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COLLEGE OF BUSINESS AND ECONOMICS

DEPARTMENT OF ECONOMICS

**NON-MARKET VALUATION OF WOF-WASHA
FOREST, NORTH SHOA ZONE, AMHARA REGION,
ETHIOPIA**

**Non-Market Valuation of Wof-Washa Forest,
North Shoa Zone, Amhara Region, Ethiopia**

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the Degree of Master of Science in Economics (Natural
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This is to certify that the thesis prepared by Alemayehu Abebe titled: *Non-Market Valuation of Wof-Washa Forest* and submitted in partial fulfillment of the requirement for Master of Science in Economics (Natural Resource and Environmental Economics) complies with the regulations of the university and meets the accepted standards with respect to originality and quality.

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Abstract

Wof-Washa Dry Afromontane Hotspot Forest is one of the oldest proclaimed state forests in central highlands of Ethiopia. The forest has been crucial in maintaining the local environmental balance. However, unsustainable use and less protection given to the forest put it in danger of depletion which calls for conservation and restoration of the forest. The study aimed at estimating the willingness to pay of the local people for the conservation and restoration of the forest. To estimate conservation and restoration value of Wof-Washa forest, contingent valuation method (CVM) were employed by using single-bounded dichotomous value elicitation technique with follow up open-ended question was used. Probit and Tobit models were applied to determine the mean and factors affecting willingness to pay for forest conservation and restoration, respectively. A total of 395 households were surveyed from five kebeles. The econometric result shows that the mean willingness to pay from single bound elicitation method was computed 29.147 ETB per month with the total willingness to pay 1,676,425.08 ETB per year. Whereas, the mean willingness to pay from open ended elicitation method was computed at 23.7062 ETB with aggregation value of 1,363,485.84 ETB per year. The probit model showed gender, age, education, non-food monthly income, distance from the forest, livestock and total farm holding significantly affecting the WTP for forest conservation.

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List of Abbreviations

BLI	Bird Life International
CE	Choice Experiment
CVM	Contingent Valuation Method
DCE	Discrete Choice Experiment
EFAP	Ethiopian Forestry Action Plan
FAO	Food and Agriculture Organization
MOA	Ministry of Agriculture
MWTP	Marginal Willingness to pay
NWFPS	Non-wood Forest Products
SUNARMA	Sustainable Natural Resource Management Association
TCM	Travel Cost Method
WTA	Willingness to Accept
WTP	Willingness to Pay
WWF	Wof-Washa Forest

Chapter One

Introduction

1.1. General Background

Valuation of non-marketed environmental goods and services is, in relative terms, a newly emerging research area particularly in Ethiopia and other developing countries (Yilma *et al.*, 2016). Valuation of the goods and services provided by forests and other natural and environmental resources is needed because these resources are under great pressure and facing severe degradation over time. Valuation can be defined “*as an attempt to put monetary values on environmental goods and services or natural resources*” (Božena K, 2019). The importance of sustainable management of non-market forest goods and services has increased during the last few years. Economic valuation methods for non-market goods and services comprise a range of empirical approaches to estimate a monetary value the trade-off a person would be willing to make to increase the amount or the quality of a good or service for which there exists no market (Bengt & Per-Olov, 2019).

Rapid deforestation and slow reforestation of degraded forest land is due to the failure of market to price forest products to capture externalities and indirect use values of watershed management, wildlife protection and other non-market environmental services of the forest and trees (Adekunle *et al.*, 2006). When quantifying economic value of a certain natural and environmental resource, decision-makers usually consider only quantifiable financial costs and benefits related to goods and services traded on the market. However, there are numerous functions of nature for which markets malfunction, are distorted or simply do not exist. Markets only exist for some of the functions of forests resource, such as fuel wood, timber and non-timber forest products. When market fails, to quantify the total benefits generated by forests, non-market valuation techniques are employed to clarify the true value of these natural and environmental resources (Lette and de Boo, 2002).

Forests and the benefits they provide in the form of wood, food, income, and watershed protection have an important and critical role in enabling people to secure a stable and adequate food supply (Jain *et al.*, 2017).

Deforestation and land degradation, however, are impairing the capacity of forests and the land to contribute to food security, and to provide other benefits, such as fuel wood and fodder. Forests of Ethiopia have suffered from severe deforestation and degradation as a result of an escalating demand for fuel wood and land for cropping and grazing (Lisanework and Mesfin, 1989). Owing to the use of different definitions of forests, tools and methods, forest cover and rates of deforestation estimates of Ethiopian forest cover remain unreliable (Yitebitu *et al.*, 2010). However, various sources indicate forest areas of the country have been reduced from 40% a century ago to an estimated less than 3% today. The current rate of deforestation is estimated to be 160,000 to 200,000 ha per year (Badeg, 2001). This shows that the country is characterized by high rate of deforestation, resulting in massive environmental degradation and constituting a serious threat to sustainable agriculture and forestry.

Wof-Washa forest straddles three districts in North Shewa zone, Amhara regional state. It is Ethiopia's oldest state forest and the only major natural forest within Amhara regional state, being continually degraded but still ecologically significant to the country and economically important to the region. The forest plays a vital role in maintaining the hydrological cycle through contributing water discharge to the main rivers including the Awash river thereby benefiting millions of people living downstream.

Managing forests sustainably and equitably is essential for maintaining the ecological integrity, maintaining or enhancing freshwater supplies, protecting and improving rural livelihoods. Therefore, conserving, restoring and enhancement of the multi-purpose Wof-Washa state forest is imperative to avoid ecosystem stress and environmentally unsustainable livelihood base of the local community. Common understanding as to recover and conserve the forest should be build. It is also difficult to estimate the local community's contribution to the restoration and conservation of the forest since they are reaping the benefit from it. Hence, in this study an attempt is made to estimate the willingness to pay of local people for the conservation, restoration, and enhancement of forest wof-washa forest using contingent valuation method.

1.2. Statement of the Problem

A forest resource serves as a source of different products and services that may be used to improve the well-being of population. Forestry, besides its direct contribution to the national economy through wood and non-timber forest products supply, also contributes significantly to various sectors of the national economy such as energy, agriculture, food, industry, health, environment and tourism (FAO, 2010). In general, the socio-economic contributions of forestry at national scale can be seen from various angles such as employment generation, earning of foreign currency, savings as well as indirect contribution through support to economic sectors, particularly agriculture (Solomon & Deme, 2017).

However, the forests of Ethiopia dwindled at alarming rate in the past few decades. At present, around 2.3 million hectare of largely disturbed forest is believed to remain from the vast areas of natural forest which once covered the country (Birhanu & Teshome, 2014). The continuous destruction of the natural forests of Ethiopia results directly in the loss of unaccounted plant and animal species as well as in a shortage of fuel-wood, timber and other forest products. Indirectly, it leads to more aggravated soil erosion, deterioration of the water quality, further drought and flooding, reduction of agricultural productivity and finally to an ever increasing poverty of rural population (Birhanu & Teshome, 2014). The problem of deforestation and loss of biodiversity is more pronounced in the central highlands of Ethiopia, particularly in the North Shewa Zone, where forests are downscaled to patches and strips on the hill tops and heads of streams. As a result, very little of the natural forest of central Ethiopia highlands remains today (Wolde & Tatese, 2018).

Wof-Washa, literally “bird’s cave” natural forest is located in the Amhara Region of Ethiopia approximately 160 km north of Addis Ababa. It is Ethiopia’s oldest proclaimed state forest and is rich in biodiversity. It is home to a number of plant and animal species that are unique and some that are endemic to Ethiopia and East Africa. Plants such as juniperus procer (Tid), Olea Africa (Weira), Hagenia Abyssinia (Kosso), Podocarpus Falcatus (Zigba) and Thymus serrulatus (Tossign) exist. Birds including the Ankober soren and Rupelles chat and animals such as Menillik Dukula, Gelada baboon and Gureza (Colobus monkey) are a few of species that have been identified. It is one of the few remaining forest areas and the only major natural forest in

Amhara region and it is known as the “lung” of Amhara region, because it is the last remnant of natural forest in the area (Wolde & Tadesse, 2018).

Wof-Washa forest provides enormous environmental and economic benefit to the local community. These include source of construction materials, fuel wood, edible fruits, source of spring water, medicinal plants, biodiversity and protection of soil erosion.

However WWF is currently highly threatened and rapidly degraded. A baseline survey carried out by Sustainable Natural Resource Management Association (SUNARMA) in June 2002 indicated that the natural forest remnants and woodlands of Wof-Washa forest were being reduced at alarming rate. The 2002 survey indicated that the natural forest cover was about 8,290 hectare, a reduction of nearly 1000 hectare from 9260 hectare identified in 1994 forest inventory carried out by North Shewa Zone Agricultural Office. A forest inventory carried out by SUANARM in March 2005, at the interim phase of Wof-Washa forest and land management project, estimated that the natural forest cover had continued to decline down to 8,222ha (SUNARMA, 2018). The shrinkage continues with the surrounding people living at the edges of the forest expanding their agricultural area and thereby reducing the forest cover to 6433 hectare (Mesfin, 2019).

The factors that are contributing to the loss of Wof-Washa Natural forest and its biodiversity are complex. However it is principally threatened by the demand for agricultural land due to population pressure and forest timber based income-generating activities that accelerate severe land degradation. The forest is an integral part of the local people’s livelihoods and economy (SUNARMA, 2014).

The continuous destruction of this forest calls for conservation and restoration of the remaining forest which is the reason of this study. This is because the forest has no guarantee of continued existence with this trend of deforestation. Apparently, losing this forest will be a disaster for local community and Ethiopia’s fragile ecology balance.

Therefore, this study attempts to investigate willingness to pay for restoring and conservation of WWF. In addition, an attempt is made to examine factors that will affect WWF. To my knowledge, this is the first non-market valuation study on WWF. Thus the finding of this research may be used as an input to formulate and implement strategies concerning with efficient forest resource management.

1.3. Objective of the Study

1.3.1. General objective

The general objective of this study is to estimate the mean willingness to pay, of local households around Wof-Washa, for the conservation, restoration, and enhancement of the Wof-Washa forest using contingent valuation method.

1.3.2. Specific objectives

- ✓ To examine the multidimensional benefit and challenges of conservation and restoration of Wof-Washa forest.
- ✓ Identify the factors that determine individuals' willingness to pay.
- ✓ To suggest possible solution to further unite the efforts of local households to environmental protection.

1.4. Significance of the Study

This study expected to provide relevant information to environmental policy makers and analysts on the attitude and values people towards on the different attributes of state forest. It also helps them to design environmental policies that are in harmony with the social values of people instead of using traditional top-down approach for the forest conservation and management. Outcome of this study can be relevant to draw successful experiences to other state forests in the country. This study, which uses Contingent Valuation Method, will provides the basis for further empirical research and becomes the area of subsequent literature.

1.5. Scope and Limitations

This study is confined to estimation of the value of selected environmental attributes of wof-washa forest. It assesses only the non-marketable attributes of the forest. Large sample size would probably give reliable estimates of parameters. However, availability of limited finance didn't allow extending the sample size beyond 395.

