HOUSEHOLD PREFERENCES ON PROVISION OF SOLID WASTE MANAGEMENT SERVICES IN KINONDONI MUNICIPALITY, DAR ES SALAAM, TANZANIA

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ABSTRACT

Privatization of solid waste management services has not achieved the anticipated results of improving solid waste management in the country. In most urban areas, the provided solid waste management services are not appreciated and supported by service receivers. This may be due to non-inclusion of household preferences and willingness to pay for solid waste management services in designing these services. A Choice Experiment Method was used in this study to assess household preferences and their willingness to pay for solid waste management services in Kinondoni municipality. Choice cards, questionnaire and checklists were used to collect data from 240 households. The solid waste management services were decomposed into 3 attributes, namely use of vehicles in transporting solid waste, frequency of solid waste collection and provision of polythene bags for storage of solid waste. Results showed that households mostly prefer use of vehicles in transportation of solid waste and frequency of solid waste collection attributes and they are willing to pay for these attributes. Provision of polythene bags attribute was not preferred by households. The estimated implicit prices per month for vehicles, polythene bags and frequency of solid waste collection were TZS 1056.022, TZS -148.128, TZS 4104.562 respectively for low income households and TZS 2713.439, TZS -1301.25, TZS 9245.522 respectively for high income households. On average, the estimated compensating surplus also known as willingness to pay per month were TZS 7192.944 and TZS 16 313.682 for low and high income households respectively. The findings also show that there are high variations in household preferences for solid waste management services. In order to improve solid waste management services in Kinondoni municipality, policy makers and solid waste management service providers should incorporate household preferences and their willingness to pay for solid waste management services when designing these services.

DECLARATION

I, Daudi Bigirwa, do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work done within the period of registration and that it has neither been submitted nor being concurrently submitted in any other institution.

_____ _____

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The above declaration is confirmed

_____ _____

Dr. Felister Mombo. Date

(Supervisor)

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LIST OF ABBREVIATIONS AND SYMBOLS

CBO	Community Based Organizations
CL	Conditional Logit
CS	Compensating Surplus
DCC	Dar es Salaam City Council
ENAREC	Environmental and Natural Resources Economics
FGDs	Focus Group Discussions
IIA	Independence of Irrelevant Alternative
kg	kilogram
km	kilometer
MEO	Mtaa Executive Officer
MNL	Multinomial Logit
RCC	Refuse Collection Charge
RPL	Random Parameter Logit
SPSS	Statistical Package for Social Sciences
SUA	Sokoine University of Agriculture
SWM	Solid Waste Management
TZS	Tanzanian Shillings
WEO	Ward Executive Officer
WTP	Willingness to Pay

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Solid waste generation is an increasing global environmental and public health problem particularly in developing countries (UNEP, 2004). In urban areas, especially in the rapidly urbanizing cities of the developing world, issues related to solid waste management (SWM) needs immediate interventions as about 20-50% of the generated solid waste are not properly managed (Abel, 2007). Since the early 1990s, many governments in developing countries showed a great deal of concern in improving urban SWM. This in fact was due to increased generation of solid waste, which increased the rate of environmental pollution as the result of poor performance of solid waste collection and disposal systems used in these countries (Kaseva and Mbuligwe, 2005).

Most of the developing countries cities often lack financial resources and institutional capacity to provide required municipal infrastructures for adequate SWM, despite their citizens' demand (Jin *et al*., 2006). Moreover, changing economic trends, rapid urbanization and population growth complicate the delivery of SWM services in developing countries (Maganga, 2013). Besides, most policies and frameworks governing SWM services in developing countries including Tanzania are directed to providers of SWM services (suppliers) and less attention has been paid to households and other service recipients (consumers) (Sansa and Kaseka, 2004). Provision of SWM services requires a concerted action of both the service providers and service receivers, especially households which are primary producers and generators of significant proportion of solid waste (Pek and Jamal, 2011).

Local government authorities in Tanzania have been responsible for providing SWM services to their citizens (Kassim and Ali, 2006). However, the increased human population has overwhelmed the capacity of local government authorities of providing SWM services to their citizens. This has made local government authorities such as Dar es Salaam City Council (DCC) and its three municipalities to privatize SWM services to private contractors and individuals, and introduced refuse collection charges (RCC) in 1994 (Majani and Halla, 1999). Privatization of SWM services aimed at increasing the coverage and delivery of SWM services to many places within the city and it was anticipated to be a solution of solid waste problems in Dar es Salaam city (REPOA, 2002; Oberlin, 2011).

Despite this initiative, SWM is still among the key environmental problem in the three municipalities of Dar es Salaam city. Results on SWM in Dar es Salaam city have not been promising as about 60% of the generated solid waste per day in the city is not collected and disposed off the dumpsite (Bubegwa, 2012). Furthermore, unclear RCC complicate the provision of SWM services as most households are reluctant to pay waste charges (Thomas and Rahel, 2013).

1.2 Problem Statement

Despite the efforts of local government authorities to improve SWM through privatizing SWM services in urban areas, SWM is still a great challenge in Kinondoni municipality (Simon, 2008). Only 41% of the generated solid waste per day in the municipality are collected and disposed off the dumpsite while the rest are haphazardly thrown in streets, road sides, drainage channels, commercial centres and open spaces (World Bank, 2011; Bubegwa, 2012). The provided SWM services are not appreciated and supported by most households in the municipality. This has made most households to rely on informal waste

pickers who collect solid waste from their households (Thomas and Rahel, 2013). The increased use of informal waste pickers has complicated SWM in Kinondoni municipality as most informal waste pickers collect and dispose solid waste in illegal dumpsites, river banks and open spaces (Oberlin, 2011). This has aggravated pollution of land, air and water resources in the municipality (Bubegwa, 2012). Effects of poor SWM are most evidenced in unplanned settlements within the municipality (Oberlin, 2013a).

Most attempts to improve SWM services in the municipality have concentrated on the supply side (service providers) while the service receivers (demand side) are often not involved (Majani and Halla, 1999; Thomas and Rahel, 2013). This hinders the success of SWM services in the municipality since household preferences and WTP for SWM services are not clearly known by the service providers. It is not known whether the provided SWM services are the ones which are preferred and demanded by households. Also, a mechanism which was used to set RCC is not clearly known by households (Thomas and Rahel, 2013). This could be a reason of households reluctance to pay RCC since they were not involved to state their willingness to pay (WTP) for SWM services. A clear understanding on household preferences and their WTP for SWM services would help in design appropriate services (Jamal, 2006). Household preferences on SWM services will tell which SWM attributes are mostly preferred by households and these attributes must be included in designing or delivery of SWM services. WTP will tell how SWM services are being valued and priced by the households.

Regardless of poor SWM in Kinondoni municipality, there is no study which has been conducted to investigate the household preferences on SWM services and their WTP for these services. Kaseva and Mbuligwe reported that SWM services are poorly developed in Dar es Salaam city because most households are reluctant to pay solid waste charges.

This may be due to the fact that the solid waste charges are based on the supply side perspective and not on the demand side perspective. Majani and Halla (1999) revealed that unclear solid waste charges and non inclusion of household preferences on SWM services have led to low community support for market based SWM in Dar es Salaam. This may be because the provided SWM services have not integrated household preferences and their WTP for these services. Thomas and Rahel (2013) insisted on the need to have transparent guidelines for setting RCC in which households and other service receivers must be involved. Furthermore, it is not clear on whether there are variations in household preferences on provision of SWM services. It is against this background the current study was conducted in Kinondoni municipality to assess household preferences and their WTP for SWM services so as to improve the delivery of SWM services in the area.

1.3 Justification of the Study

This study will be helpful in improving SWM in Kinondoni municipality and the entire city of Dar es Salaam. This is because it will provide information concerning household preferences on SWM services and their WTP for different SWM service options. Information on household preferences on SWM services could help in selection and inclusion of relevant SWM attributes which are most preferred by households during designing of SWM service policies and their implementation strategies. Results on WTP for SWM services could be used as a pricing mechanism strategy in setting appropriate solid waste charges. In this way policy makers could be able to know the most preferred SWM service attributes in delivery of SWM services as well as their implicit prices hence integrating this information in designing SWM policies and plans. Also, decision makers could be able to know the values households attach to SWM services. Results could be useful in sustainable city development plans as decision makers will recognize the values

people attach to environmental goods and services and their WTP to improve those services.

In addition, the findings of this study are useful in creating and improving market for solid waste services. Providers of SWM services would be able to arrange and deliver the demanded services as they will know the household preferences on provision of SWM services, preferred SWM service attributes and the prices households are willing to pay for those services. This could clear the mismatch between the demand and supply of SWM services. Creation and improvement of solid waste markets could also create more employment opportunities to individuals (waste crew members) who will be working with providers of SWM services such as SWM contractors. The study findings could also be used as a literature source to students and academicians undertaking similar studies.

1.4 Objectives of the Study

1.4.1 Main objective

The main objective of this study was to assess household preferences on provision of solid waste management services in order to enhance sustainable solid waste management in the cities of Tanzania using Kinondoni Municipality as a case.

1.4.2 Specific objectives

Specifically the study wanted to;

i) Estimate the implicit prices of each solid waste management service attribute
ii) Identify the most preferred solid waste management service attributes on provision of solid waste management services
iii) Estimate the compensating surplus for each improved solid waste management service option
iv) Examine variations in household preferences for solid waste management services

1.5 Research Questions

i) What are the household preferences on provision of solid waste management services?

ii) How much is a household willing to pay for each additional solid waste management service attribute?

iii) Which attributes of solid waste management services are most preferred by households?

iv) How much is a household willing to pay for each improved solid waste management service option?

v) Is there variation in household preferences for solid waste management service?

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Solid Waste Management

Solid waste is any solid material which comes from domestic, commercial and industrial sources arising from human activities, which has no value to people who possess it and is discarded as useless (Bartone and Bernstein, 1993). Solomon (2007) defines SWM as "the control, generation, storage, collection, transfer and transport, processing and disposal of solid waste consistent with the best practices of public health, economics, financial, engineering, administrative, legal and environmental considerations". SWM service is an integral part of the basic urban services and an important environmental health service. This is because poor SWM can have detrimental effects to the people exposed to these unsanitary conditions. Diseases such as cholera, typhoid, dysentery and malaria can result from poor waste management which leads to loss of human resources that is needed for the development of a certain nation (Maganga, 2013).

2.2 Solid Waste Management Stages

According to Remigios (2010), SWM system mainly comprises of four activities, which are waste generation, collection, transportation and disposal. These stages are explained below.

2.2.1 Storage of solid waste

Solid waste storage facilities fall into two broad categories namely primary which involves individual storage facilities and secondary which involves communal storage facilities. Good solid waste storage facilities need to be animal proof, insect proof, resistant to weather, washable and strong enough to meet the demand of normal use. (Cunningham,

2002). In most developing countries primary waste storage facilities being used are boxes, old tins, basins, buckets, sacs, and plastic bags (Sansa and Kaseka, 2004). However, for modern waste management a reliable form of storage is needed and requires permanent or durable containers. The secondary waste storage facilities fall into two categories namely, stationary and portable facilities. The stationary facilities are mainly concrete products and they include masonary enclosures, galvanized bins and concrete pipes. The portable facilities are movable storage facilities that are easily to handle and are usually designed for collection of waste using vehicles such as communal containers and skips (Enger and Smith, 2006).

2.2.2 Solid waste collection

Solid waste collection in developing countries falls in 4 groups. These are communal collection, block collection, kerbside collection and door to door collection (Remigios, 2010; Maganga, 2013).

Communal collection system requires households to deposit their waste at pre-determined location where some form of communal collection is stationed. This is advantageous because it reduces the sources from where the waste is to be collected by the vehicles. However, it also has some disadvantages because if waste facilities are not properly located then costs will increase because people may not use the facility and litter the waste any where hence the collection crew will have to go around collecting the scattered waste (Cunningham, 2002).

