ADDIS ABABA UNIVERSITY

College of Business and Economics

Department of Economics

'' Estimating Willingness To Pay For Continued Use Of Single Use Plastic Shopping Bags, Addis Ababa, Ethiopia ''

By

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DECLARATION

I, Saron Chali Gemechu, declare that the entailed "**E*STIMATING WILLINGNESS TO PAY FOR CONTINUED USE OF SINGLE USE PLASTIC SHOPPING BAGS, ADDIS ABABA, ETHIOPIA*** '' submitted to the department of Economics, College of Business and Economics Addis Ababa university in partial fulfillment of the requirement from the degree of masters of science in Economics is my original work and hence, declare that this thesis has not been submitted to any other institution anywhere and anytime.

SARON CHALI GEMECHU

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CERTIFICATION

This is to certify that the thesis entitled ‘’***ESTIMATING WILLINGNESS TO PAY FOR CONTINUED USE OF SINGLE USE PLASTIC SHOPPING BAGS, ADDIS ABABA, ETHIOPIA’’*** is the original work of Ms. Saron Chali Gemechu, who carried out the thesis under my guidance. Furthermore I confirm that, to the best of my knowledge this thesis has not been submitted to any other institution and does not form part of any thesis on the basis of which a degree or award was confirmed on an earlier occasions by this or any other candidate.

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Table of Contents

Contents Page

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ABSTRACT

Addis Ababa, the capital city of Ethiopia, is a diplomatic center for African union, United nation and also regional head quarter for big organizations like, UNDP, UNICEF, and FAO etc. Hence great focus must be given to the city in order to keep the attractiveness and wellbeing of the environment. But now a day, plastic shopping bags which are used to carry goods from the grocery and supermarkets are causing major problems. Their nature which is light weight, easy to carry and freely provided at the point of purchase contributed to the mismanagement and irresponsible disposal of these bags, which in turn caused plastics to be everywhere like in the streets of Addis Ababa. Hence this adverse effect must be alleviated through either shifting to using other environmentally friendly bags or proper management through intervention of appropriate policies to manage plastic bag wastes. The study has attempted to investigate the willingness to pay for plastic bag tax and the determinant of willingness to pay for the tax using Contingent Valuation Method. Additionally, the study employed three econometric models. These are Tobit Model, Probit Model and Bivariate Model. The mean willingness to pay for a tax on single use plastic shopping bags was obtained using the three models. Furthermore, the study found that tax rate on plastic bags to be highly elastic and for a higher tax on plastic bags people tend to switch to other bags which have comparatively less price.

KEY WORD: CVM, Probit, Tobit, Bivaraite

LIST OF TABLES

LIST OF FIGURE

Appendix

List of Abbreviation

CVM - Contingent Valuation Method

CSA - Central Statistical Agency

CACs - Command and Control

EPHC - Environmental Protection and Heritage Council

FAO - Food and Agriculture Organization

LDPE - Low Density Polyethylene

OLS - Ordinary Least Square Method

PSB - Plastic Shopping Bags

RB - Reusable Bags

SWM - Solid Waste Management

UNDP - United Nation Development Program

VAs - Voluntary agreements

WTP - Willingness to Pay

WTA - Willingness to Accept

CHAPTER ONE: INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Plastic shopping bags are polymer carrier bags utilized at the point of sales for carrying and transporting tradable goods. This shopping bag does not include plastic that are used for storage, dry cleaning, garbage bags and packaging bags (Nolan, 2002). EPHC (2007 Page 14) also defines plastic shopping bag as "a carry bag, the body of which comprises polymers in whole or part, provided by the retailer for the carrying or transporting of goods, but does not include a carry bag which complies with prescribed design criteria".

Plastic shopping bags was first designed and made from plastic by Swedish Engineer, Sten Gustaf Thulin in 1960's. The plastic bag was composed of Low-Density Polyethylene. However, modern civilization has been enjoying some benefits from the use and production of plastic shopping bags. According to Mesthane (1986) plastic carrier bag or sometimes called single- use bags created a new opportunity for carrying groceries at home and also somehow solved problems for waste disposal. Park (1975) stated that the usage of plastic carrier bag by consumers as a form of social change. The bags are popular to consumers not only because they are durable, versatile, convenient, functional, light weight, strong and hygienic but also due to the reason that they are freely provided at the time of purchase to consumers; easy to store and transport due to their thinness and lightness nature. Hence due to their free availability and easy transportation there is mass consumption and mis-uses of the product. However, tension does exist between convenience and environmental welfare. In order to capture the complexity of the impact of plastic shopping bag (PSB) on environment it is relevant to have some knowledge about the composition of plastic. Supermarket shopping bags are made of Low-Density Polyethylene (LDPE).One of the main problems of polyethylene is that without special treatment it is not readily biodegradable, and thus accumulates and pollutes the nature environment.

In general plastic shopping bags have two features that contribute to pollution of the natural environment. The first problem to the environment is degradability issue, plastic shopping bags (PSB) are only broken down through weathering because no biological organisms exist that can break the material down. Hence, they are resistant to biodegradation. According to studies plastic bags are estimated to take from 500 to 1000 years to break down and therefore they persist in the environment being visual pollutant. The other effect is manifested through its transportability

that is due to light weight nature of plastic bags they are easily transported by wind and water. As a result, it pollutes landfill, local landscapes, and water and storm sewer systems and water bodies. Some counties even have pet names for plastic bag pollutions; Chinese call them 'white pollution', in South Africa their boundlessness gave them the title of 'national flower' and 'road side daisies' (Kelly (2006)).

The environmental, socio-economical and political impact of plastic shopping bags have been the issue of increased world concern and Medias have been giving attention to the impact around the world (ACG, 2006). Plastic shopping bags are having significant impact on ecosystem process and biodiversity by affecting wild life feeding, hormone production, creating toxic chemicals which contributes to the loss of wild life causing impact on tourism industry and those employed with in. Moreover, socio-economic impact contains damage caused to properties such as buildings, cars, boats, and blocked drains, as well as excessive use of non-renewable resources such as oil and some natural gases. In general, according to Nolan (2002), plastic shopping bags have become a politically incorrect symbol of the threat to the environment as a whole.

As studies mentioned, general consumption of goods and services is low in developing countries compared to developed countries. This consumption also includes plastic bags consumption, which is low in developing countries compared to developed countries. This is associated with low economic development and low standard of living. However, the effect of plastic bags in particular has already become a major environmental concern in many African countries. So deep was the anxiety on plastic waste in African countries that it became one of the major discussed issue in the First African Experts Meeting on the Ten Year Frame Work Programme On Sustainable Consumption and Production (Girum, 2005).

According to historical records, the production of plastic in Ethiopia dates back to the time of Emperor Minilik II. A British company was the first to establish plastic producing plant in Ethiopia. However, it failed to convince Ethiopians to use its plastic bags. That put an end to it. Nearly a century after its closure, life without plastics appeared to be unbearable in Ethiopia. As a result, multibillion-dollar industries took over in producing plastic bags. Initially plastic bags were introduced in cities to solve problems that consumers face in carrying goods purchased from market. Moreover, they also used it for packaging and storing agricultural and industrial

products. However due to its improper disposal and lack of responsible management, its adverse impact on the environment both on natural and man-made became more than their advantage through time.

According to Mulu (2007), in Ethiopia, plastic bags are one of the major solid wastes causing major problem. Plastic bags are more used in urban areas compared to rural areas which is implies demand is higher in the cities. Additionally, according to AACA (1998), Addis Ababa is the capital city of Ethiopia and also a diplomatic capital for African Union, the United Nations Commissions for Africa and regional headquarters for UNDP, UNICEF, UNHCR, FAO and ILO. Hence great focus must be given to the city by putting in place an efficient, effective and well-organized waste management system in order to keep the beauty and attractiveness of the city.

In Addis Ababa city, plastic bag wastes are causing series problem by affecting animals through injection that is affecting their digestion process and human health through facilitating the reproduction of disease-causing organisms. Moreover, it is adversely affecting agricultural productivity through blocking drainage and affecting the quality of the soil. Consequently, the City Government issued regulations on the management of plastic bag waste in order to minimize the effect. According to EPA (2006), three steps were proposed as an intervention in the waste management. The first one is intrusion in production, importation and use. The second is through saving resource by sorting, reusing and recycling. The last is to collect and treat waste that is through reducing bulk and properly transporting the waste to land sites. The goal of these kinds of programs has been to decrease plastic bags in landfills, streets, aqua-environment, or to prevent flooding in urban areas and also mitigate risks to human health.

Globally, a number of authorities and government bodies around the world have adopted programs aimed at reducing the use of plastic shopping bags. A wide range of options were used to reduce the presence of plastic bags around the world. Both reusing and recycling helped reduce the number of plastic bags that are produced. Incentivization of shops in using alternatives were also used as alternative, for instance, the use of biodegradable or compostable plastic bags, or paper bags were also used as option to reduce plastic bags (Dunn, 2012).

Hence, the policy setting for willingness to pay estimation of plastic bags as well as willingness of individuals to switch to eco- friendly shopping bags is interesting issue to study. As a result, it will create awareness to government bodies as well as the society to show how important plastic bag waste reduction and management are which Ethiopia Government has already set the solid waste concern as National Agenda.

1.2 STATEMENT OF PROBLEM

According to CSA (2007), Addis Ababa, the capital city of Ethiopia, is divided in to 10 sub-cities and 117 districts that comprise the local administration. It is estimated that more than 4 million people are now living in Addis Ababa which is more than 30% of the urban population of Ethiopia and it is one of the fastest growing cities with a diversity of socio-economic activities. Its population has nearly doubled every decade as a result, Addis Ababa has a high rate of unemployment, high concentration of slum dwellers, and very poor-quality housing infrastructure and sanitary development. Furthermore, any pollution to the environment in urban areas exacerbates the already existing poor living and working conditions which in turn aggravates urban poverty.

Higher economic and population growth as well as rapid rate of urbanization in developing countries including Ethiopia has resulted in various environmental challenges. Urbanization is expanding the existing slum area and also creating the new once in many developing countries. According to UNEP (2004), developing and least developed countries lack of proper Solid Waste Management (SWM) which is passing a big treat on the health of the people and reducing the quality of life in urban areas, where Ethiopia is among these countries in which some portion of solid wastes are collected by municipalities and others who do not get the service either burn the waste on the road side or dump it on public places or else throw it on nearby river.

Solid waste management in the city of Addis Ababa is handled primarily by the city Government. The government issues environmental proclamations that are aimed at various sectors of the environment (land, biodiversity etc.). The major environmental body in Ethiopia is the Environmental Protection Authority (EPA). Mahiteme (2005), mentioned that solid waste practice of Addis Ababa indicated that the majority of the people in the city burn their garbage as a primary means of disposal, over 30% of rubbish is collected by the Government or NGO's, a

small percentage of the population disposes of garbage in pits or heap dumps, and substantial percentage of the population in Addis Ababa dispose their garbage by "other means" which is actually not speculated. Meanwhile, due to lack of financial and technical resource, and lack of lined, covered landfills available to receive wastes the situation of solid wastes including plastic wastes are becoming series environmental problems. Hence could be generalized that generation of waste is high and increasing over time but the waste collection service is insufficient.

Asgedom (2014), stated that the current daily Solid Waste generation in the city of Addis Ababa is estimated to be 0.5 kg per capita per day. It is estimated that approximately one million m^3 of solid waste is generated per year of which 200,000 tons are collected each year. Out of these wastes 60% are Organic, 15% recyclable and 25% are others. Plastics including plastic bags contribute the highest share next to combustible laves and vegetables. As a result, plastic wastes are becoming a serious issue when it comes to Environmental pollution and should be given due emphasis.

Plastic bags are now days highly used for shopping than other bags in Ethiopia with an estimated local production of more than 10,000 tons excluding importation. Since 2015, there are more than 486 plastic makers in Addis Ababa. Even thought, the plastic bag industries have created employment opportunities, their negative natural and environmental impact are of major issue unless managed effectively (Mulu, 2007).

These negative impacts can be alleviated through either shifting to using other more biodegradable shopping bags or proper management of the current plastic bag wastes, both of which require information on the demand for these products. This information further helps government bodies design informed policies that are financially and technically feasible to be implemented. Empirical research is needed to generate information regarding household's demand for and attitudes towards these plastic shopping bags. However, such empirical research results are scanty in Ethiopia in general and Addis Ababa in particular.

Generally, only few studies in the area of solid waste in particular plastic bag wastes are done in Addis Ababa compared to what should have been done. And most of the studies mainly focused on the supply side of waste management with little and no reference to the demand side. Furthermore, the need to fill the gap of information on the demand side for policy purpose is

necessary. Hence demand -driven approach which takes consumer preference as measured by their Willingness to pay (WTP) will be studied in this paper.

1.3 OBJECTIVES OF THE STUDY

1.3.1 General Objective

As discussed earlier, many studies in the area of solid waste management in Addis Ababa focused on the supply side and additionally according to the researcher's knowledge there are no studies done on plastic bag wastes in Addis Ababa. Hence the major concern of this study is the generation of demand- driven approach which takes consumer preference from households who are the major producers and victims of solid wastes including plastic wastes. From their responses various conclusions which is important for policy implications will be drawn.

