HOUSEHOLDS' WILLINGNESS TO PAY FOR IMPROVED SOLID WASTE MANAGEMENT: THE CASE OF ADDIS ABABA

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Abstract

The supply of solid waste management service has always been the major environmental problem for the city of Addis Ababa. The introduction of service charges in the area of solid waste management is getting much attention due to continuous financial shortage of the city government to provide this service at an acceptable level. The pricing of this service is believed to bring efficiency and sustainability in this area.

In line with this, this study was undertaken to examine the extent of solid waste management problem and households' willingness to pay for improved solid waste management services. The contingent valuation method (CVM) is used to analyze households' willingness to pay. For this 430 randomly selected households were used. The probit and tobit models are used for the empirical analysis.

The result shows that 33.98% of households in Addis Ababa are practicing illegal dumping, i.e., disposing solid waste in an open-space, street or in to rivers. Only 54.86% of households are getting solid waste collection services. As a result the vast majority of households (91.02%) are not satisfied with what the city government is doing in this area.

Most households (91.02%) are willing to cooperate with the government in financing solid waste management in order to improve this condition. The mean monthly willingness to pay is Birr 7.07 per household. It shows variation arcos different income group areas with 2.96 Birr /month for low, 7.76 Birr /Month for middle and 13.07 Birr /month for high income areas.

The tobit model shows income, time spent in the area, quantity of waste generated, responsibility of solid waste management, education, house ownership, number of children and age to be significant variables in explaining maximum willingness to pay. While in the probit model income, age, number of children, time spent in the area, quantity of waste generated and education have significant effect on willingness to pay.

The result of this study suggests there is a good chance of success if solid waste collection service charges are introduced. And these charges should take into consideration both ability and willingness to pay.

This research has also identified the need to do research on the feasibility (both technical and economic) of other final disposal methods in addition to landfilling and the nature and volume of solid waste in Addis Ababa.

1.Introduction

1.1 Background

Ethiopia is one of the least developed countries with only 254.8 Birr real GDP per capital in 2000/2001. It has one of the fastest growing populations in the world, which reached 63.5 million in 2000/2001 of which 14.9% was living in urban centers. Life expectancy is very low, being 50.9 years for male and 53.0 years for female (NBE, 2000/2001).

Continuing population growth and urbanization in developing countries is making the provision of urban environmental services very difficult. The most difficult challenge many cities in the developing world are facing today in relation with environmental health service is the proper management of solid waste.

Solid waste management in Addis Ababa had been undertaken by the city council until July 1993 when it was transferred to the Region's Health Bureau. Today refuse management is being undertaken by Environmental Hygiene Department with a special team for solid waste management. This has helped to reduce bureaucracy compared to the previous structure.

The management of solid waste involves storage at the source (primary storage or secondary storage), collection, transportation and final disposal of the refuse. There is no one best method of managing solid waste that can serve best all cities. One has to approach managing solid waste in an innovative manner since selection of the best device and practice at each stage depends on a variety of specific circumstances to the city under consideration. The factors include socio-economic as well as the nature and volume of waste (UNEP, 1987).

Poor solid waste handling is threatening the lives of Addis Ababa residents. To improve this pressing problem the regional government together with all stakeholders has to put maximum effort. The problem is usually inadequate budget compared to solid waste generation in Addis Ababa. In line with this, it is very important and timely to look for the possibility of cost sharing by households, and for this we need to analyze the demand side for improved solid waste management. Therefore, this study is designed to generate demand side information, which is vital for the planning process.

1.2 Solid Waste Management Activities in Addis Ababa

Solid waste is a general term used to describe non-liquid waste materials arising from various consumption and production activities of people. The Addis Ababa Municipality Operational Health Regulation (Legal Notice 1 /1986 E.C) defines it as follows: "Solid waste is anything discarded as public sweepings, food remains, ash, vegetable and grass remains, cigarette buts, paper of various sort, discarded grass, metals, plastics, dead animals and the like that poses environmental health risks." Others define it as any material that is generated in human activities and which is discarded as useless. Thus, there are different definitions given by different authors but for this paper the one given under Legal Notice 1/1986 E.C is used.

Abera (1997) classified solid waste in Addis Ababa based on physical composition as organic matter (kitchen wastes) about 8%, recyclable fraction (leather, glass, metal, textile, paper, rubber, wood, plastics) about 10%, combustible fraction (grass, leaves) 20%, non-combustible 3%, ashes 28% and fines 30% by weight.

The physical components of solid waste in Addis Ababa are similar to that of other developing countries where it is dominated by fines, grass and leaves while solid waste for developed countries are dominated by food, green wastes and paper.

Solid waste generation tends to be an increasing function of income both within a country and across countries. Cointreau (1992) stated waste generation per capital per day in kilogram to be in the range of 0.4-0.6, 0.5-0.9 and 0.7-1.8 for low, middle and higher income countries, respectively.

Abera (1997) calculated per capital per day solid waste generated in Addis Ababa to be 0.50 and 0.55 liters for middle and high income groups, while 0.45 liters can be taken as the daily per capital generation of solid waste for the general population, which is in the range of the developing countries.

The total solid waste generated per day in Addis Ababa is estimated to be 1400.4 m^3 per day (Environmental Hygiene Department, 2001). A large proportion of the waste is left uncollected; as a result it is disposed off in open spaces, in ditches and rivers. Dierig (1999) put the solid waste collection services to be about 50% of the total generation. But the Environmental Hygiene Department (2001) reported 70% service coverage. This figure seems a little bit exaggerated when we look at other estimates, which put it between 55 – 60 %. In any case, the coverage is far from being adequate and acceptable.

In Addis Ababa many households do not have any solid waste receptacle for storing solid waste. Even those who have storage receptacle they are usually inadequate and inappropriate. The

Environmental Hygiene Department has not tried to standardize solid waste receptacle yet. In this respect the private solid waste collectors operating in the city now are supplying their client with plastic bag for primary storage.

In Addis Ababa, there are mainly three types of solid waste collection systems which are door-to- door, block, and communal (transfer station).

Door-to-Door Collection System - this system is used for areas where transfer stations are lacking or not appropriate, and road accessibility is not limited. For this purpose the department uses the side loading and compacting-trucks while private collectors use carts.

In this collection system the disposing people and the truck meet at a defined time of hour during the day. It is the responsibility of the people to bring the waste and transfer it to the truck. Normally each collection point is to get a service of twice a week but in reality many kebeles using this system may not see the truck for more than a week or two. The main reasons for this are insufficient trucks and inefficient use of them and also maintenance problems since many of the trucks are old and many working days are wasted in garage due to lack of quick repair (Abera, 1997).

In 1995/1996 one truck was making 2.3 trips per day (Abera, 1997). The distance of the disposal site from many of the collection points contributes to the inefficiency of this system by making the trucks make lesser trips per day.

Block Collection System - this system involves the provision of large refuse container ranging from 0.1 - 8 m^3 at the premise of the blocked houses or building. When the containers are full, the owner informs the zonal health offices for collection. Both side- loaders and container-lift trucks serve this system and this service is charged at a minimum rate of Birr 11/m^3.

Transfer Station (Container System) - the majority of households in Addis Ababa get collection service through a transfer station which involves refuse containers of 4 – 8^3 located at accessible sites of kebeles. Users of this system are found within a radius of 0.5-1.0 km from the container although the recommended distance is about 150 meters from any point of waste generator. In 1997, one container was serving a population weighted mean of 6,000, although the desirable number is much lower. In 1996/97, 85% of the solid waste collection was covered by this system (Abera, 1997). But recently some kebeles have shifted from this system to door-to-door collection system, because of problems experienced with the container system. One problem with this system is delays in lifting of the containers when they are full and in this case some people do not take their refuse back home when the containers are full, but dispose it under the container. This is not an unusual thing to see in many places of Addis Ababa, and it is causing tremendous health damage to the people of Addis Ababa, especially to those living close to the containers. Because of these some people constantly complained about the containers and in some cases this system is replaced by door-to-door collection- for example in wereda 5, kebele 16. The other problem with this system is with 1.1 m^3 containers that sometimes face the risk of catching fire and also their tires and the metal parts are being stolen by individuals. Households get this service without any direct charges. But businesses pay a minimum service charge based on the 1968 E.C guidelines prepared by the then municipality in relation to the annual business tax.

There are about 78 trucks the department uses to collect and transport the refuse from the source of origin to the final disposal site. According to Abera (1997), the truck work efficiency[1] was estimated to be less than 40% of work truck-days (there are 26 work truck days in a month excluding Sundays) capacity indicating larger proportion of working days are lost due to maintenance problems.

All refuse collected in Addis Ababa has one destination, which is landfilling, in an area found in South-West of the city called "Repi". This landfill is 13 kms from the center of Addis Ababa and is 25 hectares.

The landfilling of refuses follows two-steps, that is, first the refuse is spread and leveled by a bulldozer, and then compacting by steel studded wheel type of compactor follows. At the disposal site some form of informal waste recovery takes place by individuals who collect plastics, rubber, bottles, metals, and combustible materials used for traditional fuel, and hyenas scavenge dead animals.

This landfill is causing serious health and environmental problems to people living close to the site. When the landfill was started in the present area it was with the assumption that it was far away from where people live. But now as the city expanded people are living close to the site and there is even an elementary school in the range of 100m from the site.

[1]Efficiency is calculated by taking the percentage of days the truck is working from work tuck days in a month.

Since the existing landfill has been in use for more than 30 years it is full and the preparation of new landfill sites is very urgent. Already two new sites, one in the East another one in the Western part of the city, are identified but the preparations have not been started on the ground yet. The additional landfills will help improve solid waste collection coverage, since using only one landfill for the whole city has its own effect on the efficiency of waste collection. The longer the route, the smaller the number of fleets and vice versa. Therefore, new and additional sites will help to increase service coverage and reduce operating costs (fuel, oils, grease, etc). This will reduce the expected service charge for waste collection and disposal services.

The department has to look for other disposal methods in addition to landfilling. Abera (1997) put the organic content of refuse in Addis Ababa to be 60%. This means incineration and composting could be feasible disposal methods for solid wastes in Addis Ababa. But detailed studies need to be done on the nature of refuse and the feasibility of each disposal method - both technically and economically. In addition, the city government needs to encourage and advocate the three R's (Reduce, Reuse and Recycle).

The city government has to be ready to accept and encourage the private sector, which is showing interest to participate in solid waste management. Already it has started participating in solid waste management from the low risk area - collecting solid waste from households.

There are 11 private micro-enterprises engaged in solid waste collection services, operating in eight weredas of Addis Ababa. They have created 119 job opportunities and have the capacity of collecting about 204 m^3 each week. They charge a monthly payment of 10-30 Birr, which is usually determined by a kind of bargaining with the household head. But still preparations have

not been completed by the department to enable the private sector increase its participation (Environmental Hygiene Department, 2001).

Bartone (2001) gave three possible reasons why the private sector could be a solution in the area of solid waste management, where there is very low service coverage and inefficiencies. The first reason is that the private sector may offer a means of enhancing efficiency and lowering costs. Secondly, the private sector may be able to mobilize additional funds and lastly the private sector could be well situated to draw international experiences and introduce proven and cost – effective technologies (see: Bartone 2001)

Abera (1997) estimated the cost of solid waste collection and disposal service to be around 21.11 Birr/m^3, and the return to be 1.33 Brr/m^3. This means there is a very large difference between the unit cost and return. This clearly calls for the introduction of service charges for both equity and efficiency reasons. But these service charges should not conflict with the guiding principles of the Conservation Strategy of Addis Ababa, which says, " Every resident of Addis Ababa has the right to live in a healthy environment"

1.3 Statement of the Problem

Waste is an unavoidable consequence of the consumption and production activities of a society. Proper handling of waste is becoming a serious problem of cities all over the world especially in developing countries where financial and technical scarcity is very serious.

Environmental problems in Addis Ababa are results of many contributing factors. These include unplanned construction of houses, uncontrolled location of industries and factories, migration of

people almost from all corners of the country, and most importantly, of course, is the inability of the government to find efficient ways to manage and finance environment needs of the people.

According to UNEP (1987), risks associated with inadequate solid waste management are human health, environmental and aesthetic risks. Human health risks involve disease caused by pathogenic organisms; disease caused by insects, rodent vectors, water and air pollution related diseases. Environmental risks can be land pollution, water pollution and air pollution. Aesthetic risks may arise from improper handling of waste, which may create bad odour, unpleasant vision and litter.

Man's first line of defense against disease is environmental health, i.e., proper management of solid waste, the provision of safe water and proper disposal of human excreta. All these will block and prevent disease causing organisms from entering the human body. But many preventable diseases and deaths are occurring in the developing world. WHO (1992) stated that about 90% of the diseases occurring in developing countries result from sanitary problems.

The health risk from inadequate solid waste management has been felt for long in Addis Ababa. Table 1.1 shows the top ten diseases that are caused through indiscriminate solid waste management in Addis Ababa.

The number of cases for all disease (as shown in Table 1.1) is too many for a city with less than 2.6 million population even compared to cities in developing countries. The real picture can be much worse since many cases in the city are not reported to any formal institution due to the existence of health service giving institutions in the city which do not report to the city

government and the wide spread practice of self treatment and traditional healers in the city. The overall picture calls for a major and urgent change in solid waste management in Addis Ababa.

Table 1.1 Morbidity Report due to Indiscriminate Solid Waste Collection and Disposal from 1990 E.C to 1992 E.C in Addis Ababa (Number of Cases)

	Solid Waste Related Diseases	1990 E.C	1991 E.C	1992 E.C
1	Parasitic infection	57,887	36,827	36,845
2	Bronchitis	38,100	28,849	28,780
3	Skin disease	34,426	27,119	27,047
4	Broncho pneumonia	30,219	25,744	25,158
5	Dysentery	20,782	13,596	14,631
6	Bronchial asthma and allergic conditions	11,607	7,677	6,291
7	All other respiratory diseases	7,932	3,845	7,532
8	Typhoid	6,596	3,622	4,046
9	Influenza	3,593	1,905	1,858
10	Trachoma	1,619	1,015	1,346

Source: Annual Morbidity Report of Addis Ababa from 1990 E.C to 1992 E.C

N.B 1) Data for 1990 E.C include clinics where as data for 1991 E.C and 1992 E.C is for hospitals and health centers only.

2) All other respiratory diseases include common cold, rhinitis, sznositosis.

Diseases related to poor management of solid waste cause losses of lives in the city or reduce the productivity and working days of household members, which in turn reduce their income and increase the probability of job loses. This will have its own impact on the general economic growth of the city and hence the country. Therefore, it is imperative that the government improves environmental amenities and provides clean environment at household level. For any attempt aimed at environmental quality improvement to be successful and sustainable, it has to make use of demand side information. In line with this, this study will provide the required information as to what value households give to any effort the government makes to ensure better

environmental quality. Specifically if and how much households in Addis Ababa are willing to pay for improved solid waste management.

Only few studies in the area of solid waste management are done in Addis Ababa. The first documented study in the area of refuse management was done in 1983 by Nor Consultant - a private consultant company on waste management from Norway. A French mission made the second study in 1986. In 1995, Gordon Sturdy made the third study. Abera Kumi has also made various case studies since 1994. What has been done is very little compared to what should have been done. All the mentioned studies mainly focused on the supply side of solid waste management with little or no reference to the demand side.

Demand side information is what is missing and desperately needed to design an efficient and sustainable solid waste management strategy. The results from this study have policy implications in the provision of sustainable and improved solid waste management in Addis Ababa at household level.

1.4 Objectives of the Study

As mentioned earlier, most studies undertaken in the area of solid waste management in Addis Ababa focused on the supply side, specifically in the capacity of the city government to maintain clean environment. But the prime concern of this study is the generation of demand side information from households who are the major generators and victims of improper handling of solid waste. From the analysis of households' responses about their experience in handling solid waste, their perception and their willingness to pay for improved solid waste management, various conclusions which might have policy implications will be drawn.

Specific objectives of this study are to: -

1) Examine households' handling of solid waste and their perception and attitude to wards solid waste management.
2) Examine if and how much households are willing to pay for improved solid waste management and identify factors that determine it.
3) Calculate aggregate benefits based on the responses to willingness to pay questions.
4) Examine the possibility and extent of cost recovery based on the responses to willingness to pay questions.