Block collection system relies on individual households and their efficiency to store waste. Under this system, the collection vehicle follows a pre-determined route at scheduled intervals in a week and stops at particular points, where a bell is sounded. Residents bring

their waste containers to be emptied. In this system, no containers are left outside households on communal land. However, efficiency of the system depends on observance of routine and time. It further demands there are people in the household at the time of collection (Enger and Smith, 2006; Maganga, 2013).

In kerbside collection system, garbage bags, bins and other containers are deposited at the kerbside (pavement) at fixed intervals on days when the scheduled truck is supposed to move. The system requires a very regular and well organized collection service such that the routine is followed. Containers may permanently be left outside precipitating the risk of scattering waste by scavengers. This system has been the most widely used in high income areas of developing countries. Its efficiency in terms of vehicles and labour productivity can be improved through use of standardized containers and sometimes combining it with sounding of bells (Bartone and Bernstein, 1993).

Door to door collection system is where the collection group moves from household to household collecting waste containers. This is the best system where the frequency of collection is irregular, however, it carries a very big private and security risks (Majani and Halla, 1999; Remigios, 2010).

2.2.3 Transportation of solid waste and transfer stations

The process of handling waste to their final disposal grounds depends on the vehicles capacity and time taken to travel to the disposal site. Usually, non-compaction, semi compaction and compaction vehicles with the exception of small vehicles are powerful enough to have waste directly to the site of disposal which should fall in a range of 20 km from collection areas. However, as nearby landfills become scarce or if small trucks are used, handling distance increases and the time spent by the group in travel becomes

unproductive. Such conditions will therefore necessitate a transfer station to facilitate transfer from smaller vehicles to large vehicles carrying more units for longer distances (Cunningham, 2002; Remigios, 2010).

There are two types of transfer stations, short range transfer station and long range transfer station. Short range transfer station involves non-containerized transfer station in which waste collected by short range vehicles are discharged on levelled site with concrete floor from which they will be loaded onto long range vehicles which will carry the waste to the disposal site. The site is enclosed to minimize aesthetic and odour complaints. It also involves containerized transfer stations where waste collected by primary vehicles are discharged directly into larger containers usually containers of trucks or trailers of tractors. The last type of short range transfer station is compaction transfer station where hydraulic pressure is used to compact waste and decreases their density before they are loaded onto long range vehicles for transfer to the disposal site. It is most suitable for waste like plastic, clothes, papers and polythene bags (Bartone and Bernstein, 1993; Enger and Smith, 2006).

Long range transfer stations handle large capacity waste in order of 20-40 tonne. They have become necessary has cities grow and due to lack of land to locate landfills. Long range transfer station includes road transfer station which uses heavy trucks to transfer waste to disposal site, railway transfer station which uses rail wagons to carry waste to their final disposal sites and berge transfer station where ships are used to carry waste to their final disposal sites (Enger and Smith, 2006; Remigios, 2010).

2.2.4 Solid waste disposal

Disposal is the final stage in SWM, and all the waste whether they are residential, commercial or from any other sources are collected and transported to a disposal site.

It may be a landfill site or an incinerator or some other mode of disposal such as open dumping, open burning, burying, composting, gasification and pyrolysis. However, in most of the third world countries solid waste are disposed around cities and towns along the roads, which give rise to several problems like pollution due to smoke, water pollution due to leachate, blockage of drains and sewers due to plastics and health hazards to workers and rag pickers and humans living in nearby areas (Remigios, 2010).

2.3 Solid Waste Management Services in Dar es Salaam City

The DCC and its 3 municipalities namely Kinondoni, Ilala and Temeke have for many years been confronted by growing volumes of solid waste and the inadequate provisions for its removal and disposal. The current per capita solid waste generation rate in DCC is 0.8 kg/ person/ day (Bubegwa, 2012). Historically, SWM was the responsibility of cleansing unit of health department dealing with solid waste under the DCC. The DCC had therefore to carry out the primary collection, store the waste temporarily, transport it to disposal sites, sweep streets, manage the disposal sites, and sometimes recycle the waste (Oberlin, 2011). However, the DCC failed to provide efficient and reliable SWM services to the growing city population under the centralized system (Yhdego, 1995; Majani and Halla, 1999). The failure of the local government authority to deliver SWM services to the people became a driving force for the government to decentralize SWM by granting the local government autonomy over SWM services (Majani and Halla, 1999).

From 1994, the DCC and its 3 local government authorities decided to privatize some of their principal services in waste management, specifically waste collection. The goal of privatizing SWM services was to improve SWM in the Dar es Salaam city (Yhdego, 1995). Privatization entails involvement of private operators both private companies and CBO in delivering SWM services to the people (Kassim and Ali, 2006). In DCC, solid

waste collection services were privatized starting with a five year contract covering eleven wards in Ilala municipality. Thereafter, the coverage of privatization has gradually been extended citywide in other places like Kinondoni and Temeke municipalities (Simon, 2008; Oberlin, 2011). Privatization of solid waste collection services in Dar es Salaam city adopted a concession model in which the private service providers also referred as contractors were given monopoly to render solid waste services in a particular area and to collect service charge directly from solid waste generators on behalf of the DCC (Majani and Halla,1999; REPOA, 2002). Door to door collection system is mainly used in high income areas of the city, while enclosures and handcarts are used in low income areas to collect the generated solid waste (Oberlin, 2011).

Currently, the Dar es Salaam city is using the dump site located in Pugu Kinyamwezi where all the collected solid waste from Kinondoni municipality and other municipalities in the city are disposed. Regardless the involvement of private sectors and CBO in SWM, 63% of the generated solid waste per day in Dar es Salaam city remain uncollected (Bubegwa, 2012). The concession model of privatization adopted by Dar es Salaam city gives monopoly to service providers which denies service recipients such as households a freedom of choice on the kind of SWM services they prefer (Majani and Halla, 1999). Meanwhile, under the concession model a single service provider is given concession to provide service to all streets in a ward, this means that the service users such as households have to keep up with the service provider despite the quality of services provided (Majani and Halla, 1999; REPOA, 2002). In addition, unclear RCC complicate delivery of SWM services in Dar es Salaam city as most people are reluctant to pay waste charges (Thomas and Rahel, 2013).

2.4 Valuation of Environmental Goods and Services

According to neoclassical economic theory, market prices are usually an adequate reference for the value that society places on goods and services. If a good or service has value, an individual will be willing to pay to acquire it or to accept compensation for its loss or damage. In ordinary markets, this value is observable as the price paid for the good, but with environmental goods and services, market imperfections distort their real prices or values, plus the value that individuals place on them cannot be readily observed. (Carlsson *et al*., 2003). The main concern of environmental valuation is to attach monetary values for non- marketed environmental goods and services. Environmental valuation is basically based on the assumption that individuals are willing to pay for environmental improvements and conversely, are willing to accept compensation for some environmental deterioration (Hanley *et al*., 2001). Generally, environmental valuation methods are divided into 2 main categories; revealed preference (indirect) and stated preference (direct) approaches (Hanley *et al.,* 2007). The 2 approaches differ primarily in data origin and collection method.

2.4.1 Revealed preference methods

Revealed preference methods involve the use of information from markets that are specifically related to the non- marketed value under consideration to infer value estimates. It requires exploration of people's preferences as revealed by their actions in markets, which are significantly related to the non-marketed value of an environmental good or service under consideration. In this method, we observe a real choice in some market and cleverly infer information on the trade-off between money and the environmental goods or services (Hanley *et al*., 2007). They include travel cost method for estimating the use value of recreational sites and hedonic pricing method which has been used to estimate pollution costs (Bennett and Blamey, 2001).

2.4.2 Stated preference methods

Stated preference methods for valuation assess the value of non-marketed goods by using individuals' stated behaviour in a hypothetical setting. These methods elicit environmental values directly from respondents by asking them about their preferences for a given environmental good or service under consideration (Alpizar *et al*., 2001). The most commonly used stated preference methods are Contingent Valuation Method and Choice Experiment Method (Hanley *et al.,* 2007). A Choice Experiment approach was used in this study to value household preferences and their WTP for provision of SWM services.

2.5 Choice Experiment

Choice Experiment is a multi attribute stated preference elicitation technique in which each alternative is described by a number of attributes (Hanley *et al*., 2001). In Choice Experiment, individuals are given a hypothetical setting and asked to choose their preferred alternative among several alternatives in a choice set (Birol and Koundouri, 2008). A monetary value is included as one of the attributes, along with other attributes of importance. The inclusion of a monetary value allows the calculation of individual's marginal WTP (implicit price) for a change in each of the other non marketed attributes (Alpizar *et al*., 2001; Lehtonen *et al*., 2003; Birol and Das, 2010). Thus, when individuals make their choice, they implicitly make trade-offs between the levels of the attributes in the different alternatives presented in a choice set. This allows the researcher to observe the relative importance of different attributes (Alpizar *et al*., 2001).

Choice Experiment mirrors real market situations and is consistent with welfare economics. Choice Experiment is practical from a policy and management perspective because the information it provides can be used in the design of multidimensional policies, in cost–benefit analysis and in litigation processes (Hanley *et al*., 2001; Mogas *et al.,*

2006). In a Choice Experiment, environmental changes are expressed in terms of impacts on various attributes, which have different levels in different policy scenarios (Bennett and Birol, 2010).

2.5.1 Theoretical background of choice experiment

The Choice Experiment has its theoretical grounding in Lancaster's model of consumer choice (Lancaster, 1966) and its econometric basis in random utility theory (McFadden, 1974). Lancaster (1996) asserted that the utility derived from a good comes from the attributes of that good, and not from the consumption of the good itself. The basic idea behind random utility theory is that in a given choice set, an individual will choose an alternative which gives him/her the highest utility. According to random utility theory the utility of a choice is composed of deterministic (observed) component (V) and an error (unobserved) component *(e*). The error component implies that prediction cannot be made with certainty. The utility level (U) of individual (i), associated with alternative (j), can be described by an indirect utility function, which can be expressed as;

$$U_{ij} = V_{ij} + e_{ij} \quad \textbf{(1)}$$

Where, V_{ij} is a deterministic component and e_{ij} is an error component

As Choice Experiment assumes that respondents are rational and select an alternative with highest utility, the probability that individual i will select alternative j over other alternative n is given by:

$$Prob\ (j/C) = Prob\ \{(V_j + e_j) > (V_n + e_n),\ all\ n \in C\} \quad \textbf{(2)}$$

Where C is a complete choice set. In this case the utility derived from any SWM service alternative will depend on the attributes of SWM services and a respondent will choose an alternative which gives him/her the highest utility (Alpizar *et al*., 2001; Jamal, 2006).

2.5.2 Organization of choice experiment

According to Alpizar *et al.* (2001), Choice Experiment comprises of the following elements;

a) A set of fixed choice options that have explicit names.
b) A set of attributes that describe potential differences in the choice options.
c) A set of levels or values assigned to each attribute of each choice options to represent a range of variation in that attribute appropriate to the research objectives of a particular study.
d) A sample of subjects evaluates all or a subset of the choice sets in the total experiment and chooses one of the possible options available to be chosen in each set.