Chapter Two

Literature Review

2.1. Theoretical Literature

2.1.1. Definition of Forest

Forest can be defined in various contexts and it is difficult to state a single formal definition for it.

According to the FAO, forest is defined as

- Land with tree crown cover (or equivalent stocking level) of more than *10 percent* and an area of more than *0.5 hectares* (ha).
- The trees should be able to reach a minimum height of *5 meters* (m) at maturity *in situ*.
- May consist *either* of closed forest formations where trees of various storey and undergrowth cover a high proportion of the ground *or* open forest formations with a continuous vegetation cover in which tree crown cover exceeds *10 percent*.
- *Young natural stands* and all *plantations* established for forestry purposes which have yet to reach a crown density of 10 percent or tree height of 5 m are included under forest,
- The areas normally forming part of the forest area which are *temporarily unstock* as a result of human intervention or natural causes but which are expected to revert to forest.”

2.1.2. Functions and values of Forests

Forests are renewable natural resources which provide essential goods and services that are based on both timber and non-timber. These products include wood for home and industries, cover for domestic and wild animals, food, protection of soil and water values, and recreational service. It offers important environmental service functions especially in the urban settlements. Mitigation air pollution, reducing emission of green- house gases and contribution to human health conditions cultural and spiritual values, biodiversity conservation, nutrient recycling, carbon dioxide sequestration are among other service functions of the forest (Freeman, 2014).

The wide array of products and services provided by forests can be classified in to three categories: Wood products, Non-wood Forest Products (NWFPS), and Services.

According to the working definition of FAO:

- **Wood products** are timber, chips, charcoal and fuel wood, as well as small woods such as tools, household equipment and carvings.

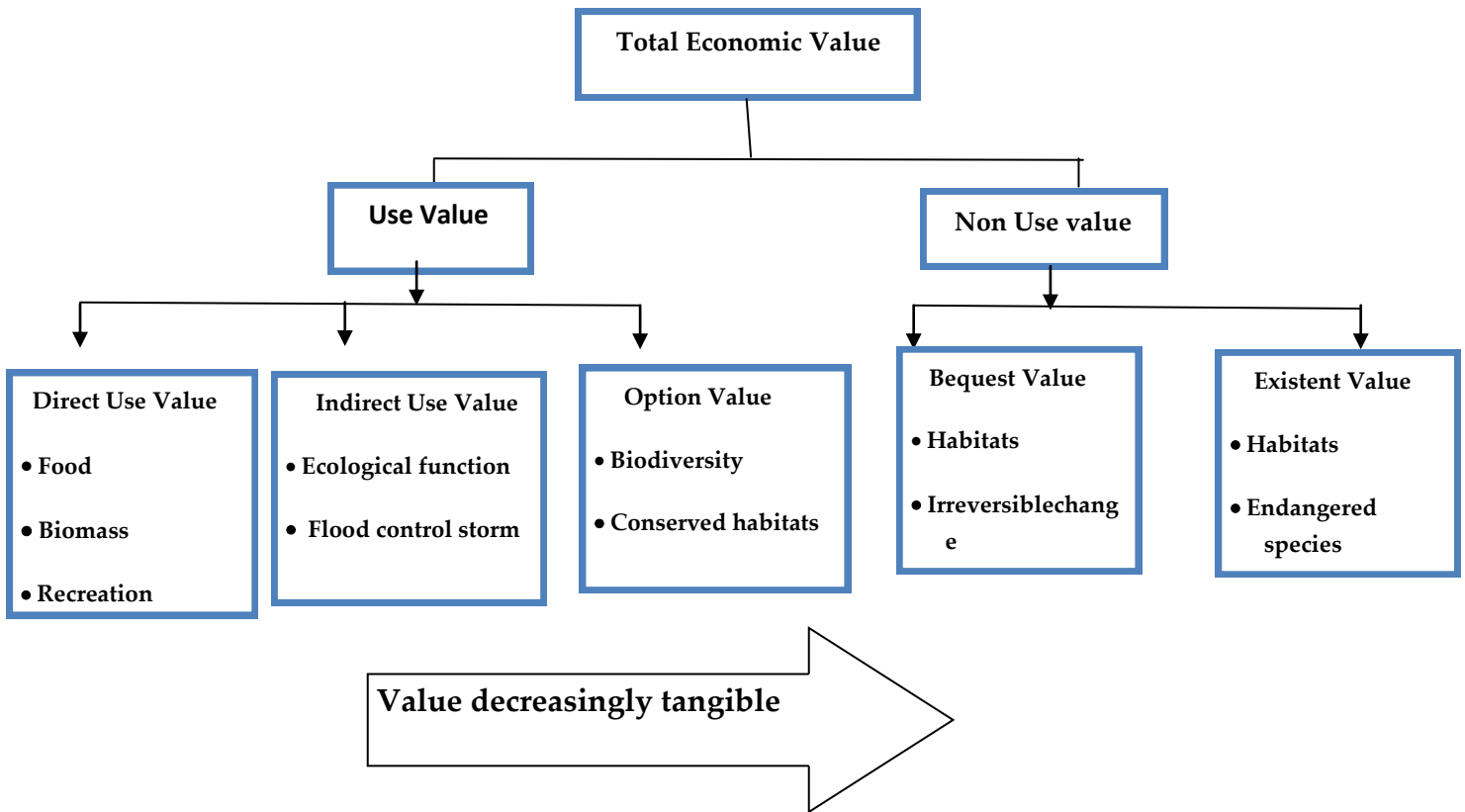
-**NWFPS** consist of goods of biological origin other than wood, derived from forests and allied land uses. The term NWFPS excludes all woody raw materials. Consequently, timber, chips, charcoal fuel wood, as well as small woods such as tools, household equipment and carvings are excluded.

- **Services** include forest services such as ecotourism, grazing, bio-prospecting and forest benefits such as soil conservation, soil fertility, and watershed protection (FAO, 1995).

2.1.3. Types of Forest Economic Values

For millennia before the industrial revolution, wood, trees and forests were the source of land for settlement, cultivation, materials for construction, woody biomass for fuel and energy, directly for food and nutrition as well. The spread of agricultural revolution directly depended on conversion of forests into cultivable land. The continuing contributions of forests to global biodiversity, the fertility of agricultural lands, and social safety of dependents mean that forests are immensely valuable for sustainability (Agrawal *et al*, 2012). Economic values related with the various functions of forests can be classified in two major categories: use values and non-values, each having some sub categories. Use values are divided in to direct use value, indirect use values and option use values. Under non-use value category we have the existence and bequest values.

Figure 2.1 Classification of total economic values of forests



Source: Adapted from Babulo et al., (2006).

Direct use values: direct uses of forests include both commercial and non-commercial activities. Commercial uses such as timber production may be significant in both domestic and international markets. Non-commercial direct uses, on the other hand, are often mainly local but can be important for the subsistence needs of rural populations and poorer groups, e.g. fuel wood, game, edible and medicinal plants (FAO, 1995). Direct uses also include important services such as forest recreation, education and research, which are often conducted on a non-commercial basis.

Indirect use values: benefits that accrue indirectly either to forest users or non-users. Example, ecological or environmental services, protection of biodiversity, aesthetic, cultural and spiritual values (Babulo et al., 2006).

Option Value: values reflecting willingness to pay to conserve and restore the option of making use of the forest even though no current use is made of it. Coined by Weisbrod in 1964 option

value represents the value (present) to potential future users of preserving or maintaining forests. Option values can exist when there is (1) uncertainty about future use among potential future users, (2) uncertainty of future availability, (3) risk aversion among potential users, and (4) irreversibility in maintaining future availability (Gray, 1994).

Existence Value: a value placed on an environmental good and which is unrelated to any actual or potential use of the good (Pearce and Turner, 1990). Existence values are intrinsic values placed by nonusers on environmental assets purely for its existence without any intention of using it directly in the future.

Bequest Value: the value that people derive from knowing that the forest is passed on to the generations. In the bequest value context of forest resource, landscape, recreation, energy and raw material availability, biodiversity, environmental conditions e.g. related to carbon storage, affecting future generations may be considered (Merlo and Briales, 2000).

2.1.4. Review of Non-Market Valuation Methods

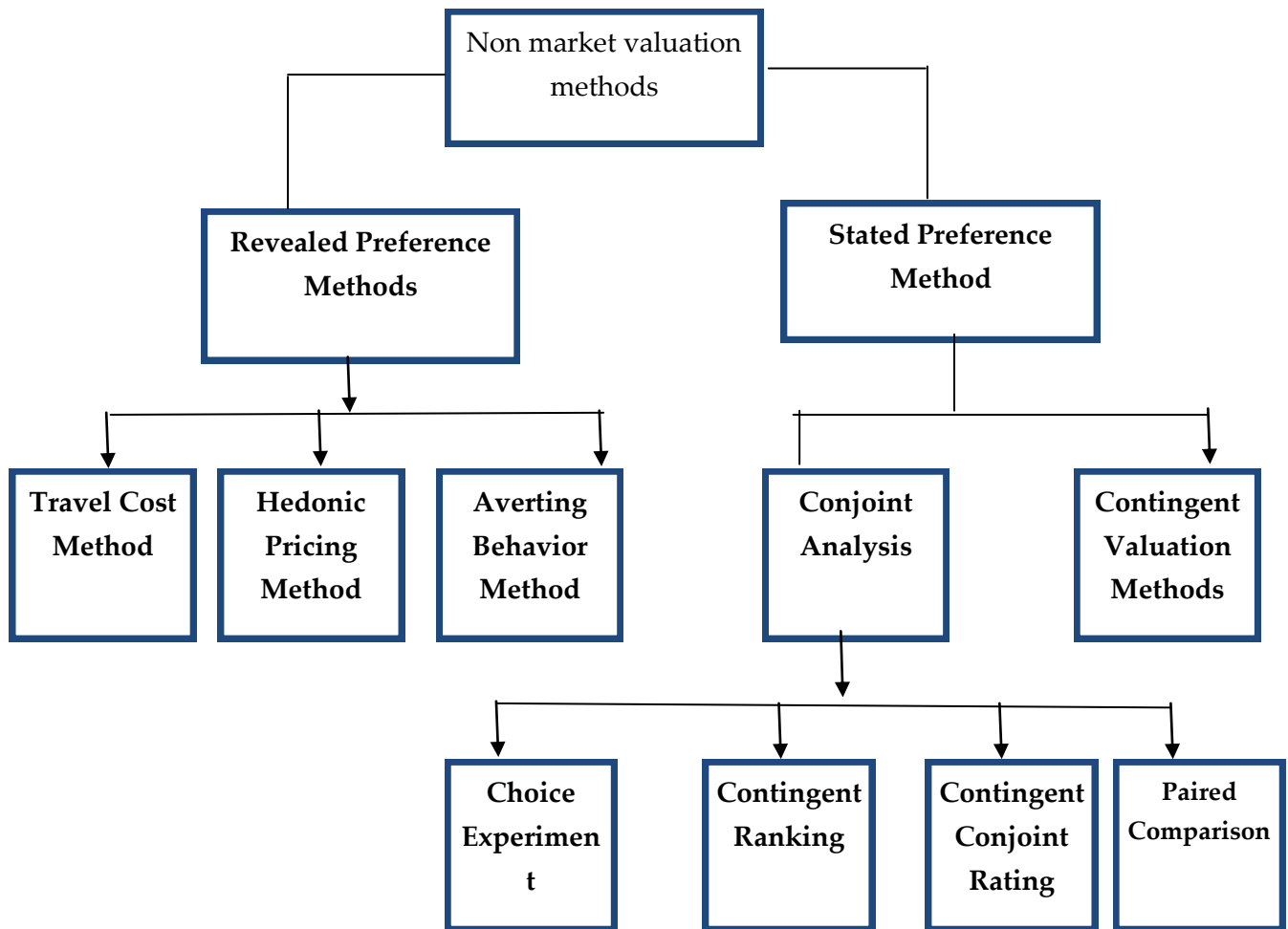
Economic valuation methods for non-market goods and services comprise a range of empirical approaches to estimate a monetary value for the trade-off a person would be willing to make to increase the amount or the quality of a good or service for which there exists no market. The two broad classes of non-market valuation methods are “Revealed Preference” and Stated Preference” methods (Young, 2005).

