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ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES

***VALUING HOUSEHOLD WILLINGNESS TO
PAY FOR THE PROVISION OF IMPROVED
SOLID WASTE MANAGEMENT PROGRAM:
THE CASE OF YEKA SUB CITY CENTER OF
ADDIS ABABA***

BY
TESFAHUN BEKELE

A thesis submitted to the school of Graduate Studies of Addis Ababa
University in partial fulfillment of the requirement for the degree of
Master of Science in Economics
(Resource and Environmental Economics)

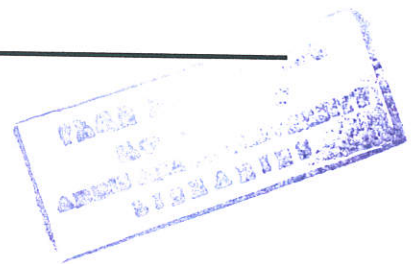


July 2007 G.C
Addis Ababa

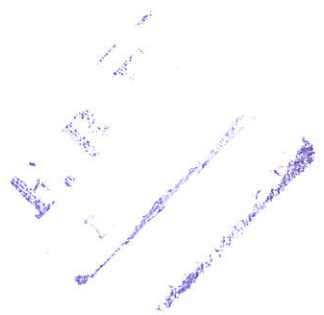
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“Valuing Household Willingness to pay for the Provision of
Improved Solid Waste Management Program: The
Case of Yeka Sub-City Center of Addis Ababa.”

By

Tesfahun Bekele Ayele



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ABBREVIATIONS

WTP - Willingness to pay.

WTA - Willingness to accept.

ISOESTMSWM – International source on environmentally sound technologies for municipal solid waste management.

TGF – Trip generating function.

CVM – Contingent valuation method.

MSWM – Municipal solid waste management.

RCRA – Resource conservation and recovery act.

EPA – Environmental protection authority.

ISWMP – Improved solid waste management program.

SWM – Solid waste service.



Abstract

The issue of 'solid waste' which refers to all material thrown out after consumption or production now a day becomes a great concern of all nations. In developing countries like Ethiopia problem of solid waste is considered to be among the most serious environmental problem. Majority of solid wastes in these countries dumped in open air with out proper management of the wastes. In Addis, solid waste problem has received many attentions by government and non government organization. Hence, many organizations participate in solid waste management particularly in clean and green Addis Ababa program. Even if many parties participate to clean the city and protect the environment, still solid waste is a crucial problem in Addis. Many organizations and majority of households have not had a proper understanding about the impacts of solid wastes on the environment, economy and community health. In the city and in the case study area, the problem of solid wastes emanates from the difficulty to find appropriate places for disposal and majority of households do not know the negative outcomes of solid wastes.

This study propose improved solid waste management program to alleviate the problem of solid waste in case study area (YEKA). In this program sampled households asked to state their willingness for the proposed program. In study contingent valuation method (CVM) is used to elicit household willingness to pay which the method has chosen by environmental economists to value environmental goods. CVM is the most applied valuation method in recent years, and it has been developed mainly in the context of environmental valuation over the last 30 years. It is therefore of great interest to study it more carefully. With CVM selected households were asked to accept for a propose change in solid waste management program.

Probit and Tobit models are used to estimate household willingness to pay and to predict the coefficients of explanatory variables. Based on the study finding the mean house hold willingness to pay is birr 9.49 (conditional mean) per month birr 113.88 per year. Household willingness to pay for the provision of improved solid waste management influenced by basic socio economic variables particularly family size, household income, and quantity of solid waste, number of children, experience, and knowledge of household on solid waste management .Management of city administration should identify these socio economic variables to minimize the problems. These variables highly important for policy and instrument to control this wide spread problem of solid waste.

CHAPTER ONE: GENERAL INTRODUCTION

1.1. INTRODUCTION

Solid waste problem is considered to be among the most serious environmental problems of Addis Ababa. Majority of solid wastes in the region have dumped in open air with out proper management of the waste. These wastes became the causes for many diseases. In Yeka sub city and in the capital as a whole, solid waste collection and disposal services are limited and unsatisfactory and the management in the region is incapable to manage all collection and disposal service.

To alleviate solid waste problem efficient and improved solid waste management system is required. Efficient solid waste management can protect the environment, promote the quality of life and support the efficiency of economic products. Along efficient methods of solid waste management sound policy measures and instruments for action should be taken at regional and local level for waste reduction. Here, participation of public also vitally important particularly for improved solid waste management system.

Public or households may participate in improved solid waste management system by paying a share of investment cost for the program. This study employs contingent valuation method (CVM) to elicit households' willingness to pay for proposed solid waste management program. CVM is particularly important in a situation where there is no market information.

In the study 230 households are interviewed to assess their willingness to pay behaviors. Majority of these households accept proposed improved solid waste management program. Using Tobit and Probit models the study estimate households' willingness to pay for proposed program. Basics coefficients of explanatory variables which determine household willingness to pay are estimated. Finally study sight basic significant variables which influence households' willingness to pay a lot. The study also provides important recommendations and policy implications in final chapter.

1.2 STATEMENT OF THE PROBLEM

The problem of waste is an issue all over the world. All countries are bound by the problem of waste. In least developed countries like, Ethiopia, the problem of solid waste has become a crucial problem particularly in urban areas. It has negative impact on economic development, health and nutrition.

In urban areas large quantities of solid wastes are dumped hazard. That is why solid waste is a concern for many. Snigtha Chakrabarti (2003) emphasizes the point by saying the following "The increasing level of solid waste is now a days a serious problem in the urban areas. A high rate of growth of population and increasing per capita income has resulted in the generation of enormous solid waste posting a serious threat to environmental quality and human health." Solid waste can be a cause for many water diseases such as cholera and dysentery. Many studies reflect this dynamic problem (Thomas C. Kinnaman and D. Fullerton 1999, Snigdhs 2003, Peter Schubeler 1996). Large numbers of death reported in different countries of Africa due to the cause of solid waste problem.

Solid waste refers to all material thrown out after consumption or production. We can observe in short distance different kinds of solid waste material in the city of Addis Ababa. In the city, now a day different interested group participate to reduce and to alleviate the problem. Still the solid waste is a crucial problem in the capital. Different government and non government organizations, individuals have involved in solid waste management program aiming at cleaning the city. There are few researches done on solid waste management of the capital. This study believes the researches gone on this issue are not enough relative to the degree of the problem. At zonal or sub city center on the other hand, no study has been made on solid waste management, or these kind of studies might be out of this study sight. In nut shell, solid waste is still a crucial problem at regional or zonal level.

In Yeka and in the capital as a whole, the problem of solid waste emanates from the difficulty to find appropriate places for disposal of solid waste and majority of households do not know specifically the negative outcomes over the environment. In Yeka sub city center, many solid wastes and materials such as plastic bags, bottles, papers, containers, food scraps such as: Vegetable and fruit discards, egg shells, spoiled food, meat and fish bones, etc; yard such as: grass clippings, flowers, plants, leaves, etc; different kinds of house hold hazardous wastes and all other wastes have thrown out side house hold hose carelessly. Of course some of solid wastes have lifted to municipal solid waste containers. But majority of solid waste containers do not collect efficiently. This reflects management of the region unable to manage all solid wastes.

In general, solid waste is the problem for the environment, household, business sectors, and government and non government organization. So, we need a mechanism to alleviate and reduce the problem through efficient participation of the communities. Above all, this paper basically

target, households to minimize such dynamic problem of solid wastes. The mechanisms for solid waste reduction could be the following: efficient solid waste disposal, incineration, recycling, the choice of regulatory measures to secure waste reduction. To alleviate this basic solid waste problem this study stick on improved solid waste management system and household willingness to pay for this improved management. Moreover, this study aims to contribute to a better understanding of household solid waste management behavior by analyzing household waste management practice and attitudes.

1.3. SIGNIFICANCE OF STUDY

As stated in previous section, solid waste is a concern for the environment; household, city government and a concern for all communities live in the city of Addis Ababa. The proposal recommendation which the study paper reflect may have vital role to alleviate or to reduce this crucial problems of the region. From improved solid waste management program, type of solid waste recycling which will indicate in the study may bring ample benefit for the environment in general households in particular.

In the capital city, the population has doubled in 20 years. The numbers of population estimated around 3 millions and the volume of solid waste has increased with the increment of population. However, there is no proper and efficient method of collection of solid wastes and solid waste management. It is estimated that “3 millions people will generate 0.252 kg / per capita/ day and the current daily waste production of the city is 2,297m³” clean and sect oral development program of Addis Ababa in the year 2004-Gc .

From existing study papers, we observe 65 % solid waste is collected, 5% recycled and 5% composed around 25-30 % of solid waste is simply dumped in to open sites. From these figures, we observe that the society and city government of Addis Ababa have not yet practiced solid waste management effectively. From solid waste management systems, solid waste recycling program may maximize the interest and benefit of house holds in particular, the environment in general.

This study, on the other hand, will give good opportunity basically for the city government, for the households, for policy maker to alleviate and reduce solid waste problems and showing a way or direction for better environmental protection.

1.4. RESEARCH QUESTION

The study will provide recommendation and solution option for solid waste problem for the case study area. Through the process of research the paper will attempt to answer the following research questions.

“How households react for new improved solid waste management program?

“Are households are willing to pay for this improved solid waste management program? ✓

“How will households pay for the service obtained from new program? ✓

“What are the factors that influence household willing to pay?

“What will be the practical recommendation and finding for existing solid waste problem in the region?

1.5. OBJECTIVES OF THE STUDY

The general objective of the study is to analyze the determinants of household willingness for changes in solid waste management program and give additional information for policy maker, researcher, and every reader about solid waste management and problems and solution option in the case study area. The study also has the following specific objectives.

1. To estimate and analyze household willingness to pay for reliable improved solid waste management program.
2. To identify the determinants and measure the level of willingness to pay by household for improved solid waste management program.
3. To determine factors that limit household for efficient and proper solid waste disposal actions.

1.6. Methodology and Data Source

Solid waste problem consider as an environmental problem. Improved solid waste management program which is the program propose in this study, is one way to control and reduce the problem of solid waste. In the study contingent valuation method (CVM) is used to value household willingness to pay for the provision of improved solid waste management program. CVM involves obtaining direct information from households (individuals) about their willingness to pay (WTP) or willingness to accept (WTA) money for the changes in environmental quality (Kahn 1998, Freeman III 1993).

To obtain, WTP information from household's single bounded open end dichotomous question will design. The questionnaires which will be designed comprise of question related to willingness to pay for improved solid waste management program, personal data description, a series of question about the relevant socio economic and demographic characteristics of the households, the characteristics of existing solid waste in the study area, household attitudes toward solid waste management will organized and administered. The data which the study uses is primary data collected from randomly selected individual households in the year 2006. Other information on solid waste management practices are obtained by interviewing of concerned city administration officials and the private firms currently engaged in solid waste activities.

A sample size of this study is 230 households which will be select by random sampling technique from Yeka sub city center of Addis Ababa. The sample of households will be interviewed face to face observation method. Before the main survey, a pilot survey will be undertake from randomly selected 20-30 household to obtain starting information and to minimize or avoid the problems and obstacles which may happen in the main survey. The survey will undertake with the help of four interviewers.

For analyzing basic study variables, estimating WTP and basic determinants of WTP the study will use Probit and Tobit models. Econometrics packages called LIMDEP and STATA will be used for analyzing basic models and study variables.

1.7. ORGANIZATION OF THE STUDY

The study organizes as follows. Chapter one introduction which deals about statement of the problem, significance of the study research question, objectives of the study, brief picture of methodology and data source finally organization of the study . Chapter two discusses relevant literature and empirical studies. This chapter deals about relevant methods for valuing environmental goods and empirical studies. Chapter three deals about conceptual frame work for municipal solid waste management. Chapter four focus on the methodology employed in the study. The chapter deals about scope and limitation, hypothesis to be tested, description and specification, description of the study area and solid waste management in case study area. Chapter five deals about empirical result and discussion from information obtained from the survey. Finally chapter six deals with conclusion recommendation and policy implication.

CHAPTER TWO: LITERATURE REVIEW AND EMPIRICAL STUDIES

2.1. Methods for valuing Environmental goods

Environmental valuation techniques are extensive and broad. These techniques help to estimate values of environmental goods. According to Freeman (Freeman III 1993) measurement of values can be placed into four categories, i.e. direct observed, indirect observed, indirect hypothetical and direct hypothetical. From these categories, this paper will explain only the most widely seen techniques which particularly linked with measuring non market environmental good (Perman 2003, Freeman III 1993, James r Kahn 1998). The techniques which will be discussed in this part are travel cost and Hedonic price from indirect observed behaviors, Contingent valuation method from direct hypothetical methods. These methods deal about qualitative changes on non market environmental goods. In the discussion, this paper will give some emphasis on contingent valuation method, because the study basically depends upon this method.

2.1.1. Hedonic pricing techniques

Hedonic pricing is an indirect method first developed by Griliches in year 1971 G.C. This technique follows revealed preference approaches. Revealed preference approaches concern about decision of people regarding changes in characteristic of environmental goods.

The method estimates the implicit prices of the characteristics that differentiate to related goods (Per-olov Johnson 1987). Major literatures consider housing price related to hedonic pricing techniques. Housing prices related to a variety of characteristics such as the house (its number and size of rooms, number of bath rooms quality of construction etc) and attributes of its surrounding such as distance to quality of schools, air quality etc (James r kahn, 1998, Per-olov Johnson 1987). Per –olov 1987 presented the following housing or hedonic price function in his book.

$$P_h = F_h (S_{h1}, \dots, S_{hj}, N_{h1}, \dots, N_{hk}, Z_{h1}, \dots, Z_{hm}) \dots\dots\dots 2.1$$

Where-

P_h = Price of housing

h = housing

S = location

N = neighborhood

Z = environmental characteristics

The partial derivatives of the hedonic price function with respect to any characteristic gives its marginal implicit price (Freeman III, 1993). If we take air as one environmental characteristic, we can estimate price of housing based on this function. According to Perman 2003, other thing being remain constant ,there is a positive relationship exists between the price that people are willing to pay for housing and the quality of ambient air standards(Perman, 2003).

2.1.2. Travel cost Method

The travel cost is the method first proposed by Hotelling in 1947. The method use revealed preference approaches like hedonic price, for valuing environmental resources particularly recreational service (Kahn, 1998; Freeman III, 1993 Perman, 2003; Per-olov Johnson 1987). According to this method the travel costs to a site can be considered as the price of access to the site. The method value the site by computing the consumer surplus for each individual in the survey, averaging the consumer's surplus and multiplying by the estimated number of recreationists (Kahn 1998). Like other demand curve analysis, consumers' surplus is the area under the demand curve above the price which is the individual actually incurred. The travel cost demand curve may be estimated by quality of environmental variables. In travel cost method analysis environmental quality affects the value of recreational activities.