The first step in building a Choice Experiment is to identify the attributes of interest. This involves an attempt to select those attributes that influence the consumer choice behaviour under investigation. It also involves a policy analysis to identify the design or marketing attributes that are relevant to policy-makers, urban designers, or marketers, even though these attributes may not be necessarily relevant to consumers. Often, attributes are elicited by small-scale qualitative research, decision nets or tables or factor listings being good examples of such research endeavours. Once the attributes and their levels have been identified, an experimental design that systematically varies these attributes across trade-off situations should be constructed. In order to increase the validity, the choice situation in the experiment must resemble choice situations in real markets as much as possible. Table 1 summarizes the steps to follow when using Choice Experiment;

Table 1: Steps to follow when using choice experiment

Stage	Description
1. Selection of attributes	Selection of relevant attributes of the good to be valued. This is usually done through literature reviews, focus group discussions or direct questioning. Sometimes they may be self-evident because of the nature of the problem. A monetary value is usually one of the attributes to allow the estimation of WTP
2. Assignment of levels	The attribute levels should be realistic and span the range over which we expect respondents to have preferences, and/or practically achievable levels
3.Choice of experimental design	Statistical design theory is used to combine the levels of the attributes into a number of alternative environmental scenarios or profiles to be presented to respondents. Complete factorial designs allow the estimation of the full effects of the attributes upon choices; that includes the effects of each of the individual attributes presented (main effects) and the extent to which behaviour is connected with variations in the combination of different attribute offered (interactions).
4.Construction of choice sets	The profiles identified by the experimental design are then grouped into choice sets to be presented to respondents. Profiles can be presented individually, in pairs or in groups.
5. Measurement of preferences	Choice of survey procedure, and conduct of survey.

***Source**:* Alpizar *et al*. (2001)

2.6 Review on Estimation of Implicit Prices for each Solid Waste Management Service Attribute

Implicit price is also known as marginal WTP, and it demonstrates the amount of money a respondent is willing to pay for each additional unit of the good or service under valuation, in this case the SWM service attributes (Birol and Das, 2010). Respondents are assumed to make complete trade-offs between the levels of the attributes when deciding on their preferred alternative. In Choice Experiment, a good under valuation is usually decomposed into various attributes, one of these attributes must be a price attribute (Birol

and Koundouri, 2008). The trade-offs between attributes expressed by respondents' choices can be used to estimate the marginal utility of each attribute (Alpizar *et al*., 2001). If money is one of the attributes, it is possible to express value estimates for the non-market attributes in terms of the implicit prices also known as marginal WTP for each individual attribute (Alpizar *et al*., 2001; Das and Birol, 2010). Solomon (2007) calculated the implicit prices for collection frequency and waste sorting, which were Birr 12.95 and Birr 17.69 respectively, meaning that respondents were willing to pay such amount for each attribute.

2.7 Review on Examining the Most Preferred Solid Waste Management Attribute

The implicit prices are important in demonstrating the trade-off between individual attributes. They allow analysis on the potential alternative allocations of resources. A comparison of the implicit prices of attributes gives some understanding of the relative importance that respondents hold for them. On the basis of such comparisons, policy makers are better placed to design resource use alternatives so as to favour those attributes which have higher implicit prices (Bennett and Blamey, 2001). This means that the attributes with higher implicit prices are the most preferred attribute as they contribute more weights in the utility function of a given alternative, unlike attributes with low implicit prices (Louviere *et al*., 2000; Metkel, 2011). Usually, the most preferred attributes are included in designing of SWM services (Das *et al*., 2008; Yonas, 2010).

Ku *et al.* (2009) used Choice Experiment to capture community's preferences on residential waste disposal system in Korea by considering various attributes that are related to residential waste disposal systems. The attributes selected were cleanness (shows food waste collection facility), collection of small items and frequency which actually indicates number of times in a week recycling vehicles pick up along with the

respected prices for the rendered options. Results revealed that residents have preferences for the cleanliness of facilities and the collection of small items but attribute of frequency of waste collection was not preferred. Das *et al.* (2008) did a Choice Experiment study to elicit community preferences for SWM services and found that community mostly preferred frequency of waste collection and covered trucks while the attribute of covered vats was not preferred by households. Knowledge on respondents preferences on SWM attributes helps in provision of better SWM services as the most preferred attributes are being considered by solid waste policy makers when designing SWM services (Ku *et al*., 2009).

2.8 Review on Compensating Surplus for each Solid Waste Management Option

Compensating surplus (CS) is the amount of money that is taken away from the person to make the utility with the environmental improvement equal to the utility before the change. It measures the change in income that would make an individual indifferent between the initial (lower environmental quality) and subsequent situations (higher environmental quality) assuming the individual has the right to the initial utility level. This change in income reflects the individual's WTP to obtain an improvement in environmental quality (Boxall *et al*., 1996; Jin *et al*., 2006; Pek and Jamal, 2011).

The ability of Choice Experiment to generate estimates of the values of many different alternative from a single application shows the strength of Choice Experiment method over other valuation method such as contingent valuation method (Jamal, 2006). From one set of choice data, the values of an array of alternative ways of re-allocating resources can be estimated (Alpizar *et al.,* 2001). This feature of Choice Experiment arises because it specifically investigates trade-offs between attributes. Choice Experiment gives an individual an opportunity to choose an alternative or package he/she prefers from a given

choice set. The chosen alternative is expected to give the highest utility (Bennett and Blamey, 2001). The compensating surplus values tell how much an individual is willing to pay for an environmental improvement for instance improved SWM services (Solomon, 2007). Studies done by (Solomon, 2007; Metkel, 2011) indicated that respondents had positive compensating surplus also known as WTP for SWM services.

2.9 Review on Examining Variations in Household Preferences on Solid Waste Management Services

Socio- economic characterists of individuals may cause variation in preferences for solid waste management options (Yonas, 2010). Examining the variations in individuals' preferences helps in designing and providing equitable solid waste services to the households as socio-economic background of individuals are considered (Karousakis and Birol, 2008). A SWM study on household preferences for kerbside recycling services done by Karousakis and Birol (2008) in London revealed variations in preferences among respondents and the variations were caused by education levels , income and distance to the recycling point. Households with higher education, higher income and those who live far away from the recycling point preferred more kerbside recycling services.

2.10 Choice Experiment and Solid Waste Management Services

Most studies in assessing preferences on SWM services have been done using Contingent Valuation Method, few studies have used Choice Experiment. Jin *et al.* (2006) applied a Choice Experiment method to estimate the public preferences for SWM programmes in Macao, China. The attributes included in the study were the need for waste segregation and recycling at source, waste collection frequency, whether the government takes measures to reduce noise in the waste collection and transportation process and accompanied by a cost to be incurred by the respondents for the different management options presented. According to the study, residents of

Macao preferred waste segregation and recycling at source, noise reduction during waste collection and transportation and lower garbage fees.

Choice Experiment was employed by Das *et al.* (2008) to estimate residents WTP for improvements in SWM services provided in Chandernagore and South Dum Dum municipalities of Greater Kolkata in West Bengal, India. The attributes used in the study were frequency of vat collection, covered vats and covered collection trucks plus a cost attribute. Results revealed that on average residents of these municipalities have significant WTP amounts, in terms of higher monthly municipality taxes, to increase the frequency of waste collection, and to ensure that waste is collected by covered trucks. Also, the findings ascertained existence of variations in household preferences and the variations were caused by education of household head, total expenditure and domestic help in waste management.

Pek and Jamal (2011) conducted a study to estimate the non-market values of improved waste disposal facilities in Malaysia using the Choice Experiment. The service attributes were psychological fear, land use, air pollution, river water quality and additional monthlycharge. Results showed that all the attributes were preferred and were significant at 1% level of significance. The study revealed that Choice Experiment can successfully be applied in developing countries, like Malaysia, on solid waste related issues with careful construction of choice sets, questions and effective data collection.

From the above reviewed literatures, it can be seen that Choice Experiment has a great potential to value preferences on SWM services and estimate the implicit prices for each SWM service attribute. With regard to Kinondoni municipality, there is scanty information on household preferences and their WTP for SWM services which has limited the success

of existing SWM services. This study employed Choice Experiment to value household preferences on SWM services and their WTP for these services. The findings of this study could be useful in improving the design and delivery of SWM services not only in Kinondoni municipality but also to other urban areas in our country.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Description of the Study Area

The study was conducted in Kinondoni municipality (Fig. 1) which is found between latitude 6^0 45' 00" S and longitude $39^0$10' 00" E (Oberlin, 2013a). Kinondoni municipality covers 531 km^2 and has a population of 1 775 049 with an annual growth rate of 4.1% (URT, 2012). The rapid population increase is influenced by both natural causes and immigration (birth rates and net immigration rates respectively) (Simon, 2008; URT, 2012). Kinondoni municipality (Fig. 1) covers a wide range of informal settlements, where solid waste is a great challenge. Kinondoni municipality generates the highest volume of solid waste in the region (2026 tonne/day), and about 60% of the generated solid waste per day in the municipality is not attended (Bubegwa, 2012). Also, existing SWM services are inadequate and ineffective which necessitates the need to establish effective strategies for improving the delivery of SWM services in Kinondoni municipality (Thomas and Rahel, 2013).

Figure 1: **Map of Dar es Salaam showing Kinondoni, Ilala and Temeke municipalities**
Source: Oberlin (2013)

3.2 Research Design

The study used cross sectional design. This design is cost effective and allows collection of data from selected respondents at one point in time. Furthermore, cross-sectional design is appropriate in describing characteristics that exist in a population and examining the relationship among variables (Kothari, 2004). This study was divided into 2 phases, the qualitative and quantitative phase. The qualitative phase was done during a preliminary study in which focus group discussions (FGDs) were conducted to select

relevant SWM service attributes to be used in a Choice Experiment. The quantitative phase was done during actual data collection. It involved 3 parts which were questionnaire survey, Choice Experiment and direct measurement on the amount of solid waste generated in each household per day. Choice Experiment was done using choice cards to capture household preferences and WTP for SWM services. Questionnaire survey collected household information to supplement Choice Experiment results.

3.3 Sampling Procedure and Sample Size

The study used both probability and non probability sampling. Probability sampling was used to select wards, streets and households while non probability sampling was used to select key informants such as municipal officials, ward officials and SWM service providers in Kinondoni municipality. Stratified sampling was used to stratify wards in Kinondoni municipality into 2 strata based on the amount of solid waste generated in each ward per day. One stratum included wards generating 0-50 tonne of solid waste per day, while the other stratum included wards generating above 50 tonne of solid waste per day. From each stratum, 1 ward was randomly selected. Mwananyamala ward was randomly selected from wards generating 0-50 tonne of solid waste per day while Kawe ward was randomly selected from wards generating above 50 tonne of solid waste per day.

With the help of Ward Executive Officer (WEO) and *Mtaa* Executive Officers (MEO), simple random sampling was used to select 4 streets also known as sub-wards or locally as "*mitaa*" from 7 streets of Mwananyamala ward namely, Kambangwa, Msisiri A, Msisiri B, Msolomi, Bwawani, Mwinjuma and Kopa in which Kambangwa, Msisiri A, Mwinjuma and Kopa streets were randomly selected for this study. Kawe ward has only 4 streets namely Mzimuni, Ukwamani, Mbezi Beach A and Mbezi Beach B, which were all included in this study. Using street household registers, the MEO helped the researcher to

randomly select 30 households from each street, making a total of 240 households used in this study.

Purposive sampling was employed to select key informants as it allows selection of key respondents who have adequate knowledge on the subject matter (Kothari, 2004). It was used to select municipal health officers, municipal environmental officers, WEO, ward health officers, MEO and SWM service providers in Kinondoni municipality.

3.4 Data Collection

3.4.1 Primary data

Qualitative and quantitative primary data were collected during the study through the following;

3.4.1.1 Focus group discussions and consultations

FGDs and consultations were done during a preliminary study to identify relevant SWM service attributes to be used in a Choice Experiment. Households were involved in FGDs whilst consultations were done with Kinondoni municipal environmental and health officials, SWM service providers, ward officials and "*mitaa"* officials.

3.4.1.2 Questionnaire survey

Questionnaire survey was done during the actual data collection in which semi structured questionnaire (Appendix 1) were used in a face to face household interviews. Questionnaire survey collected information on households' socio-economic characteristics and their SWM practices, which were used to supplement Choice Experiment results.

3.4.1.3 Direct measurement on solid waste generated on each household per day

The amount of solid waste generated in each household per day in kg was measured during the actual data collection and recorded in a checklist (Appendix 2). A spring

balance weighing 0-25 kg was used to measure the amount of solid waste generated in each household per day. Households without solid waste storage facility were provided with plastic bags (waste bags) to store their solid waste generated per day during the study, others used their own storage facilities to store the generated solid waste per day.

