Maximum Willingness to Pay and Minimum Compensation Demand for Natural Forest Protection in Dinh Hoa District, Northern Vietnam

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Declaration

I hereby declare, on oath, that I have written the present dissertation by my own and have not used other than the acknowledged resources and aids.

Hamburg, 03 December 2015

Thi Thanh Ha Nguyen

English review testimonial

I certify that the English of the dissertation

Maximum Willingness to Pay and Minimum Compensation Demand for Natural Forest Protection in Dinh Hoa District, Northern Vietnam

written by Thi Thanh Ha Nguyen was reviewed and is correct.

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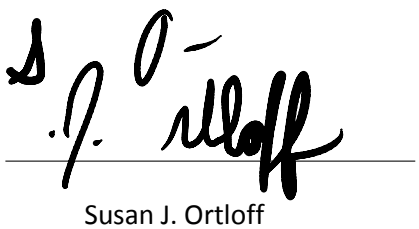

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Summary

Forests, like many other natural resources, provide a variety of ecosystem services such as watershed, habitats for plants and animals, carbon sequestration, landscape beauty, which are considered public goods. There is no cost to the public for these valuable ecosystem services. Ecosystem services users are free to enjoy their benefits and ecosystem services providers have no incentive to protect and maintain the continuous provision of ecosystem services. The market fails to value natural resources properly, and thus affects the sustainability of natural resources, particularly scarce resources. Contingent valuation method uses willingness to pay and willingness to accept as economic tools to address the market failures by providing financial incentives to sustain the provision of ecosystem services.

Direct payments to households and individuals, which are contracted natural forests for protection, have been implemented in Vietnam since 1998. However, the payment of VND 100,000 (US$ 4.8) per hectare per year is insufficient to fully compensate opportunity costs of forest protection and management, and thus does not motivate the participation of the local households. On the other hand, the Vietnamese government is limited in its payments for natural forest protection by other competing priorities. Now is the time to involve the voice and options of not only the individuals who depend on the forest for their livelihoods, but also the general public in the forest management. A clear understanding of public awareness and perception regarding natural forest protection and the diversification of financial resources to support these protection programs are necessary to ensure the sustainability of natural forest resources.

This study uses the contingent valuation method to evaluate the cost of natural forest protection, assess livelihoods of forest dependent households, and identify public perception regarding sustainable forest management in Vietnam. The study aims to determine the level of willingness to accept compensation by the local rural households that are contracted natural forests for protection, the willingness of local residents to pay for the protected forests, and the factors that influence the willingness to protect forests in a case study in Dinh Hoa district, Thai Nguyen province, northern Vietnam.

The results showed that rural households in Dinh Hoa district are poor and mainly rely on agricultural activities for self-consumption, i.e., most agricultural and forest products are used for subsistence purposes. Forest products such as fuelwood, timber, bamboo, and palm tree products are important to local household; their contribution to the total household income (21%) is significant. The acceptance of compensation level varies between the households contracted different types of forest. On average, willingness to accept is estimated to be VND 398,000 (US$ 19) per hectare per year, yielding a five-year natural forest protection in Dinh Hoa project costs of VND 18.7 billion (US$ 891,162). The estimated amount of compensation is nearly four times higher than the current payment level of the government for forest protection. The area of forest land that households hold, demographic characteristics (ethnic group), distance from homestead to the forest boundary, and types of forest products collected are the major influencing factors to willingness to accept.

The local residents are well aware of the importance of forests to their communities and perceive that the protection of natural forests is an efficient way to improve the quality of the environment. They are willing to pay VND 43,000 (US$ 2.1) per household as a one-time payment, which would raise a total fund of about VND 12.5 billion (US$ 593,810) for natural forests protection at a district scale. The willingness to pay is influenced by the level of payment, the public awareness of benefits provided by forests to communities, previous visits to the forest, and household income.

The study proved that willingness to pay and willingness to accept can be used as a proxy to identify economic incentives for local farmers to restore forest land and understand the underlying factors that influence the willingness to protect forest. The payment level estimated by this study is an empirical suggestion to amend the current payment policy to meet the local households' expectations and to encourage the involvement of the locals in the forest management in the local context in the tropics. The findings of this study support an increase in payment level for the provincial Forest Protection and Development Fund, Payments for Forest Environmental Services, and the United Nations Program on Reducing Emissions from Deforestation and Forest Degradation pilot projects which are currently being conducted in Vietnam.

Table of contents

Summary I

Table of contents III

List of tables VII

List of figures IX

List of appendices X

List of abbreviations XI

CHAPTER 1: INTRODUCTION 1

1.1. Statement of problem 1

1.2. Objectives 4

1.3. Method 5

1.4. Dissertation structure 5

CHAPTER 2: FOREST AND FOREST MANAGEMENT IN VIETNAM 7

2.1. Country profile 7

2.2. Forest resources 8

2.2.1. Forest cover 8

2.2.2. Forest ecosystem 10

2.2.3. Forest biodiversity 10

2.2.4. Timber and NTFPs harvesting, processing, and trade 11

2.3. Forest management 12

2.3.1. State management of forest resources 12

2.3.2. Forest policy reform 13

2.3.2.1. Rehabilitation programs 14

2.3.2.2. Sustainable management 16

2.3.2.3. Forest land allocation 17

2.3.2.4. Benefit sharing policy 19

CHAPTER 3: LITERATURE REVIEW 21

3.1. Payments for ecosystem services 21

3.1.1. The logic of payments for ecosystem services 21

3.1.2. PES definition 22
3.1.3. PES in the tropics 23
3.1.4. PES in Vietnam 24
3.2. Economic valuation of forest ecosystem 29
3.2.1. Reasons for valuation 29
3.2.2. The nature of economic valuation 29
3.3. Total economic value 30
3.4. Economic valuation techniques 32
3.4.1. Market valuation 33
3.4.1.1. Market price method 33
3.4.1.2. Production function method 34
3.4.2. Non-market valuation 34
3.4.2.1. Revealed preference method 34
3.4.2.2. Stated preference method 36
3.5. Contingent valuation method 38
3.5.1. Introduction 38
3.5.2. Definition of contingent valuation method 39
3.5.3. Theoretical background of the contingent valuation method 39
3.5.3.1. Demand curve and willingness to pay 39
3.5.3.2. Hicksian welfare measures 41
3.5.3.3. Willingness to pay or willingness to accept 44
3.5.4. Contingent valuation surveys in developing countries 45

CHAPTER 4: DATA AND METHODS 48
4.1. Study site 48
4.1.1. Thai Nguyen province 48
4.1.2. Dinh Hoa district 49
4.2. Sample size 51
4.2.1. WTP survey 52
4.2.2. WTA survey 54
4.3. Data collection 55
4.3.1. Survey methods 55
4.3.2. Secondary data collection 57
4.3.3. Focus group discussion 57

4.3.3.1. WTP survey 57
4.3.3.2. WTA survey 58
4.3.4. Pre-test 59
4.4. Questionnaire design 60
4.4.1. Double-bounded dichotomous choice approach 60
4.4.2. Questionnaire structure 64
4.4.2.1. WTP survey 64
4.4.2.2. WTA survey 66
4.5. Method 67
4.5.1. WTP model 67
4.5.1.1. Double-bounded logit model 67
4.5.1.2. Model specification 69
4.5.1.3. Variables definition 69
4.5.1.4. Mean and median WTP 72
4.5.1.5. WTP aggregation 73
4.5.2. WTA model 73
4.5.2.1. Double-bounded logit model 73
4.5.2.2. Model specification 75
4.5.2.3. Variables definition 75
4.5.2.4. Mean and median WTA 78
4.5.2.5. WTA aggregation 79
4.5.3. Goodness of fit 79

