RESIDENTS' WILLINGNESS TO PAY FOR IMPROVED SOLID WASTE MANAGEMENT IN DODOMA MUNICIPALITY, TANZANIA

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A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN AGRICULTURAL ECONOMICS OF SOKOINE UNIVERSITY OF AGRICULTURE. MOROGORO, TANZANIA.

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ABSTRACT

This study was carried out to assess people's willingness to pay for improved solid waste management (SWM) in Dodoma Municipality. The specific objectives where to determine the residents' willingness to pay (WTP) for improved SWM in the Municipality, evaluate factors which influence the WTP for improved SWM in the Municipality and to identify a suitable model for sustainable SWM in the municipality. The primary data were collected through stratified simple random sampling with proportionate allocation from 200 respondents from five streets which were divided into three income groups (low, middle and high). Data were analyzed using descriptive and quantitative methods. The choice modeling method and multinomial logit model were employed to elicit the WTP for improved SWM and to assess the factors that determine WTP for improved SWM. The findings' show that the majority of the respondents (63%) were willing to pay for improved SWM, whereby 58% were willing to pay TZS 3000 and 5% were willing to pay TZS 4000. The rest (37%) of the respondents opted for the status quo which was TZS 2000. The findings show that collection frequency, transport mode, disposal method, charge per month, age, marital status, education level, occupation, quantities of solid waste generated, location of the dump, and income level of the households were significant factors in influencing people's willingness to pay for improved SWM in Dodoma Municipality. In view of the main findings of the study, several policy proposals are suggested. These include increasing trucks and collection frequency per week; extending the study to other parts of the country, investigate the streets which do not benefit from solid waste collection services in order to find out if the households from those streets are willing to pay for the services, and investigation on existing SWM at commercial and industrial centers.

DECLARATION

I, John Mussa, do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work and that it has neither been submitted nor being concurrently submitted for degree award in any other institution.

_____   _____
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The above declaration is confirmed by:

_____   _____
Prof. Reuben Kadigi, M.J.   Date

(Supervisor)

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DEDICATION

This work is dedicated to my beloved mother Catherine Wambura Kitogoro and my father Mussa John Nguttu who laid the foundation of my education. From the first day you took me to school you knew that your son would arrive at somewhere. For this I think I have impressed you because at least I did not let you down. I thank you very much Dad and Mom for your heartfelt love, care and constant encouragement.

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LIST OF ACRONYMS

CDA	Capital Development Authority
CE	Choice Experiment
CM	Choice Modeling
CS	Consumer Surplus
CSA	Canadian Standard Association
CV	Contigent Valuation
EMS	Environmental Management System
ISO	Irish Standard Association
LCA	Life Cycle Analysis
MNL	Multinomial logit
MSW	Municipal Solid Waste
MWTP	Marginal willingness to pay
NBS	National Bureau of Statistics
SPSS	Statistical Package for Social Sciences
SWM	Solid Waste Management
TZS	Tanzanian shillings
WB	World Bank
WTP	Willingness To Pay

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information of Solid Waste Management

Solid waste management (SWM) is the process which involves collecting and disposing of solid wastes which are by-products of human and animal activities. Municipal solid waste (MSW) in Tanzania which includes garbage, metals, bottle or glass, plastics, paper, and fabric have been increasing in recent years because of population increase and socio- economic developments in the country (Phani *et al.,* 2006).

In general, the Municipal SWM is the collection, treatment and disposal of solid wastes generated by all categories of Municipal population in an environmentally friendly and socially satisfactory manner using the most efficient available resources. Local Governments are generally responsible for providing the SWM services, and nearly all local government laws give exclusive mandate of collecting all the wastes disposed outside homes or establishments. As cities grow economically, business activities and consumption patterns have a bearing on the volumes and types of solid waste produced. Similarly, increased traffic congestion adversely affects the production of the solid waste. Productivity loss is exacerbated by longer hauls required of the fleet, as open lands for disposal are further and further away from the Municipal centers (Sansa and Kaseka, 2004).

The challenge is to rationalize workers and vehicle performance, while expanding services to a growing Municipal population (WB, 2011). In developing countries, most of the Municipalities spend 20-50 percent of their existing budget on SWM (WB, 2011). However, it is also common that 30-60 percent of all the Municipal solid wastes in

developing countries are uncollected and less than 50 percent of the population is served (WB, 2011). In some cases, as much as 80 percent of the collection and transport equipment is either out of service, in need of repair, or maintenance (WB, 2011). In nearly all developing countries, open dumping with open burning is commonly used (WB, 2011).

Disposal of solid wastes on land is by far the most common method in most of the countries and most likely accounts for more than 90 percent of the world's municipal refuse (Aggrey and Douglason, 2010). Incineration accounts for most of the remainder, whereas decomposing of solid wastes accounts for only an insignificant amount (Sharma, 2009). Selecting a disposal method depends almost entirely on costs, which in turn are likely to reflect local circumstances. Sanitary landfill is the cheapest satisfactory means of disposal, but only if suitable land is within economic range of the source of the wastes. Typically, collection and transportation account for 75 percent of the total cost of solid waste management (Sharma, 2009).

In Tanzania, much effort has been made on SWM especially in big cities, such as Dar es salaam, Mwanza, Arusha and Mbeya. According to Mbuya (2008), urbanization in Dar es salaam city alone leads to a daily generation of 3100 tonnes of solid waste though only 1200 tonnes (39%) are collected and disposed of. Also according to a report of the controller and auditor general of the United Republic of Tanzania (URT, 2010), the problem of solid waste management is increasing and the amount of solid waste not collected is more than 50% of the total solid waste generated. This is largely attributed to the inability and lack of willingness among city residents to pay for solid waste collection and management. Contractors engaged in waste collection are reported to have failed to cover the operating costs which include labour, fuel, vehicle repair and

maintenance, just to mention a few (Sansa and Kaseka, 2004). This is because of inadequate revenue collection, which in turn, causes the waste collection vehicles to operate inefficiently (Sansa and Kaseka, 2004).

Solid wastes generated in Dodoma Municipality are from various areas which include institutions like schools, households, commercial centers like hotels, shops, offices and food markets, hospitals and street sweeping. The solid waste generated per day in Dodoma Municipality has increased from 251tones per day in 2010 to 278tones per day in 2011 (Nicodemus, 2011), but there is a very low participation of residents in solid waste management because of low awareness on SWM. The uncollected garbage is mostly dumped illegally and threatens the environment and human health leading to an increase in epidemic diseases, pollution, and global warming. If human health is affected, then labour productivity will be affected. Therefore the resources would be used in dealing with adverse human health effects instead of investing in agriculture and other productive activities.

Dodoma Municipality had a total population of 410 956 people in 2012 (NBS, 2013); and it was estimated that each person was producing an average solid waste of about 0.5kg to 0.8kg per day in 2011 (Nicodemus, 2011). The waste generated includes heavy organic waste with high moisture content, light organic or inorganic waste such as paper, plastics, glass, and other types of garbage. In total, about 278 tons of solid wastes are generated daily in Dodoma Municipality, with leader producers being domestic and commercial centers, which produce about 178 tones; institutions, which produce about 70 tones; and industries, which produce 30 tones of solid wastes (Nicodemus, 2011). In Dodoma municipality, SWM is the responsibility of local governments and so there is no suitable price mechanism to reveal the choice of stakeholders like households for

varying levels of service provision. In such a situation, information regarding households' preference for cleaner environment can be obtained if one could carefully develop the demand for improved waste management services designed in agreement with the standard of Municipal solid waste handling policy.

1.2 Problem Statement and Justification

Development of various policies and strategies on SWM which include supply side and demand side is a fundamental way of achieving sustainable SWM. However, such endeavours faced several problems including ignoring the demand side (community participation) in SWM. Community participation which is the mainstay of understanding waste management has been the main source of failure in SWM (Sansa and Kaseka, 2004).

In Tanzania, as other developing countries, most of the studies have focused on the service providers' side and forgetting the demand side (community). Such studies have not successfully addressed SWM problems and have resulted into inefficiency of the present policies on solid waste handling. There are however some studies which have included the community in solid waste management (SWM) and found out that people are unable and unwilling to pay for improved SWM. Such studies include the study by Mbuya (2008) on solid waste management in Dar es salaam in privatizing and improving revenue collection; Laumo (2005) who evaluated community participation in solid waste management in Korogwe town and Madenge (2007) who assessed the of contribution of community based organizations towards sustainable solid waste management in Dodoma Municipality just to mention a few. However, these studies are based on descriptive analysis and have not shown empirically as to how much those who have the ability and willing to pay for SWM are willing to pay. Such studies did

not allow the factors which influence willingness to pay for SWM. Moreover these studies ended up in assessing the status quo of SWM without giving the respondents different options to choose the preferred options in managing solid waste, and in addition they did not identify which is the appropriate model to be adopted for sustainable SWM. Therefore, information on the demand side would have given a good "road-map" towards the achievement of sustainable SWM. To fulfill the information gap, this study carried out a choice experiment survey to address these aspects.