Revealed Preference methods are based on how individuals actually behave whereas stated preference methods use data on what individuals say they would behave contingent on a certain hypothetical market or program (Braden and Kolstad, 1991). In general, the revealed preference approach has the advantage of being based on actual choice made by individuals. However, there are also a number of drawbacks; most notably that the valuation is conditioned on current and previous level of the non-market good and the impossibility of measuring non-use values, i.e. the value of the non-market good not related to usage such as existence value, altruistic value and bequest value (Alpizar et al., 2001).

Stated preference methods involve asking people how much they value a particular non-market outcome. This is done by surveying a sample of people that is considered to be representative of the population. The *Contingent valuation* (CV) and the *Choice experiment* (CE) are the stated

preference methods most frequently used in valuation of non-market forest ecosystem services. They consist in the measurement of values that people attribute to forest services/goods that are not traded on the market. For the needs of these methods, interview/survey schemes are developed, the purpose of which is to determine preferences with regard to the stated willingness to pay (WTP) for improving the quality of the availability of natural assets or else with reference to the minimum amount of money that someone is willing to accept to abandon a good or put up with adverse changes in the natural environment willingness to accept (Božena K, 2019).

Figure 2.2 Taxonomy of non-market valuation methods



Source: Melichar and Scasny, (undated).

The widely used non-market valuation methods in the context of forests are discussed below.

i. Travel Cost Method (TCM)

The travel cost (TCM) is claimed to be the oldest form all non-market valuation techniques. The basis of TCM was created by Harold Hotelling in 1947, when the National Park Service in the USA wanted to know the economic value of recreation in national parks (Bartczak et al., 2009). It is based on the assumption that consumers value the experience of a particular forest site at no less than the cost of time spent traveling to the site (Bishop, 1999).

The TCM uses the ‘price’ (or cost) that people pay to travel to a particular site such as a national park to estimate the value they obtain from visiting. Surveys are used to collect data on the costs people incur, and these data are used to estimate a ‘trip generation function’ that relates travel costs to visit rates (Baker, R. & Ruting, B, 2014).

Two approaches of TCM are distinguished – individual and zonal. Individual TCM calculates travel costs separately for each individual and requires a more detailed survey of visitors. In zonal TCM, the area surrounding the site is divided into zones, which can be either concentric circles or administrative districts. In this case, the number of visits from each zone is counted. This information is sometimes available (e.g. from the site management), which makes data collection from the visitors simpler and less expensive.

ii. Choice Experiment Method

Initially developed by Louviere and Hensher (1982), discrete choice experiments (DCEs) resulted from the advances in many different disciplines like psychology, statistics and economics. The pioneer in applying DCE in the context of non-market valuation of environmental resources is Adamowicz et al. (1994). The choice experiment method is a questionnaire based technique that seeks to discover individual preferences for simultaneous changes in the attributes that compose an environmental good or service. The basic premise of the choice experiment is that a forest good or service can be decomposed in a bundle of attributes or features that individuals are sensitive to changes in these attributes. Therefore, individuals are asked through a survey to state their willingness to pay to undergo these changes, (Riera, P & Signorello, G., 2012).

iii. Contingent Valuation Method (CVM)

CVM was used for the first time by Davis in 1963, in the study of hunters in Maine. The contingent valuation method (CVM) is a widely used method for estimating economic values for all kinds of natural and environmental resource which are not traded in the market and hence have no market price. CVM is typically used to estimate the benefits (or costs) of a change in the level of provision (or in the level of quality) of a public good (Riera, P & Signorello, G., 2012).

Contingent valuation involves face to face asking respondent to make choices about environmental outcomes and payments that can be used to estimate how much they are willing to pay for a non-market outcome to be provided. This outcome, or 'good', is valued as a whole (for example, the amount of money people would be willing to forgo through additional taxes for improvements in vegetation along a river). Typically, respondents are asked whether or not they would be willing to pay a set amount of money for the natural and environmental outcome to occur (Baker, R. & Ruting, B., 2014).

Contingent valuation uses surveys to estimate the highest amount that respondent would be willing to pay for a non-market good. When this method was first used, surveys typically asked people to simply state their maximum willingness to pay. It has since become more common to present respondent with a set amount of money and ask whether or not they would be willing to pay that amount for the non-market outcome to be achieved. The amount is varied across participants in a way that allows statistical models to be used to calculate average willingness to pay (Whitehead, J.C. & Blomquist, G.C., 2006).

Advantage and Limitation of Contingent Valuation Method

Contingent valuation possesses some advantage and has limitations relative to Choice Experiment valuation as a valuation method for non-market environmental benefits. Summarized below is the main advantage and disadvantage of the method as contained in Hanley et al. (2001).

Advantage:

- They are the available methods to estimate non-use values of natural and environmental resource.
- They can also be employed to estimate use values.
- The use of surveys allows collecting qualitative socioeconomic and attitudinal data on the respondents that could be relevant for understanding the variables influencing social preferences and choices.
- The use of surveys allows estimating hypothetical changes and their impact they have taken place.
- Participative/deliberative approaches before valuing the good or service at stake seem to provide with more stable results.

Limitation:

Although CVM has been widely used in cost-benefit analysis for natural and environmental resource impact assessment for several decades, it has been subject to many limitations. The main concern relates to the reliability and validity of applying CVM. The most important biases are:

- When respondents are asked about their willingness to pay hypothetically, they tend to give higher values than what they would actually pay in the real situation.
- Rather than expressing value for the good and service, the respondents might sometimes actually be expressing their feelings about the scenario or the valuation exercise itself.
- Respondents may give different willingness to pay amounts, depending on the specific form of payment chosen (e.g. if the form of payment is tax respondents may give lower values than voluntary donation).
- Starting value in the willingness to pay question tends to imply a value for the good and service (e.g. ‘Are you willing pay EUR 10 for?’), so that a starting value well higher the respondent’s true (actual) willingness to pay amount will increase the stated willingness to pay amount, while starting value well lower it will to decrease it.
- Strategic bias arises when the respondent does not provide a true answer in order to influence a particular outcome, i.e. provision of a good.

- Non-response bias is a concern, because individuals who do not participate in the survey are likely to have different values than individuals who do take part in it.

2.2. Empirical Reviews

Contingent valuation surveys have been widely applicable methods in valuing market and non-market values of environmental goods and services like forest resource (Whittington, 1998). There have been a large number of studies valuing non-market values valuation of forests in monetary terms using contingent valuation technique. A few selected case studies pertaining to certain forests in both developing and developed countries are discussed below.

Alem (2012) used contingent valuation method to elicit households' willingness to pay for restoring environmental resource: a case study of forest resource form Dire Dawa area, eastern Ethiopia. A three-stage sampling technique was used when selected sample respondents. In the first stage 38 rural kebeles were purposively selected out of the 47 kebeles based on identified as their livelihood is more attached to the environmental resources than the urban kebeles, secondly, 4 kebeles (Adada, Adigaflema, Eja Aneni and Harela) were randomly selected out of the 38 kebeles. In the third stage, proportionally with population percentage, a total of 393 households were selected randomly. The data was collected using face to face interview. Probit and Tobit models were applied to determine the mean and factors affecting willingness to pay for forest restoration, respectively.

From the econometrics models he found that the mean willingness to pay from double bounded elicitation method was computed at 94.09 ETB with the total willingness to pay of 2,026,604.51 ETB (1 US\$=18.44ETB) per annum for five years. Whereas, the mean willingness to pay from open ended elicitation method was computed at 64.82 ETB with aggregation value of 1,396,157.98ETB per year. The result from double bounded elicitation method is greater than open ended elicitation method. This might be due to anchoring effect from the double bounded method. Finally he suggested that any forest restoration intervention in the study area needs to consider monthly income, initial bids, perception, education level, ownership type and access to extension services for successful forest restoration activities. Total farm land holding and sex are also significant variables needs to consider.

Yilma et al. (2016) applied the contingent valuation method to estimate the economic value of Bale Mountains National Park, Ethiopia. Hypothetical questions were prepared to elicit the maximum willingness to pay and willingness to accept to conserve the park. Dinsho, Goba and Robe towns were purposefully selected from which 380 respondents were selected from stratified population using lottery method. Logit model was used to quantitatively analyze socio-economic factors of local people to visit the park.

From the study result indicated that visitors mean entrance fee WTP over 3 times the current entrance fee. Maximum amount of willingness to pay for the proposed conservation project scenario varied from 0 to 1000 ETB (50\$), whereas mean and mode were 35\$ and 10\$. In addition, district/nearness, education level, job, awareness of biodiversity importance and status, and income level of respondents positively affected an individual's willingness to pay.

Tefera (2006) implemented the CVM in the form of double bounded elicitation method to estimate the economic values of improved natural forest in Wondo-Washa Sub-catchment, Ethiopia. A questionnaire survey was conducted on 148 respondents from six peasant associations surrounding the natural forest. The mean WTP for a single household was 44.6 birr per year. Moreover, about 72% of the respondents gave the value of the forest at a price of 30 ETB or more per year while 18% of the respondents agreed to pay nothing assuming that they have traditional rights to the land and/or have low level of income. The bid function analysis suggested that household income has minimum influence on WTP. Therefore, it can be concluded that even the poor households were willing to pay the average values in terms of time or labor contribution to save the natural forest. On the other hand, community valuations for forest resource in the catchment do not vary much in magnitude when the payment vehicle was changed from cash to labor contribution. Therefore, people are concerned about conservation issues, what so ever their status and the situations. The concept of valuing forests is well supported by the community.

Birara and Beneberu (2019) were conducted a study to determines households willingness to pay for conservation of church forests in northwestern Ethiopia. The study used double-bounded contingent valuation method followed by open-ended question. A total of 300 households was selected using a multistage sampling technique followed by a probability proportional to sample size. Tobit model was used to analyse the data collected from respondents. The result indicated that the mean willingness to pay of the respondents in cash and labor is 178 ETB and 71.51 man-days per year, respectively. The result indicated that the mean willingness to pay of the respondents in cash and labor is 178 ETB and 71.51 man-days per year, respectively. On the other hand, the model result indicated that annual income, social position, membership to mahiber/senbete and size of the land near to church forests had a significant and positive effect on the households' willingness to pay, whereas dependency ratio had a significant and negative effect.

