WILLINGNESS TO PAY FOR WOODWORK ENTERPRISES TO RECOVER DEFORESTED SOFTWOOD TREES IN EASTERN ETHIOPIA

M.Sc. Thesis

Daniel Habtamu Hailemichael

May 2017

Haramaya University, Haramaya

WILLINGNESS TO PAY FOR WOODWORK ENTERPRISES TO RECOVER DEFORESTED SOFTWOOD TREES IN EASTERN ETHIOPIA

A Thesis Submitted to the School of Agricultural Economics and Agribusiness
Postgraduate Programs Directorate
HARAMAYA UNIVERSITY

In Partial Fulfillment of the Requirements for the Degree of
MASTER OF SCIENCE IN AGRICULTURAL ECONOMICS

Daniel Habtamu Hailemichael

May 2017

Haramaya University, Haramaya

HARAMAYA UNIVERSITY

POSTGRADUATE PROGRAM DIRECTORATE

As Thesis Research advisor, I hereby certify that I have read and evaluated this Thesis titled "**Willingness to Pay for Woodwork Enterprises to Recover Deforested Softwood Trees in Eastern Ethiopia**" prepared under my guidance by Daniel Habtamu Hailemichael. I recommend that it be submitted as fulfilling the thesis requirement.

Lemma Zemedu (PhD)	_____	_____
Major Advisor	Signature	Date
Jema Haji (PhD)	_____	_____
Co-Advisor	Signature	Date

As member of the Board of Examiners of the M.Sc. Thesis Open Defense Examination, We certify that we have read, evaluated the Thesis prepared by Daniel Habtamu Hailemichael and examined the candidate. We recommended that the Thesis be accepted as fulfilling the Thesis requirements for the Degree of Master of Science in Agriculture (Agricultural Economics).

_____	_____	_____
Chairperson	Signature	Date
_____	_____	_____
Internal Examiner	Signature	Date
_____	_____	_____
External Examiner	Signature	Date

Final approval and acceptance of the Thesis is contingent upon the submission of its final copy to the Council of Post Graduate Program (CPGP) through the candidate's department or school graduate committee (DGC or SGC).

DEDICATION

This Thesis manuscript is dedicated to my father Habtamu Hailemichael who passed before his time and to my family specially my wife, Mahlet Getachew Dera, for her partnership in all the success of my life.

STATEMENT OF THE AUTHOR

By my signature below, I declare and affirm that this Thesis is my own work. I have followed all ethical and technical principles of scholarship in the preparation, data collection, data analysis and compilation of this Thesis. Any scholarly matter that is included in the Thesis has been given recognition through citation.

This Thesis is submitted in partial fulfillment of the requirements for a Masters of Agricultural Economics Degree at the Haramaya University. The Thesis is deposited in the Haramaya University Library and is made available to borrowers under the rules of the Library. I solemnly declare that this Thesis has not been submitted to any other institution anywhere for the award of any academic degree, diploma or certificate.

Brief quotations from this Thesis may be made without special permission provided that accurate and complete acknowledgement of the source is made. Requests for permission for extend quotations from or reproduction of this Thesis in whole or in part may be granted by the Department of Agricultural Economics or the Director of Post Graduate Program Directorate when in his or her judgment the proposed use of the material is in the interest of scholarship. In all other instances, however, permission must be obtained from the author of the Thesis.

Name: Daniel Habtamu Hailemichael Signature: _____

Date: 09/05/2017

School/Department: Agricultural Economics and Agri-business.

Haramaya University, Haramaya.

BIOGRAPHICAL SKETCH

The author was born on 1978 in Harar town of Harari Regional State. He attended his primary education at Bethlehem elementary school and his secondary education at Harar Junior and Senior Secondary School (HSSS). He joined Haramaya University and graduated with Diploma in Management in July 2002. Then he worked in private Woodwork enterprise in Harar town and continued his BA Degree in Management at Haramaya University in 2003 and graduated with BA Degree in Management in July 2006. After graduation, he established his own wood and metal work and Hollow Blocks manufacturing enterprises and ran as an owner and manager until he joined the School of Graduate Studies of Haramaya University in 2012 for his M.Sc. Degree in Agricultural Economics.

ACKNOWLEDGEMENTS

First of all, I would like to give thanks to my Lord God Son of Virgin Mary for helping me in all aspects. I would like to extend my sincere gratitude and heartfelt thanks to my advisors Dr. Lemma Zemedu and Dr. Jema Haji for giving me your valuable guidance, constructive pieces of advice and comments starting from proposal development to the completion of my Thesis work without any reservation. It is safe to say that your efforts led to a substantially best document, and I appreciate the time and effort spent reading and helping with the revision process.

I would like to express my sincere gratitude to: Ms. Bethlehem Dinberu at Dire Dawa Administrative Council Small and micro enterprise; Ms. Almaz Desalegne at Dire Dawa Administrative Council Central Statistical Agency; Ms. Zewditu Teshome and Mr. Nebil Mohamed at Harar Chamber of Commerce; Mr. Jemal Mohamed at Harari Small and micro enterprises; Mr. Girma Wendu, Mr. Gamada Tufa and Mr. Wendosen Zewde at Deder district (woreda) Small and micro enterprise; Ms. Helewena Meselu at Oromia Agricultural Bureau Reforestation Agency. Special thanks also go to Mr. Bizuayehu Belete, Colonel Alemtsehay Tadesse, Mr. Gedion Getachew, Mr. Getachew Dera, Mr. Mengistu Kidane and Mr. Tekalign Bedada. Thank you for your kind support and encouragement throughout my research works.

Words cannot express my heartfelt thanks to my wife Mahlet Getachew, my beloved son Yadon Daniel and my beloved daughter Maraki Daniel. Thank you Mahi for your love, encouragement and support which made completion of this thesis possible. The person I have become is all because of you and thank you so much for trusting me and supporting me. Special thanks to my mother Zewditu Teshome and my beloved and helpful sisters Tingirt Habtamu and Meseret Habtamu who supported, inspired and encouraged me. Last but not least, I would like to thank all the Woodwork enterprise heads in Dire Dawa, Harar and Deder district who gave their precious time and responded to all the questions with patience and gave necessary information for this research work.

ACRONYMS AND ABBREVIATIONS

AFF	African Forest Forum
BoFED	Bureau of Finance and Economic Development
BTL	Border Timbers Limited
EARO	Ethiopian Agricultural Research Organization
EC	European Commission
EER	Ethiopian Environment Review
EFAP	Ethiopian Forestry Action Program
ETFF	Ethiopia Tree Fund Foundation
FFE	Forum for Environment
FGD	Focus Group Discussion
FOSA	Forestry Outlook Studies in Africa
FRA	Forest Resource Assessment
GER	Gross Enrollment Ratio
GFC	Global Forest Coalition
GTP	Growth And Transformation Plan
ISIC	International Standards for Industrial Classification
MoA	Ministry of Agriculture
MoFED	Ministry of Finance and Economic Development
NAS	Northeast African Studies
NOAA	National Oceanic Atmospheric Administration
OPPACC	Oromia Program of Plan on Adaptation to Climate Change
OECD	Organization for Economic Co-operation and Development
OSFP	Orissa Social Forestry Project
PFM	Participatory Forest Management
SNNP	Southern Nations Nationalities and Peoples
SROFEA	Sub Regional Office for Eastern Africa
SUBVP	Seemingly Unrelated Bivariate Probit
UNEP	United Nations Environmental Program
VAM	Vulnerability Assessment and Mapping
WBISPP	Woody Biomass Inventory and Strategic Planning Project

TABLE OF CONTENTS

STATEMENT OF THE AUTHOR **v**

BIOGRAPHICAL SKETCH **vi**

ACKNOWLEDGEMENTS **vii**

ACRONYMS AND ABBREVIATIONS **viii**

LIST OF TABLES **xii**

LIST OF FIGURES **xiii**

LIST OF TABLES IN THE APPENDICES **xiv**

LIST OF FIGURES IN THE APPENDICES **xv**

ABSTRACT **xvi**

1. INTRODUCTION **1**

1.1. Background of the Study **1**

1.2. Statement of the Problem **4**

1.3. Research Questions **6**

1.4. Objectives of the Study **6**

1.5. Scope and Limitations of the Study **7**

1.6. Significance of the Study **7**

1.7. Organization of the Study **8**

2. LITERATURE REVIEW **9**

2.1. Definition of Basic Concepts **9**

2.1.1. Forests, wooded land and other land 9

2.1.2. Softwood trees 10

2.1.2.1. Cupressus lusitanica 10

2.1.2.2. Juniperus procera 11

2.1.2.3. Pinus patula 12

2.1.3. Medium Density Fiberboard (MDF) 13

2.2. Deforestation and Reforestation of Forests **15**

2.2.1. Deforestation 15

2.2.1.1. Deforestation in Ethiopia 15

2.2.1.2. Logging 16

Continues…

TABLE OF CONTENTS (*Continued*)

2.2.2. Reforestation or Forest Plantation 16

2.2.2.1. Forest Plantation in Ethiopia 17

2.2.2.2. Forest Development, Conservation and Utilization Proclamation in Ethiopia 17

2.3. Economic Value of Natural Recourses 18

2.3.1. Overview of Valuation Methods 18

2.3.1.1. Stated Preference Approach 18

2.3.1.2. Revealed Preference Approach 19

2.3.2. Contingent Valuation Method (CVM) 21

2.4. Empirical Review of CVM 23

2.5. Conceptual Framework 27

3. RESEARCH METHODOLOGY 32

3.1. Description of the Study Areas 32

3.1.1. Dire Dawa Administrative Council 32

3.1.2. Harari Regional State 34

3.1.3. Deder district 35

3.2. Source of Data and Methods of Data Collection 37

3.3. Sampling Techniques and Sample Size 37

3.4. Methods of Data Analysis 39

3.4.1. Descriptive statistics 39

3.4.2. Value elicitation format 39

3.4.3. Initial bid values 40

3.4.4. Econometric method 42

3.4.5. Bivariate Probit model 46

3.5. Description of Variables and their Expected Effect 48

3.5.1. Dependent variables 48

3.5.2. Explanatory variables 48

Continues…

TABLE OF CONTENTS (*Continued*)

4. RESULTS AND DISCUSION **56**

4.1. Descriptive Analysis **56**

4.1.1. Characteristics of respondents **56**

4.1.2. Descriptive statistics for dummy variables **56**

4.1.3. Descriptive statistics for continuous variables **60**

4.1.4. Willingness to pay **62**

4.1.5. Enterprise heads WTP in the initial and follow up bids **62**

4.2. Econometrics Analysis **64**

4.2.1. Result of the Bivariate Probit model 65

4.2.2. Estimation of Average WTP 72

4.2.3. The Aggregate WTP 74

5. SUMMARY, CONCLUSION AND RECOMMENDATIONS **76**

5.1. Summary **76**

5.2. Conclusion **78**

5.3. Recommendations **79**

6. REFERENCES **82**

APPENDICES **96**

Appendix 1. Regression, Heteroskedasticity and Correlation Test Results **97**

Appendix 2. Figures in Appendix **104**

Appendix 3. Focus Group Discussions questionnaire **105**

Appendix 4. Survey questionnaire **107**

LIST OF TABLES

Table	Page
1. Woodwork enterprises and Kebele Administratives (KAs) in the study areas.	38
2. Random bid scheme used for the CV survey	41
3. Response categories and bounds on WTP	44
4. Description of dependent and explanatory variables	55
5. Descriptive statistics for sampled enterprise heads (Dummy variables)	57
6. Descriptive statistics for sampled enterprise heads (Continuous variables)	58
7. Enterprise heads responses for Double Bounded Dichotomous Choice question	62
8. Enterprise heads choices of initial and follow up bids	63
9. Descriptives on willingness of enterprise heads	64
10. Estimated Coefficients of the Seemingly Unrelated Bivariate Probit model	67
11. Parameters estimates of Bivariate Probit to compute mean WTP	73
12. Average and aggregate WTP measures by the study areas	75

LIST OF FIGURES

Figure	Page
1. Geographical Location Map of the Study Areas	36
2. Percentages of Yes response for both first and second bid values	64

LIST OF TABLES IN THE APPENDICES

Appendix Table	Page
1. OLS regression	97
2. Heteroskedasticity test	97
3. Multicollinearity test	98
4. Correlation coefficient test result	99
5. Bivariate Probit (SUBVP) regression	100
6. Marginal effects after biprobit , result1	102
7. Marginal effects after biprobit , result2	102
8. Marginal effects after biprobit , result3	103
9. Marginal effects after biprobit , result4	103

LIST OF FIGURES IN THE APPENDICES

Appendix Figure	Page
1. DBDC Contingent valuation Responses	104
2. Location of the study areas in Eastern Ethiopia	104
3. Satellite Image of the Study Areas	105

WILLINGNESS TO PAY FOR WOODWORK ENTERPRISES TO RECOVER DEFORESTED SOFTWOOD TREES IN EASTERN ETHIOPIA

ABSTRACT

This study was carried out to determine the economic value of forest by Wood work enterprises for the reforestation of softwood Pine trees in Eastern Ethiopia, namely Dire Dawa Administrative Council, Harari Regional State and Deder district (woreda) of East Hararghe Zone. Forests in Eastern Ethiopia were the major sources of softwood Pine logs. Nowadays, some of commercially important Pine species are over-exploited and in short of supply. The study was undertaken with the objective of estimating Woodwork enterprises heads willingness to pay in Dire Dawa, Harari and Deder district for the recovery of deforested softwood Pine trees in m^3 using a Contingent Valuation method in Double Bounded Dichotomous Choice format. Seemingly Unrelated Bivariate Probit model was used to examine factors affecting Woodwork enterprise heads WTP and to calculate the mean and aggregate WTP. To elicit their WTP for reforestation, 136 sample Woodwork enterprise heads were randomly selected from 1076 enterprise heads and interviewed. Among these sample enterprise heads 87.5% of them were willing to pay for the reforestation while others (12.5%) were not. The mean WTP of the enterprise heads was ranged from Birr 97.92 to Birr 174 per month per person or Birr 1175.05 to Birr 2088 per m^3 per year per person and the aggregate WTP was Birr 1264343.04 per m^3 per year and that could enable to reforest 88 hectare. From a total of 15 explanatory variables used in the model, nine variables namely second bid value, family size, capital, perception, source connection, profit, substitution, liability and distance turn out to be significant and all have the expected sign. Softwood Pine trees forest is of high value and therefore, policy makers, development practitioners and regional governments of the study areas in collaboration with the federal government should use this opportunity to mobilize Woodwork enterprises to combat softwood trees deforestation problem in the study areas by taking into account the study result and significant variables that affecting respondents WTP for reforesting this valuable resource.

Keywords: Willingness to Pay, Deforestation, Double Bounded Dichotomous Choice, Contingent Valuation, Seemingly Unrelated Bivariate Probit, Softwood Pine trees, Woodwork.

1. INTRODUCTION

1.1. Background of the Study

Ethiopia's base of natural resources is the foundation of any economic development, food security and other basic necessities of its people. Smallholder agriculture is the dominant sector that provides over 85% of the total employment and foreign exchange earnings and approximately 55% of the Gross Domestic Product (EPA, 2012). Ethiopia owns diverse vegetation resources, from tropical rain and cloud forests in the southwest and on the mountains to the desert scrubs in the East and Northeast and parkland agro forestry on the central plateau (Demel *et al*., 2010).

The Ethiopian highlands are the largest mountain complex in Africa and comprise over 50% of the African land area covered by afromontane vegetation (Breitenbach, 1963; Demel, 1996; Tamrat, 1993). The large terrestrial land surface with biologically productive climate and soil also presents the country with a huge forestry development potential. The forest resources, fertile croplands to sustain agricultural productivity, the mainstay of the country's economy; are an important endowment of the country (RFWBRE, 2010). Ethiopia's forest and woody vegetation are classified as Natural high forests, Woodlands, Bushlands, Plantations including: industrial plantations, peri-urban plantations, community plantations and catchment or protection plantations and trees on farms (farm forestry) (Bekele and Berhanu, 2001).

Owing to the extreme variations in climate, terrain, and comprising most ecological systems, Ethiopia possesses one of the largest and most diverse plant genetic and wildlife resources in the world. According to Bekele and Berhanu (2001), the size of the Ethiopian flora is estimated to range from 6500 to 7000 species of higher plants, flowering plants, conifers and ferns of which 12% are considered endemic. Out of the 300 tree species found in the country only few are used for construction and industrial purpose. Tree plantations were covering around 500000 ha, out of which 133041 ha were established as community plantations between 1978 and 1989 (Bekele, 2011). *Eucalyptus species* (58%) and *Cupressus* (29%) are

the dominant plantation species. Other species include *Juniperus procera* (4%), *Pines* species (2%) and the rest (7%) (WBISPP, 2005).

Sustainably managed forests have multiple environmental and socio-economic functions important at the global, national and local scales, and play a vital part in sustainable development. Forests can extract CO_2 and pollutants from the air, thus contributing to biosphere stability and probably relevant to the greenhouse effect: thus, forest cleans the air. Forests produce a number of goods and services. Forests provide fuel wood and timber. In addition to timber products, forests assist in controlling soil erosion, regulate rainfall, provide shelter, sequester carbon and are sites for recreational activities. Many of the benefits provided by forests do not have a market where values can be observed directly. Improved knowledge of the value of all forest goods and services will allow more informed decisions to be made in the public and private sectors. The full economic implications of managing forests in alternative ways, including the reforestation of deforested forests and degraded lands, can then be taken into account.

However, the expanse of forest areas is declining across the globe, partly as a result of logging activities which accounts for up to 43% of tropical forest losses (FRA, 2010). In Ethiopia, natural forests and woodlands covered 15.1 million ha in 1990. This area declined to 13.7 million ha in 2000. In 2005, the forest cover had further declined and was estimated to cover 13.0 million ha. In other words, annual average loss of 140000 ha has been experienced between 1990 and 2005. This shows Ethiopia lost over 2 million ha of its forests each year. In 2010, the area was estimated at 12.3 million ha or 11.9% of the total land area. Of this, the remaining closed natural high forests is 4.12 million ha or 3.37% of Ethiopia's land area (Bekele, 2011; FAO, 2010). In 2016, the forested area was estimated to be 12.4 million ha (FAO, 2016).

Deforestation and the resulting environmental degradation is a major problem in the Federal Democratic Republic of Ethiopia and a key factor challenging food security, community livelihood and sustainable development. Between 1955 and 1979, over 77% of the country's forested area disappeared and it continues to lose 8% of its remaining forests annually (Ellen,

2010). Forests in Ethiopia, are being deforested at an alarming rate and the area covered by forests is estimated at 2.4% of the total land area and the actual deforestation rate may be close to 2% (Fekadu, 2015). However, the expanse of forest areas is declining in Ethiopia, it take control of an estimated 2.76 billion tons of carbon, still playing a significant role in the global carbon balance (ECRAN and UNDP, 2010).

The largest pockets of remaining natural forests of Ethiopia are located in the Oromia and Southern Nations Nationalities and Peoples (SNNP) regions. According to Woody Biomass Inventory and Strategic Planning Project (2005), in Ethiopia the highest forest coverage that is 2205619 ha was found in Oromia region. The Forest Resource Assessment (FRA), (2010) report also shown that Oromia region has the highest forest coverage (2205619 ha) and total land and water coverage of 36 million ha in the country. Vegetation cover of the National Regional State of Oromia accounts for about 69% of the total area of the Region. Afro-alpine and sub-afro alpine, high forest, woodland, grassland, bush and shrub lands are major types of vegetation. Out of the 58 National Forest Priority Areas (NFPA) of the Country, 49 are found in Oromia and their areal coverage accounts for about 8.1% of the total surface area of the region (OPPACC, 2011).

East Hararghe zone is one of the 12 Oromia zones and found in Eastern Ethiopia. Deder district is one of the Oromia districts in this zone. Forests in Deder district have experienced so much pressure due to increasing need for wood and wood products. Indeed, commercially important softwood Pines species are over-exploited which resulted in short of supply in these forest areas. The trend in the area is to protect the remaining forests for their various social, economic and environmental values. On the other hand, there is an increasing demand for wood and wood product resulting over-cutting which brings deforestation. To strike the balance between the supply and demand to this resource, reforestation is very important; because, the future will depend on the contribution of these softwood forests plantation.

1.2. Statement of the Problem

Natural resources such as forests play a key role in the livelihoods of local people in Ethiopia. Forests are the source land for industrial and commodity crops, and of raw materials for construction, furniture, paper and pulp. However, the bases of these resources have been deteriorating over time (Bedru, *et al*., 2006). Deforestation in Ethiopia is getting worst than it was ever before. Estimates show that about 700000 ha of forests will be destroyed every year (ECRAN and UNDP, 2010; FAO, 2010). WBISPP (2004) also analyzed deforestation rates in districts where there are still natural high forests, and predicted a loss of 1.33 million ha until 2020. Correspondingly, forests in Eastern Ethiopia has been subject to extensive deforestation. According to EHZAO the prevalence of extreme land pressure and vast deforestation, causing severe environmental damage on the region (EHZAO, 2012).

This study was undertaken in Eastern Ethiopia; namely, Dire Dawa Administrative Council, Harari Regional State and Deder district. Forest in Deder district covers most of the three small rural towns these are *Kobo*, *Chelenko*, and *Karra Makkala* area forests. Nevertheless, local and neighboring loggers over-cutting and deforestation worsen it specially the *Karra Makkala* area forests. These area softwood forests have experienced so much pressure for the increasing need of wood. Logging by both legal and illegal loggers and weak conservation practices brings deforestation of this valuable softwood Pine tree resources. Illegal logging and its associated trade is a major problem for environmental, economic and social reasons, raising serious concerns about over-exploitation and poor forest management (Li *et al*., 2008).

Softwood Pine tree logs and lumber is typically used for making furniture, construction, house-building, and so on (GFC, 2010). To make the most of their production and for construction purposes Woodwork enterprises and consumers in Eastern Ethiopia using of softwood resources reaches in a high level of consumption. To the extent that consumption exceeds supply; it resulted in over-cutting of existing plantations, natural forests and woodlands which brings deforestation. Nowadays, Deder district hillsides stripped of their protective covering of vegetation specially Pines species are rapidly overexploited and softwood forests decline due to clearing for other use. Further, the volume of softwood logs

coming from these softwood tree forests become inadequate to meet the demand of local and neighboring Woodwork enterprises and consumers. Thus, its catalyzed economic impact is loss of foreign currency for importing softwood timbers from abroad to meet the supply gap. According to Export Genius report on softwood import data of Ethiopia regarding on consumer prices for imported Pines coniferous timber, there has been an increase in most prices mainly imported from Austria (Export Genius, 2016).

Deforestation brings poverty (Chomitz *et al*., 2007). The local consequences of softwood tree forests deforestation makes destruction of the resource base, deprives local communities rights and livelihoods. Increasing the probability of Pines species genetic erosion and loss in its regeneration process. One type of environmental damage leads to another damage; So, it is an established fact that overexploitation of these forests is responsible for climate variability, irregular rainfall and floods that leads to loss of biodiversity and permanent loss of soil fertility due to soil erosion and even changes in local and regional climates in the future (Alemu, 1999; Kohlin and Amacher, 2005). This also will go on to diminish the future adaptive capacity and livelihood options of local communities reinforcing a cycle of vulnerability too.

To avert all these environmental disasters being brought by deforestation, it is imperative to take action quickly and on a vast scale. It is therefore, very necessary to induce in every one's mind the importance of reforestation of this resource forests. The *Karra Makkala* area mountainous forests including *Gondela*, *Gara Tullu, Jebel Tita, Gara Obii*, are characterized by different landscapes with the altitude ranging from 2500 to 3381 meter above sea level. The coldest climate and highest elevation of these forests are very suitable agro-ecological condition to reforest Pines species in this area. According to El Zein and El Mamoun (2014) study result, elevation significantly affected soil moisture content; soil organic matter; and microbial activities, all these affected the growth of the three important Pines species (*Cupressus Lusitanica*, *Pinus Radiata* and *Pinus Putula*) positively, and this could be related to the depth to which roots can penetrate. Their analysis also showed that, there is a change in organic matter content as going from high elevations to low ones, thus resulted in a good performance of plantations of all the three species.

To this end, in this study, an attempt was made to analyze local and neighbors Woodwork enterprises heads WTP for the reforestation of deforested softwood Pines wood trees in *Karra Makkala* area forests. In addition, the study attempted to identify determinants of WTP of Woodwork enterprises. Given the relative merit and objective of this research, the economic valuation measure through a hypothetical market valuation associated with forest and tree cover changes, the Contingent Valuation Method (CVM) with a Double Bounded Dichotomous Choice (DBDC) format was used to elicit Woodwork enterprises WTP (Gregersen *et al*., 1997; Carson, 1989). So this study focused on this subject.

1.3. Research Questions

The study tries to answer the following research questions:

1. How much is the WTP of enterprise for reforestation of these softwood tree resources?
2. What are the main determinants that affect enterprises WTP?

1.4. Objective of the Study

The overall objective of the study is to assess the WTP of Dire Dawa Administrative Council, Harari Regional State, and Deder district Woodwork enterprises to reforest the deforested softwood trees in Deder district *Karra Makkala* forest.

The specific objectives of the study are:

1. To analyze status of Woodwork enterprises WTP for the reforestation;
2. To identify the determinants of WTP of Woodwork enterprises; and
3. To estimate the mean and the aggregate WTP of Woodwork enterprises in Dire Dawa Administrative Council, Harari Regional State, and Deder district.

1.5. Scope and Limitations of the Study

The study covers estimating and identifying factors affecting the selected Woodwork enterprises WTP for reforestation of the deforested area. This study was limited to Dire Dawa, Harari and Deder district of East Hararghe zone. This is mainly because of the limited resources to undertake the study at a wider scale. Even though, the study can serve as an important opportunity to identify new gaps in the literature; lack of prior research studies on the topic happens to be a limitation. The sample size was limited to few respondents this is because of the size of the total population; but, sample respondents are considered to be a representative of groups of people that ensures a representative distribution of the population.

Furthermore, most of the data collected for 2015 are a onetime data and this might not be enough to generate adequate information because there could be many variables which could potentially be changed from one survey time to another survey time within a given locality based on the type of survey used and other reasons. In addition, as the research uses contingent valuation methodology (CVM) all limitations associated with the theory are here. However, efforts have been made to minimize the limitations associated with the methodology. Finally, as this research was conducted in Eastern Ethiopia of East Hararghe zone and Dire Dawa Administrative Council, the results might not be applicable to other regions and zones of the country and should be interpreted and used cautiously.

1.6. Significance of the Study

The continued deforestation and forest degradation reveals that conventional approaches that are in use to manage forests in Ethiopia have not been able to guarantee the conservation of these resources (AFF, 2001). Plantations on deforested lands, non-forested lands even-aged forest stands carefully established. The purpose can be wood production or protection under the ownerships of the private sector, individual farmers, the community, or the state (ECRAN and UNDP, 2010). In order to fill the gap between demand and supply of wood, and reducing pressure on the remaining natural forest resources, expansion of plantation forests should be taken as an important strategy. So, this study provide its own contribution to the success of

government's five years plan to reducing deforestation by half during GTP2 and increasing Ethiopia's forest cover from about 4% to 9%. It will also support Ethiopia's special forest management strategies such as Biosphere Reserves, Clean development mechanism (CDM) and 'reduce emissions from deforestation and forest degradation' (REDD) carbon projects.