The findings from this study are expected to be of help to policy makers and other stakeholders in formulating appropriate policies and strategies to cope with problems of SWM as a result of increasing human population and socio-economic growth. The study has two significant insights for private and public policy makers in terms of inclusion of demand-side information into the plan of Municipal solid waste management attributes or services and fee structure. In addition to that the study derived the estimate of the value of changes in individual attributes in addition to changes in the total level of service attributes. Hence, the results from this study could be used to produce estimates of the value of various service options or the total value of a SWM package. Also the information could be used in negotiating a suitable tax rate with the existing private service providers in designing future concession agreements and/or consideration with new private entities for the other residential service areas.

The main output of this study is the provision of information on the divergence in terms of services that can be supplied by service providers and what the public actually needs and is willing to pay for.

1.3 Objectives of the study

1.3.1 Overall objective

The overall objective of this study was to investigate the potential for making Dodoma a clean Municipality through informed options for sustainable solid waste management (SWM).

1.3.2 Specific objectives

i. To determine the residents' willingness to pay for improved SWM in the Municipality of Dodoma,

ii. To evaluate factors which influence the willingness to pay for improved SWM in the Municipality, and

iii. To identify a suitable model for sustainable SWM in the Municipality.

1.4 Hypotheses

Consistent with the above stated objectives, the following hypotheses were directed the study:

i. The households are not willing to pay for improved solid waste management.

ii. Some specific explanatory variables are not statistically significant influence willingness to pay for improved SWM in the Municipality.

1.5 Scope and Limitations of the Study

The study was limited to the investigation of households' preferences for improved SWM options only. The study investigated only the households which were receiving the solid waste collection service. The study did not consider other types of solid waste such as commercial, industrial, and agricultural. Additionally the study did not incorporate households which were not receiving the solid waste collection services.

1.6 Organization of the Study

This study is organized into five chapters. The first chapter provides a general background to the study, including the presentation of problem statement, study objectives and hypotheses. The second chapter provides a critical review of literature relevant to the study. Whereas the third chapter presents a detailed description of the study and the methodology employed in the study. The fourth chapter presents the findings and discussion and last chapter provides conclusions and recommendations drawn from the study.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Overview

This Chapter presents a review of literature related to the willingness to pay for improved solid waste management including valuation technique as well as previous studies on the subject matter.

Worldwide, the environmental impacts have no boundaries. As Jamaludin (2001) indicates, the problem of waste management covers not only effects of the management approach itself, but also the instruments within the system, like those effects resulting from transportation to the final dumping sites from households or transfer stations. Additionally, Davio (2001) and Park (1998) considered community behavior, consumer perceptions and perceptions of government officials as other components of the system.

Indeed, there is a need for an improved planning and management system among developing nations. Recent trends in making efforts to emphasize on the environment have been steered by the development of standards at the international level such as the International Standards (ISO 14 000), the Canadian Standards Association Standard (CSAZ 750), and the Irish Standards (ISO 310). One of the aims of standardization of products and services is to meet customers' satisfaction. Therefore, some kind of consumer-based information in the management system is needed. Hence, the supporters of Life Cycle Analysis (LCA), is an important part of the environmental management systems (EMS), observe the significance of considering consumer behaviors in the design of plans for future improvements. Therefore, the level of considering of the consumer information to structure an objection of such acts should be

studied so as to make the monitoring of SWM system more effective (Addai and Abbeam, 2014).

2.2   Stated Preference Techniques

Stated preference techniques are direct valuation methods which ask people to state their preferences for environmental goods and services through their behaviour in hypothetical markets (Yonas, 2010). These methods are commonly used to estimate the non-use value of the environment by directly surveying consumers to find out their willingness to pay (WTP) or willingness to accept compensation for the existing or potential environmental attributes in a hypothetical, constructed market. The market is normally treated as hypothetical because the payments do not occur in reality. Stated Preference Methods consist of Choice Experiment, Contingent Valuation Method, Contingent Rating and Contingent Ranking. The most commonly stated preference in estimating the non-use value of environmental goods and services are Choice experiment and Contingent valuation methods. In this study, Choice Experiment technique was used because of its ability in the estimation of the values of many different options for a single application (Bennett and Blamey, 2001).

2.3   Theoretical Foundation of Choice Experiment Model

Choice experiment is a stated preference valuation technique originated from conjoint analysis. The limitations encountered in using conjoint analysis techniques to model telecommunication choices in Australia resulted into the development of the choice experiment model. The contingent ranking and rating are the variants of techniques broadly used in marketing known as conjoint analysis. The conjoint techniques were developed by Lancaster (1966), in his work on the analysis of product demand (Bennett and Blamey, 2001). The worry of economists regarding the use of ranking and rating

studies was mirrored by their marketing colleagues. The outcomes of this was the advancement of a type of conjoint analysis called choice experiment model developed by Louviere and Woodworth (1983) in which the respondents are asked to select their most preferred profile from a number of different alternatives (Yonas, 2010).

In recent times, Choice Experiment (CE) has been developed and applied in the environmental economics perspective, where it is used to estimate non-market environmental benefits and costs (Bennett, 2005). It asks a sample of people who are likely to experience the benefits or costs, a series of questions about their preferences for alternative future resource management options. In this study, the respondents were likely to select different solid waste management options. Every question, called a "choice set", presents to respondents the outcomes of normally three or four option strategies. The options are explained in terms of a common set of attributes in which the respondents select their preferred option from a choice set in a setted survey. The respondents'choice of their preferred options expresses their willingness to pay for improved SWM. Presenting more numbers of choice sets is a way of increasing the level of accuracy of the study. Though, as choice sets increase the analysis turn out become more complex. Monetary attribute is always incorporated as one of the attributes to simplify the computation of welfare measures (Yonas, 2010).

2.4 Welfare Measures in Choice Experiment Method

The possible measure of welfare in this study is marginal willingness to pay (MWTP). MWTP helps to translate into monetary terms the formerly analyzed parameters. MWTP shows how much the respondents are willing to pay for an improvement of a given certain attribute. This was the central to the analysis because monetary values of the attributes can be directly compared to each other. The values were obtained by

dividing the coefficient for each variable by the price coefficient. A WALD test (an estimation procedure) was conducted to generate not only the value of the ratio but also its distribution and significance (Vega and Alpizar, 2011).

2.5 Willingness to pay (WTP)

Willingness to pay is the maximum amount which a consumer would be willing to pay in order to receive a good or service, or to prevent damage. The aim of a consumer is to maximize utility. Therefore, if the good or service has high utility to the consumer, then the consumer will be willing to pay for such good or service for his satisfaction; and if the good or service has little and does not satisfy the consumer's utility, then he will not be willing to pay for such good or service. The consumer's ability and high willingness to pay shows that the good or service has more preference, and hence it is more demanded. A high value service is the one which satisfies the consumer the most (Sansa and Kaseka, 2004).

2.6 Empirical Studies on Solid Waste Management

Othman (2002) carried out a study at Kajang and Seremba municipalities in Malaysia using two stated preference methods: contingent valuation (CV) and choice experiment (CE) to elicit consumers' willingness to pay (WTP) for different SWM alternatives. An intention CV was to assess the aggregate value of SWM package, and that of CE was to classify the marginal values for SWM attributes.

The choice sets followed the standard LMN experimental design (where L is the number of levels, M is the number of alternatives in each choice set, and N is the number of attributes) where only the main effects were modeled. Each choice set contained three SWM options (one status quo and two improved SWM options). The

service attributes that were used in the study are transportation mode, disposal methods, collection frequency, monthly charges and free provision of multiple containers for separation of waste at source. The study found that all the attributes were significant and the signs appeared as they were predicted. The two models deduced the results that the households supported improvement of SWM, in terms of disposal methods, collection frequency, transportation mode and separation of waste at source.

Solomon (2007) employed choice experiment (CE) to evaluate household's preferences for improved SWM in Yeka, Addis Ababa. He used a sample of 242 households which were selected at random, and conducted a face-to-face interview. The attributes that were employed in the study are collection frequency, monetary charge and separation of waste at source. Two multinomial logit (MNL) models were employed for the estimation. The first model included the attributes only and the second model included the attributes jointly with socio-economic variables: age, sex, income, education level, family size and number of working household members. The findings of the basic model showed that the coefficients of all attributes were significant at 1% level. In the extended MNL model, out of the six socio-economic variables, only two of them were found significant. These are age, which was negative and significant at all levels and income, which was positive in sign and significant at 10% level. All non-monetary attributes, like in the basic model, were significant and their signs appeared as they were expected. Lastly, the results of the study reveal that the choice experiment method (CE) could be applied in the context of developing countries in identifying households' preferences that fit the requirements of the model.