1.3.2 Specific Objective

The specific objectives of this study are to: -

1) To estimate households' willingness to pay (WTP) for a tax on plastic shopping bags using contingent valuation method (CVM) in Addis Ababa
2) To examine the main determinant of households' willingness to pay (WTP) for a tax on plastic shopping bags in the city
3) Examine consumers handling of plastic bag waste and their attitude towards plastic waste management
4) Calculate the aggregate benefits on the response to willingness to pay questions

1.4 Significance of the study

The observation that plastic waste management is becoming a serious problem in Addis Ababa has motivated this study. Ethiopia is one of the least developed countries, as a result of this, budget allocated to address environmental protection and amenities is inadequate. Hence the study provides how policy information can be generated for legislative bodies concerning the level of taxation that would cause current users of plastic bags to reduce its use and switch to using environmentally friendly shopping bags. As a result of this many agents like students, consumers, and society could benefit from the outcome of the study. And also, it could be used also for reference and for education and awareness creation.

1.5 Scope and Limitation of the Study

From the three categories of waste that is liquid, gas and solid, the study focuses on solid waste with particular reference to plastic shopping bags. The scope of the study is limited to finding demand side information about plastic bag waste management from households' in Addis Ababa. Due to shortage of resource and time the geographical scope of the study focuses on Nifas- silk lafto, which is a sub-city were Addis Ababa city waste disposal site is located and high concentration of population and flow of waste is more to show the problem.

1.6 Organization of the Paper

This thesis is organized in to six chapters. The first chapter deals with the introductory part. In chapter two theoretical and empirical literatures will be reviewed. In chapter three research method and methodologies will be discussed. And in chapter four the background of the study area will be discussed briefly and in chapter five findings and results of the study will be presented and finally in chapter six conclusion and recommendations forwarded to improve plastic bag waste management in Addis Ababa will be drawn.

CHAPTER TWO: LITERETURE REVIEW

2.1 OVERVIEW OF PLASTIC BAGS

Single- use plastic bag is a bag used to carry goods and usually provided to customers at the point of sale. The most common shopping bags are made of a type of plastic called polyethylene- or polythene which is a tough, light, flexible, synthetic which is obtained by polymerizing ethylene. Single- use plastic bags are widely used because they are strong, cheap, and hygienic ways to transport goods. In recent years the production of plastics has been raising rapidly that it is estimated that between one and five trillion plastic bags are consumed world-wide each year. However, as mentioned before, some of the characteristics that make them commercially successful, these factors also contribute to making them environmentally unsound when mismanaged and difficult to recycle (UNEP, 2018).

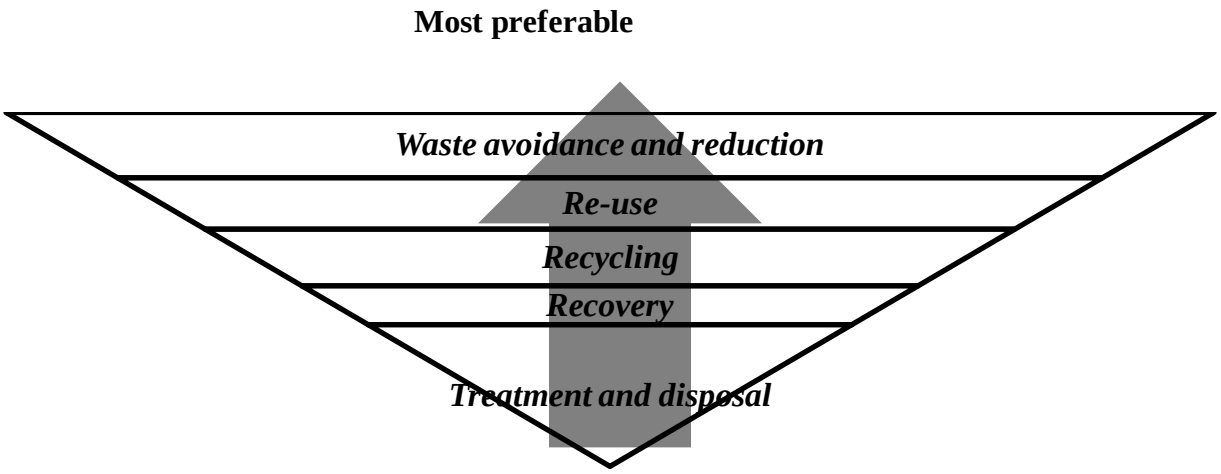
Additionally, Due to their light weight and balloon- shaped design, plastic bags are easily blown in the air and end up in land and water bodies. As a result, they pollute the environment and more likely create damage to nature. When briefly discussed, the Environmental impact of plastics is that they take up to thousands of years to decompose, contaminating soil and water, and creating ingestion and choking by wild life on land and in the ocean. It also blocks water ways and exacerbate natural disaster. Health and social impact are mostly related to the illegal disposal of plastics through open burning which accelerates the release of toxic gases, and improper discharge that quickens pandemics and air-born diseases. Additionally, they create Economic impact through creating visual pollution especially in countries that heavily depend on tourism (Mulu, 2007).

2.1.1 Hierarchy of Plastic Bag Management

The plastic waste management hierarchy consists of options for waste management during the lifecycle of waste. The first choice of measures in waste management is avoidance and reduction, at this step goods are expected to be designed in a manner that minimizes their waste components. This includes reduction of quantity and toxicity of waste generated during production. The next stage is re-using; this is using goods in a similar or different purpose without changing its form or properties. Recycling of waste is the next stage which involves separating the material from the waste stream and processing them as products or raw materials.

The fourth stage is recovery which includes regaining a material, or using the waste as a fuel. At last the lowest level of hierarchy is treating: constitutes sorting, crashing, covering and adding some chemical to suppress bad smell etc. Whereas, the final stage is disposing which refers to safest manner for disposing a waste (Zero waste, 2002). Hence in recent years, majority of countries have adopted and implemented policies for *reducing* PSB, which is the first stage, instead of the rest waste management strategies. Therefore, this paper aims mainly at reducing the use of PSB through proper policy instruments and proper management of plastic bag wastes.

Figure 1.1: Hierarchy of Plastic Bag Management



*SOURCE***:** Zero Waste, 2002

2.1.2 Currently Available Plastic Bag Policy Instrument Option

According to UNEP (2018), different types of policy interventions to reduce single-use plastic bags have been implemented both at national and sub-national levels. Governments around the world have adopted different policy tools starting from Bans to economic instruments. There are three main policy instruments. This are (1) Regulation, (2) Market- based, and (3) Non-Regulatory.

1- ***Regulation Instruments:*** It is also known as command – and -control (CACs), it sets standards to be obeyed with on what, how, when, where and how much to produce, consume, emit and clean up. It is designed in such a way that the motivation for agents to obey comes from fear of fines and penalties. Hence, a good enforcement capacity is

necessary. Most developing countries however lack such capacity and tend to have problem in their CAC approaches (UNEP 2005).

2- ***Economic Instruments:*** It is also known as market- based instruments (MBIs), by implementing an explicit or implicit price on emissions; it creates financial incentives for pollution control. These instruments use market signals to affect the behavior of both consumers and firms towards pollution. These instruments include pollution charges or levies, taxes, subsidies, tradable permits (World Bank, 2008)

3- ***NON- REGULATORY INSTRUMENTS:*** commonly used non-regulatory instrument is Voluntary agreements (VAs). There is no or little government intervention in the VAs, therefore participants are obligated to attain costs of involvement. Even though, voluntary approach allows maximum flexibility, the absence of legal enforcements lead to the possibility of free- riders (UNEP, 2018)

Table 1.1: Example of instruments to reduce Single- use plastic waste

Type of instruments to reduce single-use plastic waste		***Overview of Method***	***Example of applications***
Voluntary reduction strategies		It is based on Volunteer and choice	Promotion of reusable alternatives to single-use plastics (e.g. promotion of reusable bags)
	Public- private partnerships	Agreements sets the main goal, but leaves the choice to the private sector on how to chive the results	Voluntary agreements between government and retailers (e.g. to encourage retails to voluntarily ban or phase out single-use plastic bags) Agreements with producers (e.g. to voluntarily establish Extended Producer Responsibility, including deposit return schemes)
Public education		Requires gradual process and key to change consumers' behavior	Introduction of environmental conservation principles in school curriculums
			Social campaigns
Policy instruments	***Regulatory***	Bans the use, sale, etc. of certain single-use plastic items	Ban (total or partial) Extended producer responsibility
		Laws and acts mandating that packaging manufacturers bear some responsibility in recovering packaging waste	
	Economic	Levies or taxes on certain items	Levy on suppliers
			Levy on retailers
			Levy on consumers
	Combination of regulatory and economic		Bans and levy
			Combination of the above

Source: UNEP, 2018

2.1.3. Alternatives to Plastic Shopping Bags

There are three most commonly suggested alternatives to plastic shopping bags. These are Biodegradable bags, paper bags and reusable bags.

Biodegradable Plastic Bags*:* it was introduced as the most environmentally alternative to traditional bags, and are manufactured using the same positive image of natural fiber and degradability that paper holds. Although biodegradable plastics have been thought to address issues related to plastic shopping bags studies have indicated that they have similar environmental impact as the traditional PSB. It has been suggested that biodegradable plastics need a certain condition for degradation and decomposition. It has also been identified that they pollute waterways with chemicals and also aggravated soli and crop degradation. As a result, it can be concluded that they are not the answer (ACG, 2006)

Paper Bags: these bags are another environmentally friendlier options to PSBs and where introduced before biodegradable bags. However, there are evidences that paper bags are equally or more damaging to the environment than plastic bags. This is due to the production depends on the use of renewable resources that are trees, and milling of trees removes a carbon sink and contributes to land degradation and ecosystem damage. Moreover, Paper bags also take the highest share in emission of greenhouse gases. Additionally, their heavy nature and expensiveness than plastic bags make them a difficult alternative to PSBs (ACG, 2006).

Reusable Bags: are bags used for multiple purposes which are made of canvas, cloth, or some other washable fabric. Even though they cost more they are longer lived and the high initial cost generates a stream of saving in the future. According to ACG (2006), the lowest greenhouse gas emissions are from the use of reusable bags.

As a result, researches have recommended that reusable bags are the best options in replacing single use PSBs. And also, investigations have demonstrated that reusable bags have over all low environmental impact with low resource use, longevity and recyclability (Nolan, 2002).

2.2 THEORETICAL LITERETURE REVIEW

Environmental resources often have the characteristics of public goods. As a result externalities are common and market price cannot be relied on. Hence according to Pearce (2002), valuation is needed to identify a socially optimal decision like optimal pollution tax rate, project appraisals and also it is needed to demonstrate the importance of environmental policy, create market for non- market goods, for cost-benefit analysis of projects and policies, for pricing policies like in the design of policies for access to and maintenance of natural resources. Valuation also indicates losses and gains to different stakeholders, so the potential for trades between gainers and losers can be identified. Hence the valuation of resource needs the theoretical and empirical methods particularly for public and quasi- public goods which have externalities issues or for which property rights are not defined. The valuation of these kinds of resources develops from the welfare economics, for which the theoretical models and empirical methods will be discussed in this section.

2.2.1 The Theoretical Economic Model

Measures of individual welfare change due to change in resource are derived from utility model. To derive these welfare measures, we follow freeman (1993) and consider utility maximization theory [Max U=U (X, Q)] subject to budget constraint. Where, X is quantity for market good and Q represents non- market environmental goods like plastic bags. Hence the individual chooses and set the amount of the two goods that optimizes his/her utility, given the price of the market goods and services, fixed income and environmental resources is:

Max $U(\boldsymbol{X, Q})$ subject to $\sum P_i X_i \leq Y$ where i =1, 2 … N ---------- (2.1)

X

This utility maximization indicates maximizing a well- behaved utility function subject to budget constraint (P.X=Y). Alternatively, the indirect utility function V (P, Y), which is obtained by substituting the demand functions in to the direct utility function, can be used to derive the demand functions (using Roy's identity). The demand functions thus obtained are uncompensated. The indirect utility function, V (p, q, y), is given by:

V (p, q, y) = Max U (X, Q) subject to P*i.* X*i* ≤ y where i=1,2 … N……. (2.2)

X

According to Haab and McConnell (2002), for a given change in price, quality or a change in some public good, there are two equally valid ways of describing money welfare measures. One is compensating and equivalent variation and the other is with the idea of willingness to pay and willingness to accept. They measure the same phenomenon which is the increment in income that makes a person indifferent to an exogenous change.

Haab and McConnel, (2002) and Bateman and Willis, (1999) defined the compensating variation (Cv) and equivalent variation (Ev) measures for change in quantity or quality of environmental resources using the following equations:

$v\ (p, q^1, y- Cv) = v\ (p, q^0, y)$ …… (2.3)

$v\ (p, q^1, y) = v\ (p, q^0, y+ Ev)$ …… (2.4)

Where y is income of individual, p is price of the marketable goods and services, q is the environmental quality or quantity and v is the indirect utility and the superscripts 0 and 1 represents the situation before and after the change. Hence compensating variation (Cv) gives the maximum (minimum) amount of money that can be taken from (must be given to) a household while leaving it just as well off as it was before a fall (rise) in price. On the other hand, Equivalent variation measures the minimum (maximum) amount of monetary that must be given to (taken from) a household to make it as well off as it would have been after a fall (rise) in price.

Hence willingness to pay will be given by CS. That is,

$WTP = CS= e\ (P, Q^0, U^0) – e\ (P, Q^1, U^0) = y- e\ (P, Q^1, U^0)$ ……..……. (2.5)

This measure is related to the Cv measure, the only difference is the restriction on adjusting the purchases of the good in response to the compensating change in income.