According to Perman 2003 the first basic assumption for this method is that visits to the park are determined by the following trip- or visit generating function.

$$V_i = f(C_i, X_{1i}, X_{2i}, \dots, X_{Ni}) \dots \dots \dots 2.2$$

Where:-

V_i = is visit from the i^{th} origin

C_i = is the costs of a visit from origin i

X_s = are other relevant variables

Another basic assumption for using travel cost method is that the cost of a visit comprises travel cost and admission price. If we think that trip generating function is linear in costs, and suppress the role of other variables, the TGF has the following form (Perman 2003).

$$V_i = \alpha + BC_i + \varepsilon_i = \alpha + B(T_i + P) + \varepsilon_i \dots\dots\dots 2.3$$

Where:-

- ε_i is the error term
- C_i is the cost of a visit
- T_i is travel cost
- P is admission price

When we assume that error term in equation '2.3' the expected visits function has the following form

$$E (v_i) = \alpha + BP + B T_i \dots\dots\dots 2.4$$

For P equal to zero, estimated expected visit will be

$$E (v_i^*) = \alpha + B T_i \dots\dots\dots 2.5$$

From this equation (2.5) we can estimate Marshallian consumer surplus i.e.

$$MCS_i = \frac{-(E(v_i^*))^2}{2B} \dots\dots\dots 2.6$$

Where MCS_i is Marshallian consumer surplus; with in the assumption of travel cost method, 'α' and 'B' are estimate from the data from surveying visitors to the site.

For unbiased estimation, of travel cost method we need consider also non monetary parts of the travel cost. If we neglect the non monetary parts of travel cost such as time spent in travel then we reach at biased conclusion (Per-olov Johnson 1987).

2.1.3. Contingent valuation method (CVM)

Contingent valuation method is a direct and sometimes referred as a stated preference method. CVM is the method for valuing environmental goods which uses survey question to elicit willingness to pay for the provision of the good or willingness to accept compensation for lack of provision. In other words, in CVM studies peoples are directly asked to state their willingness to pay or willingness to accept for a change in environmental quality. For CVM questions either open or close ended need organized (James r kahn, 1998, Perman, 2003, Michael H, John L, Barbara K, Double bound dichotomous choice, 1991).

In close ended type, respondents are questioned to say whether they would be willing to pay a particular amount to preserve the environmental resource. While in open ended type, respondents are asked to state their maximum willingness to pay. The method has two basic advantages over those indirect methods. Firstly, it deal with use and non use values. but indirect methods cover only the use values. Secondly, unlike the indirect methods, CVM answers to WTP or WTA

questions go directly to the theoretically correct monetary measures of utility changes (Perman, 2003). Generally, CVM have the following strength relative to indirect methods: we can obtain direct welfare measure through CVM, CVM allows measurement of value of goods where other methods cannot do, i.e. measurement of non use values, allows researchers to directly control the definition of the good (Romano.D, 1999).

To go through with CVM, we should follow some basic steps which are (i) first-creating a survey instrument for the elicitation of individuals (ii) using survey instrument with sample the population of interest (iii) analyzing the responses (vi) computing total WTP or WTA for the population of interest and (v) conducting sensitivity analysis (Perman, 2003). In the first step researcher need explain a hypothetical situation which involves individuals who buy some improvement in environmental quality or are compensated for a decrease in some environmental quality. Then payment vehicle (a method of hypothetically extracting money from the respondent) need to be constructed (Hartwick and D. olewiler 1998)

In this method we can take responses from respondents by three different ways, i.e. face to face interviews, mail surveys and telephone interviewing. Out of these three ways face to face interviews brings many advantages such as effective information provision. In the survey, WTP questions should be prepared. This type of question specifying a sum of money which house hold willing to pay for specifying environmental quality change. In this valuation method, respondents need to ask about their demographic and socio economic status with WTP questions. For assessing the response of the respondent, we use valuation function. This function takes the WTP response as dependent variable other demographic, socio economic and attitudinal variables as

explanatory variables .With this function we can estimate respondent willingness to pay for the change in environmental quality.

Although the contingent value method has been used in this day and many environmental economists have selected the method for the valuation of environmental quality, CVM is not without problems and some difficulties (Kahn, 1998, Perman, 2003). The most observed biases which this method has are strategic biases, information biases, hypothetical biases and starting point biases. The strategic bias could rise from a contingent value format. The bias of such kind may occur when the respondent gives a false answer that deliberately aims to influence the outcomes of the survey. Respondents may become under bid because they think first they will have to pay the amount they indicate second the good will be provided no matter what amount they indicate. On the other hand respondents may become over bid because of firstly they think they will not have to pay the amount indicated secondly provision of the good depends on their indicated WTP. Information biases may occur due to lack of information about the good to be valued by people. Valuation may depend on how the information about the good and its provision and what other information the respondents have about a particular good or incident. Hypothetical bias arises due to the difference between what people say and what people do. CVM start with hypothetical question and reach with hypothetical decisions. In this regard, some researches argued that CVM lack some credibility which reflects hypothetical decisions derives by CVM may not the same to practical and actual decision. The starting point biases may occur when the survey present a range of values from which the respondents chose answer that influence the study result (Romano 1999, Kahn 1998).

The other problems of CVM are categorized in Perman 2003 book in brief, i.e. .in CVM there is high incidence of protest responses, high estimates of average WTP, low sensitivity of yes/no responses to price variation, low scope sensitivity, large difference between WTP and WTA. The translation of maximum willingness to pay or minimum compensation that a respondent is willing to accept is often a difficult task for the researcher particularly in developing countries (Dale Whittington, Great Britain, 1998). Although CVM has such kinds of problems, still many environmental economists have chosen the method by its many strength for valuation of environmental goods. Moreover, CVM can provide useful information for value and use value of environmental goods.

2.2. Empirical studies

A number of studies have been undertaken concerning environment and solid waste issues. In our country, some researchers and students took the issue of environment and solid waste for their topic of the research. From these researches, this study selects the most relevant papers for this part.

The economic valuation of the environment impact of solid waste management is the one research done outside our country. This research (Eugenian et al, 2001) present a study to determine the economic value of an improvement in environmental quality due to an alternative household garbage collection and selection system for household of San Pedro in Mexico City. The study use contingent valuation method to determine people's willingness to pay for improvement in quality of the environment brought by a garbage collection system. This research cote the problem of solid waste goes hand in hand with economic growth, i.e. developed

countries generates huge quantity of solid waste in relation to other developing countries. In the study, they use ordinary least squares (OLS) multiple linear regression model to estimate WTP. Using OLS they estimated the variables that influence willingness to pay. Based on paper finding, income, wealth education, number of children government credibility are some of the variables are some of the variable that affect household willingness to pay. The study concludes some points for example; average WTP for the project was 1.85 dollar per household, per capita income is the most significant variable. Age also a significant and has an inverse relation with WTP.

David Pearce and R.K Turner (1994) also studied on Economics and solid waste management in the developing world. In the study they gave emphasis to health hazards from uncollected waste, health hazards from collected but poorly disposed of waste, the economic burden of waste disposal on towns and cities. These problems could be the basic problems of solid waste in developing countries based of their study. From all waste management stages, the paper present waste reduction is the first in terms of solid waste control objective. They underline that regulatory instrument is very essential for solid waste management. Based on this study (David Pearce and R.K Turner (1994) instrument for solid waste management should be applied in order to raise finance or stimulate prescribed behavior via incentives. Economic instrument also has an advantage to provide a continuous incentives effect which stimulates waste generators to seek out the least cost combination of disposal, recycling and reuse.

Nathan Kamesar and Amos Nadler 2004 have undertaken CVM study to measure willingness to pay for managing solid wastes. For econometrics analysis they used regression model. The study showed that for each year of education a person is willing to pay an additional 0.33 for recycling

the community, people who live in cities that offer curbside recycling program are willing to pay 0.58 less than those who do not have one. These are some of the studies directly related to CVM which undertook out side.

In Ethiopia some researches have been undertaken concerning solid waste and environmental issue. Zewdu Belete and Yemeserach Assefa (2003) studied on the topic of willingness to pay for protecting endangered environments. In the study contingent valuation method is used to elicit the mean WTP of the respondents to changes in the environment under study. The study identified factors that determine the individual willingness to pay and identify ways of integrating the community in the conservation of the national park. The paper remarks economic demographic characteristics and others are important to appreciate WTP to protect the endangered park. To protect the park the current conservation strategy which implemented by the regional state is not consistent with the environmental policy of the Federal Government, the study paper remark. The paper also tried to estimate people's willingness to pay to protect the park and identify its determinants. In the paper it was found that the respondents' mean willingness to pay is significantly influenced by the nature of their primary activity, dependency ratio and distance from the park Dawit Walelegne in March 2003 also undertook a study with a topic public valuation for improved solid waste management in Addis Ababa. The study paper tried to estimate household willingness to for improved solid waste collection and disposal practice and the total benefits of Addis Ababa's city for a solid waste management system. The paper categorized solid waste in the following form: domestic solid waste, commercial and industrial solid waste, street sweeping. Ordinary least squares (OLS) were employing to estimate WTP and other specified variables in the study. The paper pointed out that, Municipality of Addis Ababa is not able to provide adequate service of solid waste management. Due to poor

management, the study pointed out also residents dispose solid waste in environmentally unfriendly manner. Moreover, there is a high level of indiscriminate use of public open spaces for dumping waste. Based on the study, there was tendency of actual level of segregation at source for recyclable waste and biodegradable in Addis Ababa.

Household willingness to pay for improved solid waste management in case of Adama town studied by Tolina (2005/06) for partial fulfillment of requirement for MSC in Economics. This study used contingent valuation method to elicit household willingness to pay for improved program. For econometrics analysis, he used Tobit and Probit model. The paper tried to estimate coefficients of explanatory variables and mean of household willingness to pay for improved program with three conditions i.e., moderate legal punishment, strong legal punishment, and weak legal punishment on those who may catch illegally disposing of solid waste. Incomes, age, secondary education, marital status of respondents, house ownership are estimated significant variables to estimate household maximum willingness to pay. The mean WTP under the first condition is 8.26 birr/month, 8.66 birr/month under second condition (strong enforcement) and 8.41 under the third condition (weak enforcement).

As we have been seen there have been many attempts to value the environment through contingent valuation method. In our country level too we can observe some CVM studies. We observe from these studies that CVM can help to value environmental good a lot.

CHAPTER THREE: CONCEPTUAL FRAMEWORK FOR MUNICIPAL SOLID WASTE MANAGEMENT

3.1. Municipal Solid waste management

Solid waste may arise from different sectors of the economy. It may arise from households, non hazardous solid waste from industry, commercial and institutional establishment, market waste yard waste and street sweepings. Problem of solid wastes is a concern of all, i.e. it is the concern of households, communities, non government organizations, local government, national government, private sectors enterprises, informal private sectors, etc. Specifically solid waste is a major responsibility of local governments (Schubeler Peter, 1996). So, it needs proper and efficient management.

Solid waste management may do a lot for the environments and the stated concerned bodies in the above paragraph. Mainly, Solid waste management may have the following aim protect environment, promote the quality of the urban life, support the efficiency and productivity of the economy and generate employment opportunities. Schubeler studies (1996) point out that, to manage this wastes concerned bodies should give priority for: waste minimization, maximum waste recycling and reuse and ensure the safe and environmentally sound disposal of waste.

Solid waste management may differ from one municipality to another and from one city to other city. But conventional and modern solid waste management may do similar functions and activities. Conventional solid waste management system may incorporate at least the following activities i.e. setting policies; planning and evaluating municipal solid waste activities(in this

activities we should take in to account strategic planning, legal and regulatory frame work, public participation, financial management, institutional arrangements, disposal facility siting) physically handling waste and recovering materials, including separation, collection, composting incineration and land filling; establishing training programs for solid waste management workers; identifying financial mechanisms and cost recovery systems; establishing prices for services and creating incentives; managing public sectors administrative and operations units; finally incorporating private sector businesses including informal sector collector, processors and entrepreneurs (ISOESTMSWM 1996, Schubeler 1996). In addition to these activities marketing recovered material to brokers or to end users for industrial and commercial purposes may include if the management has enough resource and structure. Of course the system also consider refuse storage and collection, street and drain cleaning, solid waste transfer and transport, disposal and resource recovery services (Bortone Carl, 1990).

For the past decades different municipalities have taken different measures for disposal of solid wastes and generally for managing these wastes. Now a day many environmental economists advise that every municipality should design solid waste management hierarchy to achieve efficient and proper solid waste management system. In most cases solid waste management hierarchy consider at least source reduction, recycling, composting, incineration and land fill (S.C. Santara 2004, Mohammed and et al 2003, ISOESTMSWM 1996).

Source reduction is the first procedure or hierarchy of solid waste management system. From the economic point of view, any municipal solid waste management may choose firstly waste reduction at source up to a point where the benefits of extra source reduction at source up to a point where the benefits of extra source reduction are broadly equal to the cost of extra source

reduction, secondly the optimal balancing of land fill, incineration and recycling finally the choice of regulatory measures to secure waste reduction and optimal disposal (David Pearce and R. Turner, 1992). This hierarchy includes product reuse (increased product life), reduced material volume (reduced the amount generated), reduced the toxicity or negative impacts of products. Being the logical starting point of solid waste management, source reduction took the attention of world wide. On this topic agreement was reached among participating nations at the United Nations conference on Environment and Development in Rio de Janeiro in 1992 (ISOESTMSWM 1996). On that conference participant agreed up on waste reduction and protection of the environment.

Sound policy measures and action could be taken at national and regional or local level for waste reduction efficiently and properly. Points that could consider for reduction of waste are redesign of products or packaging, promotion of consumer awareness and promotion of producer responsibility for post consumer wastes. International source book on environmentally sound technologist for municipal solid waste management mentioned eight basic tools for municipalities in developing countries to promote waste reduction and materials recovery. These tools are important and relevant to Yeka and the city as a whole. From these tools the following basics points should be relevant to all municipalities.

- Promote educational campaign for waste reduction and recycling and reduction of the stigma attached to waste work.
- Study waste streams such as quantity and composition analyses, recovery/recycling systems markets for recyclables and problems of existing practices to decide where there may be a facilitative/regulatory role for the municipal authority.

- Facilitate small enterprises and public-private partnership by new or amended regulations for cooperatives, loans to small-scale businesses, etc.
- Assist waste pickers to move out of manual picking by instituting retraining programs.
- Support source separation; recovery, and trading networks with information-sharing and forums of stakeholders.
- Promote innovation to create new uses for goods and materials that would otherwise be discarded after initial use (ISOESTMSWM, 1996).

From solid waste management system developing countries like Ethiopia has spend huge amount of money and labor for collection of solid wastes. Of course, collection cost is the largest cost element in most municipal solid waste management (MSWM). When we deal with collection of solid waste, we should give emphasize for collection vehicles, selection of containers, route design and operation and communal collection of solid wastes. According to internationally source book(ISOESTMSWM, 1996), the collection vehicle must be appropriate to the terrain, the type and density of generation points, the roads and the ways the vehicle travel , the type of waste or the kinds of material the vehicle will be used to collect. Depends on their budget or the nature of the management style of the municipalities, the management may choose among different types of solid waste collection vehicles such as three wheeled auto rickshaw, dumper truck ,tractor and trailer, conventional truck, fore-and-aft tipper truck , roll-top truck or they may choose from the latest models for solid waste collection .