CHAPTER 5: RESULTS 81
5.1. WTP survey 81
5.1.1. Response rate, protest and zero responses 81
5.1.2. Socio-economic characteristics of respondents 82
5.1.3. Attitudes and preferences towards forest protection 86
5.1.4. Certainty of responses 91
5.1.5. Results of regression analysis 92
5.1.6. WTP curves 96
5.1.7. Mean and median WTP 97
5.1.8. Total WTP for natural forest protection in Dinh Hoa 98
5.2. WTA survey 99

5.2.1. Response rate and protest responses 99
5.2.2. Demographic and socio-economic characteristics 99
5.2.3. Forest situation and households´ perception towards forest protection 104
5.2.4. Certainty of responses 107
5.2.5. Results of regression analysis 107
5.2.6. WTA curves 112
5.2.7. Mean and median WTA 114
5.2.8. Costs of natural forest protection in Dinh Hoa 115

CHAPTER 6: DISCUSSION 116
6.1. Perception and attitudes of local residents towards natural forest protection 116
6.2. WTP and factors influence WTP 117
6.3. Livelihoods of forest dependent households 118
6.4. WTA and factors influence WTA 119
6.5. Costs of natural forest protection 120
6.6. Payment for forest protection and PFES 121
6.7. Payment for forest protection and REDD+ 122
6.8. Payment for forest protection and poverty alleviation 123
6.9. Payment for forest protection and equity 124
6.10. Payment for forest protection and local involvement in decision making 124
6.11. Conditional payment for forest protection 125
6.12. Payment for forest protection and capacity building and technical support 126

CHAPTER 7: CONCLUSION 127
References 130
Appendix 141
Publication 167

List of tables

Table 1: Major national forest policies related to forest policy reform since 1991 14
Table 2: Forest land allocation, from VFPD (2012) 19
Table 3: Payment level for PFES, from Pham et al. (2013) and Vietnam Government (2010) 26
Table 4: Welfare measures for an environmental gain and loss 43
Table 5: Forest area in Dinh Hoa district, from FIPI (2010) 51
Table 6: Distribution of sample in WTP survey 53
Table 7: Distribution of sample in WTA survey 55
Table 8: Bid design – WTP survey 63
Table 9: Bid design – WTA survey 64
Table 10: Definition of the variables influencing WTP 70
Table 11: Definition of the variables influencing WTA 76
Table 12: Reasons for zero responses 82
Table 13: Demographic and socio-economic characteristics of respondents 83
Table 14: Average household income and expenditure 85
Table 15: Awareness of respondents towards Dinh Hoa forest situation 90
Table 16: Respondents´ perspective on Dinh Hoa forest protection (%) 91
Table 17: Reasons for accepting to bids offered – WTP survey 92
Table 18: Parameter estimate – Phu Binh and Dinh Hoa districts (Model 1) 93
Table 19: Parameter estimate – Thai Nguyen city (Model 2) 94
Table 20: Parameter estimate – Total sample (Model 3) 95
Table 21: Proportion of acceptance to the first and the second bid offered (WTP) 96
Table 22: Mean and median WTP 98
Table 23: Demographic and socio-economic characteristics of forest contracted households 100
Table 24: Forest products collected 101
Table 25: Main cultivated crops 102
Table 26: Number of domestic livestock 102
Table 27: Household incomes, separated by forest types 103
Table 28: Appraisal of changes of forest related issues (%) 106
Table 29: Forest contracted households´perspective on Dinh Hoa forest protection (%) 107

Table 30: Reasons for accepting the bids offered – WTA survey 107
Table 31: Parameter estimates – Special-use forest (Model 4)..... 108
Table 32: Parameter estimates – Protection forest (Model 5)..... 109
Table 33: Parameter estimates – Production forest (Model 6)..... 110
Table 34: Parameter estimates – Total sample WTA (Model 7)..... 111
Table 35: Proportion of acceptance to the first and second bid offered (WTA) 112
Table 36: Mean and median WTA 114

List of figures

Figure 1: Map of Vietnam, adapted from FAO (2010) 7
Figure 2: Forest cover, adapted from FAO (2010) 9
Figure 3: Land cover map, from Qeiroz et al. (2013) 10
Figure 4: The logic of PES; adapted from Engel et al. (2008) and Pagiola and Platais (2007) 22
Figure 5: Total Economic Value framework, adapted from Mourato (2014) and Pagiola et al. (2004) 31
Figure 6: Economic valuation methods, adapted from Atkinson et al. (2012) and Garrod and Willis (1999) 33
Figure 7: Demand and willingness to pay, adapted from Bateman (2004) 40
Figure 8: Indifference curves and the budget constraint, from Sloman (2009) 41
Figure 9: Measure of change in human welfare, adapted from Bateman et al. (2002) 42
Figure 10: Map of forest types in Dinh Hoa district, adapted from FIPI (2010) 50
Figure 11: Sample site of WTP survey 53
Figure 12: Sample site of WTA survey 54
Figure 13: Double-bounded dichotomous format - WTP 62
Figure 14: Double-bounded dichotomous format - WTA 63
Figure 15: Distribution of household income and expenditure by selected income class 84
Figure 16: Ranking of general issues 87
Figure 17: Ranking of important environmental issues 88
Figure 18: Ranking of forest functions 89
Figure 19: Probability of WTP the bids offered 97
Figure 20: Distribution of household incomes 103
Figure 21: Three most important roles of forests to the communities in Dinh Hoa 105
Figure 22: Probability of WTA the bids offered 113
Figure 23: Total value WTA and WTP 121

List of appendices

Appendix 1: Important products and economic value of several priority species, from Luoma-aho (2004) 141
Appendix 2: Dinh Hoa forest allocation, from ATKFMB (2013) 142
Appendix 3: Structure of WTP focus group discussion 143
Appendix 4: Structure of WTA focus group discussion 144
Appendix 5: Questionnaire – WTP survey 145
Appendix 6: Questionnaire – WTA survey 153
Appendix 7: Percentage of saying “Yes/Yes”, “Yes/No”, “No/Yes”, “No/No” - WTP survey 166
Appendix 8: Percentage of saying “Yes/Yes”, “Yes/No”, “No/Yes”, “No/No” - WTA survey 166

List of abbreviations

5MHRP	5 Million Hectares Reforestation Program
AB	Averting Behavior
ASEAN	Association of Southeast Asian Nations
ATKFMB	ATK Dinh Hoa Forest Management Board
CAC	Command-and-Control
CBA	Cost-Benefit Analysis
CBFM	Community Based Forest Management
CEPF	Critical Ecosystem Partnership Fund
CF	Community Forestry
CIA	Central Intelligence Agency
CIFOR	Center for International Forestry Research
CM	Choice Modeling
CONAFOR	National Forestry Commission
CV	Compensation Variation
CVM	Contingent Valuation Method
DBDC	Double-Bounded Dichotomous Choice
DC	Dichotomous Choice
EEPSEA	Economy and Environment Program for Southeast Asia
ES	Ecosystem Services
EV	Equivalent Variation
FAO	Food and Agriculture Organization of the United Nations
FCPF	Forest Carbon Partnership Facility
FIPI	Forest Inventory and Planning Institute
FLA	Forest Land Allocation
FMB	Forest Management Board
FONAFIFO	National Forest Financing Fund
FPDF	Provincial Forest Protection and Development Fund
GDP	Gross Domestic Product
GIZ	German Agency for International Cooperation
GSO	General Statistics Office of Vietnam
ha	Hectare