Forest research play a significant role in forest development in Ethiopia. The development can not only be shouldered by the government. The new forests policy and Forest proclamation No: 542/2007 permits the private sector and public institutions such as education institutions and military barracks to develop their own forests and managed sustainably (ECRAN and UNDP, 2010). Organizing and documenting reliable information is another significant and helpful point for improving and planning the management of forest resources and monitoring changes. So, this study will make its own contribution to this initiation. Moreover, the results of the study on the WTP for plantation decisions by these Woodwork enterprises are vital for the, government and policy makers. It will also be used as a baseline information for further studies on the socioeconomic aspects of forest resources use and it will add to the existing stock of knowledge on forest resources management that may important for researchers.

1.7. Organization of the Study

This study is organized in five chapters. Chapter one presents introduction of the study and it deals with background of the study, statement of the problem, research questions, objective, scope, limitations and significance of the study. The rest of the thesis is organized as follows. In chapter two, reviewing of definitions of basic concepts, economic valuation methods, related theoretical and empirical literatures; basically, the reviewed studies in the area of natural resources on willingness to pay in Ethiopia and in some other countries are presented. Chapter three presents the research methodology and it deals with the description of the study areas, sources of data, its collection and analysis methods, sampling techniques and sample size determination, Bivariate Probit model specification and description of variables and their expected effects. Chapter four presents the results and discussion on the descriptive statistics and econometrics analysis of the survey data. Finally, chapter five presents summary, conclusion and recommendations of the study.

2. LITERATURE REVIEW

In this chapter, definition of basic concepts, review of related empirical literature mainly concerned with natural resources valuation techniques particularly the contingent valuation method and finally, some studies that have been done in Ethiopia and elsewhere using the contingent valuation method are presented.

2.1. Definition of Basic Concepts

2.1.1. Forests, wooded land and other land

Forests: In February 2015 Ethiopia adopted a new forest definition: Forest is a land spanning at least 0.5 ha covered by trees and bamboo, attaining a height of at least 2m and a canopy cover of at least 20% or trees with the potential to reach these thresholds in situ in due course (MEFCC, 2015). The FAO's basic definition of forest is a land with relatively continuous cover of trees, which are evergreen or semi deciduous, only being leafless for a short period, and then not simultaneously for all species. It is an area of >0.5 ha with >10% tree canopy cover, with 'trees' defined as plants capable of growing >5m tall (FAO, 2001). The canopy should preferably have more than one story. Land spanning more than 0.5 ha with trees higher than 5m and a canopy cover of more than 10%, or trees able to reach these thresholds in their original and appropriate position. It does not include land that is predominantly under agricultural or urban land use (FRA, 2010).

Wooded land: Land not classified as "Forest", spanning more than 0.5 ha; with trees higher than 5m and a canopy cover of 5-10%, or trees able to reach these thresholds in their original and appropriate position; or with a combined cover of shrubs, bushes and trees above 10%. It does not include land that is predominantly under agricultural or urban land use (FRA, 2010).

Other land: All land that is not classified as "Forest" or "wooded land". land that classified as "Other land", spanning more than 0.5 ha with a canopy cover of more than 10% of trees

able to reach a height of 5 meters at maturity can be “Other land with tree cover” (FRA, 2010).

2.1.2. Softwood trees

The wood of gymnosperms is commonly referred to as softwood, and sometimes as non-pored wood. An example of softwood timber is Pines, sometimes also referred as whitewood. Softwoods come from coniferous trees which have needles instead of leaves. The timber produced from conifer trees is generally referred to as softwood, as opposed to that from broadleaved trees, which is called hardwood (despite some broadleaved species producing timber that is relatively soft) **(**Primefacts, 2008; Ragland, 2010).

Softwoods grow faster than hardwoods and so are cheaper and are easier to work with as they are softer than hardwoods. Trees grow tall and straight which makes it easier for the manufacturer to cut long straight planks of wood. Often used as furniture and building material. *Cupressus lusitanica*, *Juniperus procera* and *Pines patula* are some major species types of softwood trees.

2.1.2.1. Cupressus lusitanica

Cupressus lusitanica (*C. lusitanica*) is an evergreen native to North America commonly known as Mexican cypress (Orwa *et al.*, 2009). The tree favors moist, deep, loamy soils (Brink 2007) it grows between 1000-4000m in elevation (Orwa *et al.*, 2009). Reaching 31 heights up to 35m, it has a straight trunk with reddish brown bark and widely spread hanging branches (Dharani, 2002).

Cupressus lusitanica is naturally distributed in Mexico, Guatemala, Belize, Honduras, El Salvador and Nicaragua. In the 20th century it was introduced as a plantation forest tree into tropical Africa, where it is widely planted at higher elevations. It is also planted in Ethiopia. The wood is used for construction, furniture, poles and posts. It is also suitable for light flooring, ship and boat building, vehicle bodies, agricultural implements, boxes and crates,

interior trim, joinery, toys and novelties, turnery, draining boards, veneer and plywood, hardboard and particle board. The wood is also used for paper making, *e.g*. in Ethiopia and Kenya.

2.1.2.2. Juniperus procera

Juniperus procera is an evergreen dioecious, more seldom monoecius tree, which belongs to the family *Cupressaceae*. It is the tallest/largest juniper tree in the world (Pohjonen and Pukkala, 1992; Negash, 1995). It can reach up to 45m high when it matures (Berhe and Negash, 1998). *Juniperus procera* is the only Juniperus species, which is found in the mountains of East Africa and it is one of the two indigenous conifer species found in Ethiopia locally it is known as "*Tid*" it is naturally found in the central highlands of the country, mainly between altitudes 1800-3200m above sea level with an annual rainfall range that varies between 450 and 1200 mm (Breitenbach, 1963). The optimum altitude range, however, is between 2200 and 2500 m above sea level (Pohjonen and Pukkala, 1992).

Juniperus procera has been a very important source of wood for timber and fuel. Its wood is fragrant, fine-textured, and strait-grained. It is hardy and resistant to termites and fungal diseases. Because of these distinctive qualities, it is highly valued for the construction of houses, internal structures of churches, furniture and for poles (Negussie, 1995). In Eritrea, Ethiopia and Kenya, *Juniperus procera* is replanted in deforested areas for soil conservation or improvement and for erosion control (Couralet and Bakamwesiga, 2007). *Juniperus procera's* berries resin in combination with honey is used as stimulant and as a medicine against ulcers as well as against liver diseases (Hvoslef-Eide and Preil, 2005; Couralet and Bakamwesiga, 2007). *Juniperus procera* is also used for the preparation of traditional eye medications used in the treatment of eye infections such as conjunctivitis, blepharitis and other eye-related disorders (Klaus and Adala, 1994). *Juniperus* species have therefore become important in long term rehabilitation projects.

Juniperus procera, as a multipurpose tree, because of its use as a good alternative to the exotic species for reforestation and its drought tolerant, easily adaptability and importance for

soil and water conservation. The natural habitat of several *Juniperus* species has been greatly reduced because of overexploitation for timber and fuel wood and clearance for cultivation. Furthermore, this endogenous and very important tree is in the rapid disappearance from its natural habitats (Seblework, 2009).

2.1.2.3. Pines patula

Pines patula is an evergreen conifer commonly known as Mexican weeping pine because the foliage has a drooping or weeping look. *Pines patula* is native to Mexico and prefers sites with annual rainfall of 1000-2000mm and higher elevations of 1000-3000m (Orwa *et al.*, 2009). It thrives in moist sandy loam soils to sandy clay soils (Wormald, 1975). The tree starts to flower at two to three years of age in many parts of Southern Africa, with the two reproductive periods being January–May and September–October (Dvorak, 1997). The female cone is borne in the upper crown, while the male remains in the lower crown of the tree (Orwa *et al.*, 2009).

Many people throughout the world enjoy planting *Pines patula* primarily because it is a fast growing straight tree with around 40% of the bole branchless. The tree can grow over 30m in height and when seedlings are planted at 2.4m spacing, can fully occupy an area after two years (Wormald, 1975). Natural regeneration is uncommon so many people direct sow seeds into nursery beds and then transplant the 30 seedlings to their woodlot or plantation (Wormald, 1975).

There are many uses for the tree but the most common are for timber, fuelwood and pulp. The wood is white to yellowish white with pinkish heartwood and is strong enough for most construction jobs (Gillespie, 1992). *Pines patula* is grown by major timber companies throughout the world with similar management techniques. For example, Border Timbers Limited (BTL) in Zimbabwe harvest saw logs every 22 years and prune four times over a 10 year period at heights of 1.5m, 3.5m, and 7m (BTL, 2010).

2.1.3. Medium Density Fiberboard (MDF)

Medium Density Fiberboard (MDF) is a reconstituted wood panel product. It is a dry-processed fiberboard manufactured from wood fibers, as opposed to veneers or particles, and is denser than plywood and particleboard. MDF has an even density throughout and is smooth on both sides (EWPAA, 2016).

MDF was developed in the United States and has since 1973 been produced in Europe, where it achieved an effective breakthrough only in the 1990s. MDF is manufactured using the so-called dry process in which the wood fibers are mixed with glue and pressed in dry condition (Spanolux, 2017).

According to Spanolux, 2017 data, European standard NEN-EN 622-5 subdivides MDF into various application classes by the addition of one or more letters: H: increased moisture resistance, E: outdoor applications, L: structural applications, A: permanent loads, S: momentary (short-term) loads and FR: fire retardant applications. Based on this classification, the quality of MDF types can be defined and subdivided further in specific manner.

In principle, all thicknesses and lengths or widths of MDF are available within the press capabilities. The following dimensions of MDF in length / width / thickness produces boards are the common standard measurements. Thicknesses (mm): 6, 8, 9, 10, 12, 15, 16, 18, 19, 22, 25, 28, 30, 38. Standard board dimensions (mm): 1220 x 3050, 1220 x 3050, 1830 x 2440. The press capabilities for MDF are as follows: Widths from 2450 to 2550 mm, lengths from 3660 to 6310 mm, thicknesses from 6 to 38 mm. Standard MDF are available in a range of sizes, with the most common sheet sizes being 2400 x 1200 mm and 3600 x 1200 mm (Spanolux, 2017).

MDF is now widely used in wood workshops throughout the world. The following are some advantages of MDF as compared to soft solid wood. Due to its manufactured form, MDF offers a non-directional grain making it easy to work with. MDF is ideal for painting, cutting, machining and drilling without splinters or chipping. It also has advantages over particleboard

in screw holding ability, internal bond strength and modulus of rupture. MDF has a fine, smooth surface which is ideal for shaping or routing. It delivers a surface free of knots and grains - so is easier for finishing. For instance, MDF made from *Radiata* Pine have a very smooth surface, are easy to work and edges can be smoothly contoured. The material is a good substrate for high gloss coatings, decorative overlays and is also attractive in its raw form with a clear finish. These are mainly aesthetic. Storage of MDF is significantly easier than with sawn solid timber because they can be efficiently stored in a vertical position (Ragland, 2010; EWPAA, 2016).

Disadvantages of MDF as compared to softwood or solid wood are stated as follows: Since MDF is not as dense as real wood it is weak. So, it could be split or crack easily under a lot of stress. In contrast to softwood timber its hardest layer makes MDF not take nails easily; moreover, it is difficult to reduce its thickness and due to the glues used for their manufacture doing so will result in blades or sanding belts being quickly blunted (Ragland, 2010; DIY, 2017).

MDF generally require an additional surface such as paint or veneer and so on will not usually bring satisfactory results than softwood timber. Because of its poor moisture resistance, shrinkage and contraction nature, MDF is far less than external use that of softwood. Moisture absorption by MDF causes swelling in the thickness. While it is unlikely in cooler environments, MDF is still susceptible to attack from wood destroying beetles, fungi and termites. On the other hand softwood specially from the Pine family are highly resistance to fungi, termites, wood destroying beetles and insect attack. MDF is usually and typically expensive than softwood timber. Certain softwoods, such as Pines and Yew, have greater elasticity than MDF. Working with softwood timber is less risky than MDF. When working with MDF, it is important to be aware of the potential risks of dust and formaldehyde gas. Formaldehyde gas can be released when heated, laminated or during cutting of MDF. Inhalation of excessive amounts of MDF dust and formaldehyde gas smoke can pose a serious health risk; So, it is important that proper precautions are taken. are some properties of MDF (Ragland, 2010; EWPAA, 2016).

2.2. Deforestation and Reforestation of Forests

2.2.1. Deforestation

Deforestation is a serious damage caused by excessive logging, wood gathering for both domestic and commercial purpose, fire and live stock grazing which results total conversion of forests to other land uses (FAO, 1988). Its familiar forms of tropical forest degradation include non sustainable (but still 'selective') harvesting of timber. The clearing of forests by people and the land converted to another use, such as agriculture or infrastructure (EC, 2013).

2.2.1.1. Deforestation in Ethiopia

Deforestation and consequent land degradation are global menaces, and so are they in Ethiopia. Deforestation and degradation are impairing the capacity of forests in Ethiopia (NAS, 2001). The pressure on the forest resources themselves increased due to a higher demand on fuel wood and construction timber. Finally, uncontrolled logging and the illegal export of wood stems to urban centers like Addis Ababa and Dire Dawa is a threat for the natural high forest of the country (Reusing, 2000).

Forests and the benefits they provide in the form of wood, food, income and watershed protection play a critical role enabling people to secure a stable and adequate food supply. In 2005, the Woody Biomass Inventory and Strategic Planning Project (WBISPP) reported that 13 million ha of forest remained in Ethiopia covering 12% of Ethiopia's land mass. Ethiopians are facing rapid deforestation. Forest areas have been reduced from 40% a century ago to an estimated less than 3% today. the current rate of deforestation increased 1980's 160000 to 200000 ha per year (FAO, 1981; UNEP, 1983). The extensive deforestation has also led to the extinction of various biotas resulting in significant biodiversity loss (Hurni, 1988). Reports indicate that Ethiopia has been losing 6-9% of its GNP due to deforestation (Pearce, 1991).

In 1990 Ethiopia's forests were covered 15.1 million ha. This area declined to 13.7 million ha in 2000 had further declined to 13.0 million ha In 2005 and 12.2 million ha or 11.9% of the total land area in 2010 (FAO, 2010). In present day Ethiopia's, forests are being deforested at an alarming rate and the area covered by forests is estimated at 2.4% (less than 4%) of the total land area (Fekadu, 2015). The actual deforestation rate may be close to 2%. At this rate, about 700000 ha of 'forests' will be destroyed every year and releasing nearly 110 million CO_2 to the atmosphere (ECRAN and UNDP, 2010 ; FAO, 2010). If the trends continue with no change, the forest area will be reduced to less than 7 million ha by 2020. It is expected that past deforestation rates will continue and that about 1.2 million ha of forests and other secondary forests will be converted to other land uses mainly arable land and perennial crops by 2020 (Bekele, 2001).

2.2.1.2. Logging

Logging involves cutting trees for sale as timber or pulp. The timber is used to build homes and furniture. Logging occurs for many economical reasons, such as: agriculture (planting crops), cattle-ranching, mining, oil and gas extraction, development, and subsistence-farming. The logs are also used to make homes, furniture, paper, pencils, wood-chips for packaging products, fuel for cooking and providing heat for homes, *etc* and the pulp is used to make paper and paper products (GFC, 2010).

2.2.2. Reforestation or Forest Plantation

Forest plantations are defined by FAO (2010) as forest stands established artificially by planting or/and seeding in the process of afforestation or reforestation. Reforestation refers to establishment of forest on land that had recent tree cover, whereas afforestation refers to land that has been without forest for much longer. Plantation mainly *Eucalyptus, Cupressus* and *Pines* plantation with >5m and crown density >20% and thus is included in "Forest" as defined by FAO (2010). Evans (1992) defines plantations simply as a forest crop or stand raised artificially either by sowing or planting. Plantations can have a catalytic effect on the regeneration of some species and can be used as a management tool for restoration of

degraded lands (Eshetu, 2002; Feyera *et al*., 2002; Mulugeta and Demel, 2004; Mulugeta *et al*., 2004).

2.2.2.1. Forest plantation and development in Ethiopia

According to Bekele (2001), in Ethiopia the total area estimate of plantations were 255214 ha which comprise around 76050 ha of industrial plantation and 179164 ha of plantations for the production of fuel wood and poles, of this 79500 ha represent plantations established by farmers and communities and 99664 ha represent public sector plantations for fuel wood and pole. *Eucalyptus* and *Cupressus* are the main species in industrial plantations (58% and 29%, respectively), followed by *Juniperus procera* (4%), Pines (2%) and other species (7%) (Bekele, 2001). The current rate of industrial plantation forest development is not encouraging and their management is also poor. The supply and quality of these plantations would be low due to this low management practices. They are fragmented and mixed with many tree species with little or no commercial value.

Ethiopia's development agenda is governed by two key strategies: the Second Growth and Transformation Plan (GTP-2) and the Climate Resilient Green Economy (CRGE) strategy emphasize agriculture and forestry with respect to climate, environmental protection and forest development. In terms of forest development, it is planned to increase the share of the forest sector in the overall economy. It is also planned to increase the forest coverage through research-based forest development. The GTP-2 are planned to initiate the community to participate in environmental protection and forest development activities. It also planned to reduce deforestation by half until 2025. The CRGE strategy targets increasing Ethiopia's forest expansion by 9% or 7 million ha through planting 875000 ha per year until 2025 (EFRL, 2016).

2.2.2.2. Forest development, conservation and utilization proclamation in Ethiopia

In 1999 Environmental Protection of the House of Peoples Representatives raised one point that was about the inclusion of private forests. Proclamation No. 542/2007 together with the

accompanying policy document is one of the long awaited proclamations by Ethiopian environmentalists. It replaces the Policy and Strategy on Forest Development, Conservation and Utilization issued by the Ministry of Agriculture and Rural Development and adopted by the Council of Ministers in 1997. There are two types of forest ownership recognized under the Proclamation; namely private and state (both federal and regional) ownership (Article 3 and Article 2(6)) (Edwards, 2010).

2.3. Economic Value of Natural Resources

For market prices to represent the correct value society attaches to the good, markets need to be competitive and work freely. In such cases, prices are taken as an expression of the willingness to pay for the good, which is the total value the buyer, has for the good. But in reality markets are far from being perfect, and even they do not exist for some class of goods. Therefore, to measure the value people attach to goods, which do not have a perfect market, or any market at all; we need to understand the concept of value (Aklilu, 2002).

2.3.1. Overview of Valuation Methods

Different methods have been used to estimate the total economic value of natural resources and environmental goods. Broadly the valuation approaches can be divided into two. Stated preference (direct) approach and revealed preference (indirect) approach. The stated preference method is used by constructing hypothetical market scenarios while the revealed preference method is used where conventional or proxy market prices exist (Biniam, 2013).

2.3.1.1. Stated preference approach

Stated preference methods are based on a hypothetically constructed market. That is, under this approach people are asked to state the value they attach to that resource. The direct method of valuation include: Contingent Valuation Method (CVM), Choice Experiment Method (CEM), Contingent Ranking Method (CRM) and Conjoint Analysis Method (CAM).

Contingent Valuation Method (CVM): A CVM is a widely applied monetary valuation method for valuing environmental and natural resource related good (Jakobsson and Dragon, 1996). It uses survey question to elicit respondents' true willingness to pay (WTP) or willingness to accept (WTA) for a change in the level of environmental good or service in a well constructed hypothetical market. An appealing aspect of CVM is that it estimates the total economic value of any resources in question. Davis (1963) to be the first to use CVM to estimate the benefits of outdoor recreation. A number of methodological issues need to be addressed while using CVM in a hypothetical market.

Choice experiment method (CEM): This modeling has its origin in conjoint analysis, information integration theory in psychology and discrete choice theory in economics and econometrics (Louviere, 1988). In CEM method, individuals are given a hypothetical setting and asked to choose their preferred alternative among several alternatives in a choice set, and they are usually asked to perform a sequence of such choices. Each alternative is described by a number of attributes or characteristics. A monetary value is included as one of the attributes, along with other attributes of importance, when describing the profile of the alternative presented. Thus, when individuals make their choice, they implicitly make trade-offs between the levels of the attributes in the different alternatives presented in a choice set (Alpizar *et al*., 2003).

Contingent ranking: This method is closely related to CVM except that respondents are to rank various combinations or state of environmental good with their costs simultaneously.

Conjoint Analysis: In this method each respondent should rank a number of tasks that has a number of alternatives. A representative random utility model will be estimated for the population after estimating a utility index model for each individual.

2.3.1.2. Revealed preference approach

This method is indirect because preference revelation is indirect via a market. The method is used to study individuals' averting behavior. WTP can be estimated either by observing the

prices that people pay for goods in various markets or by observing individual expenditure of money to avoid damage and inferring WTP amounts (Abelson, 1996). This method includes surrogate market and conventional market approaches.

Surrogate market approach: this approach can also be categorized into the three. These are:

Defensive/Averting method: This method estimate expenditure involved in avoiding damage caused by a change in the state of environmental good or service.

Travel cost method: The idea of this method is to collect information about preference from people's behavior *i.e.* people do not buy the commodity (visit area) unless they find it worth its price (travel cost). But this technique captures only use values, it does not value future planned visits (Freeman, 2003).

Hedonic pricing method (HPM): This method assumes that any difference in wage or property value among and between degraded and normal land is due to the value of environmental resources or it is attributable to the state of the resource (Khandke *et al.*, 2001). The HPM identifies environmental service flows as elements of a vector of characteristics describing a marketed good typically housing. HPM is the most common indirect valuation method.

Conventional market approach: Doze response and replacement cost method are the two most important techniques here. The former tries to establish a relationship between a known cause and environmental impact while the latter estimate the benefits of replacing lost natural resources through costs of replacing the resource.

Generally, the total economic value of a resource can be valued by employing one or a combination of different methods discussed above. Each approach has its own merit and demerit. Given the relative merit and objective of this research, a Contingent Valuation Method (CVM) was used in this study.

2.3.2. Contingent Valuation Method (CVM)

Contingent Valuation Method (CVM) is a stated non-market valuation techniques and it estimates the economic value of a resource by constructing a hypothetical market and asking respondents to directly state their WTP or WTA to obtain the good or to give up the good, respectively. The contingent valuation method is said to have come into use first in the early 1960's when economist Robert K. Davis used questionnaires to estimate the benefits of outdoor recreation in a Maine backwoods area (Davis, 1963).

Since the early 1970s the contingent valuation technique has been used by economists to measure the benefits of a wide variety of goods. contingent valuation circumvents the absence of markets for public goods by presenting consumers with hypothetical markets in which they have the opportunity to buy the good in question. Because the elicited willingness to pay (WTP) values are contingent upon the particular hypothetical market described to the respondent, this approach came to be called the contingent valuation method (CVM) (Mitchell and Carson, 1989). If a researcher manages to correctly apply the procedures, CVM can able to capture the total value of the good-both use and non-use values and its flexibility facilitates valuation of a wide range of non-market goods. As a result, CVM is becoming the most preferred valuation method at present (Mitchell and Carson, 1989). Although economists were slow to adopt the general approach of CVM, the method is now present everywhere (Haab and McConnell, 2002).

In most CVM applications, the major steps are the following. First deciding what change are going to value. second, deciding how one are going to implement the questionnaire. Third, designing and administering the CVM survey. Fourth, analysis of the responses. Fifth, Estimating and aggregating benefits (WTP). Sixth, Evaluating the CVM exercise (Validation Tests).

According to Mitchell and Carson (1989) Contingent valuation survey consists three basic parts. First, a hypothetical description of the condition under which the good or service is to be offered as presented to the respondent. Second, questions which elicit the respondents‟

willingness to pay for the goods being valued are presented. Finally, questions on socio-economic, demographic characteristics and their use of the good or service under consideration are given to the respondents.

A CVM study could be undertaken using different elicitation methods or method of asking questions. This part of the questionnaire confronts the respondent with a given monetary amount, and one way or the other induces a response. This has evolved from the simple open-ended question of early studies such as "What is the maximum amount you would pay for…..?" through bidding games and payment cards to dichotomous choice questions. Below, different approaches of asking questions that lead directly to WTP or provide information to provide preferences were discussed (Haab and McConnell, 2002).

Open ended format: A CVM question in which the respondent is asked to provide the interviewer with a point estimate of his or her willingness to pay.

Bidding games: This method starts by asking respondents whether they accept a given price for the good and higher or lower prices will be offered depending on the answer given to the initial prices. The bidding stops when iterations have converged to a point estimate of WTP.

Payment cards: A CVM question format in which individuals are asked to choose a willingness to pay point estimate (or a range of estimates) from a list of values predetermined by the surveyors, and shown to the respondent on a card.

Dichotomous or discrete choice CVM: A CVM question format in which respondents are asked simple yes or no questions of the stylized form: Would you be willing to pay $t?

Contingent valuation method has been applied in many research areas involving non market valuation. The method is used widely in environmental economics and resource related researches. Numerous authors have found the CVM as appropriate tool in valuing environmental goods and it can be used to value a range of environmental goods or services in both developed and developing countries. Thus, CVM is appropriate for this study. So, this

method was applied in this study. The use of CVM in other studies is discussed in detail below.

The history of using CVM goes back to the work of Ciriary-Wanthrup (1947), he proposed that prevention or control of soil erosion generates some extra market benefits that have a nature of public good and the value could be estimated by eliciting individual WTP for the benefits through a survey method (Hanemann, 1994). But, it was Davis (1963) who uses CVM empirically for the first time to value the benefits of Goose hunting. Shultz *et al.* (1998) used contingent valuation to determine the WTP of visitors of national parks in Costa Rica (Poas National Park and Miguel Antonio National Park). They found that the mean WTP (using entrance fees as payment vehicle) to Poas National Park was US$11 for residents and US$23 for foreigners and that for Miguel Antonio National Park was US$13 for residents and US$14 for foreigners. Loomis and Gonzalez-Caban (1998) also used a Contingent Valuation Method (CVM) survey to estimate the economic value of implementing a fire management plans to reduce acres of old growth forest that burn in California and Oregon; they found that California and New England residents were willing to pay US$56 per household.

2.4. Empirical Review

From 1994-2001, University of California Department of Economics releases more than 530 papers concerning the CVM for valuing non-market resources. Among these some papers are devoted for using CVM for valuing forests (Solomon, 2004).

A study by Johansson *et al.* (1995) shows that many forest goods (services) have no market prices to reflect their value. While timber is priced on the timber market the forest as an environment for recreation is non-priced public good. Campbell (1993) also discussed the potential valuation methodologies for valuing tree-based resource and how CVM is more applicable to such kind of goods and services. Kohlin and Amacher (2005) applied CVM to the Orissa Social Forestry Project (OSFP) and show how the method can be used to support the design and implementation of certain development projects and that analysis of the bid function can give qualitative information that is difficult to identify by other methods.

Gregerson *et al.* (1997) and Dosman and Luckert (1999) also critically analyze how to measure the relevant forest values, concentrating on economic values. Which are the most common ones issued in decision making and categorizes them in to three, which are: market prices, surrogated or proxy market prices and hypothetical value measures.

A more specific research work is also done by Lynam *et al.* (1994) on the application of CVM to elicit the preferences of Zimbabwean small holder farmers for the commodities they obtain from trees. As the paper concludes, the use of CVM for valuing common access resource in the small holder farming sector can produce reliable and valid results. And as an output of the paper non-market goods and services such as ecological services, social services and shade comprise a significant proportion of the total value to small holder households of the goods and services provided by tree resources. Other studies used CVM to estimate forest DBDC questionnaire to measure the WTP for values include; Khaksar, *et al.* (2011), Khalilian (2012), Loomis *et al.* (1997), Lorenzo *et al.* (2000), Tyrvainen and Vaananen (1998), Rafiee (2011), Kesiena *et al.* (2016) *etc*. The above studies found that a majority of their survey respondents were willing to pay for the use, preservation and reforestation of forest resources.