On the other hand, if the individual has property right over the good, Equivalent surplus asks what change in income is required given the old price and consumption level of the good, so as to make the individual as well off as that person would be with the new price set and consumption point. Then willingness to accept will be given by ES. That is

$WTA = ES = e(P, Q^1, U^1) - e(P, Q^1, U^0)$ …….2.6

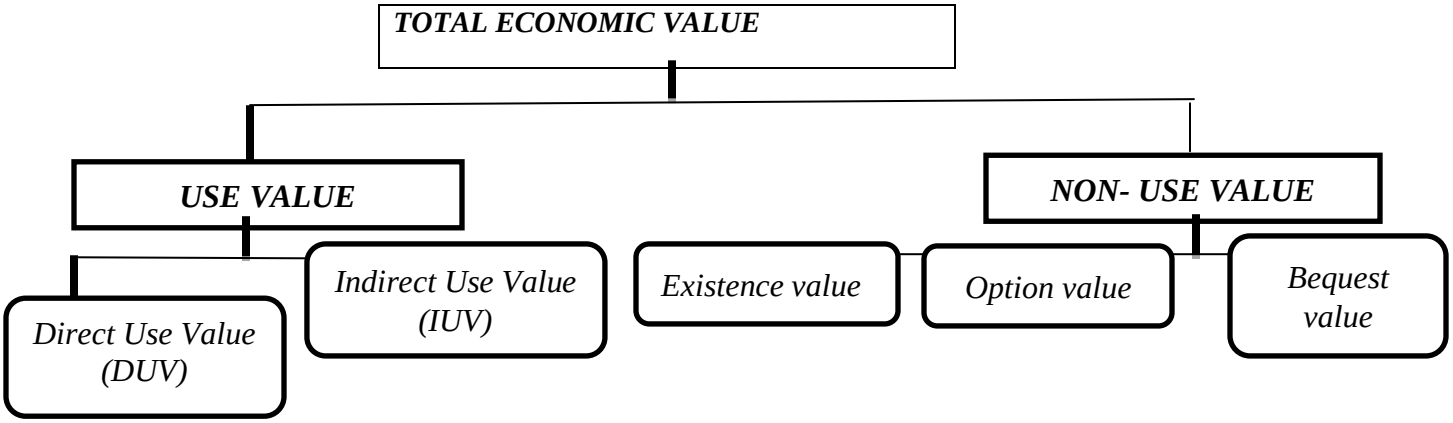
We can generalize that; CS and ES measure the welfare of individuals for change in the environmental resource in monetary value. On the other hand, WTP and WTA are methods used to estimate the monetary value of the welfare change. Furthermore, it could be concluded that WTP and WTA are derived from compensating surplus (CS) and equivalent surplus (ES) welfare measures.

2.2 Component of Value of a Resource (Environment)

The main concern is with economic value defined in a broad sense that is money value to non-market goods and services which are not bought and sold in the market place. Total economic value is composed of use and non- use value. Use value is the utility enjoyed by people who directly use the good whereas, non-use value represents the value that people assign to present the good but do not use in a commercial while both could be measured using willingness to pay or willingness to accept (Hackett and Sharpe, 2006).

Total economic value = Use value + Non-use value

Figure 2.1: Total Economic Value



Use values are classified in to direct use value (DUV) and indirect use value (IUV). Whereas, non- use values which are also known as passive use value or intrinsic value are categorized in to existence value, bequest value and option value. Direct use value is the direct benefit that comes from the use of the resource. As the name indicates indirect value is the indirect benefit that comes from the resource. On other hand, Option value is the potential future benefit of the

resource. Existence value is the value people attach not because they want to use the resource now but because they want to make sure the resource exists. Bequest value is one of the non-use values that are altruistically motivates values, one expects his/her descendants to get the good or service.

2.3 Environmental Valuation Technique

The main problem of scarcity and continuing severe damage and loss of environmental resources necessitated its conservation and raise a fundamental valuation question. Hence to conserve natural resources the values of the resources to its community must be known. There are two approaches to obtaining demand and value information for change in the quantities of non-market goods. These are stated preference method and revealed preference method

2.3.1 Stated Preference Method

According to Freeman (1993), stated preference method which is also known as direct approach is a direct countenance of individual willingness to pay or willingness to accept in compensation for any change in environmental qualities, quantities or both. Values are directly derived from responses to hypothetical questions. Therefore, the method does not depend on market information. The most common methods are Contingent Valuation method (CVM) and Choice Modeling (choice experiment, contingent ranking, and contingent rating).

1. Contingent Valuation Method (CVM)

Kristrom (1999), notes that CVM uses survey questions to elicit from a sample of consumers their willingness to pay and or willingness to accept for a certain change in the level of environmental goods and services, in a carefully structured hypothetical market. It seeks Hicksian measure of welfare influence of hypothetical change in environment conditions. According to history the first CV study was conducted by a consulting company in 1958 in which people were asked their WTP for entering national parks. And Robert K. Davis's, Harvard dissertation, is said to be the first application of the CVM in 1963, which was used to estimate the benefits of outdoor recreation.

In a status report on non-market valuation of environmental resource, Smith (1998) wrote that Contingent valuation seems deceptively simple. Just ask people what a specific hypothetical

resource change is worth to them and assume they will answer the question in exactly the terms it was asked. The standard response of CV skeptics is that "hypothetical questions yield hypothetical answers". There are four main steps in a CVM exercise:

1. Designing and administering the CV survey

CVM study could be designed under different elicitation formats. These are: ***Open Ended Format:*** are CV questions in which respondents provide with a point estimate of his or her maximum willingness to pay for an environmental improvement or minimum willingness to accept compensation. However, even if the maximum WTP or minimum WTA are obtained this elicitation format is not incentive compatible and difficult for decision making. ***Bidding Game*** are CV questions where individuals are iteratively asked whether they would be willing to pay a certain amount. The bid stops until yes changes to no or vice- versa. This method could provide better information on people willingness but could be boring to respondents and may lead to compliance and starting point bias. ***Payment card***: CV survey where respondents are asked to choose a WTP or WTA from a range of values on a card. Hence decisions are influenced by ranges (lists). ***Dichotomous or Discrete Choice:*** is a CVM question format where respondents are asked simple yes or no question of the stylized form (Haab and McConnell, 2002). When we come to administering of the survey, there are different methods of delivery modes: in- person (face- to- face), telephone, mail, and recent e-mail or online survey.

2. Empirical analysis of respondents

The information obtained from the CV survey is analyzed using three ways. The first is examining the frequency distribution of respondents to the WTP questions. The second is to look at the cross-tabulations between WTP responses and socio-economic characteristics of the respondents and descriptive statistics. The last way is using multi statistical techniques to analyze determinants of WTP responses.

3. Estimating and aggregating benefits (WTP and/ or WTA)

Welfare analysis of hypothetical data could use parametric method and non- parametric methods. Parametric estimation method runs regression where as non-parametric method doesn't run regression but come up with estimates. In the case of bidding game, payment card and open-

ended question formats non- parametric method are used. Close-ended formats use both methods. And aggregation is the process of converting the mean bid or bids to the population value figure.

4. Evaluating the CVM exercise

This describes how successful the application of CVM has been compared to other conventional surveys. The validity and reliability are evaluated in this section. Validity of a measure is the degree to which it measures individuals' true value that is his/ her true probability of accepting the offer. On the other hand, reliability is the degree of replicability of a measurement. CVM has several advantages compared to other methods like being inexpensive and fast, there has been and still is raising a lot of debate concerning the reliability of the method (Bateman et al,2002: 297).Due to the reason that CVM is built on hypothetical answers, the major area of critics comes from respondents' responses being far from reality. As a result, there will be biases. The major biases are:

Strategic Bias: occurs when respondents understates or overstate their true willingness to pay to influence either his/her payment obligation or provision of the environment good

Information Bias: occurs when respondent is required to answer for the good or service of which they have little knowledge or no experience.

Starting point Bias: this is where respondents final bid (choice) is affected be the starting value suggested to them in the beginning. This is when the respondents answer fall in the predetermined range of choice

Hypothetical Bias: this occurs due to the hypothetical nature of the payments that is due to the absence of actual budget constraint, what people say they would pay is more than they would actually pay if asked to do so.

Interviewer Bias: occurs when the respondent's response answers to impress the interviewer

Non- response Bias: happens when respondents refuse to answer the hypothetical questions.

2. Choice Experiments

In a choice experiment (CE), respondents are presented with a series of alternatives and asked to choose their most preferred. A baseline alternative, status quo, is included in each choice set for

welfare consistent estimates to be produced. Hence, respondents make trade-offs between the level of the attributes in different alternatives presented in a choice set (Alpizar et al., 2001).

2.3.2 Revealed preference methods

It is a method in which the values of environmental goods are derived by studying the revealed behavior in closely related markets through the application of some model of relationship between marketable goods and environmental services. The main advantage of revealed preference is that it relies on the actual behavior. The best-known methods are travel cost method, hedonic pricing method, and defensive (averting) behavior (Young, 2005)

1. Travel Cost Method

It is also known as recreation demand model. Even though, it was Clawson who first developed the empirical model in 1959, the original idea can be traced back to a letter from Hotelling to the director of the US National Park Service in 1947, which he suggested that the costs incurred by visitors could be used to develop a measure of the recreation value of the sites visited. Travel cost method could be defined as a model of demand for the service of a recreation site. These sites could be parks, lakes, areas with the potential of recreational activity. The model could be used to estimate the welfare effects of the elimination of a recreational site or change in the quality of the site. This method only determines the use value of an environmental good or service. The major drawback of this method is its failure to estimate non-use value and its application being limited to only for valuation of recreational sites (Pearce, 2002)

2. Hedonic Pricing Methods (HPM)

It is also known as hedonic wage model. This method is one of the revealed preference non-market valuation methods which is derived from the characteristic's theory of value (also called the Lancaster- Rosen approach) which is based on the idea that any given unit within a commodity class can be described by a vector of characteristics. The method identifies environmental service flow as elements of a vector of characteristics relating to a marketed good, typically housing. HP seeks to find a relationship between the level of environmental services and the prices of the marketed good, for instance prices of houses. Although, it is dependent on actual market prices, its major drawbacks are that it only involves real property markets and fails to estimate the non-use values of environmental resource (Freeman, 1993)

3. Defensive (Averting) behavior

According to Young (2005), this preference method is used to derive value from household expenditure for welfare gain from improved environmental resource such as clean water. The general assumption of this method is that a rational person is characterized by adopting defensive (averting) behavior if the damage avoided is more than aversive expenditure.

2.4. Empirical Literature Review

To the best of the researcher' knowledge, there is no any research conducted on this area in Ethiopia specifically in Addis Ababa. Consequently, literatures cited in this paper are researches conducted in the area of studies like improved environmental qualities such as improved: Water supply, sanitation services, solid waste management, Electricity services, etc. Hence, in this section the empirical literature, reviews some of the above mentioned non-marketed goods and services.

According to Aklilu (2002), a research conducted on households' willingness to pay for improved solid waste management in Addis Ababa using contingent valuation method (CVM). It was found that income of household to have a positive impact on the willingness to pay. It was also mentioned that age of respondents to be significant and negatively affecting willingness to pay of respondents. Whereas, number of children, time spent in the area, quantity of waste generated and education were found to have a positive and significant effect on willingness to pay.

A research conducted on the willingness to pay for improved water service in Debrezeit, Ethiopia by Gossaye, (2007) using Tobit model, showed that age, household size, water volume, reliability dummy and income variable determine household's willingness to pay for improved water service. Moreover, the age of respondents to positively and significantly affect households WTP for improved water service. On the other hand, Household size, income, and initial bid affects households WTP positively and significantly. Yibeltal, (2011) and Medhin (2006), using an open-ended question which are estimated by OLS also found age of household head to affect households WTP negatively and significantly while income and education positively and significantly affect households WTP.

Alebel (2002), also conducted a research on the determinant of willingness to pay for improved water service, a case study of Nazareth, Ethiopia. The study used primary data obtained from a

contingent valuation survey of 307 households. The elicitation method used was a bidding game and the result showed that gender, income, monthly water expenditure, quality of water and time to fetch water are important variables that explain willingness to pay. WTP is positively affected by income, monthly water expenditure, quality of water and education. Sex of respondent was found to have negative influence on the respondents WTP.

In general, as mentioned above, CVM is most broadly accepted method for estimating total economic value and in most of the literature's income and education level of households positively and significantly affect household's WTP. On the other hand, a randomly sated initial bid amount and age to have a negative and statistically effect on the household's willingness to pay.

Ethiopia is not the first nation to undertake the initiative of implementing a single use bag policy. Introducing taxes and bans on single- use plastic bags provides us with supporting information from the world. Many sources and case studies around the world offers experience to draw up and bring a successful campaign to reduce single-use plastic bags in Ethiopia.

Different legislations were introduced in some countries to reduce the use of plastic bags. These includes plastic Bans, introduction of tax on plastic carrier bags on both consumer and retailers. There was also an introduction of bill to make shoppers pay for plastic bags. In some counties a new legislation was acknowledged which is consumers were having a choice which is only buying the new government regulated bags, shopping with no bags, or taking their own bags or else using reusable bags. Some of these countries include Bangladesh after it was found that plastic was the major cause of floods during 1988 and 1998, Denmark, Hongkong, India, Japan, Kenya, South Africa, Taiwan, USA, Rwanda and some other countries introduced one of the above options for reducing plastic bags. Consequently, the number of plastic bag consumption was reduced in these countries with respect to their policy measures (Kelly, 2006).Even though setting policy by an economic approach for willingness to pay estimation of plastic bags is very challenging especially for developing countries, it is interesting issue for research and it will also augment the feasibility of policy and improve the efficiency of plastic Waste management.