Hagos *et al*. (2012) conducted a study on households' willingness to pay for improved urban waste management in Mekelle city, Ethiopia. They used contingent valuation

with a single-bounded format followed by open-ended questions. They administered their survey via in-person interviews. They randomly selected a sample of 226 household heads, and used twelve explanatory variables in the regression models based on the degree of theoretical importance and their impact on WTP. Probit and Tobit models were used to identify the determinants of households' WTP for improved solid waste management system and to analyze the mean WTP of households. The probit results indicate that the variables were significantly related to the probability of providing positive WTP values. While household income and awareness of environmental quality were positive, the age of the head was negative for WTP. The Tobit results indicate that 8 of the 12 independent variables are statistically significant, which are household income educational level, marital status environmental awareness, perception of the current SWM system, the type of solid waste service demanded by the households, house ownership, and the amount of solid waste generated by the household per week. The rest of the variables (sex of the respondents, initial fee, age of the respondents and family size of the households) had no significant effect on the amount of WTP for improved SWM.

Different authors have examined the effects of socio-economic and cognitive variables on households' willingness to pay for services. For example, Afroz *et al.* (2009) in their study on the households' willingness to pay for improved SWM in Daka city, Bangladesh revealed that age, household size and income maintain an increasing function with consumers' willingness to pay for improved solid waste management system. But the empirical findings of the age on WTP are contradictory. Afroz *et al.* (2009) revealed that maintaining all other factors constant, older people are more willing to pay than is the case with younger people. This implies that older people make more mature decisions regarding to health and environmental issues. Yet according to

Aggrey and Douglason (2010), age affects WTP SWM negatively. Older people believe that waste collection is the task of the government; thus, they are less willing to pay for SWM. Whereas, the youth generations are more familiar with the cost distribution and they are willing to pay.

Mbuya (2008) in a study on solid waste management in Dar es salaam found that waste collection contractors operate inefficiently because the communities are not paying their charges for solid waste collection because of inability and lack of willingness among city residents to pay for solid waste management (SWM). This is because of having many service-demands such as water, energy, transport, education and health care to pay for. With that long list of charged services, paying for solid waste collection is not the main concern. Therefore, lack of willingness among city residents to pay for solid waste collection leads to the failure on the part of solid waste contractors to perform their duties to the required standard. Because they fail to pay for operational costs in terms of labour, fuel, vehicle repair and maintenance. Thus, the failure in collecting solid waste makes the city environment unclean and makes city residents vulnerable to contracting such diseases as cholera, typhoid, and the like, and whose spread is associated with dirty environment. Due to this situation, residents and the Government spend most of their income on medical services. This denies both individuals and the Government opportunities to invest in agriculture and other productive ventures.

The study by Lauwo (2005) on community participation in solid waste management in Korogwe town found that the majority of the respondents (63%) were willing to contribute to solid waste collection costs. However, only 17% of the respondents were paying waste collection fees. The study indicates that high interest in contributing to solid waste management costs may bring about significant improvement in the

environmental health status. In view of the fact that the community members are willing to participate and are highly motivated in participating in solid waste management and health improvement, it is possible to involve the community in solid waste management in the Councils solid waste management system. The study also indicates that the main factors limiting participation in solid waste management include lack of financial resources (53%) among the respondents, followed by poor community participation in SWM (40%).

The study by Madenge (2005) in Dodoma Municipality found that 74% of the respondents could afford to pay for the waste collection fee every month from their monthly earnings; but this was not happening. The survey results showed that people did not pay not because they did not have the money but because they did not want to pay. This implies that people did not see the reason for paying waste collection fee on the one hand, and on the other hand they did not see SWM as their responsibility. Most of them said it was the responsibility of the government to make sure that the waste is collected and disposed of properly. The study findings also indicated that 15% of the respondents said that the waste was collected once per week, 50% said twice a week, 20% said three times a week, 10% said more than three times a week and 5% said the waste was not collected at all. This shows that on average solid waste was collected twice a week, that is why they need to increase the number of days for garbage collection so as to minimize the accumulation of the waste in the streets. Although the study tried to indicate the ability of the respondents to pay for SWM, it failed to show what factors influenced the respondents into being unwilling to pay for SWM.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Overview

This Chapter presents the methodology used to conduct the study. The Chapter begins by presenting the location of the study area, the theoretical framework of the study which is followed by conceptual framework for the study, empirical model for choice experiment method, model specifications for the study, the type of data and the method of data collection, sampling procedure and the sample size. Others include the survey design, description of payment vehicle, questionnaire design, and data processing and analysis.

3.2 Description of the Study Area

3.2.1 Location and general features

The Municipality of Dodoma is located at the south eastern end of the Tanzania Central Plateau at an elevation of 1200 metres above the sea level. The Municipality lies between 4 to 7 degrees latitude South of the Equator, and 35 to 37 degrees longitude East of Greenwich. Dodoma lies along the Great North Road a major infrastructural network of Africa which connects Cairo to Cape Town (CDA, 2014). The Municipality covers a total area of 2576 km^2. The topography of the city is mainly flat with some small, gently sloping hills.
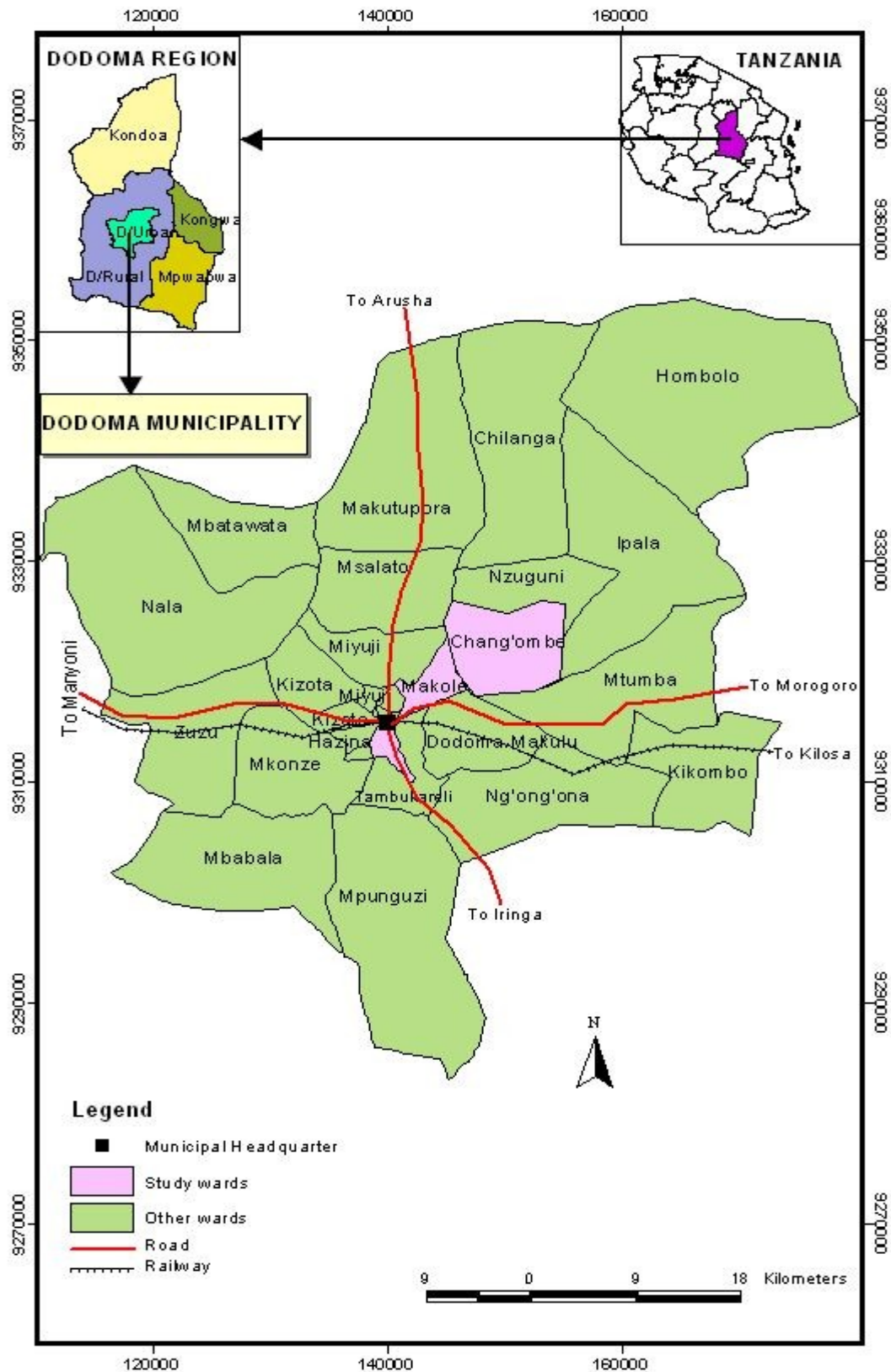
Figure 1: Map of Dodoma Municipality showing the study areas

3.2.2 Climate

Dodoma Municipality is a semi–arid District (Swai *et al*., 2012). It has a dry savannah type of climate, which is characterized by unimodal and erratic rainfall that falls between late November and mid–April. The annual average rainfall is about 500 to 700 mm and mean monthly of temperature is about 22.6°C (Swai *et al*., 2012). The District experiences flash floods during rainy seasons. In addition, it has high evaporation rate and severe soil erosions, which are caused by strong winds and relative low humidity. The District experiences long dry seasons from Mid–April to late November each year.