Limited number of CVM forest studies have been conducted in Ethiopia. A study by Solomon (2004) on contingent valuation of multi-purpose tree resources in Arsi zone Ethiopia used a Probit and Bivariate Probit models to calculate the mean WTP and to identify factors affecting WTP from the responses to the dichotomous choice question format, the net benefit of the society from two ha of *Eucalyptus* tree plantation was estimated at Birr 41000 per year. The study revealed that age, access to credit, type of ownership for the proposed tree plantation, size of land holding and site specific factors significantly affect the WTP for eucalyptus trees plantations in the same community ownership was also preferred to government ownership for the establishment of multi-purpose tree plantation project and has got a higher WTP amount than government ownership.

Alemu (2000) used CVM to examine the determinants of the value of community forestry in rural Ethiopia and its feasibility, when the plantations are established, managed, and used by the communities themselves. The value elicitation format used in the study was discrete

question with open-ended follow-up which is closer to the market scenario that respondents are familiar with compared to the single discrete choice format. The result indicates that, household income, number of trees owned and sex of household head affect WTP significantly and positively whereas household size and distance of homestead to proposed place of plantation affect WTP significantly and negatively.

Bamlaku (2015) used CVM with a DBDC technique followed by open-ended question format to elicit households' WTP to conserve the forest for improving of water quality. Bivariate Probit models was employed for data analysis. Results of the study showed that most respondents were willing to pay for the forest conservation and respondents WTP was Birr 26.31 per month added with water bills. The mean WTP for the double bounded bivariate and covariate are estimated from Birr 35 to Birr 30 per month for the initial bid and for the follow up bid respectively. Sex, education and income have positive and significant effects while age, family size and amount of bid have a negative and significant effect on WTP. The total WTP by users are estimated about Birr 1.8 million per year for the forest conservation.

Yalfal (2015) also used CVM with a DBDC technique to elicit households' WTP for the restoration of degraded forest landscapes in a hypothetical market. A Bivariate Probit model was employed for data analysis. Results of the study showed that of the total 320 respondents 75% of them were willing to pay for the restoration. Bivariate Probit model result shows that the mean WTP for the rehabilitation of degraded forest resources ranged from Birr 19.18 to 21.02. Similarly, Elmi *et al*. (2016) used CVM with a DBDC econometric method was employed to estimate households' in three forest development cooperatives WTP for sustainable forest management. Bivariate Probit model was employed for data analysis. Results of the study showed that, the mean WTP with covariates was estimated to be Birr 104.38 and Birr 55.73 per year for the initial bid and for the follow-up bid amount, respectively. The result also indicated that respondents' level of education, marital status, years of membership in the cooperatives, second bid amount, distance of residence from forest of interest, and net family income were significantly related to WTP for forest conservation. These authors concluded that, a CVM can be applied to determine WTP for

forest conservation, local people recognize and give value to the environmental services of the forest and are willing to maintain those benefits.

The use of CVM on different WTP studies has been increased in Ethiopia; to list some example, Biniyam (2013) used a Double Bounded CVM to elicit preferences for controlling the off-site effects of soil erosion. By employing a pooled Probit model he was try to estimate the mean WTP and identified the determinant factors. The result indicates that controlling the off-site effects of soil erosion offers a welfare gain of Birr 84.41. Income, level of education and off-site damage experience are the significant factors affecting WTP.

Gebrelibanos and Abdi (2012) also assesses farm households WTP for soil conservation practices through a CVM. Accordingly the Probit and Bivariate Probit model used to assess the determinants and estimate the mean WTP from the DBDC and open ended formats. Results of the study showed that most of the respondents have perceived the problem of soil erosion and are willing to pay for conservation practices. Age, sex, education, family size, perception, land tenure, total livestock units and initial bid were the important variables on the study. The mean WTP was computed at 56.65 and 48.94 person days per annum, respectively. The respective total aggregate value of soil conservation was computed to be Birr 16483104 and Birr 14239778.16 per year for five years, respectively.

Belay (2015) used both SBDC and DBDC format of CVM to elicit farmers' WTP for improved soil conservation practices in terms of labor contribution. Both the Probit and Bivariate Probit models were used for estimation. The result of the study indicated that most of the respondents have perceived the problem of soil erosion and are willing to pay for conservation. sex, education, livestock, income, slope of land, perception, frequency of extension visit are found to have a positive and significant effect on the WTP. The study also show that the mean willingness to pay estimated from the DBDC and open ended formats was 85.36 and 83.22 Labor days per annum, respectively. The respective total aggregate value of soil conservation in the study varies from 10649907 Labor days per annum (Birr 191698326) in open ended to 10909349 person days per annum (Birr 196368282) from DBDC CVM. Similarly, Tesfahun (2014) also used CVM with a DBDC question format to elicit

smallholder farmers' WTP for improved irrigation water and applied Seemingly Unrelated Bivariate Probit (SUBVP) regression model. The results shows a positive WTP for improving irrigation water facilities. Households WTP with a mean value of Birr 128.88/ha/year and the total WTP is estimated to be Birr 1753799.04/year. Moreover, the study identifies education, household size, sex, first bid, total family income and cultivated land size are the main factors having a substantial effect on households WTP.

All the above CVM studies had concluded that results from the CVM survey is theoretically and practically consistent and gives a reliable result. Consequently, the above studies assured that for CVM with a DBDC question format the most widely used model is Bivariate Probit model. Since, there is no as such significant difference between models for CVM with a DBDC format; for this study a Bivariate Probit (SUBVP) model which is appropriate for the study was used.

2.5. Conceptual Framework

The concept of economic value is one of many possible ways to define and measure value. Measures of economic value are based on what people want, which reflect their preferences. Therefore, the theory of economic value is based on individual preferences and choices. People express their preferences through the choices and tradeoffs that they make, given certain constraints, such as income or available time (Lusk and Shogren, 2007). According to these authors, economic value is measured by the maximum amount someone is willing to give up in other goods and services in order to obtain another good or service. The number of dollars that a person is willing to pay for something tells how much of all other goods and services they are willing to give up to get that item. This is referred to as “Willingness to Pay” (Lusk and Shogren, 2007).

To estimate the total economic value of natural resources and environmental goods different methods have been used. Stated preference methods are based on a hypothetically constructed market. The concept of CVM estimates the economic value of a resource by constructing a hypothetical market and asking respondents to directly state their WTP to obtain the good or to give up the good (Freeman, 2003).

During this time deforestation and consequent land degradation are impairing the capacity of forests in Ethiopia and that has become an increasingly prominent problem (NAS, 2001), and be one that has received a great deal of research and policy attention. The massive scale of the demand for wood has led to remarkably high rates of deforestation. So, the volume of logs coming from softwood Pine trees source forests is today inadequate and import of softwood timbers from abroad is increasing. Regarding consumer prices for local and imported timber, there has been an increase in most prices (Export Genius, 2016). Woodwork enterprise heads in Eastern Ethiopia are faced the same situation that requires a solution. Thus, to examine the WTP of these Woodwork enterprises for reforestation of the deforested softwood Pine trees is fundamental; because, the future supply will depend on the contribution of forest plantations.

Since, CVM is a widely applied monetary valuation method for valuing environmental and natural resource related goods; it is a preferable method to undertake this study. Thus, this method was applied. Indeed a Double Bounded Dichotomous Choice which is one of a CVM question format was developed to prepare the survey questionnaire to elicit enterprises' heads true WTP. First, questions on socio-economic, demographic characteristics and Woodwork related are given to the respondents. Second, a hypothetical description of the condition under which the softwood tree resource is to be offered as presented to Woodwork enterprise heads. Finally, questions which elicit Woodwork enterprise heads WTP for the reforestation of the deforested softwood trees are presented. In order to estimate the coefficients for the socio-economic variables and the mean WTP of respondents Seemingly Unrelated Bivariate Probit model employed in generating better estimates.

As described earlier WTP is the maximum amount of money that an individual would be willing to pay, sacrifice or exchange for a commodity. The issue is whether the Woodwork enterprise heads would be willing to spend extra money for the reforestation of deforested softwood trees. The reason that Woodwork enterprise heads would be willing to pay extra money for reducing deforestation, for safer succession and continuity of their businesses through reforestation and increasing the supply of this scarce resource and so on. Thus, the concept of WTP as a dependent variables (WTP1 and WTP2) can be delineated as, the extent of payment in Ethiopian Birr for reforestation which comes from the first and the second

WTP questions. In order to determine these variables respondents were asked their WTP by giving them randomly assigned bid values and the corresponding follow up bids which are the independent values (bid1 and bid2). The second WTP equation is likely to contain more noise in terms of anchoring bias as the respondent is assumed to take the clue from the first bid while forming their WTP for the second question. This is the relation between the two dependent variables. To overcome this condition, the first equation was used in the computing the mean WTP of enterprise heads. Enterprise heads were expected to be rational in the face of increasing costs and hence the law of demand holds. This implies that the probability of accepting the bid declines with increases in the bid amount (Ayalneh and Berhanu, 2012).

The relationship between sex of respondents and WTP offers controversial empirical evidence. Some studies have found direct associations between sex and WTP. But, in this study it was expected that there is no such difference between male and female enterprise heads on their WTP responses. Whether male or female respondents have same impact on the WTP decision Biniam (2013). With regard to educational level as a socio-economic predictor, Tamirat (2014), obtained a positive correlation between education and WTP. The higher the education level held by the respondent head, the higher likely they were to pay more for reforestation. The reason may be that Woodwork enterprise heads with higher education have more awareness and consideration of forest benefits of tree resources; hence, their WTP decision also increase accordingly.

The relationship between family size and WTP was expected to be positive. Results from empirical works carried out by Belay (2015), Gebrelibanos and Abdi (2012) described that, family size have a significant positive effect on respondents WTP for conservation practices. The reason behind this hypothesis is that, as people have many family member, their responsibility with the benefits and services of forest resources also increase. Moreover, majority of the Woodwork enterprises are family businesses; So, increase in family members makes them willing to pay for the reforestation. Differences in consumers' experience of using natural resources may also have an impact on their WTP. In this study the variable experience defined as the length of experience in years of the enterprise head on using of Pines resources at the time of interview. The more experienced the enterprise head possessed

more understanding about the resource and its importance on his or her enterprise benefit and existence. Thus, it was expected that experience about the resource affects the WTP decision positively (Clement, 2014; Frutos *et al*., 2016).

Connections between the WTP for the reforestation and capital or a wealth owned or invested by the enterprise was expected to be positive. This positive relationship between respondents' WTP and their capital level might be due to the possibility that as their capital increases, the concern about the conservation of natural resources also increases. Moreover, they can reduce the shortage of supply which helps them to continue their production. These types of enterprises, who in particular cared about continuity of their businesses (e.g., purchasing more raw materials specially wood, additional machineries, retain their workers and hire additional employees and so on). So, they would be willing to pay more to reduce the risk of extinctions of this valuable resources. Capital can be related with labor and profit positively. Woodwork enterprise with adequate workers required sufficient softwood Pines logs. Available labor for production is significantly and positively affects WTP (Mesfin *et al*., 2011). As capital and labor, profitability or financial gain of the enterprise may have a positive effect on respondents' WTP. Profitable enterprises may be able to pay too much based upon their profitability level. Kurttila and others (2016) found that forest company owners are more willing to pay to the forest with their profitability increases.

In research of Pines forests WTP, Ian *et al*., 2015, discovered that perception of respondents about standing Pine timber forests have a positive effects on respondents WTP. The reason may be that Woodwork enterprise heads with a perception of reforestation, they can make a decision about the reforestation based on their perception and attitude. However, the real situation is quite clear. It is possible that an enterprise head may be willing to pay and then form a perception and awareness of the reforestation during the survey secession. The resource consumption behavior and respondents attitudes may be consistent in many situations. The main reasons for their consistent consumption behavior are purchase motive due to scarcity. So, they would be willing to pay extra money for the reforestation. With regard to sourcing of Pines logs after the rehabilitation, Solomon (2004) obtained a positive correlation between sourcing of community plantations after the rehabilitation and WTP for

reforestation. The study by and Tamirat (2014) also arrived at a positive relationship between WTP and households source connection. They concluded, on the one hand, that the higher the source connection, the higher the WTP; and, the greater the confidence in ownership of the resource. Thus, perception of the reforestation and future sourcing for the resource after the rehabilitation are upholding each other to affect enterprise heads WTP positively.

Enterprise heads who have an access to credit service can enhance their financial problem. Moreover, it was expected that if they have an access to get credit they can improves their business and ability to invest; accordingly, their WTP decision also increases. Some studies shows that there was positive direct associations between credit and WTP either regarding cash constrained respondents to earn more income and to pay back debts (Zeller, 2000; Dagne, 2008). Thus, it was expected that credit have a positive effect on the enterprise heads WTP decision. On the other hand, liability of enterprises may have a negative effect on their WTP decision. That might be due to that they are indebted under liability of financial obligations to pay, so their concern about the reforestation decreases. Ian *et al*., 2015, found that respondents liability have negative impact on the probability of their WTP for Pine timber forests. Therefore, liability of financial obligations affects enterprise heads WTP decision negatively.

In terms of substitution, Pate and Loomis (1997) indicates that, substitutes did play a negative role in determining an individual's WTP for conservation. A negative relationship between enterprises head WTP and substitution might be due to the possibility that as substitutes for Pines logs increases, the concern about Pines logs decreases. Correspondingly, the relation between distance from the deforested area to the enterprise head workshop and WTP was expected to be negative. In terms of distance, the study by (Alemu, 2000); (Elmi *et al*., 2016) shows that, distance from respondents to the reforesting project reduced theirWTP. These authors concluded that, distance to the reforesting area was negatively and significantly influence the respondents' WTP for the reforestation. Therefore, it was hypothesized that, the WTP is expected to decrease with the increase in substitutes for Pines logs and with the increase in distance from the Woodwork enterprises' workshop to the reforestation area.

3. RESEARCH METHODOLOGY

In this chapter, description of the study areas, sources of data and its collection and analysis methods, sample size and sampling techniques, Bivariate Probit model specification and finally description of variables which influences enterprise heads willingness to pay for reforestation and their expected effects are presented.

3.1. Description of the Study Areas

3.1.1. Dire Dawa Administrative Council (DDAC)

Dire Dawa Administrative Council is one of two chartered urban settlements in Ethiopia (the other being the capital city, Addis Ababa). Dire Dawa is its capital city. This chartered town is divided administratively into two *Districts*, the town proper and the non-urban *District* of Gurgura. Dire Dawa lies in the Eastern part of the country, and it is the second largest urban settlement in Ethiopia. Dire Dawa has an estimated total land area of 1559 Km^2. It is located at 515 Km East of Addis Ababa between Addis Ababa and Djibouti. Its altitude is about 1200 meter above sea level (m.a.s.l). Dire Dawa has bimodal rainfall pattern with small rains from March to April and big rains from August to Mid September. Dire Dawa has an annual rainfall of about 604mm and mean annual temperature of 24.8 ^{o}c (CSA, 2007).

Based on the 2007 Census result of the Central Statistical Agency of Ethiopia (CSA), Dire Dawa has a total population of 342827, of whom 171930 were men and 170897 women; 232854 or 67.92% of the population were considered urban inhabitants. There were 75,693 households in Dire Dawa administrative council with an average of 4.5 persons per household. The major ethnic groups in Dire Dawa include the Oromo (46.08%), Amhara (20.09%), Somali (24.24%), Gurage (4.54%), Harari (1.08%); the remaining 3.97% of the population consists of all other ethnic groups. Some 70.9% of the population were Muslims, 25.6% Orthodox Christians, 2.8% Protestants, 0.4% Catholics, and 0.3% followers of other religions (CSA, 2007).

Infrastructure: The town has modern postal and telecommunication services including internet, fax, mobile telephone, and twenty-four hour hydroelectric power supply and international airport. Administratively the town of Dire Dawa had been divided in to 4 *'Kefitegnas'* and 24 urban kebeles and 28 rural peasant associatons, however the recent restructuring process has merged the number of kebeles in to eight with more power and responsibility. The restructuring process of the administration was not restricted to kebeles only but extended to government offices too. With the newly practiced structure 52 offices or agencies were organized under the City Administration, which is accountable to Ministry of Federal Affairs.

Municipality, Small and Micro Scale Enterprise and Housing Agency are among the newly emerged offices trying to create employment opportunity in their construction and business oriented activities that have impact on reducing household food insecurity. The livelihood of the residents predominantly depends up on manufacturing, commerce, government employment, transport service and other sectors. Since the restructuring of the administration council in 2003, few activities of income and employment generating have been implemented in the town by city administration. Out of 3218 registered loan needy people, 493 of them have got a total of 1053100 Birr through small and micro enterprise agency. Provision of skill training in the field of metal and wood work, garment, construction and business were given to 7591 participants. According to agency from 2013 to 2016 more than 124 micro level Woodwork enterprises were registered.

Dire Dawa is considered as one of the industrial, commercial and service center of the country. The town hosts many private and public owned factories and more than 1500 small and micro manufacturing enterprises in 2008. According to CSA (2008) report on large and medium enterprises there are 16 large furniture enterprises. Based on the information observed from the Dire Dawa Revenue and Custom Authority there were 561 furniture manufacturing enterprises in Dire Dawa in 2016. Owing to its strategic location and relatively better transport network, agricultural produce such as coffee, livestock, fruits, vegetables and *chat* grown on the Eastern part of the country are some of the major export items to Djibouti, Somalia and Middle East passing through Dire Dawa.

3.1.2. Harari Regional State

The Harari Peoples National Regional State is one of the eleven regional divisions of Ethiopia and is located in the Eastern part of the country. Formerly named Region 13, its capital is Harar. Based on figures from the Central Statistical Agency of Ethiopia (CSA, 2005), Harari has an estimated total population of 196000, consisting of 100000 men and 96000 women and a male to female ratio of about 1:1. In the region, 74000 or 37.8% of the population are estimated to be rural inhabitants, while 122000 or 62.2% are urban. It is the only region where the majority of its population lives in urban area.

The existing administrative division of the region is composed of 19 urban Kebeles and 17 peasant association making a total of 36 administrative divisions at Kebele level. The total area of the urban administrative units is 19.5Km^2. The rural administrative units constitute about 323.7 Km^2. Ethnic groups in the region include the Oromo (52.3%), Amhara (32.6%), Harari (7.1%), and Gurage (3.2%). The religious composition of the population of the region indicated that 60.3% are Muslims, 38.2% are Orthodox, 0.9% Protestant, 0.55 % Catholic, and 0.1% followers of other religions.

There are four large factories in the region; these are Harar Brewery, Hameresa Edible Oil Fctory, Babile Mineral Water Factory and Harar Printing Press. Eighteen large and medium furniture enterprises. Regarding the small scale industries 70 flour mills, 5 coffee roasting and packaging factories, 85 house and office furniture enterprises, 63 Blocket factories, Bakeries, Metal works and 253 micro level enterprises.

Harar town is one of the ancient towns of Ethiopia, where many people of different culture dwell in. Harar is thus, one of the tourist attraction towns in the country. The people of Harari region gets its access to potable water supply from different sources. The sources are underground water from the land where Haramaya Lake dried (which is found 25 Km from Harar town) and serves as the only source for the majority of the urban population. Whereas for the rural part of the region the sources are from shallow wells and developed springs.

3.1.3. Deder District

Deder is one of the Districts in the East Hararghe Zone Oromia Region of Ethiopia. It is named after the administrative center, Deder. Deder is bordered on the south by Malka Balo, on the west by the Mirab (West) Hararghe Zone, on the north by Goro Gutu, on the east by Meta, and on the southeast by Bedeno. Towns in the District include *Kobo*. The total area of district is about 674.24 km^2. The District has 51 kebeles having 37 rural kebele and 3 rural towns. Deder district is located at distance of 112 Km from Harar. Based on figures published by the Central Statistical Agency in 2005, this District has an estimated total population of 252524, of whom 123801 are men and 128723 are women; 25232 or 9.99% of its population are urban dwellers, which is greater than the zone average of 6.9%. With an estimated area of 545.32 square kilometers, Deder has an estimated population density of 463.1 people per sq km, which is greater than the zone average of 102.6.

The climate condition of the area 17%, 50% and 33% of Deder district is *kolla*, *Woina dega* and *Dega* of Agro-ecological zones, respectively. It is also characterized by different land scapes with the altitude ranging from 1400 to 3188 m.a.s.l. The annual rainfall ranges from 600 to 1200 mm with annual temperature ranging from 14ºc-29ºc (EHARDO, 2011). Gondela is the highest point. Rivers include the Gelan Sedi. A survey of the land in this District shows that 32.5% is arable or cultivable, 2.6% pasture, 1.7% forest, and the remaining 63.2% is considered degraded, built-up or otherwise unusable. Deder has 84 kilometers of dry-weather, 68 kilometers of asphalt-surfaced and 83 of all-weather road, for an average road density of 507.6 kilometers per 1000 sq km. About 16.4% of the urban and 7.4% of the rural population have access to drinking water. The livelihood of the Deder district basically originates from mixed farming. It comprises crop production and livestock rearing. The primary source of income is crop and *chat* production and many other vegetable and fruits.

Industry in the district includes grain mills, around 165 wood and metal working enterprises, as well as 581 registered businesses including wholesalers, retailers and service providers. Graphite, marble, copper, iron, lead and nickel deposits are known to exist, but none have been developed. There were 33 Farmers Associations with 36073 members and 4 Farmers

Service Cooperatives with 4078 members and twenty-two farmers training centers (EHZRADO, 2011).

The following figure (Figure 1) shows the geographical location map of the study areas additionally in Appendix 2 (Appendix figure 2 and 3) also shows that the location of the study areas and satellite image of the three study areas in Eastern Ethiopia.

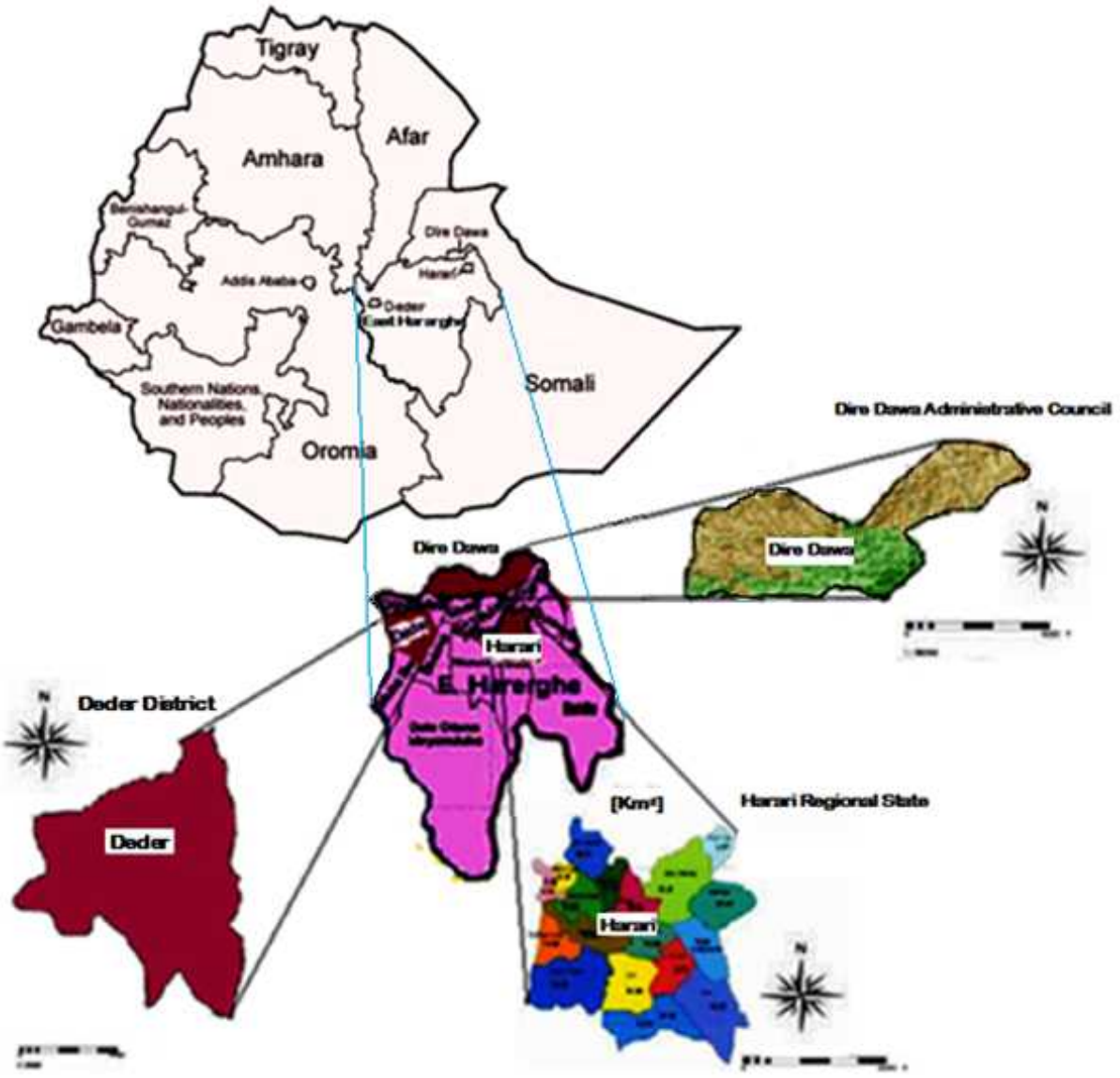


Figure 1. Geographical Location Map of the Study Areas.

Source: World Vision Ethiopia Knowledge Management, 2007.

3.2. Sources of Data and Methods of Data Collection

The data for the study are generated from both primary and secondary sources. The primary data were collected through structured questionnaire using face to face interview of the sample Woodwork enterprise heads. The distribution of Woodwork enterprise in the three study areas were 55.86% in Dire Dawa Administrative council, 33.09% in Harari Regional State and 11.06% in Deder district of the total population. The questionnaire gathered technical, institutional, and financial information of Woodwork enterprises businesses including sourcing of softwood logs and timber from softwood forests. Consecutively, a WTP scenario about the resource presented to the sampled enterprise heads including the benefit they get after the rehabilitation; then asked about their WTP for the reforestation of the deforested softwood trees by using DBDC CVM.

Secondary data were gathered from different sources, mainly from Regional Bureaus, District and zonal agriculture offices regarding forests and timber production. Personal observations and discussions with enterprise heads, experienced carpenters, saw-millers, loggers, executives and committee members of the chamber of commerce elected from the Woodwork industry around the study area to ascertain their views on the subject of selective logging and deforestation and possible solutions and opportunities. The outcome of these discussions were employed to generate qualitative information.

3.3. Sampling Techniques and Sample Size

In this study, a two stage sampling technique was used to select 136 sample Woodwork enterprises from a population of 1076 enterprises. In the first stage, 38 Kebele Administratives (KAs) which have an active enterprises on using of Pines resources in Dire Dawa, Harari and Deder district were purposively selected (see Table 1). In the second stage, on the proportion of their size 76 (55.86%) Woodwork enterprises from Dire Dawa Administrative council, 45 (33.09%) enterprises from Harari Regional State and finally 15 (11.06%) enterprises from and Deder district were selected by using the random sampling

technique. Finally, 136 representative sample enterprises were randomly selected from the three study areas.

Table 1. Woodwork enterprises and Kebele Administratives (KAs) in the study areas.