CHAPTER THREE: Methodology of the Study

3.1. Survey and Questionnaire Design

3.1.1. Survey Design

The design of the survey is a double bounded contingent Valuation Survey. CVM is mostly used to estimate the value of non- market goods, and it is also used to elicit individuals' preferences. This is conducted through a dichotomous choice method. That is the respondents will be asked if they are willing to pay a given tax amount on single-use plastic bags. If their answer is yes, the amount of the premium will be doubled in the next question; if their answer is no, another WTP question is asked using a lower bid (the bid will be halved). The double- bounded questions are followed by an open- ended question in order to know the exact willingness to pay of the respondent.

3.1.2 Questionnaire Design

After the development of the first draft of the questionnaire a pilot survey was conducted. Under this pilot survey 20 households were interviewed. The pilot survey is expected to help for two general purposes. First it is expected to provide information for the modification of the main questionnaire so as to make it understandable for respondent. Second, it helps set the three starting bids for the contingent valuation questionnaire part. The questionnaire has four parts. The first part of the questionnaire will present questions relating to households existing single-use bag and reusable bag practice. The second part constitutes question related to attitude and concern of households regarding single- use bags and reusable bags and the third part will present the contingent valuation scenario. Here the respondent is informed about the possibility of hypothetical market and relevant points will be incorporated as much as possible. Additionally, the respondents were asked if they are willing to accept the randomly offered bid using double- bounded dichotomous choice elicitation format. Finally, the fourth part includes household's demographic information such as education, age, sex, marital status, income, family size, etc.

3.1.3 Description of the study area

Among the ten sub-cities that are found in Addis Ababa city, the research chooses Nifas Silk-Lafto sub- city purposely based on the information provided on Central Statistic Agency (CSA, 2007). There are three particular reasons for choosing Nifas silk- Lafto, the first is that it is one of the top three populated sub- cities, which is one indicator of a good sample for generalization, the second is that as discussed in the literatures, household units are estimated to have a higher contribution to the source of waste, and Nifas Silk is found to have a high concentration of household units. Therefore, individuals who are currently living in these sub- cities will be selected from the sampled kebeles accordingly. Finally, the third reason is that it is the sub city where the dump site is found, as a result, there is no doubt that the sub- city contains high proportion of waste than other sub- cities, therefore, the researcher thinks Nifas silk is more descriptive of the study.

3.1.4 Sampling Design and Data Collection

One of the relevant factors for obtaining accurate estimates from CV study is an appropriate and cost- effective sampling design. Hence, the study used two staged clustered random sampling, when designing the sample. First the population frame was divided in to '*Kebeles'* and then four *kebeles* of the target population were purposefully selected from the 10 kebeles of the sub- city. We should note here that, to ensure sample representativeness of the population, the strategy adopted was to cluster the kebeles by household concentration. Hence, *kebeles* were selected because they are the top four *kebeles* with high household concentration. The selected *kebeles* are: *kebele* 06/07/08, *kebele*16/17, *kebele* 03/04/05 and *kebele* 09/14. Second, fifty individuals that reside in each kebeles were selected using systematic random sampling method. Hence, totally 200 households were selected using simple random sampling.

3.1.5 Data source and Type

The study mainly depends on primary cross-sectional data that was obtained from a contingent valuation survey. The study will also use secondary data obtained from central statistics agency (CSA), documents, books, journals and other related organizations.

3.2 Method of Data Analysis

The study employed two kinds of data analysis. The first is descriptive Method of analysis and the second econometric data analysis. Both will be discussed briefly below.

3.2.1. Descriptive Method of Data Analysis

In this section statistical techniques such as mean, standard deviation, and frequency were used to describe the survey data. This analysis is used as a prelude to the econometric analysis and can complement the later.

3.2.2. The Economic and Econometric Data Analysis

3.2.2.1 Economic model

As explained in the theoretical literature review, the economic theory agrees with compensating individuals to make them indifferent as to the original situation. In other words, adjusting individual's welfare for change on environmental resource in monetary value is necessary. WTP and WTA are methods used to estimate the monetary value of the welfare change. As mentioned in Freeman (1993), Willingness to pay is compensating payment that will make the individual indifferent and creates the opportunity to purchase the new quantity of good whose price has changed. It is determined by the difference in money expenditure pre and post change.

$$WTP = CS = e\,(P, Q^0, U^0) - e\,(P, Q^1, U^0) = y - e\,(P, Q^1, U^0) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(3.2)}$$

Where, CS is compensating Surplus, *e* is expenditure, P is prices of market good, Q^0 and Q^1 are before and after change in environmental resource, and U^0 is utility before the change.

3.2.2.2. Econometric Models and Estimation Techniques

Model Specification

The study relied on three econometric models to analyze the study. The first is a Probit model, since we rely on dichotomous responses. The model fits the data at hand. The other is a Tobit Model which helps in determining features affecting the maximum amount of willingness to pay

for a tax on single-use shopping bags. The third is bivariate model which is used to analyze responses to double-bounded valuation questions.

We should note here that the three models are used in order to compare the mean willingness to pay for a tax on single-use plastic grocery bags.

The Probit Model and the Random Utility model (RUM)

The Probit Model

According to Wooldridge (2002), Probit model is one of the well-known models for binary dependent variables which are used to model single- bounded binary answers. The model is derived from a latent variable that is expected to satisfy the classical linear regression assumption. The model is given by,

$$y_i^* = \beta_0 + \sum \beta_j x_i + u_i \quad \text{(3.3)}$$

Where y^* is the latent variable, x_i is the explanatory variable, β_j are the parameters, u_i is the disturbance term which is assumed to be independent of x_i and having a standard normal distribution with mean 0 and variance 1

$$y = \begin{cases} \mathbf{1} \quad \boldsymbol{if\ y} * > 0 \\ \mathbf{0}\ \boldsymbol{other\ wise} \end{cases}$$

Where y is the observed variable

As explained in Wooldridge, (2002), the probability of success is modeled as:

$$P(y = 1/x_i) = F(\beta_0 + \sum \beta_j x_i) \quad \text{(3.4)}$$

Where probability of success is $y = 1$ or $y^* > 0$, and for all real numbers y^*, the function F lies strictly between 0 and 1: $0 < F(z) < 1$ where, $\mathbf{z} = \boldsymbol{y_i^* = \beta_0 + \sum \beta_j x_i + u_i}$

Then the nonlinear Probit model is given by:

$$F(z) = \Phi(z) = \int_{-\infty}^{z} 1/\sqrt{2\pi} * \exp(-z^2/2)\, dx \quad \text{(3.5)}$$

Where $\Phi(z)$ is a standard normal cumulative density function for probit model and F(z) is an increasing function which is strictly between 0 and one.

The Random Utility Model

According to Habb and McConnell 2002, the basic model for analyzing dichotomous CV responses is the random utility model. The concept behind this theory is that even though an individual knows his/her utility for sure, there exists some components which are unobservable

from the view of the researcher. Hence, the researcher can only make probability statement about respondents 'yes' or 'no' responses.

The indirect utility function for the j^{th} respondent can be given by:

$U_{ij} = U_i (Y_j, X_j, \varepsilon_{ij})$……..(3.6)

Where Y_j= jth respondent's income; i=1 denotes the final state and i=0 the status quo (or the initial state); X_j= vector of respondent's characteristics and attributes of a given choice; ε_{ij}= random component of the given indirect utility

A consumer accepts a given initial bid (β_i*) which is introduced due to changes in quality or quantity of environmental good only is

$U1j (yj - \beta i^*, xj, \varepsilon 1j) > U0j (yj, xj, \varepsilon 0j)$ …… (3.7)

Due to the fact that the researcher doesn't know the preference of the respondents, probability statements of 'yes' or 'no' responses are drawn. Hence, the probability of saying 'yes' is the probability of the respondents thought whether they are better off in the given program. For individual j, the probability of saying 'yes' is given by:

$P (yes) = P [u1j (yj - \beta i^*, xj, \varepsilon 1j) > U0j (yj, xj, \varepsilon 0j)]$ ……..…… (3.8)

Assuming the utility function is additively separable in deterministic and stochastic preferences $(U_i (yj, xj, \varepsilon ij) + \varepsilon ij)$, the probability statement could be written as:

$P (yes) = P [u1j (yj - \beta i^*, xj) + \varepsilon 1j > U0j (yj, xj) + \varepsilon 0j]$ …….(3.9)

Hence the Probit model can be given by:

$T_i = \beta' X_i + \varepsilon_i$

Where, T_i is the unobservable individuals actual WTP for environmentally friendly shopping bags. The observable variable is a dummy variable WTPi,

$$WTPi = \begin{cases} 1 \; if \; Ti \geq \beta i^* \\ 0 \; if \; Ti < \beta i^* \end{cases}$$

Where, β' is vector of parameters, X_i is vector of explanatory variables and ε_i is the error term which is normally distributed with zero mean and constant variance.

According to Hanemann (1993), the probability of a 'yes' or a 'no' response, $P^{Yes \text{ or } NO}$ (βi^*), can be determined using random utility maximization which is chosen by the respondent. Hence, despite the fact the individual knows their own maximum WTP, it is known that from the random utility that the individual's WTP is a random variable from the researcher point of view.

Generally, Ti to the observer is a random variable with a cumulative distribution function (cdf) is given by G (Ti; Θ) where Θ is the parameters of the distribution which will be estimated based on the CV survey. The probability of saying 'yes' (P^Y) or No' (P^N) related to the WTP distributions are:

$$P^Y \equiv p\ \{\text{yes to } \beta i^*\} \equiv p\ \{\beta i^* \leq Ti\} = G\ (\beta i^*; \Theta)$$

$$P \equiv p\ \{\text{no to } \beta i^*\} \equiv p\ \{\beta i^* < Ti\} = 1\text{-}G\ (\beta i^*; \Theta)$$

The log-likelihood function for the response to a CV survey using the single- bounded format is given by:

$\ln L\ (\Theta) = \sum \{di^Y \ln G\ (\beta i^*; \Theta) + di^N \ln [1- G\ (\beta i^*; \Theta)]\}$

Where, $di^Y = 1$ if the i^{th} response is yes and 0 otherwise, while $di^N = 1$ if the i^{th} response is no and 0 otherwise

Additionally, one of the central concerns of estimating empirical WTP model which is based on the CV survey is to construct mean of WTP distribution. According to Hanemann, Loomis and Kanninen, (1999), the mean WTP (μ) for the single- bounded Probit model format is given by:

$\mu = - \beta_0/\beta$, where β_0 is the constant or the intercept term and β is the coefficient of the bid posed to the respondent

The Tobit Model

According to Maddala (1992), the censored regression (Tobit) is an alternative method to ordinary least square (OLS), where a Tobit model is applied when the variable to be explained is partly continuous. In other words, the dependent variable which is willingness to pay is partially observed and the latent or unobserved willingness to pay for environmentally eco-friendly shopping bags ($MWTP_i$*) assume zero value for a given part of sample. Furthermore, it could be generalized that $MWTP_i$* is observed if $MWTP_i$*> 0 and not observed if $MWTP_i$* ≤ 0.

The equation for Tobit model is given by:

$$MWTP_i^* = \alpha + \beta xi + \varepsilon_i \quad \text{..... (3.10)}$$

$$MWTP_i = \begin{cases} MWTPi* & \text{if } MWTPi* > 0 \\ 0\ if\ MWTPi* \leq 0 \end{cases}$$

Given the above equation where $MWTP_i^*$ is unobserved willingness to pay; $MWTP_I$ is individuals actual maximum willingness to pay for a tax on single-use plastic bags ;xi is a vector

of independent or explanatory variables; β is a vector of coefficients which is common to all individuals; α is the intercept and $\varepsilon_i$is the error term which is assumed to be normally and independently distributed with zero mean and constant variance. According to Haab and McConnell, (2002), the Mean willingness to pay is given by:

Mean WTP = $\mu = \sum MWTP_i \backslash n$, where n is the number of households in the sample.