The others solid waste management hierarchies which all municipalities give due attention are recycling/reuse, composting, incineration and land fills. From these hierarchies recycling is a process of solid waste to produce new products that may or may not resemble the original

product (Mohammed and et al 2003). In addition to reduction of wastes, recycling may create jobs opportunities and become a source of foreign currencies. But recycling programs may ask huge amount of money and effort for investments.

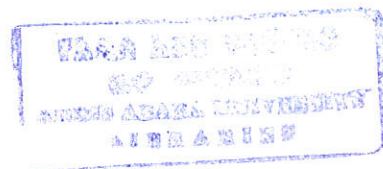
3.2. Problems of Solid wastes

Now a day, the problems of solid waste is not only the problem of city administration but also it is the problems of nations. As the point mentioned earlier, the problems of solid waste has linked with economy, community healthy, and the environment. In developing countries like Ethiopia, we observe immense problems of solid waste.

David Pearce and R.kerry (1992) categorized major problems of solid waste in to health hazards from collected waste, healthy hazards from collected but poorly disposed of waste, and the economic burden of waste disposal on towns and cities. Health hazards of solid waste are widely seen in most developing countries cities. Majority of solid waste in these countries dumped in open air with out proper management of this waste. These uncollected wastes became the causes for many diseases. David Pearce and R.kerry (1992) points out uncollected waste create various hazards, of which the most serious is health risk. In those developing countries people aged between 19 and 35 participate in sorting of solid waste for getting income. These people working in the field with out proper facilities and equipment, this point reveal how such people exposed to public health hazards. David Pearce and R.kerry (1992) revealed, during periods of heavy rain stagnant water ponds are commonly found on files sites. This type of water serve as breeding grounds for mosquitoes commonly known for vectors of infective agents for malaria and filariasis^{*1}. In addition to malaria and filariasis; eye irritation, tuber closes, diarrhea, typhoid,

dysentery, coughing, scabies caused by miss-use and miss- management of solid waste. Miss-use of solid waste may also a cause for a major food borne, water borne and soil borne diseases (S.C. Santra 2001). If these things contaminated they may transmit bacteria, viruses and parasites. S.C. Santra also mentioned the most menacing diseases of the world, diarrhea, cholera, typhoid, intestinal worms, hepatitis, and tetanus caused by contaminated water, food, and soil.

According to S.C. Santra (2001), cholera alone causes 120,000 deaths per a year and is particularly deadly in Africa. The economic impact of cholera epidemics has seen in loses of trade and tourism. More over, disease that comes from the soil affects several million people annually. From the above selected diseases, neonatal tetanus responsible for the deaths of 450,000 children every year. These all diseases in one way or another linked with solid waste problem which reflect by inefficient and improper handling of solid waste.



*1- disease caused by parasitic worms filarial that inflames and obstructs the lymphatic glands, sometime result in elephantiasis. (Encarta dictionary)

3.3. Policy directives and instrument for solid waste management

3.3.1. Policy Directives

Every country needs to have good policies and instruments for solid waste management to protect the environment, to fasten economic growth, to keep healthy of the communities. For these purpose different countries of the world designed different policies according to their internal condition, economic, social and political status of the countries. Policy and instruments of solid waste management should be powerful and influential. Majority of developed countries have influential waste policies while majority of developing countries have not had influential and powerful policies (S.C. Santra, 2001). Even some countries might not have policies for efficient utilization and disposal of solid waste.

For this purpose this study tried to observe the policies of some countries. USA, some European countries and African countries selected for this purpose. In United States of America for example, there are five categories of Environmental legislation. Santra mentioned some pollution control laws of USA in his book (S.C. Santra, 2001). Some of the laws which are related to solid waste are: - resource conservation and recovery act, 1976; pollution prevention act 1990; Toxic substance control act 1992. These acts revealed a great concern of USA on environment. For this fact we can refer the most power full disposal regulation which was formulated in 1976 for the resource conservation and recovery. Different countries in the world particularly least developed countries may learn from experiences of USA. For example, today in USA regulated land fills are constructed with a base of several inches of various grades of plastic lining to prevent leach ate from seeping (Thomas.C. Kinnaman 1999). In addition, the regulation of

federal government of united state garbage must be covered with soil with hours of disposal to reduce foul odor, discourage pests and the risk of health hazards. There are other implementations of federal Governments procedures which some of cities have followed. These procedures have decreased external cost associated with garbage disposal. The technology of land fills also make life easy for solid waste management. Of course, some environmentalist assumes land fills depress property values.

Apart from federal government, state governments in USA have immense role for efficient utilization and management of solid wastes. Thomas.C. Kinnaman (1999) cotes "Resource conservation and recovery act (RCRA) also assigned to the state the responsibility of regulating the market for household solid waste collection and recycling". We can observe from Thomas study that states can pass laws for efficient waste management for municipalities with in the state. In addition to this the strongest laws requires all municipalities to implement curbside recycling programs.

Like US European countries have similar policies on solid waste management. United Kingdom for example aims to increase the recycling rate for solid waste management (Thomas.C. Kinnaman, 1999). For this purpose UK used credits for recycling and tax on disposal of solid waste in land fills, Germany on the other hand designed unique policy called the law on waste management, which is used to internalize the external cost of packaging choices. According to the study, the German law set a target for recycling solid waste like United Kingdom. Thomas C.K also sight in his paper that Germany designed green dot program in achieving efficient quantities garbage and recycling. This program establishes a mandatory deposit on non refillable beverage containers which gives incentives to consumers to return these types of packaging. In

general, majority of European countries have solid waste management policies, and most of them have target for recycling program. The European Union itself has target of recycling program between 50 and 75 percent (Thomas.C. Kinnaman, 1999).

Solid waste management and policies are different in developing countries relative to the majority of developed countries. This different have come as the result of first 30-50 % of solid waste is uncollected second collection method is labor intensive. Their management style is poor and inefficient due to lack of skilled and professional manpower. Majority of developing countries like Ethiopia may have policies on environment. But environmental polices does not stress on waste specifically on solid waste.

Federal Democratic Republic of Ethiopia has a policy on environment at federal level designed in 1997 G.C. The goal of the policy is to improve and enhance the health and quality of life of all Ethiopians and to promote sustainable social and economic development. So as to meet the needs of the present generation with out compromising the ability of future needs (Environmental protection Authority vol. 2, 1997). EPA designed around nine specific objective to meet the over goal of environment. These objectives particularly meet the need of environmental protection. However, the objective does not mentioned about waste and solid waste specifically. In over all sense the policy and objective of the environment seems strong and influential. Some of the objectives which linked to solid wastes are for example to improve the environment of human settlements; to satisfy the physical social economic cultural and other needs of their inhabitants on a sustainable basis; to prevent the pollution of land, air and water in the most cost effective way and others(EPA, 1997). The authority also designed specific guiding principles to meet specific objective of the environment.

The guiding principles (which are nineteen in number) are more of specific and have great power for implementation. In these guiding principles points such as every person has the right to live in healthy environment, the use of non renewable resources shall minimized and where possible their availability extended, regular and accurate assessment and monitoring of environmental conditions shall be undertaken and the information widely disseminated with in the population are clearly elaborated. These points in one way or another linked to solid waste management for implementation EPA designed institutional frame work responsibility mandate and legislative frame work. The objective of legal frame work for example is to create legal frame work for implementation of the federal policy on natural resources and the environment. In addition to this implementation the authority also designed action plan. The action plan divided it to eleven cross sect oral and eleven sectors Program (EPA, 1997). In general, we may say EPA has a good policy document on environment.

In addition to EPA policy on environment Addis Ababa city administration has its own policy on solid waste management. In relative terms, city policy on solid waste is specific particularly to solid waste management. This solid waste management policy has three goals and five objectives. The objectives stress on reduction of solid waste at source, solid waste management service touch each section of the population, strengthen participation of public on solid waste management service, solid waste management service should follow rules and regulation. The goal of the policy comprise: improve solid waste management service , protect public health and clean city, reuse major solid waste which create additional wealth and reduction of poverty and finally solid waste management service should sustainable and has it's own budget to all service expenditure.

The policy selects eight types of solid waste sources from different sections of the city. These solid waste sources are household waste such as food wastes, plastics, papers etc; solid wastes from trade services such as solid wastes from shops, hotels, markets, etc; solid wastes from different organizations; solid waste from road and street solid waste comes from construction; solid wastes comes from industry; and finally solid waste screening from liquid wastes such as waste from toilet etc. More over the policy mentioned four systems of solid waste management. These solid waste management methods are dumping land filling, incineration, and finally composting and recycling. In policy document methods and approaches how these solid waste management works mentioned in detail manner. Generally the policy has good picture and seems vitally important for decision maker (Addis Ababa city administration, Solid Waste management Policy, 1995 EC).

Concerning legislation, there is no federal solid waste management act or legislation. But the city administration of Addis Ababa has it's own a comprehensive legislation on solid waste management. The legislation is waste management collection and disposal drawn in February 2004. This legislation delimited mainly individual and community act on solid waste disposal, usage and management of solid waste storage facilities, transportation of solid waste, management and disposal of solid waste generated from defined and others. Generally the legislation is clear, specific to the subject matter and may easily implement by concerned authority. The legislation incorporate also different penalties range from 5.00 birr to 7,000.00 for disobeying this solid waste management act.

3.3.2. The Choice of instrument for solid waste management

Every countries, cities and municipalities need to have reasonable instrument to reduce the problems of solid wastes. With out proper instrument, policy and regulation may have little power for efficient management of solid wastes. David pearce and R. turner (1992) have shown some of instrument, like recycling credits to stimulate increased recycling activity; land fill disposal levy to reduce the amount of waste being land filled; product charge for example packaging tax to discourage over packaging, tax concessions to stimulate recycling and reuse; deposit refund systems to increase the recycling of selected items user charges to discourage the throw away ethic and encourage reuse and recycling.

According to David and R.K Turner (1992) these instrument could used in waste management in order to raise finance and stimulate prescribed behavior. One of the main advantages of these instruments is that they provide a continuous incentive effect which stimulates waste generations to seek out least cost combination of various methods of waste management. For choosing the economic instruments Snigdha Chakrabarti (2003) has shown the optimum condition of recycling which given by the following equation:-

$$P_R + C_D + C_{DE} = C_{SC} + C_R + C_{RE} \dots\dots\dots 3.1$$

Where:-

P_R = Price of recycled material

C_D = Marginal cost of disposal

C_{DE} = Marginal environmental cost of disposal

C_{SC} = Marginal costs separate collection

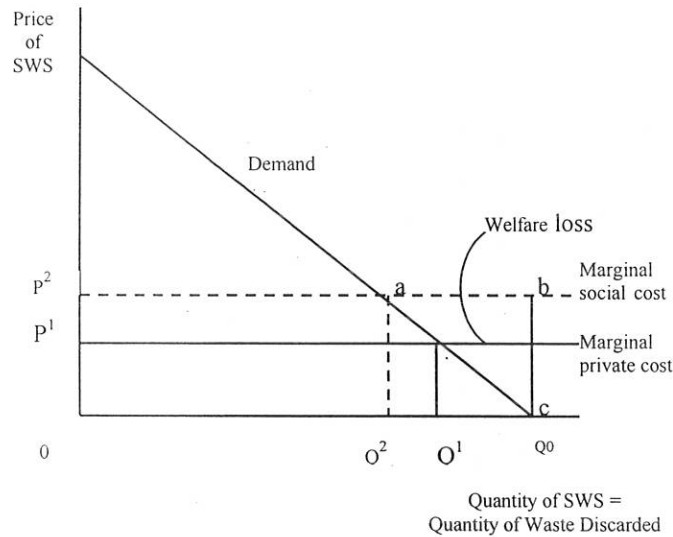
C_R = Marginal financial cost of recycling

C_{RE} = Marginal environmental cost of recycling.

According to Snigdha (2003) the left hand side of this equation is the benefit and the right hand side of the equation is cost of recycling. So, socially desirable recycling is just equal to the marginal and financial cost of disposal. For achieving socially optimal level of recycling the following instruments:-recycling credit, further recycling subsidy, credit and tax or levy on waste disposal need to have introduced. In the Snigdha study the most instrument of solid waste management mentioned in three groups. These groups are unit pricing for garbage collection, virgin material taxes and subsidies finally advance disposal fees and deposit refund system. The writer emphasize the most direct way to internalize the external cost of garbage disposal is to tax each bag of garbage.

From these instruments Eugenia Ma and et al (2004) emphasize the impact of unit price for the reduction of the amount of waste discarded by people. They advocate unit pricing system provides incentives for waste reduction. Based of the system, people may pay less amount of money if they discard small quantity of solid waste. According to the literature because of absence of information, this unit price system of solid waste management has not yet practiced in most developing countries. Based on Eugenia and other studies (2004) in a flat-fee pricing system, house holds will inefficiently generate huge amount on solid waste. This will reflect in the following figure.

Figure 1. The Demand Curve for Residential Solid Waste Services (SWS).



Source: Eugenia Ma and et al (2004)

Here the figure reflects, the demand for SWS, as measured by the quantity of household waste discarded, declines with a price increase in SWS. For economic efficiency, it is not sufficient that only the private cost of SWS is reflected in the price or marginal cost function.

For estimating price, for example P^1 , we should incorporate not only the private cost of SWS, but also the external cost. So, for efficiency or optimality, the price per unit charged to households should reflect the social cost of SWS according to the studies. The triangle abc represents the welfare loss to society under a zero marginal pricing regime. Cost and benefit of the instruments should be analyzed to select the proper and efficient instrument of solid waste management.

CHAPTER FOUR: MODEL SPECIFICATION AND DESCRIPTION OF STUDY VARIABLE AND AREA

4.1. Scope and Limitation of the study

The paper basically deals about household willingness to pay for reliable improved solid waste management program. So, study analysis is limited to demand side information .One limitation of the study derive from the methodology which the study use for valuation of environmental goods. The methodology which this paper used (CVM) has some constraint and biases (we can see the most biases of contingent valuation method in literature review part). Even if this method have some biases and constraints, by its influential outcomes and results for valuation of environmental goods, CVM still chosen by many environmental economists. The other limitation of the study could be time and resource. Due to limited time and resource particularly financial constraint, the sample of the study becomes 230 households from the case study area. But the study believes this sample is representative in general condition for estimation of WTP and other study variables.

4.2. HYPOTHEISS OF THE STUDY

It is hypothesized that the respondent's income, distance to the nearest municipal container education, family size have positively related to house hold willingness to pay for improved solid waste management program. However variables such as, age, housing ownership are negatively related with WTP. Attitude may positive or negative in relation to house hold willingness to pay for improved solid waste management program; if they think some benefit, attitude can have

positive relation with WTP; on the other had if they think no benefit from the program, attitude can have negative relation with WTP.