HP	Hedonic Pricing
ICO	International Coffee Organization
IPC	International Pepper Community
ITC	International Trade Center
IUCN	International Union for Conservation of Nature
kg	Kilogram
km	Kilometer
MARD	Ministry of Agriculture and Rural Development
MA	Millennium Ecosystem Assessment
MOF	Ministry of Finance
MONRE	Ministry of Natural Resources and Environment
MP	Market Price
NGO	Non-Governmental Organization
NOAA	National Oceanic and Atmospheric Administration (US)
NTFPs	Non-Timber Forest Products
PES	Payments for Ecosystem Services
PF	Production Function
PFES	Payments for Forest Environmental Services
PPP	Purchasing Power Parity
Ramsar	The Ramsar Convention on Wetlands
REDD	Reducing Emissions from Deforestation and Forest Degradation
REDD+	Reducing Emissions from Deforestation and Forest Degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries
RP	Revealed Preference
R-PIN	Readiness Plan Idea Note
SBDC	Single-Bounded Dichotomous Choice
SFEs	State Forest Enterprises
SP	Stated Preference
TC	Travel Cost
TEV	Total Economic Value
TSO	Thai Nguyen Statistics Office
UN	United Nations

UNEP	United Nations Environmental Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNFPA	United Nations Population Fund
UN-REDD	United Nations Program on Reducing Emissions from Deforestation and Forest Degradation
US$	United States Dollar
VFPD	Vietnam Forest Protection Department
VND	Vietnam Dong
VNFF	Vietnam Forest Protection and Development Fund
WB	World Bank
WTA	Willingness To Accept
WTP	Willingness To Pay

CHAPTER 1: INTRODUCTION

1.1. Statement of problem

Forests, like many other natural resources, provide a variety of ecosystem services (ES) such as watershed, habitats for plants and animals, carbon sequestration, landscape beauty, which are considered public goods. There is no cost to the public for these valuable ES. ES users are free to enjoy their benefits and ES providers have no incentive to protect and maintain the continuous provision of ES. The market fails to value natural resources properly, and thus affects the sustainability of natural resources, particularly scarce resources.

Although the rate of deforestation slightly decreased in the 2000s compared to the 1990s, it is still alarming in many countries, especially in tropical regions where the loss of forest is the highest (Barbier, 2007; FAO, 2010). Urbanization, agricultural activities, logging, mining, and fires are judged the direct causes of deforestation (UNCCC, 2007). Subsistence and commercial agriculture are estimated to be the proximate drivers for approximately 80% of deforestation worldwide (Kissinger et al., 2012). Effects of tropical deforestation on climate change, biodiversity conservation, and environment have been a serious global concern since the early 1990s. It is widely accepted that decreasing tropical deforestation is the key and most cost effective way to fight against global warming.

Setting up protected areas such as national parks and reserves has been widely practiced in order to combat tropical deforestation and biodiversity loss since the 1990s. The area of forest where biodiversity conservation is designated as its primary function has increased by more than 95 million hectares (ha) since 1990 to 2010 (FAO, 2010). The increasing trend of the expansion of protected areas and ever growing demands for scarce land for subsistence agriculture to meet the requirements of food commodities and forest products for escalating populations and for commercial agriculture resulted in major conflicts in several parts of the world. In many areas, the livelihoods of the local and indigenous communities in the vicinity of the protected areas have been seriously affected (MA, 2005).

In order to balance individual well-being and habitat preservation and encourage the involvement of local people in protecting natural resources, Ferraro (2001) suggested direct payment as an effective way to compensate the cost of resource maintenance. The protection of natural forests will be effective if the compensated amount exceeds the costs of the natural forest protection incurred by the individuals or individual households (Engel et al., 2008; Pagiola et al., 2003). In other words, the payment, at minimum, should equal the opportunity costs of natural forest management. Payments for ecosystem services (also known as payments for environmental services or PES) are emerging as economic tools to provide income for landowners or farmers for management, conservation, protection, and restoration of natural resources (UNEP, 2008). These schemes provide incentives to improve environmental management and the livelihoods of landowners by rewarding people´s efforts of remaining and providing ES.

The dependency of the local and indigenous communities on forest resources for their livelihoods in developing countries has motivated policy makers to decentralize forest management to participating local communities (Pokharel et al., 2015). Community Based Forest Management (CBFM) systems are becoming popular in developing countries (Maraseni et al., 2014), however, the modalities of the CBFM differ from country to country. At least 22% of the total forest area is legally managed by the communities throughout the world (Nurse and Malla, 2005) and ownership and management of forests by communities, individuals, and private companies is on the rise (FAO, 2010). Community Forestry (CF), Forest Land Allocation (FLA) for reforestation purpose, and (natural) forest contracting to individuals and households for protection purpose are the major modalities of the CBFM widely practiced in Vietnam. In recent decades, the forest and forest land management schemes have been considerably successful and have been efficient in ensuring active involvement of forest user groups, individuals, and individual households from decision making to implementation of the schemes.

Located in Southeastern Asia, in 1943 Vietnam had a forest area of over 14 million ha, with a forest cover of 43% (Collins et al., 1991). Due to the excessive reliance on slash-and-burn agriculture, agriculture land expansion, logging whether legal or illegal, and non-timber forest products (NTFPs) collection for subsistence needs, forest area declined from 55% in the 1960s to 17% in the late 1980s. The massive deforestation in Vietnam was even judged to be the most rapid among Southeast Asian countries (Collins et al., 1991; Koninck, 1999). In an attempt to restore forest cover, reforestation programs such as “Program 327” and

"Five Million Hectares Reforestation Program" (5MHRP, also known as Program 661) were launched in the 1990s to improve environmental services, promote the role of the forest sector in overall economic growth, and secure the livelihoods of the most vulnerable groups (Sikor, 1998). In Vietnam, forest land belongs to the state. Since the 1990s, the right to use barren land and planted forests was transferred to rural households and individuals to manage and protect, while the natural forest was under the management of State Forest Enterprises (SFEs) and Forest Management Boards (FMBs). The surrounding villages and households were also allocated natural forests for protection in terms of contract and regularly paid by the government (Sikor, 1998). The use-rights and obligations of households vary depending which forest type they are contracted[1].

During the period from 1998 to 2006, the payment for natural forest protection was VND 50,000/ha/year (US$ 2.4)[2]. Although since 2007 the amount of payment increased to VND 100,000/ha/year (US$ 4.8), it is too low in terms of labor cost, and did not adequately compensate forgone alternative uses. The payment is equal to 1-2% of rural household incomes (Wunder, 2005a) and not attractive enough for the people to participate in the protection program in the long term.

The weak management system and the non-corporation of the local stakeholders are the main causes of deforestation and forest depletion in Vietnam. There is little evidence of administrative penalties or ownership withdraws for non-compliance with the forest protection contract (Wunder, 2005a). The lack of adequate and justifiable payment and unclear use rights might discourage the individuals and individual households to follow the contract for the long term. Meanwhile, conversion of the natural forests into monoculture plantations and to agricultural crop cultivation has been noticed in several places of northern Vietnam.

On the other hand, the Vietnamese government is limited in its payments for natural forest protection by other competing priorities. A clear understanding of public awareness and perception regarding natural forest protection and the diversification of financial resources

[1] Law on forest protection and development 2004 classified forest into three types: production, protection, and special-use (Vietnam National Assembly, 2004)

[2] US$ 1 ≈ VND 21,000

to support these protection programs are necessary to ensure the sustainability of natural forest resources.

The major questions are: how much the government should pay for forest protection to meet the local households' expectations; are individuals who benefit from the forest aware of the important role of forest´s ES and are they willing to pay for forest protection? Now is the time to involve the voice and options of not only the individuals who depend on the forest for their livelihoods, but also the general public in the forest management.