3.2.3 Population and socio-economic activities

The Municipality had the population of 410 956 based on the projection of population census of 2012, out of the total population, 48.5% were male and 51.5% were female (NBS, 2013). The main economic activities carried out in Dodoma Municipal include Commercial, manufacturing, transportation and agriculture. Finally, the Municipal is the centre of educational activity in the region, with two universities, namely; The University of Dodoma and St. John University of Tanzania and other institutions like Institute of Rural Development and Planning.

3.3 Theoretical Framework

Economic valuation comes from welfare economics (Nijkamp *et al*., 2008) where people aim at utility maximization of goods and services. Microeconomics consumer theory for individual preferences, which presents the way for transformations of assumptions about desires into a demand function expressing the action of the consumer in a given conditions, provides the basis of economic valuation methods (Ben-Arkiva and Lerman, 1985). Choice experiment is usually derived under the basis of a utility maximizing by a consumer and therefore uses random utility theory. This theory poses

the idea that the consumers select the options that provide them with the highest level of utility. It is assumed that the utility function of a good can be divided into two sections (deterministic and stochastic) (Das *et al.*, 2008). In these economic theories, the price or value of a commodity is determined by different factors including the price of the commodity itself, individual's tastes and preferences, and prices of other related commodities (substitute and complementary commodities). A simple utility demand function for the improvement of solid waste services (Sumukwo *et al.*, 2012) can be shown as follows,

$$D = f(P, CSC, HI)$$

Where

D is the utility as expressed in the demand for the commodity

P expresses the price of the commodity to be purchased (WTP value)

CSC is the consumption of substitute and complementary goods

HI shows household use of the improved service.

3.4 Conceptual Framework

The conceptual framework for the study reflects the residents' willingness to pay for improved SWM in the Municipality of Dodoma and factors which influence the WTP for improved SWM in the Municipality.

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                          ┌─────────────────┐
                          │  Sustainable SWM │
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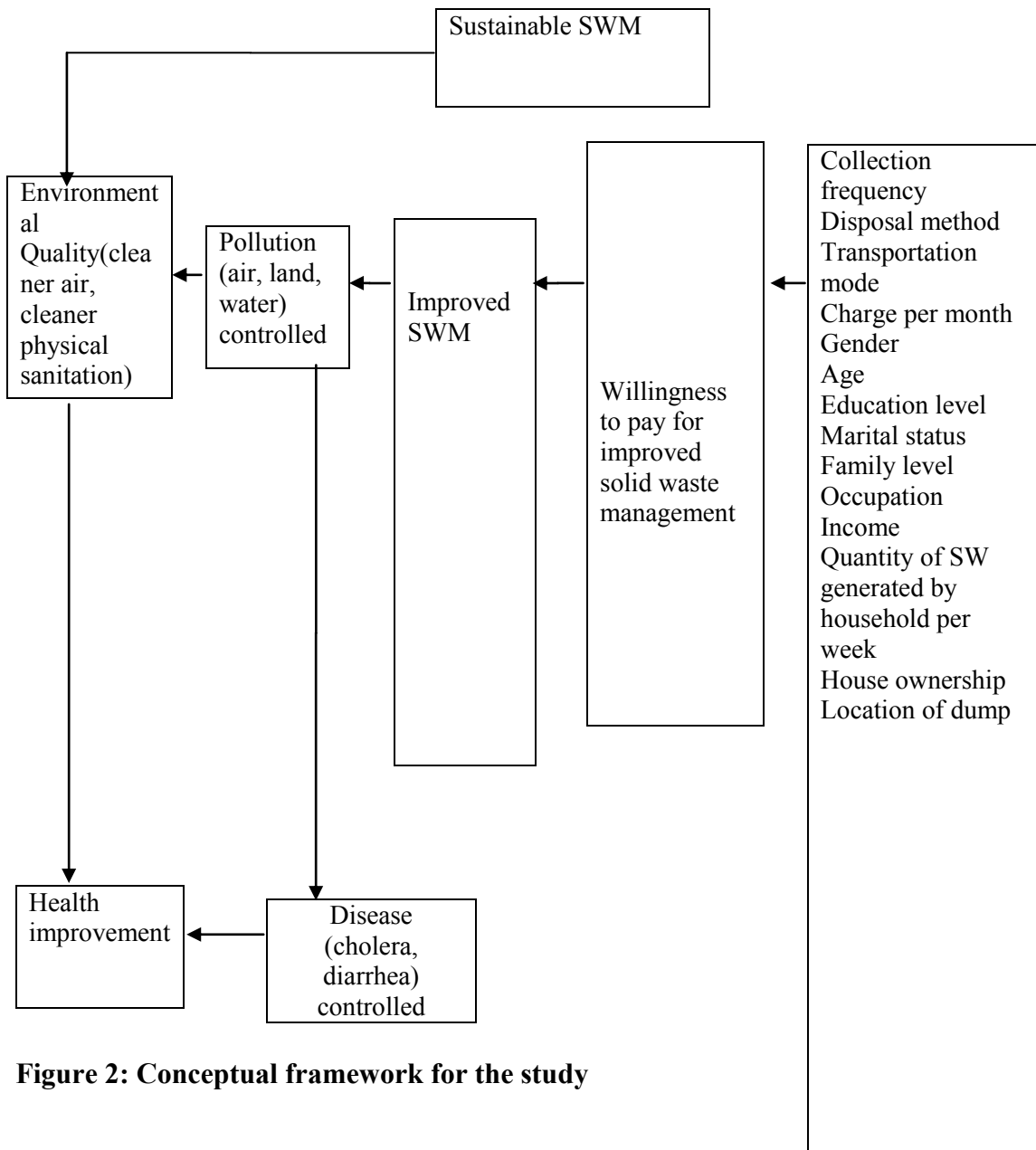
Figure 2: Conceptual framework for the study

The diagram contains the following boxes connected by arrows:

- Sustainable SWM
- Environmental Quality(cleaner air, cleaner physical sanitation)
- Pollution (air, land, water) controlled
- Improved SWM
- Willingness to pay for improved solid waste management
- Collection frequency, Disposal method, Transportation mode, Charge per month, Gender, Age, Education level, Marital status, Family level, Occupation, Income, Quantity of SW generated by household per week, House ownership, Location of dump
- Health improvement
- Disease (cholera, diarrhea) controlled

3.5 Empirical Model for Choice Experiment Method

3.5.1 Foundation of the model

Choice experiment method relies on random utility theory, in which consumers derive satisfaction not only from goods but also from attributes presented. An individual utility function is composed of a deterministic component (V_{ji}) which can be calculated based on observed characteristics, and a stochastic error component (ε_{ji}) which is unobserved, so that:

$$U_{ji} = V_{ji} + \varepsilon_{ji} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (i)$$

Where: U_{ji} is the total utility derived from option i by individual j, V_{ji} is the explainable component with the assigned attributes, and ε_{ji} is a stochastic component.

The utility function means that the probability that individual j selects option I can be expressed as the probability that the utility associated with option i is greater than the utility associated with other options. Thus, the statistical model is driven by the probability that option I is selected, which is

$P_{ji} = Pr(U_{ji} > U_{jk})$ for all $k \neq i$. This can be written as

$$P_{ji} = P_j \left[V_{ji} + \varepsilon_{ji} > V_{jk} + \varepsilon_{jk} \right] \text{ For all } k \neq i \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (ii)$$

Assuming that the stochastic component or error terms are identically and independently distributed (IID) with a type I extreme value distribution the probability that option I is selected by individual j is:

$$P_{ji} = \frac{\ell^{\beta_j x_i}}{\sum\limits_{k=0}^{K} \ell^{\beta_k x_i}} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (iii)$$

Where β_j is a vector coefficients on each of the dependent variable X. Equation (iv) can be normalized to remove indeterminacy in the model by assuming that $\beta_0 = 0$ and the probabilities can be estimated as:

$$\Pr\left(I = J \mid X_i \right) = \frac{\ell^{\beta_j x_i}}{1 + \sum\limits_{k=1}^{j} \ell^{\beta_k x_i}} , j = 0,1 \dots\dots J, \beta_0 = 0 \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (iv)$$

Estimating eguation (v) yields J log-odd ratios

$$\ln\left(\frac{P_{ij}}{P_{ik}}\right) = X_i(\beta_j - \beta_k) = X_i\beta_j, \text{ if } k = 0 \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots(v)$$

The dependent variable is therefore the log of one alternative relative to the base alternative.