Chukwuone and Okorji (2008) applied contingent valuation method to determine household's willingness to pay for systematic management of community forests in the rainforest region of Nigeria. A multistage random-sampling technique was used in selecting 180 respondent households used for the study. The study was used a Tobit model, and found that some variables such as wealth category, number of years of schooling, occupation and number of females in a household positively and significantly influence willingness to pay. Gender (male-headed households), start price of the valuation, number of male in a household and distance from home to forests negatively and significantly influence willingness to pay. The authors concluded that organizing the local community in systematic management of community forests for NTFP conservation will enhance participation and hence poverty alleviation.

Hisinya (2015) applied the contingent valuation method to estimate the economic value of Mabira forest in Uganda. The study used households in Namulaba area because it was a highly degraded area in Mabira forest. The three villages (Ntunda, Namulaba and Kateete) were purposively sampled because they were bordering the forest and highly degraded. Finally systematic random sampling procedure was used in selecting 50 households from each village making a total of 150 households studied. The value-elicitation format used was payment card format and open-ended follow-up question. Tobit model with sample selection was estimated in

determining the factors influencing the WTP for the goods and services from Mabira forest. The findings show that household size, distance of household from the forest, income of the household head, and occupation of the household head significantly influenced the WTP.

A numerical and an empirical application to an afforestation program in Spain contingent valuation and choice experiments were made by Mogas et al. (2006). The program being proposed involves an increase in forest coverage from the current 40% of the Catalonian (Northeast of Spain) to 50%. The CVM exercise was undertaken to find the maximum willingness to pay for two given new forest compositions: FOREST A and FOREST B. The new forests (Forest A) had the same extension as in the previous exercise, i.e. covering an additional 10% of Catalonia, substituting marginal agricultural land. A total sample of 1000 people older 18 years old was divided in two roughly equal sub-samples to which afforestation projects and a CVM questionnaire was randomly selected. The logit regression results from the CVM exercise for both forests A and B reveal mean annual WPT of 74.36 euros and 45.75 euros respectively.

Limaie et al. (2016) used contingent valuation method to value recreational economic values of Saravan Forest Park, north Iran. The park is one of the most well-known nature based recreational site due to its impressive landscape and endemic wild animals. The area of the park 1,487 ha and 1,332 ha or 89.57 % of this park is covered by forest. A linear logit regression model was used to analyse the data from 480 respondents. The software including MS Excel, Eviews and Shazam were used for statistical analysis of variables, mathematical calculation and parameter estimation of the logit model. Results indicated that the variables such as proposed entrance fee, monthly income, non-governmental organization membership, moralizing view on the environment and natural resources as well as length of stay have significant effect on willingness to pay for the recreational use of the study area. The study found that 91.19 % of people were willing to pay for the recreational value of the forest park and the total annual recreational value of the forest park is 22,761.6 million IRR.

Amani (2015) applied contingent valuation to estimate the economic value of forest services: a case study in Northern Jordan. He employed CVM to obtain an estimate for the population's willingness to pay for restoration and conservation of services in this area. The study used 300 samples of rural households through in-person interviews. He applied two econometric models to examine the incentives for WTP. The aggregate present value benefit is 3,569,556 Jordanian Dinar for the whole of Jordan's northern forests; this valuation is based on the amount participants were willing to contribute to maintain forest ecosystem services. The conservation cost is assumed to reflect the direct value gained from human utilization of forest services. The final econometrics results suggest a correlation between WTP and household income, as well as WTP and classification of services. The study assesses that income and forest service type most directly shaped participants' WTP for forest conservation. Finally the researcher suggests that the CVM can successfully be applied to Jordan and may be a viable and potentially useful direction for future research on environment valuation in the other developing countries in the Middle East.

It may be observed from these empirical studies that there are large numbers of direct and indirect benefits of forests. Using contingent valuation method for valuation across countries, different estimates of economic values of tangible and intangible benefits are obtained. The variations in the estimates could be partly on account of different socio-economic variables and scope of the studies. Furthermore, the literatures above suggested that contingent valuation method is a viable technique to value non-market valuation of forest in both developed and developing countries. In this study contingent valuation method is used to estimate the willingness to pay rural farm households for conservation, restoration, and enhancement of Wof-Washa forest. This adds to the limited literature on application of contingent valuation in valuing the social and environmental benefits of proclaimed state forests in Ethiopia.

Chapter Three

Data and Methodology

3.1. Description of the Study Area

Wof-Washa Dry Afromontane Hotspot Forest is located in North Showa Administrative Zone (about 9^o45' N and 39^o45' E) Central highlands of Ethiopia, and some 160 km northeast of Addis Ababa and 30 km from Debre Birhan. The forest is starched three districts Ankober, Bassona Worrana and Tarmaber (Woldie & Tadesse, 2018).

Wof-Washa forest area has an average rainfall of approximately 1400 mm per annum. Temperature range from an average to 11^oC to 20^o C however due to high elevations temperatures may be lower especially at the top of the escarpment. Cloud and mist cover is common at higher altitudes throughout the year. Rainfall in the area is highly seasonal. Most of the 1400 mm of rain falls during the Belg (short rainy season), which usually occurs during April/May and the longer Kremit (long rainy season) from mid-June to the end of September (SUNARMA, 2018).

3.2. The Socioeconomic Condition of the Study Area

The people of the study area are mainly Amhara ethnic group and highest proportion of the practiced Orthodox Tewahido Christianity. The three major ethnic groups living in North Shewa are Oromo (2.14), and the Argoba (2.71%), and Amhara (94.73%); all other ethnic groups made up 0.42% of the total population. The total population of the Wof-Washa forest is 123,387. Mixed crop cultivation and livestock production system is the main agricultural practice in the study area and it is subsistence type of agriculture system. The most widely cultivated crops in the region are teff, wheat, maize, barley, bean, zengada, pea, and sorghum. The nearest urban centers that benefit from and influence on Wof-Washa forest are Debre Birhan, Ankober, Debelle, Haraba, Debre Sina and Tarmaber. Due to high population pressure and degradation land resource is scarce. Farming activity is carried out using rain fed and irrigation systems. Local households use Wof-Washa forest as source of water, forest honey, fuel wood, fodder,

timber, charcoal, medicinal plants, tourism and wild animal's products as food supplements (Solomon & Demel, 2017).

3.3. Sampling Techniques and Sample Size

A two stage random sampling technique was used to selecting respondent households for this study. In the first phase, five kebeles from three districts were selected purposively due to their proximity and economic dependence to the forest. In the second phase, proportionally with population size, sample households were selected using simple random sampling techniques from each of the selected kebeles. The resulting sampling distribution in selected woredas and kebeles is presented in table 3.1.

In planning a survey, one must decide how many people or households will to be study in order to answer the study objectives. Several rules of thumb can be used to determine the minimum sample size required to conduct multiple regression analyses. If the study is too large it wastes resource. The sample size of the study is N number of households can be calculated using the following criteria (Greene, 2002)

The minimum sample size required for a population is $N \geq 10,000$

$$N = Z^2 P (I-P) / W^2$$

Where N= Sample size

Z=Confidence interval (using set as 95 % confidence interval level)

P= Population proportion

W= Marginal of error

The total household of the WWF community is N=× (until I will get recent data of N)

Confidence interval of 95 % (z) = 1.96

Population proportion (P) = 0.5

Margin of error (W) = 0.05

Therefore the sample size is calculated as

$$N = (1.96)^2 0.5 (0.5) / 0.05^2$$

$$N = 3.8416 \times 0.25 / 0.0025$$

$$N = 384.$$

The total sample size is limited to 395 balances the financial burden of large sample and the bias from small sample, 395 farm households were randomly selected using proportional to the total population size sampling techniques.

Table3.1. Number of households and sample size

District	Kebele	Total household	Sample taken
Bassona Worrana	Gosh Ager	1441	112
Tarmaber	Wof-Washa	1163	90
	Emebiret	625	48
Ankober	Zenbo	1023	79
	Mehal-Wonz	851	66
Total		5103	395

3.4. Data Source and Method of Data Collection

Both primary and secondary data were used for this study. The questionnaire as translated to the local language for it to be easily understood by the respondents. The survey was accomplished with face to face personal interview using single bounded dichotomous contingent valuation questionnaire designed by researcher. To gain qualitative information the researcher undertakes focus group discussion by using 40 selected households from selected kebeles. The questionnaire was administered by enumerators under the supervision of the researcher. Four enumerators hired for this purpose was select based on their educational qualification and experience in conducting survey. Short training on how to conduct the survey was given to all the recruited enumerators. Secondary data such as population data, socioeconomic information were gathered from the respective kebele administration offices. The main survey was conduct for the first three consecutive weeks in the month of April, 2020.

3.5. Questionnaire Design

The survey questionnaire comprises of three parts. The first part is about demographic and Socio-economic information like sex, age, marital status, family size, income and level of education. In the second part of the questionnaire attention is given to obtain information on

respondents' attitudes and opinions about Wof-Washa forest. Finally, the third part deals with the valuation scenario to elicit respondents' willingness to pay for restoration and conservation program.

3.6. Method of Data Analysis

The survey data was analyzed using descriptive statistics and econometric models. Descriptive statistics is used to describe the characteristics of sample units, frequency distributions, valuation responses, means and percentages. Econometric model were used calculate the mean WTP for Wof-Washa forest protection.

3.7. Model Specification

In linear regression model, the dependent variable is represented as linear function of independent (explanatory) variables; parameters estimation is done using ordinary least squares. However, when the dependent variable is binary choice or dummy, the application of linear regression has limited use. In binary choice, the basic assumption underling the model is that the individuals express the choice between two alternatives i.e. there exist probability of choing one alternative over the other alternative. Due to this parameters estimation by OLS method leads to inconsistency and bias. In such case linear probability models, such as Probit, Tobit, Logistic and Binary probit regression models are suggested as best alternative to overcome the limitation (Wooldrige, 2005).

3.7.1. The Probit Model

Probit model specifies an indirect utility function for each respondent (households) and if we assume that there is an improvement in both quality and quantity of the environment from which individuals will benefit the gain in the quality and quantity will be what the households to pay for.

Assume that the representative household gains utility from restoring and conserving the forest, the two possible levels of environmental quality involved are the status quo S^0 and a specific level of improvement, S^I .

Hence,

$V_{i0} = v(Y_i, Z_i, S_{i0}) + \epsilon_{i0}$, utility function at status quo (no restoring and conserving)

$V_{i1} = v(Y_i, Z_i, S_{i1}) + \epsilon_{i1}$, utility function with restoring and conserving

Where:

V_{i0} Represent indirect utilities at the status quo

V_{i1} Represent, the hypothetical improved scenario

Y_i Individual's income

Z_i Represent household demographic, environmental, socioeconomic, and environmental and initial bid variables

S Refer to the quality of the good being valued (restore and conserve forest)

ϵ Random disturbance

when the quality of environmental good S change from S_0 to S_1 , as the result of a policy change, the household's utility also changes from $V_{i0} = v(Y_i, Z_i, S_{i0}) + \epsilon_{i0}$, to $V_{i1} = v(Y_i, Z_i, S_{i1}) + \epsilon_{i1}$.