Selected areas to study	Total KAs in the study area	No of KAs observed	Enterprises in the study area	Sampled enterprises
Dire Dawa	52	10	601	76
Harari Region	36	19	356	45
Deder District	51	9	119	15
Total	139	38	1076	136

Source: Own computation from survey, 2015

To determine the required sample size (n) the following formula given by Yamane (1967) was used. Since there was a finite population (N) of Woodwork enterprises, the above stated formula for determining sample size become:

$$n = \frac{N}{1+N(e)^2} \tag{3.1}$$

Where, N is population size, n is Sample size and e is margin of error or level of precision at 8% (Yamane, 1967). To calculate the sample size (n) given N is 1076 which is population size and e is 8% which is acceptable sample error.

$$n = \frac{1076}{1+1076(0.08)^2} = 136$$

So, based on the above formula a sample of 136 enterprises were randomly selected from the target population. Thus, the sample size obtained was allocated to the three study areas Woodwork enterprises proportional to their size.

3.4. Methods of Data Analysis

Based on the objectives of the study both descriptive statistics and econometric models were employed to analyze quantitative data.

3.4.1. Descriptive statistics

Descriptive statistics was employed to explain the different socio-economic, demographical and institutional characteristics of the sampled Woodwork enterprises heads. These include mean, standard deviation, percentages and tables. It was also important to compare the willing and unwilling enterprise heads to pay for reforestation. In terms of different explanatory variables using t-test and chi-square ($\chi 2$) tests, for continuous and dummy variables respectively.

3.4.2. Value elicitation format

Three general measures of economic values associated with natural resources forest and tree cover change are commonly used. These are: market prices, surrogate or proxy market prices and hypothetical valuation (Gregersen *et al*., 1997). In the absence of organized markets, an intuitively appealing approach to revealing the preference of individuals is the use of Contingent Valuation Method (CVM) (Mitchell and Carson, 1989).

There are about four major elicitation methods so far used in contingent valuation (CV) surveys. These are: the bidding game, payment card and take-it-or-leave-it approach Single Bounded Dichotomous Choice (SBDC) or take-it-or-leave-it with follow up Double Bounded Dichotomous Choice (DBDC). DBDC is more efficient than Single Bounded Dichotomous Choice as more information is elicited about each respondent's WTP and the approach received the endorsement of the National Oceanic Atmospheric Administration (NOAA) panel (Arrow *et al.*, 1993 and NOAA, 1993).

Double-bounded models increase efficiency over single dichotomous choice in three ways. First, the answer sequences yes-no or no-yes yield clear bounds on WTP. For the no-no pairs and the yes-yes pairs, there are also efficiency gains. These come because additional questions, even when they do not bound WTP completely, further constrain the part of the distribution where the respondents' WTP can lie. Finally, the number of responses is increased, so that a give function is fitted with more observations (Haab and McConnell, 2002). This procedure minimizes non-response, starting point bias and also avoids outliers.

In DBDC approach, the respondent is asked a question requiring a yes or no answer about whether he or she would pay a specified amount. If the respondent says yes , another WTP question is asked using a higher amount randomly chosen from a pre specified list. If the answer is no, the follow up question proposes a randomly chosen lower amount (Mitchell and Carson, 1989). Closed-ended (DBDC) approaches, their take-it-or-leave-it format mimics the choice facing citizens in a referendum (Hoehn and Randall, 1987). For these reasons closed-ended (dichotomous choice) questions have become the standard approach to eliciting WTP (WBI, 2002). So, DBDC approach which is proposed by Carson *et al.* (1986) was applied in this study.

3.4.3. Initial bid values

Before starting the actual survey a focus group discussions (FGDs) were conducted with 12 randomly selected enterprise heads from Dire Dawa Administrative Council, Harari Regional State and Deder district. Focus group discussion involves a way of knowing important information about enterprises heads business, experience of using softwood Pines logs and lumber, rehabilitation of the resource and other issues such as WTP and qualitative information for initial bid value set-up (see Appendix 3). Each respondent was faced a random prices randomly estimated for one volume of Pine log in m^3 (Stephanie *et al*., 2008) per year for 10 years (years from planting Pines seedlings to maturity). The prices which resulted from the FGDs were determined for the initial question to set initial bid values in a monthly payment manner. All the other information from the focus group discussions was also used to refine the survey questionnaire.

Following the FGDs, the pilot survey or pre-testing was undertaken before conducting the actual survey and this ensures the content validity of CVM. The structured questionnaire was pre-tested on 10 randomly chosen enterprises to design bid level for the final survey and test the questionnaire for further fine tuning. Different authors suggested a number of methods for designing the bid levels. In the study, a method suggested by Boyle *et al.* (1988) was employed. Thus, an open-ended questions on the WTP amount in the pre-test survey were used to set the initial bid amount and the follow-up bid was determined by doubling and halving the initial bid amount.

To prepare the initial question for setting initial bid values; amounts which are obtained from the FGDs was applied. So, the range of response obtained varied between birr 150 and 1800 per month. After making proper adjustment taking Birr 150 as a base bid; then classified into four (75, 150, 225 and 300) initial bid amounts. Following Cameron and Quiggin (1994), sets of bids were determined for Double Bounded Dichotomous Choice format by making twice the initial bid if the first response is yes and half of it if the response is no. Thus, four possible outcomes were observed: (1) both answers are yes; (2) both answers are no; (3) a yes followed by a no; and (4) a no followed by a yes. The DBDC bid scheme that was used in the final CV survey is presented below in Table 2.

Table 2. Random bid scheme used for the CV survey

Initial bid (in Birr/month)	Follow-up bid (decreased) (if, no for initial bid)	Follow- up bid (increased) (if, yes for initial bid)
75	38	150
150	75	300
225	113	450
300	150	600

Source: own computation from FGD, in 2015.

The finding of the pre-test was incorporated in the final document for contingent valuation (CV) survey questionnaire. Before the actual survey, two enumerators were recruited and trained. So, the final face-to-face survey was conducted in December 2015.

3.4.4. Econometric method

In order to meet the objective and research questions of the study data econometric model specification from CV survey was analyzed by using econometric models. The main goal pursued in CV studies is to estimate the mean WTP and identify the determinants of WTP. In doing so the analysis was done by using parametric estimation framework.

The parametric analysis of response from discrete choice question is based on Random Utility Model (RUM) (McFadden, 1974; Hanemann, 1984). In the random utility formulation a consumer chooses between alternatives 0 and 1 according to which has the higher satisfaction or utility. The discrete variable may take value 1 if alternative 1 has higher utility, and it takes value 0 if the alternative has lower utility.

In the RUM the observed discrete choice response of each individual is assumed to reflect a utility maximization process. The utility arising from a yes or no response to the CV scenario of reducing deforestation by reforestation is comprised of a deterministic component (V_j) and a random (ε_j) component:

$$U_j = V_j + \varepsilon_j \tag{3.2}$$

Utility is assumed to arise benefit from the reforestation of softwood trees and absence of deforestation (environmental factors), and other socio-economic and demographic factors. If the enterprise heads accept the offered bid its revenue is reduced by the bid amount and this holds only under the following condition (Hanemann, 1984):

$$V_{1j}\,(M_j - B_j\,;\, S_j\,;\, T_1) + \varepsilon_{1j} \geq V_{0j}\,(M_j\,;\, S_j\,;\, T_0) + \varepsilon_{0j} \tag{3.3}$$

Where V_{1j} is the indirect utility in a state of controlled deforestation T_1, and V_{0j} is the indirect utility to the enterprise in the presence of deforestation effects or in the status quo T_0. Here $T_1 > T_0$ which shows the fact that the proposed scenario or reforestation have a higher benefit than the present. M_j is the benefit of the enterprise; B_j is the bid amount; S_j captures the other socio-economic and demographic factors; and the error terms, ε_{1j} and ε_{0j} are the identically and independently distributed with a mean of zero.

The general form is represented as:

$$Y_j^* = X_j \beta' + \varepsilon_j \tag{3.4}$$

where, Y_j^* is the dependent variable, X_j is the vector of independent variables that include M and S of the above specification, β' is the parameter to be estimated and the random error term is $\varepsilon_j \sim (0, \sigma^2)$. Y_j^* is a continuous latent variable and it is not observable. The observed variable is the answers yes or no , which can be given by a dummy variable $Y_j = 1$ if YES and $Y_j = 0$ otherwise, to the question regarding whether or not the respondent would be willing to pay or willing to contribute a given bid amount. The j^{th} respondent will say yes if $Y_j^* > 0$ and this will be true if the condition in equation (3.5) is satisfied.

$$Y_j = \begin{cases} 1 \text{ if } Y_j^* > 0 \text{ or } V_{1j}(M_j - B_j ; S_j ; T_1) + \varepsilon_{1j} \geq V_{0j}(M_j ; S_j ; T_0) + \varepsilon_{0j} \\ 0, \text{ if otherwise} \end{cases} \tag{3.5}$$

In the random utility framework, the maximum WTP, Y_j is a random variable. While individuals are assumed to know their maximum WTP with certainty, these values are revealed only through observed choices or elicited preferences, and determinants of these values often are unobservable, observable with error or measurable only through proxies. Thus, an observer cannot infer Y_j with certainty. Thus one can incorporate this uncertainty by specifying a cumulative distribution function $F_{\acute{\eta}}$ (.) for the maximum random WTP. The probability that a enterprise head j is willing to pay for reforestation can be expressed as the difference of his or her utility functions with and without the problem of deforestation is:

$$\left.\begin{aligned} \Pr_j(\text{Yes}) = \Pr_j(Y_j = 1) &= \Pr\left(V_{1j}(M_j - B_j ; S_j ; T_1) + \varepsilon_{1j} > V_{0j}(M_j ; S_j ; T_0) + \varepsilon_{0j}\right) \\ &= \Pr\left(V_{1j}(M_j - B_j ; S_j ; T_1) - V_{0j}(M_j ; S_j ; T_0) > \varepsilon_{0j} - \varepsilon_{1j}\right) \\ &= F_{\acute{\eta}}(\Delta V), \text{ where } \acute{\eta} = \varepsilon_{0j} - \varepsilon_{1j},\ \Delta V = V_{1j} - V_{0j} \text{ and} \\ & F_{\acute{\eta}}(\Delta V) \text{ is the cumulative distribution function (cdf).} \end{aligned}\right\} \quad (3.6)$$

The above cumulative density function in equation (3.6) provides an underlying structural model for estimating various econometric models from the discrete choice responses. In order to model the true WTP, the DBDC CVM was used, which is more information intensive and asymptotically more efficient than the SBDC method (Hanemann *et al.*, 1991).

In the DBDC model each respondent was provided an initial bid and one of follow-up bids. Thus, there are four possible outcomes: (1) both answers are yes; (2) both answers are no; (3) a yes followed by a no; and (4) a no followed by a yes responses. Let bid1 be the initial bid and denote the follow-up bid by bid2. The follow up bid is contingent or dependent upon the response to the initial bid; a lower bid is offered if the response to the initial bid is no (bid2 < bid1) and a higher bid follows after a yes response (bid2 > bid1). Thus, the DBDC survey generates four sets of responses yielding both upper and lower bounds on the respondent's WTP see the following table (Table 3) and Appendix figure 1 in Appendix 2.

Table 3. Response categories and bounds on WTP

Response to DBDC questions	Bounds on WTP implied by responses	
	Lower Bound	Upper Bound
Yes-Yes (YY)	bid2	Disposable Income (or $+\infty$)
Yes-No (YN)	bid1	bid2
No-Yes (NY)	bid2	bid1
No-No (NN)	0 (or $-\infty$)	bid2

Source: Statistical Analysis of Discrete Response CV Data. (Hanemann and Kanninen, 1999).

Following Haab and McConnell (2002), the econometric modeling for the formulation of double-bounded data is given as:

$$WTP_{ij} = \mu_i + \varepsilon_{ij} \tag{3.7}$$

Where: WTP_{ij} is the WTP of individual *j*, it represents a vector of values of the dummy response variable and *i=1,2* represents DC1 and DC2, respectively*;* μ_i is mean value for first and second answers*;* including bids β is a corresponding vector of coefficients. The error term, ε_{ij} incorporates both individual and question specific error. Setting $\mu_{ij} = X'_{ij}\,ß_i$ allows the means to be dependent upon the characteristics of the enterprise respondents and X'_{ij} *(i=1,2)* is a vector of explanatory variables. To construct the likelihood function, the probability of observing each of the possible two-bid response sequences (yes-yes, yes-no, no-yes, no-no) are given as follows. The probability that the respondent *j* answers to the first bid and to the second bid is given by (Haab and McConnell, 2002):

$$Pr(yes, yes) = Pr(WTP_{1j} > t_1\,,\, WTP_{2j} \geq t_2) = Pr(«_1 + £_{1j} > t_1,\, «_2 + £_{2j} \geq t_2) \tag{3.8}$$

$$Pr(yes, no) = Pr(WTP_{1j} \geq t_1\,,\, WTP_{2j} < t_2) = Pr(«_1 + £_{1j} \geq t_1,\, «_2 + £_{2j} < t_2) \tag{3.9}$$

$$Pr(no, yes) = Pr(WTP_{1j} < t_1\,,\, WTP_{2j} \geq t_2) = Pr(«_1 + £_{1j} < t_1,\, «_2 + £_{2j} \geq t_2) \tag{3.10}$$

$$Pr(no, no) = Pr(WTP_{1j} < t_1\,,\, WTP_{2j} < t_2) = Pr(«_1 + £_{1j} < t_1,\, «_2 + £_{2j} < t_2) \tag{3.11}$$

The j^{th} contribution to the Likelihood function is given as:

$$L_j(« / t) = Pr(«_1 + £_{1j} > t_1,\, «_2 + £_{2j} \geq t_2)^{YY} \times Pr(«_1 + £_{1j} \geq t_1,\, «_2 + £_{2j} < t_2)^{YN} \times Pr(«_1 + £_{1j} < t_1,\, «_2 + £_{2j} \geq t_2)^{NY} \times Pr(«_1 + £_{1j} < t_1,\, «_2 + £_{2j} < t_2)^{NN} \tag{3.12}$$

Where: t_1 and t_2 are the first and the second bid prices; *YY* equals 1 for a yes-yes answer, 0 otherwise, *YN* equals 1 for a yes-no answer, 0 otherwise, *NY* equals 1 for a no-yes answer, 0 otherwise and *NN* equals 1 for a no-no answer, 0 otherwise. This formulation is referred to as

the bivariate discrete choice model. Assuming normally distributed error terms with mean zero and respective variances $\pm_1^2$ and $\pm_2^2$, then WTP_{1j} and WTP_{2j} have a bivariate normal distribution with means μ_1 and μ_2, variances $\pm_1^2$ and $\pm_2^2$, and correlation coefficient °. And the j^{th} contribution to the Bivariate Probit likelihood function becomes:

$$L_j(\alpha / t) = c_{\pm 1 \pm 2}(d_{1j}((t_1 - \alpha_1)/\pm_1), d_{2j}(t_2 - \alpha_2)/\pm_2), d_{1j} d_{2j} \circ \quad (3.13)$$

Where: $c_{\pm 1 \pm 2}$ = Standardized bivariate normal distribution function with zero means

$d_{1j} = 2y_{1j} - 1$, and $d_{2j} = 2y_{2j} - 1$

$y_{1j} = 1$ if the response to the first question is yes, and 0 otherwise

$y_{2j} = 1$ if the response to the second question is yes, 0 otherwise

° = correlation coefficient

± = standard deviation of the errors.

3.4.5. Bivariate Probit model

The Bivariate Probit model introduced by Cameroon and Quiggin (1994) has become a general parametric modeling approach for double-bounded CV survey. It is argued that the responses to the two Dichotomous Choice (DC) questions may not be independent, but rather path dependent *i.e.* the response to DC2 may be related to the response to DC1. Sequential presentation of WTP questions DBDC suggests that responses to these questions might not be independent if unobserved factors influence both responses.

To deal with these issues, Bivariate Probit (Seemingly Unrelated Bivariate Probit) (SUBVP) model was used to this study to estimate preference parameters and identify correlation in the unobserved factors influencing responses across the two WTP equations. In general, a Bivariate Probit (SUBVP) model is specified as:

$$Y_{j1}^* = \beta_1' X'_{j1} + \varepsilon_{j1} \quad (3.14)$$

$$Y_{j2}^* = \beta_2' X'_{j2} + \varepsilon_{j2} \quad (3.15)$$

In the data Y_{j1} andY_{j2} are only observable through the two discrete choice responses such that:

$$Y_{j1} = \begin{cases} 1 \text{ if } Y_{j1}^{*} > \text{Bid1} \\ \\ 0 \text{ if } Y_{j1}^{*} \leq \text{Bid1} \end{cases} \quad \text{and} \quad Y_{j2} = \begin{cases} 1 \text{ if } Y_{j2}^{*} > \text{Bid2} \\ \\ 0 \text{ if } Y_{j2}^{*} \leq \text{Bid2} \end{cases} \tag{3.16}$$

$$\begin{aligned} &E[\varepsilon_1] = E[\varepsilon_2] = 0 \\ &Var[\varepsilon_1] = Var[\varepsilon_2] = 1 \\ &Cov[\varepsilon_1, \varepsilon_2] = \rho \end{aligned} \tag{3.17}$$

As the second WTP equation is based on the first WTP question response, the error terms are correlated and hence the two equation can be estimated jointly using model developed by Cameroon and Quiggin (1994), which assumes Bivariate Normal distribution (BVN) for the two valuations,

$$BVN\ (\beta_1 X_1', \beta_2 X_2' , \sigma^2_1 , \sigma^2_2 , \rho) \text{ or } BVN\ (0,0; 1,1; \rho). \tag{3.18}$$

The two questions have four possible pairs of response: (Y_{j1}, Y_{j2}) = (1,1), (1,0), (0, 1) and (0, 0). Combining the associated probabilities of all possible responses in the likelihood function, equation (3.13) can be estimated using the Bivariate Probit (SUBVP) Model.

After running regression of dependent variable on a constant and on independent variables the mean WTP (μ) is determined from the Bivariate Probit model. Depending on the normality assumption μ was calculated by using the formula specified by Haab and McConnell (2002).

$$\mu = - \alpha / ß \tag{3.19}$$

where: μ = The mean willingness to pay for reforestation the deforested softwood trees; α = a coefficient for the constant or intercept term; $ß$ = a slope coefficient for the amount of the bid value that the enterprise heads were asked to pay which is a point estimate of 1/±. An estimate for the dispersion parameter or standard deviation (±) of WTP is given by:

$$± = -1 / ß \tag{3.20}$$

3.5. Description of Variables and their Expected Effect

The main objective of this study is to estimate Woodwork enterprise heads willingness to pay for reforestation. The descriptions of dependent and explanatory variables are continued here under.

3.5.1. Dependent variables

The willingness to pay for reforestation (WTP): The decision to pay for reforestation and the magnitude of payment are the first and second dependent variables of the study measured in probability and Ethiopian Birr, respectively. For instance, Adugna (2013), considered, willingness and magnitude of payment (WTP) as a dependent variable in his study to measure the willingness of a farmers to pay for reforestation and rehabilitation of forests in a dichotomous nature. Yalfal (2015) also considered, WTP as a dependent variable in his study to elicit households' WTP for the restoration of degraded forest landscapes in a hypothetical market in a DBDC format. Similarly, Elmi *et al*. (2016) had also used households' WTP as a dependent variable in their study to estimate households' in three forest development cooperatives WTP for sustainable restoration of forests in a DBDC format.

The first WTP question (WTP1): This is a dummy dependent variable that measures the extent of payment in Birr for reforestation which comes from the first WTP question. The respondent’s answer to the first question is either yes = 1 or no = 0.

The second WTP question (WTP2): This is a dummy dependent variable that measures the extent of payment in Birr for reforestation which comes from the second WTP question. The respondent’s answer to the second question is either yes = 1 or no = 0.

3.5.2. Explanatory variables

In addition to the estimation of mean WTP, this CV study also aims to assess the effect of explanatory variables (covariates) on Woodwork enterprise heads WTP. The independent

variables that are hypothesized (expected) to affect Woodwork enterprise heads WTP decision are combined effects of various factors such as enterprises characteristics, socio-economic, demographic and institutional characteristics in which enterprises operate. These covariates relevant to this study were identified and selected based on the findings of past studies and existing theoretical explanations. Thus, there are 15 potential explanatory variables hypothesized to affect Woodwork enterprise heads WTP for reforestation of softwood trees.

Initial bid amount (BID1): It is the initial or base bid at the initial dichotomous choice question. In this study the bid price was used as one of the explanatory variables in the analysis. Even though this variable included in the regression analysis it also examines the existence and significance of starting point bias. Four bid levels were determined through the focus group discussions to set initial bids as a base bid level. The initial bid value was expected to influence the likelihood of the WTP and it is expected that higher bid values have a negative effect on enterprise heads willingness to pay for the reforestation *i.e.* enterprise heads are expected to be rational in the face of increasing costs and hence the law of demand holds (Ayalneh and Berhanu, 2012). According to Biniam (2013), initial bid offered has been found to be negative and significantly related with WTP for controlling off-site effects of soil erosion. Thus, it was expected that the initial bid value negatively correlated with the Woodwork enterprise heads WTP.

Follow up bid amount (BID2): It is the follow up bid (bid2) at the second dichotomous choice question. It was expected that higher bid values have a negative effect on respondents WTP. Solomon (2004) stated that, the follow up bid value have a negative effect on households willingness to pay for multi-purpose tree resources and significant at 10% level. Negassa, 2014 and Elmi *et al*., 2016 has also indicated that, as the level of the bid increases, the probability of saying yes for that bid decreases. Enterprise heads were expected to be rational in the face of increasing costs and hence the law of demand holds. This implies that the probability of a yes declines with increases in the bid. Thus, it was expected that the follow up bid at the second dichotomous choice affects the enterprise heads WTP decision negatively.

Sex (SEX): This is a dummy variable where 1 if the presence of a female respondent, and 0 if male. And the sign is not hypothesized priory. The major use of these softwood tree resources were to made house and office furniture and construction wood. Even though the consumption of these softwood trees for furniture and construction is the major concern of males, female respondents as a head of Woodwork enterprise they have same impact on the WTP decision. A study by Biniam (2013) shows that households sex brings no difference on their WTP. Thus, in this study it was expected that there is no such difference between male and female enterprise heads on their WTP responses.

Education level of the enterprise head (EDUCATE): It is a continuous variable. Years of formal schooling education attainment by the head. The variable was explained by the years of formal schooling and it ranges from grade 0 to 16 years (no education = 0 years; level two certificate = 14; diploma = 15 and degree and above = 16). It was expected that when enterprise heads are more educated, their awareness and consideration of forest benefits of tree resources in their valuation increases and hence, their WTP decision also increase accordingly. According to Tamirat (2014) education of the respondent has positive relationship with households' WTP for improved water services. It indicates that households with any kind of formal education were willing to pay more than those without formal education or illiterate groups. Thus, highest level of education was expected to have a positive impact on an enterprise heads willingness to pay.

Family size (FAMILY): It is a continuous variable referring to the number of the family members under the enterprise head. The positive correlation to the enterprises head WTP was expected to increase with the increase in number of his or her family member. It was expected that as people have many family member, their responsibility with the benefits and services of forest resources also increase. A study by Belay (2015) described that, the larger the family size, the higher the probability that future generation will farm the land and reap the future benefits of conservation investments. Gebrelibanos and Abdi (2012), also shows that, family size have a positive effect on WTP for soil conservation practices and it was found to be significant at 5% probability level. Thus, positive contribution from this variable was expected.

Experience of enterprise head (EXPER): This is a continuous variable and it was defined as the length of experience in years of the enterprise head on using of Pines resources at the time of interview. The more experienced the enterprise head possessed more understanding about the resource and its importance on his or her enterprise benefit and existence. It was expected that experience about the resource affects the WTP decision positively. A WTP study by Frutos and others (2016) indicates that, there is a positive relation between experience and WTP to harvest natural resources. According to these authors, the mean WTP is higher for commercial harvesters for wild edible mushrooms from forests depends on harvesters' experiences influence on WTP at the 1% level (Frutos *et al*., 2016). Clement (2014) also indicates individuals who have an experience to the natural environmental resource is likely to have high WTP for that resource (Clement, 2014).Thus, in this study positive relation was expected.

Capital of the enterprise (CAPITAL): Capital is a wealth owned or invested by the enterprise it is a continuous variable. Wealth is accumulated stock of useful goods that having economic value that uses to the production of the enterprise output. These including, vehicles, machineries, working capital, employees and raw materials owned and so on. If the enterprise is active on its production and has enough capital to run the business it requires more logs and lumber or timber inputs to run daily operation; so that, they may offer the highest bid amount and their WTP decision also increase accordingly. According to Solomon (2004) wealth had a significant and positive effect on the WTP for reforestation of multi-purpose trees. Another WTP study by Biniam (2013) shows that households who own large farm size are expected to cultivate and earn more. So a positive relation was expected.

Access to credit (CREDIT): It is a dummy variable whether the enterprise head have access to credit from any source and takes 1 for those who have an access for credit and 0 otherwise. Enterprise heads who have access to credit were expected to have high WTP because it was expected that if they have an access to get credit they can improves their business and ability to invest; accordingly, their WTP decision also increases. According to Dagne (2008) access to credit was an important factor and had a positive and significant effect on the WTP for irrigation water at 10% level. Zeller (2000) also shows that the positive relationship between

credit and WTP as credit enables cash constrained respondents to earn more income, to pay back debts and offer highest bids with the hope of increase output. Thus, it was expected that credit have a positive effect on the enterprise heads WTP decision.

Perception of reforestation (PERCEPT): It is a dummy variable which takes a value of 1 if the average response to the question designed to measure enterprise heads perception for the reforestation program was >2 and 0 otherwise. Likert item was used to measure enterprises heads attitudes to the question statement. The data was combined into dichotomous or two nominal categories Agree and Disagree, which allows to carry out the Chi-square test. Enterprise heads rated based on their agreement about their perceptions that increasing their WTP for reforestation based on four-point scale: 1 = Strongly disagree to 4 = Strongly agree (Mogey, 2007; Krosnick and Presser, 2009; Sorrel, 2010; Ian *et al*., 2015). Enterprise heads who have perception or an awareness about the reforestation program, it is indeed affects their WTP positively. According to Ian *et al*., 2015 study result, perception of respondents about standing Pine timber forests have a positive effects on respondents WTP decision to buy Pine timber insurance. Thus, it was expected that perception of environmental problems by enterprise heads affects their WTP decision positively.

Sourcing of Pines resources (SOURCE): It is a dummy variable taking value of 1 if the respondent can use Pines logs after the rehabilitation of the deforested softwood forests as a source supply and 0 otherwise. Positive effect of this variable on WTP was expected because enterprises with future supply of Pines logs from the softwood forests source are expected to be more interested to pay for the reforestation as they can get more supply through private ownership of this scarce resource. The study by Solomon (2004) showed that the respondents who were told that they will used the plantation after the rehabilitation were significantly willing to pay more for the plantation than un told respondents. According to Tamirat (2014) households' connection to the source of water point positively affect the likelihood of households' WTP for improved water service and is highly positively significant. Thus, a positive relation was expected.

Profit or gain of enterprises (PROFIT): It is a dummy variable taking value of 1 if the enterprise is profitable and 0 otherwise. The economic contribution or financial gain from manufacturing or providing service of an enterprise is a profit for this enterprise. According to the study result of Kurttila and others (2016), forest company owners are more willing to pay to the forest service with their profitability increases. In his WTP study Tamirat (2014) finds that monthly income has positive effect on WTP of households for improved water services. Therefore, in this study positive correlation of profit and WTP was expected.