Besides, another checklist (Appendix 3) was used to collect information pertaining to SWM services from key informants during the study. It had 2 sections, 1 section had questions for Kinondoni municipal health and environmental officials, Mwananyamala and Kawe ward officials while the other section had questions for SWM service providers within Kinondoni municipality.

3.4.1.4 Choice experiment and designing of choice experiment

Choice cards were used in a Choice Experiment to assess household preferences and their willingness to pay for SWM services. The aim of Choice Experiment was to determine the implicit prices of each SWM service attribute, the compensating surplus of each SWM option and variations in household preferences for SWM services using choice cards. In order to construct the choice cards, the SWM service need to be decomposed into different attributes and a combination of various levels of this set of attributes results in a scenario of change in environmental quality (Jin *et al*., 2006). A first step was to define the choices to be presented to the interviewees which was done during a preliminary study. Secondly, a design was made which limited the number of choices given to each respondent and maximized the information obtained from the experiment. Thirdly, the interviewees were selected and the Choice Experiment was undertaken.

- **Determination of relevant SWM services attributes and levels**

Any Choice Experiment study necessitates FGDs and consultations to be conducted prior the actual data collection so that respondents can select or suggest their most relevant

attributes and levels to be included in the Choice Experiment (Louviere *et al.,* 2000; Alpizar *et al.,* 2001; Hensher *et al*., 2005). In this study, FGDs and consultations were conducted during a preliminary study in order to allow the respondents to suggest their relevant SWM service attributes and levels (choices). Households were involved in FGDs while key informants were involved in consultations.

At the household level, 4 FGDs were held at Msisiri A primary school, Garden area in Mwinjuma street, Bondeni near *Mto* Mbezi in Ukwamani street and T Square area in Mbezi Beach B street. The groups consisted of both men and women, and each group had 8 to 12 persons. The first group had 6 women and 4 men, the second group had 4 women and 4 men, the third group had 7 women and 5 men while the fourth group had 3 women and 8 men.

Also, consultations were held with officials at the municipal and wards levels, where health officers, ward executive officers were also involved to select or suggest the most relevant SWM service attributes and levels in line with households' preferences on SWM services. Consultations were also done with providers of SWM services in the municipality. Four SWM service attributes, 3 with 2 levels and 1with 4 levels were suggested from the FGDs and consultations (Table 2). Details on the suggested SWM service attributes and levels are presented in section 4.3 of this work.

Table 2: Relevant SWM service attributes and levels (choices)

Attribute	Description	Levels
Vehicles with a covering material for transporting solid waste	Vehicles with a covering material such as nets should be used for carrying the generated solid waste from households to the disposal site	No (status quo) and Yes (vehicles with covering materials will be used)
Provision of polythene bags for storing solid waste	Polythene or plastic bags for storing solid waste at households while waiting for collection services	No (status quo), yes (polythene bags will be provided)
Frequency of solid waste collection	The number of times solid waste are collected from the households	Once per week regular and twice per week regular
Payment	The price of SWM service per month in TZS	1000, 3000, 5000 and 10 000

- **Creating the choice experiment design**

The number of options that can be created from 4 SWM service attributes, 3 with 2 levels and 1 with 4 levels is 2^3x4^1 (32). JMP software was used to construct 6 choice cards from the SWM service attributes and their levels. Each choice card consisted of 2 SWM options and an opt out or neither option. The neither option was introduced as an alternative in the choice sets, to enable the respondent to choose no change in SWM by keeping the current SWM situation. This enables estimation of welfare measures that are consistent with demand theory (Hanley *et al*., 2001). To reduce the burden upon the respondents, the 6 choice cards were blocked into 2 blocks each with 3 choice cards so each respondent had to complete 3 choice cards. The researcher clearly explained each choice card to the interviewee. This helped the respondent to understand the SWM options and their levels

hence choosing his/her most preferred option from each choice card. Choice cards that were designed and used in this Choice Experiment are shown in Table 3, 4 and 5 below;

Table 3: Choice card 1

Given the following solid waste management options, which one would you prefer?

Card No.	**Attributes**	**SWM option I**	**SWM option II**	**Neither SWM option I nor SWM option II**
1	Vehicles for transporting solid waste	No	Yes	
	Provision of polythene bags for storing solid waste	Yes	No	
	Frequency of solid waste collection	Once per week regular	Twice per week regular	
	Cost of solid waste service per month in TZS	1000	3000	
	I prefer			

Table 4: Choice card 2

Given the following solid waste management options, which one would you prefer?

Card No.	**Attributes**	**SWM option I**	**SWM option II**	**Neither SWM option I nor SWM option II**
2	Vehicles for transporting solid waste	No	Yes	
	Provision of polythene bags for storing solid waste	No	Yes	
	Frequency of solid waste collection	Once per week regular	Twice per week regular	
	Cost of solid waste service per month in TZS	3000	5000	
	I prefer			

Table 5: Choice card 3

Given the following solid waste management options, which one would you prefer?

Card No.	Attributes	SWM option I	SWM option II	Neither SWM option I nor SWM option II
3	Vehicles for transporting solid waste	No	No	
	Provision of polythene bags for storing solid waste	No	Yes	
	Frequency of solid waste collection	Twice per week regular	Once per week regular	
	Cost of solid waste service per month in TZS	10 000	5000	
	I prefer			

3.4.2 Secondary data

Secondary data were used to enrich the findings from the primary data. Secondary data were collected from journals, research papers, books, municipal and ward reports. They included information related to solid waste, SWM services and use of Choice Experiment in SWM services. Key informants such as Kinondoni municipal health and environmental officials, ward officials were interviewed to provide the necessary secondary data pertaining to SWM services in Kinondoni municipality.

3.5 Data Analysis

Both quantitative and qualitative methods were used to analyse the collected data. Questionnaire data (respondents' socio-economic characteristics, households SWM practices) and amount of solid waste generated in each household per day were analysed using SPSS 16.0 software in which descriptive statistics such as frequencies, percentages and means were estimated. Choice Experiment data were analysed using Limdep 9.0

Nlogit 4.0 software. Microsoft excel was also employed for data entry for variables analysed using Limdep 9.0 Nlogit 4.0 software. Qualitative data were analysed using content analysis method.

3.5.1 Estimation of implicit price of each solid waste management service attribute

Implicit prices also known as marginal WTP was estimated using a conditional logit (CL) model. The CL model was used because it is usually modelled based on choice specific attributes (attributes of a good or service under valuation) and not on the individual characteristics (Greene, 2002). CL model holds two assumptions, which are homogeneous preferences among respondents and independence of irrelevant alternative (IIA). The IIA states that the relative probabilities of two options being chosen are unaffected by introduction or removal of other alternatives (McFadden, 1974). Use of CL model helps to capture respondents' preferences on specific choice attributes, in this case SWM service attributes in a Choice Experiment as individual characteristics are assumed to be homogeneous (Boxall and Adamowicz, 2002). The relevant SWM service attributes identified during FGDs and consultations were modelled in the CL model. The following CL model was used;

$$U_{njt} = ASC + \beta_1 Z_1 + \beta_2 Z_2 + \beta_3 Z_3 + \ldots \beta_n Z_n \quad \ldots\ldots(3)$$

Where;

U_{njt} is indirect utility function of alternative *j* for individual *n* at choice situation *t*

$Z_1 - Z_n$ SWM service attributes such as use of vehicles with a covering material for transporting solid waste, provisional of polythene bags for storing solid waste, frequency of solid waste collection and payment of SWM services per month.

$\beta_1 - \beta_n$ Coefficient parameters for SWM service attributes,

ASP Alternative specific constant

Implicit prices for each solid waste management service attribute

The implicit prices were calculated using the coefficient parameters from results of CL model in equation 3 above. Referring to Alpizar *et al*. (2001) the implicit price or marginal WTP for each SWM service attribute was estimated using equation 4 below;

Marginal WTP = _ ($\beta_{attribute}/\beta_{monetary}$)……**(4)**

Where;

($\beta_{attribute}$) is the estimated coefficient on the non-market attribute (SWM service attribute) such as use of vehicles with a covering material for transporting solid waste, provision of polythene bags for storing solid waste and frequency of solid waste collection.

($\beta_{monetary}$) is the estimated coefficient on the cost attribute (payment of SWM service per month)

3.5.2 Examination of the most preferred solid waste management service attributes

The calculated implicit prices (marginal WTP) for each SWM service attribute were used to identify the most preferred SWM service attribute in which SWM service attributes with higher implicit prices are most preferred while the ones with lower implicit prices are least preferred.

3.5.3 Estimation of compensating surplus

Compensating surplus also known as WTP is the amount of money that is taken away from the person to make the utility with the environmental improvement equal to the utility before the change. In theory, economic welfare measures are the amount of money (given or taken away) that makes a person as well-off as they would be before a change or the amount of money (given or taken away) that make a person as well-off as they would

be after a change. This change in income reflects the individual's WTP to obtain an improvement in environmental quality (Boxall *et al*., 1996; Jamal *et al*., 2004). Algebraically, welfare measure can be expressed as:

U(M, 0) = U (M – CS, 1)……**(5)**

Where;

U is utility, *M* is income, *CS* is compensating surplus and the second argument in the utility function is 0 for the base situation and 1 for the "changed" situation which in this case is the improvement in SWM services.

Assessment of economic welfare involves an investigation of the difference between the well being (utility) achieved by the individual under the status quo (or constant base) alternative and some other alternative. It is therefore a matter of considering the marginal value of a change away from the status quo. As the CS measures the change in income that would leave a certain individual indifferent between the current SWM and the proposed improved SWM system, the utilities attached to the current SWM and the improved SWM service need to be calculated. According to Bennett and Blamey (2001) an estimation of CS for an environmental improvement in this case improvement in SWM services follows the following procedures;

First, the values of the SWM service attributes that are associated with the current SWM situation are substituted in the equation that estimates the indirect utility associated with the current SWM option (baseline scenario).The monetary attribute is assigned a value of zero for this stage.

Second, the values of the SWM service attributes that are associated with an alternative allocation of resources in this case improved SWM services are substituted into the equation that relates to the relevant change alternative (improved SWM service option). The value of the relevant alternative specific constant (ASC) is also included in the calculation of the indirect utility value for alternative (improved) SWM option. The monetary attribute is again assigned a value of zero.

Finally, the utility value associated with the change alternative (improved SWM option) is then subtracted from the utility value associated with the current SWM option. If the model is linear (in the monetary attribute) this "*indirect utility difference"* is then divided by the negative of the coefficient associated with the monetary attribute. A negative value for the indirect utility difference $(U_0 - U_1)$ indicates that the respondents are willing to pay the amount of the surplus in order to experience an improvement in the well-being resulting from a re-allocation of the resources from the current SWM to the change alternative (improved SWM system).

Referring to Morrison *et al.* (1999) the CS for each improved SWM service option was estimated using the CL model results (equation 3 above) through the following equation;

$$CS = -(1/\beta_{monetary})(U_0 - U_1) \quad \text{.....(6)}$$

Where;

CS is the compensating surplus

$\beta_{monetary}$ is the marginal utility of income (generally represented by the coefficient of the monetary attribute in a Choice Experiment)

U_0 and U_1 represent the indirect utility before and after the change under consideration

A negative value for this surplus estimate indicates that the respondents are willing to pay the amount of the surplus in order to experience an improvement in the well-being resulting from a re-allocation of the resources from the status quo to the change alternative. The complexities caused by the existence of the scale parameter within each β coefficient (non- market attribute) are avoided by dividing throughout by the β coefficient of the monetary attribute. By setting up multiple scenarios of alternative resource allocation (by varying the values the attribute can take) and repeating this arithmetic exercise, an array of values associated with the array of scenarios can be estimated.