1.2. Objectives

The dissertation aims to evaluate the cost of natural forest protection in a case study carried out in Dinh Hoa district, northern Vietnam to provide possible suggestions for developing appropriate payment policy to encourage people to protect the natural forest in a local context.

The dissertation has the following objectives:

1) To assess the awareness and perception of residents in Thai Nguyen province towards natural forest protection;
2) To estimate the maximum willingness to pay (WTP) of residents in Thai Nguyen province for natural forest protection in Dinh Hoa district;
3) To identify the differences of payment levels between urban and rural residents;
4) To assess the livelihoods of rural households which are contracted and allocated natural forests for protection;
5) To estimate the minimum willingness to accept (WTA) compensation of rural households which are contracted and allocated natural forests for protection;
6) To identify the differences of payment levels expected by the households which are contracted and allocated different types of forests (special-use, protection and production forests);
7) To determine the factors that influence of the WTA and WTP for forest protection; and
8) To evaluate the cost needed for protecting Dinh Hoa forest.

1.3. Method

The contingent valuation method (CVM) has become the main tool used in cost-benefit appraisals and environmental impact assessments in environmental economics (Bateman et al., 2002; Mitchell and Carson, 1989; Pearce et al., 2006) in both developed (Pearce et al., 2006) and developing countries (Pearce et al., 2002). Established as a preference technique, contingent valuation is a survey or questionnaire–based approach to obtain the monetary valuation assignment on non-market goods and services under hypothetical markets described in the survey scenario. In developing countries, CVM is commonly applied in areas such as water supply and sanitation, recreation, tourism, national park management, and biodiversity conservation (Whittington, 1998). Whittington (2010) reports hundreds of stated preference studies successfully conducted in developing countries over the past two decades.

In this study, we performed two contingent valuation surveys: WTP and WTA survey, using a double-bounded dichotomous format, to debrief the local WTP and WTA the compensation for natural forest protection. A logit model was used to estimate the parameters of explanatory variables.

1.4. Dissertation structure

This dissertation consists of seven chapters.

Chapter 1 describes the statement of problem, the aims, and the structure of dissertation.

Chapter 2 introduces the local context of the study. The chapter summarizes the socio-economic characteristics of Vietnam and describes forest resources and forest management. In this chapter, the forest policy reform is mentioned, including the context of policy reform, forest rehabilitation programs, sustainable forest management, process of FLA, and the benefit sharing policy.

Chapter 3 provides the literature review of economic evaluation of forest ecosystem and application of CVM in environmental economics. This chapter analyses the rationale of payments for forest environmental services, explains the reasons for economic valuation, and provides economic valuation techniques including market and non-market valuation. The chapter then describes the CVM and its application in the environmental researches in

developing countries. The limitation of applying CVM in developing countries is carefully discussed.

Chapter 4 expresses the study design, data collection, and the methods. First, the chapter describes the characteristic and the rationale of choosing study sites. Second, the chapter interprets the steps and methods of collecting data. The survey methods and questionnaire design are thoroughly discussed. Third, the chapter explains the double-bounded logit models and defines the explanatory variables. Finally, the chapter interprets the parameter estimation of the mean and median values of WTP and WTA, and the method of aggregation of WTP and WTA.

Chapter 5 reports the results of the study. This chapter is divided into two parts: part one describes the results of WTP survey and part two reports on the WTA survey. Both parts provide the socio-economic characteristics of respondents, the attitudes and preferences towards forest protection, and the regression results. In the section covering regression results, the impacts of explanatory variables and the fit of models are described. The chapter presents the estimated mean and median values and the aggregation of WTP and WTA.

Chapter 6 discusses the findings of the study. This chapter discusses perception and attitudes of the local residents towards natural forest protection, the levels of WTP, and the factors influencing their WTP. The livelihoods of rural households which are contracted the allocated natural forest land for protection, their WTA compensation for natural forest protection, and the factors influencing their WTA are explained. The chapter discusses the findings in supporting the payment policy related to Payments for Forest Environmental Services (PFES), Reducing Emissions from Deforestation and Forest Degradation (REDD), poverty alleviation, equity, local involvement in decision-making, conditional payment, capacity building, and technical support.

Chapter 7 concludes the empirical findings of the study and possible implication of contingent valuation approach as an economic tool to provide incentives to the willingness to protect forests.

CHAPTER 2: FOREST AND FOREST MANAGEMENT IN VIETNAM

2.1. Country profile

Vietnam covers an area of approximately 33 million ha, including about 31 million ha of land area and about 2 million ha of inland water area (FAO, 2010). The S-shaped country extends from $23^{0}30'$N to $8^{0}30'$N, for more than 1,650 kilometers (km). Vietnam borders the Gulf of Thailand, Gulf of Tokin, as well as China, Laos, and Cambodia, and has a coastline of 3,444 km (MONRE, 2008). Hilly and mountainous areas account for three quarters of the country. The lowland areas are influenced by two major river deltas: the Red River in the north and the Mekong River in the south.

Figure 1: Map of Vietnam, adapted from FAO (2010)

The climate system combines tropical conditions in the south and monsoon seasons in the north (Collins et al., 1991; MONRE, 2008). There are two monsoon seasons: the north-easterly monsoon with a warm, dry season from October to March, and the south-westerly monsoons with a hot, rainy season from May to September. Annual average rainfall ranges from 1,300 mm to 3,200 mm (MARD, MOF & MONRE, 2003).

Vietnam has 64 provinces belonging to 8 regions, of which the Red River Delta in the north and the Mekong River Delta in the south are the most populous. 68% of the total population of 89 million people are rural (GSO, 2012). “Kinh” is the largest Vietnamese 10

ethnic group (86%) living mainly in cities, towns, and lowland centers, whereas the remaining 53 minority ethnic groups are dispersed across the remote mountainous regions and depend considerably on natural resources for livelihood (Qeiroz et al., 2013; UNFPA, 2011).

With a GDP of US$ 186 billion at current price, Vietnam is ranked the 55th economy in the world (WB, 2014). From 2000 to 2013, Vietnam showed a rapidly expanding growth with the annual GDP growth rate of approximately 7.5% (WB, 2014). In 2012, the GDP per capital was around US$ 1,700, up 25% compared to 2011 (WB, 2012b). Vietnam belongs to the lower-middle income group. In 2008, about 17% of the population lived on less than US$ 1.25 per day and approximately 43% on less than US$ 2 per day (WB, 2012b). As half of the poor are minority ethnic groups who live in rural, remote, and mountainous areas, the progress of poverty alleviation has slowed.

The agricultural sector, including agriculture, forestry, and fishing, accounted for 18% of GDP in 2012 (WB, 2012a), down from 40% in the early 1990s. Agriculture employed approximately 60% of the labor force and accounted for 30% of export values in 2005 (WB, 2012b). In recent years, Vietnamese agricultural products such as rice, coffee, black pepper, cashew, and tea have been among the top ten exporters in the world (FAO, 2013, 2015c; ICO, 2013; IPC, 2014; ITC, 2011). According to FAO (2014), Vietnam is the world´s 9th largest marine fisheries producer country, the world´s 15th largest inland fisheries producer country, and the world´s 4th largest exporter of fish and fishery products.