1.5 Significance of the Study

The understanding that waste management is becoming a very serious problem in Addis Ababa has motivated this study. Ethiopia is one of the poorest countries in the world and the economy is growing at a very slow rate. As a result of this, budget allocated by the government to provide environmental amenities is always inadequate. Thus, it is high time households contribute to the provision of environmental services such as solid waste management. This is also clearly stated in the Draft Proposal of Solid Waste Management (1994), which put two options for solid waste management in Addis Ababa as long-term strategy. One option is to privatize the service entirely if the conditions for that are satisfied. The second option, if the first fails or mismanagement is observed, is that the government with a special department and with its own revenue through service charges will take over. In both cases, service charge is going to be the source of financing solid waste management.

In Addis Ababa about 2.6 million people live in unplanned and poor housing conditions with 0.15kg per capital per day generation of solid waste and about 55-60% of the waste is left uncollected. This shows that solid waste management is becoming the major source of health, environmental and aesthetic problems to residents of Addis Ababa. To alleviate these problems it is now becoming clear that households (who generate 76% of the total solid waste in Addis Ababa) have to share the cost with the city government and for this we need to examine households' willingness to pay for this service. The information can be used to increase people's welfare by introducing cost recovery by tapping into households' willingness to pay.

1.6 Limitations of the Study

The scope of this study is limited to obtaining demand side information about solid waste management from households in Addis Ababa. The contingent valuation method which this study is going to use, even if it is the best for it measures total economic values and not requiring detailed micro data, it has its own limitations. The hypothetical nature of the questions used in CVM surveys may pose problems since respondents may have little incentive to provide their true willingness to pay. This study could not take more than 430 households due to shortage of financial resource.

2. Literature Review

2.1 Theoretical Literature Review

2.1.1 Theory of Waste Generation and Externality

All gaseous, liquid and solid wastes, which are usually called 'emissions', are the inescapable and "unfortunate" consequences of human activities. If these wastes are not properly dealt with, they can cause tremendous damage to consumers, firms and the nation at large since most wastes have externality effect.

Externality is a situation where one or more of the variables in the consumption function of an individual or production function of a firm fall under the control of another economic agent. Externality can be positive or negative. Positive externality occurs when one economic agent benefits from the action of another economic agent whereas negative externality decreases the utility or production of another economic agent – like disposing solid waste on street or into a river.

Cropper and Oates (1992) characterize pollution as a public "bad" that results from "Waste discharges" associated with the production and consumption of various goods and services. This was explained using utility function of a representative consumer, which is given as:

$$U = U(X, Q) \quad \ldots\ldots (1)$$

Where X = a vector of private goods

Q= level of pollution

In this equation U_X (the derivative of U with respect to X, $\partial U/\partial X$) is assumed to be positive which means a unit increase in X will increase the utility of the consumer while U_Q (the derivative of U with respect to Q, $\partial U/\partial Q$) is assumed to be negative which implies the level of pollution is inversely related to the utility of the individual. The level of pollution (Q) measures, for instance the level of water contamination, bad odour or unpleasant aesthetic view, or in short unclean environment.

In this analysis the production of X and Q are given by:

$$X = X (L, E, Q)\text{……....2}$$

$$Q = Q (E)\text{…… 3}$$

Where L includes a vector of inputs used in the production of X like labor and capital while E stands for the quantity of waste discharges. In this production function X_L (the derivative of X with respect to L, $\partial X/\partial L$) is positive while X_E (the derivative of X with respect to E, $\partial X/\partial E$) and X_Q (the derivative of X with respect to Q, $\partial X/\partial Q$) are negative. Waste emissions (E) is treated as an input determining the level of X. This is because the attempts of emission reduction (abetment activities) by a firm will require the reduction in the level of other inputs employed in the production of X. This means a reduction in E will decrease X. Q also affects the production of X; this is the case when firms (households) are the victims of pollution. For instance, the production of X can decrease as a result of absenteeism of workers due to illness, which comes as a result of unclean environment, or the discharge of untreated waste from a chemical industry can reduce the fishery business somewhere else.

Equation (3) shows emission (E) determining the level of pollution, and, in this model, Q_E (the derivative of Q with respect to E, $\partial Q/\partial E$) is positive. For instance, increased disposal of solid waste in an open space would pollute the environment more (unpleasant odour, insect breeding, etc.), keeping other factors constant.

But victims can defend themselves from pollution by taking various measures like paying for proper management of solid waste. This can be represented as:

$$F= F\ (L, Q) \quad \ldots\ldots (4)$$

This shows the level of pollution to which the individual actually is exposed (F) depends on the level of inputs employed in defensive activities (L) and the level of the pollution itself (Q).

Substituting Eq. 4 into Eq. 1, we have the utility function of the victim as:

$$U= U\ [X, f\ (L, Q)] \quad \ldots\ldots 5$$

From Eq.5 it can be seen that the individual will maximize his/ her utility given the unit prices of X and L and budget constraint. This maximization process will satisfy the first-order conditions for pareto-efficiency which means the individual will allocate his/her limited income between X and L so that the marginal Birr spent yields the same marginal utility whether it is spent on X or L. Therefore, eliciting households' willingness to pay for an improved solid waste management (their willingness to contribute for defensive activities, L) is supported by basic environmental economic theories.

2.1.2 Instruments for Environmental Management

Rapid population growth, financial shortage and institutional problems are the major challenge to urban environmental management of developing nations. Many cities have improved their environmental management by applying various instruments. Instruments for environmental management can be classified based on different characteristics. Luc (1998) classified them into two major categories as effect-directed and source-directed. Effect-directed instruments are aimed at improving the quality of the environment without changing the behavior of the polluters. In other words, these measures are corrective rather than preventive. Some effect-directed instruments are water treatment plants, filters to purify air, noise insulation walls, etc. But source - directed instruments are preventive measures, which are intended to protect the environment by changing the behavior of the polluter. Some of the examples are education, information, agreements (voluntary or imposed), subsidies, taxes, etc. In general, preventive (source-directed) measures are preferred to corrective (effect-directed) measures.

Depending on factors such as the extent of pollution already occurred, the institutional capacity of the regulator, the nature of the ambient, etc., different forms of source directed instruments can be applied. Many environmental (waste) managements have been done using command and control approaches (CAC) that involve direct regulation along with monitoring and enforcement system and the regulatory instruments used were standards, permits and licenses. But these methods have been criticized for being costly and difficult to enforce (Bernstein, 1993).

As alternative to CAC, in recent years economic instruments have received much attention. Winpenny (1998) defines economic instruments (EI) as policy measures that use prices and market mechanisms to induce the desired changes in the behavior of producers and consumers.

Economic instruments, by appealing to the financial self-interest of agents and not to their observance of laws and regulations or their response to exhortation or altruism, are believed to introduce a more flexible and economically efficient measure and also decrease government involvement.

In theory, economic instruments are supposed to bring a desirable result, but, in practice, they do not give a satisfactory result when used alone. As witnessed in many countries, the result of economic instrument depends on an effective system of regulation and monitoring, information, campaigns and exhortation (Bernstein 1993, Winpenny 1998).

In many cities of developed and developing countries, satisfactory results in the area of solid waste management have been recorded using economic instruments with the support of other instruments. Some of the economic instruments used in solid waste management are user charges, waste disposal charges, product charges, deposit refund schemes (DRSs) and subsidies. These economic instruments are explained with some examples as follow.

User charges- in most developed country cities, user charges are considered normal payments, and rarely act as incentives. Usually, households pay a flat rate and it is collected to cover total expenditures, and does not reflect the marginal social costs of environmental effects (Bernstein 1993, Winpenny 1998).

Some cities have introduced solid waste pricing systems that provide continuous incentives for households to reduce waste generation. For instance, a pay per-bag system in towns of New

Jersey and Pennsylvania reduced waste collection by up to 50%, and a variable garbage can rate in Seattle, Washington, waste collection fell by 30% (Bernstein 1993).

In Grenada, the introduction of charge for domestic waste (US $20/ ton) with the help of the World Bank has contributed to raise waste collection services coverage form 50% to 90% in a few years (Sterner, Forthcoming)

Waste Disposal Changes- the rate of payment, in this case, depends on the type of waste and the method of treatment before dumping. In general, in cities using these systems incinerated and composted waste faces a lower rate than landfilled waste.

Only few countries apply waste disposal charges, and the highest unit charge is in Denmark. Some states of the USA also impose disposal charges on some items such as tires and used oil.

Product charges- in many countries a tax is levied on some products to cover the cost of safe disposal of these items. Most product charges on waste are applied to non-returnable containers, lubricant oils, plastic bags, fertilizer, pesticides, tires, car fuels, etc.

Most of these charges are introduced to raise money for environmental improvement, and charge levels are too low to affect users' behavior. There are some success stories, though, in Italy, where the use of plastic shopping bags fell by 20-30% soon after the introduction of a tax (Bernstein 1993).

Deposit Refund Schemes (DRSs)-this involves surcharging the buyer of potentially polluting products, which is refunded (in some cases more than the surcharge) when they return the empties or the product to an approved center for recycling or proper disposal. DRSs are becoming a popular way of encouraging the recycling, reusing or safe disposal of polluting items rather than carelessly throwing away.

Some of the DRSs are introduced by business organizations for their own commercial reason. But there are also countries with mandatory DRSs. Bernstein (1993) stated that ten states in the USA and Denmark have implemented mandatory deposits on soft drinks and beer containers.

DRSs are very successful in many countries. The return rate in Australia and Sweden is 80-90%. The return rates for many countries are less than 60% for plastic bottles and containers- 90-100 % for beer and soft drink containers (Winpenny, 1998). In practice, DRSs appear to be more effective because they reward good behavior.

Subsidies- these are some form of financial assistance given to waste authorities and /or the private sector for various aspects of solid waste management. These instruments take various forms like grants, loans and tax allowances. For instance, in Poland a 20% income tax cut is given for a by-product production that uses wastes as input (Bernstein 1993).

2.1.3 Waste Management Instruments in Addis Ababa

The Ethiopian government has approved the Environmental Policy of Ethiopia in 1997, based on the Rio Earth Summit-1992, which recognizes the need for sustainable development and environmental management. But still environmental management in Addis Ababa is very poor mainly due to lack of environmental instruments-economic, laws, regulations and standards (Dierig 1999).

In Addis Ababa, the city government gives most of the solid waste collection service and the entire transportation and disposal service. The majority of the households get the service of solid waste collection service and disposal without any direct charge. Only those households using the block collection system pay a minimum amount which is 11 Birr /m^3.

Several attempts were made to introduce service charges (sanitation fee) to households in Addis Ababa. It was Nor consult (1982), which raised the need of fee for solid waste management in Addis Ababa first. After that the World Bank (1988,1994,1995), the Regional Government Health Bureau (1995) and Abera (1997) also raised the issue, though it has not been implemented on the ground yet.

Based on Abera (1997) a review of the available sanitation fee proposals for solid waste generator in Addis Ababa are summarized as follows:

Nor Consult (1982)

To establish sanitation fee, the principles used by Nor Consult were:

- All waste generators shall contribute towards the cost of the solid waste management

- The sum of all contributions paid shall correspond to the cost of the system
- The proposed fee shall be linked to the ability to pay.

Based on these principles and relevant data, the household annual sanitation fee was not to exceed 3% of the monthly household rent, and the total expenses (both capital and operational) per collected solid waste is a weighted mean sanitation fee which is paid by the government and public institutes. Commerce and industry pay 125% of this mean; the household generators pay 90% of the weighted mean.

A Workshop Proceeding on the Household Sanitation Fee Appraisal, 1995

This workshop, which was organized by Region 14 Health Bureau, was held in April 1995 to appraise sanitation fee for Solid waste. Based on Abera (1997), the main subjects of the workshop are presented as follows:

The workshop examined the legal background for the sanitation fee. The Legal Notice of 112/1940 E.C stated solid waste collection fee for businesses and households to be a function of their type and grades. But this sanitation fee was replaced by Legal Notice 36 /1968 E.C because of the nationalization of extra houses by the government. In 1968 E.C, the then Addis Ababa Municipality designed a guideline for annual sanitation fee for business according to their business annual tax. This guideline took the license fee as proxy for the generation of waste, i.e., the more the license fee the more solid waste generated, and the more the sanitation fee should be. This was a good move at least in theory since it recognizes the need to give incentive for waste reduction.

Then the workshop used the following criteria to recommend its own sanitation fee:

- All generators should contribute a payment
- All expenditure should equal the total contributions
- The more the waste generated the more the fee
- The average household generates $1m^3$ per year while a low waste generator of an establishment generates 3.16 m^3 per year.
- A 20% payment difference was taken to consider the rate of waste generation across the strata of the business groups.
- The average cost of $1.0m^3$ was 20.0 Birr for the1987 E.C. The cost is considered for the annual fee per year for the middle income household.

Based on these principles the workshop proposed fees for households and businesses as shown in Table 2.1.

Table 2.1 A workshop Proposed Sanitation Fee, 1995

Commercial, Industrial and Service Rendering Establishments	Waste Generation Grading	Fee /Annum
High Generators	1st	268
	2nd	224
	3rd	167
Medium Generators	1st	156
	2nd	130
	3rd	108
Low Generators	1st	90
	2nd	75
	3rd	63
Household Generators	High Income Group	28
	Middle Income Group	20
	Low Income Group	12

Source: Abera (1997)

The workshop, also for the first time, considered the following solid waste generators: Sugarcane trading 1 Birr /quintal, 'teff straw chid' at 0.50 Birr /donkey load, 'bekolo eshet' trading at 1 Birr /quintal; 'shimbra eshet' and 'ketema' at 0.50 Birr /quintal; 'chat' trading 1 Birr/ Kg.

The workshop also proposed mode of payment for the sanitation fee as shown in Table 2.2.

Table 2.2 The Mode of the Sanitation Fee Proposed by the Workshop.

Solid Waste Generator Type	Mode of Payment (fee tied with)
Household	House rent or land use fee
Business	Business license fee
Industrial establishments	License fee
Public establishment	Fee transfer to Finance Bureau and/or
Street Vendors (straw, ketema, chat, shimbra eshat, bekole eshet)	Direct charge

Source: Abera (1997)

Sanitation Fee Proposal by Abera (1997)

Abera (1997) after analyzing household income groups, housing tenure types, house rent paying status and based on the following criteria recommended sanitation fee for households and business establishments. The Criteria were:

- A principle of cross subsidy is involved in the unit fee formulation
- All generators shall contribute
- Public institutes pay the weighted mean unit cost
- Commercial, industrial institutes pay 125 % of the public institutes
- A high cross subsidy, less than 50% is considered for the household.

All households pay 3% or less of their monthly house rents The middle income group is expected to cover the operational cost of collecting and disposing solid waste while the low and high income groups pay 20% and 200% of that of the middle income group, respectively.

Based on the above criteria and other related data and making some assumptions Abera recommended sanitation fee for households and businesses to be as shown in Table 2.3

Table 2.3 Recommended Sanitation Fee for 1996

Types of Refuse Generators	**Unit cost (Birr/m^3)**	**Generation rate (Liter/capital/day)**	**Generation (m^3/Year)**	**Sanitation fee (Birr/Year)**
Commercial/Ind-sustrial	26.38	-	-	-
Public	21.10	-	-	-
Household (Average)	7.86	0.45	0.854	6.71
Low Income	2.3	0.45	0.854	1.97
Middle Income	11.50	0.50	1.023	11.77
High Income	23.0	0.55	1.082	24.89

Source: Abera (1997)

Important improvements have been made as we go from Nor Consult (1982) to Abera (1997). But all proposals seem to be taken away by the principle of "all generators shall pay". Experiences in some cities show that for a satisfactory result in solid waste management the provision of this service should not entirely depend on the ability of the household to pay for this service since there are externalities involved in this service. If one refuses to pay and if he/she is excluded from the service then controlling the activities of the individual will be very expensive if not impossible. This individual will have an incentive to dispose of the waste on the street since the private cost of doing that is lower than the social cost. From this illegal disposal, it is all the

individuals including those who are paying and getting the service that get hurt. Therefore, to improve solid waste management in Addis Ababa, the first step should be the generation of demand side information for solid waste management. The fees charged should be low enough for all people so that no one will have any incentive to dispose waste illegally and this could mean no service charge for some households even though they are generating, if we want to improve solid waste management, and hence increase the welfare of people living in Addis Ababa. After all, the basic principles of environmental management of Addis Ababa declare solid waste management to be a merit good, and every one shall get at least a minimum service no matter what her /his ability or willingness to pay for the service is.

In Addis Ababa, DRSs are playing a very important role in waste minimization. DRSs in Addis Ababa are used for soft drink, beer and some food items in which people pay a surcharge and are re-funded when they return the empties. But this practice is not a result of environmental law, but it is introduced by firms for commercial reasons.