The Bivariate probability Model

It is one of the extensions of Probit model which is used to analyze responses to double-bounded valuation question. According to Greene (2012), the bivariant Probit model involves more than one equation, with correlated error terms. This equation is given by as follows:

$y_{1i}^* = X_{1i}\beta_1 + \varepsilon_{1i}$, $\quad y_{1i} = 1$ *if* $y_{1i}^* > 0$, *0 other wise*

$y_{2i}^* = X_{2i}\beta_2 + \varepsilon_{2i}$, $\quad y_{2i} = 1$ *if* $y_{2i}^* > 0$, *0 other wise*

Given the above equation, the probability that $y_{1i} = 1$and $y_{2i} = 1$ is given by:

Pr ($y_{1i} = 1$) = Pr ($\varepsilon_{1i} > - X_{1i}\beta_1$) and Pr ($y_{2i} = 1$) = Pr ($\varepsilon_{2i} > - X_{2i}\beta_2$)

The assumption in a bivariant Probit model is that the error terms have zero mean and one variance, but are correlated (cov ($\varepsilon_{1i}, \varepsilon_{2i} \neq 0$)) with ρ. hence the generic bivariate probability is given by:

Pr ($y_{1i} = 1, y_{2i} = 1$) = $\Phi_2 (X_{1i}\beta_1, X_{2i}\beta_{2,} \rho)$, Where, Φ_2 is a bivariate normal distribution,

Generally, According to Haab and McConnell (2002), the probability of the responses is given by:

Pr (Yes/Yes), P^{YY} = Pr ($WTP_i^1 > B^1$, $WTP_i^2 > B^2$)

Pr (No/No), P^{NN} = Pr ($WTP_i^1 < B^1$, $WTP_i^2 < B^2$)

Pr (Yes/No), P^{YN} = Pr ($WTP_i^1 > B^1$, $WTP_i^2 < B^2$)

Pr (No/Yes), P^{NY} = Pr ($WTP_i^1 < B^1$, $WTP_i^2 > B^2$)

In the doble bound approach, the log-likelihood function can be presented as:

$\log L^{DB} (\alpha, \beta, I_i^{yy}, I_i^{yn}, I_i^{ny}, I_i^{nn}) = \sum I_i^{yy} \log p_i^{yy} + \sum I_i^{yn} \log P_i^{yn} + \sum I_i^{ny} \log P_i^{ny} + \sum I_i^{nn} \log P_i^{nn}$

where I_i^{yy}, I_i^{yn}, $I_i^{ny}$and$I_i^{nn}$are the dummy variables (1, 0) denoting the group to which the i^{th}respondent belong, $I_i^{yy}$are those who answer YES to the first and second bid, $I_i^{yn}$are those who answered Yes to the first and NO to the second, etc.

At last, as mentioned on Haab and McConnell (2002), the mean willingness to pay (MWTP) for bivariate Probit Model is given by:

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

Where α is the constant and β is the coefficient of the bid posed to the respondent

Generally, the estimable model is given by:

$$MWTP_i = \alpha + \beta_1 REIN + \beta_2 REFSIZE + \beta_3 REAG + \beta_4 REED + \beta_5 Bid1 + \beta_6 RESEX + \beta_7 HOUSE + \beta_8 RESUP + \beta_9 REYS + \beta_{10} RbFree + \beta_{11} PERC + \beta_{12} ATT + u_i$$

Where, α is a constant term and u_i is the error term

3.3 Definition of Variables and Hypothesis

The willingness to pay and accept amount and if households are willing to pay a levy or not for a continued use of plastic grocery bags and whether a household is willingness to accept subsidy for switching completely to eco-friendly bags like reusable bags is expected to be affected by many factors. Hence these factors will be discussed with their expected signs below:

Definition for Variables of Willingness to pay and Hypothesis

The definition and expected effect of variables that are hypothesized to affect the dependent variable are discussed below:

MWTP (Mean willingness to pay): this is the maximum willingness to pay for a tax on plastic bags. It takes an open-ended question format and is analyzed using Tobit model.

Willingness to pay 1 (Wtp1): the respondent would be provided with randomly given levy on a single plastic shopping bag bid level (Bid1), and would say 'yes' if he/she is willing to pay the levy on the plastic bag and 'no' if not willing (single bounded dichotomous questions). A dummy variable 1 is given if the respondent is willing to accept the randomly offered bid and 0 other wise.

Willingness to pay 2 (Wtp 2): it is the willingness to pay for single plastic grocery bag tax when its price is Bid 2 (the first bid will be doubled if the respondent response for Bid1 is 'YES' and it will be halved if the response was 'NO').

Bid1: it is the initial Bid of the study, depending on economic theory of demand, higher bid results in lower willingness to pay. Therefore, initial bid is expected to negatively affect the household head willingness to pay and hence negative sign is expected.

RESEX: The sex of the respondent: gender is one of the determinants of household's preference. A dummy variable 1 is assigned if the respondent is male, 0 otherwise. However, the expected sign cannot be determined before the survey.

REIN: The respondent monthly income: is the monthly income of the respondent in terms of birr. In addition, all sources of income and also the sum of the head's and other members of the family are included. Low income respondents are less likely expected to be willing to pay for plastic bag tax, other things remaining constant, than those with high incomes. Hence a positive sign is expected

REMS: Respondents Marital Status: a dummy variable 1 is assigned if the respondent is married; 0 otherwise. The expected sign of the coefficient is negative since married people are expected to be more cautious of health of their family and are responsible for the future, it is expected that they will switch to using Reusable bags instead of paying a higher tax for plastic bags

REED: The Education level of respondent: it is assumed that, households with higher educational level are prone to be willing to pay than people with lower educational level for plastic bag tax. Hence a positive correlation is expected. A dummy variable 1 is given if the household is literate and 0 if the household head is illiterate.

REAG: age of the respondent- this measures the age category of the respondent, increasing age is expected to have an inverse relationship with WTP. This is because older respondents might not be willing to pay for plastic bag tax than younger respondents and additionally, the older respondents might be familiar for using reusable bags at the time of purchase. it is expected to have a negative sign.

REFSIZE: it is the number of family with in the household. Family size is a continuous variable, and as it increases the willingness to pay decreases, hence, it is expected to have a negative effect on household's willingness to pay.

RBFREE: Free reusable bags: it is whether a respondent prefers to use reusable bags if they were free of charge at the point of purchase during shopping**.** A Dummy variable 1 is assigned if reusable bags were free and would use more often and; 0 otherwise.

RESUP: Support for government: it is support for government to conduct national plastic bag levy. It is assumed that respondents who support the plastic bag levy would be willing to pay to pay for plastic bag tax.

HOUSE: House ownership: this is a dummy variable which takes a value of 1 if the household owns a house in Addis Ababa and 0 otherwise. Since a house ownership is a sign of wealth, households who own a house are expected to be willing to pay for plastic bag tax as compared to household who does not own a house. Hence, a positive effect is expected.

REYS: respondents' year of stay: This is the length of time the household lived in Addis Ababa measured in years. The length of time the household lived in Addis Ababa increases the environmental impact of PSB making the household shift to alternative shopping bags and we expect this to have a negative impact on WTP.

PERC: this is the perception of households on whether reusable bags help reduce the availability of plastic bags on the streets of Addis Ababa. It takes the value of 1 if the respondent thinks it reduces, and 0 other wise. A household with high perception on reusable bag is expected to not be willing to pay for plastic bag tax, because he/ she would prefer to use reusable bags instead of paying a tax on plastic bags. Hence, a negative sign is expected.

ATT: this is the attitude of households towards the impact of plastic bags on the environmental. It takes the value of 1 if the respondent has awareness about the impact, and 0 otherwise. Household with high awareness is expected to be willing to pay more than less award household. Therefore, a positive sign is expected.

CHAPTER 4: Background Information about the Study Area

This chapter provides brief background information about Addis Ababa. This is important to create some awareness and understanding on the aspects related to plastic wastes in Addis Ababa.

4.1 Brief explanation of Size, Population, Demography and structure of Addis Ababa

Addis Ababa is the capital city of Ethiopia. This capital city holds 527 square kilometers of area in Ethiopia. It is also the largest city in the county by population of 3,384,569 according to the 2007 census. The city has a higher population of female residents than male residents. The annual growth rate of the city has been estimated in recent years to be 3.8%. Additionally, the city is considered to be the safest in terms of being the head quarter of African Union and United nations Bodies. In terms of the economy, trade and commerce are the most popular industries, followed by manufacturing and production, home marketing, and civil administration. Tourism is also one of the growing industries in the city (Hayal et al, 2014).

Addis Ababa is divided in to 10 administrative sub-cities: Akaki- Kality, NifasSilk- Lafto, Kolfe-Keranio, Gulele, Lideta, Kirkos, Arada, Addis Ketema, Yeka, and Bole. Under these Sub Cities there are a total of 99 kebeles. From these sub- cities, the top five populous are in order: Kolfe-Keranio, Yeka, Nifas Silk- Lafto, Bole, and Gulele. Whereas, in terms of prevailing household units, concentrated amount of household units is found in the following Sub- cities in descending order: Kolfe- Keranio, Yeka, Bole, and NifasSilk- Lafto, Central Statistics Agency (CSA, 2007)

4.2 Waste Generation and Management in Addis Ababa

Waste generated and its Compositions: the increasing in waste due to the cities rapid population and economic growth is one factor to waste management challenges. It is estimated that Addis Ababa generates 730,000-meter tons of municipal solid wastes annually and that the per-capita waste generation rate is approximately 0.45 kilograms per day. Additionally, it is indicated that, 70% of waste is generated from households, 9% from commercial areas, 6% from street sweeping, 5% from industrial waste, and the remaining are from hotels, hospitals, and other facilities (Community Development Research, 2011).

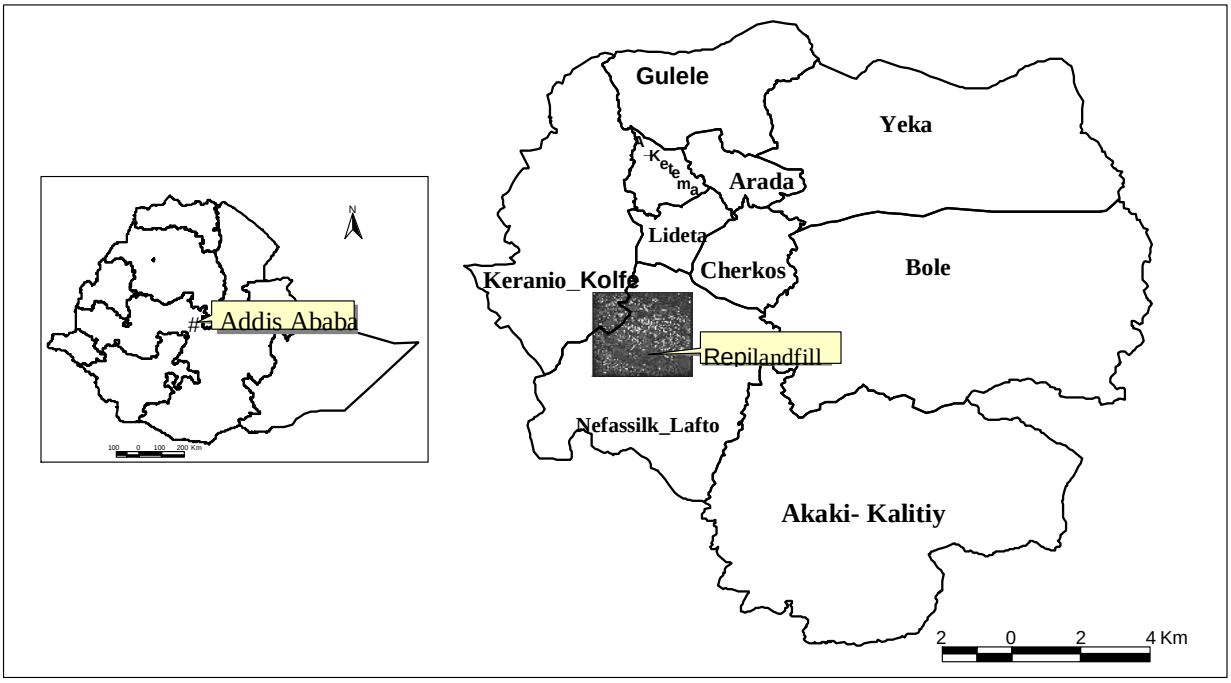
Waste generation rate also varies among the ten sub-cities of Addis Ababa which might be due to their population size. In 2010, it is estimated that 140,500 m^3 is generated in Kolfe- Keranio, 120,000 m^3 in Yaka and 150,000 m^3 in NifasSilk sub-cities (Hayal et al, 2014).

Source of Waste*:* in Addis Ababa it is estimated that about 76 percent of waste comes from households, 18 percent from institutions and 6 percent from street sweeping (Community Development Research, 2011).

Collection System*:* the government issues environmental proclamation targeting various sectors of environment. The major environmental body in Ethiopia is the Environmental Protection Authority (EPA). The EPA is responsible for issuing environmental policies of Ethiopia including waste management proclamations. The main national policy on waste management is the Solid Management Proclamation which was released in 2007. Moreover, in the prevailing policy on solid wastes, solid wastes are collected by government employees, private companies and Micro and small Enterprise. Generally, in Addis Ababa, solid waste collection service is divided in to two sub- systems. These are primary and secondary collection. The primary collection is made by Micro and small enterprise where they are the major collectors of wastes. And the secondary is made by municipality transports from garbage containers to the final dumping site (Hayal et al, 2014).

Final Disposal of Solid Waste: Currently, there is only one open dumping site where all the wastes are collected and are disposed- off. The site is known as "Repi" or "Koshe". The Repi land fill site is located in the south- west area of Addis Ababa in Lafto- NifasSilk sub city. It was established in 1964. It was located at a safe distance from settlement, but now a days the city has expanded towards the site and settlements surrounding the site are with no doubt are affected because the site attracts all types of diseases (Mahiteme, 2011).

Figure 4.1: Map showing location of 10 sub- cities and current location of dump site at Repi



Source: Mahiteme (2011)

4.1.3 Brief review of Plastic bags in Addis Ababa

Girma, (2004) mentioned that, the most distinguished solid waste in Addis Ababa now a days are low- density Polyethylene (LDPE) plastic bags. He found that LDPE plastic bags wastes have increased dramatically during the past decades due to the fact they are convenient for carrying and hand out to shoppers for free. Even though the light nature of the bags does not contribute in terms of volume to solid waste, the main problem is there improper disposal in the streets, rivers, parks, etc. As a result, they are becoming a major environmental hazard to urban and rural landscapes and also water bodies. Currently, in Addis Ababa, there is neither formal nor informal sector to recycle these bags as a result most of the urban household waste contains them.