4.3. Definition and specification of study variables

The provision of improved solid waste management and household willingness to pay for this program may influenced by a number of explanatory variables. For basic econometrics analysis, the study selects the following relevant variables listed and specified in table 4.1.

Table 4.1 Characteristics and definitions of the variables evaluated in the study

VARIABLES	NOTATION	CONCEPT	CHARACTERISTICS
Willingness to pay	WTP	Willingness to pay for proposed improved solid waste management program. It is one if yes and zero if other wise.	Dichotomous
Starting bid	Bid	It is bid provide for households for the provision of new program	Discrete and quantitative
Age of the respondent	Age	Age ranges 18 years and above	Continuous and quantitative
Family size	Familys	It is number of individuals living in household	Continuous and quantitative
Sex of the respondents	SEX	If the respondent is female it is one and zero if is other wise.	Dichotomous

knowledge or experience	EXP	One if household has some knowledge or experience on solid waste management, zero if other wise	Dichotomous
Type of house ownership	HARG2	It is one if household rent house from individual, and zero if other wise.	Dichotomous
Education	HHED	Household head education status	Continuous and quantitative
Income	HDMI	Household monthly income	Continuous and quantitative
Occupation	HHDC1	ONE if household head is self employee, zero if other wise	Dichotomous
Occupation	HHDC	ONE if household head is civil servant, zero if other wise.	Dichotomous
Distance	DIST	Household distance to nearest municipal container.	Continuous and quantitative
quantity	HQSG	Quantity of solid waste household generate per week	Continuous and quantitative
Maximum willingness to pay	MWTP	Household willing to pay at the maximum for proposed program	Continuous and quantitative

Responsibility	RSWM	One if solid waste management is a responsibility public and state, Zero if other wise.	Dichotomous
children	CHIL	Number of children in household below 18 th years.	Continuous and quantitative
Service of boys and girls	FASW	One if boys and girls discard solid waste to the nearest municipal container, zero if other wise	Dichotomous
Household use municipal container	WSDM	One if household discards solid waste to the nearest municipal container, zero if other wise.	Dichotomous

Table 4.1 source own

The above listed variables which are in one way or another expected to influence household willingness to pay for improved solid waste management program. From these variables some variables expected to influence WTP positively while other variables influence WTP to improve solid waste management negatively. Expectation of variables sign rise from some literatures and studies which are similar to this study. These expectations may prove through the study result. Hence, expectations of the study socio economic variables are the following.

AGE

Some studies related to solid waste management reflects age and household willingness to pay for solid waste management has negative relation (Altaf and Deshazo 1996, Othman 2002). These

studies reflects that younger people might be more eager to participate in solid waste management program while elder people may not want to participate in solid waste management program relative to young generation. Based on such type of studies references this study also expected age may has negative sign.

Family size

Some studies (Lex Hemelaar and Maria Muller, F:\markating of waste management services in south countries, htm) suggest that size of households determines the expenditure pattern. On the average large family size has spent relatively huge amount of money for household expenditure. Due to minimize cost of expenditure large family size may inclined to say no for additional external cost, such as costs for improvement of solid waste management program. Study in Pakistan (Altaf and Deshazo 1996) shows family size and household willingness to pay for improved solid waste management program has negative relation. Due to such references this study expected family size has negative sign.

Sex

In most developing countries woman are mostly responsible for household, hence solid waste management consider a responsibility of woman. So we may think that, women are more likely than men to be involved in handling solid waste (A.Woltery de Baat, 2005). For such and other factors this study expected sex may have positive sign (sex is dummy variable where sex is equal to one if respondent is female and zero if other wise).

HARG2

According to some studies the status quo of house property is an indicator for the awareness of the environment (Lex Hemelaar and Maria Muller, F:\markating of waste management services

in south countries.htm). By this indicator, if household head is the owner of the house, he or she may more willing for proposed program relative to the household live in the house paying rent to the owner of the house. Since HARG2 is dummy variable where HARG2 is equal to one if household is rent payer and zero if other wise, the study expected HARG2 may has negative sign.

Monthly income (HDMI)

Income considers the basic explanatory variable in the study. Economic theory reflects that income and quantity demand have positive relation. The income effect in contingent valuation (CV) studies, as defined measures the changes in stated willingness to pay for a proposed good associated with a change in income (Felix Schläpfer 2004). Lack of a positive income effect is commonly interpreted as an indication that respondent may not consider their budget constraint when making hypothetical choices. However in general assumption which is income and household willingness to pay has direct relation, we expect income is a strong determinant of WTP and has positive sign.

HHED (Educational level)

Many authors noted that education (HHED) is needed to improve the success of solid waste management program (James Gray- Donald, [http://www.nistpas.gov.vn/root/data/Nghiencuu/Luanvan/Donald Master Thesis](http://www.nistpas.gov.vn/root/data/Nghiencuu/Luanvan/Donald%20Master%20Thesis)). Educational back ground help household to cooperate for the proposed improved solid waste management program. So, the study expected HHED has positive sign.

Distance (DIST)

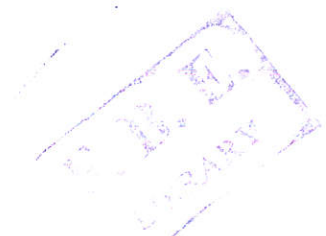
Distance is important variable for decision of household willingness to pay for improved solid waste management program. Household need time to discard its solid waste. If household is too far from municipal container, household may spend significant time. Here, time may consider as money. Based on this proposition, household which live far from municipal container would pay more than household live near municipal container. So, the study expected DIST (distance) has positive sign from the coefficients of household willingness to pay for improved solid waste management program.

HQSG (quantity of solid waste (per kg) that household discard its solid waste per week)

Every household generate small or huge quantity so solid waste per week. Household who generate relatively huge quantity of solid waste may face more problems of storage and disposal of solid waste. This household is more willing to pay for the improvement of solid waste management program relative to household who generate small quantity of solid waste. Due to such facts household who generate huge quantity of solid waste would be more willing than household who generate small quantity of solid waste. So, this paper expected DIST has positive sign.

HHDC1

Self employment and any types of occupations may not have significant effects on household willingness to pay for proposed program. But self employment and any occupation may induce household positively for the proposed improved solid waste management program. Hence, this paper expected HHDC1 (HHDC1 is dummy variable where HHDC1 is equal to one if household



head is self employee and zero if other wise) may has positive sign from the coefficients of household willingness to pay for the proposed program.

CHIL (number of children below 18th year in household)

If number of children increased in one household, the family size became large and quantity of solid waste generated from the household may become increased. If quantity of solid waste is large it may ask household some storage and other facilities. For this fact, household may cooperate to pay for proposed improved solid waste management program to reduce their quantity of solid waste and to take additional advantage. In similar fashion, household who has many children may also cooperate for the proposed program. Study in Pakistan (Altaf and Deshazo, 1996) indicates number of children may have positive sign for the coefficient of household willingness to pay for improved solid waste management program. Hence, this study expected CHIL has positive sign.

EXP

Experience and knowledge on solid waste management could be important factor for household willingness to pay decision. It is generally believed that household who has some experience and knowledge on solid waste management may cooperate for new improved solid waste management program. Knowledge and experience may provide household to know the side effect of solid waste such as negative impacts of this waste on environment and on public health. Since EXP is dummy variable where EXP is equal to one when household has some knowledge or experience and zero if other wise, the study expected EXP may has positive sign due to the above reasoning.

BID

Bid for improved solid waste management program should be reasonable and affordable for service taker households. If bid is high and unaffordable for the majority households, respondents may not cooperate for the proposed program. Many studies shows bid and household willingness to pay goes in different direction. If bid is high, household willingness to pay could be small. If bid is small, household willingness to pay could be high. So, this study expected starting bid might has negative coefficient sign.

FASW (see table 4.1 for interpretation of the variable)

Here the study wants the effects of boys and girls who discard household solid waste of household willingness to pay for proposed program. Pre test indicates that households who use boys and girls to discards their solid waste did not willing to pay relative to other households. Based on this estimation, this study paper expected FASW may show negative sign.

WSDM (See table 4.1 for the interpretation of the variable)

Households who use municipal solid waste service probably know at least the advantage of municipal container relative households who do not use municipal solid waste service. These households expected to participate in this improved solid waste management program. So, the study expected WSDM may show positive sign from the coefficients of household willingness to pay for the proposed program.

4.4. Model Specification

The study basically estimates the value of household willingness to pay for the provision of improved solid waste management program. And also the paper identifies the determinants of household WTP. Here, dependent variable (WTP) will test through selected explanatory variables. As we see in the introductory part for collecting household WTP data I used both single bounded dichotomous choice and open ended CVM format.

Willingness to pay is a categorical variable. For such categorical variable, we basically use either logit or probit model or other similar models to estimate the coefficient of regression models. So, this study choose probit model for testing the probability of household willingness to pay for proposed improved solid waste management program. The probit model in this study framed under Random utility theory. The central themes of Random utility theory reflects that although one person knows his/her utility certainly, it has some components are unobservable from the view of the researcher. As a result, the researcher can only make probability statement about respondent's yes or no responses. In this particular problem respondent's yes or no WTP responses to the proposed new improved solid waste management program.

According the rule, the indirect utility function for j^{th} respondent can be specified as follows:

$$U_{ij} = U_i (Y_j, X_j, \varepsilon_{ij}) \dots\dots\dots 4.1$$

Where $Y_j = j^{\text{th}}$ respondent's (household income)

$i = 1$ denotes the final state and $i = 0$ the statu quo (or the initial state)

$X_j =$ vector of household characteristics and attributes of a given choice.

$\varepsilon_{ij} =$ random component of the given indirect utility.

From this function, the households or consumers accepts the proposed bid only if:

$$U_{1j}(Y_j - B_i^* X_j, \varepsilon_{1j}) > U_{0j}(Y_j, X_j, \varepsilon_{0j}) \dots\dots\dots 4.2$$

Where B_i^* is proposed bid. This condition will meet if a payment or the initial bid B_i^* is introduced due to the changes in measurable attributes. For the above inequality, researcher can only make probability statement of yes or no responses, because the random component of preferences can not be known. According to literature, the probability that the respondent says yes is that probability that respondent thinks that he/she is better off in the proposed program.

For household j, the probability is:

$$P(\text{yes}) = [U_{1j}(y_j - B_i^*, X_j, \varepsilon_{1j}) > U_{0j}(y_j, X_j, \varepsilon_{0j})] \dots\dots\dots 4.3$$

This probability statement provides an intuitive basis to analyze binary responses (Hanemann 1991).

Probit Model

Probit Model is a probability Model. The model can be obtained from a simple latent variable Model. This model can be defines as:-

$$Z_i = B_0 + B'X_i + \varepsilon_i \dots\dots\dots 4.4$$

Where:

- Z_i is unobservable households actual WTP for improved solid waste management service. Z_i is simply a latent variable, what we observe is a dummy variable WTP_i , which is defined as

$$WTP_i = 1 \text{ if } Z_i \geq B_i^* \dots\dots\dots 4.5$$

$$WTP_i = 0 \text{ if } Z_i < B_i^* \dots\dots\dots 4.6$$

B' is vector of parameters of the model

X_i is vector of explanatory variables

ε_i (the error term) and is assumed to have random normal distribution with mean zero and common variance δ^2 (Green, 1993)

B_i^* initial bid

Since the study use single bound CVM format, we need specify this type of format, In the single bounded elicitation format, the j^{th} respondent is asked if she/he would be willing to pay the initial 'bid' , (B_i^*) to get, say a given improvement in environmental quality. The probability of a "yes" response, or a "no" response $P^{\text{Y or N}}(B_i^*)$ can be cast in terms of random utility maximization chosen by the respondents. It is clear from the random utility frame work that the individual, WTP is a random variable from the point of view of the researcher. Thus , while the individual knows his/her own maximum WTP, Z_i to the observer is a random variable with a given cumulative distribution function (cdf) denoted by $G(Z_i, \theta)$ where θ represents the parameters of this distribution ,which are to be estimated on the basis of the responses to the cv survey. After the work of Hanemann(1989) the response probabilities related to the underlying WTP distribution are:

$$P^{\text{Y}} = P\{ \text{yes to } B_i^* \} \equiv P \{ B_i^* \leq Z_i \} = G(B_i^*, \theta) \dots\dots\dots 4.7$$

$$P^{\text{N}} = P \{ \text{no to } B_i^* \} \equiv P \{ B_i^* > Z_i \} = 1 - G(B_i^*, \theta) \dots\dots\dots 4.8$$

The resulting log – likelihood function for the response to a cv survey using single bounded format is

$$\text{Ln } L(\theta) = \sum \{d_i^Y \ln G(B_i^*, \theta) + d_i^N \ln [1 - G(B_i^*, \theta)]\} \dots \dots \dots 4.9$$

Where '1' if the i^{th} response is yes and '0' other wise, and $d_i^N = 1$ if the the i^{th} response is no and 0 other wise. One of the main objectives of estimating empirical WTP model based on the CV survey response is to derive central value (mean) of the WTP distribution (Hanemann, Lomis and Kanninen 1991). Mean WTP (μ) using the model for the single-bounded probit model formally defined as follows:

$$\mu = -\alpha/\beta$$

where α is the constant(or intercept)

β is the coefficient of the bid

Tobit Model

Alternative method to OLS when the dependent variable response is zero for a significant fraction of the observation is the so called Tobit model. The Tobit model is also known as a censored regression model (Greene 1993). In a censored model some samples values are reported at limit value instead of actual values. In this study MWTP (maximum willingness to pay) is a latent variable which is not observed when it is less than or equal to zero but is observed if it is greater than zero. The Tobit model can be described in terms of a latent variable MWTP (Greene 1993, Charlie Hallahan <http://www2.sas>)

$$\text{MWTP}_i = \alpha + B'X_i + \varepsilon_i \text{ if RHS} > 0 \dots \dots \dots 4.10$$

$$= 0 \text{ other wise (i.e., RHS} \leq 0) \dots \dots \dots 4.11$$

The observed variable Y satisfies:

$$Y = \text{MWTP} \text{ if } \text{MWTP} > a$$

$$Y = a \text{ if } \text{MWTP} < a$$

for some limit value a.

Where

MWTP = Maximum willingness to pay

RHS = Right hand side

α = intercept

B' = vector of coefficients

X_i = vector of independent variables

ε_i = Disturbance term which is independently and normally distributed with mean zero and common variance

$$\delta^2 \text{ with } \varepsilon_i \sim N(0, \delta^2)$$

The marginal effect on $E[\text{MWTP}/x]$ is the usual formula for a linear model, but that the marginal effect on the mean of the censored variable Y is a positive multiple β . The marginal effects are:

$$\frac{\partial E[\text{MWTP}^*/\partial x]}{=} \beta$$

and

$$\frac{\partial E[y/x]}{\partial x} = \beta \Phi((\beta'x - a)/\delta).$$

Where Φ = standard normal density function.

center of the sub city, 474110 km² forest, 80 km² area bounded for industry, 20100 km² different service construction have built on, 350 km² used for different purpose of the community, area bounded for different purpose 655 km², area bounded for transport and service 90 km², area bounded for expansion of different service is 9372 km², Area used for road communication is 3675 km².