Assuming that the bid level is given by b_i .

$$\Delta v_i = [v(Y_i - b_i, Z_i, S_{i1}) + \epsilon_{i1}] - [v(Y_i, Z_i, S_{i0}) + \epsilon_{i0}]$$

if $\Delta v_i > 0$, then household i will say 'yes' to the bid amount

$\Delta v_i < 0$, then household i will say 'no' to the bid

$\Delta v_i = 0$, then household i will be indifferent

In terms of probability, the probability of a yes response is:

$$P(\text{yes}) = P [v(Y_i - b_i, Z_i, S_{i1}) + \epsilon_{i1}] > [v(Y_i, Z_i, S_{i0}) + \epsilon_{i0}]$$

On the other hand the probability of the utility maximizer i giving a no response is given by:

$$P(\text{no}) = 1 - P(\text{yes}).$$

With a single bounded value elicitation format for contingent valuation, the i^{th} household is asked if she/he would be willing to pay the initial bid (b_i) to get a given restoration and conservation (both quality and quantity improvement). This is a random variable from the point of view of the researcher and the probability of yes or no response can be presented as:

$$P(\text{yes to } b_i) = P(p \geq b_i)$$

$$P(\text{no to } b_i) = P(p < b_i).$$

For estimating limited dependent variable model like WTP response, maximum likelihood methods are indispensable due to the fact that heteroskedasticity in conditional variance of dependent variable is automatically accounted for because maximum likelihood estimation is based on the distribution of the dependent variable conditional on vector of explanatory variables. Therefore the log likelihood function of this single bounded survey response is:

$$\ln L(\theta) = \sum_{i=1}^N \{d_i^y \ln F(b_i^y, \theta) + d_i^n \ln [1 - F(b_i, \theta)]\}$$

Where:

b_i is the offered bid

d_i^y if the i^{th} response is yes and 0 otherwise;

d_i^n if the i^{th} response is no and 0 otherwise

θ represent the vector of parameters that index the distribution of WTP.

$F(b_i, \theta)$ is the cumulative distribution function for the probability of yes response

$1 - F(b_i, \theta)$ is the cumulative distribution function for the probability of no response

Therefore the probit model for household's willingness to pay restoration and conservation can be specified as follows:

$$\text{WTP}_i = \alpha + \beta_1 \text{BID} + \beta_2 \text{AGE} + \beta_3 \text{GEND} + \beta_4 \text{FSIZE} + \beta_5 \text{MSTA} + \beta_6 \text{EXPE} + \beta_7 \text{EDUC} + \beta_8 \text{BENE} + \beta_9 \text{DIST} + \beta_{10} \text{LARE} + \beta_{11} \text{LIVS} + \beta_{12} \text{PART} + \epsilon_i$$

The main objectives of estimating empirical MWP model based on the contingent valuation survey response is to derive mean of the WTP distribution (Hanemann, Loomis and Kanninen, 1991).

Mean WTP using model for single bounded probit model format is defined as

$$\text{Mean WTP} = -\alpha/\beta \quad \text{Where: } \alpha \text{ is intercept term and}$$

β is the coefficient of the bid proposed to the respondent.

3.7.2. The Tobit Model

The valuation of open-ended bids has traditionally been addressed using standard ordinary least-square regressions ignoring the censoring implied by zero bids. The failure to recognize explicitly the censored or truncated distribution of bids in open-ended contingent valuation surveys results in biased and inconsistent estimates of the parameters (Maddala, 1983). A straightforward way of fixing this problem is the Tobit model (Tobit, 1958) which recognizes those WTP values censored at zero.

As it is described above, in our model the dependent variable (WTP) is not fully observed and this variable assumes zero values for a substantial part of the sample. To estimate the maximum willingness to pay of the household and its determinants we use Tobit model.

The general formulation for Tobit model will be:

$$\text{MWTP}_i^* = \alpha + \beta X_i + \epsilon_i$$

Where: $\text{MWTP}_i = \text{MWTP}_i^*$ if $\text{MWTP}_i^* > 0$

$$\text{MWTP}_i = 0 \quad \text{if } \text{MWTP}_i^* \leq 0.$$

$MWTP_i^*$ is household's unobserved maximum willingness to pay for restoration and conservation of Wof-Washa Forest.

$MWTP_i$ is household's observed maximum willingness to pay for restoration and conservation of Wof-Washa Forest.

Then coming to our specific situations with a list of explanatory variables,

$$WTP_i = \alpha + \beta_1 BID + \beta_2 AGE + \beta_3 GEND + \beta_4 FSIZE + \beta_5 MSTA + \beta_6 EXPE + \beta_7 EDUC + \beta_8 BENE + \beta_9 DIST + \beta_{10} LARE + \beta_{11} LIVS + \beta_{12} PART + \varepsilon_i$$

These variables are selected because of most of the time the household's decision regarding willingness to pay for conservation and restoration is affected by these variables.

3.8. Description of Variables and their expected signs

WTP: WTP is defined as the maximum of amount of money the individuals' willing to pay for restoration and conservation WWF. The dummy variable takes the value of "1" for the households willing to pay for the proposed bid, otherwise 0.

BID: This is the variable referring to randomly assigned payment for the program provided. As demand theory suggests bid value (price) and willingness to pay (demand for) have inverse relationship if the good in question is normal good. Hence, the expected sign for bid is negative.

AGE: refers to the age of household head and measured in years. Older people have long years of experience with the forest and its services. They may wish to pass this to their children and youngsters. So the variable is expected to be positive.

Gender (SEX): Refers to the gender of household head. It is a dummy variable that takes a value of '1' for male household heads and '0' for females. The expected sign of this variable is difficult to state in advance.

Education Level (EDUC): The variable refers to the number of years a respondent spent in formal education. Respondent with higher level of education are expected to have better understanding of environmental management and relatively know more about the negative impact of natural resource degradation. Thus, the expected sign is positive.

Family Size (FSIZE): This relates to the total number of people living under a single roof sharing the same income. Generally, large family size require more money to lead life and thus less money may be left over for other uses like payment for environmental improvements, forest restoration and conservation in this case. On the contrary, large families appreciate a clean environmental and healthy family since the various costs of pollution or environmental degradation to the family may be huge. Hence, the expected sign for household size is ambiguous.

Marital status of the respondent (MSTA): Marital status is defined as a variable which describes whether the respondent is married or single. This also a dummy variable taking value ‘1’ if the respondent is married and ‘0’ otherwise. Since married people are expected to have more family and children in their family member, they are expected to be more willing to pay for the program. Thus, the expected sign is positive.

Distance of the homestead from the forest (DIST): It is a continuous variable expressed in minutes of time taken to reach forest proper. Respondent’s distance from forest inversely related to the WTP for forest restoration and conservation program. Because as the distance between residence area and forest increases households may perceive that they are less benefited from forest.

Land area (LARE): The area of land owned by household’s head. Respondent’s land area directly related to the WTP for forest restoration and conservation.

Participation in environmental conservation (PIEC): This is a dummy variable which takes a value of “1” if the respondent has ever participated in voluntary plantation soil & water conservation campaigns and “0” if not. It is expected that a respondent who has participated in

plantation campaigns voluntarily at least once choose improvement plans in the forest. And expect positive related with WPT.

Tropical Livestock unit (TLU): The total number of livestock of the respondent and convert in to tropical livestock unit. Household's livestock directly related to the WTP for forest restoration and conservation because the main source of animal's food get from the forest.

Benefit from existing forest service (BEFS): It is dummy variable taking 1 if the respondent is beneficiary from existing forest goods and service, 0 otherwise. The expected sign of this variable coefficient is positive since the respondent who beneficiary from existing forest goods and service delivered by these forests.

Monthly non-food expenditure (MNFE): Is monthly non-food expenditure of household's head. Expected sign is negative if the respondent has more expenditure not able to pay for forest conservation.

Table3.2. Definition and expected effect of variables.

Variables	explanation	measurement	Expected sign.
WTP	Respondent's willingness to pay for the proposed Change, Dummy variable.	1=Yes 0=No	
GEND	Sex of respondent is a dummy variable.	1= male 0 =female	+/-
AGE	Age of head of the family.	year	+
EDUC	Education level of the respondent is continuous Variable.	year	+
FSIZE	Size of the family, continuous variable.	Number	+/-
MSTA	Marital status of respondent, dummy variable.	1=married 0= single	+
PIEC	Participation in environmental conservation, dummy variable.	1=participate 0=if not	+
TLS	Animal holdings converted to tropical units.	Convert in to tropical livestock unit	+
LARE	Total area of land owned by household's head	hectare	+
BEFS	Benefit from existing forest service, dummy variable.	1= beneficiary 0= if not	+
MNFE	Monthly non-food expenditure, continuous variable.	Birr	-
DIST	Distance of the forest from the residence.	Minute/Hours	-
BID	Offered bid price to the respondent, continuous variable.	Bid value in Birr	-

Chapter Four

Data Analysis and Results

In this chapter we deal with the empirical findings and discuss the results obtained. The data obtained from contingent valuation survey is analyzed and presented using descriptive statistics and econometric models. Descriptive statistics were used to calculate the socio-economic and demographic characteristics of sampled households and the econometric model were used calculate the mean WTP for Wof-Washa forest protection. In total 395 sampled households received a questionnaire that included the contingent valuation question; due to item non-response 371 are available for analysis.

4.1. Descriptive Statistics

4.1.1. Socio-economic Characteristics of Respondents

Out of 371 households 198 (53.37%) of the respondents are male and 173 (46.63%) are female respondents. In relation to marital status the data reveals that 239 (64.42%) of the respondents are married while 132 (35.585) are not. The education data shows that from sampled respondents 279 (75.20 %) attended their formal education, the remaining 92 (24.80) have not attended formal education. The majority of the respondents were within primary education. The mean of years that household head spend to in school is about 2.558.

The descriptive statistics on socio-economic characteristics and some attitudes of the respondents is summarized in Table 4.1.

Table 4.1 Socio-economic characteristics of the respondent

Variables	Mean	Std.Dev.	Minimum	Maximum
Age	36.56	12.41203	20	69
Gender	0.539	0.499	0	1
Family size	4.4447	2.001	1	9
Monthly non-food expenditure	815.29	881.95	300	3200
Distance of the forest from the residence	8.8436	5.2044	1	40
Education	2.558	2.281242	0	12
Animal holdings converted to tropical units (Livestock)	3.66	3.2365	0.8	15
Participation in environmental conservation	0.625	0.484	0	1
Marital status of respondent	0.644	0.4794	0	1
Total area of land owned by household's head (hectare).	1.268	0.657	0.4	4
Benefit from existing forest service	0.5859	0.4934	0	1

We note from table 4.1 that the average family size of respondents is 4.45 with a minimum of 1 member per household and maximum of 9 members per household. The data on age shows a wide range of starting from 20 up to 69 where the average respondent age is found 36.56. With regard to the average monthly household's expenditure (Non-food household expenditures) of 815.29 ETB per month, which ranges from a minimum expenditure of 300 ETB to the maximum expenditure of 3200 ETB. The number of livestock owned was converted in to tropical livestock unites converted into tropical livestock units and the data shows that on average a household owned about 3.66 tropical livestock units. The total farm land hold of the sampled households was also estimated at 470.67 hectare with average of 1.27 ha.