3.5.4 Examining variations in household preferences on SWM services

The random parameter logit (RPL) model was used to examine variations in household preferences on SWM services. This is because the CL model used above assumes homogeneous preferences among respondents and holds the IIA assumptions hence it cannot examine variations in households' preferences. Choices made in CL model depend on the characteristics or attributes of an alternative and not on individual characteristics so it can not tell whether there are variations in households' preferences on a given product or service such as SWM services (Louviere *et al*., 2000; Greene, 2002). In order to examine variations in households' preferences, models which relaxes CL model assumptions are used for instance the RPL model. The RPL model assumes individual have heterogeneous or varying preferences and does not hold the IIA assumption (Greene, 2002). The RPL model estimates the mean of the population which is the mean weight utility parameter of a given attribute in the population, and it estimates the standard deviation of the coefficient parameter which measures how an individual deviates from the population mean (Louviere *et al*., 2000). The following equation was used;

$$U_{njt} = \alpha_{nj} + \gamma_j S_n + \beta_n X_{njt} + \varepsilon_{njt} \quad \text{.....(7)}$$

Where;

U_{njt} is indirect utility function of alternative *j* for individual *n* at choice situation *t*

α_{nj} is the alternative specific constant which captures the intrinsic preference for SWM alternative

S_n respondents' socio-economic characteristics

X_{njt} SWM service attributes

β_n coefficient for SWM service attributes.

γ_j coefficient parameters for households' characteristics

$\gamma_j S_n$ captures systematic preference heterogeneity as a function of individual characteristics

ε_{njt} is the error term.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Household Solid Waste Management Practices

4.1.1 Solid waste generation rate

From the study findings it was estimated that the amount of solid waste generated in each household per day was 4.030 kg/household/day. On average, the per capita solid waste generation rate was 0.804 kg/person/day in which the amount of solid waste generated per person per day in Mwananyamala ward was 0.675 kg/person/day whilst in Kawe ward was 0.932 kg/person/day. The difference might be attributed due to the difference in income levels between the 2 wards, where the former is categorized as medium income area while the latter is categorized as high income area. The results are quite in line with that of Bubegwa (2012) who indicated that the amount of solid waste generated per person per day in Dar es Salaam was 0.8 kg/person/day. Additionally, Kasozi and vonBlottnitz (2010) reported that the per capita solid waste generation in middle income settlements in Nairobi was 0.82 kg/capita/day.

On contrary, the study findings differ with Oberlin (2013b) who found that the per capita solid waste generation rate in Kinondoni municipality was 0.44kg/person/day. The difference may be because Oberlin used a sample of 75 respondents and she conducted her study in only two streets of Midizini and Mkunguni, the streets are categorized as very low and middle income settlements respectively. Also, it could be due to population dynamics in the study areas. Boadi and Kuitunen (2004) did a related study in middle income level society in Accra and revealed that the per capita solid waste generation was 0.68 kg/capita/day. On the other hand, Kathirvakle *et al.* (2003) reported a per capita solid waste generation rate of 1.7 kg/person/day in Malaysia.

However, the study finding on solid waste generation rate exceeds the World Bank standards for developing countries which ranges from 0.4 – 0.6 kg/person/day (Pek and Jamal, 2011). This justifies that solid waste generation is a among the key environmental problems in Kinondoni municipality. Table 6 below summarises daily solid waste generation rate in the study area.

Table 6: Daily solid waste generation in the study area

Street/"*Mtaa*"	Solid waste generated per household per day in kg (kg/household/day)	Solid waste generated per person per day in kg (kg/capita/day)
Kambangwa	4.336	0.808
Msisiri A	2.751	0.554
Mwinjuma	3.402	0.638
Kopa	3.978	0.702
Mzimuni	3.105	0.601
Ukwamani	2.470	0.570
Mbezi Beach A	5.609	1.185
Mbezi Beach B	6.595	1.374
AVERAGE	**4.030**	**0.804**

4.1.2 Physical composition of solid waste generated by households

Households indicated that most of their solid waste (67.23%) are composed of food waste, 18.63% are composed of plastic materials, 3.65% are composed of paper waste, 2.83% are composed of garden waste while 7.66% are composed of other solid waste such as ashes, glass, metals, sand, silt, sweepings and many more. Oberlin (2013a, b) also reported that food waste constitute a larger proportion (64.4%, 74.1% respectively) in households' solid waste stream. This may be as a result of cooking which is done in almost every household, usually cooking is associated with high generation of food waste from food peelings and food remains. The findings show a high percentage of plastic material waste such as polythene bags and plastic bottles, this could be to the fact that nowadays, there is an

escalating use of polythene bags as packaging materials in shops, supermarkets and market places. Moreover, many industries are using plastic containers such as food containers, water, soft drinks and drugs bottles which have increased the quantity of plastic waste in households. The presence of ashes in solid waste stream signifies that some households in Kinondoni municipality are using firewood and charcoal as their energy source especially in cooking. The findings are in line with Oberlin (2013b) who indicated that households' overdependence on firewood and charcoal has increased ashes in a solid waste stream in Kinondoni municipality.

4.1.3 Storage of solid waste

The study observed that 94.6% of the total households have solid waste storage facilities while the rest about 5.4% do not have solid waste storage facilities, they just store waste on the ground or throw them in a nearby environment such as roads, river banks, open spaces and drainage channels. This agrees with Boadi and Kuitunen (2004) who reported that most households in Accra have waste storage facilities regardless of their appropriateness and durability.

Furthermore, among the households who have solid waste storage facilities, 40.1% of them use buckets for storage of solid waste while waiting for collection services, 23.8% use polythene bags and 21.6% use dustbins to store solid waste (Fig.2). Some households asserted that there is no proper schedule for solid waste collection as some of them do stay with their waste for either a week or 2 weeks or even 3 weeks waiting for collection services. The researcher observed that dustbins are used mostly by households who earn high incomes per month (TZS 500 000 and above) whereas polythene bags are mostly used by households who earn low incomes per month (below TZS 500 000). This could be attributed by the fact that the latter cannot afford to purchase dustbins. Again, 14.5% of

the households use other types of storage facilities such as old drums, old tins, sacks and boxes to store their solid waste (Fig. 2). However, most of these storage devices are not appropriate for storing solid waste because some of them can easily be damaged as a result of weather changes for example boxes when left outside are destroyed by rain when it rains (Sansa and Kaseka, 2004; Enger and Smith, 2006).

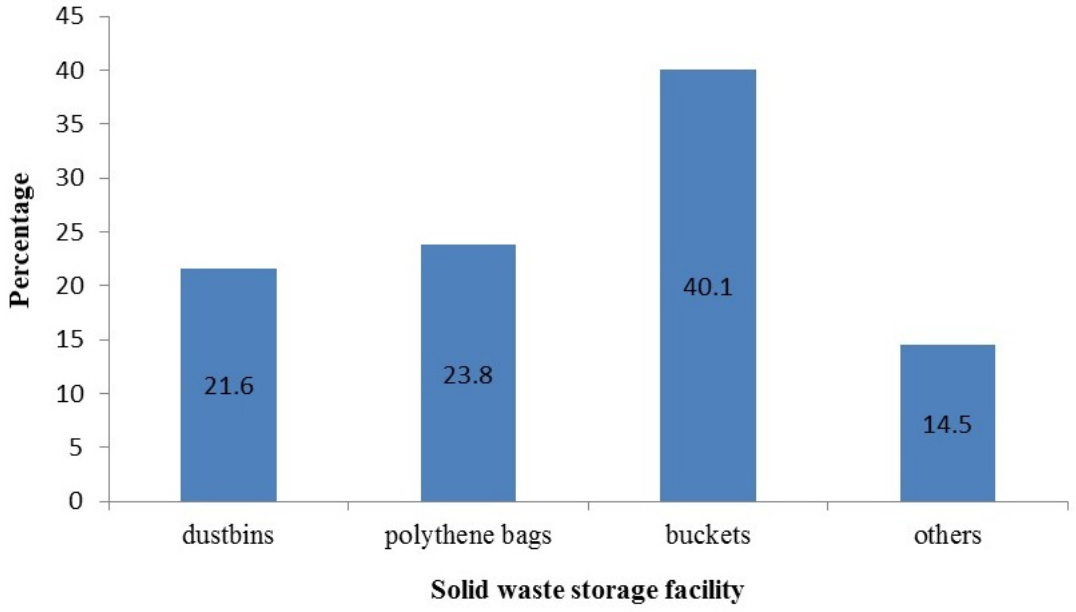

Figure 2: Types of solid waste storage facilities used by households

4.1.4 Sorting of solid waste

The study findings revealed that most households (86.2%) do not sort their solid waste at their households as only 13.8% of them do sort the waste into biodegradable and non-biodegradable waste. This hinders the success of SWM in their areas since solid waste sorting is an important stage in SWM as it enhances resource recovery, transportation and disposal of solid waste. Sorting of solid waste protects households' health as they cannot be easily exposed to hazardous substances, minimizes injuries, prevents waste collectors against injuries and enhances solid waste disposal (Karousakis and Birol, 2008).

The findings agree with Oberlin (2013a) who ascertained that sorting of solid waste is poorly done in Kinondoni municipality.

4.1.5 Reusing of solid waste

The results revealed that only 8.8% of the households reuse their generated solid waste while the rest do not reuse their waste. Solid waste that are mostly reused include plastic bottles, food waste for feeding animals, boxes and polythene bags which are used for packaging purposes and lightening charcoal. The findings agree with Oberlin (2013a) who identified that reusing and recycling programs are poorly developed in Kinondoni municipality. Reusing of solid waste helps to turn waste into useful resources thereby reducing the volume of solid waste which are transported to disposal places, more so it reduces the demand of virgin resources for manufacturing new products such as plastic bottles and polythene bags. Also, it increases the economic value of waste and saves energy (Karousakis and Birol, 2008). The high percentage of households who do not reuse their solid waste indicates that most households are not informed on ways of turning solid waste into useful resources which could add value to discarded solid waste that is a reason most of them treat their solid waste as useless or worthless things.

4.2 Existing Solid Waste Collection and Disposal Services

4.2.1 Providers of solid waste collection and disposal services

The study results indicated that most households (69.2%) are serviced by individual waste collectors mainly the youths locally known as "*mateja*" or "*viroba guys*" who are informal SWM service providers. Furthermore, 16.2% of the households are serviced by private SWM service companies and CBO who are formal SWM service providers as they collect solid waste and dispose them to the official designated dumpsite located in Pugu Kinyamwezi (Table 8). Companies which are providing SWM services in the study area

are GT Usafi company, Rose Millennium company, Sumaita company and Fiber communications which are operating in Mbezi Beach B, Mbezi Beach A and Kopa streets. Also, there is a CBO known as Garden mazingira group which delivers SWM services in Mwinjuma street. The study disclosed that currently there are no SWM service provider in Mzimuni, Ukwamani, Kambangwa and Msisiri A streets. However, it was noted that many households are not satisfied with the services which are currently being provided by SWM service companies and CBO as they are not reliable. This has made many households to drop from using these services.

The findings also indicated that few households (0.8%) receive solid waste collection and disposal services from Kinondoni municipality trucks (Table 7), these included mainly those households located near main roads where municipal trucks collect solid waste. This proves the fact that Kinondoni municipality has inadequate facilities to deliver solid waste services to households in its jurisdiction. Currently, Kinondoni municipality collects solid waste from main roads, public places and open spaces only. It can also be seen from Table 7 that 13.8% of the households are not serviced by anyone. These people claimed to manage solid waste in their own compounds, while others throw waste in open spaces, along river banks and roadsides thereby intensifying SWM problems in Kinondoni Municipality.

The findings revealed that majorities of respondents rely on informal waste collectors (Table 7) who do not have appropriate facilities for collecting and transporting solid waste to disposal places. Most of informal waste collectors dispose the collected solid waste in inappropriate places such as open spaces, river banks, road sides, swampy areas and in neighbours' veranda. The results are in line with Okot-Okumu and Nyenje (2011) who

reported that majorities of households in Kampala city are serviced by informal waste pickers.