Law and regulations are applied for environmental management in Addis Ababa. Ethiopian Penal and Civil Codes are exercised for activities that harm the environment. For instance Article 3/1 of Legal Notice 1986 E.C, states that it is illegal to dispose refuse in or around prohibited areas, and this could result up to 3 months imprisonment or fines up to 300 Birr in a judicial process, or could be fined up to 100 Birr directly (Legal Notice No 1/1986). But for law and regulations to give results, people need to know that they exist, and the city government has to educate the people about the desirability and how to keep the environment clean.

The private sector has already introduced service charge for solid waste collection from households. It has also started the provision of a plastic bag for solid waste storage and the use of carts to collect the waste from the houses and take it to the transfer station where the waste will be taken for final disposal.

The three R's (Reduce, Reuse and Recycle) should always be part of a well-designed solid waste management. The three R's are almost non-existent in Addis Ababa. Following Public holidays some people collect grasses ('ketema') and 'atela' (residual from a local drink 'tela') to be used as feed for cattle. There are also some people who collect and/or buy broken objects made of clay for recycling purpose. There are also some waste recoveries from the disposal site usually called 'Koshe', which include metal, plastic, some compostable material, etc.

The city government has to embrace and give every possible support to individuals and NGOs, which, in most cases address the poorest part of the community in Addis Ababa, who are usually the victims of environmental problems disproportionately. This is in accordance with the promise given in the draft of Environmental Protection Authority for Implementation of the Environmental Policy of Ethiopia (1998), which states among others, political and popular support to be given for all environmental management activities.

2.1.4 Valuation Methods for Environmental Goods

For market prices to represent the correct value society attaches to the good, markets need to be competitive and work freely. In such cases, prices are taken as an expression of the willingness to pay for the good, which is the total value the buyer, has for the good. But in reality markets are far from being perfect, and even they do not exist for some class of goods. Therefore, to measure

the value people attach to goods, which do not have a perfect market, or any market at all; we need to understand the concept of value.

In the economics literature, the total (economic) value people attach to an environmental good is divided into two groups - use value and non-use value. Use value refers to the benefit people get by making actual use of the good now or in the future. Use value is divided into direct use value, indirect use value and option value. Living in a clean environment is a direct use derived from a better waste management and prevention of some diseases, because of better waste management is the indirect use. The option value is the future (expected) benefit the individual gets form living in a clean city in the future.

Non-use value is divided into existence and bequest value. According to Krutilla (1967), existence value is the value people attach to environmental service not because they want to use the resource now or in the future, but because they just want to make sure the resource exists. Bequest value can be use or non-use value that one expects his/her descendents to get from the environmental amenity or service (Kartman 1997).

Environmental valuation techniques help to estimate the value people attach to environmental amenity or services, i.e., how much better or worse off individuals are or would be as a result of a change in environmental quality. Since there are no existing markets for environmental goods, people's valuation for these kinds of goods will have to be derived from "hidden" or implicit markets by looking at the consumption of related private gods (Hedonic Pricing Methods, Travel Cost Methods, etc,) or by constructing artificial markets where people are asked to reveal their preferences (Contingent Valuation Method).

The valuation method this study is going to use is the CVM. One reason for using CVM is its superiority over other valuation methods, which is its ability to capture, both use and non-use values. Using other valuation methods like Hedonic pricing and travel cost method will underestimate the benefits people get form improved solid waste management since they measure use values only. As Freeman (1993) noted non-use values could be larger in some cases, and, in these cases, using methods, which do not capture non-use values, will underestimate the total value.

The other reason for using CVM is its ease of data collection and requirement compared to other valuation methods. For instance, hedonic pricing method requires detailed micro data about the prices of houses and house characteristics, which are very difficult to get in Addis Ababa. One top of that hedonic pricing method and the travel cost method are not relevant for measuring willingness to pay for improved solid waste management.

Therefore, CVM is the best valuation method available for measuring the total value people give for improved solid waste management in Addis Ababa.

2.1.5 Contingent Valuation Method (CVM)

2.1.5.1 Review of CVM

CVM is an environmental valuation method, which uses an artificial market to measure consumer preferences by directly asking their willingness to pay or willingness to accept for change in the level of environmental good or service.

If correctly applied, CVM will enable researchers capture the total value of the good- both use and non-use values and its flexibility facilitate valuation of a wide range of non-market goods. As a result, CVM is becoming the most preferred valuation method at present (Mitchell and Carson 1989).

In most CVM applications the major steps are the following

- Designing and administering the CV survey
- Analysis of the responses
- Estimating and aggregating benefits (WTP and / Or WTA) and the total revenue
- Evaluating the CVM exercise (Validation Tests)

Designing and administering the CV survey is a very critical step to obtain satisfactory results from CV surveys. The question and the description of the hypothetical market should be put in such a way that they are easy to be understood fully by the respondent so that biases in the survey can be minimized. One way of minimizing biases in CVM exercise is to undertake pilot survey that also helps to generate starting values, if bidding game or closed- encoded elicitation techniques are to be used in the main survey.

Contingent valuation survey covers three basic parts (Mitchell and Carson 1989). First, a hypothetical description of the condition under which the good or service is to be offered as presented to the respondent. Second, questions which elicit the respondents' willingness to pay for the goods being valued is presented. Thirdly, questions on socio-economic, demographic characteristics and their use of the good or service under consideration are given to the respondents.

The analysis exercise involves the calculation of frequency distribution, as well as cross tabulations of willingness to pay figures with socio – economic and demographic data and other variables and also the estimation of bid function.

Aggregating benefits involves summing up the total willingness to pay for the environmental good for the whole population under consideration in order to get the total value of the good.

Evaluating the CVM exercise involves under taking reliability and validity test, which determines whether the CVM results are acceptable, or not. There are different elicitation methods (formats) to be used in a CVM application. These include open–ended, closed- ended (take-it or leave–it), iterative–bidding (bidding game), payment card and closed- ended with a follow up (binary with a follow up).

Open-Ended Format- simply asks the respondent what maximum price he/she is willing to pay for the given environmental good. This method has the advantage of avoiding starting point biases. But it is characterized by large number of non-responses and protest zero. Mitchell and Carson (1989) argue this is due to difficulty respondents face to pick a value out of the air without some form of assistance.

Closed–Ended Formant - this technique, which is also called a dichotomous choice question format, simply asks if the respondent is willing to pay a specified amount of money for the proposed change. This method has the advantage of being familiar with respondents like in real world markets where buyers face posted prices so it is easier for buyers to answer. But, this

method suffers from a number of shortcomings. One of which is starting value biases. This method gives limited information on benefits and hence suffers from efficiency. Moreover, large sample is required for estimation of benefits, because maximum willingness to pay is not obtained directly from this method.

Bidding Game Format– this method starts by asking respondents whether they accept a given price for the good and higher or lower prices will be offered depending on the answer given to the initial prices. If the answer to the initial price is yes, higher price will be offered, and this will continue until the yes answer is changed to no and the process is reversed, if the respondent rejects the initial price.

This method is better than closed ended format as far as efficiency is concerned, that is, there is higher probability that respondents give their actual maximum willingness to pay. But it suffers from starting point biases and may be boring to respondents. Moreover, respondents may give answers only to avoid additional questions.

Payment Card- this method uses cards which contain a large array of possible willingness to pay amounts and the respondent will be asked to pick a price from the cards. This method is better than open–ended format in the sense that it could be simpler to respondents, hence larger proportion of response could be obtained. But this method requires the respondent to be literate, and this makes it of little use in countries like Ethiopia where a large proportion of the population is illiterate.

Closed- Ended With a Follow Up-this method starts with a closed-ended question, but to increase efficiency an open–ended follow up question is added in which the respondent gives his/her actual maximum willingness to pay. This method, like the bidding game, suffers from a starting point bias. It is more familiar to people living in Addis Ababa where a seller gives an initial price and if buyers are not willing to take the good at that price. Then the seller encourages the buyer to name a price. Compared to bidding game, this technique is easier for both the interviewer and respondents. This study is going to use this method to elicit willingness to pay.

2.1.5.2 Critiques on CVM

One of the main criticisms on CVM relates to the fact that many people have little experience in making explicit decision on the value of the environmental good. Therefore, some people have difficulties to accept results obtained through CVM as true willingness to pay which will be revealed if the good valued were to be supplied in reality. But many studies have shown that CVM can give a reliable result if applied correctly and carefully (see Onwnujekwe 2001).

Another criticism relates to a large difference between willingness to accept and willingness to pay for the same good. Various explanations have been given for this difference but the most dominant one is by Hanemann (1991) who related this difference directly to income elasticity of demand for environmental goods and inversely to the elasticity of substitution between environmental and other goods. Hanemann argued the substitution between environmental and other goods is very small resulting a higher willingness to accept than willingness to pay for environmental goods. Loss aversion, giving up the property right in case of willingness to accept and the fact that willingness to pay is constrained by income while willingness to accept is not are additional explications given for the difference.

CVM is also criticized for being susceptible to some biases some of which are explained below:

Starting point bias–occurs when the respondent's willingness to pay is influenced by the initial value suggested. This problem is encountered when the elicitation format involves starting values.

Boyle et al (1985) give three possible sources for staring point biases. First, starting point bias may arise if the good being valued is not well defined or when the respondents do not well perceive the good clearly. Secondly, if the bidding game is used and the starting value is significantly different from the respondent's actual willingness to pay, the respondent may get bored with the process, and stop the bid before her/his real willingness to pay is reached. Thirdly, the respondent may think the true value for the service to be around the staring point (Kartman 1997).

Compliance bias–occurs when the interviewer is leading the respondent towards the answer he/she is expecting. Compliance bias can also come because of the sponsor of the good being valued. This bias can be reduced by carefully designing the survey, good training of the interviewers and good supervision of the main survey (Mitchell and Carson 1989).

Strategic bias –arises when the respondents expect something out of the result of the study and report not their real WTP/WTA but something which they think will affect the research outcome in favor of them. Respondents may tend to understate their true willingness to pay if they think they have to pay their reported willingness to pay, but their response will not affect the supply of

the good. But if they think they will not pay their reported willingness to pay and if they want the good to be supplied they overstate their WTP for the good (Mitchell and Carson 1989). To reduce this bias, giving detailed description of the good being valued will help.

Hypothetical bias- inherent in CVM is its hypothetical nature. If respondents are not familiar with the scenario presented, their response cannot be taken as their real willingness to pay. This bias can be minimized by a careful description of the good under consideration for the respondents.

Part–whole bias - occurs when the respondent fails to distinguish between the part of the good being evaluated and the total group of the goods into which that part falls (See Vredin 1997).

Despite all these and other shortcomings, CVM is still the best valuation method available for elicitation of households willingness to pay for improved solid waste management and many of the biases can be minimized by a careful designing of the survey, proper training of the interviewer, conducting pilot survey and monitoring and supervision of the main survey.

2.1. 5.3 Derivation of Welfare Measures for Improved Solid Waste Management

The relevant measures for quality changes as in case of improving solid waste management are Compensating Surplus (CS) and Equivalent Surplus (ES).

To derive these welfare measures, we follow Freeman (1993), and consider a utility maximization problem [Max U= U (X, Q)] subjected to a budget constraint. Where X is a vector of quantity for market goods and Q is the status of a non-market environmental good like solid

waste management. The solution to this problem will be a set of Marshalian (uncompensated) demand and the indirect utility function, V (P, Q, Y) where P is a vector of market prices for market good X and Y is the level of income for the individual.

Let us say there are two possibilities for Q. Q^o is the initial level of Q while Q^1 is the new (improved) level of Q, which is expected to improve the welfare of the individual. Then compensating surplus (CS) will be defined as:

$$V (P, Q^1, Y- CS) = V (P, Q^0, Y)=U^0$$

And equivalent surplus (ES) will be:

$$V (P, Q^0, Y+ES)= V (P, Q^1, Y)= U^1$$

The welfare measures of CS and ES can also be represented as the integral of the Hecksian (compensated) demand curves. This is done by taking the dual of the maximization problem. The first order condition of this minimization problem gives the Hecksian (compensated) demand function as:

$$\bar{X} = (P, Q, \bar{U})$$

Then the indirect expenditure function can be obtained as:

$$e(P, Q, \bar{U}) = P.X(P,Q, \bar{U})$$

CS and ES can be defined as:-

$$CS=e(P, Q^0, U^0) - e(P, Q^1, U^0)$$

$$ES=e(P, Q^0, U^1)- e(P, Q^1, U^1)$$

And in terms of the area under the Hecksian demand curves, CS and ES are given as follows

$$CS = \int_{Q_0^0}^{Q_1^0} \bar{X}\,(P, Q^0, U^0)\,dQ$$

and

$$ES = \int_{Q_0^1}^{Q_1^1} \bar{X}\,(P, Q^1, U^1)\,dQ$$

In the absence of property rights, willingness to pay refers to the maximum amount of money an individual is willing to give up in order to secure a welfare improvement or to prevent a welfare decline. Then willingness to pay will be given by CS. That is,

$$WTP = CS = e(p, Q^0, U^{0}) - e(P, Q^1, U^0) = \int_{Q_0^0}^{Q_1^0} \bar{X}\,(P, Q^0, U^0)\,dQ$$

But, if the individual has property rights over the good, then willingness to accept compensation refers to the minimum amount of money the individual is willing to accept for forgoing welfare improvement or welfare deterioration. Then willingness to accept will be given by ES. That is,

$$WTA = ES = e(P, Q^0, U^1) - e(P, Q^1, U^{1}) = \int_{Q_0^1}^{Q_1^1} \bar{X}\,(P, Q^1, U^1)\,dQ$$

As noted earlier, CVM can measure both willingness to accept and willingness to pay. But in this study, we measure willingness to pay, since in general willingness to accept is used in case of deprivation while willingness to pay, is used for cases which improve the current state, and the issue here is improving solid waste management in Addis Ababa. Therefore, our reference utility level is U^0 (the existing utility level, Freeman 1993) and households responses to the willingness to pay questions will directly give us Compensating Surplus (CS) which is an estimate of total value households in Addis Ababa give to the proposed improved solid waste management.

2.2 Empirical Literature Review

A number of empirical studies in the area of environmental and public goods have used the contingent valuation method and reliable results have been found. In Ethiopia, too, some researches undertaken using this method have shown CVM to be an important instrument.

Vredin (1997) used CVM mail survey with an open-ended format to elicit Swedish households' willingness to pay for the preservation of the African Elephant (Coxodota African). A random sample of 1500 individuals were drawn and some methodological aspect of CVM, i.e., time–horizon and payment vehicles were also addressed. The result show that household income and the dummy variable indicating the respondent's preference about the herd of Africa elephants to increase in the future are significant at 5% level. In addition the results do not show any significant difference between the different time-horizon of payment obligation. That is, annual payment obligation for three years and an equivalent commitment for ten years do not show significant difference. The payment vehicles of tax and voluntary payment also do not show any significance difference.

The researcher also observed some symbolic and part–whole biases, that is, the respondents willingness to pay is biased upward since they value something more inclusive and larger than intended. To examine the existence of the part-whole, the question given to the respondents was, "What do you think of when you hear the word 'African elephant?" Some of the answers given to this question include explanations about ivory and poaching, safaris, zoos and some about savannah. This shows some respondents were valuing more than the intended good – the African Elephant.

This research also shows mail surveys might not be appropriate for CV survey, even for developed nations like Sweden. Some of the problems with mail surveys are the response rate (the proportion of questioner that were returned partially or completely answered to the total questioner dispersed) was 60.2%, additional explanations could not be given if needed, fixed sequence might have not been followed which might have affected the outcome of the result.

Rogat (1998) used CVM to elicit willingness to pay of people in Santiago, Chile, for a 50% reduction in the level of emissions caused by the transport sector. For this purpose, one thousand households were interviewed – half of which were interviewed in the summer season and the rest in winter. The Tobit results show that willingness to pay for the reduction in emission was found to be affected by income, education, car ownership and degree of concern about future generation. Factors such as gender, age and whether individuals suffer from pollution- related diseases or not had lesser influence on the willingness to pay amount. In this study the total willingness to pay was found to be different when respondents were asked for a monthly payment and when they were asked for lump sum payment.

Kartman (1997) addressed some methodological issues in CVM by applying it in the area of health. He measured willingness to pay for reduction in Angina Pectores attacks- WTP for a more effective drug. For this, a sample of 402 Swedish Angens Pectores patients was interviewed by telephone with bidding game with open-ended format.

Logistic regression and linear regression analysis were run for binary and bidding game questions, respectively. In both analyses, the bid (the initial value) and income were significant at 1% level. For both formats, linear and log- linear specifications were given. Based on

McFadden's R^2 and the percentage of correctly predicted responses, the log-linear specification fits the binary data best while the linear specification was best fit for the bidding game data.