Substitution of other input (SUBSTIT): It is a dummy variable which takes a value of 1 for those who uses substitute inputs in place of Pines logs and lumber and 0 otherwise. The enterprise heads who are used more substitutions in place of Pines logs and lumber are not expected to pay for the reforestation. A WTP study by Pate and Loomis (1997) indicates that, substitutes did play a negative role in determining an individual's WTP for conserving degraded lands. According to these authors, more substitutes in close proximity to the respondents, the less they should be willing to pay for natural resources and public goods. Thus, negative correlation of substitution to enterprise heads WTP was expected.

Labor availability (LABOR): It is a dummy variable which takes a value of 1 for those who have available labor in their enterprises for the reforestation program and 0 otherwise. Since labor is a key production factor to Woodwork enterprises they possess many labor in their organization. Woodwork enterprise heads as a forester may need to have available labor to enhance their reforestation decision. Therefore, an enterprise with available workers is hypothesized to be more likely to support the reforestation plan. According to Mesfin *et al*. (2011), the larger the number of work force in the productive age group in the family, the higher the probability of accepting the bid and for forest conservation. They concluded that, labor is significantly and positively affects WTP. So in this study, a positive relation was expected.

Liability of Enterprises (LIABILTY): It is a dummy variable which takes a value of 1 for those who are indebted under liability of financial obligations to pay claims and 0 otherwise. Enterprise heads who had a liability of financial obligations due to taxes, borrowing, injury or damage claims made by third parties against their ownership may deserved the reforestation

program as an additional source of cost they may be concerned about financial losses in general and they are not expected to pay for the reforestation. According to Ian *et al*., 2015, respondents liability arise from purchasing forestland insurance have negative impact on the probability of their WTP for potential standing Pine timber forests insurance by reducing the funds available for other forestry-related costs. Therefore, it was hypothesized that, the WTP is expected to decrease with the increase in liability of financial obligations. Thus, in this study it was expected that liability of financial obligations affects enterprise heads WTP decision negatively.

Distance from the deforested area (DIST): This is a continuous variable refers to the time that Woodwork enterprise heads as a forester may need to go to the to the proposed plantation. The closer the plantation to the respondent enterprise, the more willing the enterprise heads to pay for reforestation. On his study on the communities' WTP for the conservation of forests Alemu (2000) showed that, distance of homestead to proposed forest plantation affects WTP significantly and negatively. Another WTP study by Pate and Loomis (1997) also found that, distance changes which are relatively close to the public good in question should have a more positive impact on WTP than distance changes which are farther away. Therefore, it was hypothesized that, the WTP is expected to decrease with the increase in distance from the Woodwork enterprises' workshop to the reforestation area. Thus, in this study it was expected that the more farther distance affects enterprise heads WTP decision negatively.

The following table (Table 4) summarizes dependent variables and independent variables that are hypothesized to influence the WTP and with their expected sign.

Table 4. Description of dependent and explanatory variables

Variables	Description	Variable type	Measurement	Expected sign
Dependent				
wtp1	WTP when price is bid1	Dummy	1=Yes, 0=No	
wtp2	WTP when price is bid2	Dummy	1=Yes, 0=No	
Independent				
bid1	Initial bid amount	Continuous	Birr	-
bid2	Follow up bid amount	Continuous	Birr	-
sex	Sex of the enterprise head	Dummy	1=Female,0=Male	-/+
educate	Years of formal schooling	Continuous	Years	+
family	Number of Family members	Continuous	Counts	+
exper	Pines logs using experience	Continuous	Years	+
capital	Capital of the enterprise	Continuous	Birr	+
credit	Access to credit	Dummy	1=Yes, 0=No	+
percept	Perception of reforestation	Dummy	1=Yes, 0=No	+
source	Source connection to the area	Dummy	1=Yes, 0=No	+
profit	Profitability of the enterprise	Dummy	1=Yes, 0=No	+
substit	Using substitute to Pines logs	Dummy	1=Yes, 0=No	-
labor	Availability of labor	Dummy	1=Yes, 0=No	+
liabilty	Liability of enterprises	Dummy	1=Yes, 0=No	-
dist	Distance to the reforestation	Continuous	Hours	-

4. RESULTS AND DISCUSSION

In this chapter, data obtained from the survey is analyzed using both descriptive and econometric analysis. In the first part, socio-economic, demographic and institutional characteristics that affect Woodwork enterprise heads' WTP for the reforestation are analyzed. In the second part econometric analysis is made to identify factors that determine enterprise heads' WTP for the reforestation. Finally, the mean and aggregate economic value of the reforestation of Softwood Pines trees are estimated.

4.1. Descriptive Analysis

4.1.1. Characteristics of respondents

For this study, a total of 136 Woodwork enterprise heads were interviewed. Since all respondents gave valid responses further discussions are made using all 136 enterprise heads. To compare the willing and unwilling enterprise heads different descriptive statistics on both discrete or dummy and continuous variables were performed. First, descriptive statistics for dummy variables are presented; consecutively, descriptive statistics for continuous variables are presented.

4.1.2. Descriptive statistics for dummy variables

Table 1. presents the $\chi 2$-test results of dummy variables to verify whether there are a significant differences between willing and unwilling enterprises heads in terms of these variables. Sex and credit access not statistically significant whereas all factors were implying that the enterprise heads were not similar in terms of labor availability, source connection, perception of reforestation, liability of financial obligations to pay, their profitability and using of substitution of other inputs in place of Pines logs and lumber.

Table 1. Descriptive statistics for sampled enterprise heads (Dummy variables)

Dummy Variables	Categories	Willing Ent. Heads = 119		Unwilling Ent. Heads = 17		χ2 value
		No	%	No	%	
Sex	Male	106	89.1	16	94.12	0.41
Credit Access	Accessed	73	61.34	10	58.82	0.04
Labor Availability	Available	102	34.45	7	29.41	18.54***
Source connection	Consented	51	42.86	3	17.65	3.947**
Perception of reforestation	Agree	53	44.53	4	23.53	2.697*
Liability to pay debt	Liable	46	38.66	13	76.47	8.66***
Profitability of enterprises	Profitable	107	89.92	12	70.59	5.08**
Substitutes to Pines lumber	Use substitution	24	20.17	7	41.18	3.73**

Source: own computation from survey, 2016

***, ** and * means significant at the 1%, 5% and 10% probability levels, respectively.

Sex: from the total surveyed Woodwork enterprise heads, 122 respondents were males while 14 respondents were females. As shown in Table 1. there is no significant difference between willing and unwilling enterprise heads in terms of their sex ($\chi 2 = 0.41$). Thus enterprises heads sex makes no differences on their WTP decision.

Credit Access: from the total surveyed Woodwork enterprise heads, 83 of them were having an access to credit, of these 73 of them were willing while 10 respondents were unwilling. As shown in Table 1. there was no significant difference between willing and unwilling enterprise heads in terms of credit access ($\chi 2 = 0.04$).

Labor Availability: the sample respondents were asked whether they have available labor for the reforestation to enhances them willing to pay. As shown in Table 1. out of the total 109 who have available labor, 102 were willing while 7 of them were unwilling enterprise heads. The result showed that there is a significant difference between willing and unwilling enterprise heads in terms of labor availability at 1% probability level. Thus, those enterprise heads have available labor were more willing than enterprises with unavailable labor for reforestation.

Source connection: respondents responses to the question of future source connection to the deforested area after rehabilitation shows 54 respondents were consented to the connection. Out of these respondents 51 of them were willing while the remaining 3 of them were unwilling enterprise heads. The result showed that there is a significant difference between willing and unwilling enterprise heads in terms of source connection at 5% probability level. Thus, those who approve future source connection to the deforested area after rehabilitation were more willing to pay for reforestation.

Perception: in the survey question Woodwork enterprise heads also asked whether they agree or not their perception for the reforestation makes them willing to pay. Of the total 57 respondents; 53 of them were willing while, the rest 4 of them were unwilling respondents. The variable was statistically significant at 10% probability level; this showed that there is a significant difference between willing and unwilling enterprise heads in terms of their

perceptions of reforestation. So, those who have perceptions of reforestation were more willing to pay for reforestation.

Liability: from the total 119 willing enterprises heads, 46 of them were indebted under liability of financial obligations to pay while the rest 73 of them were not liable. As shown in Table 1. there were 13 indebted unwilling respondents. The test result proved that there is a significant difference between willing and unwilling enterprise heads in terms of liability at 1% probability level. Thus, those respondents who did not liable for financial obligations were willing to pay more for the reforestation.

Profit: respondents were also asked about their business profitability and out of the total 119 profitable enterprise heads; 102 of them were willing while, the rest 17 of them were unwilling respondents. The chi-square result proved that there is a significant differences between willing and unwilling enterprise heads in terms of their profitability at 5% probability level. Thus, those who are profitable enterprises were willing to pay more for the reforestation than unprofitable enterprises.

Substitution: Respondents responses shown that inputs such as MDF (Medium Density Fiberboard), *Ecalyptus, Cordia abyssinica (Wanza) etc.* were using as substitutes in place of Pines logs and lumber. From the total 119 willing enterprises heads, 24 of them were using substitutes while the rest 95 of them were not using substitutes. As shown in Table 1. there were 7 substitutes user unwilling respondents. The test result proved that there is a significant difference between willing and unwilling enterprise heads in terms of using of substitutes in place of Pines logs and lumber at 5% probability level. Thus, those who were not using substitute inputs in place of Pines logs and lumber were willing to pay more for the reforestation.

4.1.3. Descriptive statistics for continuous variables

To compare the willing and unwilling enterprise heads in terms of different explanatory continuous variables t-test was undertaken. Table 2. presents the output results of t-test of these variables to verify whether the means for willing and unwilling enterprise heads are equal or not.

Capital: It is a crucial variable that explains the overall wealth owned or invested by the enterprise. The SPSS output in Table 2. shows that the average capital of willing enterprise head is Birr 485833.01, versus Birr 91647.06 for unwilling enterprises heads. The test result confirmed that, the difference in means of capital amount between willing and unwilling enterprise heads were found to be significant at 1% probability level. Economic theory stated that, people's WTP for any non-inferior commodity should increase as wealth increases. Thus, enterprise owners who have more capital were willing to pay more for the reforestation than enterprises heads owning less capital.

Results for the rest continuous variables or education, family size, experience and distance to the deforested area in terms of difference in means between willing and unwilling enterprise heads were found to be strongly positive but insignificant.

Table 2. Descriptive statistics for sampled enterprise heads (Continuous variables)

Continuous variables	Total Sample Enterprise Heads =136)		Willing Enterprise Heads = 119		Unwilling Enterprise Heads = 17		Difference in means	t-value
	Mean	SD	Mean	SD	Mean	SD		
Education	10.16	4.2595	10.85	3.81	9.47	4.709	1.378	1.383
Family size	3.82	1.3775	3.93	1.307	3.71	1.448	0.227	0.661
Experience	10.345	5.8625	11.22	7.237	9.47	4.488	1.748	0.968
Capital	288740.034	343401.31	485833.01	626710.04	91647.06	60092.58	394185.95	2.583***
Distance	3.285	2.035	3.39	2.06	3.18	2.01	0.218	0.410

Source: own computation from survey, 2016

*** and * means significant at the 1%, and 10% probability levels, respectively

4.1.4. Willingness to pay

In order to model WTP for reforesting softwood Pine trees a double bounded contingent valuation method was used. Before conducting the actual survey, a pilot study was made to design the bid vectors. Consequently, for the final survey four bid amounts (75, 150, 225 and 300 in Birr per month) were used as initial bid or base values and each respondent faced a random initial bid and the follow-up bid was determined depending on the response for the initial and second bid. The following table (Table 3) presents sample enterprise heads responses for Double Bounded Dichotomous Choice question in the three study areas.

Table 3. Enterprise heads responses for Double Bounded Dichotomous Choice question

Regions	No-No	No-Yes	Yes-No	Yes-Yes	Total
Deder District	0	1	2	12	15
Dire Dawa	4	7	18	47	76
Harari	3	2	11	29	45
Total	7	10	31	88	136

Source: Own computation from survey, 2016

4.1.5. Enterprise heads WTP in the initial and follow up bids

In order to determine the enterprise heads WTP for the reforestation, they were asked their WTP by giving them randomly assigned four initial bid values (75, 150, 225 and 300) and the corresponding follow up bids. Hence, given the randomly assigned initial bids, out of the total enterprise heads who are willing to pay 119 of them said yes or they were willing to accept the initial bids. And the remaining 17 respondents said no or they were not willing to pay the initial bids (see Table 1). The follow up bids were doubled for those enterprise heads who were willing to pay the given initial bids and halved for those enterprise heads that were not willing to pay the initial bids.

Hence, given the randomly assigned follow up bids 98 enterprise heads said yes or they were willing to accept the follow-up bid and 38 enterprise heads said no or they were not willing to accept the follow-up bids. Out of the total 136 respondents 7 of them both answers were no (No-No) for DBDC CV questions; 10 of them answers no followed by yes; 31 of them answers yes followed by no; finally the rest 88 of them answers both choices yes (Yes-Yes) see Table 4 and Figure 2.

Table 4. Enterprise heads choices of initial and follow up bids

Bid values	Responses at initial and follow up bids				
	No-No	No-Yes	Yes-No	Yes-Yes	Total
75 /(150/38)	7	4	4	5	20
150 /(300/75)	0	3	9	6	18
225 /(450/113)	0	3	6	15	24
300 /(600/150)	0	0	12	62	74
Total	7	10	31	88	136
Percent (%)	5.15	7.35	22.79	64.71	100

Source: Own computation from survey, 2016

In the survey questionnaire, enterprise heads were asked whether they are willing to pay for the reforesting of the deforested area. Consequently, Table 5. presented the willing and unwilling enterprise heads responses. As described earlier, among the sample enterprise heads about 119 respondents are willing to pay and the remaining 17 of them are not willing to pay for the reforestation in the given scenario. This indicates that the reforestation of the deforested softwood Pines trees is supported by about 87.5% of the enterprises heads. Those who refused to pay anything are treated as having zero WTP. They were asked to state their reasons and they reasoned that, they didn’t use Pines logs and lumber anymore because they totally substitute by Medium Density Fiberboard (MDF).

Table 5. Descriptives on willingness of enterprise heads

Responses	Frequency	Percent (%)	Cumulative
WTP	119	87.5	87.5
UNWTP	17	12.5	100
Total	136	100	

Source: Own computation from survey, 2016

The following figure shows the percentages of Yes responses for the first and second bid values.

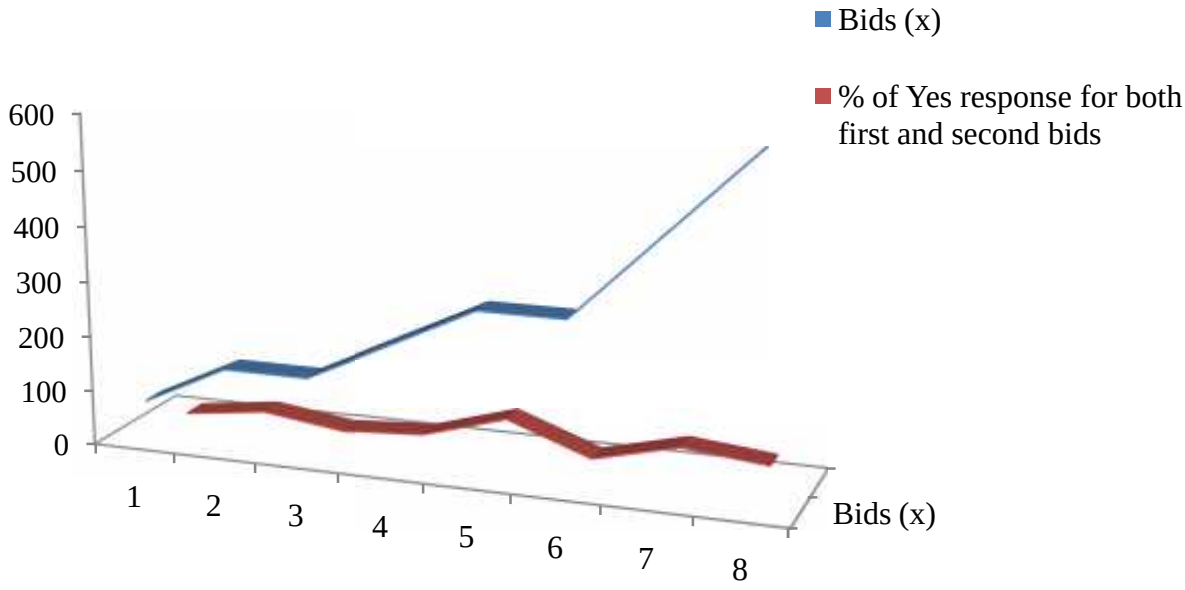


Figure 2. Percentages of Yes response for both first and second bid values.

Source: Result from the survey, 2016.

4.2. Econometrics Analysis

Econometric analysis helps a lot in meeting the overall objectives for estimation of the WTP of enterprise heads and hence, it is used to estimate the coefficients of variables that affect the willingness of enterprise heads to pay for the reforestation. The econometric models used here are based on the specifications developed in the previous chapter.

In order to model the true WTP from DBDC CV survey and to estimate the coefficients of variables the econometric model namely Bivariate Probit (SUBVP) was employed. Before estimating the effect of the explanatory variables on enterprise heads WTP decision for reforestation, tests was made for the prevalence of heteroscedasticity and multicollinearity since these problems reduces the precision of estimating the coefficient of variables. Heteroscedasticity occurs when the error variance has non-constant variance. Multicollinearity refers to a situation where the explanatory variables are highly intercorrelated (Maddala, 1997).

According to Greene (2008), when we use cross-sectional data we may encounter problem of heteroscedasticity. Accordingly, Wooldridge (2002) explained that, in order to correct the heteroscedasticity problem it can estimate the robust standard errors instead of the usual standard errors. Thus, the econometric models which are used in this study are corrected for heteroscedasticity problem using the robust command in Stata (see Appendix table 2 in Appendix 1). From correlation matrix (correlation coefficient analysis), it is observed that there is no multicollinearity problem among independent variables. To check for the existence of collinearity among the explanatory variables the Variance Inflation Factor (VIF) method was used in the study. Following Gujarati (2004), if the VIF of a variable exceeds 10, that variable is said to be highly collinear. Therefore, from correlation matrix generated using the survey data it is shown that there is no series multicollinearity problem in the study (see Appendix table 3 and 4 in Appendix 1).

4.2.1. Results of the Bivariate Probit model

The Bivariate Probit model introduced by Cameroon and Quiggin (1994) has become a general parametric modeling approach for double-bounded CV survey. The argument here is sequential presentation of WTP questions (DBDC) suggests that responses to these questions might not be independent if unobserved factors influence both responses.

In the case of Bivariate Probit analysis we have two binary response variables that vary jointly. However, to estimate the coefficients needed to account for this joint distribution, first

we have to check whether the correlation between the two error terms rho (ρ) is different from zero. If the correlation between the two error terms is different from zero, it is possible to employ the Bivariate Probit (SUBVP) model. Therefore, in this study, the Bivariate Probit (SUBVP) model was employed because, as it is clearly shown in Table 6, the rho (ρ), is different from zero which is about 0.5547 and the Wald test shows that this correlations are statistically different from zero at 5% level of significance. The overall significance test against the null hypothesis of all explanatory variables including the constant term are zero is tested by the Wald chi-squared test (see Appendix table 5 in Appendix 1); the probability is statistically significant at 1% level of significance so the null hypothesis is rejected.

To deal with these issues, a SUBVP model was used and estimated preference parameters and correlation coefficient of the unobserved factors influencing responses across the two WTP equations. The results of SUBVP model with covariates included shows that the Wald test of goodness-of-fit under the null hypothesis that all parameters are zero can be rejected (see Appendix table 5 in Appendix 1). The model is jointly significant at 95% level of confidence [Wald $\chi2(30) = 158.24$; Prob. > $\chi2 = 0.0000$] or at least one of the variable included in the model is different from zero (see Appendix table 5 in Appendix 1).

The rho (ρ) or the coefficient of the correlation between random errors in both regression equations is moderately high (0.5547) and the two disturbances are significantly correlated at 1% which indicates that the estimation of the SUBVP model resulted in estimation efficiency. Thus, the correlation coefficient implies, error terms of the two responses are positively and significantly correlated. The LR test for rho = 0 [$\chi2(1) = 4.16258$ and Prob. > $\chi2 = 0.0413$] suggests that the two disturbances are significantly correlated at 5% level of significance. The results of the Bivariate Probit (SUBVP) regression and marginal effects after biprobit (mfx) was computed by STATA 14. Appendix table 6 in Appendix 1 presented the SUBVP regression result of WTP1 and WTP2; the whole data of the regression is presented in Appendix table 5.

Table 6. Estimated Coefficients of the Seemingly Unrelated Bivariate Probit model

Variables	WTP1 n = 136			WTP2 n = 136			Marginal effects
	Coef.	Robust Std. Err.	z	Coef.	Robust Std. Err.	z	dy/dx
Bid1	0.0155	0.004	3.86***				0.0000
Bid2				-0.0031	0.001	-2.53**	-0.001**
Sex*	1.2659	0.842	1.50	-0.1366	0.838	-0.16	-0.0223
Educate	0.0003	0.063	0.01	0.0552	0.052	1.07	0.0084
Family	-0.2424	0.210	-1.15	0.6069	0.174	3.48***	0.0919***
Exper	-0.0443	0.051	-0.86	0.0604	0.045	1.36	0.0092
Capital	0.0635	0.036	1.77*	0.0141	0.007	2.05**	0.0021**
Credit*	0.5071	0.658	0.77	0.3293	0.444	0.74	0.0527
Percept*	-0.3731	0.569	-0.69	1.3943	0.494	2.82***	0.1959***
Source*	-0.2261	0.537	-0.40	1.1187	0.429	2.61***	0.1523***
Profit*	-1.0624	0.648	-1.64	2.1158	0.632	3.35***	0.6283***
Substit*	0.8178	0.451	1.81*	-1.0042	0.537	-1.87*	-0.1071**
Labor*	-0.5454	0.557	-0.98	1.0993	0.539	2.04**	0.2511
Liabilty*	0.9123	0.576	1.58	-0.9318	0.466	-2.00**	-0.1342**
Dist	1.5104	0.541	2.79***	-3.4154	0.460	-7.43***	-0.8885***
_cons	-1.2596	1 .446	-0.87	-3.3948	1.251	-2.71***	
/athrho	0.6251	0.306	2.04**				
rho	0.5547	0.212	2.61***				
Wald test of rho = 0:			chi2(1) = 4.16258			Prob > chi2 = 0.0413	

Source: Own computation from survey, 2016

Legend: ***, ** and * represent statistically significant at 1%, 5% and 10% level of significant, respectively (* p<0.1; ** p<0.05; *** p<0.01)

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

As presented in Table 6, out of the variables that expected to influence WTP1, the initial bid, capital, substitution and distance were significant. Except capital the other three variables did not have the expected sign in the first equation. In the contrary of negative sign the positive sign of bid1 value, substitution and distance indicates that, these variables were determine the first WTP question contrastingly. While in the follow-up question, the second bid amount, family size, capital, perception, source connection, profitability, substitutions, availability of labor, liability of financial obligations and distance to the deforested area all these ten variables turn out to be significant and all have the expected sign to determine WTP2.

Here after the marginal effects of Bivariate Probit (SUBVP) regression result of the two responses coefficients and influence of covariates are presented and interpreted. The marginal effect indicates the change in probability of an event due to a unit change in continuous explanatory variable and the change of dummy variable from 0 to 1 for discrete variables. As shown in Table 6, unexpectedly, the initial bid value was insignificant. This result is in line with the result of the WTP study conducted by Assefa (2015) and by Elmi *et al*. (2016).

The coefficient of the second bid value was negative and significant at 5% significance level. Holding other things constant per each Birr increases in the second bid value the probability of accepting the proposed WTP value on average decreases by 0.10% points. This indicates that the higher the bid price for the reforestation, the less likely the enterprise heads would be willing to pay, which makes a sense and support the claim that respondents are rational based on the economic theory. Figure 2**,** also emit more light on this indicating that, as the bids increased the Yes response decreased accordingly. According to Elmi *et al*., 2016 study result, second bid amount was negatively and significantly affects respondents WTP for reforestation at 1% significance level. Correspondingly, Mesfin *et al*. (2011) and Adugna (2013) were obtained same negative effect on their WTP for reforestation study at 1% significance level.

The variable family has the expected positive sign and is significant at 1% level of significance. This implies that, the probability of accepting a higher bid increases with the family size of the enterprise heads increases. The enterprise heads for which their demand for the resource increases with an increase in their family size. Specifically, holding other things

constant a one person increase in the enterprise heads family size increases the probability of accepting the proposed willingness to pay value by 9.19%. A WTP study by Abdullah and Mariel (2010) finds that, respondents who had larger households are more reliant and Willing to pay more. The authors argue that family size has a positive effect on WTP.

Capital of the enterprise is found to affect the enterprise heads decision to say yes for a given bid, positively and significantly at 5% level of significance. The implication is that the higher the capital of the enterprise heads their WTP decision also increases accordingly. The marginal effect of capital amounts shown that, per each ten thousand Birr increase in an enterprise heads' capital, holding other things constant, the probability of accepting the proposed WTP value increased by 0.21%. According to Solomon (2004) wealth had a significant and positive effect on the willingness to pay for the reforestation of multipurpose indigenous trees. In similar manner, Tamirat (2014) also proved that wealthy households were more willing to pay for improved water services and the variable was positively and statistically significant at 5% level of significant.

As expected the study found that perception of reforestation affect the enterprise heads decision positively and significantly at 1% level of significance. The marginal effect indicates that the enterprise heads who have a perception of reforestation were 19.59% and were more willing to pay than the non perceived enterprises heads, holding other things constant. The implication is that, enterprises heads with knowledge and experience of softwood Pines resources to constitute their perception were more interested to pay for the reforestation. In line with this study, the study by Ian *et al*., 2015 shows that, perception of respondents about standing Pine timber forests have a positive effects on respondents WTP decision to buy Pines timber insurance. On the other hand, the study by Nassauer, 1989, shown that land owners have been shown to hold negative perceptions of riparian forest buffers reforestation practices that contradicted their aesthetic norms for attractive agricultural land.

The variable source which captures enterprises future private connection to the deforested area on sourcing of Pines logs after the rehabilitation. As expected source connection is found to affect the enterprise heads decision positively and significantly at 1% level of significance.

Positive effect of the variable was resulted because, enterprises heads are more interested to pay for the reforestation to get Pines logs supply through private ownership. The implication is that enterprises heads with a consent of future using Pines logs resources after the rehabilitation of softwood forests as a source supply makes them more interested to pay for the reforestation. The marginal effect indicates that the enterprise heads who have a consent of future source connection are 15.23% more willing to pay than the non consented enterprises heads, holding other things constant. The study by Solomon (2004) revealed that, community ownership for multi-purpose indigenous trees plantations and using these resources after rehabilitation makes respondents more willing to pay for theirs reforestation. The study by Tamirat (2014) also shows that, households private connection to source of water point affects households WTP positively and significantly at 1% level of significance.