To interpret the effects of explanatory variables on the probabilities, (Green, 2008) marginal effects are usually derived as

$$\delta_j = \frac{\partial P_j}{\partial X_i} = P_j\left[\beta_j - \sum_{k=0}^{J} P_k\beta_k\right] = P_j(\beta_j - \bar{\beta}) \dots\dots\dots\dots\dots\dots\dots(vi)$$

Therefore the full model is specified as follows:

$$V_i = \beta_i X_i + \varepsilon_{ij} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots(vii)$$

Where: β_i is a set parameter to be estimated, V_i is a set of choice options, X_i is a set of independent variables, and ε_i is an error term. This study selected Multinomial Logit Model (MNL) to investigate the choice of SWM options and determinants of WTP of households because it is commonly used in studies of improved SWM involving multiple choices and it is easier to compute. The benefit of using a MNL model lays on its computational simplicity in calculating the choice probabilities that are expressible in analytical form (Tse, 1987).

3.5.2 Model specifications for this study

For the first specific objective, the following model was used to show the Marginal willingness to pay (MWTP) of the service attributes in describing respondents' choice for various options of solid waste management:

$$V_i = \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon_i \dots\dots\dots\dots\dots\dots\dots\dots(viii)$$

To address specific objective two, the marginal effects of explanatory variable from Multinomial logit choice options were conducted to observe the factors influencing respondents WTP for improved SWM.

$$V_i = \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 Gd + \beta_6 Ag + \beta_7 Ed + \beta_8 Ms + \beta_9 Fm + \beta_{10} Oc + \beta_{11} In + \beta_{12} Qg + \beta_{13} Ho + \varepsilon_i \dots\dots\dots\dots\dots (ix)$$

Note: The constant was excluded from the model because there is no essential reason to choose one or the other of the two generic alternatives presented to the respondents.

Where: V_i is utility of individual for option i (1= status quo, 2= choice option A, 3 = choice option B), X_1 is collection frequency, X_2 is disposal method, X_3 is Transport mode, X_4 is monthly charge, and Gd is gender, Ag is age, Ed is education level, Ms is marital status, Fm is family size, Oc is Occupation, In is income, and Qg is quantity of solid generated per week by household, Ho is House ownership. β's are coefficients.

3.5.2.1 Expected signs for the explanatory variables

Table 1 below shows the expected signs for the explanatory variable.

Table 1: Expected signs for the explanatory variables

Variables	Expected sign
Collection frequency	+
Disposal method	+
Transportation mode	+
Monthly Charges	–
Age	+
Sex	+
Marital status	+
Education level	+
Family size	+
House ownership	+
Quantity of solid waste generated	–
Location of the dump	+
Occupation	+
Household monthly income	

From table 1, the sign expected for collection frequency was positive, because an increase (improved) collection frequency promotes sanitary and quality of environment and generally increase the respondents' utility. Disposal method was expected to have positive sign, because an improved disposal method leads to the sanitary and quality environment. Transportation mode was expected to have positive sign, because improvement in the transport method influences the utility of the respondent positively. Monthly Charges was expected to have negative sign, because an additional cost affects utility negatively. Age was expected to have positive sign since the older people are expected to be willing to pay more than younger people. Sex was expected to have positive sign for its coefficient, because women are expected to be more involved in improved SWM than men. Marital status was expected to have positive sign for its coefficient, since the married people are expected to support improved SWM than singles. Education level was expected to have positive sign for its coefficient, because educated people are expected to have the knowledge on environment (SWM). Family size was expected to have positive sign for its coefficient, because a family with large size is expected to support improved SWM. House ownership was expected to have positive sign for its coefficient, because the households that own their houses are likely to support improved SWM. Quantity of solid waste (SW) generated was expected to have positive sign for its coefficient, because households that generate much quantity of SW are likely to support improved SWM. Location of the dump was expected to have negative sign for its coefficient, because households that live around (near) the dump are likely to support improved SWM to protect their health than those that live far from the dump. Occupation was expected positive sign for its coefficient, since employed people are likely to support improved SWM than unemployed. Household monthly income was expected to have positive sign for its coefficient, since households with

higher monthly income are likely to support improved SWM than those with smaller income.

3.6 Type of Data Required and Method of Collection

The type of data required were the cross sectional data. Cross sectional data are the data collected at the same point in time. Primary data and secondary were collected from the field as the source of information for this study. The data for the present study was collected over a period of five months (February 2014 to July 2014). Before the exercise was carried out, sources and types of information to be gathered and methods to be used had already been identified. Primary data were collected through field survey, whereby a semi structured questionnaire was used.

3.7 Sampling Procedure and Sample Size

The question of what sample size to use in choice experiment method is always a difficult question to answer. However, different papers reported rules of thumb for estimating the sample size required for choice experiment method. For example, Orme (1998) suggests the following formula in estimating the sample size required for choice experiment method;

$$n = 500 \frac{1^{*}}{J.S} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots(x)$$

Where: n is the suggested sample size, 1^{*} is the largest number of levels for any of the attributes, J is the number of options, and S is the number of choice situations in the design. Therefore, with the help of the above formula the sample size of 500 respondents was obtained. It is clear that a larger sample is good for statistical precision, but time and financial limitations were the obstacles for not choosing a relatively large sample. Therefore, this study used the sample size of 200 respondents because of the

reason mentioned above. Thus the primary data for this study were collected from 200 households selected from three wards (Uzunguni - high income level, Makole - middle income level, and Chang'ombe - low income level) of Dodoma municipality. The stratified simple random sampling with proportionate allocation was used to select 200 respondents from the above 3 mentioned wards.

Image ward has four streets (Image, Kilimani, Chinyoyo and Nyerere) with a total population of 1562 households. Among these four streets, only one street - Image street, which has a total population of 306 households has solid waste collection service. Therefore in Image ward, the sample was taken at Image street only, and 18 respondents were interviewed.

Chang'ombe ward also has four streets (Chilewa, Chang'ombe juu, Mazengo and Hamvu) with a total population of 2223 households. From these four streets, only two of them have solid waste collection service (Chilewa and Chang'ombe juu). Therefore Chilewa with a total population of 600 households and Chang'ombe juu with a total population of 404 households were surveyed, and 35 respondents were interviewed from Chilewa street and 23 respondents were interviewed from Chang'ombe juu street. Thus the total sample size taken at Chang'ombe ward was 58 respondents.

Makole ward has three streets (Makole, Chadulu B and Chimuli) with a total population of 2258 households. Among these three streets, two of them had solid waste collection services. Therefore, the sample was selected from these two streets Makole and Chadulu B, with a total population of 1290 and 883 households respectively. Hence in Makole ward, 124 respondents were selected out of whom 73 respondents were interviewed; whereas 51 respondents were interviewed from Chadulu B.

The following is the formula which was used in sampling estimation from all wards selected

$$n_j = \sum W_j n \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots(xi)$$

Where: $W_j = \dfrac{N_j}{N}$

n_j is the total number of samples in wards, W_j is correction factor, N_j is the total population size in ward j and N is the total population in all wards.

3.8 Survey Design

The choice experiment method was used in this study, therefore experimental design was constructed based on the compensating surplus (CS) welfare measure. The CS measures the change in income that would make an individual indifferent between the initial (lower environmental quality) and successive situations (higher environmental quality) assuming that the individual has the right to initial utility level. This change in income reflects the individual's willingness to pay (WTP) to obtain an improvement in environmental quality.

The overall improvement of solid waste management was presented in terms of attributes and their levels. Because of the time and budget constraints the study employed the low cost choice experiment method in which the predetermined choice sets of realistic conditions were used; therefore, the non-option set was not included in the choice sets because the selected attributes with their level practically reflect the realistic conditions of the study area.

The attributes and levels selected are;

   i.   Collection frequency: once per week, twice per week and three times per week.

  ii.   Disposal method: open landfill, Sanitary landfill and Incinerator.

 iii.   Transportation mode: hand pushcarts, Open trucks and Covered trucks.

 iv.   Charge per month: TZS 2000, TZS 3000 and TZS 4000.

From these attributes with their levels, three pre-determined option sets were created with the help of some respondents from the baseline survey done in the study area were presented, in which a respondent was asked to choose and tick a preferred option.

3.9 Description of Payment Vehicle

The decision of choosing which payment vehicle to use depends on the resource to be valued, the socioeconomic characteristics of the sample and the institutional structure governing the area (Chiueh and Ming, 2008). In this study, fund contributions through increasing service charge per month was selected as the payment vehicle for improvement of SWM services in Dodoma municipality.