Kartman (1997) also examined some methodological issues in CVM. For this he used the valuation of 400 Swedish patients diagnosed as having reflux Oesophagitis to address scope and question order effects on the outcome of CVM exercises. In the logistic regression analysis of the binary question data, CVM was proved to be sensitive to changes in scope, that is, the WTP was significantly and positively affected by the probability of being free from symptoms increase and as a risk of having a relapse once recovered is decreased. In short, the WTP in this study was found to be significantly affected by the size of the health gain valued. But question order effect in this study was insignificant.

The responses given to the open-ended with follow-up question in the WTP for reflux oesophagitis here used to investigate whether there was a scope effect in the open-ended follow-up and to test for the presence of starting point bias. The result showed the absence of significant scope effect and starting point biases.

Other methodological issues were tested by Onwujekwe (2000) in Nigeria. He compared the theoretical and predictive validity of the binary with follow-up format and the bidding game format, using the stated and revealed willingness to pay for insecticide – treated nets in two rural communities in Enugu state. A pre- tested interviewer–administered questionnaire with each elicitation format was applied in one of the two communities. In Orba community which received binary with follow up elicitation format, the adjusted R^2 was 17.7%, and sex and expenditure on school fees were significant at 1% while education and presence of malaria in the household were

significant at 5% level. In Mbano community where the bidding game format was used, the adjusted R^2 was 19.4% and sex and age were significant at 1% while the number of people living in the household was significant at 5.6%.

In this analysis, income was not included as explanatory variable because many households refused to state their income. Though it was not significant, the mean and median willingness to pay values for Mbano were higher where the bidding game format was used. The author stated this difference could be due to the higher income in Mbano community where the bidding game was used.

To evaluate the predictive validity of the two formats, the nets were offered to both communities shortly after the elicitation of their willingness to pay. The result showed that the bidding game predicted 85% of the responses correctly, while the binary with follow up predicted 75% correctly. But the chi-square analysis did not show statistical significance difference in values between the two communities at 5% level of significance. Onwujekwe concluded by emphasizing the need for the development of an endogenous willingness to pay elicitation technique, which is more similar to normal markets in rural Nigeria.

Alta and Deshazo (1996) disproved the conventional presumption that households give low priority to solid waste management compared to other urban service and they are unwilling to pay for it. Using the bidding game format they concluded that 82% of the households were interested in the improved solid waste services and 80% were willing to pay. Out of those households who are interested in the service but are unwilling to pay anything for it, 84% said it is the responsibility of the government to give that kind of services. Out of the total households who

said they are not interested in the service (18% of the total) 62% said that it was the government's responsibility to collect and dispose solid waste while 29% said that they were satisfied with the existing services. The OLS results showed that WTP for solid waste management in Gujarwala is positively and significantly correlated with disposable income, education and property indicating that waste management is a normal economic good. The mean willingness to pay was found to be Rs. 9.80 per month, indicating a prospect for cost recovery.

Alemu (2000) used CVM to examine whether rural households of Ethiopia are willing to pay for community forestry or not. The data for this study was collected in 1996 using binary with open-ended follow up formats. He showed CVM could be used to value environmental good even in rural Ethiopia. In the questioner, households were given the chance to contribute money or labor to the proposed plantation. This is due to liquidity problems rural people have which helped to make the survey more realistic.

The Tobit regression showed that income, household size, distance of homestead to plantation, number of trees owned and sex of household head are found to be significant variables explaining willingness to pay for community forestry in rural Ethiopia.

Tseghabirhan (1999) made another application of CVM in rural Ethiopia. He used an open-ended format to elicit willingness to pay for irrigation water in Tigray region from a sample of 82 randomly selected households. The regression results showed that credit (1%) and education (5%) are significant while age, experience in operation and management of irrigated farming and cultivated area are not significant. The research also pointed out that if irrigation water charges

are to be implemented–they should be based on socio-economic and technological factors in the area, rather than making it flat.

The reviewed literature indicates that CVM can be used in different areas when market prices are missing and CVM is a better environmental valuation method, for it can capture both use and non-uses values. These literature have helped for this research to identify the potential socio-economic, demographic and factors related to the good under consideration that could help to explain willingness to pay.

3. Methodology

3.1 Definition of Variables and Hypothesis

Like any other environmental and public goods, the willingness to pay amount and whether households are willing to pay or not for an improved solid waste management is expected to be affected by various factors. Some of these factors with their expected signs are defined as follows.

IHH (Monthly Income of the Household) - this variable refers to the monthly money income of the household in terms of Birr. It includes the income of the head and all other members of the household from all sources. There is a general agreement in environmental economics literature on the positive relationship between income and demand for improvement in environmental quality. Therefore, we expect income to affect willingness to pay and its amount positively and significantly.

SR (Sex of Respondents)-this is a dummy variable taking 1 if the respondent is male; 0 otherwise. This study expects female respondents to be more willing to pay than men, since traditionally it is the role of women to clean the house and dispose the waste.

AR (Age of Respondents)-this refers to the age of the respondent and it is expected to affect willingness to pay negatively. This is because old people may consider waste collection, as government's responsibility and could be less willing to pay for it. While the younger generation might be more familiar with cost sharing like for education, health, etc and could be more willing to pay.

ER (Education of Respondent)-this variable is taken to capture the level of understanding of the respondent about the desirability of proper management of solid waste. It is hypothesized that the higher the level of education the more the respondent would understand the consequence of mishandling solid waste and the more the value the individual would given in order to avoid the risk of being a victim of unclean environment. **ERPD** is a dummy variable taking 1 if the respondent has attended primary educations; 0 otherwise. ERSD is a dummy variable taking 1 if the respondent has attended secondary education; 0 other wise. ERTD is a dummy variable taking 1 if the respondent has attended any tertiary educations; 0 other wise. Education is expected to have positive and significant effect with higher levels having higher effects on willingness to pay and its amount.

MSR (Marital Status of Respondent)-whether the respondent is currently single or not is expected to influence the value the individual gives for the proposed change. MSR is dummy variable taking 1 if the respondent is married; 0 otherwise, and it is expected to have a positive sign. This is due to the fact that married people are likely to be more responsible to keep the environment clean than single ones because married respondents are likely to have larger family size and hence face higher risks than those not married.

TS (Time Spent in the Area)-this refers to the number of years the household has been living there. This is expected to influence willingness to pay in the positive direction, since the longer the year the household has been there, the more they would understand the problem of solid waste management of that area, and the more they are expected to pay.

NCH (Number of Children in the Household)-this refers to the number of children below 15 years of age. This variable is expected to have a positive effect on willingness to pay. This is due to the fact that the more children in the household, the more willingness to maintain a clean environment in the future in which children will grow with lesser risk due to cleaner environment.

QW (Quantity of Waste Generated)-this variable stands for the quantity of waste the household generates within a week. For this the unit of measurement used is a shopping plastic bag ('Kurtu'), which was common almost to all respondents during the survey. The study hypothesizes willingness to pay to be positively related with the quantity of solid waste generated, since the higher the generation, the more would be the problem households face in storage and taking the waste for collection, and they would be willing to pay more.

RSWM (Responsibility of Solid Waste Management)-this variable is taken as proxy to examine the attitude of the respondent towards cost sharing in solid waste management. RSWM is a dummy variable taking 1 if the respondent believes households have responsibility to the improvement of solid waste management (including cost sharing) with the government; 0 otherwise, i.e., if the respondent feels it is entirely government's responsibility. This study expects positive attitude towards cost sharing to influence willingness to pay in the positive direction.

CDH (Case of Diseases in the Household) -this is a dummy taking 1 if any member of the household was attacked by any one of waste related diseases such as typhoid, dysentery, influenza, trachoma, etc. in the past one year; 0 otherwise. This study hypothesizes that being a

victim of any of waste related diseases would increase the willingness to pay for improvements in solid waste management.

HA (Housing Arrangement)-this is a dummy variable taking 1 if the household is renting the house from kebele, Public Agency or individuals; 0 otherwise (if the household owns the house in which it is living). Those living in their own houses are expected to be more willing to pay for the improvement. This could be partly explained by the belief some renters have that the owner of the house should pay solid waste charges. The fact that house owners get extra income from renting rooms in their house or extra houses in their compound is also expected to make them more willing than those who pay a good part of their income as house rents.

SP (Starting Price)- As mentioned earlier this study has used starting prices in eliciting willingness to pay amounts. Therefore, the existence of starting point bias is examined by including the starting price in the regression analysis.

SRH (Status of Respondent in the Household)-this variable is included to examine whether interviewing the head rather than its representative has an impact on willingness to pay and it take 1 if the respondent is the head of the household; 0 otherwise. The study expects heads to be more willing than their representative since the latter might happen to be less courageous to give the correct value wondering what the reaction of the head would be.

3.2 Model Specification

Given the nature of the data, two econometric models are used one of which is a Probit model to identify which factors are responsible for being willing or unwilling to pay for the improved services and Tobit model is used to identify factors determining the amount a household is willing to pay for the improved solid waste management.

The Probit Model

This model is used to identify factors that influence a household's willingness to pay decision. The dependent variable in this model will have a value 1 if the household gave a positive willingness to pay amount for the suggested improvement; 0 otherwise.

The Probit Model is built on a latent variable with the following formulation:

$$MWTP^* = X_i\beta + \varepsilon_i \ldots \ldots \quad 1$$

Where

β = a vector of coefficients

X_i = vector of Independent Variables

If $MWTA^* > O$, we have $WTP_= 1$ and if $MWTP^* \leq 0$, we have $WTP= 0$. Therefore based on equation 1 the Probit model will be:

$$Prob(WTP=1)=\beta_o+\beta_1 IHH+\beta_2 SR+\beta_3 AR+\beta_4 ERPD+\beta_5 ERSO+\beta_6 ERTD+\beta_7 MSR+$$
$$\beta_8 TS+\beta_9 NCH+\beta_{10} QW+\beta_{11} RSWM+\beta_{12} CDH+\beta_{13} HA+ \beta_{14} SP+$$
$$\beta_{15} SRH + \varepsilon_i \ldots \ldots \quad 2$$

Where

All the variables are as defined in section 3.1

$\beta_0 - \beta_{15}$ = Coefficients and ε_i = error term

The Tobit Model

In the survey, only 12 (2.8%) of the total sample of 424 were eliminated as invalid responses (protest zeros) from the analysis and this may be too small to result in sample selection bias. Therefore the Tobit model is used given that there is a censoring from below at zero willingness to pay. Since using OLS in this circumstance will result inefficient estimates.

There could be some problem of heteroscedasticity in the data since this problem is common in cross sectional data. But this problem cannot be detected in Tobit model.

Let MWTP* be 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. Following Long (1997), the Tobit model for observed MWTP is given by:

$$MWTP_i = \begin{cases} MWTP^* = X_I\beta + \varepsilon_I ; if MWTP^* \phi 0 \\ 0; if MWTP^* \leq 0 \end{cases}$$

With $\varepsilon_i \sim \mathcal{N}(0,\sigma^2)$

Where

$MWTP_i$ = maximum willingness to pay

X_i= a vector of explanatory variables

β = a vector of coefficients

ε_i = the disturbance term

Expanded in terms of the variables

$$MWTP^* = \beta o+\beta_1 IHH+\beta_2 SR+\beta_3 AR+\beta_4 ERP+\beta_5 ERS+\beta_6 ERT+ \beta_7 MSR + \beta_8 TS+\beta_9 NCH+\beta_{10} QW+\beta_{11} RSWM+\beta_{12} CDH+\beta_{13} HA+\beta_{14} SP + \beta_{15} SRH + \varepsilon_i$$

With $\varepsilon_i \sim \mathcal{N}(0,\sigma^2)$

Where

All the variables are as defined in section 3.1

β_0 - β_{15} = are coefficients

3.3 Description of Study Area and Source of Data

Addis Ababa is the capital of Ethiopia and it is also the largest urban center in the country (already fourteen times larger than the second largest city – Dire Dawa). It is also where head quarters of some continental and international organizations like the Organization of Africa Unity (OAU) and the United Nation Economic Commission for Africa (UNECA) are found.

The population of Addis Ababa is projected to reach 2,646,000 by 2002 with 3.79% annual growth rate, (CSA 1994). The total area of the city is about 540 square kilometers and it is situated between 9 degrees north latitude and 39 degrees east longitude.

Addis Ababa is administered by the Federal Regional Government. It is divided into six administrative zones, 28 weredas and 328 kebeles. Addis Ababa also includes some rural Kebeles in the outskirts. The 1994 census put rural residents of Addis Ababa to be 28,149 (1.35%).

Literacy rate in Addis Ababa was around 83% in 1994. About 97.15% of Addis Ababa population lives in non-storied housing units with an average household size of 5.1 persons. The majority of houses (82.15%) in the city are traditional and they are non-planned, their walls made of wood and mud, their floors of earth, and the roofs consisting of simple corrugated iron sheets (CSA, 1994).

Addis Ababa was found about a hundred years ago. It had a good opportunity to provide its citizens with a suitable living environment. Today it is facing ever increasing environmental problems, which include changing temperature patterns, eradication of green areas, unsolved problems of solid and liquid wastes, etc. However, Addis Ababa's main environmental problems are not the "green" issues (natural resource degradation) but it is the "brown" issues (pollution and other environmental problems) that are damaging the health and life of the residents.

The data this study mainly uses is primary generated by a survey. Some secondary data is also used which is obtained from the Environmental Hygiene Department of Addis Ababa and other sources

3.4 Survey Design and Administration

In this study, the main survey was preceded by a pilot survey. Based on Mitchell and Carson (1989), the questionnaire has three parts, which are household characteristics, solid waste handling problems and perception, and lastly questions on willingness to pay for the suggested improvement in solid waste management (as shown in Appendix).

The pilot survey was conducted in all income group areas (low, middle and high) with an open-ended elicitation format. From the pilot survey, starting values (since the elicitation format used is closed ended with an open ended follow up) and many important experiences have been obtained for the main survey. For instance one respondent interviewed in Bole area characterized the survey as an attempt by the government to steal the jobs of street children and refused to cooperate. This and other experiences have helped to minimize problems in the main survey. For instance, more information on the hypothetical nature of the survey was given in areas where the private sector is already giving collection services.

For areas where larger low income earners are believed to live, the pretest was done in two kebeles one in Wereda 11, kebele 23 ('Sheromeda') and the other in Wereda 7, kebele 32, ('Atobis tera'). A total of 30 households were covered in both kebeles and the lowest monthly willingness to pay from the open-ended question was zero while the highest was 8 Birr. The modal value was 3 and the mean 2.52 (≅2.50), which is one of the starting prices used in the main survey. For the middle income, the pretest was undertaken in 'Keranio' and 'Kore' areas of the city. From 30 households covered in both kebeles, the minimum monthly willingness to pay amount was 3 Birr while the maximum was 30 Birr. The mean willingness to pay for this group was 7.97 (≅8.00 Birr), which is one of the starting prices given to households in the main survey. For high income areas 2 kebeles- one in 'Bole' area and another one in 'Old Airport' area- were used. From both kebeles, 20 households were covered and the minimum monthly willingness to pay was zero while the maximum was 35 Birr. The mean value, 20 Birr, was used as the third initial value in the main survey.

This study has made a considerable effort to make the sample as representative as possible. It started by stratifying kebeles in Addis Ababa into different income groups. This step was very important but very difficult to do, because willingness to pay for improved solid waste management involves demand estimation, and its main determinant is expected to be income. Therefore, to have a more reliable estimate of total willingness to pay, we need to stratify households into income groups. Doing this was difficult due to lack of previous studies, which could help classify kebeles in Addis Ababa into different income groups. In the absence of such information, this study has tried to use other proxies like the proportion of house ownership in a given kebele and other additional information obtained from Kebele administration. Based on social needs survey 1980 (sited in Abera 1997) and information from various administration offices, the kebeles in Addis Ababa were roughly divided into three income groups. For instance if kebele-owned houses are more than 60%, that kebele is treated as low income where larger proportion of low income earners are believed to live. These areas mostly included the dirtiest parts of the city with a very high density of houses and people, and are usually severely affected by environmental problems.

The middle and high income kebeles are characterized by higher proportion of public agency and individual owned houses. To distinguish between the two groups information from kebele administration offices on each kebele was gathered and compared. Those kebeles where higher proportion of relatively high income earners are found are taken as high income kebeles, and the rest where higher proportion of middle income earners are found are treated as middle income kebeles. In some cases, own judgments were also used. This study would like to remind the reader that the stratification is just an approximation in the absence of any other formal way of stratification and acknowledges the problems of using proxies and unpublished information.