Table 7: Providers of solid waste collection and disposal services

Provider of SWM services	Frequency	Percent
Kinondoni municipal council	2	0.8
Private SWM companies/CBO	39	16.2
Individual waste collectors *"mateja"*	166	69.2
None	33	13.8
Total	**240**	**100.0**

4.2.2 Transportation facilities used in delivery of solid waste management services

The study findings showed that 54.6% of the transportation facilities used in delivery of SWM services are push carts/wheel barrows while 17.1% are vehicles. This could be due to the fact that wheel barrows/pushcarts are mostly used by individual waste collectors who are the main providers of SWM services in the study area. Also, the study results indicated that 28.3% of SWM service providers do not use any transport facility. These included mainly individual waste pickers who use sacks or buckets to carry waste from the households. Sacks and buckets are mainly used to collect waste in areas with no access roads/routes hence no any vehicle or push cart can reach the houses. Most households indicated that they are more relying on informal waste collectors because there are no waste collection vehicles in their streets but they would prefer their waste to be collected by vehicles. The findings agree with Boadi and Kuitunen (2004) who detailed that, informal transport facilities such as push carts are mainly used to collect solid waste in most urban areas of developing countries.

4.2.3 Solid waste disposal places and methods of disposal

The study ascertained that most of the generated solid waste are not disposed to the appropriate disposal place as only 15.0% of the solid waste are disposed to the official designated Pugu dumpsite whereas the rest are disposed to informal dumping sites or places such as "*Bonde la Mto Mbezi"* and "*Bonde la IMTU*" where 40.4% of solid waste are being disposed to, and 22.9% of the solid waste are disposed in "*Bwawani*" area in Msisiri A street. Furthermore, 6.6% of solid waste are disposed in households' compounds while 2.0% of the solid waste are disposed in Bunju dumpsite. The remaining 12.9% of solid waste are left uncollected in open spaces, roadsides and drainage channels.

Furthermore, the findings reveal that controlled dumping is used to dispose solid waste in Pugu dumpsite while dumping, burning and burying are used to dispose solid waste in river banks, valleys, swampy areas, open spaces and in households' compounds. The results are quite similar to those of (Sansa and Kaseka, 2004; Oberlin, 2011; Okot-Okumu and Nyenje, 2011) who reported that most solid waste generated in Kampala City are dumped in illegal dumpsites.

4.3 Definition of Choices/Attributes used in a Choice Experiment

The following SWM service attributes and levels were identified by households, government officials and SWM service providers in Kinondoni municipality during FGDs and consultations. These attributes were used in a Choice Experiment.

4.3.1 Vehicles with covering materials for transporting solid waste

Most households who participated in FGDs suggested use of vehicles in collection and transportation of solid waste since their municipality has few vehicles and do not collect solid waste from their households. Others argued that their over reliance on informal waste

collectors, locally known as "*mateja*" have escalated solid waste problems in their streets as most informal waste collectors dump waste in illegal places. This may be due to the fact that the facilities they are using (push carts, wheel barrow, sucks and buckets) cannot practically reach to the disposal site located in Pugu Kinyamwezi. Households believed that use of vehicles will improve SWM in their area as great volumes of waste will be taken to Pugu dumpsite, which is located about 30 km from their municipality.

Few households who are serviced by SWM service providers disclosed that the vehicles which are used by SWM service providers do not have covering materials for securing waste, this causes littering of solid waste on roads when they are being transported. They insisted that the vehicles to be used in SWM should have a covering material such as net or tarpaulins for securing the waste. The municipal and ward officials argued that the MEO are required to find SWM contractors who will bring vehicles for collecting solid waste in their respective streets since the municipality do not have enough vehicles.

The selected levels for this attribute were "NO" which is a status quo in which vehicles without covering materials are used to transport solid waste and "YES" in which vehicles with covering materials such as nets will be used to transport solid waste from the households to disposal place. This attribute was also used in SWM studies by Jamal (2006) and Das *et al.* (2008).

4.3.2 Provisional of polythene/plastic bags for storing solid waste

Households wanted polythene/plastic bags to be provided by SWM services providers since they do not have appropriate devices for storing waste while waiting for collection services. Provision of polythene bags ensures proper storage of waste at the households

and increases the efficiency of solid waste collection as it saves time during waste collection.

Provision of polythene bags was also supported by ward officials and SWM contractors who insisted that given the economic situation of most of their households it is very economical to provide households with polythene bags so that most of them can afford the payment of SWM services. Polythene bags are cheaper in comparison to other storage facilities such as dustbins.

This attribute was given 2 levels which are "NO" as a status quo in which polythene bags are not provided to households and "YES" in which polythene bags will be provided to households. Jamal (2006) also used this attribute in his SWM study.

4.3.3 Frequency of solid waste collection

This attribute is concerned with the number of times solid waste are collected from the households to disposal places. This was considered important to the households because only 40% of the generated solid waste per day in Kinondoni municipality is collected (Bubegwa, 2012). Most households believed that increase in frequency of solid waste collection will improve SWM in their area as great volumes of solid waste will be collected and taken to disposal sites.

Households who are serviced by SWM service providers such as SWM contractors in their streets revealed that existing SWM services are not effective as most SWM contractors are not reliable and do not have a regular routine for collecting waste which makes most households to stay with solid waste in their backyards for a long period of time for instance 2 to 3 weeks. Respondents from streets which are not serviced by SWM

contractors insisted that the SWM contractors who shall be contracted by their MEO to collect solid waste regularly, otherwise they will not be willing to pay for unreliable services.

This attribute was given 2 levels which are "once per week regular" in which solid waste will be collected regularly once in every week and "twice per week regular" in which solid waste will be collected regularly twice in every week. This attribute was also used by (Jin *et al.,* 2006; Solomon, 2007; Das *et al.,* 2008; Ku *et al*., 2009; Yonas, 2010) in their SWM studies.

4.3.4 Payments on solid waste service per month in TZS

In order to measure the willingness to pay for changes in other attributes, an attribute related to pricing of SWM services was included. Respondents suggested that the prices of SWM services should be low and should base on their socio economic status in order to allow many households to afford the services other than setting high prices which many households will not afford. Most of the respondents recommended the SWM service price to be based on the amount of prices they are currently paying to either street waste pickers or SWM service contractors.

Almost the same was pointed out by some ward and street officials as they said that regarding the life standards of their people, the monthly SWM service prices should range between TZS 3000 and TZS 15 000. The municipal health officials added that their municipality lacks enough funds to deliver SWM services hence households are supposed to support the municipality through contributing towards the provision of these services. Based on households' preferences, the payment attribute was given 4 levels which are TZS 1000, TZS 3000, TZS 5000 and TZS 10 000.

4.4 Choice Experiment Results

As the study findings in Table 8 show a great variation in monthly income earnings among respondents (standard deviation of income is 471 800), Choice Experiment data were grouped into 2 groups, in which 1 group included households earning below TZS 500 000 per month (low income) while the other group included households earning TZS 500 000 and above per month (high income). This categorization helped to obtain better estimates or calculations of marginal WTP (implicit prices) and WTP (compensating surplus) of the households.

Table 8: Household income earnings per month

Income levels in TZS	Frequency	Percentage	Mean	Min	Max	S. deviation
<100 000	22	9.2	448 885.41	30 000	3 3 500 000	471 800
100 001-300 000	90	37.5				
300 001-500 000	66	27.5				
500 001-700 000	26	10.8				
> 700 000	36	15.0				

Table 9: Preference of the respondents (low income households)

	Conditional logit model (low income)		
Variable	**Coefficient**	**Standard Error**	**P > [Z]**
Vehicles	1.398 616	0.582 471	0.000
Storage	-0.196 184	0.199 206	0.324
Collect	5.106 896	0.771 188	0.000
Payment	-0.001 324	0.000 181	0.000
ASC	-0.782 604	0.153 514	1.000

Number of observations= 1449, no. of parameters= 5, log likelihood= -113.072, Info.criterion AIC=0.933, Info.criterion BIC=1.003, Info.criterion HQIC= 0.961, Pseudo $R^2 = 0.335$

Where - vehicles (vehicles with a covering material), storage (provision of polythene bags), collect (*frequency of solid waste collection), payment (cost of SWM services), ASC (alternative specific constant*)

Results in Table 9 show that coefficients of vehicles and frequency of solid waste collection attributes were both significant at 1% level while the coefficient of provision of polythene bags for storage of solid waste was insignificant. The estimated coefficients of vehicles with a covering material for transportation of solid waste and frequency of solid waste collection have positive signs (Table 9). The positive signs on these attributes advocate that improvements in the levels of these attributes will increase the utility of the respondents. The significance and positive signs on these attributes imply that these SWM service attributes are significant/important factors in the choice of a SWM option. The negative sign and insignificance of the coefficient of provision of polythene bags for storage of solid waste implies that, this attribute is not important and is not preferred by households. The estimated coefficient for the cost of SWM service (payment attribute) has a negative sign, indicating a decrease in utility of respondents as the monthly SWM service charge increases. This means that respondents become less willing to pay for changes as SWM service costs keep increasing. The ASC which captures the element of the choice which cannot be explained by the SWM service attributes is negative and insignificant. In this Choice Experiment the ASC was specified to account for the proportion of participation in SWM services.

Table 10: Preference of the respondents (high income households)

	Conditional logit model (high income)		
Variable	**Coefficient**	**Standard Error**	**P > [Z]**
Vehicles	0.395 863	0.464 953	0.039
Storage	-0.189 839	0.006 931	0.000
Collect	1.348 829	0.334 074	0.000
Payment	-0.000 145	0.000 092	0.000
ASC	-0.958 825	0.782 246	0.000

Number of observations =711, no. of parameters=5, log likelihood= -186.582, Info.criterion AIC=1.623, Info.criterion BIC=1.696, Info.criterion HQIC= 1.653, Pseudo $R^2 = 0.297$

Where - vehicles (*vehicles with a covering material), storage (provision of polythene bags), collect (frequency of solid waste collection), payment (cost of SWM services), ASC (alternative specific constant*)

The coefficients for vehicles with a covering material in transporting solid waste and frequency of solid waste collection attributes were significant at 5% and 1% level of significance respectively and both have positive signs (Table 10). The significance and positive signs on these attributes indicate that these SWM service attributes are important factors in a choice of SWM option and inclusion of these attributes in a SWM option will increase the utility of the households. The coefficient of provision of polythene bags for storage of solid waste had a negative sign and was significant at 1% level (Table 10). This implies that this attribute was not preferred by the households. The estimated coefficient for the cost of SWM service (payment attribute) had a negative sign, indicating a decrease in utility of respondents as the monthly SWM service charge increases. This means that households become less willing to pay for changes as SWM service costs keep increasing. The ASC is negative and significant. With regard to Sasao (2004), a negative ASC means that respondents prefer to select any improved plan for this case improved SWM options than to select the neither option, while a positive ASC means that it is preferable for the respondents to select a neither option than any improved plan.

4.4.1 Implicit prices (marginal WTP) for each SWM service attribute

Estimation of implicit prices are made on a "ceteris paribus" basis that is, they are estimates of respondents' WTP for additional unit of the attribute of concern in this case a SWM service attribute, given that everything is held constant. The CL model results in Table 9 and 10 (coefficients of SWM service attributes) were used to estimate the implicit prices for each SWM service attribute for both low and high income households. The estimated implicit prices of each SWM service attribute for low and high income households are presented in Table 11 and 12.