Distance of the homestead from the forest which expressed in minutes of time taken to reach the forest proper. From survey data the average time (minutes) to reach the forest proper is close to 10 minutes. With regard to level of satisfaction with existing forest service 217 (58.49 %) of the respondent is satisfied with existing forest good and service. Furthermore, respondents were asked whether they have ever participated in voluntary plantation campaigns 63 % of the total sample responded that they did.

4.1.2. Factors Contributing for Wof-Washa Forest Degradation

The local farming community uses the WWF for various purposes. These are for grazing, charcoal production, making household utensils, micro-climate regulations like erosion and flooding, agroforestry practices, fresh water spring, timber production and wild life view in order of importance. However, some of these uses like grazing, tree cutting to make household charcoal, utensils and timber production and firewood collection are environmentally unsustainable. Taking this in to account and in the interest of identifying the most important degrading factors, respondents were asked to rank the various factors responsible for degradation and deforestation of the forest.

The findings from this as in Table 4.2 reveal that energy demand and timber production is rated as the first reason (ranked 1st by 141(38. %) respondents) accountable for degradation of the forest. This indicates that households in the study area, as in other areas of Ethiopia, depend on fire wood for their energy needs which is destructive for natural forest like this. The second most degrading factor is farm land expansion. Locals intentionally burn the forest to convert into farm land and practice agroforestry. Forest fire has been overwhelmingly clearing the forest. This factor is ranked third because respondents believe that the forest regenerates very soon after the fire stops. However, this is not always true particularly if the cleaned land is encroached. Animal grazing is given as the last rank by 65.34 % of the respondents. This might also be because the dung that animals drop fertilise the soil and facilitate regeneration and plant growth.

Table 4.2: Factors Contributing for Wof-Washa Forest Degradation

Rank	Farm land expansion		Energy demand (charcoal & Firewood) and timber		Forest fire		Over grazing	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
1 st	83	22.37	141 ¹	38.00	117	31.53	30	8.1
2 nd	159 ²	42.85	119	32.07	73	19.67	20	5.5
3 rd	101	27.22	55	14.82	137 ³	36.9	78	21.06
4 th	28	7.56	56	15.11	44	11.9	243 ⁴	65.34
Total	371	100	371	100	371	100	371	100

1,2,3 and 4 indicate rank of factor

source: Author's computation from survey data

4.1.3. Current Problems Related to Deforestation and Degradation

Deforestation and deterioration of forest covers directly or indirectly result in various environmental, economic and social problems in places where it occurs. To mention few, there will be limited rainfall, drying up of springs and water points, loss in biodiversity, flooding and soil erosion as a result of which productivity falls. A fall in productivity of land in rural communities whose livelihood is almost entirely based on farming causes a fall in income which consequently results in various social problems.

In order to identify the major problems which are actually there because of deforestation, respondents were asked to rank the possible problems.

Table 4.3: Problems related to deforestation and degradation of Wof-Washa forest

	Drying up of springs		Biodiversity loss		Flooding and Soil erosion		Limited rainfall	
Rank	Frequency	%	Frequency	%	Frequency	%	Frequency	%
1 st	61	16.44	79	21.29	78	21.02	153 ¹	41.25
2 nd	87	23.45	43	11.59	167 ²	45.01	74	19.95
3 rd	163 ³	43.93	111	29.91	60	16.17	37	9.99
4 th	60	16.18	138 ⁴	37.21	66	17.8	107	28.81
Total	371	100	371	100	371	100	371	100

^{1,2,3&4} rank of problems in order of severity

Source: computed from survey data

The survey result reported in Table 4.3 shows limited rainfall is the most critical environmental problem the local people are suffering from. Limited and seasonal rainfall negatively affects productivity and makes life more uncertain particularly for the farming community. The second dispiriting problem resulted from deforestation and degradation of forest is flood risks and soil erosion. Tree roots would tie up soil and the leaves reduce the power of rain drops which hit and erode soil. However, if they are removed, fertile soil will be washed away and transported from the farm plot. The third problem reported is drying up of springs. The local households has no facility to clean water and thus uses water for drinking, cooking, animal watering and other home consumption. Respondents also ranked loss of biodiversity as the fourth main environmental problem. Protection from human and animal intervention, plantation and teaching the local community to raise environmental awareness were suggested solutions by the respondents to restore or maintain the forest.

4.1.4. Reasons for Limited Tourist flow to Wof-Washa.

Wof-Washa Forest is endowed with mosaic of landscapes, natural and plantation forests, mosaic of traditions and cultures, the presence of historical site in the vicinity, variety of bird species, and the presence of different wild mammal species including the large body-sized endemic gelada and Menelik's bushbuck. However foreign and domestic tourist flow to this site is very

limited by different factors. To investigate the main factors accountable for limited recreational experience at the site, respondents were asked to prioritize these problems. Accordingly, almost all respondents 97.6 % indicated that problem of infrastructure such as electricity, road, regular transport and clean water, is the main reason for limited tourist flow and recreational experience. Resting facilities like hotels and lodges were reported as the second main problem which hindered tourist flow and stay in the site. Respondents also showed that limited advertisement of the site as a historical place and recreational amenity as one of the constraining factors.

Table 4.4 Reasons for Limited Tourist flow to Wof-Washa

	Infrastructural problems		Problem of resting facilities		Security problems		Lack of advertisement	
Relevant	363¹	97.84	314²	84.63	213⁴	57.41	297³	80.05
Irrelevant	8	2.16	57	15.37	158	42.59	74	19.95
Total	371	100	371	100	371	100	371	100

1,2,3 and 4 rank of problems

Source: computed from survey data

4.2. Econometrics Analysis

4.2.1. Households Willingness to Pay and Starting Bids

Before conducting the final survey pretest pilot survey was done using 40 randomly selected households to set up the starting bid prices and elicit the payment vehicles. From the pilot five starting bids were determined 5,10,15,25, and 50 Birr per month. The data were collected from the surrounding sampled households that live around WWF area. From respondents who were asked for willingness to pay for conservation and restoration of WWF, the data revealed that 371 (93.92%) are willing to pay a positive values for the program and the rest 24 (6.08%) are protested against the proposed program and not willing to pay for. The reasons of unwilling households were their economic condition and also they see it as it is government obligation to conserve the forest.

Based on the different starting bid level offered the data indicates around 228 (61.45%) have said 'yes' to the first price that they have been given and the rest 143 (38.55%) have refused and gave a lower bid than the initial price proposed to them. The frequency of response for yes declines with an increase in the initial bids. The frequency of yes answer for the lowest initial bid exceeds

the second lowest bid by 11.84 %. The frequency difference between the second and the third lost bid is also 19.74 %. The third one exceeds fourth lowest bid by 18.86 %. The frequency of yes answer difference between the fourth and fifth initial bid is 12.09%. The frequency of the yes answers for the lowest initial bid exceed frequency of the highest bid by 62.53% within a range of 45 birr. This figure clearly shows us that the amount of the bid and the people’s willingness to pay relates inversely. As price increases peoples willingness to pay decreases.

Table 4.5 Table proportion of yes answers by response for offered bids.

Starting bid	Number of respondents	Number of “yes” answers	Number of “no” answers	Share of “yes” (%)
5	76	70	6	92.1
10	76	61	15	80.26
15	76	46	30	60.52
25	72	30	42	41.66
50	71	21	50	29.57
Total	371	228	143	61.45

Source: computed from the survey

4.2.2. Probit Model Estimation Result

Apart from descriptive analysis, econometric analysis was used to present the major determinants of households’ willingness to pay and to estimate the coefficient of socio-economic variables that affect households’ willingness to pay for forest conservation and restoration. Before we estimate willingness to pay, we must test the problem of multicollinearity which existence of perfect linear relationship between some or all of explanatory variables of the model (Guirati, 2004). Multicollinearity becomes a serious problem if the correlation coefficient is 0.8 or above. Based on this there is no problem of multicollinearity on our data (see appendix 1). To avoid the problem of heteroscedasticity we use robust estimation.

To test the overall significance of the model the Chi-square distribution is used in this study. The results shows that the probability of the Chi-square (χ^2) distributions is 405.35 with 12 degree of freedom less than the tabulated counterfactual is 0.0000. This means the variables explaining the willingness to pay for conservation of forest fits the probit model.

The estimate result of factors affecting the households’ WTP for forest conservation and restoration is presented in Table 4.6 below.

Table 4.6 Coefficients and Marginal effects of the Probit Model.

Variables	Coefficient	Robust Std. Err	P> z	dy/dx
BID	-.0403985	.0114959	0.000***	-.0027723
AGE	.0600441	.0173425	0.001***	.0041204
GEND	.5528765	.2904023	0.057*	.0379401
DIST	-.0867336	.0423152	0.040**	-.0059519
FSIZE	.3420154	.0905884	0.000***	.0234701
MSTA	1.287375	.3671113	0.000***	.0883435
EDUC	.1104992	.0550165	0.045**	.0075828
PART	.449529	.3187021	0.158	.030848
EXPE	-.0004727	.0002777	0.089*	-.0000324
BEFS	1.538931	.317611	0.000***	.105606
LARE	.7652514	.224681	0.001***	.0525139
TLV	.2526166	.0562778	0.000***	.0173353

Number of Obs. = 371 pro > chi2 = 0.0000

Wald chi2 (12) =73.50 pseudo R2 = 0.8195

Log likelihood = -44.649012 LR chi2 (12) = 405.37 Pro > chi2 = 0.000

dy/dx= is for discrete change of dummy variable from 0 to 1

Note: ***, ** and * significant at 1%, 5% and 10% probability levels, respectively

Bid amount (BID):-The result of probit model shows that the initial bid level affects household's willingness to pay at less than 1 % level of significance, with a negative sign which indicates that the increase of initial bid reduce the probability that households are accepting the proposed bid price. The marginal effect shows that keeping all other variables constant; a one birr increase in the bid amount will decrease the probability of accepting the proposed bid price by 0.277 %.

Age of household head (AGE):- Age has positive coefficient as expected and statistically significant at less than 1% level of significance. The positive and significant correlation between willingness to pay and age might be perhaps because of two reasons. Older people are more financially stable so that they are more willing to pay for conservation and restoration. Another probable reason is older people are wise; they took in to consideration the bequest value of the forest so that they are eager to hand over resources to their children and grandchildren, so that the probability of their WTP for conservation and restoration activities may increase. The marginal effect shows that keeping all other variables constant; a one year increase in the age of

respondents will increase the probability WTP by 0.41%. The result agrees with the work of Alem (2012) but contradicts with the findings of Chukwuone and Okorji (2008).

Gender of head household (GEND):-The variable gender of respondent is positively related to the probability of respondents WTP for forest conservation and restoration. It is significance at 10 % level of confidence. The result revealed that those male headed households were found to be more willing to pay forest conservation practices to forest services than female headed households.