3.10 Questionnaire Design

The questionnaire was the main instrument of survey used in this study. The questionnaire started with the description of the SWM situation in Dodoma municipality so as to build and convince the respondents to make better option for improved SWM, and incorporated the socioeconomic and demographic characteristics of the respondents, and choice sets which included the attributes and their levels in Dodoma municipality.

3.11 Data Processing and Analysis

In the estimation of economic value and factors that determine willingness to pay for improved SWM, both qualitative and quantitative methods were used to analyze the data. For more precise analysis, computer based statistical software such as Microsoft excel, SPSS 16 and Stata 11.0 were used for data analysis. Descriptive statistics and tables were used to present the results.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Overview

This chapter presents the findings of the study. The chapter begins by presenting socio-economic characteristics of respondents, econometric results and sustainable model for SWM in the Municipality of Dodoma.

4.2 Socio-Economic Characteristics of the sample households

The socio-economic characteristics discussed in this section include, sex, marital status, education level, household size and age, occupation, dumps distance, income and quantity of solid waste.

4.2.1 Sex of the head of household

Table 2 below shows the distribution of households by sex.

Table 2: Distribution of households by sex (%)

	Street name					Total
Sex	Chadulu B	Chang'ombe juu	Chilewa	Image	Makole	
	n=51	n=23	n=35	n=18	n=73	n=200
Male	10.5	5.0	7.0	4.0	15.0	41.5
Female	15.0	6.5	10.5	5.0	21.5	58.5
Total	25.5	11.5	17.5	9.0	36.5	100.0

From the results in Table 2, 41.5% of the households were males and 58.5% of the households were females. This implies that females were more involved in SWM in the study area than males. Traditionally, it is the role of females to clean the house and

dispose of the waste. Hence, it is expected that females would prefer improved SWM than males. Understanding gender division of the households is important in assessing SWM.

4.2.2 Marital status of the heads of households

Table 3 below shows the distribution of heads of households by marital status.

Table 3: Distribution of heads of households by marital status (%)

	Street name					Total
Status	Chadulu B	Chang'ombe juu	Chilewa	Image	Makole	
	n=51	n=23	n=35	n=18	n=73	n=200
Single	2.5	1.0	1.0	0.0	3.0	7.5
Married	23.0	10.0	16.5	9.0	32.5	91.0
Others	0.0	0.5	0.0	0.0	1.0	1.5
Total	25.5	11.5	17.5	9.0	36.5	100.0

From the findings in Table 3, majority of the heads of households (91%) were married, 7.5% of the heads of households were single, and 1.5% of the heads of households were in other categories such as widows or widowers. This implies that the responsibility of SWM is equally distributed to all groups as categorized above. Marital status influences decision making at the household level, including SWM. Married people are expected to have children and large family than people living single; the former are therefore expected to support improved SWM. Therefore, understanding the distribution of marital status of the households is essential for assessing management of solid waste.

4.2.3   Education level of the heads of households

Table 4 below shows distribution of heads of households by education level.

Table 4: Distribution of heads of households by education level (%)

Education level	Street name Chadulu B n=51	Chang'ombe juu n=23	Chilewa n=35	Image n=18	Makole n=73	Total n=200
Primary	11.0	10.5	14.0	0.0	16.5	52.0
Secondary	3.5	1.0	2.5	0.5	5.0	12.5
College	11.0	0.0	0.5	8.5	15.0	35.0
Adult education	0.0	0.0	0.0	0.0	0.0	0.0
None	0.0	0.0	0.5	0.0	0.0	0.5
Total	25.5	11.5	17.5	9.0	36.5	100.0

From the findings in Table 4, majority of the heads of households (52%) had attained primary education, 12.5% of the heads of households had attained secondary education, and 35% of the heads of households had attained college education. Increase in education level leads to an increase of knowledge on SWM. It is believed that as the education level increases so is the capacity of the people to become more knowledgeable on SWM and hence becoming more willing to pay for improved SWM (Sumbi, 2004).

4.2.4 Household size and age of heads of households

From the findings, the average of household size seems to be high (5). It is expected that large size families generate large amount of solid waste. Therefore, households with large family sizes are likely to support improved SWM than the household with smaller family size. The average of household age also seems to be high (43) because it is believed that, the older people are more willing to pay for improved of SWM because older people make wiser decisions on health and environmental issues like SWM, probably due to their age (Loomis *et al.,* 2000). Thus understanding age of respondents in assessing improved SWM is important.

4.2.5   House ownership status

Table 5 below shows distribution of households' house ownership status.

Table 5: Distribution of households by house ownership status (%)

House ownership	Chadulu B n=51	Street name Chang'ombe juu n=23	Chilewa n=35	Image n=18	Makole n=73	Total n=200
Rent	12.0	4.5	5.0	0.0	17.5	39.5
Self ownership	13.5	7.0	12.5	9.0	19.0	60.5
Total	25.5	11.5	17.5	9.0	36.5	100.0

From the findings in Table 5, majority of the households (60.5%) own the houses they live in and 39.5% of the households rent the houses they live in. People living in their own houses are expected to be more willing to pay for improved SWM because they are not paying rents and are supposed to care of their home; on the other hand, those renting the houses they live in are expected to be less willing to pay for improved SWM because much of their income is used for paying rent and for building their own houses.

4.2.6   Average quantity of solid waste generated by households

The average quantity solid waste generated by the households per week is a bag of 65.5kg with the minimum of a bag of 25kg and the maximum of a bag of 150kg. Understanding, the average quantity of solid waste generated by the respondents (households) is important in improving SWM. This is because it is likely that the higher average quantities of solid waste generated per week by the households would highly motivate people to pay for improved of SWM, and smaller average quantities of solid waste generated would less likely motivate people to pay for improved of SWM, because households who generate large quantity of solid waste will have a pile of waste

at their home than those who generate small quantity of solid waste and hence creates odors if the waste will not be collected frequently. Therefore to avoid odors at their homes, they are likely to support for improved SWM.

4.2.7 Occupation of the heads of households

Table 6 below shows the distribution of heads of households' occupation.

Table 6: Distribution of heads of households' occupation (%)

	Street name					Total
Education level	Chadulu B	Chang'ombe juu	Chilewa	Image	Makole	
	n=51	n=23	n=35	n=18	n=73	n=200
Civil servant	6.5	1.0	0.5	5.0	7.5	20.5
NGOs	4.0	0.0	0.0	0.5	5.5	10.0
Self employed	15.0	10.0	17.0	3.5	23.5	69.0
Farmer	0.0	0.5	0.0	0.0	0.0	0.5
Total	25.5	11.5	17.5	9.0	36.5	100.0

The findings in Table 6 show that majority of the heads of households (69%) were self employed, 20.5% of the heads of households were civil servants and 10% of the heads of households worked with NGOs. Understanding occupation of the heads of households is important in assessing willingness to pay for improved SWM, because employed people are likely to be more willing to pay for improved SWM than those unemployed since employed people are likely to have more income than those unemployed.

4.2.8 Dump distance from the households

Table 7 below shows distribution of households by dump distance.

Table 7: Distribution of households by dump distance

Dump distance from the house	%
Far (3-above) km	88.5
Near (0-2) km	11.5
Total	100.0

The findings in Table 7 show that majority of the households (88.5%) were far from the dump, 11.5% of the households were near to the dump. This implies that all the respondents in all the streets were far from the dump site, except for the respondents in Chang'ombe juu street, as these lived near the dump site.

4.2.9   Average monthly households income

From the findings the average income of the households seems to be high (TZS 601 000) with minimum income of TZS 3000 and maximum of TZS 4 000 000. Assuming SWM is a normal good; households with higher income are likely to pay more for the improved SWM.

4.2.10   Choice selection

Table 8 shows the distribution of SWM choices selected by the respondents.

Table 8: SWM choices selected by respondents (%)

Street	Status quo	Option A	Option B	Total
Chadulu B	5.0	18.0	2.5	25.5
Chang'ombe juu	8.5	3.0	0.0	11.5
Chilewa	13.0	4.5	0.0	17.5
Image	0.5	7.5	1.0	9.0
Makole	10.0	25.0	1.5	36.5
Total	37.0	58.0	5.0	100.0

From the findings in Table 8, majority of the respondents (58%) selected option A, 37% of the respondents selected status quo and 5% of the respondents selected option B. Therefore, 63% of the respondents selected improved SWM showing that majority of the respondents were willing to pay for improved SWM. Specifically, in Chadulu B Street out of 25.5% respondents, 5% selected status quo, 18% selected option A and 2.5% selected option B. In Makole Street out of 36.5% of respondents, 10% selected status quo, 25% selected option A and 1.5% selected option B. In Image Street out of 9% of respondents, 0.5% selected status quo, 7.5% selected option A, and 1% selected option B. Therefore in Chadulu B, Makole and Image Streets, option A which includes sanitary land fill as disposal method, twice collection frequency per week, open truck as a transport method and 3000 as charge per month were found to be feasible for implementation. Whereas in Chang'ombe juu Street out of 11.5% of respondents, 8.5% selected status quo, 3%selected option A, and none selected option B. And in Chilewa Street out of 17.5% of respondents, 13% selected status quo, 4.5% selected option A and none selected option B. Therefore, in Chang'ombe juu and Chilewa Streets status quo which includes open dump, once collection frequency per week, push carts and TZS 2000 monthly charges should be maintained because most of the households are not able to pay more for improved SWM because of having low monthly income. Alternatively, the Municipal should have a budget which will help the low income earners in these streets to improve SWM.