Table 11: Implicit prices of each SWM service attribute (low income households)

SWM service attribute	Implicit prices in TZS (low income group)
Vehicles	1 056.022
Storage	-148.128
Collect	4 104.562

Implicit prices of each SWM service attribute for households who earn a relative low amount of income per month (< *TZS 500 000*) are presented in Table 11 above. The implicit prices (marginal WTP) for the attribute of vehicles with a covering material for transporting solid waste is TZS 1056.022. This means that on average households are willing to pay an additional charge of TZS 1056.022 per month to ensure that vehicles with a covering material are used to transport solid waste to the disposal site. Use of vehicles with a covering material in transportation of solid waste will increase households' utility as it will minimize littering of solid waste on roads (Das and Birol, 2010). Furthermore, use of vehicles with a covering material will ensure that great amount of solid waste are transported from households to the disposal site.

The implicit price for the attribute of frequency of solid waste collection is TZS 4104.562 (Table 11). This implies that households are willing to pay an additional charge of TZS 4104.562 to ensure improvements in collection of solid waste from their households. Improvement in frequency of solid waste collection will add utility to households as great volumes of solid waste will be collected from the households. This will improve streets' cleanness and minimize environmental pollution. It can also be seen from Table 11 that the attribute of provision of polythene bags for storing of solid waste has a negative implicit price (TZS -148.128). This means that households are not willing to pay any additional charge for provision this attribute.

Table 12: Implicit prices of each SWM service attribute (high income households)

SWM service attribute	Implicit prices in TZS (high income group)
Vehicles	2 713.439
Storage	-1 301.25
Collect	9 245.522

The implicit prices per month of each SWM service attributes for respondents who earn a relative high amount (*TZS 500 000 and above*) are presented in Table 12. The findings show that respondents are willing to pay an additional charge of TZS 2713.439 per month to ensure that vehicles with a covering material are used to collect and transport solid waste from their households to disposal sites. Furthermore, respondents are willing to pay an additional charge of TZS 9245.522 per month to ensure that, there is improvement in frequency of solid waste collection from their households to disposal site. Improvement in frequency of solid waste collection will increase the volume of solid waste collected, hence improving SWM in their area. On the other hand, provisional of waste bags for storage of solid waste has a negative implicit price (TZS -1301.25). This means that respondents do not prefer the provision of polythene bags and they are not willing to pay any amount for this attribute.

4.4.2 Most preferred solid waste management service attributes

The implicit prices are important in demonstrating the trade-offs between individual attributes. A comparison of implicit prices of attributes gives some understanding on the relative importance that respondents hold for them. Usually, most preferred attributes have higher implicit prices than least preferred attributes. On the basis of such comparisons, policy makers are better placed to design resource use alternatives so as to favour those

attributes having higher implicit prices (Jin *et al.,* 2006; Solomon, 2007; Pek and Jamal, 2011).

Regarding the implicit prices shown in Table 11 and 12, it can be seen that frequency of solid waste collection attribute is a most preferred attribute since it has the highest implicit price in both groups. This means that respondents are more interested on how often their generated solid waste will be collected from their households to disposal sites, that is why they are more willing to pay to ensure improvement in frequency of solid waste collection in their area. Probably, this is due to the fact that only 40% of the solid waste generated per day in Kinondoni municipality is collected to disposal sites, the rest is haphazardly thrown in streets, road sides and open spaces (Bubegwa, 2012). Therefore, respondents believe that improvement in frequency of solid waste collection will ensure more volumes of solid waste are collected from their streets to disposal site.

The study findings show that only 15% of the generated solid waste are disposed to Pugu dumpsite, the rest are thrown in illegal dumpsites, hence improvement in frequency of solid waste collection could reduce the volumes of solid waste in their streets. The implicit prices of the frequency of solid waste collection attribute are comparable to Yonas (2010) and Metkel (2011) who reported that households were more willing to pay for frequency of solid waste collection than any other attribute.

The use of vehicles with a covering material in transportation of solid waste is a second preferred attribute in both groups (Table 11 and 12). This means that respondents are also more concerned to see improvements in the quality and quantity of waste collection vehicles in their municipality. This might be due to the fact that Kinondoni municipality has few vehicles for collecting solid waste and most of the vehicles which are used by

SWM service providers do not have covering materials such as nets for securing the waste from littering on roads. Respondents believed that an increase in number of vehicles with covering materials will improve solid waste in their municipality as more solid waste will be carried to Pugu dumpsite, moreover, it will minimize littering of waste on roads. The findings are comparable to those of (Das *et al.,* 2008; Das and Birol, 2010; Metkel, 2011) who revealed that respondents had significant WTP amounts for the use of vehicles with covering materials in transportation of solid waste.

On the other hand, it can be seen from Table 11and 12 that provision of polythene bags for storage of solid waste attribute is not preferred by households in both groups. This is indicated by its negative implicit price meaning that households do not prefer this attribute and they are not willing to pay for provision of polythene bags. This may be due to the fact that many households already have their own ways of storing solid waste in their households, where facilities such as dustbins, buckets, tins, boxes, sacks and even polythene bags are being used, that is why they are not willing to pay for this attribute. This is supported by (Fig.2) which shows that 21.6% of the households use dustbins, 23.8% use polythene bags and 40.1% use buckets for storing solid waste. Therefore, a most pressing challenge to majorities of households was not on storage of their solid waste but was on how the generated solid waste are carried from their households to the disposal place. Another reason for negative preference on provision of polythene bags may be because polythene bags are not durable in storing solid waste unlike dustbins and buckets which are durable and can store solid waste for a long period of time. In additional, the researcher thinks that polythene bags were not preferred because some of the households especially the educated ones are aware on the environmental implications caused by polythene bags. A negative preference on provisional of polythene bags attribute will discourage the use of polythene bags. Countries such as Uganda and Rwanda

have formulated policies to discourage the use of polythene bags as they cause a great deal of environmental implications (Sansa and Kaseka, 2004)

4.4.3 Compensating surplus (WTP) for each improved SWM option

A particular strength of Choice Experiment is its ability to generate estimates of the values (WTP) of many different alternatives from a single application (Bennett and Blamey, 2001). In order to calculate the compensating surplus different scenarios (current option and proposed options) need to be considered. Seven SWM service scenarios were considered from the choice cards that were used in this Choice Experiment. These were;

- **Baseline scenario (Current situation)**

Vehicles without a covering material are used to transport solid waste

Polythene bags are not provided to households for storage of solid waste

Frequency of solid waste collection in the few households who receive SWM services from SWM service providers is either once per week irregular or once per fortnights or once per 3 weeks, so it was assumed to be zero.

i) SWM service option 1

Vehicles without a covering material are used to transport solid waste

Polythene bags are provided to households for storage of solid waste

Frequency of solid waste collection is once per week regular

ii) SWM service option 2

Vehicles with a covering material are used to transport solid waste

Polythene bags are not provided to households for storage of solid waste

Frequency of solid waste collection is twice per week regular

iii) SWM service option 3

Vehicles without a covering material are used to transport solid waste

Polythene bags are not provided to households for storage of solid waste

Frequency of solid waste collection is once per week regular

iv) SWM service option 4

Vehicles with a covering material are used to transport solid waste

Polythene bags are provided to households for storage of solid waste

Frequency of solid waste collection is twice per week regular

v) SWM service option 5

Vehicles without a covering material are used to transport solid waste

Polythene bags are not provided to households for storage of solid waste

Frequency of solid waste collection is twice per week regular

vi) SWM service option 6

Vehicles without a covering material are used to transport solid waste

Polythene bags are provided to households for storage of solid waste

Frequency of solid waste collection is twice per week regular

The estimated coefficients of SWM service attributes from the conditional logit models of both low and high income households were used in calculations of CS. From the results of the CL models, the values (marginal WTP) for the SWM service attributes that were used in calculations of CS for respondents in low income group are TZS 1056.022 for *vehicles* and TZS 4104.562 for *collect.* The values of marginal WTP that were used in estimating CS for respondents in high income group are TZS 2713.439 for *vehicles* and TZS

9245.522 for *collect.* The marginal WTP for *storage* was negative in both groups so it is assumed to be zero. The estimated CS values for various SWM options in both low and high income householdsare presented in Table 13 and 14 respectively.

Table 13: Compensating surplus per month for SWM options (low income households)

SWM options	SWM service attributes levels			Compensating surplus
	Vehicles	Storage	Collect	(WTP) in TZS
Current SWM option	0	0	0	0
SWM option 1	0	1	1	4 104.562
SWM option 2	1	0	2	9 265.146
SWM option 3	0	0	1	4 104.562
SWM option 4	1	1	2	9 265.146
SWM option 5	0	0	2	8 209.124
SWM option 6	0	1	2	8 209.124

Estimates of low income households' willingness to pay (CS) per month are presented in Table 13 above. The CS values are interpreted as the price or money that households are willing to pay for the change from the current SWM situation (baseline scenario) to the improved SWM service options (change scenarios). For example the WTP per month for low income households to change from the current situation (vehicles without a covering material are used to transport solid waste, polythene bags are not provided and frequency of solid waste collection is either once per week irregular or once per fortnights or once per 3 weeks) to improved situation of SWM service option 2 (vehicles with a covering material are used to transport solid waste, polythene bags are not provided and frequency of solid waste collection is twice per week regular) is [*TZS 1056.022(vehicles) +TZS*

*4104.562 *2 (collect)*] = *TZS 9265.146.* The average WTP per month for low income households was *TZS 7192.944*.

Table 14: Compensating surplus per month for SWM options (high income households)

SWM options	SWM service attributes levels			Compensating surplus (WTP) in TZS
	Vehicles	Storage	Collect	
Current SWM option	0	0	0	0
SWM option 1	0	1	1	9 245.522
SWM option 2	1	0	2	21 204.483
SWM option 3	0	0	1	9 245.522
SWM option 4	1	1	2	21 204.483
SWM option 5	0	0	2	18 491.044
SWM option 6	0	1	2	18 491.044

High income households have varying WTP for different SWM service options as shown in Table 14. For instance, the WTP per month for households to change from the current situation (vehicles without a covering material are used to transport solid waste, polythene bags are not provided and frequency of solid waste collection is either once per week irregular or once per fortnights or once per 3 weeks) to improved situation of SWM service option 6 (vehicles with a covering material are not used to transport solid waste, polythene bags are provided and frequency of solid waste collection is twice per week regular) is [*TZS 0*(*storage*) *+TZS 9245.522 *2* (*collect*)] = *TZS 18 491.044.* The average WTP per month for high income households was *TZS 16 313.682*.

Estimation of CS values for each improved SWM service option shows the strength of Choice Experiment method in comparison to other stated preference methods such as

contingent valuation method (Jamal, 2006). Various hypothetical scenarios for improved SWM services were created and their values were estimated as shown in Table 13 and 14. Policy makers can use these values to set appropriate prices for improving SWM services regarding the preferences of households on SWM services and their socio-economic status. For instance, households can be grouped into low and high income groups like it was done in this study since income is usually a major factor that influences someone's WTP for a given service.

Table 15: Interpretation of codes used for SWM service attributes and levels

SWM service attribute	Levels
Vehicles with a covering material for transporting solid waste. Coded as "*vehicles*	*No*- vehicles without a covering material are used for transporting solid waste. Coded as "0" *Yes*-vehicles with a covering material are used for transporting solid waste. Coded as "1"
Provision of polythene bags for storage of solid waste. Coded as "*storage*"	*No*- polythene bags are not provided. Coded as "0" *Yes*- polythene bags are provided. Coded as "1"
Frequency of solid waste collection. Coded as "*collect*"	*Once per week regular*. Coded as "1" *Twice per week regular*. Coded as "2"

4.5.4 Variations in households' preferences for SWM services

RPL model were run for low income households, high income households and for both groups (combination of low and high income households). For each SWM service attribute, the estimated coefficient for the mean of the distribution and the variance (coefficient standard deviation) of the distribution are given. The associated standard errors are given between brackets, so that standard inferences about the significance of the coefficient can be drawn. If the estimate of the variance is insignificant, and thus not

different from zero, then one can infer that the preference parameter is constant across the population. If the mean coefficient is insignificant, and thus not different from zero, but the variance estimate is significant, it does not mean that the attribute does not affect choice, but rather that there is a diversity of preferences, both positive and negative. If both the estimate of the mean and of the variance are found to be insignificant, and thus not different from zero, then it can be said that this attribute has no impact on choices (Birol *et al*., 2006). The RPL model results are shown in Table 16, 17 and 18.