A two- stage stratified sampling procedure was employed to generate a random sample of about 430 households. In a city with approximately 518, 824[1] households in 2002, it means the sample has covered 0.083 % of the total households. The study would have benefited from higher sample size but due to inadequate funding the sample could not be increased.

The two stages in the sampling procedure were: first all kebeles in Addis Ababa were stratified by income groups as described earlier. Then four kebeles from low income

kebeles, 4 kebeles from middle income kebeles and 2 kebeles from high income kebeles were randomly selected. Secondly, households were selected from each selected kebele by randomly picking the starting house from the household number lists obtained from the respective kebele offices and then systematically sampling the kebele.

The total number of households taken from each income group was based on the 1995/1996 – CSA household income, consumption and expenditure survey with 32.9 % (less than 3399 Birr/Annum) for low income group; 49.9 % (3400-12,599 Birr/Annum) for middle income group and 17.2 % (greater than 12,599 Birr /Annum) for high income group.

For the survey 8 enumerators with a minimum of technical school diploma and six of them having some experience in conducting survey were employed. They were given a two-days long training in the nature and administration of the survey.

[1]The number of households in 2002 is calculated using population projection for 2002 and the mean family size of 5.1 (CSA-1994)

The three starting prices (2.50, 8 and 20 Birr/month) were equally and randomly distributed in all kebeles covered in the survey. Monitoring and supervision were conducted with the help of kebele administration.

Except for some minor bureaucracy, which delayed the starting of the survey in some kebeles, the cooperation given for this study from kebele administrators was beyond expectations. Like most CVM surveys some problems were encountered but none of them were large enough to threaten the continuation of the survey. The survey was conducted in Amharic language from February 11 up to March 5, 2002.

4. Analyses and Interpretation of Empirical Findings

In this section, information obtained in the survey is analyzed using both descriptive and econometric analysis with stata virsion 7. Aggregation of the willingness to pay amount and interpretation of the results are also made.

4.1 Descriptive Analysis of the Survey Data

As stated earlier for this study a total of 430 households, 141 (32.9 %) from low income areas, 215 (49.9 %) from middle income areas and 74 (17.2 %) from high income areas were interviewed. From these 6 questionnaires were dropped because they lacked the required information, and out of the remaining 424, 12 were rejected for giving a zero value in protest of the proposed change, which was known from responses to follow up questions given to those reporting a zero willingness to pay amount. The distribution of the protest zeros with their specific reasons across income groups are given in Table 4.1

Table 4.1 Distribution of Protest Zeros

Reasons	Total	Low Income Areas	Middle Income Areas	High Income Areas
Continue Using the Existing System	3	1	1	1
It is the Responsibility of the Government	5	1	3	1
Do not Trust the Government	4	0	1	3
Total	**12**	**2**	**5**	**5**

Source: 0wn Survey 2002

Form the table it can be seen that 83.3% of protesters come from middle and high income areas. Households in high income areas seem to be less confident in the government in this context- 3 cases out of 4. In the survey some respondents raised some examples in which the government failed to provide some service after promising and collecting money. As a result some respondents rejected the suggested improvement saying they are not willing to pay for the government for they do not believe the government is capable of providing the suggested services.

Some respondents seem to be comfortable with the existing services. For instance in 'Zenebe Work' area households found near the river were found to be less willing to pay for the improvement than those found further away from the river. Therefore, some rejected the improvement because they do not have or see any problem with the existing service. One household head in a high income area rejected the suggested improvement saying the waste is desirable for them since they use it as a manure for plants in their compound and he said they need to be paid if one is to take their waste.

Others argue that collecting and disposing solid waste is entirely the responsibility of the government and should be covered from tax collections.

These 12 (2.79%) were eliminated from the analysis since they are protest zeros and are too small to create sample selection bias. Therefore further discussions are made using the remaining 412 households who gave valid responses.

4.1.1 Household Characteristics

The minimum household size is 1 while the maximum is 17 and the mean household size was found to be 6.16. The minimum number of children in a household is 0 while the maximum is 6 and the mean is 1.83. The mode for family size is 5 with 17.92%. About 44.57 % of households have a family size of 1-5, while 48.82% have between 6-10 and 6.61% have more than 10 family size. Family size does not show any significant difference across the three income groups with 6.33, 6.05 and 6.13 for low, middle and high income areas.

The survey result shows 70.63% of the households interviewed were male headed while 28.37% were female headed. In this survey 74.32% of the respondents reported that they were the head of the household. About 71.27% of the respondents were male while 28.73% were female. With regard to marital status, 73.06% of respondents said they were married while 26.94 % said they were not: not married, widowed, separated and divorced. The youngest respondent was 20 years of age while the oldest was 80 with mean value of 48.3 years. As far as mean age of respondent is concerned there is no big difference across the three income groups.

Education shows significant difference across the income groups with a mean year of education of 7.71. Table 4.2 shows distribution of education by level for respondents across the three income groups. For the sake of simplicity the years of education of respondents is divided into four levels. Illiterate level refers to those who cannot read and write while elementary level includes those who can read and write and those with a formal education with less than or equal to six grade. Secondary level includes those who have a formal education greater than 6 but less than or equal to 12. The tertiary level includes those who go to some institutions after completing grade 12.

Table 4.2 Distribution of Education by Level

Educational Level	Total		Low Income Areas		Middle Income Areas		High Income Areas	
	Nº	%	Nº	%	Nº	%	Nº	%
Illiterate	79	19.17	50	37.04	26	12.56	3	4.49
Elem. (Read & Write –6)	80	19.42	30	22.22	39	18.84	11	15.71
Secn.(6-12)	205	49.76	52	38.52	117	56.54	36	51.43
Tertiary (>12)	48	11.65	3	2.22	25	12.08	20	28.57
Total	**412**	**100**	**135**	**100**	**207**	**100**	**70**	**100**

Source: Own Survey 2002

As can be seen from the table 49.46% of the respondents have a secondary education while the illiteracy rate is 19.17%. Fifty of the illiterate about 63.29 %, are found in low income areas. Some of these said they had participated in the illiteracy campaign but now have forgotten how to read and write. In low income areas only 2.22% of the respondents have tertiary (>12) level of education.

In all the respective income group areas a higher proportion of the respondents have secondary education like the total sample with 38.52%, 56.53% and 51.43% for low, middle and higher income areas. This is also supported by the mean year of schooling, which is 7.71.

The study also has attempted to categorize household heads into different occupational categories. The first group includes government employees, which includes both contract and permanent employees. This group as shown in Table 4.3, is about 25.97%. The second group includes those working for private organizations and non-governmental organizations and it contains about 19.42% of the head of the household. The third group includes those working in

their own businesses, about 11.41%. The fourth group is about 20.3% which include those who are working for themselves but are very small like weavers, those selling things on the street or 'Gulit", those who sell wood and leaves etc. The fifth group includes those who are not currently working at all or engaged entirely on domestic activities.

Table 4.3 Occupational Category in Addis Ababa

Categories	Total		Low Income areas		Middle Income areas		High Income areas	
	Nº	%	Nº	%	Nº	%	Nº	%
Government employees	107	25.97	19	14.07	71	34.30	17	24.57
Private /NGO's	80	19.42	10	7.41	50	24.15	20	28.57
Own business	47	11.41	12	8.89	21	10.14	14	20.00
Small own–account workers	84	20.39	62	45.93	19	9.18	3	4.29
Not currently in a paid job	94	22.82	32	23.7	46	22.22	16	22.86
Total	**412**	**100**	**132**	**100**	**207**	**100**	**30**	**100**

Source: Own survey 2002

As one expects, the low income areas have higher proportion (45.93%) of small own-account workers and unemployment rate (23.7%) while the high and middle income areas have smaller proportions of household heads in these categories.

In this survey, getting information on household income was difficult. In cases households refuse to reveal their incomes, their monthly expenditures on main consumption items are used to estimate their incomes. The mean income for the whole sample is 710.36 Birr per month with a minimum of 63 Birr and a maximum of 5000 Birr. For low income areas where a relatively

larger proportion of low income earners are found, the mean monthly income is 268.25 Birr with a minimum of 63 Birr and a maximum of 1850 Birr per month. In middle income areas, the mean monthly income is 763.40 Birr and the minimum and maximum incomes are 100 and 4200 Birr, respectively. For high income areas where larger proportions of the households are high income earners, the minimum monthly household income is 130 Birr while 5000 Birr per month is the maximum. The mean income is 1406.20 Birr.

The mean income from this study is a little bit higher than previous studies. This, to some extent can be explained by the recent salary increment starting January 2002, for government employees who are 25.97% in the sample.

The mean years a household has lived in the area it is currently living is 18.34 years with a minimum of half a year and a maximum of 50 years. The survey result shows 61.41% of the interviewed households live in their own houses while 38.59% live in houses rented from kebeles, government agencies or individuals. The majority of households (65.18%), in low income areas, live in rented houses. But the proportion decreases in middle (23.6%) and high (31.43%) income areas. The rented houses in low income areas are mainly owned by kebeles while in middle and high income areas they are owned by government Agencies and individuals. The natures of the houses in low income areas are very poor, very old and usually made of wood and mud with earth floor. In many of these areas there are no roads linking the villages to main roads. In one case, a respondent in 'Shero Meda' area said this kind of questionnaire should also be prepared for construction of roads. In middle and high income areas the situation is much better except for some areas of "Zenebe Work" (Wereda 24, Kebele 12) which is taken as middle income area. In this area, too, there is a road problem specially in the summer time.

4.1.2 Solid Waste Handling, Problems and Perception

Like in other cities, in Addis Ababa, the volume of solid waste generated varies with income. To get an estimate of weakly solid waste generation in the household, the study used a plastic shopping bag (‘ kurtu’), which is familiar to almost all respondents. The mean weekly generation per household per week was 1.31 with a minimum of 0.25 ‘Kurtu’ and a maximum of 3 ‘Kurtu’. While, for low income areas, the mean is 1.03 ‘Kurtu’ with a minimum of 0.25 and a maximum of 3 ‘kurtu’ per household per week. For the middle income areas, the mean is 1.41 while it is 1.54 for high income areas. The minimum and maximum for middle and high income areas are the same which are 0.5 and 3 per week, respectively. Note that there was no actual measurement of solid waste generation, but respondents were encouraged to estimate the weekly generation in terms of ‘kurtu’. The important point the study wants to emphasize is how the ‘estimate’ varies across households and how this affects their willingness to pay.

From the households covered in this study, 374 (90.05%) said they have some kind of solid waste storage receptacle used as a primary solid waste receptacle to store solid waste and 41 (9.95%) said they do not have any storage receptacle. These storage receptacles are not standardized and are made up of various materials, but those getting the private solid waste collection service are provided with a plastic bag.

The distribution of the materials from which primary solid waste storage receptacles are made is shown in Table 4.4.

Table 4.4 Summary Statistics for Solid Waste Storage Material used by Households

Material	Total		Low Income Areas		Middle Income Areas		High Income Areas	
	Nº	%	Nº	%	Nº	%	Nº	%
Plastic	191	51.48	72	63.72	72	37.89	47	69.12
Metal	98	26.42	32	28.32	50	26.32	16	23.53
Wood, Bamboo	15	4.04	4	3.54	10	5.26	1	1.47
Sisal	65	17.52	4	3.54	58	30.53	3	4.41
Other material	2	0.54	1	0.88	0	0	1	1.47
Total	**371**	**100**	**113**	**100**	**120**	**100**	**68**	**100**

Source: Own Survey 2002.

Abera (1997) states plastic and paper made of receptacles are not common in Addis Ababa. But this study discovers 51.48% of the interviewed households are using plastic materials. This could be the result of plastic bags and containers introduced in the market recently. This can also be partly explained by the provision of plastic bags by the private solid waste collectors. The second most common storage material is metal (26.42%). Most of the plastic and metal receptacles are not purchased for storing solid waste but are used for this when they are not important any more to serve what they are bought for initially- some are containers of foods while some others are used to carry water. Sisal materials and wood (bamboo) take the third and fourth place with 17.52% and 4.04% respectively. Other materials include paper, cartons, clothes, etc. For all income group areas plastic is the most common material followed by metal except for middle income areas where sisal is the second most common material.

In most cases the storage receptacles are inappropriate with no lids, and the waste is dispersed off the containers by chickens and other domestic animals. There is also a problem of space for solid

waste receptacles specially in low income areas where they usually are put close to the houses and/or kitchens. This becomes the source of unpleasant view and smell resulting in a favorable condition for fly breeding which can transmit various diseases.

This study also tried to look at the common ways households dispose their solid waste. Table 4.5 gives a summary of this. As it can be seen from the table, the use of 'Genda' (34.47%) is the most common way of disposing solid waste by households. The use of truck is the second common method. Only 4.6% in middle and high income areas are using private collectors on regular basis. From Table 4.5, it can be concluded that it is 54.86% of the households that are getting government solid waste collection services directly (container system and use of trucks) or indirectly (through private collectors who dispose solid waste they collect to the containers which is lifted by the government eventually). The rest use other disposal methods dug hole burn and /or bury 11.17%, 14.32% of hoseholds throw the waste into an open space or street which some, if reach main streets, could be collected through street sweeping and 19.66% of the households throw it into the river which is accepted as a correct and best way of dealing with solid waste by most of those using this method.

In low income areas all methods, except private collection, are used and the most common one is the use of trucks unlike the other two groups where use of containers is the most widely used. Currently use of trucks in low income areas is superior over the container system due to problems with the latter method. One problem of the container system in low income areas is its requirement of adequate space which in some cases should also serve as disposal site if the container is full. But these kinds of space is hardly found in low income areas of the city. Another

problem of this system is the wide spread practice of theft on some parts of the containers. Because of these and other problems the container system is being replaced by use of trucks.

Table 4.5 The usual way of disposing solid waste by Households

Disposal Methods	Total		Low Income Areas		Middle Income Areas		High Income Areas	
	Nº	%	Nº	%	Nº	%	Nº	%.
Use of container "Genda" (Transfer station and block collection)	142	34.47	33	24.44	79	38.16	30	42.86
Use of Trucks (Door-to-door collection)	65	15.78	56	41.48	0	0	9	12.86
Private collectors	19	4.61	0	0	5	2.42	14	20.00
Dug hole bury /Burn in the compound /village	46	11.17	12	8.84	30	14.49	4	5.71
Throw in to street /open space	59	14.32	20	14.81	38	18.36	1	1.43
Throw into the nearby river	81	19.66	14	10.37	55	26.57	12	17.14
Total	**412**	**100**	**135**	**100**	**207**	**100**	**70**	**100**

Source: Own survey 2002

In middle and high income areas the most common method is container system which depends usually on the availability of enough space. The Environmental Hygiene Department uses no trucks for middle income areas while it supplements the container system with trucks (12.86 %) in high income areas. This might suggest regional bias in the provision of the services of solid waste collection. As a result there is a large difference between high and middle income areas with regard to illegal disposal of solid waste on street, open space and river which is about 44.93% for middle income areas while it is only 18.57% for high income areas. There is a huge difference between high and middle income areas in using dug hole bury /burn method too-with 14.49% for middle and 5.71% for high income areas. In general, households in middle income

area gets the least from the government which is only 40.58% while it is 65.92% for low and 75.72% for high income areas.

The survey result shows households getting solid waste collection service form the private sector pay a monthly amount of 10 up to 25 Birr, mainly determined by a type of bargaining with the household head. It is usually considered as a good will to help street children. This was reflected by some respondents who said solid waste collection has to be left for street children. The frequency of solid waste collection is two times a week in most cases. And 18 (94.74%) out of the 19 respondents getting the private collection services said they are satisfied with their services and would like to continue using the services.

As expected the majority of respondents are not satisfied with the existing solid waste management in Addis Ababa. This group, which is about 91.5%, feels the current service is far below the required level, and said something has to be done soon. Only 8.50% of the respondents said they are satisfied with what the government is doing in this area. The dissatisfaction with solid waste management in Addis Ababa is almost similar in all income group areas- which is 90.66%, 92.05% and 90.26% for low, middle, and high income areas, respectively.

When asked about which institute (between private and government) the respondent thinks is better to handle solid waste management in Addis Ababa, 70.63% said government organizations while 29.37% said private organizations. Households favoring private organizations are 4.44%, 39.6% and 47.14% in low, middle and high income areas, respectively. This difference across income group areas should not be surprising given that the private sector has already shown a good result in many high and some middle income areas. Households in low income areas are

also suspicious of the private sector which they think gives them services in sufficient amount only if they pay the amount that makes the private sector profitable. This issue was raised many times in low income areas.