Concerning population, the city has 398, 896 projected population. From this total sum 195, 459 are female and 203, 437 are male. Yeka sub city is the center of many economical and social activities. In Yeka there are more that 10 small scale manufacturing industries, their capital range from fifty thousands birr up to twenty million birr. In the city we observe different market places, from these places shola market shola “Gebeya”) is the biggest one. In this sub city we can find hotels from small scales up to large standard hotels.

In Yeka sub city from projected household number (79,779) around 4576 household live in kebele or government houses. The city is also a center of education and health. In this city I found around 116 elementary grade, 48 secondary school, one government college and more than ten private colleges. From all private colleges five of them are health colleges. ^{*2}

^{*2}. Yeka economic and social figures collected from Yeka sub city center.

4.6. Solid waste management in Yeka Sub city center

Solid waste in Yeka City center (in Addis Ababa too) should collect, transport and dispose in manner that does not pollute the environment and harm health (Regulation no 13/2004). But in the area we observe inefficient solid waste management system and majority of households do not know the negative outcome of the waste. The study identified some relevant points which will be discussed here.

Although there is no reliable data on the amounts generated in Yeka sub city center, it is roughly estimated that the city administration (Yeka sub city) produces 200³ of solid waste per day. The per capita waste generated on the average is 0.22 kgs which is consistent to the capital city (Damit Walelegne 2003). One family size or household on the average discard 5.84 kilo of solid waste per week. From all kebeles of Yeka sub city center kebele 19 and kebele 08/15 is the kebeles' which generate large amount of solid waste.

The study indicates that only 40 % of the interviewed household has some knowledge or experience about solid waste management. This suggest that majority of households have little information or knowledge about solid waste management. From all interviewed household 42.4% of households use municipal solid waste container and 38.5 % use private solid waste collectors association who give door to door solid waste collection service. The remaining percent of households (19.1%) discard their solid waste around river, road or any open places or burn or land filled their solid waste in their compound. The study observes from result that, the distance between municipal container and each household is too far. It takes 634 meter on the average,

even some household far more than two kilo meter. This point gives us some hint to say there is poor solid waste management in the region.

Solid waste management in Yeka basically divided in to government (Municipal), Private solid waste collector cooperatives, and individual household solid waste management system. In the capital there is one office which manages and controls the activities of each sub city. In Yeka sub city administration also there is one division (solid waste management group) which manages and control solid waste collection and disposal activities.

Municipality city administration gives service for collection and disposal of solid waste. The city administration collects household solid waste through door to door collection service and gives municipal container service. By door to door collection system households living in accessible streets dump their solid waste in the trucks at a specific time in the week. But this system is inaccessible for the majority of households living the region. Municipal container is the major service of municipality of Yeka. Municipal city put different size of container at different places. The number of container is not more than 3 in each kebele. The assumption of these containers is every household drop their solid waste in the container and city administration will lift up to disposal place. But all things related to collection and disposals are not good.

Solid waste management group in Yeka sub city center is poorly organized. Manpower and facilities to collect and manage all solid waste in the region are not enough. There are only five all types solid waste collector cars. All waste collected by municipality and private solid waste collectors are brought to a single land fill at Repi. Of course, all types of solid waste are dumped at Repi land fill site with out any effort of segregation. These all produce inefficient collection

and disposal of solid waste, which bring dissatisfaction to the majority of households. The other way of solid waste collection is collection of solid waste by private solid waste collectors' cooperatives. These private collectors give door to door solid waste collection service to households. Private collectors discard households' solid waste to near by municipal container. From solid waste collectors groups some cooperative discard household solid waste in the rivers. Private collectors receive 10 birr per month per family on the average to give their service. Households also exercise some solid waste management system in their households. Some households collect and segregate their solid waste to burn and landfill their solid wastes. Other households wrongly discard solid waste to near by river, road, and any open places. Majority of these households don not know the consequences of this act.

5. EMPIRICAL FINDINGS: RESULTS AND DISCUSSION

In this part both descriptive and econometric analysis are used to investigate the information obtained from the survey. All result obtained with the help of LIMDEP and STATA econometric soft ware. The study use STATA particularly for descriptive statistics and LIMDEP for main part of econometrics analysis. In data collection activity, sum of 230 households were interviewed. From this total sample only 177 households (76.96%) were analyzed. The remaining 53 (23.04%) are either invalid or incomplete responses.

5.1. Descriptive Statistics

It is generally understood information regarding socio-economic demographic characteristics and attitude of the respondent is important to appreciate their WTP to provide new solid waste management schemes. In this part socio- economic variables, which may have a great influence on WTP for proposed environmental program will be analyze in detail.

According to the survey result, 101 respondents (57.06%) are female and remaining, are male respondents. From these household around 75% .i.e133, households are male headed. The respondent's age ranges from 21 up to 80(see table 5.1). Significant portions of (more than 80%) respondents are active labor force. The mean age is 40 years.

Table 5.1 Households age category

AGE boundary	Freq	percent	cum
21-25	19	10.73	10.73
26-30	37	20.90	31.63
31-35	23	12.99	44.62
36-40	29	16.38	61
41-45	18	10.17	71.17
46-50	16	9.04	80.21
51-55	12	6.78	86.99
56-60	11	6.22	93.21
61-65	4	2.26	95.47
66-70	3	1.7	97.17
71-75	2	1.13	98.3
76-80	3	1.7	100
Total	177	100	

Table 5.1 Source own

Households' family size ranges from one up to thirteen. The mean value of households' family size is five members. Around 90% of households have family size up to eight members (see table 5.2). In the study family size consider a significant variable and expected to influence WTP for proposed program. From the total respondents 125(70.62%) are married and the remaining

29.38% are among divorced, unmarried, widow and others.

Table 5.2 households' family size

FAMILY-SIZE	Freq	Percent	Cum.
1	9	5.09	5.09
2	20	11.3	16.39
3	26	14.69	31.08
4	20	11.3	42.38
5	25	14.12	56.5
6	33	18.64	75.14
7	23	12.99	88.13
8	7	3.95	92.08
9	3	1.69	93.77
10	8	4.52	98.29
11	1	0.57	98.86
12	1	0.57	99.43
13	1	0.57	100
Total	177	100.00	

Table 5.2 Source own

In the case study area individual household income ranges from 105.00 -5000.00 birr. The mean income household is 1117.45 birr. Household's income has generated from different sources. 38.42% of households' income derives from government services, 38.42 % of households income derives from self jobs, while the remaining percent (23.16 of households' income generated from working in private organization and other sources.

House arrangement also has different features. From all respondents 54.24% owned house privately. 14 households (7.91%) rent house from kebele of house agency. The remaining 37.85 % of households rent house from individual of have house by means of different conditions. Respondents education start from 0 level(illiteracy) up to 18th years level of education (maximum level of respondents education is 2nd degree) The mean level of education is 11th grade , this reflect that majority of respondents in the case study area are literate and can read, understand literal academic demonstration.

Table 5.3 Household income distribution

Income	Frequencies	percent	Cum%.
100-500	66	37.29	37.29
501-1000	55	31.07	68.36
1001-1500	18	10.17	78.53
1501-2000	16	9.04	87.57
2001-2500	3	1.69	89.26
2501-3000	10	5.65	94.91
3001-3500	4	2.26	97.17
3501-4000	1	.57	97.74
4001-4500	1	.57	98.31
4501-5000	3	1.69	100
Total	177	100	

Table 5.3 source own

5.2 Households willingness to pay for the provision of improved solid waste management system

To meet the objectives i.e. to get households willingness to pay for the provision of solid waste management single bounded open end CVM question raised to the sampled households. In the study WTP influenced by different socio economic variables, some of these variable highly significant and majority are insignificant. If we take family size, this variable is significant in Probit and insignificant with Tobit model but the variable has negative sign in both models. Age one the other hand is tested as insignificant in both models. Education and income are both significant variables by different significant levels with Tobit model. In Probit model education is insignificant variable while household head income is significant variable with 5% significant level. There are also other variable which will be discussed in next title.

Based on selected socio economic variables effects respondents answer the given single bounded open end CVM questions. From all 177 respondents 148(83.05%) respondents said yes for the participation in new schemes (program). On the same token they are willing to pay some amount money from their income. These people assumed understand the benefit and the outcome of new program and have positive attitude particularly for new solid waste management program. The mean value of maximum willingness to pay is 9.84(9 birr with 85 cents), and some people can afford bid up to 30 birr. On the other hand 25 (14.12%) respondents are unwilling to participate in new program. These people unable to participate in new improved solid waste management program due to a numbers of reasons. Some of respondents saying no because of their income may not afford to pay for this program, other respondents assume this type of program only a concern of the government or city administration, other people saying no due to improper

understanding of solid waste and solid waste management some respondents protest due to think of no positive expectation, others simply protest with out reason.

Based on the result 148 respondents are willing to pay 9.85 birr (predicted max bid) for the provision of new improved solid waste management program. In the case study area there is 398,896^{*3} projected total populations. If we divide this total population with predicted family size, we may predict 79, 779 households in the region. From all over households of Yeka only 83.05% (331283) population or 66256 households are potential payers for the provision of improved solid waste management program.

These potential payers are willing to pay a sum of 652621.6 birr per month and 7,831459.2 birr per annum from their potential monthly income of 74037767.2 birr (household no multiply by predicted monthly income). This figure predicts that potential payers can pay 0.88% of their income for provision of new schemes.

From the share investment cost calculation responsible management consider 652621.6 birr which is the share of households per month for investment and total cost of new solid waste management program. If we assume households share is 50 % of total cost for five year

^{*3} Source Yeka sub city center

investment period, households will pay 7,831,459.2 birr per annum 39,157,296.00 birr for all five years and government and other donor will contribute e this amount too because their share also 50 % of total investment cost. This figure indicates that households or public have great potential for this type of environmental and public interest investment.

5.3. Econometric Analysis

In Model specification part, the study used two selected Models (Probit and Tobit) for analysis of socio economic explanatory variables and estimation for coefficients of the variables. By the help of these two Models two maximum likelihood estimates are made. Probit Model is used to analyze factors affecting a probability of positive willingness to pay for the provision of new solid waste program. Some influential and significant variables which influence the probability positive willingness to pay are identified with the Probit Model. Majority of socio economic variables affect positively or negatively the probability of positive WTP with insignificant degree. Tobit model is used for testing relevant socio economic variables whether they affect positively or negatively the amount of money households are willing to pay for proposed new improved solid waste management program. In this model maximum willingness to pay for proposed program became explained or dependent variable, while other socio economic variables became explanatory or independent variables.

The study did not start estimation through the selected models with out some important tests. The first test was, if the problem of multi-co-linearity exists in socio economic variables. If such kind of problem is entered with out correction our prediction becomes insignificant or even incorrect.

The presence of multi-co-linearity may observe through the help of correlation matrix analysis (Gujarati 2003). If correlation coefficient is 0.8 and above gives us some hint of the presence of multi-co-linearity (see Annex F). So with this test the study identified two variables distance and time up to the nearest municipal container. To reduce this problem the paper dropped time variable from analysis other variables couldn't have such kind of problem.

The other test is the presence of heteroscedasticity problem in the model. Such kind of cross sectional data encountered with heteroscedasticity problem. If the test result shows that the null hypothesis of homoscedasticity is rejected shows that there is the presence of heteroscedasticity problem. In the study the existence of heteroscedasticity problem tested in both Probit and Tobit Models by log-likelihood ratio (LR) test (see Annex A). With log LR test the study found heteroscedasticity problem exist in this data. Of course, heteroscedasticity is a common problem of cross sectional data. To control heterogeneity problem in both model the study use hetro command for estimation of maximum likelihood.

To measure goodness of fit R^2 is not the exact measure for such kind model rather in Tobit and Probit Model we used Likelihood ratio index. Likelihood ratio index tested before the general analysis. Likelihood ratio index results presented in Annex B, with this test the study found Probit model explains about 17.4 % of the variation in explained variable.

5.3.1. Probit Model- Results and Discussion

In Probit model the study analyze the impact of socio economic variables on positive probabilities of willingness to pay for proposed program (provision of improved solid waste

management program). Before analysis, the study considered the following basic assumption of the model(F:\Logit and Probit Models.htm).

- The observations on dependent variable are assumed to have been randomly sampled from the population of interest.
- Dependent variable is caused by associated explanatory variable and explanatory variables determined by influences outside the model.
- There is uncertainty in the relation between dependent variables and explanatory variables as reflected by a scattering of observations around the functional relationship.

Probit results (Probit result presented in table 5.4) show that four socio economic and attitudinal variables were significant at least at 10% level of significant. Significant variables of the Probit results are family size, household income, quantity of solid waste which household discard per week and Bid. The interpretation of each result will be the following.

Age

In the Probit model the variable Age has positive sign. Age has 0.002 marginal effects. But Probit result indicate age is insignificant at 10% level of significant. In addition the sign of the variable is not like the expectation. The result may shows aged people are more willing to pay for the proposed program than young people (other things remain constant). Of course age in the case study area may not consider as factor to affect the probability of household willingness to pay for improved solid waste management program, because age tested as insignificant variable.

Family size

As expected Family size has negative sign. Small family size is more willing than large familysize to say yes for proposed program. Probit result shows that family size has $-.0341^{**}$ marginal effect, which interprets as the increment of one family size reduced the probability of positive willingness to pay by 3.41 percents. More over, family size is a significant variable with five percent degree of significant level. This indicates that family size has a great influential role on positive willingness to pay.

Table 5.4 . Maximum likelihood Estimates With PROBIT model

Variable	Marginal effect	Standard Error	b/St.E	P [Z >z]	Mean of x
Constant	.0422	.1924	.219	.8263	
BID	-.0075*	.0044	-1.695	.0901	11.3277
AGE	.0021	.0025	.844	.3985	40.0452
FAMILYS	-.0341**	.0160	-2.134	.0328	5.0282
SEX	.0619	.0522	1.186	.2356	.5706
HARG2	-.0450	.06	-.750	.4534	.3672
HDMI	.0001**	.0001	1.865	.0622	1117.452
HHDC	.0204	.0633	.323	.7466	.3842
HHED	.0089	.0072	1.233	.2176	11.3898
DIST	-.0001	.0001	-.935	.3500	667.5141
HQSG	.0216**	.0092	2.358	.0184	5.6808
HHDC1	.0284	.0648	.438	.6611	.3842
CHIL	.0216	.0250	.864	.3876	1.6554
EXP	.0871	.0587	1.483	.1380	.3842
WSDM	-.0063	.0557	-.114	.9093	.4294
FASW	-.1082	.0672	-1.610	.1074	.1469
RSWM	.0053	.0620	.085	.9321	.2881

Table 5.4 Source own survey.