Profit of the enterprise is found to affect the enterprise heads decision to say yes for a given bid, positively and significantly at 1% level of significance. This positive effect indicated that profitable enterprises were more likely to say yes to the initial and follow up bids than unprofitable enterprises. This result is also in line with the basic economic theory, which states that individual's demand for most commodities or services positively related with income or gain level. Keeping the influences of other factors constant, a one Birr increase in profit of the enterprise increases the probability of accepting the proposed bid price by about 62.83%. According to the study result of Kurttila *et al*. (2016), foresters are more willing to pay to the forest service with their profitability increases. Similarly, Adugna (2013) finds that income from production increases farmers WTP for the reforestation of bamboo forests and the variable was significant at 1% level of significance.

With respect to using substitution input in place of Pines logs and lumber, is negative as expected and significant at 5% level of significance. For a 1% increase in using of substitutes the probability of accepting the proposed bid level decline by 10.71%. The rationale behind this result is that as enterprise heads using substitutes, they might have lower demand and expectations of future consumption of Pines logs and lumber resources. Thus, they are not willing to pay more than the non users of substitutes inputs. A study result by Pate and Loomis (1997) indicates that, substitutes did play a negative role in determining an

individual's willingness to pay for the conservation of wet lands. According to these authors, more substitutes in close proximity to the households, the less they should be willing to pay.

The variable liability describes the indebtedness of the enterprise head under liability of financial obligations to pay claims. The coefficient of this variable is negative as expected and significant at 5% level of significance. The marginal effect show that a 1% increase in liability, the probability of accepting the proposed bid level will decrease by 13.42% points, ceteris paribus. This indicates that, the more the enterprise heads are liable to financial obligations, the less likely they would be willing to pay. This could be because, enterprise heads may believed that, the payment for the reforestation program become an additional costs or they may concerned about their financial losses. According to Ian *et al*., 2015, respondents liability arise from purchasing forestland insurance have negative impact on the probability of their WTP for potential standing Pine timber forests insurance by reducing the funds available for other forestry-related costs.

Finally, the last variable distance from the enterprise to the deforested area has a negative impact as expected on the enterprise heads WTP and it is statistically significant at 1% level of significance. The marginal effect of this variable show that a hour increase in distance to the deforested area the probability of accepting the proposed bid level will decrease by 88.85% points, ceteris paribus. This indicates that the more farther the enterprise to the deforested area, the less likely the enterprise heads would be willing to pay. A study result by Elmi *et al*., 2016 shows that, distance from respondents to the reforesting project reduced their WTP and the authors concluded that, the variable is negatively and significantly influence the respondents' WTP for the reforestation at 1% significance level. Pate and Loomis (1997) also indicates that, distance has a negative effect on households willingness to pay for wetlands and contamination control. Similarly, Befikadu *et al.* (2007) explained that, households would have less access to information and other services due to the farthest and time taking distance from their homestead to agricultural office. So, they were not be willing in watershed conservation activity. These authors concluded that, distance affects farmers' WTP negatively.

Appendix table 6 to 9 in Appendix 1, are presented different probabilities that the enterprise heads WTP for the first and for the second WTP questions. Marginal effects after biprobit result 1 in Appendix table 6 shows that, the joint success probability of the enterprise heads willing to pay both the first and the second willingness to pay question is 91.8%. Marginal effects after biprobit result 2 in Appendix table 7 also revealed that, the success probability of the enterprises heads willing to pay only the first WTP question is 8.2%. Similarly, Appendix table 8, presented the marginal effects after biprobit result 3, it shows that the probability of the enterprise heads willing to pay only the second WTP question is 0.0004%. Finally, Appendix table 9 presented the marginal effects after biprobit result 4, it shows the joint probability that enterprises heads fail to pay both first and the second WTP question is 0.003%. All these results suggesting that, enterprise heads are more likely to pay both the first and the second WTP question simultaneously.

4.2.2. Estimation of Average WTP

As described earlier, the binary response categories admit themselves to a probabilistic definition of WTP and distributional specifications of WTP allows one to calculate the probability that sample responses falls within any of this four set described above. According to Haab and McConnell (2002), double-bounded models substantially increase the complexity of the analysis, because now the second question may depend in some way on the first question. It is instructive to look at the double-bounded model in a general form to understand the nature of efficiency gains and estimating an empirical WTP model based on the CV survey responses to derive a mean of the WTP distribution. As shown in Table 7, the mean WTP of the enterprise heads for the reforestation was calculated using the formula specified by Haab and McConnell (2002).

The coefficients α and β were estimated by running the seemingly unrelated Bivariate Probit model using the first bids and second bids as explanatory variables. As shown in table 7, rho (ρ) the correlation coefficient parameter that estimates the coefficient of correlation between random errors in both regression equations is moderately high (0.531) and the two disturbances are significantly correlated at 1% level of significance; which indicates that, the

estimation of the SUBVP model resulted in estimation efficiency. According to Haab and McConnell (2002), the researcher must decide which estimates from the double bounded question to use so as to calculate the mean WTP. They explained that parameter estimates from the first equation are generally used in the computing mean WTP because, the second equation parameters are likely to contain more noise in terms of anchoring bias as the respondent is assumed to take the clue from the first bid. Thus, the mean WTP (μ) is estimated from the first equation and the formula specified by Haab and McConnell (2002) were used. This was also applied by Ayalneh and Birhanu in 2012, by Meseret and Endrias in 2016 and by Elmi *et al*., 2016. Table 7 presents, the computed mean WTP amount from the SUBVP model opted for the reforestation by sample Woodwork enterprise heads. The mean estimated from the initial bid and the follow up bid values ranged from Birr 97.92 to Birr 174 per month per person or Birr 1175.05 to Birr 2088 per m^3 per year per person if the scenario of reforesting the deforested softwood Pines trees resources on the deforested area is implemented.

Table 7. Parameters estimates of Bivariate Probit to compute mean WTP

Variables	Coefficients	Robust Std. Error
WTP initial bid		
Bid1	0.0101	6.32
_cons	-0.989	-2.77
WTP Second bid		
Bid2	0.0022	0.0006
_cons	-0.348	0.257
ρ***	0.531	0.177
Mean WTP $\mu = -\alpha/\beta$ = (-0.989/0.0101)*–1 = 97.921		

Log-likelihood = -104.07288

Wald test of rho = 0: chi2 (1) = 5.73593 Prob > chi2 = 0.0166

Source: Own computation from survey, 2016

4.2.3. The Aggregate WTP

According to Haab and McConnell (2002), the parameter estimates from the first equation are generally used in computation of the mean WTP. thus, in order to have a valid aggregation from the SUBVP on dichotomous choice CV questions with a follow up the the mean from the first equation were used in this study to aggregate enterprises WTP.

Hence, Table 4 shows that, the total amount for the NN and YY responses accounted for about 5.15% and 64.71% respectively of the total responses and the remaining 22.79% and 7.35% count for the YN and NY answers respectively. This means that the first bid amount was closer to the unobserved true value of the enterprise heads willingness to pay. Additionally, the YY response which have the highest percentage (64.71%) response take as yes response in the study which are initiated from the first WTP question.

For example of YN response, let the first random bid for the enterprise head be Birr 50 and let the enterprise head accept the first bid. Then the second bid becomes Birr 100, the enterprise head rejects the second bid. This means that the enterprise heads true WTP is greater than or equal to Birr 50 but definitely less than 100; then the true WTP lies between Birr 50 and Birr 100, so the initial bid will be a better unbiased estimate than the second one. The same is true for the rest 30.14% of the YN and NY responses initial bid provides closer estimates of the true value.

The estimated sample mean WTP calculated in Table 7 Birr 97.92 per month per person or Birr 1175.05 per year per m^3 per person was applied to estimate the aggregate WTP of the enterprises. The aggregate WTP for reforestation estimates are obtained based on this estimated mean amount and the total number of beneficiary Woodwork enterprise heads in the three study areas. As presented in Table 8, the total number of beneficiary Woodwork enterprise heads in the three study areas were 1076. The Aggregate WTP of the enterprise heads from the reforestation was found to be Birr 1264343.04 per m^3 per year. After 10 years this money amounts to be Birr 12643430.4.

To calculate the hectare that could be reforested by Birr 12643430.4; first it is crucial to know the current average Pine log price per m^3. According to the information observed from Eastern Hararghe Oromia Agricultural Bureau Reforestation Agency, the current average one m^3 Pine log price is Birr 1000, thus Birr 12643430.4 ÷ Birr 1000/m^3 will be generated 12643.4304m^3 Pine logs. The recommended spacing and planting of Pine by Atkinson and Fitzgerald in 2002 is 2 meter and 1210 seedlings/acre or (2.471× 1210 = 2990 seedlings/ha). Thus, the total number of Pine seedlings planting in one ha becomes 2990; and if after planting 3% or 90 seedlings are reduced by different factors, and after 5 to 7 years 10% or 300 of the planted Pine are reduced by thinning, the rest 2600 Pine seedlings could be take one ha. Approximately, 18 Pine logs are required to make one m^3, this was obtaining by considering the size of 10 years old Pine log. Thus, 12643.4304m^3 × 18 logs/m^3 equals to 227582 matured Pine logs that will cover 88 ha.

Table 8. Average and aggregate WTP measures by the study areas

The study areas	Total Enterprises in the study area	Mean WTP for the reforestation	Total WTP for the reforestation	
		(Birr/month)	(Birr/month)	(Birr/Year)
Dire Dawa	601	97.92	58849.92	706199.04
Harari	356	97.92	34859.52	418314.24
Deder District	119	97.92	11652.48	139829.76
Total	1076	97.92	105361.92	1264343.04

Source: Own computation from survey, 2016

5. SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1. Summary

Deforestation and poverty are challenging problems in Ethiopia. The deforestation-poverty link is complicated by the institutional failures related to management of natural resources. Sustainably managed forests have multiple environmental and socio-economic functions important at the global, national and local scales. The expanse of forest areas is declining across the globe, partly as a result of logging activities. The massive and global scale of demand for wood resources has led to remarkably high rates of deforestation. Logging provides access roads to follow-on settlers thus logging catalyzes deforestation which brings poverty. Thus, unsustainable logging, selective logging, commercial logging and illegal forest activities, are also major factors to deforestation and serious degradation.

This study was carried on in Eastern Ethiopia. The selected study areas were Dire Dawa Administrative Council, Harari Regional State and Deder District. Forest in and arround Deder district covers most of the three small rural towns. These are *Kobo*, *Chelenko*, and *Karra Makkala* area forests. These area forests were the major source of softwood logs to Dire Dawa, Harari, Deder, and many other neighboring regions and Districts Woodwork enterprises. Nevertheless, local and neighbor loggers over-cutting and deforestation worsen it specially the *Karra Makkala* forest. Indeed, some of commercially important softwood Pines trees are over-exploited.

Owing to this fact, the consequence of these softwood trees deforestation to Dire Dawa, Harari, and Deder district Woodwork enterprises and their WTP for reforest these softwood trees is not yet studied and documented. So, this study was focused on this subject. Reforestation is the massive replanting of forests which have been hewn, cut down, chopped off or deforested for the use of trees. Thus, the study examined the WTP of Woodwork enterprises for reforestation. The main objective of the study was to estimate the WTP of Dire Dawa, Harari, and Deder district Woodwork enterprises to reforest the deforested softwood trees in Deder district *Karra Makkala* forest. Specifically, to identify the determinants of

WTP of Woodwork enterprises for the reforestation and to estimate the mean WTP per m^3 per year to aggregate benefit of WTP measures by the study areas.

To achieve the objective of the study, A two stage sampling technique was used to select sample Woodwork enterprises and both primary and secondary data were collected. The primary data was collected from 136 sample Woodwork enterprise heads selected from population of 1076 enterprises in Dire Dawa, Harari, and Deder District. Descriptive statistics was used to analyze the Woodwork enterprise heads characteristics that affects their willingness to pay for the reforestation. In order to model the true WTP from DBDC CV survey the econometric model namely Seemingly Unrelated Bivariate Probit was employed to estimate the coefficients for the explanatory variables and the mean WTP.

Correspondingly, Four sets of bid prices which were identified from the focus group discussions on the pilot survey were using for the study. These are (75, 38, 150), (150, 75, 300), (225, 113, 450) and (300, 150, 600) Birr per m^3 of Pines log per month. The result of the CVM survey showed that out of 136 sampled respondents 87.5% of them were willing to pay for the reforestation, whereas 12.5% of the respondents were not willing to pay.

The Seemingly Unrelated Bivariate Probit model revealed that, of the total explanatory variables used in the model regression nine explanatory variables (second bid value, family size, capital, perception, source connection, profit, substitution, liability and distance) turned out to be significant and all have the expected sign. The model also revealed that the mean WTP for the enterprise heads was Birr 97.92 per month per person or Birr 1175.05 per m^3 per year per person. The aggregate WTP measures by the enterprises in the study areas which is estimated to be Birr 105361.92 per month or Birr 1264343.04 per m^3 per year. After 10 years this money amounts to Birr 12643430.4 and that could be reforest 88 ha. The mean WTP of enterprise heads could be an indicator of the importance of reforestation in the deforested areas and the significance of reforestation to the whole enterprise heads and community in the region.

5.2. Conclusion

The finding of the study clearly shows socioeconomic, demographic, institutional characteristics of Woodwork enterprise heads and Woodworking related variables that affect enterprise heads WTP for the reforestation. Based on these findings, it can be concluded that the sampled enterprise heads in the three study areas are willing to pay for the reforestation of deforested softwood trees in the deforested areas. Among the sample enterprise heads those who refused to pay anything are treated as having zero WTP and their major reason was using of substitute inputs mainly Medium Density Fiberboard (MDF) for Pines logs and lumber. The result also proved that, majority of enterprises were family businesses: Thus, enterprise heads with larger family size were more willing to pay for the reforestation.

Woodwork enterprises heads were relying on their knowledge and experience of softwood Pines and timber resources to constitute their perception. Here the inference is that, enterprise heads who have perception or an awareness about the reforestation program, indeed more willing to pay for the reforestation. Correspondingly, willing enterprise heads also longing for Pines resources from the deforested softwood forests source as they can get more supply through private ownership of this scarce resource after the rehabilitation. The study result also confirm that profitable enterprises were many times more likely to pay for the reforestation than unprofitable enterprises. Similarly enterprises heads who have more capital were willing to pay more for the reforestation than enterprises heads owning less capital. The strong positive relation between enterprise heads capital and profit to their WTP decisions shows that, using of Pines tree resource is the main economic concern to Woodworking business.

Based on the findings from the survey, it can be concluded that there was a strong negative relation between substitution and respondents WTP. Enterprises heads who were using more substitute inputs in place of Pines logs and lumber were not willing to pay for the reforestation. They had a lower demand and expectations of future consumption of Pines logs and lumber resources. Therefore, they were not willing to pay more than the non users of substitutes inputs. Correspondingly, liability of financial obligations affects enterprise heads WTP negatively. The more the enterprise heads are liable to financial obligations, the less

likely they would be willing to pay. The survey result also showed that, distance to the deforested area also has a strong negative relation to enterprise heads WTP decision. The more farther the enterprise to the reforestation area, enterprise heads were not willing to pay.

5.3. Recommendations

In order to save softwood tree forests from extinction and sustain their valuable benefits, coordinated and participatory urgent action need to be taken to reforest and rehabilitate the resource. Based on the findings of this particular study, the following points need to be considered as a possible policy implications in order to enhance the sustainable and proactive participation of respondents in Eastern Ethiopia on the reforestation and rehabilitation of the deforested softwood tree forests.

Since, larger family size and economic factors such as capital and profitability of the business are positively and significantly related to the probability of enterprise heads WTP; this has to be correctly considered for successful reforestation project or for policy implications. The positive effect of larger family size was an indicator to enterprises were family businesses and attached more of the benefits of the softwood Pines tree resources to them. The positive effect of profit also indicated that profitable enterprises were more willing to pay than unprofitable enterprises. Thus, government should think on how these resources could be supplied to enterprises to support their business. Moreover, specific economic factors that may affect the decision of enterprise heads have to be studied separately from these determinants in order to maintain appropriate estimation. The WTP amount in terms of cash could be a signal for the government to consider cash contribution as an important input while designing and implementing reforestation projects and policies concerned to business enterprises.

Perception about the reforestation of softwood trees have a positive and significant effect on the probability of an enterprises heads WTP decision. Enterprise heads who have perception or an awareness about the reforestation program, it is indeed affects their WTP positively. The perception of respondents are formed by their common sense reasoning, personal experience, social communication, cultural traditions and so on. Here the notation is that, Woodwork

enterprises heads were relying on their knowledge and experience of softwood Pines and timber resources to constitute their perception. Regarding, awareness creating programs on consideration of forest benefits of tree resources should be undertaken to increase respondents valuation and also increase their WTP decision accordingly. Therefore, due emphasis on teaching and awareness increasing programs should be given based on the concepts of reforesting the resource. Delivering these kind of programs will have a vital role in enhancing the willingness of enterprise heads to pay for the reforestation.

Enterprises heads confirmed that sourcing the supply of Pines logs in future from the deforested softwood forests after rehabilitation makes them fervently interested to pay for the reforestation; This is due to the fact that they have a good sense of ownership and believe they can get more supply through the connection after the rehabilitation. The connection between enterprises and the deforested areas should be encouraged and strengthened through proper reforestation scheme. Since Woodwork enterprises were the most users attached more value for the direct uses or benefits of softwood Pines tree resources, the government should think on how these resources could be supplied to these enterprises without compromising sustainability of these highly valuable tree resources. In order to introduce a sustainable reforestation scheme, enterprises should be given the right to play the major role in managing, controlling and sustainable use of the resource after rehabilitation. To be effective and sustainable, the participation of the Woodwork enterprises in each step of the reforestation process of the deforested softwood trees forests is important.

The result of the study also revealed that, scarcity of softwood tree resources leads Woodwork enterprises to using of substitutes inputs. The result showed that substitution affects enterprise heads WTP negatively as they have lower demand and expectations of future consumption of Pines logs and lumber resources. Thus, they are not willing to pay more than the non-users of substitutes inputs. It is also better for the policy makers to point out substitutes users, while designing a reforestation scheme. Similarly, A study result also shows that, distance has a significant negative effect on enterprise heads willingness to pay. The more farther the enterprise to the deforested softwood areas, the less likely the enterprise heads would be willing to pay. Thus, to increase respondents valuation and to implement successful

reforestation program, special facilities, supports and incentives for the reforestation should be included in the scheme.

Liability of financial obligations have a negative and significant effect on the probability of an enterprises heads WTP decision. Indebted enterprises concerned more on reducing costs related with financial obligations due to taxes, borrowing, injury or damage claims made by third parties against their ownership and so on. They deserved the payment for the reforestation program as an additional source of financial losses. Policy makers should point out financially liable respondents, while designing a reforestation program. Thus, liable enterprises should be supported through, long-term loan repayment, awareness creation programs for business management to deduct expenses (regional programs), loss deductions, incentives for reforestation, reducing combined impact of federal and regional state taxes, to enhancing them for the successful reforestation scheme.

Furthermore, enterprise heads in the study are acknowledged the deforestation of softwood trees forests and they have showed their initiation to reforest these forests. The regional governments of the study areas in collaboration with the federal government should use this opportunity to mobilize Woodwork enterprises to combat softwood trees deforestation problem. The restoration measures, therefore, are necessary to enable the resource regenerate and save it from being permanently vanished.

Finally, beside Woodwork enterprises, the study did not include other community groups who generate various direct and indirect benefits from the softwood Pines tree resources in the study areas. It should be noted that, including these community groups on the reforestation programs may have a significant implications for the success of softwood trees rehabilitation. As described earlier Woodwork enterprises WTP represents one potential financing mechanism for the rehabilitation, other potential mechanisms such as private and public payment mechanisms should also be explored. Thus, the deforested softwood trees reforestation scheme could be complemented and strengthened by other studies such as willingness to accept, willingness to contribute of labor and comparing cost and benefit of reforestation practices.

6. REFERENCES

Abdullah, S. and Mariel, P. 2010. Choice Experiment Study on the Willingness to Pay to Improve Electricity Services. *Energy Policy*, 38(8): 4570-4581.

Abelson, P.W. 1996. Project Appraisal and Valuation of the Environment. NewYork, NY: St. Martin's Press.

ADB (Asian Development Bank). 1999. Handbook for the Economic Analysis of Water Supply Projects. Economics and Development Resource Center. Philippines.

Adekunle, M.F., Momoh, S. and Agbaje, B.M. 2008. Valuing Urban Forests: The Application of Contingent Valuation Methods. *Ethiopian Journal of Environmental Studies and Management*, 1(2): 61-62.

Adugna Lake. 2013. Determinants of Willingness To Pay for Conservation and Rehabilitation of Bamboo Forests: The Case of Bambasi Woreda, Benishangul Gumuz. An MSc Thesis, Haramaya University.

AFF (African Forest Forum). 2001. Forest Plantation and Woodlots in Ethiopia. African Forest Forum (AFF) working paper series volume 1; December, 2001. Nirobi, Kenya.

Aklilu Amiga. 2002. Households Willingness to Pay for Improved Solid Waste management: The case of Addis Ababa. An MSc Thesis, Addis Ababa University. Addis Ababa, Ethiopia.

Alemu Mekonnen. 1999. Rural Household Biomass Fuel Production and Consumption in Ethiopia: A case study. *Journal of Forest Economics*, 5(1): 69-97.

Alemu Mekonnen. 2000. Valuation of community forestry in Ethiopia: A contingent valuation study of rural households. *Environment and Development Economics*, 5(3): 289–308.

Alpizar, F., Carlsson, F. and Martinsson, P. 2003. Using Choice Experiments for Non-market Valuation. *Economic Issues*, 8: 83-110.

Anemut Belete. 2006. Determinants of Farmers' Willingness to Pay for the Conservation of Simen Mountains National Park. An MSc Thesis, Haramaya University.

Arrow, K. 1993. Report of the NOAA Panel on Contingent Valuation. *Federal Register* 58 (10): 4601-4614.

Assefa Mitike. 2015. Fishermen's Willingness to Pay for Fisheries Management: The case of Lake Zeway. An MSc Thesis, Haramaya University.

Atkinson, M. and Fitzgerald, S. 2002. Successful Reforestation: The Wood-Land Work Book. pp.5. Oregon State University, USA.

Ayalneh Bogale and Birhanu Urgessa. 2012. Households' Willingness to Pay for Improved Rural Water Service Provision: Application of Contingent Valuation Method in Eastern Ethiopia. *Journal of Hum Ecol*, 38(2): 145-154.

Bamlaku Ayenew. 2015. Economic Value of Wondo Genet Catchment Forest in Domestic Water Supply Services, Southern Ethiopia. *Journal of Economics and Sustainable Development*, 6(9): 213-221.

Bedru Babulo, Muys, B. and Mathijs, E. 2006. Economic Valuation Methods of Forest Rehabilitation in Enclosures. *Journal of the Dry lands*, 1(2): 165-170.

Befikadu Alemayehu, Amare Haileslassie, Fitsum Hagos, Seleshi Bekele, Tesfaye Tafesse, Peden, D. and. Everisto, M. 2008. Prospect of Payments for Environmental Services in the Blue Nile Basin: Examples from Koga and Gumera Watersheds. Project Workshop Proceedings. Addis Ababa University, Ethiopia.

Bekele Million. 2011. Forestry Outlook Studies in Africa, Ethiopia (FOSA), available on: http://www.fao.org/docrep/004/ab582e/AB582E02.htm# Page Accessed in 8/07/2011.

Bekele Million and Berehanu Leykun. 2001. Forest Genetic Resources Working Papers (FGR/2E), FAO, IPGRI and ICRAF, Rome.

Bekele Shiferaw and Holden, S.T. 1998. Resource Degradation and Adoption of Land Conservation Technologies in Ethiopian Highlands: A case study in Andit Tid North Shewa. *Journal of Agricultural Economics*, 18: 233-247.

Belay Kasaye. 2015. Farmers Willingness to Pay for Improved Soil Conservation Practices on Communal Lands in Ethiopia. An M.sc. Thesis, Addis Ababa University.

Biniyam Tilahun. 2013. Valuing the Economic Benefits of Controlling Off-Site Effects of Soil Erosion: Empirical Evidence from the Eastern Highlands of Ethiopia. An M.sc. Thesis, Addis Ababa University.

BoFED (Bureau of Finance and Economic Development). 2008. Socio-economic Profile of Oromia. Finfinne, Ethiopia.

Boyle, K. J., Welsh, M. P. and Bishop, R.C. 1988. Validation of Empirical Measures of Welfare Change: Comment. *Journal of Land Economics*, 64: 94-98.

Breitenbach, F.V. 1963. The Indigenous Trees of Ethiopia 2nd Ed. pp.305. Ethiopian Forestry Association, Addis Ababa, Ethiopia.

Brink, M. 2007. *Cupressus lusitanica* Mill [Internet]. *In*: D. Louppe, A.A. Oteng-Amoako, M. Brink, editors. Prota 7(1); [updated 2011 Sept 10, cited 2011 Sept 15]. Available from: http://database.prota.org/PROTAhtml/Cupressus%20lusitanica_En.htm.

BTL (Border Timbers Limited). 2010. The Border Timbers Limited Forestry division Mutare, Zimbabwe; [updated 2011 Sept 11, cited 2011 Sept 11]. Available from: http://www.bordertimbers.com/forestry.html.

Cameron, T. A. and Quiggin, J. 1994. Estimation Using Contingent Valuation Data from a Dichotomous Choice with Follow-up Questionnaire. *Journal of Environmental Economics and Management*, 27(3): 218-34.

Campbell, B. 1993. Monetary Valuation of Tree-Based resources in Zimbabwe: Experience and Out Look University of Zimbabwe, Paper Prepared for the FAO Expert Consultation on Non-wood Forest Products.

Carson, R.T. 1991. Measuring the Demand for Environmental Quality: *Constructed Markets*. Elsevier Science Publishers, in J.B Braden and C.D. Kolstad, B.V., North Holland.

Carson, R.T. Hanemann, M. and Mitchell, R.C. 1986. Determining the Demand for Public Goods by Simulating Referendums at Different Tax Prices. Department of Economics, University of California, San Diego.

Chomitz, K. M., Buys, P., Luca, G. D., Thomas, T. S. and Wertz-Kanounnikoff, S. 2007. *At Loggerheads? Agricultural Expansion, Poverty Reduction and Environment in the Tropical Forests*. pp. 2-43. World Bank Policy Research Report. World Bank, Washington DC.

Ciriacy-Wanthrup, S. 1947. Capital Returns from Soil Conservation Practices. *Journal of Farm Economics*, 29:1181-1196.

Clement, A. 2014. Human Values and Biodiversity Conservation: The Survival of Wild Species. Edward Elgar Pub. Ltd. Cheltenham, UK.

Couralet, C. and Bakamwesiga, H. 2007. *Juniperus Procera* Hochst. ex Endl., in: *Prota (Plant Resources of Tropical Africa / Ressources végétales de l'Afrique tropicale)*. Louppe, D., A. A. Oteng-Amoako and M. Brink (eds). PROTA, Wageningen, Pays Bas, Netherlands.

CSA (Central Statistical Agency). 1994. Population and Housing Census for Ethiopia: Result for Dire Dawa Provisional Administration. Addis Ababa, Ethiopia.

CSA (Central Statistical Agency). 2004. Report on Urban Bi-Annual Employment Unemployment Survey. First Year Round 2. Statistical Bulletin 319. Addis Ababa, Ethiopia.

CSA (Central Statistical Agency). 2005. Statistical Report on Population Size, 2006. Addis Ababa, Ethiopia.

CSA (Central Statistical Agency). 2007. Population and Housing Census Report-Dire Dawa Region-2007, Central Statistical Agency, 2010-07, Addis Ababa, Ethiopia.