It is only 37 (8.89%) of the households interviewed that said it is entirely government's responsibility to collect and dispose solid waste properly while the majority 375 (91.02%) said it is households' responsibility too (including fair financial obligations). This in general suggests that there is a good chance of success if service charges are introduced in this area. The proportion of respondents saying it is entirely government's responsibility is 19.26%, 4.35% and 2.86% for low, middle and high income areas, respectively. From this we may generalize that there is a wider room for cost sharing in high and middle income areas than in low income areas. To some extent this can be explained by the fact that households in low income areas have to satisfy their other basic needs before they start to worry about the environment so they are less willing to make it as their responsibility.

Only 7 (1.70%) out of 412 respondents were not able to name at least two diseases, which come as a result of indiscriminate solid waste management. All the rest gave a list of diseases, which could be the result of recent discussions in mass–media on improving solid waste management.

To the question on the occurrence of cases of disease as a result of indiscriminate solid waste management on any member of the household in the past one year, 43.45% said yes while 56.55 % said no. The low income areas are highly affected (50.37%) while 41.06% and 37.14% of the households have experienced one of those diseases in middle and high income areas,

respectively. This difference across the income group can be the result of biased service provision and other socio–economic factors.

4.1.3. Households' Willingness to Pay

As described earlier 12 observations were eliminated as invalid responses. From the remaining 412 observations, 27 (6.55%) are true zeros. From these 20 are from low income areas while 6 and 1are from middle and high income areas, respectively. About 93.45% (385) households give positive amounts as their willingness to pay starting from 0.25 Birr per month.

The mean monthly willingness to pay amount is 7.09 Birr with a minimum of 0 and a maximum of 35 Birr per month. For low income areas the minimum is 0, the maximum is 20 Birr while the mean willingness to pay is 2.96 Birr per month. The mean for middle income area is 7.76 while it is13.07 Birr per month for high income areas. The minimum and the maximum willingness to pay amounts are the same for both middle and high income areas with 0 and 35 Birr per month.

The mode for the willingness to pay amount is 5 Birr per month with 65 (15.78%) cases and the median value is also 5 Birr per month. The standard deviation for the WTP amount is 6.83. The distribution of willingness to pay amount are summarized using class boundaries as shown in Table 4.6

The vast majority (80.83%) of the respondents gave a willingness to pay amount of below 11.5 Birr per month while 16.28% of the respondents gave between 12 and 20.5 Birr. And only 2.92% of the respondents reported their willingness to pay to be between 21 and 35.5 Birr per month.

When we look at the willingness to pay amount by employment categories, we find those having their own business to offer the highest willingness to pay amount, which is 11.03 Birr. The second highest willingness to pay amount is obtained from government employees with 8.6 Birr. Private / NGO employees (8.46Birr), currently unemployed (5.24 Birr), and those engaged in small self employment (2.13 Birr) take the third, fourth and fifth place, respectively. The higher offer from non-employed household heads might be explained by income from other household members, transfer payments from relatives or renting extra houses etc.

Table 4.6 Summary of WTP Amounts in Class Boundaries

Class Boundaries	Total		Low Income Areas		Middle Income Areas		High Income Areas	
	Nº	%	Nº	%	Nº	%	Nº	%
0-2.5	144	34. 45	92	68.15	46	22.22	6	8.5
3-5.5	106	25.73	27	20.00	68	32.90	11	15.71
6-8.5	28	6.80	5	3.70	18	8.70	5	7.14
9-11.5	55	13.35	7	5.19	38	18.36	10	14.29
12-14.5	6	1.46	0	0	4	1.93	2	2.86
15-17.5	30	7.28	1	0.74	13	6.28	16	22.86
16-20.5	31	7.52	3	2.22	14	6.76	14	20
21-23.5	0	0	0	0	0	0	0	0
24-26.5	6	1.46	0	0	2	0.95	4	5.71
27-29.5	0	0	0	0	0	0	0	0
30-32.5	3	0.73	0	0	3	1.45	0	0
33-35.5	3	0.73	0	0	1	0.48	2	2.8
Total	**412**	**100.01**	**135**	**100**	**207**	**100**	**70**	**100**

Source: Own Survey 2002

The relationship between willingness to pay amount and mean values of some variables are summarized in table 4.7

Table 4.7 Relationship between WTP and mean values of some variables

Dep. Variable.	0-2.5	3-5.5	6-8.5	9-11.5	12-14.5	15-17.5	18-20.5	24-26.5	30-32.5	32-35.5
Age res.	52.76	46.02	41.25	45.18	49.33	42.5	45.87	41.67	45.67	32.33
Nº Ch	1.24	2.30	1.82	1.67	1.33	1.97	2.52	3	4.33	4
Income	256.7	482.7	572.7	926.0	984.1	1546.97	1749.03	2247.83	2612.67	3233.33
Time. Spen	16.61	17.78	17.5	16.18	18.33	18.33	18.03	20.79	25.33	20.67
Qua. waste	0.95	1.16	1.42	1.54	1.50	1.82	2.13	1.67	2	2.67
Starting Pri.	11.34	10.08	9.66	9.24	8.16	6.93	8.23	7.25	12.17	8.33

Source: Own survey 2002.

As can be seen from Table 4.7, except the starting price, all the rest show a constant pattern as willingness to pay increases Age generally tends to decline as willingness to pay increases while time spent, number of children, quantity of waste generated and income tend to rise with willingness to pay amounts. This relationship is examined using a rigorous technique in the next sub-section.

To the question about the payment vehicle, 76% of the household preferred the payment to be made by its own without associating it to any utility payment. About 12% want to pay with water bill. While 10% said they want to pay it with electric bill and the rest said it should be paid with the house rent or land use rent. Those who prefer to pay with utilities argue that, if it is tied with some utility payment that will make them more determined to pay so that they may not lose the other service too. Those preferring not to associate it with any of the utilities say they want it to be collected by a special unit established for this purpose. They add water bills are collected usually every two months and the electric bill is already high and adding on that may make some

households less cooperative. There is no big variation across income group areas except that all households that want to pay with house/land rent are found exclusively in low income areas.

4.2 Econometric Analysis

Before the maximum likelihood estimates was run, test was made for the prevalence of multicollinearity since this problem reduces the precision of estimating the coefficient of variables having this problem.

According to Gujarati 1997, a correlation coefficient of 0.8 is sufficient to indicate the existence of multicollinearity problem and one solution to solve this problem is to drop one of the variables creating the problem.

Based on this education, age and marital status of head are dropped because they were found to be significantly correlated with their respondent counterparts. One problem that may arise when we drop a variable is specification problems. To check whether asking the representative and not the head significantly affects the willingness to pay, a dummy variable SRH (Status of Respondent in the Household) is included in the model. Family size was also dropped since it was found to be significantly correlated with number of children in the household. The decision to drop family size and not number of children was based on the higher relevance of the later variable observed from regression results. It is also known that in Addis Ababa, children are usually blamed by adults for creating wastes in and around the house.

As discussed in the previous sections two maximum likelihood estimates are made: a Tobit Model to identify the socio –economic and solid waste related factors that affect the amount a

household is willing to pay and another a Probit Model to identify factors that are responsible to make a household willing or unwilling to pay.

4.2.1 Results from the Probit Model

The maximum likelihood estimates for a household to be willing or not is corrected for potential heteroscedasticity problem. As shown in table 4.8 the Wald chi square which is 57.84 shows the overall significance of the Probit Model at 1% level of significance. The pseudo R^2 is 68.48%, which implies that percentage of the variation in the probability of being willing to pay or not is explained by the variables included in the model.

Starting Price- was expected to have a positive impact. However, the sign is negative and is insignificant suggesting that there is no significant starting point bias.

Sex of Respondent- this variable was expected to have a negative effect, i.e, female are more willing to pay than male. But the sign is positive and is insignificant which may enable us to conclude that sex is not important variable in explaining willingness to pay for solid waste management.

Age of Respondent - as anticipated age has a negative and significant (at 1%) effect on willingness to pay. This means age has the effect of reducing the probability of willing to pay.

Marital Status of Respondent- this variable has a positive effect as expected but it is significant only at 12.5% suggesting that it is not an important variable in explaining willingness to pay.

Status of Respondent in the Household- despite its sign in the Tobit Model in the previous section, this variable has a positive sign in Probit Model as expected. But since it is not significant at 10% it would have an insignificant impact on willingness to pay.

Table 4.8 Maximum Likelihood Estimates for Willingness to Pay (Probit Model)

Explanatory Variables	Coeff.	Rob. Stan. Errs	Z	P>/z/	Mar. effect
Starting Price	-0.0005	0.0257	0.000	1.000	-7.39e-13
Sex Res.	0.2282	0.4083	0.559	0.576	4.27e-07
Age Res.	-0.0426	0.0138	-3.080	0.002	-6.00e-08
Mar.St.Res.	0.5544	0.3610	1.536	0.125	1.93e-06
Stat Res. HH	0.6761	0.5422	1.247	0.212	2.58e-06
Nº Chl.	0.3189	0.1890	1.687	0.092	4.49e-07
Log. Income.	1.3098	0.4580	2.860	0.004	1.84e-06
T.Spent	0.0530	0.0304	1.739	0.082	7.45e-08
Qun. Waste	2.0466	0.6948	2.946	0.003	2.88e-06
Res.SWM	0.2862	0.4103	0.698	0.485	7.78e-07
Case Di.HH	0.2820	0.3799	0.742	0.458	4.71e-07
Prim E.	0.8246	0.4377	1.884	0.060	4.64e-06
Sec. E	1.1505	0.5411	2.126	0.033	6.72e-07
Ter. E	1.5281	0.5441	2.808	0.005	7.52e-07
Hous. Arangem	-0.5463	0.4599	-1.188	0.235	-1.20e-06
Constant	-7.2873	2.4933	-2.923	0.002	-
Pseudo R^2	0.6848	-	-	-	-
Wald chi^2	57.84	-	-	0.003	-

Number of Children-this has a positive impact on willingness to pay and it is significant at 10%. This, as was explained earlier, is in line with our expectation and the result indicate that an

additional child will increase the probability of being willing to pay by 4.49 X 10^{-7}, keeping all other factors constant.

Income of the Household-is positive and significant (at 1%) for the reasons given in the previous section. If the income of the household increases by 1%, the probability of being willing to pay will increase by 0.1.84 X 10^{-6}, keeping all other factors constant.

Time Spent in the Area-has a positive sign as expected and it is significant at 10% for the reasons given in the previous section. An additional year in the area increases the probability of willingness to pay by 7.45 X 10^{-8}, keeping all other factors constant.

Quantity of Waste Generated-this variable is significant at 1% and has a positive effect on willingness to pay as was expected. One more 'Kurtu' generation of solid waste per week will increase the probability of willingness to pay by 2.88 X 10^{-6}, keeping all other factors constant.

Responsibility of Solid Waste Management-this variable has the expected sign but not significant. This situation may be explained by the fact that some who said households are not responsible may give small willingness to pay amount which they may not mind paying so would be in the positive willingness to pay category. These could be the reason for the insignificant effect of responsibility of solid waste management in the Probit model while it explains the willingness to pay amount in the Tobit model (Table 4.9) significantly.

Cases of Disease in the Household-has a positive effect on willingness to pay but it is insignificant showing in the probit model this variable is not an important variable to explain willingness to pay.

Education Dummies-Being in primary, secondary and tertiary level and not illiterate has a significant and positive impact at 10%, 5% and 1% significance levels, respectively.

Housing Arrangement-has a negative sign as expected but not significant. Therefore, we conclude that house ownership has an insignificant effect on willingness to pay for solid waste management in Addis Ababa.

4.2.2 Results from Tobit Model

The Tobit results obtained from stata virsion 7 are given in table 4.9. The LR chi square which measures the overall significance of the model, i.e., with the null hypothesis that all coefficients are zero is rejected at 1% significance level showing that at least one of the coefficient is different from zero. The pseudo R^2 is 18.12%, which implies that percentage of the variation in willingness to pay amount is explained by the variables included in the model. Both LR chi square and the pseudo R^2 are significant at 1% implying the model is acceptable to explain the relation between willingness to pay amount and its explanatory variables.

Starting Price-as expected this variable has a positive sign showing a starting point bias but it is insignificant. This could be the result of efforts exerted in training the interviewers who were told and remained frequently even after the survey had began, that especially in the willingness to pay part respondents should be advised and allowed to make an informed and free decision.

Sex of Respondent-as expected this variable has a negative sign but it is insignificant.

Age of Respondent-this variable is significant (1%) and as expected has a negative effect on willingness to pay amount. This shows that as people age their willingness to pay amount decreases. This probably can be the result of older respondents accustomed to free government services- in the previous government. But, the younger people are likely to be more familiar to cost sharing like for education, health services etc.

Marital Status of Respondents-this variable has a positive significant suggesting that married people are willing to pay more than those not married. But it is not significant at 10% so it has little to do with willingness to pay

Status of Respondent in the Household-despite expectations this variable has a negative sign but it is not significance. Thus asking the representative and not the head does not significantly affect the willingness to pay.

Number of Children in the Household-this has a positive impact on the willingness to pay amount and it is significant at 10%. The more children one has, the more could be the probability of being a victim of mishandling solid waste and hence the household willing to pay more. This positive relationship can also be the result of bequest value. The more children one has, the more bequest value he/she would expect, and hence the more the willingness to pay to make Addis Ababa cleaner for the future generation.

Income of Household-this variable has a positive and significant (at 1%) impact on the willingness to pay amount as expected. This shows that solid waste management is a normal economic good whose demand changes in the direction of income change. This implies that solid waste service charges may need to be a function of income to maximize cost recovery. A 1% increase in the income of the household will increases willingness by 3.74 Birr, keeping all other factors constant.

Time Spent- this variable is positive and significant (at 1% level) on willingness to pay amount. This could be because of longer stay in the area would help to understand the problem more. One additional year in that house makes the household pay Birr 0.079 more per month.

Responsibility of Solid Waste Management-this variable is significant at 1% and has a positive sign as expected suggesting that those respondents who feel it is the responsibility of households to manage solid waste, give higher offers than those who said it is entirely the responsibility of the government. A positive attitude to awards cost sharing increase the willingness to pay amount by Birr 0.3463 per month, keeping all other factor constant.

Case of Disease in the Household- this variable is not significant. This suggests the fact that the household was a victim in the past one year does not affect willingness to pay significantly. This may be the result of failure to know exactly the type of diseases one has due to wide spread practice of traditional healers and self-treatment in the city.

4.9 Maximum Likelihood Estimates for the Determinants of WTP (Tobit Model)

Explanatory Variables	Coeff.	Stnd. Error	T-Ratio	P-Valve	Marg. Effect
Starting Price	0.017	0.029	0.058	0.560	.00343271
Sex Resp.	-0.151	0.473	-0.320	0.749	-0.1904273
Age Resp.	-0.050	0.019	-2.603	0.010	-0.05525797
Mar. St. Resp	0.563	0.507	1.11	0.267	0.80122031
N^{o} Chl.	0.2590	0.1515	1.709	0.088	0.25854176
Res. St. HH	-0.731	0.473	1.546	0.127	-0.81545486
Log Inc.	3.622	0.322	11.240	0.000	3.7367479
Time Spent	0.0813	0.0262	3.100	0.002	0.07885437
Res. SWM	1.5979	0.5319	3.004	0.003	0.34631338
Case Dis. HH	0.4069	0.428	0.951	0.342	0.53625072
Qun. Waste	2.4231	0.4364	5.552	0.000	2.3868705
Prim. E	1.130	0.580	1.95	0.052	0.42101452
Sec.E.	1.301	0.604	2.154	0.032	0.62031765
Ter. E.	2.455	0.7397	3.318	0.001	2.0576591
Hous. Arr.	-0.956	0.455	-2.103	0.036	-0.57085014
Constant	-20.12	2.2167	-9.080	0.000	-19.722242
Pseudo R^2	0.1812	-	-	-	
LR chi ^{2}	483.55	-	-	0.000	

Quantity of Solid Waste Generated- this has a positive and significant (1%) impact as expected. This can be explained by the fact that, the more a household produces solid waste the more the problem in dealing with solid waste and hence the more would be the willingness to pay. One “Kurtu” additional generation of solid waste per week would increase the willingness to pay by 2.39 Birr, keeping all other factors constant.

Education Dummies-show positive and significant effect at 10%, 5% and 1% levels of significance for primary, secondary and tertiary levels respectively. This result not only shows there is a positive impact of education on willingness to pay amount but also that higher levels of schooling lead to higher willingness to pay. This may be explained by the opportunity education gives to people to understand the consequence of inadequate solid waste management This result suggests that investing in education of people both formally and informally might help to maintain clean environment.