CHAPTER 5: Results and Discussions

5.1.1 Households' Plastic Bag use and Management

The data was collected from households by means of questionnaire which helped to collect data on existing households' behavior, valuation, socio demographic and economic characters, attitude and willingness of respondent. Totally, 200 questionnaires were distributed, but only 186 (93%) was considered valid. Out of 200 questionnaires, 14 (7%) questionnaire were discarded due to incomplete and invalid responses.

The first section of the questionnaire evaluated the existing households' single bag and reusable bag practice: preference of households on plastic product, reason for their preference, where plastic bags end after being used once; if households have information and ever used reusable bags, and frequencies and so on. Hence, it was found that, out of 186 valid respondents, 149 (80.11%) respondents used plastic bags more than plastic bottles. On the other hand, 37 (19.89%) used plastic bottle more. Regarding the reason why they prefer plastics instead of other materials, 68 (36.6%) respondents thought that plastics were freely given when shopping, 40 (21.5%) respondents thought they prefer plastics because it is light in weight, 27 (14.5%) respondent believed it was found whenever and wherever they want to carry goods, and 47 (25.3%) respondents thought absence of alternatives on their visited shops were the reason for their preference whereas 4 (2.1%) respondents did not know their exists other alternative materials used to carry purchased good in the market.

About the evaluation of where plastic bags end up after being once used, 71 (38.17%) respondents responded that they throw them away after being used once, 79(42.47%) respondents stated that they reuse some and throw some away, 17(9.14%) respondents answered that they reuse all of the plastic bags bought, 10 (5.38%)respondents responded that after they have once used plastics they dispose it by taking it to secondary storage or "Genda" and 9 (4.84%) respondents said private collector take it.

Table 5.1: How households threat plastic bag after being used once

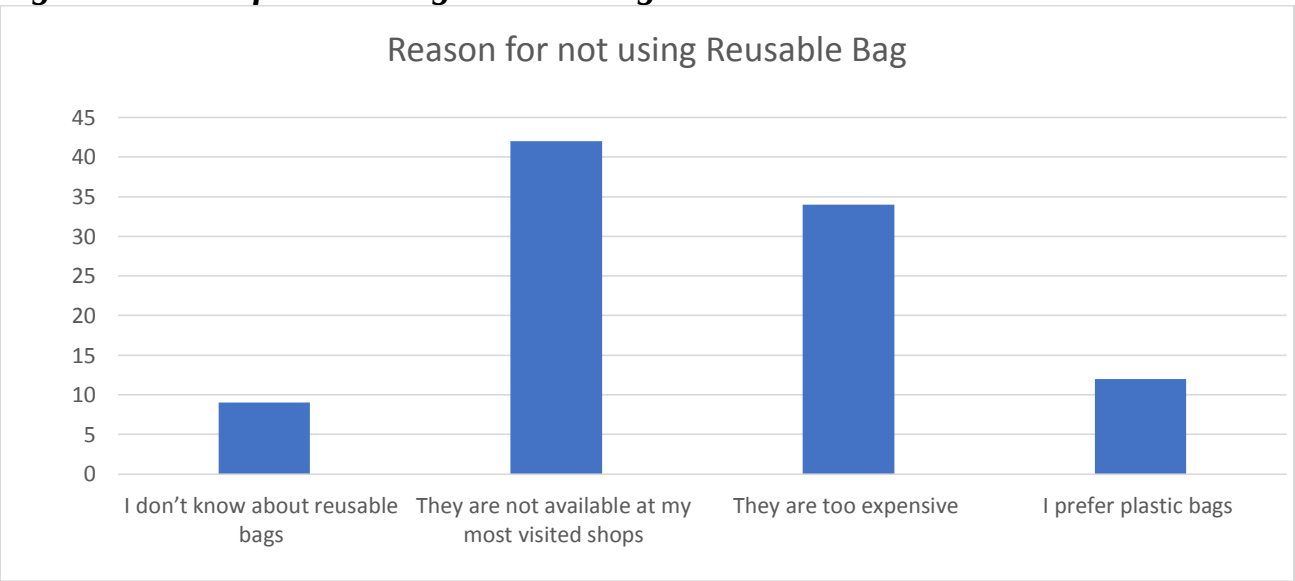
where plastic bags end after being used	Freq.	Percent	Cum.
throw them away	71	38.17	38.17
reuse some and throw some away	79	42.47	80.65
reuse all of them	17	9.14	89.78
take it to 'Genda'	10	5.38	95.16
Private collectors take it	9	4.84	100.00
Total	186	100.00	

Source: Own survey, 2020

The above table is also described in the chart below, which indicates that most of the households reuse some and throw some single-use plastic bags after being used once.

Of the total surveyed households, 23.66% said they used on average less than 5 single- use plastic bags per week. About 86.24% reported that they use between five up to ten single- use plastics per week. And 30.11% said they purchased more than ten plastic bags per week. As to the knowledge and usage of reusable bags, 52.15% respondents have used Reusable bags before whereas, the remaining 52.15% respondent have not ever used reusable bags before. Out of the respondents who have used reusable bags, 23.66% said they used it occasionally but not often, 11.83% used it sometimes and 12.37% used most of the time when visiting a shop. And out of respondents who do not use reusable bags, 42 respondents justified the reason they are not using reusable bag is due to unavailability of this bag at their most visited shops, 34 of them replied they do not use reusable bags because it is expensive and 12 respondents prefer plastics than reusable bags whereas 9 respondents said they do not know what reusable bags are.

Fig 5.2: Reason for not using reusable bags



Source: Own survey, 2020

5.1.2 Socioeconomic and demographic Characteristics of households

As mentioned before, a total of 200 households were interviewed, out of which 14 responses were dropped due to the above-mentioned reason. As a result, 186 questionnaires were used for the survey. Out of 186 households, 94(50.54%) were male respondents whereas 92(49.46%) were female respondent. Of the surveyed households, 61.29% are married.

The respondents' age shows that the average is almost 35years which ranges from 16 to 75. The average year of schooling is 2.65 ranging from zero years of schooling to Master's Degree and above. Out of this 15.05% are illiterate, 26.34 have completed primary, 36.56% did attend their secondary education and 22.04% have completed their tertiary education (Bachelor, master's degree) and more. The average family size of surveyed households is 2.91 with a minimum of one household member and maximum of 7 household members.

One of the most challenging parts was the inquiry about the income of households. Some respondents were not willing to state their income. Nevertheless, respondents were well informed that their answer was needed for a research and any information provided was confidential. Hence, respondents stated their earnings. The average monthly income of households is birr 7439, which ranges from a minimum of birr 1000 to a maximum of birr 30,000 per month. The

survey result also illustrates that 75.27% does not own houses where as 24.73% live in their own houses. Additionally, 8% households lived in their respective kebeles less than one year, 38.71% lived between 1 to 5 years and 53.23% lived more than five years.

Table 5.2: Characteristics and behavior of surveyed households

Variable	**Observation**	*Mean*	*Std. Dev.*	**Minimum**	*Maximum*
RESEX	186	0.505376	0.5013205	0	1
REMS	186	0.612903	0.488408	0	1
REAGE	186	34.0914	14.14394	16	75
REED	186	2.655914	0.986335	1	4
RESIN	186	7439.78	4555.48	1000	30000
REFSIZE	186	2.908602	1.186919	1	7
REYS	186	12.46505	12.12247	5	69
HOUSE	186	0.247312	0.432614	0	1
ATT	186	0.645161	0.4797558	0	1
SUPLEVY	186	0.763441	0.4261163	0	1
RESUP	186	0.752688	0.4449334	0	2
PERC	186	0.919355	0.2730243	0	1
RBFREE	186	8655914	0.3420114	0	1
WTPTAX	186	0.967742	0.1771616	0	1
BID1	186	1.52957	0.4032796	1	2
MAXWTP	186	1.513441	0.8901606	0	5

Source: computed from surveyed data (2020)

Note: The description of each variable is in part 3.3

5.1.3. Households willingness to pay for continued use of single- use plastic bags

In the questionnaire, households were asked if they were willing to pay randomly offered three initial bids and follow up bids. As a result, out of 186 households who are willing to pay for single use plastic bags 77 (41.40 percent) of them said 'yes' or were willing to accept the initial bids and the remaining 109 (58.60 percent) said 'no' or were not willing to accept the initial randomly offered bid.

After the first willingness to pay question, the follow up bid was based on the response of the bid that is if the households were willing to pay the initial bid the second bid offered will be doubled, and if they refused to pay the initial bid then the second follow up question was halved. Given the assigned follow up bids households 97 (52.15 percent) said 'yes' or were willing to accept the follow-up bid and households replied 'no' or were not willing to accept the follow- up bid.

Hence, this result is consistent with demand theory, that is, as price of a given good increases the quantity demand of that good decrease, other things remaining the same. As indicated in the above table, given the initial bid households were willing to accept the initial bid more than the second follow up bid for the 'yes' initial answer.

Table 5.3: Household's willingness to pay for initial and follow up bids

WTP1	**WTP2**		**Total**
	0	1	
0	18	59	77
1	71	38	109
Total	**89**	**97**	**186**

Source: Own survey (2020)

5.2 Results of Econometric Analysis

In this section, econometric method of data analysis will be used to estimate the coefficients of factors that affect households' willingness to pay for continued use of single use plastic bags. Hence to estimate the coefficients, Tobit, Probit and Bivariate models is employed. Probit model is used to estimate coefficients of independent or explanatory variables on WTP. Moreover, Tobit model is employed in order to estimate the coefficients of the explanatory variables for the open- ended contingent valuation questions, in other words, it is used to estimate the impact of variables that affect households' maximum willingness to pay for single use plastic bags. And the bivariate model is used to check the efficiency of single- bounded dichotomous answers.

As stated in econometric theory, cross sectional data most likely face heteroscedasticity problem. Since we are using cross sectional data, we may encounter heteroscedasticity problem. Hence, the model is corrected for heteroscedasticity problem through the robust command in Stata. The multicollinearity of independent variables is checked through correlation coefficient analysis. Therefore, it is observed that there exists no multicollinearity problem in the study. This is because, Gujarati (2004) stated that there exists multicollinearity problem when the correlation coefficient between two explanatory variables is greater than 0.8. Hence, the correlation coefficient analysis from the survey data shows that there is no serious multicollinearity problem in the study. The broad explanation is available in the Appendix section.

In this part, the results obtained using the three models will be presented and discussed below.

5.2.1 Results and Discussion of the Probit Model

The Probit estimation results and the marginal effects of the explanatory variables are obtained using STATA version 14.2 and are presented in the table below. The coefficients of the Probit Model show the significance and the direction of effect of the independent variables on WTP. Whereas, the marginal effect shows the probability of respondents of accepting or rejecting the offered bid for a unit change in continuous and dummy variables. The coefficients and marginal effect of the Probit model is presented in the table below.

Table 5.4: Maximum likelihood estimates of the Probit model

Variable	Coef	Robust Std. Err	P>|z|	Marginal Effect
RESEX	0.0894369	0.2696176	0.74	0.337654
REAGE	-0.0249853	0.009802	0.011	-0.0094341
REED	0.0412584	0.1307756	0.002	0.0155786
REIN	0.0002951	0.0000515	0.000	0.0001114
REFSIZ	-0.076157	0.1273382	0.550	-0.0287558
REYS	0.0098198	0.0117011	0.401	0.0037078
HOUSE	0.0122647	0.3392415	0.971	-0.0046357
ATT	0.8154973	0.2766082	0.003	0.309812
RESUP	0.737918	0.2720199	0.007	0.2786271
PERC	-0.2318705	0.4228409	0.013	-0.082182
RBFREE	0.55426171	0.3982907	0.164	-0.199611
BID1	-2.940966	0.4339804	0.000	-1.110466
cons	3.359583	1.112548	0.003	
Number of obs. = 186 Wald chi2(13) = 73.70 Prob> chi = 0.0000 Pseudo R2 = 0.5078				

Source: Own survey (2020)

As shown at the bottom of the table 186 observations were used in the analysis. The Wald chi2 (13) is *73.70* with p-value (Prob> chi2) of 0.0000. This indicates that the Probit model as a whole is statistically significant. Hence, the hypothesis that all coefficients of the explanatory variables are equal to zero is rejected. This implies that the hypothesis that there are no independent variables that affect households' probability of accepting the randomly offered bid for single- use plastic bag is rejected.

The likelihood ratio is also employed in order to see if the model has some explanatory power. The test is given by:

$$LRT = 2\,[L(\beta 0, \beta i) - L(\beta 0, 0)]$$

Where LRT is the likelihood ratio test, which is a test against the null hypotheses that all the slopes coefficients are equal to zero, L (β0, βi) is maximized value of the log likelihood of the model being estimated, and L (β0, 0) is the value of the likelihood estimated with the constant term. Therefore, the null hypothesis of all slopes are equal to zero is rejected if LRT ≥ critical $\chi 2$ value (Johnson & Dinardo, 1997). Hence in this model our maximized log likelihood value is -61.838237 and the value of log likelihood is -133.83. Therefore, LRT is

$$LRT = 2(-61.838237-(-133.83))$$
$$= 143.983526$$

The critical value $\chi 2$ (13) at 5 percent significant level is 73.70. As a result, the null hypothesis is rejected. This explains that the model has explanatory power. Additionally, it is useful to measure the R^2 for goodness of fit when the dependent variable is a dummy variable. This is calculated using the likelihood ratio, 1- L (β0, βi)/ L (β0, 0) = 0.5379. In our model the result shows that the model explains about 53.79% of the variation. As indicated in the Table 5.4, age of households' is statistically significant and affects household decision to accept the randomly offered bid negatively. This indicates that as the age of the household increases, then the probability of accepting the given bid also decreases. This result is consistent with the finding of (Dunn, (2012)). This could be explained as, all else equal, households who are younger are assumed to possess more income and generally busier than the older age groups, hence they could be more willing to pay a tax than be bothered to bring or having to use reusable bags.