CSA (Central Statistical Agency). 2008. Statistical Metadata Report of Large and Medium Enterprises, CSA, Addis Ababa, Ethiopia.

CSA (Central Statistical Agency). 2010. Statistical Abstract of Ethiopia, CSA, Addis Ababa, Ethiopia.

Dagmar, R. 2001. Recklies Management Project. Online www.themanagement.de(mail: drecklies@themanagement.de).

Dagne Minalu. 2008. Determinants of Farmers' Willingness to Pay for Irrigation Water in Jabitehinan Wereda of Amhara Region Ethiopia. An MSc Thesis, Haramaya University.

Davis, K. 1963. Recreation Planning as an Economic Problem. *National resource Journal of Agricultural Economics*, 3: 239-249.

Demel Teketay. 1996. Seed Ecology and Regeneration in Dry Afromontane Forests of Ethiopia. Acta Universitatis Agriculturae Sueciae, Silvestria 4. Umea, Sweden.

Demel Teketay, Mulugeta Lemenih, Tesfaye Bekele, Yonas Yemshaw, Sisay Feleke, Wubalem Tadesse, Yitebetu Moges, Tesfaye Hunde, and Demeke Nigussie. 2010. Forest Resources and Challenges of Sustainable Forest Management and Conservation in Ethiopia. *In*: F. Bongers, and T. Tennigkeit, (eds). *Degraded forests in Eastern Africa: management and restoration*. Earthscan Publications.

Dharani, N. 2002. Field Guide to Common Trees and Shrubs of East Africa. Struik Nature, Cape Town, South Africa.

DIY (Do It Yourself). 2017. Advantages and Disadvantages of Medium Density Fiberboard (MDF), available on: http://www.doityourself.com.

Dosman, D. and Luckert, M.K. 1999. A Micro-economics Primer: An Introduction to Valuation Methods for Agro-Forestry Project in Developing Countries Institute of Environmental Study (IES) Publications.

Dvorak, W. 1997. The improvement and Breeding of *Pines Patula*. Procedings of the 24th Southern Forest Tree Improvement Conference; Orlando (FL): Southern Forest Tree Improvement Committee.

EARO (Ethiopian Agricultural Research Organization). 1999. Forest Research Strategic Plan: Draft. July, Addis Ababa, Ethiopia.

EC (European Commission). 2013. The Impact of EU Consumption on Deforestation: Comprehensive Analysis of the Impact of EU Consumption on Deforestation. Final Technical Report, 063.

ECRAN and UNDP (Ethiopian Climate Research and Networking and the United Nations Development Program). 2010. Current Status and Future Management Options in View of Access to Carbon Finances; Literature Review Prepared for the Ethiopian Climate Research and Networking and the United Nations Development Program, October, 2010. Addis Ababa, Ethiopia.

Edwards, S. 2010. Ethiopian Environment Review (EER). *Forum for Environment*: 1(1), 8-9

EFAP (Ethiopian Forestry Action Program). 1994. Ethiopian Forestry Action Program study summary report. Ministry of Natural Resource Development and Environmental Protection. Addis Ababa, Ethiopia.

EFRL (Ethiopia's Forest Reference Level). 2016. Ethiopia's Forest Reference Level Submission to the United Nations Framework for Conventions on Climate Change: January, 2016. UN.

EHZAO (East Hararghe Zone Agricultural Office). 2012. Annual report. East Hararghe Zone, Addis Ababa, Ethiopia.

EHZARDO (East Hararghe Zone Agriculture Research and Development Office). 2011. Annual Report. East Hararghe Zone, Addis Ababa, Ethiopia.

Elias, P. and Boucher, D. 2014. Planting for the Future. How Demand for Wood Products Could Be Friendly to Tropical Forests. Union of Scientist Conference. online *www.ucsusa.org/futurewooduse.*

Ellen, W. 2010. Participatory Forest Management (PFM) in Ethiopia, Practice and Experiences. FAO, SFE. June, Addis Ababa, Ethiopia.

Elmi Nure, Zeleke Ewnetu and Yemiru Tesfaye. 2016. Economic Valuation of Forest Conserved by Local Community for Carbon Sequestration. *Journal of scientific research on Low Carbon Economy*: 7(2016), 88-105.

El Zein, A. and El Mamoun, H. 2014. The Effect of Coniferous Plantations (*Cupressus Lusitanica*, *Pinus Radiata* and *Pinus* Putula) on the Soils of Jebel Marra. *Journal of forest products and industries*: 3(3), 167-169.

EPA (Environmental Protection Agency). 2012. National Report of Ethiopia, the United Nations Conference on Sustainable Development (Rio+20). Federal Democratic Republic of Ethiopia, pp. 17. Addis Ababa, Ethiopia.

Eshetu Yirdaw. 2002. Restoration of the Native Woody Species Diversity Using Plantation Species as Foster Trees in the Degraded Highlands of Ethiopia: Academic Dissertation. University of Helsinki, Finland.

ETFF (Ethiopia Tree Fund Foundation). 2001. Paper Presented at International Conference on Contemporary Development Issues in Ethiopia, Kalamazoo, Michigan, U.S.A. August 16-18, 2001. Deforestation and Land Degradation on the Ethiopian Highlands: A Strategy for Physical Recovery. http://www.etff.org/badeg_def.htm (1 of 9) [08/10/2003 11:16:18].

Evans, J. 1992. Plantation Forestry in the Tropics. 2nd Ed. Clarendon press, Oxford. p. 403.

EWPAA (Engineered Wood Products Association of Australasia). 2016. Wood Product Categories and the use of MDF. Available from: http://www.Woodsolutions.com.au/ Wood-Product-Category/Medium-Density-Fiberboard-MDF#tab-overview.

Export Genius. 2016. Ethiopians Customs Imports Data of Coniferous Includes Hs Code, Value, Quantity, Coniferous Importers of Ethiopia. C-7/224-225, Sector-7, Rohini, New Delhi, India.

FAO (Food and Agriculture Organization). 1981. Forest Resource of Tropical Africa, Part 2, Country Briefs. Forestry Paper 7.

FAO (Food and Agriculture Organization). 1988. An Interim Report on the State of Forest Resources in the Developing Countries. Rome.

FAO (Food and Agriculture Organization) 2001. Forest Resource Assessment. Tropical countries. FAO Forestry paper series 112. pp. 59. FAO, Rome.

FAO (Food and Agriculture Organization). 2010. Food and Agriculture Organization (FAO), Global Forest Resources Assessment 2010 Country Report: Ethiopia, Rome, Italy.

FAO (Food and Agriculture Organization). 2016. Forestry Contribution to National Economy and Trade in Ethiopia, Kenya and Uganda. Addis Ababa, Ethiopia.

Fekadu Gurmessa. 2015. Forest Loss and Climate Change in Ethiopia. *Journal of Agriculture and Environmental Management*, 4(5): 216-224.

Feyera Senbeta, Demel Teketay and Bertake N. 2002. Native Woody Species Regeneration in Exotic Tree Plantations at Munessa-Shashemene Forest, Southern Ethiopia. *New Forests*, 24: 131-145.

FRA (Forest Resources Assessment). 2005. Global Forest Resources Assessment Country Report Ethiopia. Rome, Italy (www. fao.org/forestry/ fra/fra2010/en/, accessed date September 15, 2010).

FRA (Forest Resources Assessment). 2010. Global Forest Resources Assessment - Country Report Ethiopia. Food and Agriculture Organization (FAO), Rome, Italy.

Freeman, A. 2003. The Measurement of Environmental and Resource Values: Theory and Methods. 2nd Ed. Resource for the Future, Washington, D.C.

Frutos, P., Martinez-Pena, F., Aldea, J. and Campos, P. 2016. A Model to Estimate Willingness to Pay for Harvest Permits for Wild Edible Mushrooms: Application to Andalusian Forests. *Journal of forests*, 7(292): 3-14.

Gebrelibanos Gebremedhin and Abdi Khalil. 2012. Households' Valuation of Soil Conservation Practices in Adawa Woreda: A Contingent Valuation Study. *Journal of Economics and Sustainable Development*, 3(13): 97-107.

GFC (Global Forest Coalition). 2010. Global Forest Coalition, Getting to the Roots: Underlying Causes of Deforestation and Forest Degradation, and Drivers of Forest Restoration. December, *O Le Siosiomaga* Society Inc., (*OLSSI*), Samoa.

Gillespie, A. 1992. *Pines patula Schiede* and *Deppe*. Rio Piedras (PR): United States Department of Agriculture Forest Service, Institute of Tropical Forestry. Report: 54.

Greene, W. 2008. Econometric Analysis. Sixth Edition New York University Pearson Education, Inc., publishing as Prentice Hall.

Gregersen, H., Lundgren, A., Kengen, S., Byron, N. 1997. Measuring and Capturing Forest Values Issues for the Decision-maker, Xi World Forestry Congress, Volume 4, Topic 24. Antalya, Turkey.

Gujarati, D.N. 2004. Basic Econometrics, Fourth Edition. The McGraw−Hill Companies.

Haab, T.C. and McConnell, K. E. 2002. Valuing Environmental and Natural Resources: The Econometrics of Non-Market Valuation. Edward Elgar Publishing, Northampton.

Hanemann, W.M. 1984. Welfare Evaluations in Contingent Valuation Experiments with Discrete Responses. *American Journal of Agricultural Economics,* 66: 332-341.

Hanemann, W.M. 1994. Valuing the Environment through Contingent Valuation. *Journal of Economic Perspectives,* 8: 19-43.

Hanemann, W.M. and Kanninen, B. 1999. The Statistical Analysis of Discrete Response CV Data. Willis, K.G. (Eds.), Valuing Environmental Preferences: theory and practice of the contingent valuation method in the US, EU and Developing countries**.**

Hanemann, W.M., Loomis, J. and Kanninen, B. 1991. Statistical Efficiency of Double Bounded Dichotomous Choice Contingent Valuation. *American Journal of Agricultural Economics*, 73: 1255-1263.

Hoehn, J.P. and Randall, A. 1987. A Satisfactory Benefit Cost Indicator from Contingent Valuation. *Journal of Environmental Economics and Management,* 14: 226-247.

Hurni, A. 1988. Degradation and Conservation of the Resources in the Ethiopian Highlands. *Mountain Research and Development*, 8(2): 123-130.

Hvoslef-Eide, A. K. and Preil, W. 2005. Liquid Culture System for In-vitro Plant Propagation. pp. 588. Springer, Dordrecht.

Ian A., Yiling, D., Keith, C. and Habio, Y. 2015. Willingness To Pay For Potential Standing Timber Insurance. *Journal of Agricultural and Applied Economics*, 47(4): 510-538.

Jakobsson, K.M. and A.K., Dragon. 1996. Contingent Valuation and Endangered Species. Methodological Issues and Applications. pp. 77-115. Edward Elgar Pub. Ltd.

Johansson, P., Kristrom, B. and Matisson, L. 1995. Economic Values of Non-Timber Forest Goods and Services. In: Hytonen, M. (Ed), Multiple-Use Forestry in the Nordic countries, METLA, Finnish Forest Research Institute, Helsinki: Research center.

Kesiena, T., Saka, O. and Opeyemi, I. 2016. Willingness to Pay For Environmental Service Functions of Mangrove Forest In Uzere, Delta State, Nigeria. *Journal of Resources Development and Management*, 16(2016): 1-7.

Khaksar, H., Daneshvar, M., Kalateh V. and Akbari, M. 2011. Estimated Value of Forest Recreation Park in Mashhad Using Contingent Valuation. *Journal of Agricultural Economics*, 3(2): 61-78.

Khalilian, S., Khodaverdizadeh, M. and Kavoosi, M. 2012. Determining the Conservation Value of Qvrigl Wetland and Application of Analytical Hierarchy Process (AHP) in Order to Distinguish the Consumptive and Non-Consumptive Values. *Journal of Environmental Studies*, 60: 23-34.

Khandke, K., Peterson, K., Booth, B. and Holladay, S. 2001. Contingent Valuation and land use patterns: An application to the Enore River Watershed in Upstate South Carolina Austin, Texas.

Klauss, V. and Adala, H. S. 1994. Traditional Herbal Eye Medicine in Kenya. *World Health Forum*, 15: 138-143.

Kohlin, G. and Amacher, G. 2005. Welfare Implications of Community Forest Plantations in Developing Countries: The Orissa Social Forestry Project in India. *American Journal of Agricultural Economics*. 87: 855-869.

Krosnick, J. and Presser, S. 2009. Likert Questionnaire Design. Handbook of Survey Research 2nd Ed. James D. Wright and Peter V. Marsden (Eds). San Diego, CA: Elsevier. NY.

Kurttila, M., Hujala, T., Hanninen, H. and Kumela., H. 2016. Family Forest Owners' Opinion on Potential Forest Leasing Service in Finland. University of Natural Resources and Life Sciences, Vienna, Austria.

Legesse Negash. 1995. Indigenous Trees of Ethiopia: *Biology, Uses and Propagation Techniques*. printed by the SLU Reprocentralem, Umea, Sweden, ISBN pp. 231.

Li, R., Buongiorno, J., Turner, J., Zhu, S. and Prestemon, J. 2008. Long-term Effects of Eliminating Illegal Logging on the World Forest Industries, Trade, and Inventory. *Forest Policy Economics*, 10: 480–490.

Loomis, J. and Gonzalez-Caban, A. 1998. A Willingness to Pay Function for Protecting Acres of Spotted Owl Habitat from Fire. *Ecological Economics*, 25(3): 315-322.

Loomis, J., Brown, T., Lucero, B. and Peterson, G. 1997. Evaluating the Validity of the Dichotomous Choice Question Format in Contingent Valuation. *Journal of Environmental and Resource Economics*, 10: 109-123.

Lorenzo, A.B., Blanche, C., Qi, Y. and Guidry, M. 2000. Assessing Residents' Willingness to Pay to Preserve the Community Urban Forest: A Small-City Case Study. *Journal of Arboriculture*, 26(6): 319-325.

Louviere, J.J. 1988. Conjoint Analysis Modeling of Stated Preferences. *Journal of Transport Economics and Policy*, 22: 93-119.

Lusk, J. L. and Shogren, J. F. 2007. Experimental Auctions: Methods and Applications in Economic and Marketing Research. New York: Cambridge University Press.

Lynam, T.J.P., Campbell, B.M. and Vermeulen, S.J. 1994. Contingent Valuation of Multipurpose Tree Resources in the Smallholder Farming Sector, Zimbabwe, Studies in Environmental Economics Department of Economics, Gothenburg University.

Maddala, G.S. 1997. Limited Dependent and Qualitative Variables in Econometrics. Introduction to Econometrics. 2nd Ed. Macmillan Pub. Co. New York, USA.

Mamat, M.P., Alias, R., Awang, N.A. and Lim, H.F. 2013. Willingness to Pay for Protecting Natural Environments in Pulau Redang Marine Park. *African Journal of Environmental Economics and Management Malaysia*, 1 (5): 120-125.

McFadden, D. 1974. Conditional Logit Analysis of Qualitative Choice Behavior. *Frontiers in econometrics*, P. Zarembka (ed.) New York: Academic Press, 105-142.

MEFCC (Ministry of Environment, Forest and Climate Change). 2015. Minutes of Forest sector management: February, 2015. Addis Ababa, Ethiopia.

Meseret Birhane and Endrias Geta. 2016. Farmers' Willingness to Pay for Irrigation Water Use: The Case of Agarfa District, Bale Zone, Oromia National Regional State. *International Journal of Agricultural Economics*, 1(2): 35-39.

Mesfin Tilahun, Kidanemariam Gebregziabher, Kindeya Gebrehiwot, Mathijs, E., Muys, B., Vranken, L., Deckers, J. and Bauer, H. 2011. Contingent Valuation Analysis of Rural Households' Willingness to Pay for Frankincense Forest Conservation. *Challenges for Agriculture, Food and Natural Resources*. Zurich, Switzerland

Mitchell, R.C. and Carson, R.T. 1989. Resources for the Future: Using Surveys To Value Public Goods: The Contingent Valuation Method, Washington D.C.

Mogey, N. 2007. "So You Want to Use a Likert Scale?" Learning Technology Dissemination Initiative. Heriot-Watt University.

Mulugeta Lemenih and Demel Teketay. 2004. Restoration of Native Forest Flora in the Degraded High Lands of Ethiopia: Constraints and opportunities. *Ethiopian Journal of Science*, 27: 75-90.

Mulugeta Lemenih, Taye Gidelew and Demel Teketay. 2004. Effects of Canopy Cover and Understory Environment of Tree Plantations on Species Richness, Density and Sizes of Colonizing Woody Species in Southern Ethiopia. *Journal of Forest Ecology and Management,* 194: 1-10.

NAS (Northeast African Studies), 2001. Northeast African Studies (1SSN0740"9133) (New Series) 2001: *Journal of East African Studies,* 8(1): 7-26.

Nassauer, J. 1989. Agricultural Policy and Aesthetic Objectives. *Journal of Soil and Water Conservation*: 44(5), 384-387.

Negassa Fufa. 2014. Estimating the Value for Conservation of Wonchi Crater Lake (Application of Contingent Valuation Method). An M.sc. Thesis, Addis Ababa University.

Negussie Achalu. 1995. Monographic Review on *Juniperus excelsa*. pp. 4. Alemaya University of Agriculture, Faculty of Forestry.

NOAA (National Oceanic and Atmospheric Administration). 1993. Report of the NOAA Panel on contingent valuation. *Germany Federal Register,* 58: 20-22.

ODB (Oxford Dictionary of Business). 1996. Oxford University Press, Great Clarendon Street, Oxford ox2 6DP, Cox and Wyman. Berkshire Great Britain.

OPPACC (Oromia National Regional State Program of Plan on Adaptation to Climate Change). 2011. Oromia National Regional State Program of Plan on Adaptation to Climate Change. Finfinne, Ethiopia.

Ortiz, P.L. Arista, M. and Talavera, S. 1998. Low Reproductive Success in Two Subspecies of *Juniperus Oxycedrus L*. *International Journal of Plant Science*, 159: 843–847.

Orwa, C., Mutua, A., Kindt, R., Jamnadass, R. and Simons, A. 2009. Agroforestry Database: A Tree Reference and Selection Guide Version 4.0. Kenya: World Agro-forestry Center ICRAF; [updated 2011 Sept 10, cited 2011 Sept 21].

Pate, J. and Loomis, J. 1997. The Effect of Distance on Willingness to Pay Values: A Case Study of Wetlands and Salmon in California. *Journal of Ecological Economics*, 20: 199 -207.

Paulos Asrat. 2002. Determinants for Farmers' Willingness to Participate in Soil Conservation Practices in the Highlands of Bale: The Case of Dinsho Farming System Area. An M.Sc. Thesis, Alemaya Universty.

Pearce, N. 1991. New Environmental Policies: The Recent Experience of OECD Countries and Its Relevance to the Developing World. In OECD: Environmental Management in Developing Countries: Paris.

Pohjonen, V. and Pukkala, T. 1992. *Juniperus Procera Hocht*. ex Endl. in Ethiopian Forestry. *Forest Ecology and Management*, 49: 75-85.

Primefacts. 2008. Profitable and Sustainable Primary Industries. May, 2008; Australia. Available from: www.dpi.nsw.gov.au/primefacts.

Putz, F. E., Blate, G. M., Redford, K. H., Fimbel, R. and Robinson, J. 2001. Tropical Forest Management and Conservation of Biodiversity: An Overview. *Conservation Biology*, 15: 7-20.

Rafiee, H. and Amirnejad, H. 2011. Public Preferences and Willingness to Pay to Protect Forests in Mazandaran Province, The case of the Solomon Strait Sari. *Journal of Forest and Wood Products*, 63(4): 355-367.

Ragland, J. 2010. Wood in Practice. Design, Architecture und Environment for Kunstpadagogik. University of Applied Arts, Vienna.

Reusing, N. 2000. Change Detection of Natural High Forests in Ethiopia Using Remote Sensing and GIS Techniques: International Archives of Photogrammetry and Remote Sensing. Vol. XXXIII, Part B7. Amsterdam.

RFWBRE (Review of Forest Woodland and Bushland Resources in Ethiopia). 2010. Review of Forest Woodland and Bushland Resources in Ethiopia up to 2008, EER (Ethiopia Environment Review), Addis Ababa, Ethiopia, p. 126.

Sabie, R. 2006. South Africa: Sabie. Forestry; [updated 2006, cited 2011 Sept 11]. Available from: http://www.sabie.co.za/about/forestry/.

Seblework Belaineh. 2009. Somatic Embryogenesis in *Juniperus Procera* using *Juniperus Communis* as a Model. Institute of Biodiversity Conservation. *Journal of Environmental Economics*, 1 (2): 95-105.

Shultz, S., Pinazzo, J. and Cifuentes, M. 1998. Opportunities and Limitations of Contingent Valuation Surveys to Determine National Park Entrance Fees: Evidence from Costa Rica. *Journal of Environment and Development Economics*, 3(1): 131-149.

Solomon Jebessa. 2004. Contingent Valuation of Multi-purpose Tree Resources: The case of Arsi zone, Ethiopia. An M.sc. Thesis, Addis Ababa University.

Sorrel, B. 2010. Likert Scale Examples for Surveys. ANR Program Evaluation Iowa State University Extension.

Spanolux. 2017. MDF Manual: Spanolux Wood Based Solution. The Spanogroup furniture components manufacturing companies in Vielsalm and Oostrozebeke, Belgium.

Stephanie A., Michael, A., Rachel, H. and Jacob, D. 2008. Influence of Purchaser Perceptions and Intentions on Price for Forest Land Parcels: A Hedonic Pricing Approach. *Journal of Forest Economics*, 14 (2008): 47–72.

Tamrat Bekele. 1993. Vegetation Ecology of Remnant Afromontane Forests of the Central Plateau of Shewa, Ethiopia. *Journal of Acta Phytogeographica Suecica*, 79: 1-59.

Tamirat Minota. 2014. Determinants of Households' Willingness To Pay for Improved Water Supply Service in Dilla Town, Southern Ethiopia. An M.sc. Thesis, Addis Ababa University.

Tesfahun Alemayehu. 2014. Smallholder Farmer's Willingness to Pay for Improved Irrigation Water: A Contingent Valuation Study in Koga Irrigation Project, Ethiopia. *Journal of Economics and Sustainable Development,* 5(19): 5-15.

Tietenberg, T. 2003. Environmental and Natural Resource Economics. 6th International Edition, Pearson Education, Inc.

Tyrvainen, L. and Vaananen, H. 1998. The Economic Value of Urban Forest Amenities: an Application of Contingent Valuation Method. *Journal of Landscape and Urban Planning*, 43: 105-118.

UNEP (United Nations Environmental Program). 1983. Ecology and Environment: What Do We Know About Desertification? *Desertification Control*, 3: 2-9.

UNFF (United Nations Forum on Forests). 2013. 10th Session of United Nations Forum on Forests, Istanbul, Turkey.

Urquhart. 2007. Tropical Deforestation: Stelten Forests. Also available online http://earthobservatory.nasa.gov/Library/Deforestation/).

WBI (World Bank Institute). 2002. Environmental Economics and Development Policy Course. July 15-26, 2002, Washington, D.C.

WBISPP (Woody Biomass Inventory and Strategic Planning Project). 2004. Forest Resources of Ethiopia. Addis Ababa, Ethiopia.

WBISPP (Woody Biomass Inventory and Strategic Planning Project). 2005. A National Strategy Plan for the Biomass Sector. Woody Biomass Inventory and Strategic Planning Project: Addis Ababa, Ethiopia.

WFP (World food Program). 2009. World food Program-Ethiopia Vulnerability Assessment and Mapping (VAM) September, Addis Ababa, Ethiopia.

Wooldridge, J. M. 2002. Econometric Analysis of Cross Section and Panel Data. The MIT Press Cambridge, Massachusetts London, England.

Wormald, T. 1975. Pines Patula. Department of Forestry, Commonwealth Forestry Institute. Oxford (UK).

Yalfal Temesgen. 2015. Valuing Community Based Forest Landscapes Restoration: The Bivariate Probit Analysis for Degraded Forest Lands in NorthWestern Ethiopia. *Journal of Marketing and Consumer Research*, 8: 58-63.

Yamane, T. 1967. Statistics: An Introductory Analysis. 2nd Ed., Harper and Row, NY.

Zeller, M. 2000. Product Innovation For The Poor. The Role Of Microfinance, Policy Brief No. 3: Rural Financial Policies For Food Security Of The Poor. International Food Policy Research Institute. Washington. PMCid:PMC92312.

Zewdu Belete and Yemesrach Assefa. 2003. Willingness-to-Pay for Protecting Endangered Environments: The Case of Nechsar National Park, Ethiopia. *Organization for social science research in Eastern and southern Africa.* Issue 31, report series.