Distance of the homestead from the forest (DIST):- As expected this variable showed negative relation with the WTP for forest conservation and is statistically significant at 5%. This is because the farther the family residence and the more inaccessible the benefits from the forest is, the lower the probability of WTP for conservation and restoration of this forest. The result agrees with the work of Chukwuone and Okorji (2008), Hisinya (2015) and Limaiei et al. (2016).

Family size (FSIZE):-Household's family size is also found to have a positive sign and statistically significant at below 1 % level of significance. The possible explanation here could be large number of people in a given family may create strong financial power which increases the amount that family is willing to forest conservation. The result agrees to with the work of Hisinya (2015).

Marital status of respondent (MSTA):-Marital status of the respondents has a positive sign as expected and statistically significant at 1% level of significance. The result revealed that households who were married to be more willing to for forest protection.

Education level of the respondent (EDUC):-Education of the household head also statistically significant at 5% level of significance. As expected education had a positive relationship with the WTP. That means household head with higher education levels were more likely to state positive WTP, and on average, they actually stated higher conditional and unconditional WTP than household head with lower educational levels. This result suggests that investing in education of people might help to restore forest resource in degraded environment. The marginal effect of the result shows that the household head being educated, the probability of willingness to pay for forest conservation and restoration increases by 0.75%. The result agrees with the work of Alem (2012) and yilma et al. (2016).

Participation (PART):- This is a dummy variable which takes a value of “1” if the respondent has ever participated in voluntary plantation campaigns and “0” if not. The variable participation of the respondent is positively related to the probability of respondents WTP for forest conservation. The result revealed that households who were participate in voluntary plantation campaigns to be more willing to for forest protection. This is probably due to the fact that households who were participate in voluntary plantation campaigns to have positive environmental opinion.

Tropical Livestock unit (TLU):- The total number of livestock of the household’s head and convert in to tropical livestock unit. Household’s livestock is also found to have a positive sign and statistically significant at below 1 % level of significance. .This is probably due to the fact that main source of their animal’s food get from the forest. The result agrees with the work of Alem (2012).

Non-food household’s expenditure (EXPE):-Household’s average monthly expenditure has a negative sign as expected and is statistically significant at 10 % level of significance. This negative effect indicates that households with higher monthly expenditure were less likely to say yes than households with lower expenditure. The result also shows that keeping the influences of other factors constant at their mean value, a one birr increase in expenditure of households, decrease the probability of accepting the propose bid by about 0.0032%.

Benefit from existing forest service (BEFS):- Forest benefit and willingness to pay has positive relation and statistically significance at less than 1% level of significance. The household who benefits from the forest has positive willingness to pay for forest conservation and restoration because they want to increase their benefits by conserving the forest area. The result also shows that keeping other factors constant the increase of forest benefits increase the probability of willingness to pay for forest conservation by 10.56 %.

Land area (LARE):- Total area land owned by household head and willingness to pay has positive relation and statistically significance at less than 1% level of significance. The significant result indicate that households who have higher land area were more likely to say response for the propose bid than the respondents with small land area. This is probably due to

the fact that larger farm size earns more income from crop production especially cash crops. The marginal effect estimates of also shows, that keeping the influences of other factors constant, a one hectare increase in the land of household head increases the probability of willingness to pay forest conservation by 5.25%.The result agrees with the work of Alem (2012) and Birrara and Bneberu (2019).

4.2.3. Tobit Model Estimation Result

The initial bid price is found statistically significant at lower than 1% level of significance and negative related with willingness to pay. That the amounts of payment proposed to the households are the major determinant of the amount that households are willing to pay for the proposed improvement. This could be due to inverse relationship between the own price of goods or service and the quantity demanded. The result explains the theory of demand for the normal goods and service.

The other factor affects maximum willingness to pay is gender of household head. This is a dummy variable that takes 1 if the household head is male and 0 otherwise. It has a positive relation with maximum willingness to pay and significant at less than 1 % level of significance. Other things remain constant; male household head has high maximum willingness to pay than female household held.

Table 4.7 Estimated Result of Tobit Model

Variables	Coefficient	Robust Std. Err	P> t
BID	-.0078825	.0016774	0.000
AGE	.0104163	.0019924	0.000
GEND	.0726112	.040659	0.075
DIST	-.0345581	.0081137	0.000
FSIZE	.0550177	.0111275	0.000
MSTA	.3532826	.0585719	0.000
EDUC	.020208	.0099157	0.042
PART	.0649876	.0453714	0.153
EXPE	-.0000554	.0000475	0.244
BEFS	.2326043	.0523414	0.000
LARE	.1340623	.0327078	0.000
TLV	.0258142	.0069411	0.000

The result of the tobit model shows that education level of the respondents is positively and significantly related to WTP. The possible reason could be that literate individuals are more concerned about forest resource than illiterate one. Educated individuals relatively know more about the significance of resources, and they are concerned more about the environmental resource.

Forest Benefits one the variables that affect household's willingness to pay. This variable has a positive relation with households' willingness to pay and statistically not significant. This might be because household who are beneficiary by the forest may be willing to pay forest conservation and restoration to increase his/her benefits.

Household's family size is also has a positive sign and statistically significant it suggesting that those respondents with large family size are more likely to contribute positively for forest protection.

Generally Tobit model is employed to answer the question "what are the factors that influence households' mean maximum willingness to pay for the conservation and restoration forest." The result of the model indicated that age, gender, educational level, family size, marital status, tropical livestock unit, and benefit from existing forest service has statistically significant and positive effect on households' willingness to pay. This implies that the above variables increase the willingness to pay of respondents unlike negatively related variables. The rest non-food expenditure and distance from home are negative effect on households' willingness to pay for forest conservation and restoration.

4.2.4. Calculating Mean WTP: From Single bounded model estimate

One of the main objectives of estimating empirical willingness to pay based on the CV survey response is to derive central value (mean). One objective of estimating probit model is to calculate the mean WTP for conservation and restoration of WWF by running a regression of binary choice variable on the bid values (see below Table 4.7)

Mean WTP (μ) using the model for the single bounded format is defined as follows:

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

Where α = is the constant (intercept) term;

β = the coefficient of the bid.

$$\mu = -1.088662 / -.0373506 = 29.147108$$

Table 4.8 Computation of Mean from single bounded method

Variable	Coef.	Robust Std. Err	P> z
BID	-.0373506	.0047211	0.000
CONSTANT	1.088662	.1147348	0.000

Source: computed from the survey

To determine the mean willingness to pay from the open ended follow up questions we simply averaged maximum WTP figures across respondents as follows:

$$\text{Mean WTP} = \sum^n_i y_i / n$$

$$\text{Mean MWTP} = 8795 / 371 = 23.7062 \text{ ETB.}$$

Where, Mean MWTP is mean maximum willingness to pay, $\sum^n_i y_i$ is summation of maximum willingness to pay of the sampled respondent and n is number of sampled respondents. The mean willingness to pay from the sampled respondents is 23.7062 ETB per household per month, which ranges from a minimum of 5 to a maximum of 100 ETB from open-ended question (see Table 4.9 below).

Table 4.9 Mean WTP calculation from open ended elicitation format

variable	Obs	Mean	Std.Dev	Min	Max
Mwtp	371	23.7062	17.01081	5	100

4.2.5. Estimating Total willingness to pay

Mean WTP is used as a measure of aggregate value of forest restoration and conservation in this study. As it is indicates in table 4.10 below, the aggregate WTP is calculate by multiplying the mean WTP by the total number of households in the population. Following this, the aggregate

WTP for restoring forest resource was computed at 1,676,425.08 birr per year. Whereas, from open ended questions the total WTP for restoring resource was also computed at 1,363, 485.84 birr per year.

Table 4.10 Total WTP for forest conservation and restoration

Total household	Expected households to have a protest zeros	Expected households with valid responses	Total WTP for forest protection per month (Birr).	Total WTP for forest protection per year (Birr).
5103	310	4793	139,702.09	1,676,425.08
5103	310	4793	113,623.82	1,363,485.84

Chapter Five

Conclusion and Policy Implications

5.1. Conclusion

Wof-Washa dry afro-montane hotspot forest is one of the oldest proclaimed state forests in the central highlands of Ethiopia. The principal objective was to estimate the mean willingness to pay of local rural farm households for conservation and restoration of Wof-Washa forest. To achieve the objective of the study, contingent valuation method (CVM) was used by using single bound dichotomous questions followed by open-ended questions. The data for this purpose came from 371 rural households who live in the five kebeles surrounding Wof-Washa forest. Twelve explanatory variables were selected for analysis purpose based on their theoretical importance in determining willingness to pay the analysis was made by both descriptive and econometrics method.

Increasing demand for energy in the form of charcoal and firewood, overgrazing and farm land expansion were found the most degrading factors of the forest. Local environmental problems due to deforestation like drying up of springs, limited rainfall, biodiversity loss, and erosion and flood risks were found to become pressing in the area.

Based on the hypothetical market of Wof-Washa forest, household were asked to state whether they are willing to pay or not for conservation and restoration of Wof-Washa forest. The result shows that out of 371 respondents 228 (61.45%) were willing to pay the given bid amount, while the rest 143 (38.55%) were not willing to pay the given bid amount for forest conservation.

Tobit and probit models were employed to answer the question “what are the factors that influence households’ mean and maximum willingness to pay for the conservation and restoration forest.” The result of the model indicated that age, gender, educational level, family size, marital status, participation, tropical livestock unit, and benefit from existing forest service had statistically significant and positive effect on households’ willingness to pay in terms of cash. This implies that the above variables increase the willingness to pay of respondents unlike negatively related variables.

The results of the study on willingness to pay showed that the households were willing to pay for conservation and restoration forest resource. The mean willingness to pay value of households for conservation and restoration forest resource based on the single bounded dichotomies choice was computed at 29.147108 Birr per month. Whereas, the mean willingness to pay from open ended format was also computed at 23.7062 Birr per month. The study found that the value of forest conservation and restoration from open ended format was lower than single bounded elicitation format significantly. The study conclude that there could be a problem in applying a closed-ended elicitation format to forest conservation and restoration in developing countries since a forest conservation and restoration typically implies a community based scenario and such a scenario invites to anchoring effect. The well-known problem of anchoring effect and/or compliance bias is also difficult to avoid in such settings. Application of a closed-ended format under such circumstance would exaggerate the WTP for forest conservation and restoration.

5.2. Policy Implications

Based on the main finding of the study the following recommendations are forwarded.

Education level of the respondents is positively related to the willingness to pay (WTP) for forest conservation and restoration project, this indicates that investment on education to enhance the awareness level of farm households about forest resource can be used as a strategy to facilitate environmental protection and conservation. From least preference for environmental protection observed from households, we suggest that continuous awareness creation program to be designed and implemented at different levels. This can be done through public enlightenment campaign through mass media and raising the issue in places like edir and public meetings.

Integration of indigenous knowledge with modern conservation approaches in the planning and implementation process is essential to improve and promote local participation in conservation restoration of forests; local knowledge not only provides relevant information on the use of forest but also contributes valuable information on how to maintain and conserve it.

Developing the forest for nature-based tourism seems to be a promoting business in the future since eco-tourism activities can also improve the incomes of the local people through creating different job opportunities, such as souvenir selling, horse renting, and tourist guiding services all of which can help make eco-tourism economically viable in WWF.