2.2. Forest resources

2.2.1. Forest cover

In 1943, the natural forest covered 14.12 million ha, or 43% of national land area. Forests were allocated mainly in mountainous and hilly areas. During the war period (1945-1975), 4 million ha of forests were damaged by bombardment and application of pesticides (Agent Orange) (Collins et al., 1991). After war period, Vietnam lost 300,000 ha/year between 1973 and 1985 (Sikor, 1998) and 100,000 ha/year between 1980 and 1990 (FAO, 2009). The massive deforestation in Vietnam was even the most rapid among Southeast Asian countries (Koninck, 1999). Forest loss after war period was mainly caused by the excessive reliance on slash-and-burn agriculture, the expansion of agricultural land, logging whether

legal or illegal, and NTFPs collection for subsistence needs (Collins et al., 1991; Koninck, 1999). In 1990, forest area decreased to 9.18 million ha, equivalent to 27% of total land area. The rich and medium levels of stocking were replaced by the secondary and degraded forests. The forest quality has consequently fallen in terms of biodiversity and ecological integrity.

Driven by the attempt to restore and rehabilitate forest land, reforestation programs such as Program 327 and Program 661 (or 5MHRP) were launched in the 1990s. Program 327 lasted from 1992 to 1998 focusing on the re-greening of barren land and hills, including the protection of existing forest areas, natural regeneration, and forest plantation. These objectives were continued under the 5MHRP program, which started in 1998 to obtain the target of increasing the nationwide forest coverage to 43% by 2010.

As a result of these programs, Vietnam gained approximately 13.8 million ha (44% of land area) of forest, leading to a 39.5% increase in coverage by 2010. Of this increase, about 10.4 million ha are naturally regenerated forest and 3.4 million ha are planted forest (To and Tran, 2014). Primary forest or rich forest remained on only 80,000 ha (FAO, 2010) (Figure 2).

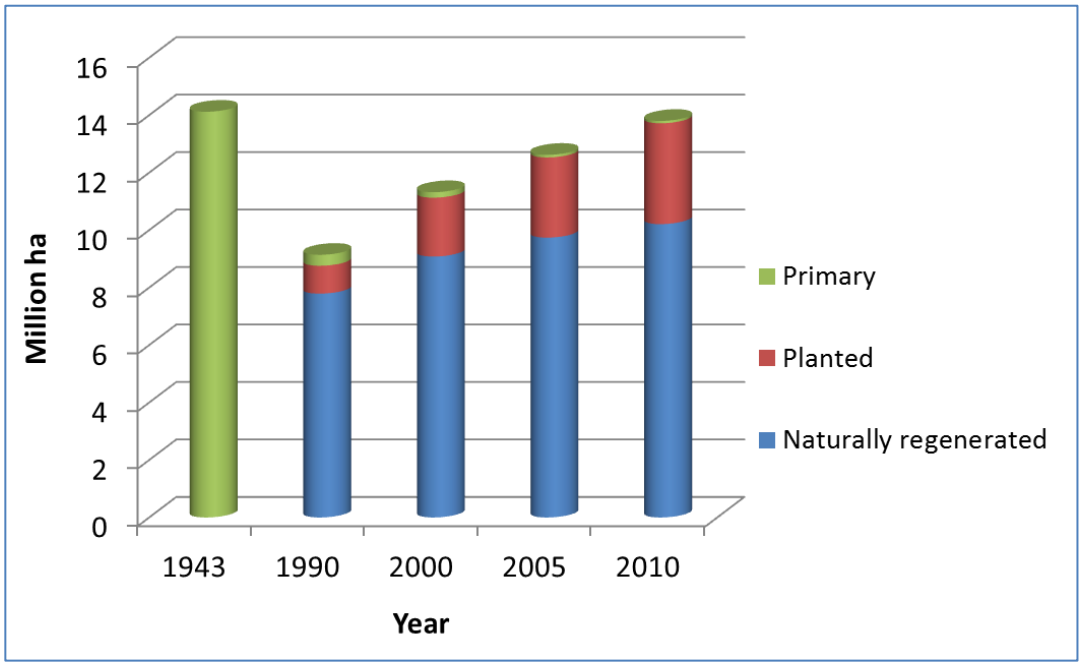


Figure 2: Forest cover, adapted from FAO (2010)

2.2.2. Forest ecosystem

Vietnam has a diversity of forest types due to the versatile topography and climate (Jong, 2006). Evergreen closed tropical rain forests, semi-deciduous closed tropical humid forests, evergreen broad leaved forests on limestone are founded mostly in the north and north central, while needle leaved forests are the natural vegetation of the upland in the north and Central Highlands. The Central Highlands is covered by dry dipterocarp forests. Mangrove forests grow in the provinces along the coast line and Melaleuca cajuput forests are found in the Mekong Delta region. Bamboo forests are common from the north to the central, Central Highlands, and the Southeast in Vietnam (UN-REDD, 2011).

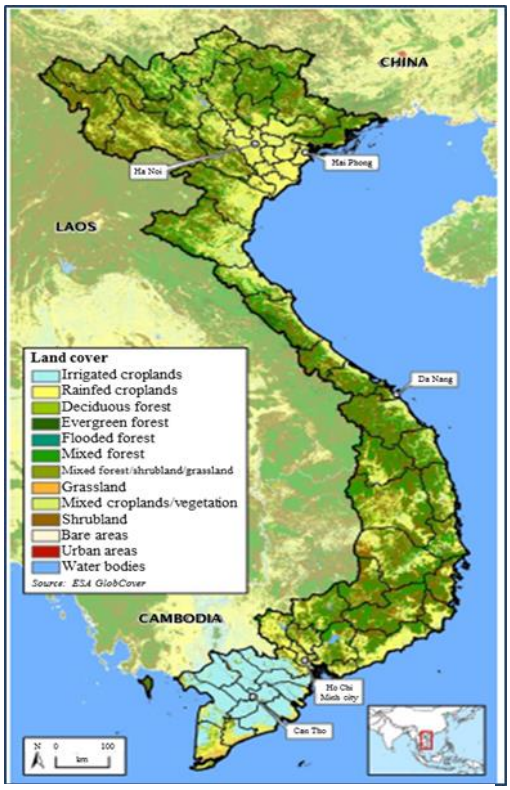


Figure 3: Land cover map, from Qeiroz et al. (2013)

2.2.3. Forest biodiversity

Vietnam is known as the world´s 16th richest in biodiversity (MARD, MOF & MONRE, 2003; Qeiroz et al., 2013). The country´s diverse topography, climate, and soil are considered the main causes for its variety in ecosystems and species.

Forests in Vietnam contain on estimate about 12,000 predicted plant species, of which over 7,000 species have been identified and around 2,300 are used by humans for food, medicines, and animal fodder (Collins et al., 1991). Many tree species have high economic value (Appendix 1). There are over 160 mammal species, 723 bird species, 180 reptile species, 80 amphibian species, and approximately hundred fish species (Collins et al., 1991). At least 10% of floral and faunal species are endemic to the country (Collins et al., 1991; Qeiroz et al., 2013). A pronounced loss of forest biodiversity along with the loss of forest area for several decades has been observed. Currently, 512 species are threatened, of which 61% are under the threat of extinction (IUCN, 2012). The main causes of the

biodiversity loss are hunting and trade in wildlife, habitat loss, degradation and fragmentation, climate change, logging, and unsustainable exploitation (CEPF, 2012).

In order to prevent biodiversity degradation, a system of 173 national protected areas has been established, covering around 2.5 million ha. The system includes 30 national parks, 58 national reserves, 11 species habitat conservation areas, 45 landscape protection areas, 20 experimental and scientific research areas, and 9 marine protected areas. In addition, there are three UNESCO Natural World Heritage Sites, eight UNESCO Biosphere Reserves, five Ramsar Wetlands, four ASEAN Heritage Parks, and 65 Important Bird Areas internationally recognized (Qeiroz et al., 2013).