APPENDICES

Appendix 1

Regression, Heteroskedasticity and Correlation Coefficient Test Results

Appendix table 1. OLS regression

. regress maxwtp bid1 sex educate family exper capital credit percept source profit substit labor liabilty dist

Source	SS	df	MS
Model	16859307.1	14	1204236.22
Residual	2632483.3	121	21756.0603
Total	19491790.4	135	144383.633

Number of obs = **136**
F(15, 120) = **55.35**
Prob > F = **0.0000**
Adj R-squared = **0.8493**
Root MSE = **147.5**

maxwtp	Coef.	Std. Err.	t	[95% Conf.	Interval]
bid1	1.877422	.2270484	8.27***	1.42792	2.326924
sex	34.38418	42.90119	0.80	-50.55004	119.3184
educate	7.160706	3.351138	2.14**	.5262452	13.79517
family	-.2780136	10.36094	-0.03	-20.79022	20.2342
exper	2.245406	2.181019	1.03	-2.072495	6.563308
capital	3.574545	.262229	13.63***	3.055394	4.093697
credit	30.44551	20.87296	0.69	-39.40195	81.14788
percept	38.1054	29.94439	1.27	-21.17742	97.38822
source	-42.57851	31.53956	-1.35	-105.0194	19.86237
profit	61.17527	42.92564	1.43	-23.80735	146.1579
substit	.3033569	34.41408	0.01	-67.82839	68.43511
labor	14.34215	44.15202	0.32	-73.06842	101.7527
liabilty	-3.861273	29.33553	-0.13	-61.93869	54.21614
dist	-122.9145	34.74917	-3.54***	-191.7096	-54.11935
_cons	-172.0571	77.5389	-2.22**	-325.5658	-18.54841

Appendix table 2. Heteroskedasticity test

. hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
Ho: Constant variance
Variables: fitted values of maxwtp

chi2(**1**) = **24.67**
Prob > chi2 = **0.0000**

. imtest, white

White's test for Ho: homoskedasticity
against Ha: unrestricted heteroskedasticity

chi2(**121**) = **115.42**
Prob > chi2 = **0.3431**

Cameron and Trivedi's decomposition of IM-test

Source	chi2	df	p
Heteroskedasticity	115.42	110	0.3431
Skewness	5.89	14	0.9693
Kurtosis	3.94	1	0.0473
Total	125.24	125	0.4772

Appendix table 3. Multicollinearity test

. vif

Variable	VIF	1/VIF
Bid1	2.41	0.415530
Labor	1.94	0.515736
Capital	1.54	0.650426
Source	1.49	0.671739
Exper	1.43	0.698478
Credit	1.38	0.725636
Percept	1.36	0.732801
Liabilty	1.32	0.756813
Substit	1.30	0.767531
Profit	1.26	0.793761
Dist	1.23	0.810305
Family	1.16	0.859640
Sex	1.06	0.941223
Educate	1.04	0.964901
Mean VIF	**1.42**	

Source: Own computation, 2016

Appendix table 4. Correlation coefficient test result

. pwcorr wtp1 wtp2 bid1 bid2 sex educate family exper capital credit percept source profit substit labor liabilty dist, sig star(.10),(.05),(.01)

	wtp1	wtp2	bid1	bid2	sex	educate	family	exper	capital	credit
wtp1	1.0000									
wtp2	0.1115	1.0000								
bid1	0.5548***	0.3543***	1.0000							
bid2	0.7370***	0.2887***	0.9532***	1.0000						
sex	0.0549	-0.0048	-0.0093	0.0119	1.0000					
educate	0.1186	0.0158	0.0557	0.1112	-0.0030	1.0000				
family	0.0570	0.2659***	0.2585***	0.2055**	0.0430	-0.0657	1.0000			
exper	0.0833	0.1748**	0.2446***	0.2444***	0.0593	0.0527	0.1755**	1.0000		
capital	0.2178**	0.3239***	0.4348***	0.4307***	0.0243	0.0381	0.1679*	0.4330***	1.0000	
credit	0.0171	-0.1280	-0.1380	-0.1047	-0.1758**	-0.0006	-0.0122	-0.2716***	-0.1955**	1.0000
percept	0.1408	0.1636*	0.2474***	0.2546***	0.0555	0.0832	0.1975**	0.2040**	0.1351	0.0676
source	0.1704**	0.2039**	0.2666***	0.2418***	-0.0276	-0.0490	0.0475	0.0108	0.2246***	-0.3684***
profit	0.1933**	0.0619	0.2653***	0.2402***	-0.0183	0.0318	-0.0950	-0.1250	0.0451	0.0171
substit	0.1656*	0.0913	0.2767***	0.2722***	0.0110	-0.0275	-0.0394	0.0935	0.0989	-0.2904***
labor	0.3693***	0.3474***	0.6524***	0.6039***	-0.0740	0.0444	0.1599*	0.1567*	0.3006***	-0.1331
liabilty	0.2523***	-0.0160	0.2713***	0.3125***	0.0524	0.1387	0.0604	0.1155	0.0530	0.0915
dist	0.0825	-0.6961***	-0.2664***	-0.2092**	0.0070	0.0334	-0.1426*	-0.1677*	-0.2856***	0.1459*

	percept	source	profit	substit	labor	liabilty	dist
percept	1.0000						
source	-0.2020**	1.0000					
profit	-0.0394	0.1704**	1.0000				
substit	-0.0358	0.3693***	0.1656*	1.0000			
labor	0.0118	0.2909***	0.2020**	0.2569***	1.0000		
liabilty	0.3226***	-0.0477	0.2075**	-0.0159	0.2338***	1.0000	
dist	-0.1008	-0.1159	0.1375	-0.1568*	-0.2481***	0.0788	1.0000

Appendix table 5. Bivariate Probit (SUBVP) regression

. biprobit (wtp1 = bid1 sex educate family exper capital credit percept source profit substit labor liabilty dist) (wtp2 = bid2 sex educate family exper capital credit percept source profit substit labor liabilty dist), vce(robust)

Fitting comparison equation 1:

Iteration 0: log pseudolikelihood = **-51.240742**
Iteration 1: log pseudolikelihood = **-26.986656**
Iteration 2: log pseudolikelihood = **-22.967312**
Iteration 3: log pseudolikelihood = **-22.297422**
Iteration 4: log pseudolikelihood = **-21.890348**
Iteration 5: log pseudolikelihood = **-21.811342**
Iteration 6: log pseudolikelihood = **-21.811059**
Iteration 7: log pseudolikelihood = **-21.811059**

Fitting comparison equation 2:

Iteration 0: log pseudolikelihood = **-80.565977**
Iteration 1: log pseudolikelihood = **-36.781886**
Iteration 2: log pseudolikelihood = **-32.869082**
Iteration 3: log pseudolikelihood = **-32.431779**
Iteration 4: log pseudolikelihood = **-32.424396**
Iteration 5: log pseudolikelihood = **-32.424373**
Iteration 6: log pseudolikelihood = **-32.424373**

Comparison: log pseudolikelihood = **-54.235432**

Fitting full model:

Iteration 0: log pseudolikelihood = **-54.235432**
Iteration 1: log pseudolikelihood = **-53.24889**
Iteration 2: log pseudolikelihood = **-53.220755**
Iteration 3: log pseudolikelihood = **-53.220729**
Iteration 4: log pseudolikelihood = **-53.220729**

Seemingly unrelated Bivariate Probit	Number of obs	= **136**
	Wald chi2(**30**)	= **158.24**
Log pseudolikelihood = **-53.220729**	Prob > chi2	= **0.0000**

	Coef.	Robust Std.Err.	z	[95% Conf.	Interval]
wtp1					
bid1	.0155308	.0040287	3.86***	.0076347	.023427
sex	1.265881	.8416552	1.50	-.383733	2.915495
educate	.0003368	.0631942	0.01	-.1235216	.1241953
family	-.2424436	.2100829	-1.15	-.6541985	.1693113
exper	-.0442962	.0513016	-0.86	-.1448455	.0562531
capital	.0635211	.0358026	1.77*	-.0066507	.133693
credit	.5070471	.6576289	0.77	-.7818819	1.795976
percept	-.3731213	.5373337	-0.69	-1.426276	.6800335
source	-.226109	.5714701	-0.40	-1.34617	.8939518
profit	-1.062375	.648143	-1.64	-2.332712	.207962
substit	.8178079	.4507878	1.81*	-.0657199	1.701336
labor	-.5453542	.5572946	-0.98	-1.637632	.5469232
liabilty	.9123438	.576441	1.58	-.2174597	2.042147
dist	1.510435	.5411273	2.79***	.4498453	2.571025
_cons	-1.259591	1.446479	-0.87	-4.094638	1.575455
wtp2					
bid2	-.0031343	.0012364	-2.53**	-.0055576	-.000711
sex	-.1366071	.8379599	-0.16	-1.778978	1.505764
educate	.0552052	.0515441	1.07	-.0458193	.1562297
family	.6069212	.1743142	3.48***	.2652718	.9485707
exper	.0603807	.0444999	1.36	-.0268375	.147599
capital	.014132	.0068894	2.05**	.000629	.027635
credit	.3293276	.4438003	0.74	-.5405049	1.19916
percept	1.394343	.4938457	2.82***	.4264229	2.362262
source	1.1187	.4290575	2.61***	.2777631	1.959638
profit	2.115834	.632005	3.35***	.8771274	3.354541
substit	-1.004188	.5372044	-1.87*	-2.057089	.0487133
labor	1.099273	.538479	2.04**	.0438737	2.154673
liabilty	-.9318435	.4660016	-2.00**	-1.84519	-.0184971
dist	-3.415409	.4594528	-7.43***	-4.31592	-2.514898
_cons	-3.394791	1.250904	-2.71***	-5.846517	-.9430655
/athrho	**. 6251083**	**. 3063896**	**2.04****	**.0245957**	**1.225621**
rho	**. 5546747**	**. 2121245**	**2.61*****	**.0245908**	**.8413044**

Source: Own computation, 2016.

Appendix table 6. Marginal effects after biprobit result 1.

. mfx compute, at(mean wtp1=1, wtp2=1) predict(p11)

y = Pr(wtp1=1, wtp2=1) (predict)

= **0.91796366**

variable	dy/dx	Std. Err.	z	P>z	[95%	C.I.]	X
bid1	3.53e-07	.00000	0.16	0.870	-3.9e-06	4.6e-06	232.721
sex*	-.0222918	.14627	-0.15	0.879	-.308978	.264395	.102941
educate	.0083635	.00753	1.11	0.267	-.006394	.023121	10.6765
family	.0919425	.02931	3.14	0.002	.034495	.14939	3.90441
exper	.0091466	.00687	1.33	0.183	-.004328	.022621	11
capit	.0021424	.00089	2.41	0.016	.0004	.003885	43.7279
credit*	.0526568	.07469	0.71	0.481	-.093727	.19904	.610294
percept*	.1959029	.07048	2.78	0.005	.057771	.334035	.419118
source*	.152297	.05833	2.61	0.009	.037979	.266615	.397059
profit*	.628305	.19264	3.26	0.001	.250734	1.00588	.875
substit*	-.107138	.05188	-2.07	0.039	-.208819	-.005457	.772059
labor*	.2511164	.17839	1.41	0.159	-.098522	.600755	.801471
liabilty*	-.1341575	.06143	-2.18	0.029	-.254556	-.013759	.566176
dist	-.8885467	.06111	-14.54	0.000	-1.00832	-.768772	.205882
bid2	-.0004748	.00021	-2.26	0.024	-.000887	-.000063	445.632

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

Appendix table 7. Marginal effect after biprobit result 2.

. mfx compute, at(mean wtp1=1, wtp2=0) predict(p10)

y = Pr(wtp1=1, wtp2=0) (predict, p10)

= **0.08200302**

variable	dy/dx	Std. Err.	z	P>z	[95%	C.I.]	X
bid1	3.53e-07	.00000	0.16	0.870	-3.9e-06	4.6e-06	232.721
sex*	-.0222918	.14627	-0.15	0.879	-.308978	.264395	.102941
educate	.0083635	.00753	1.11	0.267	-.006394	.023121	10.6765
family	.0919425	.02931	3.14	0.002	.034495	.14939	3.90441
exper	.0091466	.00687	1.33	0.183	-.004328	.022621	11
capit	.0021424	.00089	2.41	0.016	.0004	.003885	43.7279
credit*	.0526568	.07469	0.71	0.481	-.093727	.19904	.610294
percept*	.1959029	.07048	2.78	0.005	.057771	.334035	.419118
source*	.152297	.05833	2.61	0.009	.037979	.266615	.397059
profit*	.628305	.19264	3.26	0.001	.250734	1.00588	.875
substit*	-.107138	.05188	-2.07	0.039	-.208819	-.005457	.772059
labor*	.2511164	.17839	1.41	0.159	-.098522	.600755	.801471
liabilty*	-.1341575	.06143	-2.18	0.029	-.254556	-.013759	.566176
dist	-.8885467	.06111	-14.54	0.000	-1.00832	-.768772	.205882
bid2	-.0004748	.00021	-2.26	0.024	-.000887	-.000063	445.632

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

Appendix table 8. Marginal effects after biprobit result 3.

. mfx compute, at(mean wtp1=0, wtp2=1) predict(p01)

y = Pr(wtp1=0, wtp2=1) (predict, p01)

= **0.000004337**

variable	dy/dx	Std. Err.	z	P>z	[95%	C.I.]	X
bid1	3.53e-07	.00000	0.16	0.870	-3.9e-06	4.6e-06	232.721
sex*	-.0222918	.14627	-0.15	0.879	-.308978	.264395	.102941
educate	.0083635	.00753	1.11	0.267	-.006394	.023121	10.6765
family	.0919425	.02931	3.14	0.002	.034495	.14939	3.90441
exper	.0091466	.00687	1.33	0.183	-.004328	.022621	11
capit	.0021424	.00089	2.41	0.016	.0004	.003885	43.7279
credit*	.0526568	.07469	0.71	0.481	-.093727	.19904	.610294
percept*	.1959029	.07048	2.78	0.005	.057771	.334035	.419118
source*	.152297	.05833	2.61	0.009	.037979	.266615	.397059
profit*	.628305	.19264	3.26	0.001	.250734	1.00588	.875
substit*	-.107138	.05188	-2.07	0.039	-.208819	-.005457	.772059
labor*	.2511164	.17839	1.41	0.159	-.098522	.600755	.801471
liabilty*	-.1341575	.06143	-2.18	0.029	-.254556	-.013759	.566176
dist	-.8885467	.06111	-14.54	0.000	-1.00832	-.768772	.205882
bid2	-.0004748	.00021	-2.26	0.024	-.000887	-.000063	445.632

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

Appendix table 9. Marginal effects after biprobit result 4.

. mfx compute, at(mean wtp1=0, wtp2=0) predict(p00)

y = Pr(wtp1=0, wtp2=0) (predict, p00)

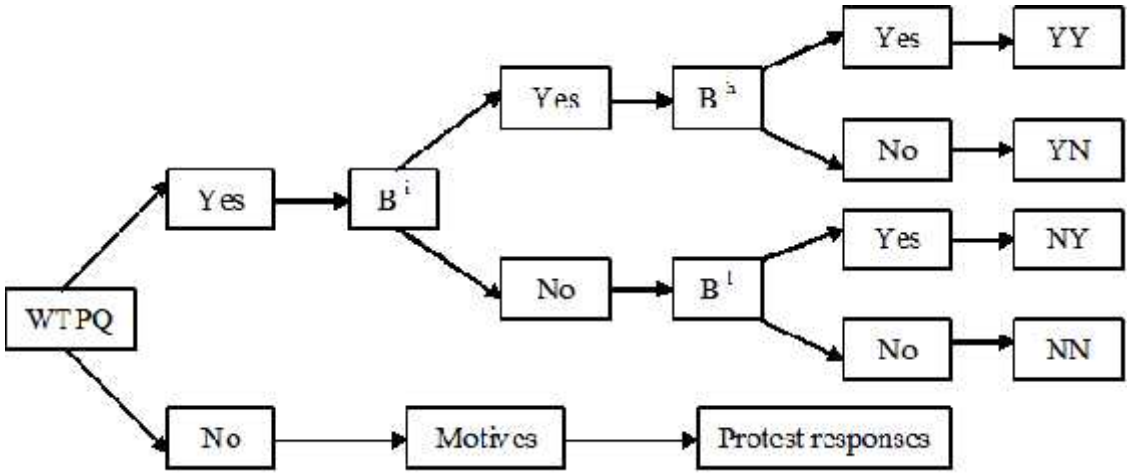
= **0.00002898**

variable	dy/dx	Std. Err.	z	P>z	[95%	C.I.]	X
bid1	3.53e-07	.00000	0.16	0.870	-3.9e-06	4.6e-06	232.721
sex*	-.0222918	.14627	-0.15	0.879	-.308978	.264395	.102941
educate	.0083635	.00753	1.11	0.267	-.006394	.023121	10.6765
family	.0919425	.02931	3.14	0.002	.034495	.14939	3.90441
exper	.0091466	.00687	1.33	0.183	-.004328	.022621	11
capit	.0021424	.00089	2.41	0.016	.0004	.003885	43.7279
credit*	.0526568	.07469	0.71	0.481	-.093727	.19904	.610294
percept*	.1959029	.07048	2.78	0.005	.057771	.334035	.419118
source*	.152297	.05833	2.61	0.009	.037979	.266615	.397059
profit*	.628305	.19264	3.26	0.001	.250734	1.00588	.875
substit*	-.107138	.05188	-2.07	0.039	-.208819	-.005457	.772059
labor*	.2511164	.17839	1.41	0.159	-.098522	.600755	.801471
liabilty*	-.1341575	.06143	-2.18	0.029	-.254556	-.013759	.566176
dist	-.8885467	.06111	-14.54	0.000	-1.00832	-.768772	.205882
bid2	-.0004748	.00021	-2.26	0.024	-.000887	-.000063	445.632

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

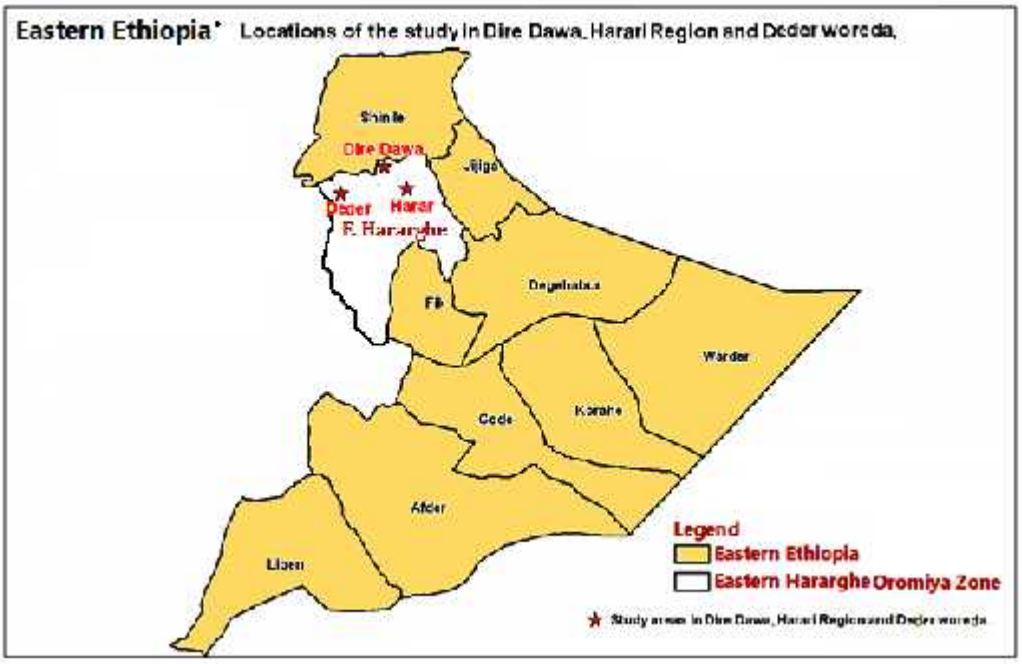
Appendix 2

Figures in Appendix



Appendix figure 1. DBDC Contingent valuation Responses

Source: Own design, 2016



Appendix figure 2. Location of the study areas in Eastern Ethiopia

Source: WFP-Ethiopia Vulnerability Assessment and Mapping (VAM) 2009 (WFP, 2009).

Appendix figure 3. Satellite Image of the Study Areas

Source: Us Department of State Geographer Image Landsat, © 2016 Google.

Appendix 3

Focus Group Discussions (FGDs) Questionnaire to determine initial bid

I. Introduction

We are conducting a study concerning the deforested softwood Pines trees resources plantation in Eastern Ethiopia, so that we could get some information which will help us for this research. Hence your opinion and perception will help us in this regard. Your answer will not be related to your name and any personal information so it is highly confidential. We only want to know your opinion so there is no right or wrong answer in this questionnaire. We would like to thank you in advance for your collaboration**.**

A. Characteristics of the Enterprise and Attitudinal Questions

1. Name of the Enterprise? _____
2. Name of the respondent? _____
3. Position in the Enterprise? _____
4. Experience: How many years you own or run in this enterprise? _____
5. Employee size: how many employee members do you have? _____
6. Registered capital in Birr? _____ in the year 2015.

B. Questions on softwood Pines tree resources.

7. Can you use Pines log or lumber for your production? _____ A) Yes B) No
8. If your answer for number ***7 is yes***, from where did you get? _____
9. How many years you have experiencing to use Pines log or lumber for your production?
10. Do you agree that softwood Pines tree logs is the most important wood resource for you and other Woodwork enterprises in your area? _____ A) Yes B) No C) I don't now
11. How is the current supply of softwood Pine tree logs specially in your enterprise area?
12. What is your comment on the past, present and future supply of Pines logs in your area?
13. What action should be taken to bring back the supply of Pines resources as previous?
14. Is rehabilitating of softwood Pines tree resources is important for you?__ A) Yes B) No
15. If your answer for number ***14 is yes***, How? _____ or ***if No,*** Why? _____

II. The Valuation Scenario

As you may notice that, if no action is taken to these softwood Pines tree resources that you use as an input in your organization will be destroyed completely within a few years; and this means that all the economic benefits obtained from these resources will be gone. In addition to this, sever environmental problems including desertification and environmental degradation will takes place. But you and other Woodwork enterprises have the opportunity to maintain the existing trees and establish new Pines tree plantations in Deder District *Karra Makkala* area forests in collaboration with the other Woodwork enterprises which wants to reforest these deforested softwood trees. If the forest is established you will be get an access to get this scarce resource in future. As a community you also get other social and environmental benefits from the establishment.

The following amounts in question number 16, shows different list of prices in Birr which sets for a one m^3 Pine log per year. The price you choose will be used to set the initial bid and it will be changed to a monthly payment in the survey questionnaire. So, that will going to be evaluated all the sample Woodwork enterprises in Eastern Ethiopia.

16. Which price you are willing to pay for one m^3 Pine log every year for ten years for the reforestation?

    A. 1200 B. 1500 C. 18000 D. 2400 E. 3000 F. 3600

17. If you increase your WTP; What is the maximum amount that you are willing to pay for the reforestation? _____ Birr.

Appendix 4

Survey questionnaire

A Contingent Valuation Study

Contingent Valuation Survey Questionnaire for Softwood Tree Reforestation in Eastern Ethiopia.

I. General and Socio-Economic Variables Information

1. Questionnaire number _____ Name of the enumerator _____

Signature _____ Date_____ Starting time_____ Supervisor _____

2. Research area: Region _____ Administrative Council _____ District _____

Kebele Administrative (KA) _____ Rural Town (RT) _____ Other _____

We are conducting a study in partial fulfillment of an MSc. thesis at Haramaya University concerning the deforested softwood tree resources plantation in Eastern Ethiopia. This questionnaire was developed to get some information which will help us for this research. Hence, your genuine opinion and perception will help us in this regard. Your answer will not be related to your name, enterprise and any personal information so it is highly confidential. We only want to know your opinion so there is no right or wrong answer in this questionnaire.

A. Characteristics of the Enterprise and Attitudinal Questions

1. Name of the Enterprise_____

2. Name of the respondent _____

3. Sex _____ 1. Male, 0. Female

4. Age _____ years

5. Marital status_____ 1. Married, 2. Single, 3. Divorced, 4. Widowed

6. Have you attended a formal schooling?_____ 1. Yes 0. No

7. ***If Yes in question 6***, please indicate your formal schooling _____ years.

8. Family size _____ in the year 2015.

9. Experience in running this enterprise _____ years.

10. How many employees do you have? _____ employees.

11. Capital of the enterprise in Birr? _____ in the year 2015.

B. Questions on Input and output of the Enterprise

12. Do you agree that softwood or Pines tree logs is the most important wood resource for you and other Woodwork enterprises in your area? ____ 1. Yes 0. No I don't now

13. Is Pines log and lumber is a main input for your production?_____ 1. Yes 0. No

14. ***If your answer in Question 13 is yes***, what are the major products you produced from these softwood Pines logs and lumber? List your answer on their priority:

    A) _____

    B) _____

    C) _____

    D) _____

15. Is that these softwood trees or Pines log and lumber economically contribute to your business? _____ 1. Yes 0. No

16. How many years you have experienced to use Pines log or lumber for your production? _____ years.

17. Do you substitute Pines by other inputs like MDF, *Ecalyptus* or *Cordiya Abisinica etc*.? _____ 1. Yes 0. No

18. ***If your answer in Question 17 is yes,*** Why you substitutes other inputs for Pines?

    _____

19. How is the current supply of softwood Pines tree log in your area?_____
    1. Sufficient 0. Scarce

20. If It is scarce, what action should be taken to bring back the supply of Pines resources as previous?_____

21. Do you have an awareness or perception of the reforestation program? ___1. Yes 0. No

22. ***If your answer in Question 21 is yes***, do you agree your perception makes you willing to pay for reforestation?___1. Strongly disagree 2. Disagree 3. Agree 4. Strongly agree

23. Nowadays, from where did you get softwood Pines resources? _____

24. Does the source include Deder district specifically *Karra Makkala* forests?_____
    1. Yes 0. No

25. What is your comment on the past, present and future supply of softwood tree Pines logs and lumber in your area?_____

26. Is your enterprise profitable in this business?___1. Yes 0. No Entrepreneurship

27. ***If your answer is yes for Q. 26***, what are the major reason for your enterprise profitability?_____
    1. Entrepreneurship skill 2. Free access to softwood log 3. Supply of Pines logs/ lumber

28. Do you have an access to take credit from government or private lenders? 1. Yes 0. No

II. The Valuation Scenario

As you may notice that, if no action is taken to these softwood tree resources that you use as a major input in your organization will be destroyed completely within a few years; and this means that all the economic benefits you said which you get from these trees will be gone. In addition to this sever environmental problems including desertification and environmental degradation will takes place. But you and other Woodwork enterprises has the opportunity to maintain the existing trees and establish new Pines tree plantations in Deder district *Karra Makkala* area forests (_____ km from this Enterprise).

"Consider the Region, Administrative council or District" in collaboration with the other Woodwork enterprises which wants to recover the deforested softwood trees to maintain the existing trees and also established a new tree plantation which would be controlled and managed by yourselves or with the help of government. If the forest is established you will be get an access to get this scarce resource in future. As a community you also get other benefits from the establishment.

Different prices in Birr listed in question number 31 shows a sets of prices for one m^3 Pine log divided for 12 months. The price you and other sample Woodwork enterprises choose will be used to undertake this study on selected regions and District in Eastern Ethiopia.

29. Are you willing to pay money per month for ten years to reforest these softwood trees?
_____ 1. Yes 0. No

30. ***If your answer for Q.29 is Yes please go to Q.31***, But ***If it is No,*** Why you are not willing to pay to reforest the deforested softwood trees? Tell me your reasons according to your priority:

A) _____

B) _____

C) _____

D) _____

E) _____

31. Please choose one of the following prices (75, 150, 225, 300) _____ are you willing to pay this amount every month for ten years to reforest these deforested softwood trees _____ 1.Yes 0. No

32. ***If your answer for Q.31 is Yes***, Would you like to pay___Birr? (*increased 2 times*).
1.Yes 0. No

33. ***If your answer for in Q.31 is No***, What about ____ Birr? (*decreased by half*).___1.Yes
0. No **Then ask:**

34. What is the maximum amount that you are willing to pay for the reforestation per year for ten years? _____ Birr.

35. ***If Yes in Q.32 and if the respondent willingness to pay in Q.32 is greater than maximum amount in Q.34***, **then ask:**

You said that you are willing to pay _____ Birr (***in Q.32***) but when I ask you your maximum willingness to pay you said _____ Birr (***in Q.34***) which is less than the amount you already agreed to pay previously why?

36. ***If No in Q.32 and If the respondent willingness to pay in Q.31 is greater than maximum amount in Q.34***,**then ask:**

You said that you are willing to pay_____ Birr (***in Q.31***) but when I ask you your maximum willingness to pay you said _____ Birr (***in Q.34***) which is less than the amount you already agreed to pay previously why? _____

37. ***If No in Q.32 and Yes in Q.33 and If the respondent willingness to pay in Q.33 is greater than in Q.34***, **then ask:**

You said that you are willing to pay_____ Birr (***in Q.33***) but when I ask you your maximum willingness to pay you said_____ Birr (***in Q.34***) which is less than the amount you already agreed to pay previously why?_____

38. Are you anticipated to use future supply of Pines logs from the deforested forests after the rehabilitation through private ownership for the resource? _____1.Yes 0. No
    Justify your answer _____

39. Besides their production purpose, do you have available labor for the reforestation program to enhances you willing to pay? _____1.Yes 0. No

40. ***If No in Q.38*** why? Justify your answer _____

41. Are you indebted under liability of any financial obligations to pay?_____1.Yes 0. No

42. ***If Yes in Q.41,*** is your liability to any financial obligations affects your WTP decision? _____1.Yes 0. No

43. ***If Yes in Q.42,*** how? Justify your answer _____

44. Is the distance from your enterprise to the deforested area in terms of time hour brings any difference on your willingness to pay decision? _____1.Yes 0. No

45. ***If your answer is Yes for Q.44,*** how this distance per hour affects your WTP decision? _____

46. Finally, what situations that makes you pay more for the reforestation program in general?
    A) _____
    B) _____
    C) _____
    D) _____
    E) _____

THANK YOU FOR YOUR COOPERATION!