Table 16: RPL model for low income households

RPL model (low income households)				
Attribute	**Coefficient**	**(S.E)**	**Coefficient std**	**(S.E)**
Vehicle	1.747***	0.369	0.165***	1 652.892
Storage	-0.047	0.189	0.883**	1 330.927
Collect	2.006***	0.310	0.221***	614.759
Payment	-0.006***	0.703		
ASC	-0.815***	0.139		

No of observations= 1449, log likelihood=-421.881, Pseudo R^2=0.144, Chi^2= 143.011***,df= 3, Info criterion AIC= 0.968, Info criterion BIC= 1.011, Info criterion HQIC=0.984

significant at 10% level, ** significant at 5% level, * significant at 1% level.*

The coefficients for vehicle and collect attributes are positive and significant, meaning that low income households positively value these attributes (Table 16). Provison of these attributes in SWM services will add utility to the respondents. The attribute of storage is not significant and is negatively preferred by the respondents indicated by its negative coefficient. However estimates of its variance (0.165) is significant meaning that there is a diversity in preferences for this attribute among low income households. The attribute of

payment has negative and significant coefficient meaning that higher prices of solid waste reduces the probability of SWM options being chosen. The coeffiecient of collect attribute (2.006) is higher than that of vehicle (1.747), implying that low income households are more interested to see improvement in frequency of solid waste collection in SWM services as it will ensure more volumes of solid waste are collected from their households. Table 16 shows that there is low variations in households preference for SWM services among low income households indicated by low values of the variances (coefficient std).

Table 17: RPL model for high income households

RPL model (high income households)				
Attribute	**Coefficient**	**(S.E)**	**Coefficient std.**	**(S.E)**
Vehicle	2.212***	0.443	90 158.318***	1 783.473
Storage	-0.531***	0.203	62 786.641***	1 352.353
Collect	0.141**	0.376	8 505.726***	598.286
Payment	-0.0001**	0.739		
ASC	-1.771***	0.169		

No of observations= 711, log likelihood=-307.273, Pseudo R^2=0.139, Chi^2= 100.005***,df= 3, Info criterion AIC= 0.886, Info criterion BIC= 0.938, Info criterion HQIC=0.906

significant at 10% level, ** significant at 5% level, * significant at 1% level*

Explanations on the sign and significance of coefficients for SWM service attributes in high income households is the same like those explained in low income households. However, storage attribute is significant, meaning that this attribute is important though it is negatively preferred. This may be due to the fact that this group recognize the importance of having solid waste storage facilities but they are not contented on using polythene bags as waste storage facilities. The vehicle attribute has a highest and significant coefficient meaning that this group prefer more improvement in quality of

waste collection vehicles. The estimated variances/coefficients std (Table 17) are very high and significant meaning that there is high variations in preferences for SWM services among high income households.

Table 18: RPL model for low and high income households (combined)

RPL model (low and high income households)				
Attribute	**Coefficient**	**(S.E)**	**Coefficient std.**	**(S.E)**
Vehicle	0.629**	0.322	470 159.695***	1 576.957
Storage	-0.176	0.166	165 468.821**	1 208.971
Collect	1.361***	0.283	18 261***	526.212
Payment	-0.0004***	0.596		
ASC	-0.869***	0.127		

No of observations= 2160, log likelihood=-439.269, Pseudo R^2=0.188, Chi^2= 204.417***,df= 3, Info criterion AIC= 1.007, Info criterion BIC= 1.051, Info criterion HQIC=1.023

significant at 10% level, ** significant at 5% level, * significant at 1% level*

When all respondents were combined in one group (Table 18), the coefficients for vehicle and collect were positive and significant meaning that they are positively valued by all respondents. However, the collect attribute is most preferred than vehicle attribute. The storage attribute is not significant but its variance (coefficient std) is significant meaning that there is diversity in preferences for this attribute among the households. Combination of low and high income households increased the variations in preferences for SWM services indicated by high values of coefficient std (Table 18). This signifies that there is high variations in households' preferences for SWM service attributes and it was logical to categorize respondents into two groups (low and high income households) so as to get better estimates of marginal WTP (implicit price) of SWM services attributes and CS values. Also income is a significant factor affecting household preferences for SWM service options.

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Non inclusion of household preferences in designing SWM services has limited the success of existing SWM services in Kinondoni municipality. Most households do not appreciate and support the existing SWM services as they are expensive, inadequate and unreliable. This has made most households in Kinondoni municipality to rely on informal waste pickers who further complicate SWM as they dump waste in illegal dumpsites and open spaces. This study assessed the household preferences on provision of SWM services in Kinondoni Municipality. The study revealed that households in Kinondoni municipality have preferences on provision of SWM services and they are WTP for provision of these services. This implies that households are willing to support the delivery of proper SWM services in their streets which in turn would improve SWM.

The SWM service was decomposed into 3 SWM attributes, namely use of vehicles with a covering material for transportation of solid waste, provision of polythene bags for storage of solid waste and frequency of solid waste collection. The implicit prices for use of vehicles with a covering material, provisional of polythene bags and frequency of solid waste collection attributes were TZS 1056.022, TZS -148.128, TZS 4104.562 respectively for low income households and TZS 2713.439, TZS -1301.25, TZS 9245.522 respectively for high income households. High income households were willing to pay higher implicit prices in comparison to low income households.

The estimated implicit prices for each SWM service attribute were used to identify the most preferred attributes. Frequency of solid waste collection and use of vehicles with a

covering material in transporting solid waste were the most preferred SWM attributes while provision of polythene bags attribute was not preferred by the households. Improvements in means of transporting solid waste to disposal sites and frequency of solid waste collection will improve SWM in Kinondoni municipality as great volume of waste will be carried and disposed to official designated dumpsite located in Pugu Kinyamwezi. Provisional of polythene bags attribute is not preferred by households as it would encourage generation of more waste and polythene bags cause great environmental implications.

The compensating surplus per month for low and high income households were TZS 7192.944 and TZS 16 313.682 respectively. Providers of SWM services can collect a total of TZS 1 158 063.984 and TZS 1 288 780.878 per month from 161 low income households and 79 high income households respectively who were involved in this study. On average, each household is willing to pay TZS 11 753.313 per month for SWM services. This amount can be used by SWM service providers to support the provision of appropriate SWM services to households.

The study also ascertained that there are high variations in household preferences on SWM services. The variations are mainly attributed by individual characteristics such as income. The findings show that variation in household preferences on SWM services increases when both low and high income households are grouped together but it decreases when each group is treated separately. The existence of high variations in household preferences on SWM services necessitates the need to consider households' socio economic characteristics especially income when setting solid waste charges. High income households have good cash flows and are more willing to pay for provision of SWM services unlike low income households.

5.2 Recommendations

Based on the above conclusions, the following are recommended;

In order to ensure sustainable SWM in Kinondoni municipality, policy makers in the municipality should integrate household preferences and willingness to pay for SWM services when preparing SWM policies. This will help to design appropriate SWM policies which can easily be appreciated and supported by households.

SWM service providers in Kinondoni municipality should consider the household preferences on SWM services and their willingness to pay when designing SWM services to households. For instance, they must provide the mostly preferred SWM attributes in their services. Polythene bags should not be provided since this attribute is not preferred by households and they cause great environmental implications.

The implicit prices and compensating surplus estimated in this study should be used by decision makers and SWM service providers in Kinondoni municipality as financial indicators in setting appropriate prices for SWM services. In order to encourage the payment of solid waste charges, solid waste prices should be differentiated from one group and another basing on their socio economic characteristics such as income and the amount of solid waste generated in each household. High income households can easily afford the payment of high solid waste charges unlike low income households.

Variations in household preferences on provision of SWM services should be considered when designing and delivering SWM services to households. In order to design appropriate SWM services for households in a particular area, the economic status of households residing in that area need to be considered. Socio economic characteristics especially income influences household preferences for SWM services.

More research on valuing household preferences for SWM services is recommended to other urban areas since a clear understanding of household preferences for SWM services would help to design and deliver appropriate SWM services to households. Provision of appropriate SWM services will enhance sustainable SWM in urban areas.

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APPENDICES

Appendix 1: Questionnaire

QUESTIONNAIRE FOR HOUSEHOLD PREFERENCES ON PROVISION OF SOLID WASTE MANAGEMENT SERVICES IN KINONDONI MUNICIPALITY

Introduction

I am Daudi Bigirwa a student of Master of Science in Environmental and Natural Resource Economics from Sokoine University of Agriculture. I am doing a research on "**Household Preferences on Provision of Solid Waste Management Services in Kinondoni Municipality**". I hereby request you to participate in this study through helping me to fill this questionnaire. This study is for academic purpose and the information collected from you will be handled with great confidentiality.

PART I: RESPONDENT'S SOCIO-ECONOMIC CHARACTERISTICS

Prior information

Questionnaire serial number……. Date of interview…….

Ward…….. Sub ward/ Mtaa…….

Instruction: Please tick the number besides your correct answer and fill the space provided

1.Sex 1) Female 2) Male

2. Age in years ……

3. Marital status

1) Single 2) Married 3) Widow/er 4) Divorced

4. Education level

1) No formal education 2) Primary 3) Secondary 4) Tertiary

5. The number of people living in your household

1) < 5 2) 5-7 3) 8-10 4) > 10

6. Occupation

1) Employed 2) Business 3) Casual labour 4) Others …….

7. How much do you earn per month in TZS? ……..

PART II: SOLID WASTE MANAGEMENT

Instruction: Please tick the correct answer and fill the space provided

8. Mention the types of solid waste you mostly generate at your households

..……

9. Do you have solid waste storage facility? 1) Yes 2) No

10. If your answer for qn. 10 is yes, which facility do you use?

1) Dustbins 2) Polythene bags 3) Boxes 4) others……

11. Do you sort your solid waste? 1) Yes 2) No

12. Do you reuse/recycle some of your solid waste? 1) Yes 2) No

13. If your answer for qn.13 is yes, which solid waste do you reuse?

.....

14. Do you sell materials recovered from your solid waste? 1) Yes 2) No

15. Who provides solid waste collection and disposal services in your household?

……

16. Are you satisfied with the provided SWM services? 1) Yes 2) No

17. If your answer for qn.17 is no, explain why? ……..

……

18. Which transportation facilities are used to transport waste from your household?

……

19. Mention the methods which are used to dispose solid waste in your area

……

……

20. What is your advice on how to improve solid waste management services in your area?

……

……

……

Thank you for your cooperation

Appendix 2: Checklist for recording the amount of solid waste generated in each household per day

S/No	Solid waste in kg	S/No	Solid waste in kg	S/No	Solid waste in kg

Appendix 3: Key informants' checklist

A. Questions for municipal environmental officers and wards/streets leaders

1. What is SWM service and how is it being organized in your area?
2. Are the available SWM services satisfactory? Explain your answer.
3. How much quantity of solid waste is being generated in your area per day and how much is being collected?
4. How much does each household pay for solid waste services per month?
5. What factors hinder SWM services in your municipal/ward/street?
6. How can SWM services be improved in your area?

B. Questions for SWM service providers

1. Which areas do you deliver your service?
2. Which facilities do you use? Are they enough? Are they of good quality?
3. What is your schedule for collecting waste in your designated area?
4. How many households do you serve per day?
5. What is the quantity of solid waste do you collect per day?
6. How much do you charge each household for SWM services per month?
7. Who sets SWM charges? Are you satisfied with the price?
8. Do you sort and recover useful materials from the collected solid waste? Why?
9. Which disposal method is used to dispose wastes? Is it environmentally friendly?
10. What challenges do you encounter in your day to day delivery of SWM services?
11. How can SWM services be improved at the households and in the municipality?