4.3 Econometric Results

4.3.1 Results of the standard multinomial logit model

Table 9 shows the estimated coefficients and their associated standard error and P-values for standard multinomial logit model.

Table 9: Standard multinomial logit model results

	Coefficient	Standard Error	P[|Z|>z
Variable			
Status quo (base outcome)			
Option A			
Collection frequency	0.350**	0.147	0.018
Transport mode	0.261***	0.181	0.000
Disposal method	0.192*	0.080	0.08
Charge per month	-0.084***	0.016	0.000
Option B			
Collection frequency	0.328**	0.119	0.006
Transport mode	0.192***	0.157	0.000
Disposal method	0.179*	0.074	0.081
Charge per month	-0.082***	0.012	0.000

*** Significant at   1%   ** Significant at 5%   * Significant at 10%

From the findings in Table 9, all the coefficients of the attributes are significant with their expected signs. Positive signs and significance of the coefficients of the attributes (disposal method, transport mode, collection frequency) show that there is the probability of willingness to pay for improved SWM by the respondents according to the attributes presented, because upgrading these attributes raise their utility. Monthly charge has a negative sign for its coefficients and significant, showing that there is the probability of household's utility to decline as the monthly charge increases. This shows that the households become less willing to pay for improvement as the monthly charges increases.

4.3.2   Marginal willingness to pay (MWTP) for improved SWM

Table 10 below shows marginal willingness to pay for improved SWM attributes and their associated P-values.

Table 10: Marginal willingness to pay for improved SWM

Attribute	MWTP(in US $)	P-value
Collection frequency	0.237**	0.002
Transport mode	0.189***	0.000
Disposal method	0.153*	0.000

Note: The exchange rate at that time of study was TZS1650 = US$1

From the findings in Table 10, the MWTP for improved SWM in all attributes have positive signs showing that the welfare of the respondents increase as the attributes of SWM were improved. The respondents were willing to pay an additional $ 0.237 which was equivalent to TZS 391.05 if the collection frequency was improved, $ 0.189 which is equivalent to TZS 311.85 if the transport mode was improved, and $ 0.153 which is equivalent to TZS 252.45 if the disposal method was improved.

4.3.3 Marginal effects of explanatory variable from multinomial logit model

Table 11 below shows the estimated marginal effects of explanatory variable from multinomial logit choice options conducted to observe the factors influencing respondents WTP for improved SWM.

Table 11: Marginal effects of explanatory variable from multinomial logit model

Variable	Option A	Option B
Collection frequency	0.043**	0.045**
Transport mode	0.039**	0.038**
Disposal method	0.017*	0.015*
Monthly charge	- 0.005***	-0.005***
Age	0.008**	0.007**
Sex	0.007	0.009
Marital status	0.029**	0.026**
Education	0.015***	0.016***
Family size	0.007	0.004
Quantity of SW generated	0.055**	0.053**
House ownership	0.003	0.003
Dump location	0.002*	0.002*
Occupation	0.037**	0.034**
Household Income	0.132***	0.131***

*** Significant at 1%   **Significant at 5%   *Significant at 10%

From the findings in Table 11, eleven variables out of fourteen seem to have significant influence on the probability of willingness to pay for improved SWM. The age variable had a positive sign and was significant implying that the probability of willingness to pay for improved SWM by older people was higher than the younger people. This is because older people make wiser decisions on health and environmental issues like SWM, probably due to their age. The marital status variable also had a positive sign and was significant as it was expected, since the probability of married people to have children is higher and hence support for improved SWM than singles. Education level of the respondents had a positive sign and was significant as it was expected showing that there is the probability of educated people to have the knowledge on environment especially on SWM and hence support the improvement of SWM. The quantity of solid waste generated had a positive sign and was significant implying that there is the probability for the households who generated much quantity of solid waste to support

the improvement of SWM than was the case with those who generated small quantities of solid waste. The location of the dump site had a positive sign and significant but the expected sign was negative because the households who are living around (near) the dump were probably more supportive to improved SWM to protect their health than were those who are living far from the dump. Therefore, the positive sign showed that there was the probability for these people living nearby to be more willing to pay for improved SWM than those people living far from the dump, and this had been influenced by the monthly income level of the households. The households living near the dump site were found to have low monthly income than those living far from the dump site. The occupation variable had a positive sign and significant as it was expected, since the probability of employed people to support improvement of SWM was higher than that of the unemployed. The households' monthly income had a positive sign and significant as it was expected which implies that the probability of households with higher monthly income to support improvement of SWM was higher than those with lower incomes.

4.3.4 Sustainable model for SWM in the municipality of Dodoma

The descriptive results presented in Table 9 show that majority of the respondents (58%) opted for option A which included sanitary landfill, open truck, twice collection frequency per week and TZS 3000 monthly charge, 5% of the respondents opted for option B which included incineration, covered truck, three times per week and TZS 4000 monthly charge. Whereas 37% of the respondents opted for status quo in which the majority of the people in this group were from low income households. Also, the study revealed that low income households generated small quantities of solid waste compared to the middle and high income people. Therefore, a suitable model for sustainable SWM in the Municipality of Dodoma was the use of sanitary landfills as

opted for by the majority especially low class group who said that "we are still having plenty of land, there is no need for incinerator at this time". The use of both hand driven push-carts and open trucks which are covered with hard nets or canvas on the top of the load, the covered trucks of solid waste collection were not preferred because they are expensive and most of the contractors who collect and dispose of solid waste can not afford to buy them. Collection frequency of twice per week was indicated by the middle and high income streets where big piles of garbage were found to have accumulated; on the other hand in the low income streets, a collection of once per week was preferred. In addition, a monthly charge of TZS 3000 was suggested by middle and high income people and that of TZS 2000 was suggested by low income people; thus, the municipal should charge low tax to contractors of solid waste who collect wastes from people in the low income streets as opposed to taxes charged to contractors who collect wastes from people in middle and high streets in order to help them in managing the operating costs. Finally, the open spaces should be reserved in the streets for the construction centers for temporarily disposal of solid waste by households directly or by collectors who will be going to the households to collect wastes using hand driven push-carts and the trucks and take the waste to the dump site.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

The main objective of the study was to investigate the potential for making Dodoma a clean municipality through informed options for sustainable SWM. The simple choice experiment survey was used to obtain estimates of the WTP for improved SWM in Dodoma municipality. The findings from this study showed that 63% of the respondents were willing to pay for improved SWM on average of TZS 3000 per month, and 37% of the respondent were willing to pay TZS 2000 per month. The WTP was found to be significantly influenced by the following variables; age, marital status, education level, quantity of solid waste generated, location of the dump site, occupation, and income level.

5.2 Conclusions

In view of the aforementioned results of the study, the following are the conclusions.

i. **WTP for improved SWM**

The study findings show that majority 63% of the respondents are willing to pay for improved SWM, and they were also willing to pay for an additional amount of TZS 391.05, TZS 911.85 and TZS 252.45 for collection frequency, transport mode and disposal method if these attributes were improved. Therefore, the Municipal Management should take some initiatives of improving these attributes by building sanitary landfills and inform the solid waste contractors that the households are willing to pay for improved SWM in order to increase frequency of collection   and reduce health risks to the households. If there is

improvement of health status among the households, then the households will be able to participate in production process and stimulate economic growth.

ii. **Factors that determine the WTP for improved SWM**

Based on the findings of the study, it can be concluded that collection frequency, transport mode, disposal method, charge per month, age, marital status, education level, occupation, quantities of solid waste generated, location of the dump, and income level of the households were significant factors in influencing people's willingness to pay for improved SWM in Dodoma municipality. Sex, house ownership and family size were found to be insignificant factors in influencing people's willingness to pay for improved SWM in Dodoma municipality.