Housing Arrangement- this variable has a negative sign as expected with a 5% level of significance. This to some extent can be explained by the income effect of house ownership in Addis Ababa as some of them get extra income by renting rooms in their house or extra houses in their compound. Specially if the owners have no financial obligation to meet because of the house, this will help to reduce the financial obligation to the household. As observed in this study those who pay rent for the house they live feel that solid waste disposal charges should be paid by the owner of the house.

4.3 Estimating Total Willingness To Pay and Total Revenue

In this section total willingness to pay and the total revenue at various prices that households in Addis Ababa are willing to pay is calculated. The demand curve for improved solid waste management is derived and comparisons between costs of providing the current service with willingness to pay for the improved service will be made to see the extent of cost recovery.

Based on population projection for 2002 and family size of 5.1 per household (CSA 1994), we have around 518,824 households in Addis Ababa. To make the aggregation, we will utilize the class boundaries for maximum willingness to pay as defined in section 4.1.3.

From the class boundaries (intervals) for the willingness to pay amount, the class mark (willingness to pay amount mid point) is calculated and the result is show in table 4.10 Col. (2).

Table 4.10 Total WTP and Total Revenue from Solid Waste Management Services

Class Boun. for WTP Amount	Class Mark for WTP Amount	Sample Distri.		Total Nº HHs	Total WTP	Sam. HHs WTP at least that amount (Cumm.)		Total HHs WTP at least that a mount (Cumm.)	Total Revenue
(1)	(2)	(3) Nº	(4) %	(5)	(6)	(7) Nº	(8) %	(9)	(10)
0-2.5	1.25	144	34.95	181,337	226,671.25	412	100	518,824	648,530
3-5.5	4.25	106	25.73	133,484	567,307	268	65.05	337,487	1,434,319.75
6-8.5	7.25	28	6.80	35,261	255,642.25	162	39.32	204,004	1,479,029
9-11.5	10.25	55	13.35	69,260	709,915	134	32.54	168,744	1,729,626
12-14.5	13.25	6	1.46	7,556	100,117	79	19.19	99,483	1,318,149.75
15-17.5	16.25	30	7.28	37,778	613,892.5	73	17.73	91,928	1,493,830
18-20.5	19.25	31	7.52	39,038	751,481.5	43	10.45	54,149	1,042,368.25
21-23.5	22.25	0	0	0	0	12	2.93	15,111	336,219.75
24-26.5	25.25	6	1.46	7,556	190,789	12	2.93	15,111	381,552.75
27-29.5	28.28	0	0	0	0	6	1.47	7,556	213,457
30-32.5	31.25	3	0.73	3,777	118,031.25	6	1.47	7,556	236,125
33-35.5	34.25	3	0.73	3,777	129,362.25	3	0.74	3,778	129,396.5
Total		**412**	**100**	**518,824**	**3,663,209**				

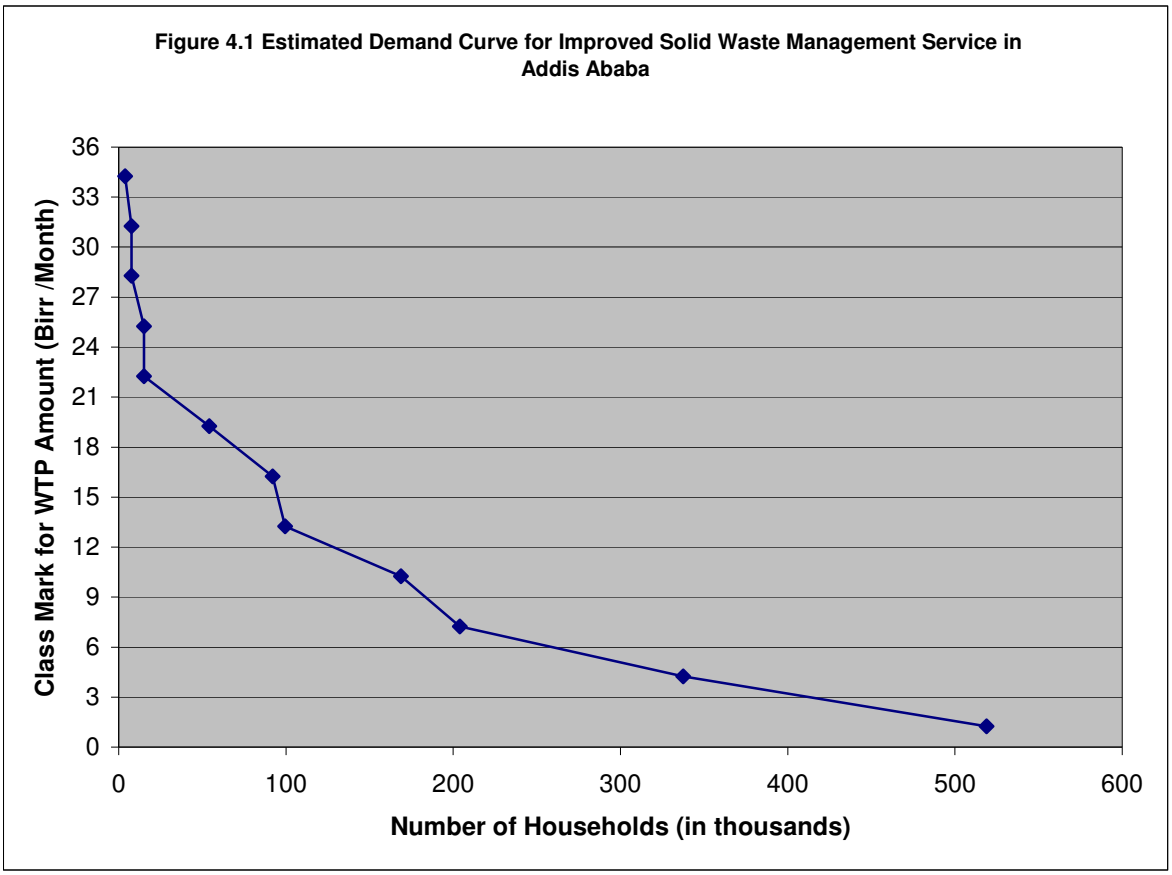
Source: Own Survey 2002

Total number of households (Col. (5)) is obtained by taking the proportion of sample households falling in that boundary and multiplying it by the total number of households. To get the total willingness to pay (Col (6)), we multiply the class mark (Col (2)) by the total households willing to pay that amount (Col. (5)).

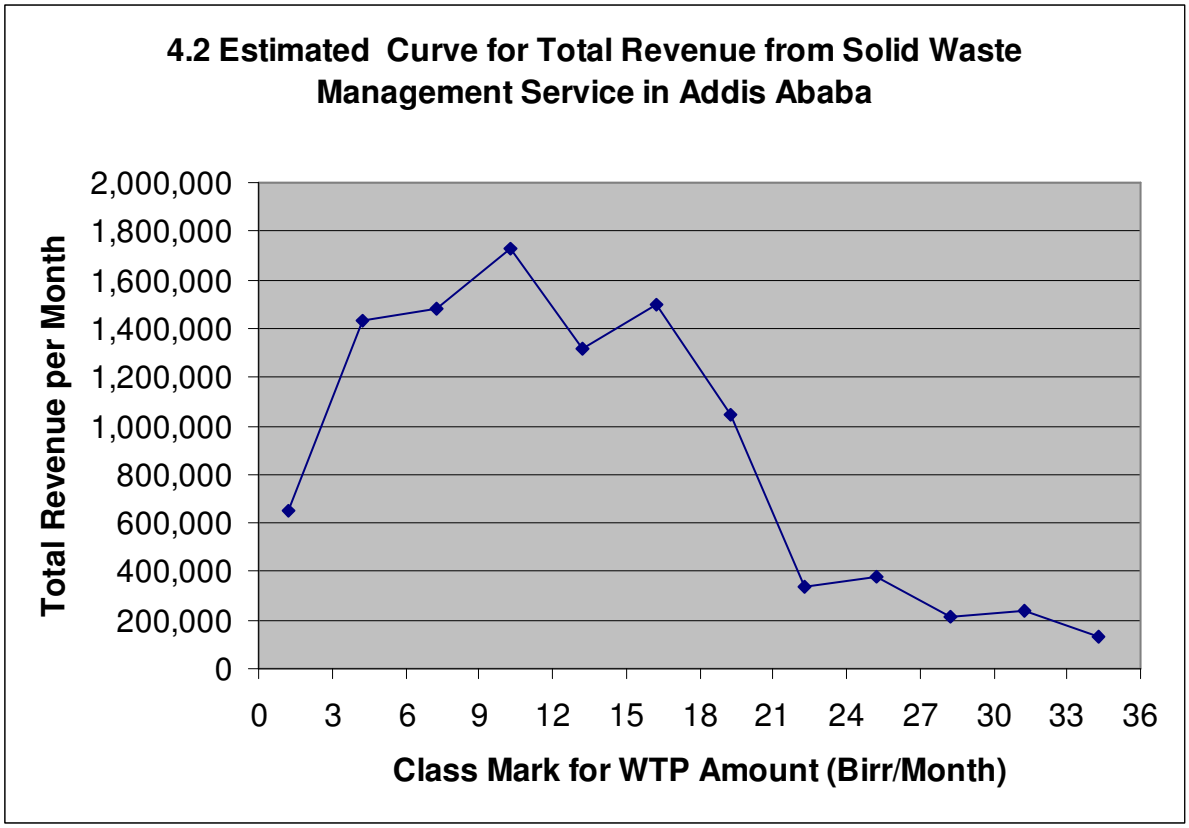
The grand total willingness to pay (3,663,209 Birr) is obtained by summing up total willingness to pay amounts at each class mark, and this is the amount all households in Addis Ababa are expected to pay if the suggested improved solid waste management is to be a reality.

As the monthly payment (class mark) increases, the number of households willing to pay that amount declines. This can be observed from the values col. (9), which continuously decline as class mark increases. This relationship can be more easily observed by deriving a demand curve for the improved solid waste management. For this we measure the class mark along the vertical axis and the number of households willing to pay at least that class mark per month along the horizontal axis.

As shown in figure 4.1 the demand curve has a negative slope like most economic goods under normal conditions. This implies that increasing price has a disincentive effect on the demand for improved solid waste management, keeping all other factors constant.



Total revenue (Col. (10)) that can be collected from charging a given price is obtained by multiplying the class mark by the corresponding total number of households willing to pay at least that amount (col. (9)). AS can be seen from Col. 10, total revenue first increases as monthly payment increases and reaches a maximum of 1,729,626 Birr per month when the monthly payment is 10.25 per household. After that it decreases and reaches a minimum of 129,396.50 Birr per month at the highest service charge due to a small number of households (only 3778) willing to pay that amount. This can also be seen from Figure 4.2.



Since the service of solid waste management is a public and merit good, its price should not be fixed at revenue (profit) maximizing level but the issues of efficiency and equity have to be considered.

According to Abera (1997), the total cost of the present solid waste management is about 21.11 Birr /m^3, including both operational and capital cost. The yearly solid waste generation by a household is about 0.854 m^3. From this it means that, the city government spent 18.03 Birr per year to give the current solid waste collection and disposal service for a household. At the lower service charge of 1.25 per month, annual payment from a household will be 15 Birr. Which implies 83.20 % cost recovery. But, this is only if the department charges the lowest price to all households. And if the different income group areas are to be charged, their mean willingness to

pay, then it means that amount collected from a household in low income area with a mean value of 2.96 will be 35.52 Birr per annum. While for the middle income areas with a mean value of 7.76 Birr, the annual collection from a single household will be 93.12 Birr and for a household found in a high income area with a mean value of 13.07 Birr per month the annual collection will be 156.84 Birr. This suggests that there is a very wide room for cost recovery by improving the existing service. We must remember that the value given by households in the survey is not for the existing service but it is for the hypothetical improvement. The result shows that improving the service from its very low current level might not be more costly than the current service since households in Addis Ababa are very much willing to pay for improvement in solid waste management. There is also a possibility of cross subsidy in case some households are unable or unwilling to pay since the middle and high income households are giving higher willingness to pay amounts.

5. Summary and Conclusion

This study was initiated by a major environmental hazard the people of Addis Ababa are facing. Inadequate supply of solid waste management has always been a main environmental problem in the city. The major cause of this problem is inadequate finance for this service. Hence the main objective of this study is to see the possibility of cost recovery by looking at the demand side of solid waste management in Addis Ababa, through service charges. Though it has never been implemented on the ground, some proposals on service charges for solid waste management have been prepared in Addis Ababa. But all of them concentrated on cost recovery and "All generators should pay" principles without looking at the ability and willingness to pay of households for this service directly. This study tries to fill this gap. For this the Contingent Valuation Method (CVM) is used to estimate the value households in Addis Ababa give for an attempt to improve solid waste management. Four hundred twenty four randomly selected households were interviewed after stratifying kebles in to different income group. The elicitation technique used was closed – ended with an open ended follow-up.

Information gathered from the survey was also analyzed using descriptive statistics and econometrics models. The descriptive analysis indicate about 9.95% of households interviewed have no primary storage receptacle. Despite earlier believes that plastic materials are least commonly used for storage, this research discovered that 51.48% of the available primary storage receptacles are made of plastics. This might be the result of recent changes of patterns in favor of plastic materials, which are becoming most common in every activity due to their relative inexpensiveness. This increase in quantity of plastic materials is complicating the environmental problems of Addis Ababa. Other materials from which primary storage receptacles are made include metals, wood (bamboo), sisal and some other.

About 34.47% of households in Addis Ababa dispose their solid waste into secondary containers (use of transfer station and block system). This system is less common in low income areas of the city due to its requirement of space. About 15.78% of households use trucks (Side – loaders and compactors) while 11.17% of households try to manage their waste themselves by digging a hole bury and/or burn in the compound or in the village. Only 4.5% of households most in high and some in middle income areas use organized private solid waste collection service with a monthly service charge of 10-25 Birr per household who say they are highly satisfied (94.76%) with what they are doing.

From the interviewed households, 140 (33.98%) reported to practice illegal dumping by throwing the refuse into an open space, street or rivers. This is increasing the cost of street sweeping in main roads of the city and also the rivers of Addis Ababa are carrying various wastes in to the country side with its own implications on the health of the people who use the rivers water for various activities including drinking without any treatment. Illegal dumping is more common in middle income areas compared to other areas which could be the result of wider space as compared to low income areas. This may be due to less service provision compared to high income areas. The survey results show that only 54.86% of the households are getting solid waste collection service including those getting private collection services. This shows that the department is serving almost only half of the total household in Addis Ababa. The department says there is 70% coverage, but this is based on daily generation and collection and not on the number of households getting collection services. To reduce the health and other environmental risks from inadequate solid waste management, it is high time the department tries to provide solid waste collection service at household level, especially in low and middle income areas where these problems are most severe.

Given this service coverage it is not surprising that the households in Addis Ababa are overwhelmingly (91.02%) dissatisfied with what the government is doing in this area. And the majority (91.02%) of the respondents feel that households have to cooperate (including in financing) with government to improve this condition.

The mean monthly willingness to pay amount was 7.09 Birr per household for the whole sample while for low, middle and high income areas the corresponding figures are 2.96, 7.76 and 13.07 Birr per month, respectively. These figures in general indicate there is a possibility for cost recovery or even for profit if acceptable solid waste management is provided at household level. These willingness to pay amounts are much larger than the proposed sanitation fees by earlier studies.

The total willingness to pay amount from the total households in Addis Ababa is 3,663,209 Birr per month. The maximum total revenue that can be collected per month is 1,729,626 Birr when a service charge of 10.25 Birr per month per household is charged.

The first most preferred payment vehicle is a monthly charge collected by its own, i.e., with out relating it to any utility charges.

Based on the nature of the data, a Tobit Model is used to identify factors explaining the amount a household is willing to pay. Tobit model was selected due to the censoring of willingness to pay amount at zero. The Probit Model is also used to identify factors responsible for being willing or not willing to pay for the proposed improvement.

The Tobit Model shows that the willingness to pay amount is affected by various factors. Income of household, time spent in the area, quantity of waste generated, responsibility of solid waste management, education dummies, being the owner of the house in which one is living and the number of children in the household have positive and significant effects on willingness to pay. Respondent's age has a negative and significant effect on willingness to pay amount. The starting price does not significantly affect the willingness to pay suggesting there is no starting point bias. The rest of the explanatory variables (sex of respondent, marital status, respondent status in the household, case of disease in the household) were also found to be insignificant to explain willingness to pay.

