collections and management in urban areas like Dar es Salaam. One, there should be a stronger stakeholders' participation and involvement in issues of waste collection and management in urban areas like Dar es Salaam. Two, proper channels for enhancing knowledge and awareness about waste collection and management issues should be promoted to bring forth and raise the desired level of awareness. Third, the governments should work on all factors that have been found significant in this study to help enhance the 3Rs initiative approach with the aim of addressing the challenges of wastes management.

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