Superscript indicates: *** Significant at 1%, ** Significant at 5%, * Significant at 10%

Sex

A Dummy variable Sex equal to one when sex is female, and zero if other wise. Like expectation sex variable has positive sign. This indicates females are more willing than male for improved solid waste management program. Woman in developing countries generally responsible for household management, this may be one reason, for answer why woman more inclined to say yes for this type of program. The result indicates that that when sex is female, the variable has positive marginal effect on probability of positive WTP. The variable has .0619 marginal effects, which interpreted as when sex is a female the probability of positive willingness to pay increase by 6.19percents units. But sex is insignificant variable at least at 10% significant level. This shows sex difference has insignificant role on the probability of positive WTP for improved solid waste management program.

HARG2

This variable is dummy variable where HARG2 is equal to one if household live in the house by paying house rent to the owner's and zero if other wise. Like expectation HARG2 has negative sign and has - 0.045 marginal effects. The marginal effect of the result interpreted, if household pay rent for the house which he or she live in, the probability of positive willingness to pay for the proposed program will reduce by 4.5 percent. But HARG2 is insignificant variable to affect the probability of positive willingness to pay, because the variable tested with 10% significance level.

HDMI (Income of household)

As expectation the variable household income has positive sign. If one household has more income he will cooperate to pay for proposed program. On the contrary, poor people assumed are not willing to pay for new program. Based on the result, HDMI has .00001 marginal effects, which interpreted as when income increased by one unit (birr) the probability of positive WTP will increased by 0.001 percents. In addition Income is significant variable at 5 % significant level. This reflects that income has an immense role for improved solid waste management program.

HHDC

HHDC is dummy variable; it is one if household head is civil servant or zero if it is other wise. Like expectation this variable has positive sign. This sign indicates that, one household is more willing to pay for improved solid waste management program if household head is working in government organization. The marginal effect of this variable is .0204, this result interpreted as, if household head is civil servant the probability of positive willingness to will increase by 2.04 percents. But HHDC is insignificant variable to influence positive WTP, because HHDC is insignificant at 10% significant levels.

HHED (Household head level of education)

As expectation HHED has positive sign. The result indicates that education has positive influence on probability of yes for improved solid waste management program. The more household head is highly educated, the more he or she will say yes to pay for proposed program. The marginal

effect of HHED is 0.0089, which interpreted as when household head education increase by one unit the probability of positive WTP increased by .89 percents. But education is insignificant variable with 10% level of significance.

DIST (Distance to nearest municipal container)

Distance variable has negative sign in Probit result. The result implies, when distance household to nearest municipal container become long the Probability positive willingness to pay for the proposed program will reduced. Sign Probit result is not like expectation. Household who live far from municipal container may not cooperate to pay for such program, or they may dump their solid waste in any open place out of municipal container with out any penalties. Or households who live far from municipal container may not know the side effect of solid waste, which discards with out care. But like most of the variables Distance tested as insignificant variable at 10 % significant level.

HQSG (quantity of solid waste dispose off from household)

As expectation HQSG has positive sign. This reflects quantity of solid waste and the probability of positive willingness to pay go in the same direction. HQSG is significant variable with 5% significant level and has 0.0216 marginal effects. The marginal effect of HQSG interpreted as when quantity of solid waste which discards from household increase by one unit the probability of positive willingness to pay will increase by 2.16 percents. The result indicates that quantity of solid waste which discards from each household has some influential role for testing the probability of household willingness to pay for proposed improved solid waste management program.

HHDC1

HHDC1 is dummy variable where HHDC1 is equal to one when household head is self employee, zero if other wise. Like expectation HHDC1 has positive sign, which reflects, other things remains constant, the more household head become self employee the more he/her is willing to pay for the proposed program. HHDC1 also do not consider the major factor for the probability of household willingness to pay for the proposed program, because HHDC1 tested as insignificant variable with 10% level of significance.

CHIL (Household children below 18th years)

Probit result shows chil variable has positive sign. This results indicates, when number of children in household become large household may say yes to pay for improved solid waste management program. The sign of the Probit result is consistent with the expectation. The marginal effect of Chil is 0.0216 which interpreted as, if household children increase by one probability of positive willingness to pay for the proposed program will increase by 2.16 percent. CHIL tested as insignificant variable with 10% significance level like most of socio economic and attitudinal variables. This indicates number of children has insignificant role for decision of households for improved solid waste management program.

EXP

EXP is dummy variable where EXP is equal to one if a respondent has some experience or knowledge on solid waste management, and equal to zero if other wise. Like expectation Probit result has positive sign. This implies, when household has some knowledge, awareness or any

experience on solid waste management, household may say yes for the proposed program. In the probit result EXP has 0.0871 marginal affect , which interpreted as, when respondents has some knowledge or experience on solid waste management , the probability of positive willingness to pay for the proposed program will increase by 8.71 percents. But like other variables EXP tested as insignificant variable with 10% significance level.

BID

Like expectation Bid has negative sign and has -.0075 marginal effects. This result indicates when bid increase by one unit the probability of positive WTP for improved solid waste management program will decrease by 0.75 percent. More over, Bid tested as significant variable with 10 % significance level. This shows Bid is important variable for the probability positive willingness to pay for improved solid waste management program.

FASW

FASW is dummy variable where FASW equal to one when solid waste from household carried by boys and girls to nearest municipal container, or zero if other wise. As expectation FASW has negative sign. If girls and boys carried solid waste to the nearest municipal container, the result predicts household will not cooperate to pay for the proposed program. The marginal effects of FASW is -0.1082 , which interpreted as , when household use boys and girls to carry solid waste to nearest municipal container the probability of positive willingness to pay for the proposed program will decrease by 10.82 percent. FASW has insignificant role for decision of WTP for proposed improved solid waste management program, because the variable tested as insignificant

at 10% level of significance.

WSDM

WSDM is dummy variable where WSDM is equal to one if household discard their solid waste to the nearest municipal container and zero if other wise. WSDM has negative sign. This sign indicates that, if household use municipal container, he or she not inclined to say yes for proposed improved solid waste management program. But like most of socio economic variables which are tested in this study this variable tested as insignificance variable.

RSWM

This variable is also dummy variable where RSWM is equal to one if household think solid waste management is a responsibility of both government and public and equal to zero if other wise. Household may think solid waste management is a responsibility of either public or government or both. But households, who think solid waste management is only a responsibility of government or only responsibilities of public are insignificant number. On the other hand, households who think solid waste management is a responsibility of both government and public (RSWM) relatively large. RSWM is still insignificant variable to affect the probability of positive willingness to pay for the proposed program, because RSWM tested as insignificant variable with 10% significance level.

5.3.2. Tobit Model Results and Discussions

In Tobit model dependent variable is maximum willingness to pay and explanatory variables are socio economic variables which one way or another affect the household willingness to pay for



proposed new program. Maximum likelihood estimates with Tobit model presented in table 5.5. Like the Probit model some variables are significant and most of the variables are insignificant with major significance levels. The specification of Tobit Model is the following:

$$\text{MWTP}_i = \alpha + B'X_i + \varepsilon_i \quad \text{if RHS} > 0$$

$$= 0 \quad \text{other wise (i.e, RHS} \leq 0)$$

where $\varepsilon \sim N(0, \delta^2)$

MWTP= maximum willingness to pay

B' = coefficient of explanatory variables

X_i = explanatory variables

Based on the study variables the model will have the following form:

$$\text{MWTP}_i = B_0 + B_1(\text{BID}) + B_2(\text{Age}) + B_3(\text{Familys}) + B_4(\text{sex}) + B_5(\text{HARG2}) + B_6(\text{HDMI}) + B_7(\text{HHDC})$$

$$+ B_8(\text{HHED}) + B_9(\text{DIST}) + B_{10}(\text{HQSG}) + B_{11}(\text{HHDC1}) + B_{12}(\text{CHI}) + B_{13}(\text{EXP})$$

$$+ B_{14}(\text{WSDM}) + B_{15}(\text{FASW}) + B_{16}(\text{RSWM}) + \varepsilon_i$$

Table 5.5. Maximum likelihood estimates with Tobit model

Variable	Marginal effect	Standard Error	b/St.Er	P [Z > z]	Mean of X
Constant	2.5761	3.747	.687	.4918	
BID	.0525	.8656	.606	.5444	11.3277
AGE	-.00004	.0463	-.001	.9996	40.0452
FAMILYS	-.4860	.3125	-1.555	.1199	5.0282

SEX	-.6491	1.0109	-.642	.5208	.5706
HARG2	-2.5928**	1.1664	-2.223	.0262	.3672
HDMI	.0026***	.0006	4.781	.0000	1117.4520
HHDC	-.7754	1.2138	-.639	.5229	.3842
HHED	.3383**	.1477	2.291	.0220	11.3899
DIST	-.0005	.0009	-.536	.5922	667.5141
HQSG	.3365**	.1645	2.046	.0408	5.6808
HHDC1	-.2233	1.2732	-.175	.8608	.3842
CHIL	.5005	.4968	1.007	.3138	1.6554
EXP	2.1665**	1.0064	2.153	.0313	.3842
WSDM	-.8435	1.0510	-.803	.4222	.4294
FASW	-.2885	1.4172	-.204	.8387	.1469
RSWM	-.1863	1.0861	-.172	.8638	.2881

Table 5.5 Source own survey,

Superscript indicates: *** Significant at 1%, ** Significant at 5%, * Significant at 10%

With TOBIT model estimation the study identified five significant variables: HARG2, HDMI, HHED, HQSG and EXP. From these significant variables HDMI (household income) is the most significant variable and influence household willingness to pay at most, because this variable tested as significant variables with 1% significance level. Remaining variables are insignificant to influence household willingness to pay in the study area. The interpretation of Tobit model result (see table 5.5) presented here.

Age

Based on Tobit result Age has a positive impact on household willingness to pay for proposed program, because this variable has positive sign from the coefficient household maximum willingness to pay. The sign of this result implies, when respondent age increased respondents are more willing to pay the amount for proposed program. But age is not affect household willingness to pay significantly, because age tested as insignificant variable at 10 % significant level.

FAMILYS (family size)

Based on the result, family size has negative significant impact on household WTP. This variable is not influential for testing household willingness to pay in the study area, because FAMILYS tested as insignificant at 10% significance level. The variable has negative sign which indicates that respondent willingness to pay will increase as household family size decreases and decrease as family size increased.

Sex (see table 4.1 for the interpretation)

Based on Tobit result Sex has negative sign. This result implies that men respondents are more willing to pay relative to female counter parts. But sex different is insignificant role to affect household willingness to pay, because Sex tested as insignificant at least at 10% level of significance.

HARG2 (see table4.1 for the interpretation)

With the reference of Tobit result HARG2 has negative coefficient sign. This variable significantly affects WTP because the variable tested as significant at 5% significance level. The sign of the variable indicates that if a household live in house by renting from individual, maximum willingness to pay for proposed program will reduced (other things remain constant).

HDMI (Income of household)

Income in Tobit Model is very influential and significant variable for estimating maximum willingness to pay for proposed program, because HDMI is tested as significant at 1% level of significance. This is an indication for saying income can influence WTP a lot. The variable has positive sign. The sign indicates that when income of household increase respondent willingness to pay will increase and when income of household decrease respondent willingness to pay will reduce.

HHDC (see table 4.1 for the interpretation)

Based on the result HHDC has negative coefficient sign. This indicates that, if household head working in government organization, respondent will not will to pay for proposed program. The variable is insignificant like other variables.

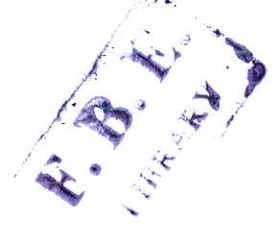
HHED (Respondent education)

Education in Tobit model is very significant explaining factor for household maximum willing to pay. HHED has positive Sign and tested as significant at 5% significance level. The sign of the variable indicates that when respondent education increased /decreased, respondent willing to pay

will maximized/minimized.

DIST (Distance to nearest municipal container)

Here Dist has negative coefficient sign. The result indicates that distance and WTP go in different direction. This relation unexpected, initial bid arrangement, type existing solid waste management, or negative expectation may produce such type of result. Of course, DIST tested as insignificant variable like most of socio economic variables.



HQSG (quantity of solid waste discard from household per week)

As expected, HQSG has positive coefficient sign. This reflects that house hold quantity of solid waste produce positive influence on maximum WTP. The more household discard quantity of sold waste, the more they are willing to pay for the proposed program. In addition HQSG tested as significant variable with 5% level of significance. So, we can say that HQSG has some influential role on household WTP.

HHDC1 (see table 4.1 for the interpretation)

With the reference of Tobit model the variable has negative coefficient sign. The result interpreted as if household head source of income derive from self employee his WTP for proposed program will reduced. Though the variable has negative impact on household willingness, this variable tested as insignificance like most of the variables.

CHIL (number of children below 18th years)

In Tobit Model CHIL has positive sign. This shows when household children increase/ decrease it is expected that willingness to pay will increase/decrease by some amount. But this variable

tested as insignificant variable .

EXP (see table 4.1 for the interpretation)

Based on Tobit result EXP has positive coefficient sign. The result points out that if household has some knowledge or experience on solid waste management he /she is more willing to pay for the proposed program. The variable is significant at 5% significant level, which reflects experience has some impact on household willingness to pay.

BID

Bid has positive sign with Tobit model result. This reflects Bid and maximum willingness to pay goes in the same direction. However, this result is unexpected, bid and maximum willingness to pay should go in different direction based on price and demand theory. Bid in this study consider the price for proposed program. This result may cause by starting bid bias and may also cause by household miscalculation or the result or due to other reasons. But Bid still insignificant impact to affect household maximum willingness to pay, because the variable tested as insignificant variable with 10% level of significance.

WSDM (see table 4.1 for the interpretation)

Some household use municipal services like municipal container and other households do not use municipal container. To test the impact of such condition on household willingness to pay, WSDM tested in Tobit model. In Tobit model result, the variable WSDM has negative sign. This indicates household who use municipal container do not willing to pay for proposed program. This may reflects households who use municipal container may not interested with the service or they may not want to pay more for this program. However, WSDM tested as insignificant like

other most socio economic variables.

FASW (see table 4.1 for the interpretation)

Majority of households use boys, girls, women or men from family member of the household to discard their solid waste. Households who use only girls or only boys or only women or men are very insignificant in number. Household who use both girls and boys are relatively large number. To test the effects of this condition FASW tested in Tobit model. In Tobit result FASW has negative sign. The sign of the coefficient variable indicates that when household use both boys and girls from family member, respondent willingness to pay will reduce relative to household who don't use both girls and boys. Even if the sign of FASW indicate negative sign, the variable has a insignificant impact on household willingness to pay, because FASW tested as insignificant variable with 10% significance level.

RSWM (see table 4.1 for interpretation)

Households thinking of solid waste management could a responsibility of both government (city administration) and public may has an impact on household willingness to pay for proposed program. To test such condition RSWM tested in Tobit model. With Tobit model RSWM has negative sign. The sign of the coefficient indicates that, when household think solid waste management could be a responsibility of both government and public, respondent maximum willingness to pay could reduced or minimized. Still, RSWM tested as insignificant variable with 10% significance level. So, RSWM could not consider the major factors to affect household willingness to pay for proposed program.