The coefficient of income is statistically significant at 1 percent level of significance and has positive sign. This implies that households with higher income are more willing to pay the plastic bag tax, ceteris paribus, than households with lower income. These results are in line with the results of (Yibeltal, (2011)).

Educational level of the households has a positive and statistically significant effect on the house holds' probability of accepting the randomly offered bid. This indicates that more educated households may have more knowledge and awareness on how plastics affect the wellbeing of the

environment and hence are prone to be more willing to pay, other things remaining constant, than people with lower educational level for single- use plastic bags.

Initial bid that is randomly offered to households has negative sign and is statistically significant even at one percent. This indicates that the higher the bid level, the less likely is the household is willing to accept the randomly assigned bid.

From the respective of supports for government to impose national plastic levy is statistically significant at 1 percent significant level and indicates that households who support the plastic bag levy will be willing to pay a tax for plastic bags, ceteris paribus. Attitude of households is another coefficient which has positive sign and is statistically significant. This shows that households with greater attitude are more willing, other things remaining constant, than lower attitude households. The variable RBFREE (reusable bag for free), is positive and statistically significant indicating that, all else equal, households who are willing to switch to using reusable bags full time if they are available for free are more willing to accept the offered bid.

Regarding household's perception towards whether or not reusable bags reduce availability of plastic bags on the street indicates the higher the perception the less likely households tend to be willing to pay for the randomly offered bid, other things remaining constant. The sex, family size, and ownership of house of respondents are other independent variables with a positive sign but are statistically insignificant; as a result they are considered less relevant for this study.

As discussed in the methodology section, the mean WTP for the Probit model can be calculated by dividing the negative of the constant (intercept) by the bid coefficient. Hence, Mean WTP = $\beta o/ \beta$ = -3.359583/-2.940966 = 1.1423. These show that the mean WTP that is found from the closed- ended question is 1.14 birr for tax on single use plastic bags.

5.2.2 Marginal Effects of Probit Model

As discussed above, the coefficient of Probit model only provides the significance level and direction or sign of effects of explanatory variable on the dependent variable. Due to the reason that Probit models measure the change in unobservable variable consistent with a change in one of the explanatory variables, it is not easy to interpret the magnitude of coefficients as OLS method. Hence the very common interpretation of Probit model coefficients is through its marginal effects.

The marginal effect estimates of Table 5.4 shows that, keeping other things constant, one year increase in the age of the household heads primes to a decrease in the probability of accepting the randomly offered bid by 0.94 percent. Regarding accepting the randomly offered bid, more educated households are more willing to pay tax, ceteris paribus, than the later. Hence other things remaining constant, the probability of accepting the assigned bid by the literate household is 1.56 percent higher than the illiterate.

Another determinant of households' choice to accept or reject the assigned bid is income of households. The result indicates that a one birr increase in the income of the households, ceteris paribus, results in increase in households' probability of accepting the randomly offered bid by 0.01 percent. Another result of the marginal effect estimate showed that, keeping other things equal, a change in the attitude of households about environmental concern, increases household's probability of accepting randomly offered bid.

As indicated in Table 5.4, the marginal effect shows that, one percent increase in the presence of reusable bags, which are freely provided to households at their time of visit to shop, holding other things constant, decreases household's probability of accepting single- use bag tax by 18.9 percent. On the other hand, increase in acceptance of support by the government to impose national levy, leads to 27.8 percent increase in willingness to accept tax on plastics. And from the perspective of perception of households on reusable bags, one percent increase in perception of households on the awareness of reusable bags decrease the presence of plastic bags on the street of Addis Ababa, decreases the probability of willingness to pay tax on plastics by 8.42 percent.

5.2.3 Results and Discussion of the Tobit Model

In the Table 5.5 the results of Tobit estimates of maximum willingness to pay for continued use of single- use plastic bags are presented. As it is indicated in the table, the model is overall significant. This could be explained as the null hypothesis which states that the coefficients of all explanatory variables including the constant term are equal to zero is rejected because the P-value (Prob> F) is equal to 0.0000. Generally, the Tobit regression results using STATA version 14.2 are given below.

Table 5.5: Tobit estimation of Maximum Willingness to pay for continued use of plastic bags

Variable	Coef	Std. Err	P>|t|	t	Marginal Effect	Mean
RESEX	-0.07516	0.103566	0.469	-0.73	-0.0751559	0.5053763
REAGE	-0.01055	0.002946	0.000	-3.58	-0.0105476	34.0914
REED	-0.11598	0.045868	0.012	-2.53	-0.1159782	2.655914
REIN	0.000141	1.28E-05	0.000	11.05	0.0001413	7439.785
REFSIZ	-0.08979	0.037921	0.019	-2.37	-0.0897896	2.913978
HOUSE	0.123012	0.143928	0.394	0.85	0.1230122	0.2473118
ATT	0.225288	0.105001	0.033	2.15	0.2252884	0.6451613
RESUP	0.0800138	1.101523	0.432	0.79	0.0800138	0.7526882
PERC	-0.14434	0.15941	0.366	-0.91	-0.1443379	0.9193548
RBFREE	-0.32161	0.197213	0.100	-1.63	-0.3216097	0.8655914
BID1	-0.08029	0.13697	0.050	-0.59	-0.0802916	1.52957
cons	1.729229	0.328185	0.000	5.27		

Number of obs = 186 F (12, 174) = 21.34 Prob> F = 0.0000

- (dy/dx) is for discrete change of dummy variable from 0 to 1

The result for the variable income shows that it has positive relation with household's willingness to pay and highly significant at 1% level. This is consistent with the general demand theory, which stated that a positive relationship exists between income and quantity demanded in case of normal goods. Other things remaining the same, as income of households increase by 1 birr then the predicted value of households' maximum willingness to pay for plastic tax increase by 0.014 percent. Education of households has the expected positive sign and is significant at 5 percent. This could be explained as households who are educated are more likely to be aware and know the environmental impact of plastics. Hence the household's education affects maximum willingness to pay positively and also significantly. The age of households affects households' maximum willingness to pay negatively and significantly. This could be explained as younger households are willing to pay as compared to older households. This is because younger households are assumed to be productive and earn more income hence; their maximum willingness to pay is higher than old households. Therefore, keeping other things constant, as the

age of household heads increase by one year the predicted value of households' maximum willingness to pay decreases by 0.011 percent. Household size has negative sign and statistically significant at 1 percent level of significance. The negative sign and the significance of household size indicates that the predicted maximum willingness to pay decreases with the number of people in the household. This might be because large households could use more plastic bag and a tax on consumption would lead to higher expense than it would be for a smaller household.

The other independent variable, freely availability of reusable bags, has negative and statistically significant at 10 percent significance level. This explains that households who would switch to using reusable bags if they were freely provided at the time of visit to shop would pay less tax. Hence, as the free availability of reusable bags increase the maximum predicted willingness to pay decreases. The other independent variable is attitude which is positive and statistically significant at 5 percent. This suggests that awareness about environmental impact of plastic bags increase predicted maximum willingness to pay.

The other independent variables, in the Tobit model, are statistically insignificant, hence less relevant to the study.
As discussed in the methodology part, the mean WTP for Tobit model can be calculated by dividing the reported maximum WTP amount by the surveyed number of households.

Mean WTP = $\mu = \sum Ti/n$ where Ti is the maximum willingness to pay amount by the surveyed households' and 'n' is the sample size.

Hence, Mean WTP = $\mu = 281.5/186 = 1.51344$ birr

Hence the mean found from the open- ended format is 1.51 birr for tax on single use plastic bags.

5.2.4 Bivariate Probit Model Results and Discussion

According to Haab and McConnell (2002), double-bounded dichotomous choice models increase efficiency when compared to single bounded dichotomous choice models. This is because there is an efficiency gain from no-no, no-yes, yes-no, yes- yes pairs which increase the number of responses. In this model, the respondent will be asked a given randomly offered bid and if he/ she is willing to pay that amount then, the second bid will be doubled, but if the respondent is not willing to pay the initial bid, then the second bid offered will be halved.

Before applying the bivariate Probit model, we have to check if the correlation between the two error terms is different from zero or not. Tabel 5.6 shows that the correlation between the two error terms is different from zero that is -0.7593 and is statistically significant. The Wald chi2 (1) is 35.0213 with p- value (Prob> chi2) 0.0000. This shows that the model is statistically significant, compared to model with no predictor.

Table 5.6 Bivariate regression of the Double Bounded Dichotomous choice questions

Variable	Coef.	Robust Std Err.	P›|z|
WTP1			
Bid1	-1.509796	0.2492429	0.000
cons	2.311641	0.3930003	0.000
WTP2			
Bid2	-1.5001662	0.0293213	0.000
cons	2.1237504	0.3625469	0.000
rho (ρ)	-0.7593619	0.002	
Wald test of rho=0:	chi2 (1) = 35.0213	Prob> chi2 = 0.0000	
Number of obs = 186			
Wald chi2(2) = 39.15			
Prob> chi2 = 0.0000			

Source: own survey, 2020

As shown in the above table initial and the second offered bid negatively and significantly at one percent affects household's willingness to pay. According to Haab and McConnell (2002), the mean willingness to pay by bivariate Probit model is calculated as:

Mean WTP = $\mu = -\alpha/\beta$ where α is the constant term, β is the coefficient for the bid

Hence, the mean WTP corresponding with the initial bid is:

$$Mean\text{WTP}_1 = \mu_1 = -\alpha_1/\beta_1$$

$$Mean\text{WTP}_1 = \mu_1 = -(2.311641/-1.509796) = 1.53 \text{ birr}$$

On the other hand, the mean WTP using the coefficient of the second bid is computed as:

$$Mean\text{WTP}_2 = \mu_2 = -\alpha_2/\beta_2$$

$$Mean\text{WTP}_2 = \mu_2 = -(2.1237504/-1.5001662) = 1.42 \text{ birr}$$

Then the mean willingness to pay for a tax on plastic bags is calculated from the mean WTP from the first bid and constant and the follow- up bid and constant term.

$$Mean \text{ WTP} = \mu = Mean\text{WTP}_1 + Mean\text{WTP}_2/2$$

$$Mean \text{ WTP} = \mu = 1.53+1.42/2 = 1.47 \text{ birr}$$

Hence it can be generalized that the mean willingness to pay for the open- ended is greater than the mean of the close- ended format, which is, 1.51 birr for open ended and 1.47 birr for close ended questions. The Probit regression and the bivariate regression result of mean willingness to pay is approximately the same.

5.3 Estimating Total Willingness to pay and Total Economic Benefit

In this section we will deal with estimating the aggregate willingness to pay, aggregate revenue and derive the demand curve. In determining the aggregate willingness to pay we first determine the willingness to pay interval and their respective mid points. Then since we have information about total number of households, it is easy to calculate the aggregate willingness to pay.

Based on CSA (2007), we have around 655,118 households in Addis Ababa. Then to aggregate, we use class boundaries for maximum willingness to pay. Then the grand total willingness is equal to 100,478.7 Birr, obtained by summing total willingness to pay at each mid points of willingness to pay (sum up column 5). As indicated in the table below, as the mid points of willingness to pay increases, the total number of households willing to pay decreases.

when we come to aggregate economic benefit of plastic shopping bag tax, it can be calculated by using the mean willingness to pay which was obtained by open- ended questions. As discussed in section 5.3.3 the Tobit model found the mean willingness to pay to be 1.51 Birr and hence the

aggregate economic benefit is equal to 989,228.18, which is calculated by multiplying the mean willingness to pay and total number of households. whereas, the aggregate benefit from the close- ended or single bound dichotomous choice model is 746,834.52 birr.

Table 5.7 Aggregate Willingness to pay and Aggregate Economic Benefit of tax on plastic shopping bags

Max WTP (1)	Mid for WTP (2)	Sample Households		Total number of HHs (4)	Total WTP (cents) (5)	Sample HHs WTP at least cumulative		Total HHs willing to pay at least cumulative (7)	Total HHs WTP at least cumulative (8)
		freq	Percent (3)			freq	percent (6)		
0- 0.5	0.25	23	12.37	81,038.09	20,259.52	186	100	655,118	163,779.5
0.75- 1	0.125	71	38.17	250,124.05	31,265.51	163	87.63	574,079.90	71,759.99
1.5- 2	0.1	69	37.1	243,048.77	24,304.87	92	49.46	324,021.36	32,402.14
2.5- 3	0.25	18	9.67	63,349.91	15,837.47	23	12.36	80,972.58	20,243.15
4- 5	0.5	5	2.69	17,622.674	8,811.33	5	2.69	17,622.67	8,811.34

Source: Own survey, 2020

2 is computed from (1) = summing the first and the second value and dividing by two

4 is calculated by multiplying (3) and 655,118, for instance, 0.1237*655,118 = 81,038.09

5 is computed by - (2)*(4)

7 is calculated as = (6)*655,118

8 Aggregate revenue is calculated as = (2) * (7)

5.4 Checking for Validity

One of the most relevant things to do when using contingent valuation method is to check how good the valuation estimates are. Several validity tests have emerged in order to check the contingent valuation estimates. Some of these tests are discussed below briefly.