Our study indicates that Wof-Washa forest resources are important to supplement livelihoods of the people living in the vicinity of the forest, so that the local administration should take in to consideration this livelihood issue before changing the forest area in to other development tradeoffs.

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Appendices

Appendix-1: Questionnaire Used for the Survey

ADDIS ABABA UNIVERSITY
DEPARTMENT OF ECONOMICS

Contingent Valuation Survey questionnaire Designed for Beneficiary of
Wof-Washa Forest.

Name of the interviewer: _____

Date of interview: _____

Starting time: _____

Ending time: _____

Code of the interviewee: _____

Dear Respondent, my name is _____ (interviewer name). This questionnaire is prepared by Mr. Alemayehu Abebe who is a final year MSc student at Addis Ababa University. At this time he is doing a thesis on Non-Market Valuation of Wof Washa Forest for his MSc in economics. You are randomly selected to give accurate information on your perception and observation about Wof-Washa forest. Information you provide will be kept strictly confidential and will only be used for study purpose. It will be very crucial to estimate how much the forest is environmentally valuable to the nearby people and help the community have common understanding about the problems of restoration and conservation of the forest. Policy makers will also use the results to make appropriate and informed policy about this and other forests in the country. Put “√” mark to show that it is your choice and put number for ranking “1” is the top rank.

PART 1: Socio-Economic Characteristics of the Respondent

1.1. Sex of the household head: 1. Male _____ 2. Female _____

1.2. Age of the household head : _____

1.3. Respondents' marital status: 1. Single _____ 2. Married _____

1.4. What is your highest formal education level in years? _____

1.5. Total number of your household members? _____

1.6. How much is the monthly non-food expenditure of the household's head in birr? _____

1.7. What is the size of your farm land in hectare? _____

1.8. Number of your livestock? _____

Animals	
ox	
cow	
sheep	
goat	
donkey	
camel	
other	
total	

PART-II: General Questions on Respondents Observation, perception and Attitude about Wof-Washa Forest.

2.1. How much time does it minutes take to reach the forest (minutes/hours)?_____

2.2. Have you ever participated in voluntary plantation or soil and water conservation campaign in WWF?

Yes_____ No_____

2.3. Do you get benefits from the Wof-Washa forest?

1. Yes _____ 2. No _____

2.4. If your answer in 2.3 above is 'yes', what benefits do you get from the Wof-Washa forest? Rank in order of use intensity (1 is the best rank)

- a. Charcoal and firewood _____
- b. Grazing land _____
- c. Agro-forestry practice _____
- d. Timber production _____
- e. Wild life view _____
- f. Fresh water spring _____
- g. To make household utensils _____
- h. Micro-climate regulation (protection of soil erosion and flood control) _____
- i. Others (specify) _____

2.5. Have you observed a reduction in the Wof-Washa forest cover since when you first came to this place? 1. Yes _____ 2. No _____

2.6. If your answer to 2.5 is 'yes', what do you think are the possible causes for this? Rank in order of importance (1 is the highest value).

- a. Farmland expansion _____
- b. Tree cutting for fuel wood, charcoal and timber production _____
- c. Forest fire _____
- d. Demand for grazing land _____
- e. Others (specify) _____

2.7. If you believe forest fire is a problem in WWF, what do you think are the major causes of forest fire outbreak in the forest? Rank in order of importance.

- a. Illegal charcoal production _____
- b. Intentional made to expand grazing and farm land _____
- c. I don't know _____
- d. Other specify _____

2.8. What environmental problems have you observed following deforestation? Rank in order of severity.

- a. Drying up of springs _____
- b. Reduction in the number of animal and plant species _____
- c. More flooding and soil erosion _____
- d. Limited rainfall _____
- e. Others, Specify _____

2.9. Have you observed a fall in productivity of your farm land? 1. Yes 2. No

2.10. If your answer to 2.9 is 'yes', do you think that this is due to deforestation on the WWF?

1. Yes 2. No

2.11. Who do you think is responsible for the deforestation and associated problems?

Multiple answers are possible.

- a. Government
- b. The local people
- c. Non-government organization (NGO)
- d. Other specify

2.12. What problems hindered tourist flow to Wof-Wash forest?

- a. problem of infrastructure such as electricity, road and water _____
- b. Absence of resting facilities such as hotels and lodges _____
- c. Security problems namely guards _____
- d. Lack of advertisement about the site by the government _____
- e. Other _____

PART-III: The Contingent Valuation Scenario

Wof-Washa forest is one of prominent natural forest that is mentionable for its area and the diversified life within the Amhara national regional government. And since it is very important, it has been nicknamed as the lungs of the region. The society in the surrounding area has been using it for different purposes for a long period. For example, it has been using it for grazing of livestock, fire wood, source of wood for construction and different purposes. But different studies show that the forest cover has been decreasing at a rapid pace in the past 15 years. Due to this, the benefit the society gets from the forest has decreased accordingly.

By taking care (restoration) of the remaining and performing rehabilitation (conservation) development works, it is possible to ensure the society's benefit. For example, the surrounding society, instead of deploying livestock near the forest, by making them cut the grass that will be used as feed for livestock when it grows and by making them use it by taking it to their residential house. Having the tree breeding stations that prepare country and broad tree species that will be used for the feed of the livestock, by planting the prepared ones in place that are deserted and alongside with the forest development work, it is possible to cover the society's need for food livestock. For the purpose of fire wood, to decrease the deforestation that is performed, the small and micro enterprise that is found in the surrounding should provide stoves (like Lakech & Mirt) that are modern and minimize cost with fair prices. By performing these works, it is possible to protect the forest from the danger that found lurking on it. If the total cost required for this program is not known in advance. However, we want to know if you are willing or not willing to contribute for the activity. The contribution will be made monthly for one year. The money will be collected by a committee established from the community at the end date of the month.

3.1. Are you willing to participate in this program?

A. Yes

B. No

If yes go to question 3.2, if No go to question 3.4

3.2. As we have stated earlier, the cost required is not known in advance. However, if you are a decision maker in your household and asked to contribute Birr _____ monthly for one year, would your household be willing to contribute the money?

A. Yes

B. No

3.3. What would be the maximum amount your household would be willing to pay per month for one year? _____ Birr.

3.4. Could you tell us why you are not willing to be part of the program or why not you do not want to pay nothing?

A. Because you think the program should be provided free of charge

B. You are satisfied with the existing situation

C. You cannot afford it

D. If you have other reason, specify _____

Appendix 1.2: Goodness of fit for Tobit and Probit Model

Appendix -2: Goodness of fit for Probit and Tobit model

Appendix 2.1. Probit model estimation results of household's WTP for forest conservation and restoration (with robust standard errors).

WTP	Coef	Robust Std. Err	Z	P> z	[95% Conf. interval]	
BID	-.0403985	.0114959	-3.51	0.000***	-.0629301	-.0178668
AGE	.0600441	.0173425	3.46	0.001***	.0260533	.0940348
GEND	.5528765	.2904023	1.90	0.057*	-.01163015	1.122055
DIST	-.0867336	.0423152	-2.05	0.040**	-.1696699	-.0037973
FSIZE	.3420154	.0905884	3.78	0.000***	.1644654	.5195653
MSTA	1.287375	.3671113	3.51	0.000***	.5678499	2.0069
EDUC	.1104992	.0550165	2.01	0.045**	.0026688	.2183297
PART	.449529	.3187021	1.41	0.158	-.1751156	1.074174
EXPE	-.0004727	.0002777	-1.70	0.089*	-.001017	.0000715
BEFS	1.538931	.317611	4.85	0.000***	.9164245	2.161437
LARE	.7652514	.224681	3.41	0.001***	.3248847	1.205618
TLV	.2526166	.0562778	4.49	0.000***	.1423141	.3629191
CONS	-5.313851	.9644829	-5.51	0.000***	-7.204203	-3.4235
Number of observation	371					
Log pseudo likelihood	-44.649012					
Wald Chi2(12)	73.50					
Pseudo R2	0.8195					
Prob > Chi2	0.0000					

Appendix 2.2: Tobit model estimation with robust standard error.

WTP	Coef	Robust Std. Err	t	P> t	[95% Conf. interval]	
BID	-.0078825	.0016774	-4.70	0.000	-0.0111812	-.0045838
AGE	.0104163	.0019924	5.23	0.000	.0064981	.0143345
GEND	.0726112	.040659	1.79	0.075	.0073485	.1525709
DIST	-.0345581	.0081137	-4.26	0.000	-.0505146	-.0186017
FSIZE	.0550177	.0111275	4.94	0.000	-.0331344	.0769011
MSTA	.3532826	.0585719	6.03	0.000	.2380954	.4684698
EDUC	.020208	.0099157	2.04	0.042	.0007019	.0397021
PART	.0649876	.0453714	1.43	0.153	-.0242395	.1542146
EXPE	-.0000554	.0000475	-1.17	0.244	-.0001487	.0000379
BEFS	.2326043	.0523414	4.44	0.000	.12967	.3355385
LARE	1340623	.0327078	4.10	0.000	.0697376	.198387
TLV	.0258142	.0069411	3.72	0.000	.0121639	.0394645
CONS	-.4202919	.1537998	-2.73	0.007	-.7227537	-.1178301
/sigma	.3417739	.0199686			.3025039	.3810441
Number of observations	371					
Log pseudo likelihood	-145.03943					
F(12, 359)	44.96					
Pseudo R2	0.6283					
Prob > F	0.0000					
Obs. summary	143 left – censored observation at wtp <= 0					
	228 uncensored observations					
	0 right – censored observation					

Appendix 3: Multicollinearity test

Variance covariance matrix used for testing the existence of Multicollinearity. Here the rule is the value of correlation above 0.8 needs a solution and the variable considered responsible for the existence of multicollinearity is those independent with higher correlation coefficient.

Correlation coefficient matrix for explanatory variables

	Bid	Age	Gend	Dis	Fsize	Msta	Educ	Part	Expe	Befs	Lare	Tliv
Bid	1.000											
Age	-0.236	1.000										
Gend	-0.105	0.066	1.000									
Dis	0.1730	-0.337	-0.149	1.000								
Fsize	-0.080	0.295	0.118	-0.312	1.000							
Msta	-0.257	0.336	0.050	-0.310	0.295	1.000						
Educ	-0.165	0.334	0.046	-0.305	0.288	0.268	1.000					
Part	-0.1170	0.199	0.013	-0.169	0.102	0.157	0.204	1.000				
Expe	-0.219	-0.176	-0.084	0.222	-0.032	-0.178	-0.171	-0.051	1.000			
Befs	-0.282	0.203	0.056	-0.217	0.209	0.242	0.259	0.093	-0.193	1.000		
Lare	-	0.344	0.069	-0.302	0.280	0.290	0.235	0.137	-0.151	0.248	1.000	
Tliv	-0.074	0.306	0.131	-0.198	0.291	0.276	0.184	0.070	-0.090	0.144	0.301	1.000

As the results on the table shows there is no multicollinearity among variables, it is not as such a bid problem since all variables correlation coefficient is found to be less than 0.8 (Gujarati ,1995).