In overall analysis from all socio economic variables, household income, household head education, Experience, Quantity of solid waste, types of housing ownership are the most

significant variable to determine household maximum willingness to pay in TOBIT model. While in PROBIT model family size, household income, quantity of sold waste which discard from each household and bid are the most influential variables to determine the probability of positive willing ness to pay.

5.3.3 Revenue analysis from household WTP

From simple arithmetic calculation, the study predict the mean of maximum willingness to pay could be 9.85 , with Tobit model the study estimate conditional mean of maximum willingness to pay at sample point equal to 9.48. Tobit estimation considers the effect of all socio economic variables.

Table 5.6 Revenue at different price of household WTP

Class Boundary WTP (in birr)	MID pt for WTP	SAMPLE DIST		Total no of HHs	Total WTP	Sample HHs WTP at least that amount		Total HHs WTP at least that amount (cumm)	Total revenue
		freq	%			No	%		
(1)	(2)	(3)	(4)	(5)	(6)=2x5	(7)	(8)	(9)	(10)=9x2
0-2	1	31	17.51	13969	13969	177	100	79779	79779
3-5	4	24	13.56	10818	43272	146	82.49	65810	263240
6-8	7	4	2.26	1803	12621	122	68.93	54992	384944
9-11	10	63	35.59	28393	283930	118	66.67	53189	531890
12-14	13	3	1.7	1356	17628	55	31.07	24787	322231
15-17	16	34	19.21	15326	245216	52	29.38	23439	375024
18-20	19	8	4.52	3606	68514	18	10.17	8114	154166
21-23	22	0	0	0	0	10	5.65	4508	99176
24-26	25	8	4.52	3606	90150	10	5.65	4508	112700
30-32	31	2	1.13	902	27962	2	1.13	902	27962

- Table 5.6 source own data

If city administration of Yeka sub city center decide based on optimal bid (optimal bid is the bid which bring higher revenue, See table 5.6) they choose bid 10.00birr. At that level of bid Yeka sub city center can earn birr 531,890.00 per month and 6,382680.00 per year. Table 5.6 indicate that if at least 100% of the population participate for the contribution of bid city administration can get 79,779 .00 revenue from household share for investment of new program. If 82.49 % of household participate city administration can get 263,240.00 birr per month and so on. Optimal bid 10.00 birr which provide 531,890.00 birr revenue per month obtained from only 66.67% of the population. Of course majority of households (28,393) participate in optimal bid category.

If we add additional bid on optimal bid revenues gets from households and households who participate in the proposed program will decrease. On the contrary if we reduce the bid below optimal bid revenue become decrease but households who participate in the program may increase. Here the general demand analysis exercised with the relation of bid and number of households willing to pay that proposed bid.

CHAPTER SIX CONCLUSION RECOMMENDATION AND POLICY IMPLICATION

6.1 CONCLUSION

In general the study mentioned in literature and empirical studies the basic methods for valuing environmental goods. Major environmental valuing techniques are clearly elaborated. From these methods contingent valuation method is the selected model for this type of study. CVM uses survey question to elicit willingness to pay or willingness to accept. So, the study selected CVM method, to elicit WTP for the provision of improved solid waste management program. In conceptual framework part the study described points and theories on solid waste management and problems. Efficient and proper solid waste management can do a lot for economic and environmental and societal benefit of a given city. From the practical experience of yeka sub city center, the study observed poor and inefficient solid waste management system.

In the study, major solid waste problems of developing countries like Ethiopia mentioned briefly. Health hazards of solid waste problems are widely seen in least developing countries even in Addis Ababa majority of children diseases directly or indirectly linked with inefficient solid waste management system. Good and efficient solid waste management techniques and systems are not enough to control solid waste problems, proper policy and practical instruments are necessary important for better result.

With the given problem statement the study use two Model (Probit and Tobit) for estimating household willingness to pay for proposed improved solid waste management program. Probit model is used to estimate basic significant variables for testing the probability of positive household willingness to pay for proposed improved solid waste management program, while Tobit model is used to estimate the determinants of household maximum willingness to pay for proposed program. Income, education, quantity of solid wastes and experiences and knowledge of household on solid waste management and HARG2 (household housing arrangement) are basic determinants of household willingness to pay in the study area. The study concludes that there is a significant relationship among household willingness to pay and these variables. However; age, sex, household nature of work (HHDC and HHDC1), distance and remaining dummy variables: WSDM, FASW, and, RWWM were found to be insignificant variables.

The study also found out that 83.62% of households are willing to pay for proposed improved solid waste management program, while 16.38 % of households says no to pay a small amount of money for the proposed program. Shortage of income and consider solid waste management the concern of the city administration or the government were the major reasons for households to say no or unwilling to pay for proposed program. In general, the result implies that majority of Yeka community is willing to improve existing solid waste management.

6.2. Recommendation and Policy implication

The result of the study indicates that majority of case study area need improved solid waste management program. The study proposed two sub programs: the first sub program is directed to

the frequency of solid waste collection from municipal solid waste container and the distance between household home and container, the second sub program concerns strengthen recycling of solid waste program. Here, in the program many shops which collect recyclable used product from households will be established. These shops gives reasonable amount of money for the return of each used products. This condition motivates the community to store and give their recyclable used products to new shops. In over all effects, solid waste in the community may reduce significantly, since program generate additional income for households and city administration the program may appealing for all parties.

For provision of this program, the study identified basic significant variable with probit and Tobit model estimation. Household income, Family size, bid and Quantity of solid waste which household discard are basic significant variables with Probit model. These four variables have a significant impact for the probability of positive willingness to pay. Quantity of solid of solid waste discards from each household and income has positive impact, while bid and Family size have negative impact on probability of positive willingness to pay. With Tobit model five variables are significant for at least 10 % significant level. City administration or responsible bodies for solid waste management should give due attention to these significant variable for better maximum benefit for proposed program. In Tobit model from the significant variables only HARG2 (household who live in the house by paying rent) has negative sign but the remaining significant variables have positive sign. HARG2 has influential role for household willingness to pay. Household who live in rent house are not willing to pay for the proposed program or they may not pay more for the program. So, city administration should develop at least a sense of ownership for the house which they live to motivate their willingness to pay.

From positive significant variables Income of household highly influential variable with Tobit model. Any strategy or plan to increase the income of household could motivate or strengthen household willingness to pay based on this study result. Like income education of household need expand to strengthen household willingness to pay not only for solid waste management but also for all sector of the economy. Experience or knowledge on solid waste management has some impact for household willingness to pay decisions. If household has some experience, respondent may will to pay more for proposed program. So, households need have some experience or knowledge to control, to manage, to discard their solid waste efficiently and economically. On this regard expansion of education and some advocacy services on solid waste are important. So, city administration should developed purified program to reach households to expand or extend experience and knowledge on solid waste management. The last but not least significant variable in Tobit model is quantity of solid waste has a positive impact on household willingness to pay. If household has a huge quantity of solid waste, household may willing to pay some amount of money. Here, the study should not encourage households to have large quantities of solid waste to induce them to pay more, but the study may encourage household to use their solid waste and reduce the cost of the waste for example be means of compose, solid waste recycling option (which the study indicates in the 2nd sub program) or any other chosen method to manage their solid waste efficiently.

Finally the study selected Yeka sub city center from capital city. Provision improved solid waste management program is a responsibility of all. City administration or state, public, all government and non government organization need participate in the program. If the city

administration open door for public to participate for this program health and environmental problem derives from solid waste will minimized. By doing so households and city administration may generate additional financial and non financial benefit, City become clean and comfortable to live.

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APPENDICES

Annex A. Test of Heteroscedasticity

In both Probit and Tobit estimation heteroscedasticity problem were tested. The method this study used to test heteroscedasticity is Log likelihood ratio test (LR) test. The LR statistics of testing the null hypothesis of homoscedasticity assumption obtained by:

$$\lambda_{LR} = 2[\text{Log } L_u - \text{Log } L_r]; \text{ where}$$

$$\lambda_{LR} = \text{Log likelihood ratio test}$$

$$\text{Log } L_u = \text{the value of unrestricted log-likelihood function}$$

$$\text{Log } L_r = \text{the value of restricted log-likelihood function}$$

λ_{LR} has $\chi^2(n)$ distribution with n degrees of freedom where n is the number of independent restriction. If the data do not support the null hypothesis (homoscedasticity assumption), then the value of the test- statistic became large and null hypothesis is rejected i.e, $\lambda_{LR} > \chi^2(n)$. With Log likelihood ratio test estimation I found the following test.

1st with probit estimation

$$\text{Log } L_u = -64.19655$$

$$\text{Log } L_r = -78.93951$$

$$\begin{aligned} \text{Since } \lambda_{LR} &= 2[\text{Log } L_u - \text{Log } L_r] \\ &= 2[-64.19655 - -78.93951] \\ &= 2[14.74296] \\ &= 29.48592 \end{aligned}$$

λ_{LR} result (29.486) is greater than the critical value of the chi square at 16 degree of freedom at 95% which is 26.3. This comparison indicate we should reject homoscedasticity assumption and accept heteroscedasticity assumption.

2nd with Tobit estimation

$$\text{Log } L_u = -514.1430$$

$$\text{Log } L_r = -547.8888$$

$$\begin{aligned} \text{Since } \lambda_{LR} &= 2[\text{Log } L_u - \text{Log } L_r] \\ &= 2[-514.1430 - (-547.8888)] \\ &= 2[33.7458] \\ &= 67.4916 \end{aligned}$$

With estimation, the critical value of the chi square at 16 degree of freedom is 26.3 at 95% level. Here also the value of λ_{LR} is greater than the critical value then we conclude we reject the null and accept heteroscedasticity assumption.

Annex B. Tests for Goodness of fit

For testing goodness of fit I use likelihood ratio index (Green 2nd edition, 1993) which equivalent to R^2 in conventional OLS regressions model. It is computed using the formula

$$\text{LRI} = 1 - \ln L / \ln L_0$$

Where $\ln L$ is the value of unrestricted log likelihood function and $\ln L_0$ is the value of restricted log likelihood function. LRI is lies between 0 and 1. If it is one implies perfect fit. According to Green values between zero and one have no natural interpretation but as LRI approaches to one may some sign of improvement in goodness of fit, and that LRI increases as fit of the model improves.

Probit estimation

$$LRI = 1 - \ln L / \ln L_0$$

$$\ln L = -64.19655$$

$$\ln L_0 = -78.93951$$

$LRI = 0.187$ this means that the model explains about 18.7 % of the variation in explained variable.

Annex C. A Contingent valuation survey questionnaire

Name of Interviewer.....

Date of interview..... Length of interview..... Minute

Location (kebele).....

INTRODUCTION TO THE RESPONDENT

This survey is being undertaken by a student of Addis Ababa University Faculty of Business and Economics in the Department of Economics. The questionnaire is designed to obtain information on the current situation solid waste in the capital city. The result of questionnaire helps to present research for partial fulfillment for the award of MSC in Economics. Your responses will help to improve solid waste management system of the city and help policy makers to make practical decisions.

The interview will take a few minutes and the answer will be completely confidential and strictly for academic purpose. Your responses will be opinions and there is no correct answer. So, honest discussion is the best way ahead.

PART A- RESPONDENTS ATTITUDE TOWARD SOLID WASTE AND SOLID WASTE MANAGEMENT

1. Do you have prior knowledge or experience concerning any solid waste management

practice? 1. Yes ____ 2. No ____

If you say yes, answer question 2; if you say no jump to question 3.

2. Please mention your prior solid waste management knowledge or experience.

3. What are types of solid waste that come out from your house mostly?

Please order them.

- ____ 1. food, fruits and kitchen waste.
____ 2. Broken glasses, bottles, and aluminum goods.
____ 3. used plastics and papers.
____ 4. used and surplus: medical goods, tablets and packages.
____ 5. other ____ specify ____

4. What is estimated quantity of solid wastes generated from your house per week?

____ Kilo or ____ 'Madaberiya'

5. How do you dispose off your solid waste?

1. We take all solid waste to nearby municipality storage container ('genda') ____
2. We keep all solid waste for private collectors _____
3. We throw all solid waste around river, road and street and in any open
places _____
4. We take some solid waste to nearby municipality container ('genda') and we
dispose remaining solid waste in any open places _____
5. We dig a hole around the house/ in the village and bury or burn it _____
6. We keep some solid wastes for recycling purpose, we take the remaining to

municipality storage container ('genda') _____

7. We keep some solid wastes for solid waste compose, we take the remaining to
municipality storage container ('genda') _____

8. Other _____ specify _____

6. If you used some of your solid waste for recycling purpose please specify types of recyclable
solid wastes.

7. What is your benefit you get from solid waste recycling?

If you dispose off your solid waste in municipal solid waste container answer from
question 8, If not jump to question 13.

8. How do you take your solid waste to municipal container?

1. By daily laborers (by cash) _____ 2. By member of house hold _____
3. By cart _____ 4. By own car _____ 5. Other _____ specify _____

9. If you used daily laborers how much you pay per week? - _____

10. What time it take from your home up to the nearest municipal container?

1. Below 10 min _____ 2. From 10-20 min _____ 3. from 21- 40 min _____
4. From 41- 60 min _____ 5. above 60 minute _____ specify _____

11. If you take your solid waste by members of house hold, who has taken solid waste from the
home up to municipal container?

1. Girls ____ 2. Boys ____ 3. Girls and boys ____ 4. Adult women ____ 5. Adult men ____ 6. Other ____ specify _____

12. By what time frequency, you take your solid waste to municipal container?

1. Daily ____ 2. Two days per week ____ 3. Three days per week ____ 4. Four days per week ____ 5. Five days per week ____ 6. Six days per week ____ 7. One day per week ____ 8. Other ____ specify _____

13. If you keep your solid waste for solid waste collector cooperatives by what frequency they collect solid waste from your home per week?

1. One day per week ____ 2. Two days per week ____ 3. Three days per week ____ 4. Four days per week ____ 5. Five days per week ____ 6. Six days per week ____ 7. Daily ____

14. How much you pay for the service you get from solid waste collector cooperative?

1. 5 birr per month ____ 2. 10 birr per month ____
3. 15 birr per month ____ 4. Other ____ specify _____

15. Are you happy with the service of solid waste collector cooperative?

1. Yes ____ 2. No ____

16. If you answer question 15 'No' what is your reason for your answer?

17. How far it long, from your home up to the nearest municipal container?

1. below 50 meter ____ 2. From 51- 150 meter ____ 3. From 151- 300 meter ____ 4. From 301- 500 meter ____ 5. above 500 meter ____ specify _____

18. Are you happy with municipal solid waste container service ('ghenda')

1. Yes ___ 2. No ___

19. If you answer question 18 'No', what is your reasons for your dissatisfaction?

1. Municipal solid waste container is very far from my home ___

2. Solid waste from container is not collected quickly ___

3. Some solid wastes have dispose of out side the container ___

4. The environment around the municipal container is not clean ___

5. Other ___ specify ___

20. How important do you consider solid waste is part of the economy?

1. Very important ___ 2. Fairly important ___ 3. Fairly unimportant ___

4. Unimportant ___

21. Who do you think should be responsible for efficient and proper solid waste management?

1. Only state or City administration ___ 2. Community ___ 3. Private Investor ___

4. City administration and community ___ 5. Non government organization ___

6. Other ___ specify ___

22. What are your reasons for your choice in Question 21?

23. How do you perceive the problem of solid waste in the city?

1. A series problem ___ 2. A fairly series problem ___

3. Not a very series problem ___ 4. It is not a problem at all ___

5. Other ___ specify ___

24. If you have thrown your solid waste outside municipal solid waste container, please specify

your dump sites.