► **Convergent Validity** – this test checks if the result of estimate of a given hypothetical scenario is significantly different from the result of the estimates some other technique. As discussed in methodology section, the study has employed, single bounded dichotomous model, double bounded dichotomous choice model, closed- ended and also open-ended questions. The results obtained from this model are approximately equal.

► **Construct Validity -** it tests the consistency of the signs and significance level of feature that affect the willingness to pay with reference to theoretical expectations and economic theory. Within the pre expectation of the theory of demand, which states that the price is directly related to quantity demanded, that is as the price of a certain good increases, other things remaining constant, the demand for that good decrease, the initial bid that is randomly offered to the households affects willingness to pay negatively, showing consistency with the prior study. The other thing is income, where economic theories suggest that as the income of an individual increases, keeping other things the same; his /her demand also increases. This theory is also consistent with our study that is as the income of household's increase, their willingness to pay also increases. Generally, other factors that affect willingness to pay also have the same signs and hence the construct validity test is also satisfied in this study.

CHAPTER SIX: CONCLUSIONS AND POLICY RECOMMENDATION

6.1 Conclusions

This study was initiated by a serious environmental problem the people of Addis Ababa are facing. Single- use plastic shopping bag has always been a major environmental problem in the city. The main cause of this problem is irresponsible disposal of this bags and lack of proper management due to their free availability at the point of purchase. As a result, the main objective of this study is to look at the possibility of reduction in the availability of plastic bags on the streets of Addis Ababa, through charging individuals for plastic bags at the time of visit to shop for purchasing goods. Hence, in this study the demand side of plastic bag management was analyzed.

In order to estimate household's willingness to pay for single use plastic bag tax in Nifas-silk lafto, Addis Ababa, using contingent valuation method (CVM), descriptive and econometric method of data analysis was used. Three econometric models were employed; Tobit and Probit and Bivariate model. And out of 200 sample households 14 (7 percent) responses were invalid and 186 (93 percent) responses were valid.

The result from the Probit model revealed that households' income, education level, support from the government to conduct the levy and attitude towards the environmental impact of plastic bag positively and significantly affects the probability of accepting the assigned bid to the sample households. Whereas, age, initial bid, availability of reusable bags for free at the time of purchase and perception towards whether or not reusable bags reduce the availability of plastics on the streets of Addis Ababa negatively and significantly affects the probability of willingness to pay. On the other hand, households' sex, family size, and ownership of house are statistically insignificant.

In the Tobit model household's income, education, and attitude positively and significantly affects households' maximum willingness to pay for tax on plastic bags. On the other hand, households' age, family size, freely available reusable bags and initial bid negatively and significantly affects the probability of saying "yes", whereas households' sex and ownership of house are statistically insignificant.

The results from the Bivariate Probit model shows that, the initial bid (Bid1) which was offered to households negatively and significantly affects the household's willingness to pay. This shows that as the initially assigned bid to household's increases, the willingness to pay for plastic bag tax decreases, keeping other things constant. In line with the initial bid, the follow-up bid (Bid2) affects willingness to pay for plastic bag tax negatively and is statistically significant.

In this study the mean willingness to pay for plastic bag tax was also computed from the open-ended and dichotomous choice questions. The mean willingness to pay for plastic bag tax from the open- ended question was computed using Tobit model was 1.51 birr. Whereas, the mean willingness to pay for plastic bag tax from single- bounded dichotomous question was computed using Probit model was 1.14 birr and the mean willingness to pay for plastic bags from double-bounded dichotomous question was 1.47birr. As a result, the mean willingness to pay for plastic bag tax from open- ended questions is greater than closed- ended question. The other relevant part of the objective is estimating the total economic benefit of plastic bag tax using household's willingness to pay. The aggregate economic benefit from the single-bounded dichotomous choice model is Birr 746,834.52 and from the open- ended question it is equal to989,228.18. Additionally, corresponding with the theory of demand, keeping other things the same, as the price of plastic bags increases the quantity demand for plastic shopping bags decreases. As discussed in section 5.4, as the mid points of willingness to pay increases the number of households who are willing to pay decreases. Hence two general conclusions could be drawn from these. The first is that tax rates on plastic bags are highly elastic. That is a small tax on plastic shopping bags will yield a considerable reduction in the use of plastic shopping bags. The second is as the tax rates are higher, people will tend to switch to other bags which have comparatively less price.

6.2 RECOMMENDATION

1. Policy makers should balance between households' demand for and supply of plastic bag through estimating the implicit prices of the points or attributes of plastic bag waste management.
2. Any policy towards plastic bag waste management should include the demand side information in order bring the desired environmental impact
3. Policy makers should consider allocating portion of the revenue which is collected through the tax from plastic shopping bags, to bags which are eco- friendly like reusable bags
4. The city government should design and implement relevant incentive to encourage manufacturers to produce reusable bags which are environmentally friendly and convenient to users.

5- The city government as well as concerned bodies should organize awareness creation activities for households so that households and individuals prefer environment friendly reusable shopping bags.

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APPENDIX 1

Contingent Valuation Survey Questionnaire

Code: _____

Place of interviewer: _____(Write kebele number)

Name of interviewer _____

Household Questionnaire (Main Survey)

Ⅰ. Introduction

Hello, how are you, I am …….. I am assisting an ongoing research by **SaronChali** who is a student in Addis Ababa University faculty of business and Economics in the Department of economics. This survey is taken as a partial fulfillment of the award of MSC in economics. This questionnaire is designed to obtain information on the current situation of plastic wastes and households' willingness to pay for a tax on single- use bags at the point of check out in Addis Ababa. Hence your view is very important input for officials and policy makers in their attempt of improving environmental well-being of the city. Additionally, your opinion will help to understand the attitude of people towards environmental improvement and their involvement. Further, you are required to participate in this discussion as truthfully as you can because all the information collected are confidential and only for academic purpose only.

THANK YOU IN ADVANCE

Ⅱ. Background information

Single- use plastic bags are bags that are used to carry goods and usually provided to customers at the point of sale (check-out) and usually disposed of after being used. Recent Studies have found that Single- use plastic bags are major source of wastes in cities across Addis Ababa and all over the world. As a result, there have recently been programs implemented across the world in order to discourage the use of plastics. Among this program a per- bag fee is among the most commonly implemented strategies. A per- bag fee (tax) is a fee which is applied at the time groceries are purchased. In other words, it refers to a cost for each plastic bag at checkout.

An alternative to charging a fee per bag is promoting households to use of reusable bags and bring their own reusables grocery bags for grocery shopping, Reusable bags are one -time cost bags made for multiple purposes and are made of canvas, cloth, or some other washable fabrics. The average cost of a reusable shopping bag in Ethiopia is around 7 birr per bag

SECTION Ⅰ: EXISTING HOUSEHOLDS' SINGLE-USE BAG AND REUSABLE BAGS

PARTICIPATION FREQUENCY AND EXTENT

Again, single-use plastic bags are bags used to carry goods and usually provided to customers at the point of sale. Reusable bags refer to bags made out of a strong material that can be used for multiple times.

1. Which plastic product do use excessively?
   a- Plastic bag b- plastic bottles c- other (please specify) ----------
2. Why do you prefer to use plastic products especially plastic bags?

a- They are freely given or cheap to me when I purchase goods
b- They are light in weight
c- Availability where ever and whenever required
d- There is no alternative material in the market
e- Lack of awareness of the community
f- Other (please specify) ----------

3. What do you do after you have once used them for carrying your product?
   a- I throw them away
   b- I reuse some and throw some away

c- I reuse some all of them

d- I recycle them

e- I don't use plastic bags

f- I take it to the nearby secondary storage (Genda)

g- Private collectors take it

4. On Average, how many single- use plastic bags do you use per week?

   a- < 5 b- 5-10 c- >10 d- None

5. Have you or anyone in your household ever used, or are currently using, reusable shopping bags for grocery shopping?

   a- Yes b- No

If your answer to #5 is Yes proceed to #6 and otherwise answer #7

6. Approximately, how often do you use reusable shopping bags?

   a-Always b- most of the time c- sometimes d- Occasionally, but not often e-never

7. The reason I don't use reusable bags is because…….. (select all that apply)

   a- I don't know about reusable bags

   b- They are not available at my most visited shops

   c- They are too expensive

   d- I prefer plastic bags

   e- I forget to bring my reusable bag

   f- Other: ----------

8. How do you get plastic bags used for carrying your groceries?

   1 I pay for them separately

   2 The shop owners give me free of charge whenever I buy items from them

9. How often do you buy from shops that offer free plastic bags?

   1. Always 2. Most of the time3. Sometimes 4. Never

SECTION ll: ATTITUDE AND CONCERNS

10. Have you heard environmental impact of plastic bag waste?

a- Yes b- No

11. If your answer to #10 is 'Yes', how?

1- Tv/radio 2- School 3- books and published materials 4- Other

12. what are the problems? (please check all that apply)
    a. Deterioration of natural beauty of the environment
    b. Human and animal health problems
    c. Blockage of drain system
13. Based on your opinion, should the utilization of plastic bags be continued or discontinued?
    a. Continued b- Discontinued
14. Do you think that tax on plastic bags would reduce plastic waste problem?
    1- Yes 2- No c- Unsure
15. If your answer is "Yes/ unsure", who do think is responsible to do so?
    a- Government b- the community
16. Do you think using reusable bags help reduce the amount of plastics that end up in the streets of Addis Ababa?
    a- Yes b- No
17. If reusable bags were available free-of-charge, would your household use them more frequently?

a- Yes b- No

SECTION iii: HOUSEHOLDS' WILLINGNESS TO PAY QUESTIONS

Single- use plastic bags are bags that are used to carry goods and usually provided to customers at the point of sale (check-out) and usually disposed of after being used. Recent Studies have found that Single- use plastic bags are major source of wastes in cities across Addis Ababa and all over the world. As a result, there have recently been programs implemented across the world in order to discourage the use of plastics. Among this program a per- bag fee is among the most commonly implemented strategies. A per- bag fee (tax) is a fee which is applied at the time groceries are purchased. In other words, it refers to a cost for each plastic bag at checkout.

18. Are you willing to pay a tax on single- use plastic shopping bags?
    1. Yes 2. No

If your answer is No, please respond to question #19, and if Yes proceed to # 20.

19. Why would you not pay a tax on single- use bags?
    1- I cannot afford to pay

2- I use reusable bags at the time of shopping

3- Would rather see money spent on other service

4- Proper management of plastic waste is the responsibility of government

5- Other reasons (specify)…….

20. Are you willing to pay _____(*X*) birr/ cent for a single plastic bag?

1. Yes 2. NO

If your answer to #20 is 'Yes' then proceed to #21, if No move to #22

21. Would you be willing to pay _____ (2X) birr/cent for a single plastic bag?

Yes No

22. Would you be willing to pay _____ (0.5*X*) birr/cent for a single plastic bag?

Yes No

23. What is the maximum amount that you will be willing to pay for a single plastic bag?

.....birr/ cent

24. If your grocer begins charging you a set amount per plastic***ti***,which is more than your household's maximum willingness to pay, would you switch to using reusable bags brought wit you from home in the future visit to the grocery store?

a- Yes, my household would switch to reusable bags

b-No, my household would pay***ti*** per plastic bag

SECTION iv: HOUSEHOLDS DEMOGRAPHIC INFORMATION

25. What is your gender?

a- Male b- Female

26. Marital status of the respondent?

a- Married b- other wise

27. What is your age group? _____

28. What is the highest level of education you or anyone in your household has completed?_____

29. Would you please tell me your households' income per month? (if the respondent is not willing to answer the households' income please ask his own income)_____

30. How many people currently live in your household (including children)? _____

31. How many years have you lived in Addis Ababa?

1. < 1-year 2 -1-5 year 3 >5 year

32. Do you have your own house in Addis Ababa?

1. Yes 0. No

33. If your answer is 'No', then where do you live?

1. Rented private house 2. kebele house 3. Government house

34. If your answer is Yes, then where do you live?

1. Condominium/apartment 2. Other

APPENDIX2- Correlation Matrix

. correlate resex reage reed rein refsize reys house att perc1 perc2 respo rbfree
(obs=186)

	resex	reage	reed	rein	refsize	reys	house	att	perc1	perc2	respo	rbfree
resex	1.0000											
reage	0.0095	1.0000										
reed	-0.0837	-0.2143	1.0000									
rein	-0.0152	-0.0904	0.0745	1.0000								
refsize	-0.0265	0.1544	0.1039	0.2642	1.0000							
reys	-0.0393	0.3015	-0.0198	-0.0966	0.0203	1.0000						
house	0.0686	0.0546	0.0612	0.2023	0.3364	-0.0195	1.0000					
att	0.0080	-0.0135	0.0719	0.2978	0.0790	0.0838	0.1126	1.0000				
perc1	0.0455	-0.0913	0.0610	0.0813	0.0519	0.1370	0.0748	0.1671	1.0000			
perc2	0.0624	-0.0779	-0.0434	-0.0196	-0.0716	0.0351	0.0782	-0.0546	0.0084	1.0000		
respo	-0.0182	-0.0393	-0.0471	-0.0618	0.0209	0.0300	-0.1298	-0.0335	0.0011	-0.0761	1.0000	
rbfree	-0.0115	-0.0868	-0.0096	0.0968	0.1045	-0.0618	0.0067	0.0372	0.1392	0.0570	0.1001	1.0000