The increase of forest cover in recent years is also seen as a promising step towards halting degradation and improving forest biodiversity. However, the promotion of planted forests and naturally regenerated forests for economic incentives is widely considered more attractive than biodiversity regeneration. Primary forest land continues to decrease and is subject to degradation. Poor management, unsystematic and inconsistent legislations, and limited community participation are also considered to contribute to the degradation of biodiversity in Vietnam (MONRE, 2008).

2.2.4. Timber and NTFPs harvesting, processing, and trade

The domestic and export demands for timber and NTFPs are rapidly increasing together with the rapid growth of Vietnam´s economy. By 2005, round wood harvested for pulp production, woodchips, composite boards, and other wood products for export and domestic use amounted to approximately 2.7 million m^3 with about 300,000 m^3 originating from natural forests (FAO, 2009). In 2014, plantation harvest volume was about 10.3 million m^3; no natural timber harvesting quota was provided (MARD, 2015)[3]. Timber products export turnover was US$ 6.3 billion by 2014, including about 4.5 million tons of furniture and about 6 million tons wood chip (MARD, 2015). Since 2010, Vietnam has become the main furniture exporter in Southeast Asia. Vietnam wood products have been

[3] Vietnamese government issued a logging ban in 1993 to halt the exploitation of natural forests throughout the country (To and Sikor, 2006) and issued annual quota for harvesting such as 620,000 m^3 in 1996, 522,700 m^3 in 1997, 300,000 m^3 in 1998, 160,000 m^3 in 1999, and 300,000 m^3 since 2000 (Durst et al., 2001).

exported to 120 international markets, of which the United States, Japan, China, EU, and South Korea are major export markets. In 2014, Vietnam spent US$ 2.5 billion on importing timber and timber products, mainly from Laos, the United States, Cambodia, China, and Malaysia (MARD, 2015). The annual domestic timber and timber products sales have been estimated around US$ 1 billion in recent years (To and Canby, 2011). Fuelwood harvest for rural areas has maintained at a level of 25-26 million m^3/year. The annual value of NTFPs exports was around US$ 200 million in the period of 2004-2005, including major products such as bamboo, rattan and rattan products, bee honey, cinnamon, attar, herb, medicine, resin, and natural chemicals (FAO, 2009).

In total, the forest sector in Vietnam contributes over 1% to the country´s GDP, excluding significant contributions of forest product processing industry, exports, and environmental values (FAO, 2009). According to official records, the wood processing industry supplies more than 300,000 jobs (To and Canby, 2011). Forest sector serves the subsistence needs of around 26 million people and contributes 10-15% of total incomes of forest households (FAO, 2009).

2.3. Forest management

2.3.1. State management of forest resources

Before the 1990s, forest land and forest products were considered national assets and were owned by the state. The state controlled forest resources under the management of SFEs, from managing, exploiting, processing, and distributing. These SFEs exploited forest resources as much as possible to meet the external forest products´ demand. The annual increment was far lower than the annual cut. According to Sikor (1998), the annual decrease of forest was about 300,000 ha. In addition, the lack of financial investments and the poor management structure restrained the forest management capacity. State forestry failed to manage forest resources in a sustainable manner and the SFEs, hence, were one of the major contributors to the serious forest decline in Vietnam (Jong, 2006).

The failure of the state-centralized control system further raised conflicts between local and state management. In this period of time, the concept of forest management implied the protection of forests from local dwellers (Nguyen, 2001). Only 1 of the 22 million people living in the mountainous regions adjacent to forests were employed by SFEs (Sikor,

1998). The remaining local population had to rely on other resources for their livelihoods and subsistence needs. Since forest policies were not seen to benefit their interests, it was impossible to get the local population to cooperate. Forests belonged to the state but were free for utilization by the locals. Timber and NTFPs became free commodities and forest clearing for cultivation went uncontrolled. Regardless of government attempts to regulate law enforcement and administrative punishment, forests were continuously depleted and degraded.

2.3.2. Forest policy reform

To diminish deforestation and rehabilitate forest resources, two national programs, Program 327 and Program 661, were launched. At the same time, a number of official regulations were issued (National Assembly laws, government decrees and decisions by the Prime Minister and official circulations). The major national forest policies are summarized in Table 1.

These policies concentrated on the following points:

- Forest rehabilitation;
- Sustainable management and utilization of forests;
- Development of social forestry with the participant of multi sectorial economics;
- Improvement in the rural livelihoods by benefit sharing mechanism.

Table 1: Major national forest policies related to forest policy reform since 1991

Year	Policy	Content
1991	Law on protection and development of forests	
1992	Decision 327/CT	Policies on the use of unoccupied land, "barren" hilly areas, forests, denuded, beaches and waterfront
1993	Land Law	
1994	Decree 02/CP	Regulations on forest land allocation to organizations, households, and individuals for long-term use and sustainable forestry development
1995	Decree 01/CP	Allocation and contracting of land for agriculture, forestry, and aquaculture production to state enterprises
1998	Decision 661/QD-TTg	Objectives, tasks, policies, and implementing organizations of 5MHRP
1999	Decree 163/1999/ND-CP	Allocation and lease of forest land to organizations, households, and individuals for long-term forestry purposes
	Circular 56/1999/TT-BNN	Guide developing of regulations on forest protection and development to villages/hamlets and communities
2001	Decision 08/2001/QD-TTg	Regulation on management rules of special-use forest, protection forest, and production forest.
	Decision 178/2001/QD-TTg	The rights and obligations of households and individuals allocated and contracted forest and forest land for benefit-sharing
2003	Land Law	Revise Land Law 1993
2004	Law on protection and development of forests	Revise Law on protection and development of forests 1991
2006	Decision 186/2006/QD-TTg	Promulgating the regulation of forest management
2007	Decision 100/QD-TTg	Revise Decision 661/QD-TTg

2.3.2.1. Rehabilitation programs

Program 327

Following the Chairman of the Minister Council´s Decision No 327-CT, dated September 9, 1992, the government established Program 327. This program lasted from 1993 to 1998, covering forestry, agriculture, aquaculture, and resettlement and new economic zones. In the forestry domain, the objective of this program was the re-greening of barren land and hills, including the protection of existing forest areas, natural forest regeneration, and forest protection. In 1994, focus turned to critical and slash-and-burn areas. In 1995, the

program concentrated on protecting forests and special-use forests from slash-and-burn practices. In the period from 1996 to 1998, the program paid attention solely to maintaining and expanding forest protection activity. In general, Program 327 had a strong focus on forest protection.

The program was successful in regenerating 299,000 ha and replanting 397,000 ha of forest. 1.6 million ha were contracted to 466,000 households for protection. In total, 6,791,700 ha of forests were protected (Jong, 2006). Forest cover increased from 27% to 33%. However, there were critical issues associated with this program. The program was too top-down driven with poorly planned and unpractically implemented practices (MARD, 2001). District authorities and SFEs used 50% of forest protection funds made available by Program 327 for inefficient and counterproductive measures (Sikor, 1998). New tree planting relied on a few fast-growing exotic species such as Eucalyptus, Caribbean pine, and Acacia instead of a slower process of assisted natural regeneration. It is widely accepted that in Vietnam, achieving a quick increase in forest cover through economic incentives was considered much more attractive than natural forest regeneration.

Program 661

Program 661, or 5MHRP, was approved by parliament in 1997 and by the Prime Minister under Decision No. 661/QD-TTg, dated July 29, 1998. The program was a continuation of Program 327 and lasted from 1998 to 2010. The objectives of 5MHRP were specified as follows:

- Establish five million ha of new forest (two million ha of special-use forest and protection forest and three million ha of production forest) along with the protection of existing forests, in order to increase forest cover to 43%; protect the environment; alleviate natural disasters; increase water availability; preserve gene resources; and protect biodiversity.