In the Probit Model the starting price, sex of respondent, status of the respondent in the household, responsibility of solid waste management, case of disease in the household and housing arrangement are found to be insignificant. In this model age of respondent has a negative and significant effect on willingness to pay like in case of Tobit model. Number of children in the household, income, time spent in the area, quantity of waste generated and educational dummies have a positive and significant effects on willingness to pay.

The identification of the variables and their relative importance in explaining the willingness to pay amount might help to tap the maximum willingness to pay of households for solid waste services in Addis Ababa, if and when service charges are implemented.

Policy implications of this study can be summarized as follows: -

- Service charges for solid waste management should be based on willingness and ability to pay than making it flat and compulsory across all income groups. This means service charges should be set at a level that does not encourage illegal dumping and maximize cost recovery. The proposed solid waste management fees by various researchers in the past have not looked into the willingness and ability to pay of households seriously. As a result most of them suggested a sanitation fee much lower than what the market reflects. Therefore, this study recommends that the proposed sanitation fees need to be revised before they are put into operation.

- Resources spent on education are well spent resources as far as improving solid waste management is concerned. The city government needs to under take educational campaign in the city on how to deal with solid waste including the avocation of the three R'S (Reduce, Reuse and Recycle).

- This research has witnessed road problems in various parts of the city especially in low and middle income areas (Some respondents have expressed the problem-see Section 3.3). Therefore, minor road construction has to be encouraged and supported. These roads are very important in increasing truck efficiency by reducing the time to visit a site and also helps to reduce the cost of spare parts.

- The service of solid waste management seems to be biased in favor of high income areas, and this has to be corrected so that no one get more than its 'fair' share at the expense of others.

- Households report lots of trouble in primary storage. Hence the department should try to introduce standardized waste storage receptacles which are affordable to poor households through cross subsidies.

- Environmental Policies and laws have helped a lot to bring a desired result in many parts of the world. In Addis Ababa there are some environmental laws prohibiting activities that harm the environment. For instance there is a law against illegal dumping of solid wastes in Addis Ababa. But the result of this study shows that 33.98 % of the households are practicing illegal dumping. Therefore, for laws to be effective people need to know they exist and fast court ruling should be given on those violating environmental laws.

5. BIBLIOGRAPHY

Abera Kumi. (1997). "A Comprehensive Overview on Addis Ababa Municipality Solid Waste Management and Its Environmental Health Inspection Services" Environmental Health Department Region 14 Administration Health Bureau, Addis Ababa, Ethiopia.

Addis Ababa City Government Annual Health Reports: 1990-1992 E.C. Addis Ababa, Ethiopia.

Addis Ababa City Government (1997). "The Conservation Strategy of Addis Ababa:Policy and Strategy on Natural Resource and Environment" (Vol.2). Regional Conservation Strategy Secretariat, Addis Ababa City Administration Environmental Protection Bureau. Addis Ababa, Ethiopia.

Addis Ababa Environmental Hygiene Department (2001). The first Quarterly Report for Fiscal Year 20001/2002. Addis Ababa, Ethiopia.

Alemu Mekonnen. (2000). "Valuation of Community Forestry in Ethiopia: A Contingent Valuation Study of Rural Households". **Environment and Development Economics.** 5 (2000): 289-308.

Altaf. A.A. and Deshaz O. J. (1996). "Household Demand for Improved Solid Waste Management: A Case Study of Gujarwala Pakistan'.**Word Development**, Vol. 24, No. 5, pp 857-868.

An Y. M. (2000). "A Semiparametric Distribution for Willingness to Pay and Statistical Inferance with Dichotomous Choice Contingent Valuation Data". **American Agricultural Economics Association.**

Bahl R.W. and Johanes F.L. (1992). "Urban Public Finance in Developing Countries." Oxfored Univericity Press. New York.

Barton C.R. (2001). "The Role of the Private Sector in Municipal Solid Waste Service Delivery in Developing Countries: Key to Success." "The Challenge of Urban Government: Policies and Practices." Freire M. and Stren R. (editors). World Bank. Washington,D.C.

Baumol W.H and W.E Oates (1988). "The theory of Environmental Policy" (2nd edition) . Cambridge University.

Bernsteins J.D.(1993). " Alternative Approaches to Pollution Control and Waste Management: Regulation and Economic Instrument." Discussion Paper. WorldBank. Washington, D.C.

Brookshere D.S and D.L Coursey (1987). "Measuring the value of a Public good: An Empirical Comparison of Elicitation Procedures". **The American Economic Review**: vol.77. No: 4.

Carl B., Janis B. and Freederick W. (1990)."Investment in Solid Waste Management Opportunities for Environmental Improvement." Working paper. World Bank, Washington, D.C.

Carlsson, F. and Lundstrom S. (2000)."Political and Economic Freedom and the Environment: the Case of Co_2 (200:5)." **Environmental Economics and Development**. Unit for Environmental Economics Department of Economics. Gothenburg University.

Cointreau S.J (1982). "Environmental Management of Urban Solid Wastes in Developing countries: A project Guide". Urban Development Technical Paper No. 5. World Bank: Washington D.C.

Convery Frank J. (1995). "Applying Environmental Economics in Africa". World Bank Technical Paper No. 277. World Bank. Washington D.C.

Crooper M.C and W. Oates (1992). Environmental Economics. **A survey Journal of Economic Literature.** Vol. XXX No:2.

CSA (1998). "Revised Report on the 1995/1996 Household, Income, Consumption and Expenditure Survey". Statistical Bulletin 204. Addis Ababa , Ethiopia.

CSA (1995). "Analytical Report for Addis Ababa from the 1994 Population and Housing Census of Ethiopia". Vol. (I), Addis Ababa, Ethiopia.

CSA (1995). "Statistical Report for Addis Ababa from the 1994 Population and Housing Census of Ethiopia". Vol. (I), Addis Ababa, Ethiopia.

Dierig S. (1999)."Urban Environmental Management in Addis Ababa: Problems, Policies, Perspectives and the Role of NGO's." Humburg : African Studies.

Dixon J. A and Hufschmidt M.M (1986) (edit) "Economic Valuation Techniques for the Environment". A case Study Work Book. East-West Environment and Policy Institute. The Johns Kopkins University Press. Baltimore, Maryland.

Federal Democratic Republic of Ethiopia Environmental Protection Authority (1998). "Draft for Institutional Responsibilities for the Implementation of the Environmental Policy of Ethiopia." Addis Ababa, Ethiopia.

Freeman III, A.M, (1993). "The Measurement of Environmental and Resource Value: Theory and Methods". Resource for the Future, Washington, D.C.

Gabre Emanuel Teka (1984). "Human Waste Disposal-Ethiopia: A Practical Approach to Environmental Health". United Printers Pvt. Ltd. Co. Addis Ababa, Ethiopia.

Girma Deffar(1998), "Economic Valuation of Environmental Goods in Ethiopia: A Contingence Valuation Study of Abiyata Shall Lakes National Parks Studies in Environmental Economics and Development." Unit For Environmental Economic, Department of Economics, Gothenburg University. "(1998:6).

Gordon S.P and Gordoen F.S. S. G. (1994). "Contemporary Statistics A Computer Approach". McGraw. Hill, Inc.

Gujarati, D. N, (1995). "Basic Econometrics." (3rd edition). McGraw - Hill International Editions. Economic Series, USA.

Hammer J.S and Shetty S. (1995) "East Asia Environmental Principles and Priorities for Action." World Bank, Washington, D.C.

Hanemann W.M (1991). "Willingness to Pay and Willingness to Accept: How much can they differ". **American Economic Review.**

Huda S.N. (2000). "The Market Based Instrument." A Review for Application for the Management of South Africa's Environment Environmental Economics and Development. Unite for Environmental Economics. Department of Economics, Gothenburg University. (2000-2).

Karman B. (1997). "The Contingent Valuation Method: a Contribution to the Discussion." Kompendiet. Gutenberg. Memorandum 230.

Kreimer A. and M. Munasinghe (1992). (edit.) . Environmental Management and Urban Vulnerability. World Band Discussion Paper. Washington DC.

Legal Notice No. 1/1986 E.C "Hygiene and Environmental Sanitation Regulation for the Region 14 Administration". Addis Ababa, Ethiopia.

Linn J.G. and R.W Bahl (1992). "Urban Public Finance in Developing Countries." Published for the world Band. Oxford University Press. New York.

Long J. Scott (1997). "Regression Models for Categorical and Limited Dependent Variable." Sage Publication.

Luc L. (1998) " Instrument for Environmental Management." "Environmental Management in Practice: Instrument for Environmental Management." Nathan B. and etal (editors). (Vol.1). T.J. International Ltd. Padstow, Cornwall. Great Britain.

National Bank of Ethiopia (2000/2001). Quarterly Bulletin. First Quarter 2000/2001. Volume 16, No. 1, Addis Ababa, Ethiopia.

Madala G.S. (1983). "Limited - Dependent and Qualitative Variables in Econometrics." Cambridge University Press.

Maddala G.S (1992) "Introduction to Econometrics" (2nd edition). Prentice - Hall. U.S.A.

Mitchell R.C and R. T. Carson (1988). "Using surveys to value Public Goods: The Contingent Valuation Method." Resource for the Future.Washington D.C.

Mlay Wand and Ahmed A.G.M (1998)(edits.). "Environmental and sustainable Development in Eastern and Southern Africa: Some Critical Issues". Anthony Rowe Ltd. Chiphenham, Wiltshire. Great Britain.

Onwujekwe O. (2001). "Searching for a Better Willingness to Pay Elicitation Method in Rural Nigeria: The Binary Question with Follow-up Method Versus the Bidding Game Technique." Health Economics. Nº 10:pp.147-153.

Pugh M. and P. Rushbrook (1999). "Solid Waste Landfills in Middle-and Lower Income Countries: A technical Guide to Planning, Design, and Operation." World Bank. Washington D.C.

Rogat J. (1998). "The Value of Improved *Air* Quality *in* Santiago De Chile." Kompendiet, Gutenberg.

Sasseuille D.R. and W.G Wilson (1999). "Sustaining Environmental Management Success: Best Business Practices from Industrial Leaders". John Wiley and Sons. Inc.

Schelhaas R.M (1982). "Solid Waste Disposal and Utilization in Developing Countries." Bulletin 310. Department of Agricultural Research, Royal Tropical Institute, Amsterdam.

Spending L. (1996). "Environmental Management for Business.". John Willey and Son Ltd.

Sterner T. (Forthcoming). "The Selection and design of Policy Instruments: Applications to Environmental Protection and Natural Resource Management." The World Bank and Resources for the Future.

Tsegabirhan W/Giorgies. (1999) "Estimating Willingness to Pay for Irrigation Water*: A* Contingent Valuation Case Study-on Small Scale Irrigation Schemes in Tigray-Ethiopia." (thesis). Addis Ababa University, School of Graduate Studies.

Unemol L., J. Bojo and K. G Maler(1992)(2nd edit.). "Environment and Development: An Economic Approach." Kluwer A Cademic Publishers. Netherlands.

United Nations Environment Programme (UNEP) (1987). "Policy Guidelines for the Control of Environmental Pollution in Urban Areas of Developing Countries." Nairobi, Kenya.

Vredin M., (1997), "The African Elephant, Existence Value and Determinant of Willingness to pay." Umeas University, Umea Economic Studies No. 441.

Warford J.J and G. Schramm (1994).(editors). "Environmental Management and Economic Development". Johns Hopkins University Press.

World Bank (1995)."Maintaining the Environment". The World Bank Group and the Environment since the Rio Earth Summit. Washington, D.C.

World Bank (1997). "The Impact of Environmental Assessment." A review of World Bank Experience. World Bank-Technical Paper N^{o}. 363. Washington, D.C.

WHO (1992). "Our Planet, Our Health": Report of the WHO Commission on Health and Environment, Geneva: WHO.

WHO (1994). "Global Comparative Assessments in the Health sector: Disease Burden, Expenditures, and Intervention Packages." Geneva: WHO.

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Appendix

Household Questionnaire (Main Survey)

This survey is being undertaken by a student of Addis Ababa University Faculty of Business and Economics in the Department of Economics as partial fulfillment for the award of MSC in economics. This questionnaire is designed to obtain information on the current situation of solid waste and households' willingness to pay for an improved solid waste management in Addis Ababa.

The information collected will be confidential and for academic purpose only. Thus you are requested to participate in this discussion as truthfully as you can.

Name of the interviewer: _____

Income Group: _____

Date of Interview: _____

Section 1 Household Characteristic

1. Name of Respondent: _____
2. Name of Head of Household: _____
3. Address:

   Wereda: _____ Kebele: _____ House N^{o}. _____.

4. Gender of Respondent

   1. Male 2. Female

5. Genders of Head

   1. Male 2. Female

6. Age of Respondent_____

7. Age of Head_____

8 Respondent Marital status

1. Married 2. Single

9. Head Marital Status

1. Married 2. Single

10. What is the total number of members of your household?

_____ Adults

_____ Children below 15 years of age.

11. Educational level of Respondent_____

12. Educational level of Head_____

13. Household Head Profession

A. Government sector

B. Private sector

C. Own Business

D. Small own account Worker

E. Not currently Working for Money

14. How much do the head of the household get monthly (in Birr)? _____

15.Other monthly income of the household from other members and other sources (in Birr)? _____

16. Main monthly Expenditures of the household (in Birr)

A. Housing _____

B. Food _____

C. Energy Consumption (Electricity, Diesel, Charcoal, Firewood, etc.,)_____

D. Phone_____

E. Education_____

F. Health_____

G. Other Expenses ('Eder', 'Ekube', etc.) _____

17. How long have you been staying in this house (in Birr)?_____

18. Housing arrangement?

A. Privately Owned

B. Rented from kebele

C. Rented from Rented Houses Agency

D. Rented from individual

Section 2: Current Situation of Solid Waste Management

19. How many 'Kurtu' of solid waste are generated in your household per week? ___

20. Do you have a storage receptacle for solid waste in your house or in your compound?

A. Yes B. No

If Yes, go to Question 21

If No, go to Question 22

21. What is it made of?

A. Plastic B. Metal C. Wood (Bamboo) D. Sisal

E. Other (specify)_____

22. What are the main problems you encounter in solid waste storage?

_____

_____

23. How do you dispose off your solid waste?

A. Take it to the nearby secondary storage receptacle ("Genda")

B. Digging a hole around the house / in the village and bury or burn it

C. Throw it on an open space or on the street

D. Throw it in to the nearby river

E. Private collectors take it

F. Any other (specify) _____

If the answer is "E" go to Question 24

24. A) How much do you pay for this service per month? _____

B) How many times they collect your waste per week? _____

C) Are you satisfied with their service? _____

25. Is your household getting the services of solid waste collection or disposal from the government?

A. Yes B. No

26. Are you satisfied with the existing waste collection and disposal service Provided by the city government?

A. Yes B. No

27. What do you suggest to improve this condition?

_____

_____

28.Who do you think is responsible to properly manage solid waste (for instance financing it) in Addis Ababa ?

A. The city government only B. Households only C. Both

29. Which of the following do you think is the best institute to handle solid waste management in Addis Ababa?

A) The city government B) Private companies

30.What are your reasons for choosing the city government/private companies?

_____

_____

31.What problems do you think, households face as a result of mishandling solid waste?

_____

_____

32.Can you mention some diseases related to poor solid waste management?

_____

_____

33. Did any of your family members suffered from (died of) any of the mentioned disease in the past one year?

A. Yes B. No

Section 3 Households' Willingness to Pay for Improved Solid Waste Management

Assume that the city Government is planning to provide an improved solid waste management in your area. Suppose this service involves collecting your solid waste by the house twice every week, transport the waste safely where it is going to be disposed off and the disposal involves making quality compost from decomposable solid waste and manage undecomposable wastes separately by recycling those which can be recycled and the reset will be landfilled properly.

However, implementing this program is very costly. Therefore, households are required to pay for this service.

34. Would your household be willing to pay **Birr 2.50/8.00/20.00 per month** for this improved solid waste management service?

    A. Yes B. No

35. What is the maximum amount your household is willing to pay per month (in Birr)?_____

    Go to Question 36, if the maximum willingness to pay is positive.

    Go to Question 37, if the maximum willingness to pay is 0.

36. In what form should the money be collected?

    A. With water bill

    B. With electric bill

    C. On its own

    D. Any Other (specify)_____

37. Could you tell me the reason why your household does not want to pay anything for this improved solid waste management?

A. We are poor and we cannot pay

B. We are satisfied with the current situation (it does not need improvement)

C. Proper management of solid waste is the responsibility of the government

D. Other reasons (specify)_____

_____