1. Any place around river ___
2. Any open place outside home ___
3. Any place around streets and roads ___
4. Other ___ specify _____

25. What is your reason for your solid waste dumping in any open place (around river, road etc)?

1. Municipality storage container ('genda') is far from my household. _____
2. Private solid waste collection fee is unaffordable _____
3. I have not had enough money for such expenditure _____
4. I have not have storage place of solid waste _____
5. I consider it as normal and right action _____
6. Other ___ specify _____

26. What other problems do you for proper handling of solid waste by each household?

PART B- WILLINGNESS TO PAY QUESTIONNAIRE

Introduction

Many people, who live in Addis Ababa, think that the current inappropriate handling of solid waste in the capital is causing serious human health and environmental problems. Many people particularly children have victimized by the problem of solid waste. If solid waste is efficiently and properly managed, environment of the region properly will protect manageably, city become clean and comfortable for life, additional job opportunity and income will create. In relation to this topic, assume that the Municipality is planning to provide an improved solid waste management program in your area. . For this new solid waste management improvement program, two sub basics programs have designed:

- By first sub program each house hold on the average can get nearer municipal container within 100- 200 meter. The speed of solid waste collection time can be raise up to 500% on the minimum. In addition to this collection of solid wastes ,municipality of Addis Ababa in dump site separate the decomposable solid waste from the indecomposable ones and making quality compost from the former that can be sold to users at a reasonable price. From the indecomposable wastes those which can be recycled will be recycled and the rest will be land filled.

- The second sub program concerned with solid waste recycling program. By this program many shops established at your site for buying recyclable goods from community. Household sell their broken recyclable goods such as: glasses, bottles, aluminum products; used papers with reasonable price. The shops also return the cost of recyclable package goods (these goods need not have any damage or problems) from households. In general with the formation of these programs: environment can be protected properly; city become clean and comfortable for life, house hold may get additional revenue, many jobs opportunity will be created. However, implementing this program is very costly for the municipality and the users are required to share the cost of running the program by paying a user charge for the service per month.

So, you require paying the share of investment cost for this improved solid waste management program. Your share of payment depends on the volume and quantity of solid waste which you dispose of, from your home. Investment on this program will undertake before you pay for the program. Your payment share is to cover the share of investment cost. This cost divided in to a number of years. Based on the above information, answer the following willingness to pay questions.

27. Are you willing to participate in this program?

1. Yes _____ 2. No _____

If you answer question 27 is yes answer question 28, if you say no jump to question 31.

28. For this solid waste improvement program, do you pay 5/10/15/20 birr per your total solid waste that comes out in a month? 1. Yes _____ 2. No _____

If you answer question 28 is yes or no answer question 29.

29. What do you pay at maximum per your total solid waste that comes out in a month?

30. What type of payment vehicle could be use for this program?

1. Tax per month _____ 2. Service charge per month _____ 3. Other ___ specify _____

31. If you say no for question 27, what is your reason for your unwillingness to participate for this solid waste management improvement program?

1. I consider solid waste management improvement program a concern of state _____

2. I consider existing solid waste management enough for me _____

3. I have not had enough money to for this program _____

4. I do not expect fruitful result from this program _____

5. Other _____ specify _____

SECTION A- RESPNDENT PERSONAL DATA

32. What is your name? _____

33. Name of head of household _____

34. Your address: kebele _____ House no _____

35. Gender (observation) 1=female ___ 2=male ___

36. How old are you? _____

37. Marriage status

1. Married ___ 2. Single ___ 3. Separated ___ 4. Widow _____

5. Widower _____ 6. Other ___ specify _____

38. Are you the head of the house hold?

1. Yes ___ 2. No _____

If you say yes jump to question 41, if you say no answer question 39 and 40.

39. Who lead house hold economically? _____

40. What is your relation with the head of the household? _____

41. How many people live in household including your self?

1. Total _____ 2. Adults (above 18th year) _____

3. Children (below 18th year) _____

42. What is your level of education in number of years? _____ Years.

43. What is the education level of the household head? _____ Years.

44. What is the education level of the most educated member of your household in number of years? _____ Years.

45. How much is your monthly income, in birr _____

46. Main Expenditures of the Household (in Birr):

1. Housing: ___ 2. Food: ___ 3. Energy consumption (Electricity, Diesel,

Charcoal, Firewood, etc.): _____ 4. Phone: ___ 5. Education: _____

6. Health: _____ 7. Other Expenses ('Eder', 'Ekube', etc.): _____ 47. How

long have you been staying in this house (in months)? _____

48. Housing arrangement? 1. Privately Owned _____ 2. Rented from kebele _____

3. Rented from Rental Houses Agency _____ 4. Rented from individuals _____

5. Other _____ specify _____

49. How much income in birr do you estimate your household receives monthly? _____

50. What is source of monthly income who leads house hold economically? 1. Civil

servant _____ 2. Self employee _____ 3. Private Organization employee _____ 4. Other _____

Specify _____

51. Do you have a servant? 1. Yes _____ 2. No _____

52. What is your religion? 1. Orthodox _____ 2. Muslim _____ 3. Protestant _____ 4.

Catholic _____ 5. Jehovah witness _____ 6. Other _____ Specify _____

THANK YOU

Annex D. Maximum likelihood Estimates – PROBIT MODEL

```

| Binomial Probit Model
| Maximum Likelihood Estimates
| Model estimated: Aug 15, 2007 at 10:46:50PM.
| Dependent variable           Y
| Weighting variable           None
| Number of observations       177
| Iterations completed        6
| Log likelihood function      -64.19655
| Restricted log likelihood    -78.93951
| Chi squared                  29.48591
| Degrees of freedom          16
| Prob[ChiSqd > value] =      .2085815E-01
| Hosmer-Lemeshow chi-squared = 13.76903
| P-value= .01715 with deg.fr. = 5

```

Variable	Coefficient	Standard Error	b/St.Er.	P[Z >z]	Mean of X
Constant	.2261768393	1.0294554	.220	.8261	
BID	-.4016348058E-01	.24621364E-01	-1.631	.1028	11.327684
AGE	.1116122046E-01	.13283738E-01	.840	.4008	40.045198
FAMILYS	-.1826061072	.85679282E-01	-2.131	.0331	5.0282486
SEX	.3314057129	.28364092	1.168	.2426	.57062147
HARG2	-.2409940326	.31971548	-.754	.4510	.36723164
HDMI	.3526606315E-03	.19742692E-03	1.786	.0741	1117.4520
HHDC	.1094949352	.33836829	.324	.7462	.38418079
HHED	.4761338121E-01	.38619180E-01	1.233	.2176	11.389831
DIST	-.2133732085E-03	.22468560E-03	-.950	.3423	667.51412
HQSG	.1158517462	.52514862E-01	2.206	.0274	5.6807910
HHDC1	.1522749391	.34766753	.438	.6614	.38418079
CHIL	.1157497560	.13363130	.866	.3864	1.6553672
EXP	.4667711684	.31199094	1.496	.1346	.38418079
WSDM	-.3398148871E-01	.29864537	-.114	.9094	.42937853
FASW	-.5798272903	.35738742	-1.622	.1047	.14689266
RSWM	.2833891989E-01	.33264132	.085	.9321	.28813559

(Note: E+nn or E-nn means multiply by 10 to + or -nn power.)

Matrix: Las
[17,4]

Partial derivatives of $E[y] = F[*]$ with |

| respect to the vector of characteristics. |
 | They are computed at the means of the Xs. |
 | Observations used for means are All Obs. |

Variabl e	Coefficient	Standard Error	B/St.E r	P[Z >z]	Mean of X
Constant	.4221399056E-01	.19241132	.219	.8263	
BID	-.7496173328E-02	.44223713E-02	-1.695	.0901	11.3276
AGE	.2083147224E-02	.24675130E-02	.844	.3985	40.0455
FAMILYS	-.3408188261E-01	.15969390E-01	-2.134	.0328	5.02824
SEX	.6185406817E-01	.52155134E-01	1.186	.2356	.57062
HARG2	-.4497949415E-01	.59990339E-01	-.750	.4534	.36723
HDMI	.6582111862E-04	.35297188E-04	1.865	.0622	1117.4
HHDC	.2043630185E-01	.63250327E-01	.323	.7466	.38418
HHED	.8886634154E-02	.72070305E-02	1.233	.2176	11.389
DIST	-.3982430135E-04	.42612383E-04	-.935	.3500	667.51
HQSG	.2162274677E-01	.91716515E-02	2.358	.0184	5.6807
HHDC1	.2842082710E-01	.64820341E-01	.438	.6611	.38418
CHIL	.2160371117E-01	.25002760E-01	.864	.3876	1.6553
EXP	.8711888342E-01	.58728969E-01	1.483	.1380	.38418
WSDM	-.6342356928E-02	.55690373E-01	-.114	.9093	.42937
FASW	-.1082198506	.67214842E-01	-1.610	.1074	.14689
RSWM	.5289219269E-02	.62049581E-01	.085	.9321	.28813

(Note: E+nn or E-nn means multiply by 10 to + or -nn power.)

```
| Fit Measures for Binomial Choice Model |
| Probit model for variable Y |
+-----+
| Proportions P0= .163842 P1= .836158 |
| N = 177 N0= 29 N1= 148 |
| LogL = -64.19655 LogL0 = -78.9395 |
| Estrella = 1-(L/L0)^(-2L0/n) = .16840 |
+-----+
```

Efron	McFadden	Ben./Lerman
.20338	.18676	.77459
Cramer	Veall/Zim.	Rsqr ML
.18040	.30289	.15345

Information Criteria	Akaike I.C.	Schwarz I.C.
	.91748	216.38765

Frequencies of actual & predicted outcomes
 Predicted outcome has maximum probability.
 Threshold value for predicting Y=1 = .5000

Actual	Predicted		Total
	0	1	
0	4	25	29
1	0	148	148
Total	4	173	177

Annex E. Maximum likelihood Estimates – TOBIT MODEL

Normal exit from iterations. Exit status=0.

```

+-----+
| Limited Dependent Variable Model - CENSORED |
| Maximum Likelihood Estimates                |
| Model estimated: Aug 15, 2007 at 10:54:51PM. |
| Dependent variable                          MWTP |
| Weighting variable                          None |
| Number of observations                       177 |
| Iterations completed                        4 |
| Log likelihood function                     -514.1430 |
| Threshold values for the model:              |
| Lower= .0000 Upper=+infinity                |
| LM test [df] for tobit= 38.891 [ 17]        |
| ANOVA based fit measure = .335667          |
| DECOMP based fit measure = .335096         |
+-----+

```

Variable	Coefficient	Standard Error	b/St.Er.	P[Z >z]	Mean of X
Constant	2.772906920	4.0280576	.688	.4912	
BID	.5648552438E-01	.93155359E-01	.606	.5443	11.327684
AGE	-.2501159312E-04	.49885073E-01	-.001	.9996	40.045198
FAMILY5	-.5231304093	.33666809	-1.554	.1202	5.0282486
SEX	-.6986750943	1.0878799	-.642	.5207	.57062147
HARG2	-2.790916411	1.2556238	-2.223	.0262	.36723164

HDMI	.2845525185E-02	.59445144E-03	4.787	.0000	1117.4520
HHDC	-.8346690557	1.3064388	-.639	.5229	.38418079
HHED	.3641036946	.15897530	2.290	.0220	11.389831
DIST	-.5016528631E-03	.93660903E-03	-.536	.5922	667.51412
HQSG	.3622282109	.17716124	2.045	.0409	5.6807910
HHDC1	-.2403243814	1.3704476	-.175	.8608	.38418079
CHIL	.5387169670	.53487051	1.007	.3138	1.6553672
EXP	2.332024945	1.0838829	2.152	.0314	.38418079
WSDM	-.9079754255	1.1311749	-.803	.4222	.42937853
FASW	-.3104876257	1.5255731	-.204	.8387	.14689266
RSWM	-.2005623600	1.1690524	-.172	.8638	.28813559

Disturbance standard deviation

Sigma 6.325016178 .38427784 16.459 .0000
 (Note: E+nn or E-nn means multiply by 10 to + or -nn power.)

Matrix: Las
 [18,4]

+-----+
 | Partial derivatives of expected val. with |
 | respect to the vector of characteristics. |
 | They are computed at the means of the Xs. |
 | Observations used for means are All Obs. |
 | Conditional Mean at Sample Point 9.4879 |
 | Scale Factor for Marginal Effects .9290 |

Variable	Coefficient	Standard Error	b/St.Er	P[Z >z]	Mean of X
Constant	2.576109142	3.7470879	.687	.4918	
BID	.5247665354E-01	.86560661E-01	.606	.5444	11.327684
AGE	-.2323647910E-04	.46344654E-01	-.001	.9996	40.045198
FAMILYS	-.4860029813	.31253423	-1.555	.1199	5.0282486
SEX	-.6490889704	1.0108788	-.642	.5208	.57062147
HARG2	-2.592840470	1.1664493	-2.223	.0262	.36723164
HDMI	.2643573569E-02	.55295976E-03	4.781	.0000	1117.4520
HHDC	-.7754312161	1.2138244	-.639	.5229	.38418079
HHED	.3382626548	.14763624	2.291	.0220	11.389831
DIST	-.4660497319E-03	.86994870E-03	-.536	.5922	667.51412
HQSG	.3365202773	.16450254	2.046	.0408	5.6807910
HHDC1	-.2232681636	1.2732016	-.175	.8608	.38418079
CHIL	.5004833353	.49683124	1.007	.3138	1.6553672
EXP	2.166517288	1.0064317	2.153	.0313	.38418079
WSDM	-.8435349118	1.0510213	-.803	.4222	.42937853
FASW	-.2884518067	1.4171644	-.204	.8387	.14689266
RSWM	-.1863281185	1.0860791	-.172	.8638	.28813559

Sigma .0000000000(Fixed Parameter).....

(Note: E+nn or E-nn means multiply by 10 to + or -nn power.)

DECLARATION

I, the undersigned, declared that this thesis is my original work and it has never been presented in any university. All sources of materials used for this thesis have been duly acknowledged.

Name: Tesfahun Bekele Ayele

Signature:  _____

Confirmed by advisor: Chakradhara Panda(Dr)

Signature: _____

Place and date of submission: Addis Ababa University, July 2007