- Provide material for construction as well as raw material for the producing of paper, wood-based panels, NTFPs, and fuelwood, both for local consumption and export; develop the forest product processing industry; and make forestry an important economic sector, contributing to the improvement of the socio-economic situation in mountainous areas.

- Use open land and bare hills efficiently; create employment opportunities; contribute to alleviation of hunger and poverty reduction; support sedentary cultivation; create stable social conditions; and strengthen national defense and security.

After 12 years, 4.6 million ha of forest were planted. Forest cover increased to nearly 40% (MARD, 2010). The lack of funds, no interest of farmers in the rate of loan, and the insufficient land allocation were major obstacles of the program (Jong, 2006).

2.3.2.2. Sustainable management

The forest exploitation system was gradually replaced by a sustainable management system. The great concern for the protection of natural forest and reforestation was addressed in Program 327 and Program 661. Wood harvested from natural forests was limited to 300,000 m^3 per year instead of 1 million m^3 as before.

The Law on Forest Protection and Development issued in 1991, revised in 2004, classified forests in Vietnam into three categories addressing the major modes of utilization: protection forests, production forests, and special-use forests. The purpose of this classification was to strengthen the forest functions of production, protection of environment, and conservation of biodiversity (Do and Le, 2003).

- Protection forests are designated for the protection of soil and water, including headwater protection forests, wind and sand shielding protection forests, protection forests for tide shielding and sea encroachment prevention protection, and protection forests for environmental protection.

- Special-use forests are designated for the conservation of biological diversity, scientific research, historical and cultural relics, landscape, and services of recreation and tourism. National parks, nature conservation zones, landscape protection areas, and scientific research and experimental forests are included.

- Production forests are designated for the production of timber and NTFPs, including natural production forests, planted production forests, and seeding forests.

By 2010, the country´s forest resources consisted of 6.52 million ha of production forest, 5.1 million ha of protection forest, and 2.1 million ha of special-use forest (FAO, 2010).

The management of these three types of forests was established in the Regulation of the Management of Special-use, Protection and Production forest, pursuant to the Prime Minister's Decision 08/2001/QD-TTg. The benefit sharing policy (Decision No. 178/2001/QD-TTg, 2001) clarified the rights and obligations of allocated and contracted forest households along with each type of forest. These economic incentives ensured promoting the participation of the local population in sustainable forest management.

2.3.2.3. Forest land allocation

Households and individuals

To reduce deforestation and improve local livelihoods, the forest use rights were transferred from the state to local users, guided by Land Law in 1993. Households and individuals were identified as the basic management entities of forest and forest land (Sikor, 1998). Land belongs to the state, but the long term rights to use forests and forest land can be assigned to the locals. In the beginning, only barren land and planted forests were allocated to households and individuals for protection and management. SFEs remained the owners of natural forest and contracted the responsibility for forest management and protection to the farmers living adjacent to the forests (MOF, 1993).

When Program 327 was implemented, the patches of forest land allocated and contracted to households and individuals were very small. Each household or individual received on average five ha of forest land (Wunder, 2005a). The local people claimed that they were not clear about the boundaries of forest allocated and contracted; and they did not understand most of the policies (Haimo, 2010; Wunder, 2005a). Furthermore, Program 327 paid most attention to forest protection and ignored the benefit sharing mechanisms. The FLA process was slow and not very productive.

By 1999, FLA was expanded by Decision No. 187/1999/QD-TTg. SFEs handed forest land back to the districts which further allocated to households and individuals. Since 1999, households and individuals could get so-called Red Book Certificates (based on the red cover of the certificates) for the forests allocated to them. These certificates were valid for

50 years and were intended for renewal without land use change. The households and individuals holding a Red Book Certificate have the right to transfer, exchange, rent, inherit, mortgage, and contribute their land as capital for joint ventures with both domestic and foreign organizations. Recently, natural forests have also been allocated to households and individuals. Compared to households and individuals who are allocated barren land or planted forests, households and individuals who are allocated natural forests have fewer rights. They are not allowed to transfer, exchange, rent, inherit, mortgage, and contribute their land as capital. The right of harvesting forest resources is likewise limited, depending on the quality and protective function of the forests.

The maximum of forest land allocated to a household or an individual for a period of 50 years is 30 ha. On expiry of time-of-use, beneficiaries are allowed to extent the lease if they wish to continue to use the forest land, given that the forest was used properly. The state also contracts forest land to the households and individuals for long term development and protection. The period of contracts depends on the type of forests (specified in the contract).

State Forest Enterprises

According to Decree 200/2004/ND-CP, SFEs were restructured into two types:

- SFEs do their own business by self-finance and operate through market mechanisms became Forest Corporations;
- SFEs managing national parks and watersheds were converted to FMBs, financed by the state. These units can be run as profit making public services.

Depending on the type of forest, forest land was assigned to FMBs or households, individuals, and organizations.

- Special-use forests smaller than 1,000 ha were allocated to households, individuals, and organizations; forests equal or larger than 1,000 ha to FMBs.
- Protection forests smaller than 5,000 ha were allocated to households, individuals, organization; equal or larger than 5,000 ha to FMBs. A Forest

Protection unit would be set up in case protection forests are equal or larger than 20,000 ha.

- Production forest were allocated or leased to households, individuals, and organizations

The FLA realized by 2012 is summarized in Table 2.

Table 2: Forest land allocation, from VFPD (2012)

Forest user group	Million ha	%
State forest enterprises	1.97	15
Management Boards	4.52	33
Army	0.27	2
Households, individuals	3.51	26
Communities	0.30	2
Other organizations and economic entities	0.84	6
Commune People´s Committees	2.10	16
Total	13.51	100

2.3.2.4. Benefit sharing policy

Under Program 661, the Vietnamese government financed the protection and establishment of special-use and protection forests and supplied loans to production forests. From 1998, payment for forest management and protection was VND 50,000/ha/year (Vietnam Government, 1998) which increased to VND 100,000/ha/year from 2007 (Vietnam Government, 2007). Payment for zoning off for regeneration was similar, VND 100,000/ha/year.

The benefits and obligations of households and individuals who are assigned, leased, and contracted forests land for performing the tasks of managing, protecting, zoning off for regeneration, planting, and tending vary depending on the type of the forest (Vietnam Government, 2001). As this dissertation focuses on natural forests, the benefits and obligations of households and individuals assigned, leased, and contracted forests for planting and tending will not be discussed.

Special-use forest

Households and individuals assigned, leased, and contracted natural forests subject to

special-use forest planning are funded by the state for management, protection, and zoning off for regeneration. They are allowed to conduct scientific researches and cultural, social, and ecotourism activities.

Protection forest

Households and individuals assigned, leased, and contracted natural forests subject to protection forest planning are funded by the state for management, protection, and zoning off for regeneration. They are allowed to exploit NTFPs and dry, dead, and diseased trees. They can exploit 30% of total volume of bamboo when forest coverage reaches 80% of assigned land and 20% of timber volume by selective cutting when the forests are allowed for exploitation.

Production forest

Households and individuals assigned or leased natural forests subject to production forest planning are allowed to undertake agroforestry practice. They can inter-plant agricultural and pharmaceutical plants, graze cattle under the forest canopy, collect dead trees, and harvest forest products to meet their own consumption. They can exploit 10 m^3 of timber to build a new house. When forests are exploitable, they are allowed to enjoy 100% of timber removals if forests are depleted secondary forests, 70 to 80% if restored forests after milpa farming, and 2% each year if rich forest of more than 100 m^3/ha. With respect of bamboo forests, they can exploit 95% of forest products.

Households and individuals who are contracted natural production forests for protection are allowed to exploit secondary forest products, inter-plant agricultural plants, and graze cattle under the forest canopy. When forests are exploitable, they can use 1.5 to 2% of timber exploited for each contractual year.