5.3 Recommendations

In view of the main findings of this study and the above conclusions, the following recommendations are made.

i. Because the households are willing to pay for improved solid waste management, the municipal should take the initiatives of establishing sanitary landfills, and inform and emphasize the service provider (solid waste contractors) to improve the solid waste collection by increasing trucks and collection frequency per week.

ii. The Municipal should use a suitable model for SWM as proposed by study which is the use of Sanitary landfills, the use of both hand driven push-carts and open trucks covered by hard nets or canvas on the top of the load. In the middle and high class streets, frequency collection should be twice per week

and once per week in low income streets since big piles of garbage were found to the middle and high income streets compared to low income streets. The monthly charge for the middle and high income streets was suggested to be TZS 3000 and TZS 2000 for low income streets.

5.3.1 Recommendations for further Research

This study was done in Dodoma municipality and may not be a representative of the whole country. Therefore, extending the study to other parts of the country is highly recommended for sustainable solid waste management in the country. Also the study surveyed only the streets which were provided with the SWM services. In the municipality, there are some streets which are not provided with SWM services, and also the study did not survey the commercial centers and industries. Therefore, it is recommended that other studies be carried out to investigate the streets which do no benefit from solid waste collection services in order to know if the households from such streets are willing to pay for the service. If they are willing they should be provided with the service. Finally, other studies should be carried out to investigate the existing SWM in the commercial and industrial centers.

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APPENDICES

Appendix 1: A Questionnaire for the Heads of household

A CHOICE EXPERIMENT QUESTIONNAIRE FOR VALUING IMPROVED SOLID WASTE MANAGEMENT SERVICE IN DODOMA MUNICIPALITY

Enumerator's Name………………… Date of interview……………………

Street…………………………. Ward…………………..

Starting time……………….. End time…………………

Hello! How are you? Thank you for giving me your valuable time.

I am a student at Sokoine University of Agriculture. I am undertaking a research titled "Willingness to pay for improved solid waste management in Dodoma Municipality" as a partial fulfillment for the award of MSc. in Agricultural Economics and this interview is part of his research. You are chosen randomly from the population living in the municipality. The information obtained from this interview will be used to help policy makers make informed decisions. The interview may take a few minutes. This interview is absolutely secret; your name will never be associated with your answers. Most of the questions have to do with your attitudes and opinions, and there is no right or wrong answers.

SECTION A:

1: Statement of the Issue

This study tries to identify the attractive future solid waste management (SWM) system in Dodoma municipality based on the values that households attach for different service attributes which take various levels. Currently the SWM in Dodoma municipality is so very bad because the service provider has forgotten to include your participation which

is very important toward achieving good SWM which leads to quality environment and hence protect our health. Generally the research attempts to estimate your" willingness to pay for the improved SWM options. In order to come up with better management options implemented, some fund must come from you. The payment for the service will be increased at some amount, which will be charged per monthly by the service provider. The information obtained is confidential and may be used to design future waste management policy. You are invited to participate in this survey by providing answers to the best of your knowledge.

2: Introducing the Choice Sets

I am assessing household's preferences for a choice of improved SWM options. These options are defined in terms of the service attributes of frequency of collection per week, waste disposal methods and waste transportation methods.

Transport method: Currently the collectors use **hand-driven pushcarts** because of shortage of fund to enable them to buy trucks. The continuous using of pushcarts leads to inefficiency of solid waste management because if the distance of dump site is far away from your residence area, the pushcarts drivers are not capable to collect solid waste (SW) twice or three times a day because of tiredness and time, and on top of that, the hand-driven pushcarts are uncovered which lead to spillage some of loads(waste) back onto streets and roads resulting to the complication of garbage collection, and most of the waste remain uncollected. The uncollected garbage is mostly dumped illegally and lead to the threat of environmental quality and our health due to increase in epidemic diseases, pollution, and global warming. Therefore if our health is affected, we will spend more income for treatment instead of investing in economic activities. Thus to improve our SWM we need to have trucks. There are open trucks and covered trucks.

Open trucks: Open trucks will reduce almost the problem of all hand-driven pushcarts except the spillage of spillage of some waste back onto streets, because the trucks are uncovered. Also it is expensive in its operation since it needs fuel and maintenance, just to mention few. But it is somehow efficient in SWM.

Covered trucks: Covered trucks are very expensive but they are best trucks in SWM since they solve the problem of waste spillage, and keep the environment more clean and quality. Here are the three pictures illustrating pushcart, open truck and covered truck.

Plate 1: Pushcart in Dodoma

Plate 2: Open truck in Dodoma

Plate 3: Covered truck in Morogoro Municipality.

Disposal method: Currently the method of disposal in the municipality is **open landfill (dumping)** which is not friendly to the environment since it poses serious threat to ground water resources and soil. The contamination of soil by heavy metal can cause adverse effects on our health, animals and soil productivity. Open landfills are considered illegal because they do not adhere to government policy regarding the burying of waste and the controlling of groundwater contamination.

The conversion of open landfills to **sanitary landfills** and **incinerator** is an essential step to avoid future cost from present mismanagement. **A sanitary landfill** is a waste disposal facility where layers of compacted garbage are covered (buried) with layers of earth. When the facility reaches capacity, a cap is applied to close the site. **An incinerator** is a unit or facility used to burn trash and other types of waste until it is reduced to ash. The device is constructed of heavy, well-insulated materials, so that it does not give off extreme amounts of external heat. The high levels of heat are kept inside the furnace or unit so that the waste is burned quickly and efficiently. However, these two methods of disposal are costly and require the complicated engineering design and construction. Here are the pictures illustrating the three different waste disposal methods.
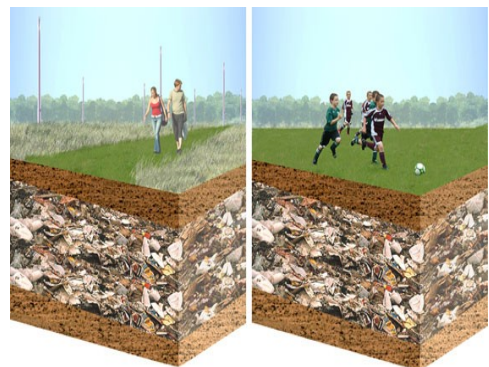

Plate 4: Open landfill in Dodoma

Plate 5: Sanitary landfill in Aiken USA

Plate 6: Incinerator in Malmo, Sweden

Collection frequency: Currently the collection frequency is once per week because of poor transport mode and cost. Collecting waste once per week is less expensive but it leads to improperly stored waste which creates odor and vector problems. Therefore to overcome the problem there should be several number of trips per week in collecting SW such as twice or more than twice per week. The advantage of more trips per week is the reduction of litter and storage requirement. But it is more expensive, requires more fuel, just to mention few.

Therefore the improvement in these service attributes will cost your household. There are no rights or wrong answers it is only to have your say in what future policy options regarding solid waste management should look like. The given service attributes take on different levels and these levels are independent of each other. Before answering the choice sets, we do request you to keep in mind your available income and other things on which you may need to spend money. Here there are three Options. The status quo refers to the current solid waste management services and in this case the quality of the environment continues the way it is at present and no less or more payment is required from you. Option A and Option B correspond to two different projected situations that

would employ households paying an additional amount of money to achieve an improved environment than the current SWM situations in your area. Therefore you are expected to carefully look at your income and choose among proposed options accordingly. There are three choice sets to be dealt with.

3: Choice sets

Consider carefully the following 3 alternatives. Suppose these options were the only ones available, which one would you choose? (Please tick in the box given below your preferred option).

Attributes	Status quo	Option A	Option B
Dispose method	Open landfill	Sanitary landfill	Incinerator
Transport mode	Pushcarts	Open trucks	Covered trucks
Collection frequency	Once per week	Twice per week	Three times per week
Charge per month	2000	3000	4000

4: Socioeconomic and Demographic Aspects

1: Age of respondent ………………..

2: Sex a) Male ☐   b) Female ☐

3: Marital Status: a) Single ☐   b) Married ☐   c) Other, specify…………………

4: Level of education attained by the respondent (Enter years of schooling as appropriate)

    1=Primary, 2 = Secondary, 3= College, 4 = Adult education, 5 = None ☐

5: How many family members do you have in your home? ☐

6: Is the house where you live yours? a) Yes ☐   b) No ☐

7: How much of solid waste do you generate in your house per week?

a) 1 bag of 50kgs ☐   b) 2 bags of 50kgs ☐   c) 3 bags of 50kgs ☐   d) 4 bags of 50kgs ☐

e) Other specify…………………………………………………………………..

8. Is the location of dump site near to your house? a) Yes ☐   b) No ☐

9: What is your main occupation?

 a) Civil Servant ☐   b) NGOs Worker ☐   c) Self-employed (non-farm) ☐

d) farmer ☐

e) Other(s)…………………………………………………….

11: How much is your households' approximate monthly income in Tsh?

....

THANK YOU FOR YOUR COOPERATION

Appendix 2: Plates showing the image of SWM in the study area

Plate 1: Shows storage of solid waste at households' resident

Plate. 2: Shows transportation of solid waste from households'resident to dump

    area

Plate 3: Shows disposal area of solid waste in the Municipality