Households and individuals who are contracted natural production forests for zoning off for regeneration are funded by the state. They have the similar benefits from forests as those who are contracted natural production forests for protection. If they make self-investment in zoning off for regeneration, they can use 2.5 to 3% of timber exploited for each contractual year.

CHAPTER 3: LITERATURE REVIEW

3.1. Payments for ecosystem services

3.1.1. The logic of payments for ecosystem services

PES has been used recently as an instrument to convert non-market values into economic incentives for local providers for the adoption of land use and management that support ES (Engel et al., 2008; Tacconi et al., 2010). Many ES benefits are not perceived by ecosystem managers, causing ecosystem mismanagement. The scope of PES implementation is to identify and correct this problem (Engel et al., 2007).

According to the MA (2005), ecosystems such as forests provide societies with a number of valuable ES. These are supporting services (providing habitats for wildlife), regulating services (storing carbon, regulating water quality, and preventing soil erosion), provisioning services (timber and NTFPs), and cultural services (forest recreation, education, and landscape). These services benefit people directly and indirectly. Many ES are public goods: they are non-excludable and non-rival in production. Non-excludable goods imply that the supplier cannot prevent people from consumption without payment and non-rival goods infer goods which can be consumed by more than one person at the same time (Bateman et al., 2002; Mitchell and Carson, 1989).

Under the pressure of fast growing populations, more and more forest land is being converted to other land use purposes (Wunder, 2005b). While some land users might get additional benefits from other alternative land uses, others might face adverse events. For example, for downstream populations, deforestation could induce the loss of ES such as water filtration and impose additional costs for them. The beneficiaries might want to compensate land users to secure the continuous provision of services, and land users can get income for their additional protection efforts. Engel et al. (2008) and Pagiola et al. (2003) argue that the payment for land users should exceed the benefit loss for alternative land use choice; otherwise they would not be willing to change their behavior. Conversely,

the payment needs to be less than the benefit for beneficiaries, as otherwise they would not be willing to pay. PES, thus, provides direct incentives for local actors to supply ES. The logic of PES is illustrated in Figure 4.

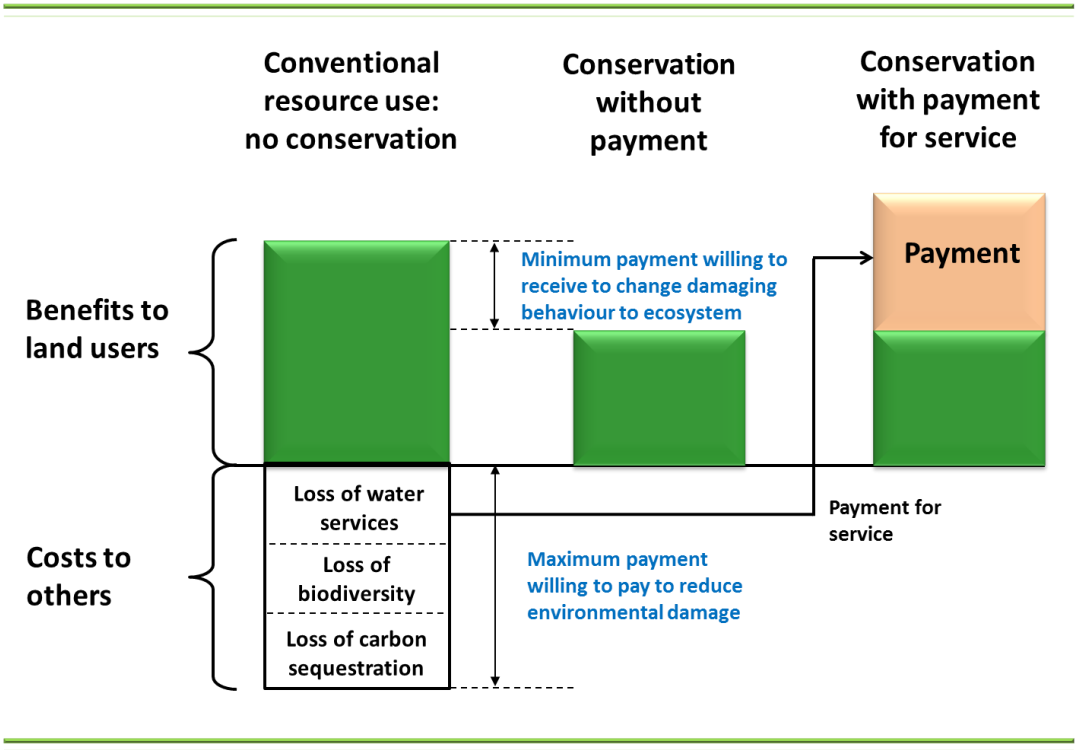


Figure 4: The logic of PES; adapted from Engel et al. (2008) and Pagiola and Platais (2007)

PES programs provide a valuable bridge between ES users and ES providers or winners and losers, which brings benefit to both and to the environment. Equitable compensation is an economic incentive, which is believed to be more efficient than the direct tool of a command-and-control (CAC) mechanism. Providers and users are more flexible because they have chances to negotiate and to reveal their choices and their voices. These reasons explain why PES programs receive much attention for nature conservation (Barrett et al., 2013).

3.1.2. PES definition

Wunder (2007) defines PES as "a voluntary transaction" where a "well-defined ES" is being "bought" by "an ES buyer" from "an ES provider" if and only if the "ES provider secures ES provision".

PES is a voluntary agreement, not a forced transaction between providers and buyers. Buyers are the actual users of ES who are clearly informed about the value of ES and obtain direct incentives to ensure the appropriate performance of the respective PES scheme. In many cases, buyers are the third parties such as governments, non-governmental organizations (NGO), or international agencies who represent service users. The crucial difference between direct users (user-financed) and indirect users (government-financed) is who has the decision power in negotiations of the payment (Engel et al., 2008). Sellers might be private land holders, local communities, and governments who have property rights or management rights for the land. Both providers and buyers reach consensus on the ES to be traded. For instance, downstream water users might want to pay upstream farmers for ordinary clean water. Carbon sequestration, landscape beauty, biodiversity, and watershed protection are the most typical environmental services being traded. A core principle is that the negotiations are conducted in a way that all parties involved will benefit. To ensure reliable and continuous payments, contract compliance is required.

3.1.3. PES in the tropics

PES has gained interest throughout the world, especially in Latin America (Pagiola et al., 2005). PES has been implemented in Latin America since the mid-1990s. The main ES that PES programs applied in these countries are water services, followed by biodiversity conservation, carbon sequestration, and landscape beauty conservation.

Costa Rica is a pioneer country in elaborating and implementing PES nationwide and one of the successful conservation stories in developing countries (Pagiola, 2007). PES was first introduced in 1996 under Forestry Law 7575 (Pagiola, 2007; Porras et al., 2013). All established forests were not allowed to be converted to other land uses; and any law incompliance would be punished by prison sentences. In addition, it offered the possibility to provide payment for new plantations, sustainable logging and natural forests conservation. Between 1997 to 2012, the PES scheme has protected 860,000 ha of forests, reforested an area of 60,000 ha, and supported the sustainable forest management of 30,000 ha of forests (Porras et al., 2013). Thanks to this program, forest cover increased from 21% in 1983 to 51% by 2010 (Porras et al., 2013). Other countries in South America developed PES focusing on conservation forests for water services in both nationwide and small scale cases, such as Mexico, Colombia, and El Salvador (Pagiola et al., 2005).

In Southeast Asia, PES has been implemented in Indonesia, Cambodia, and Vietnam at both regional and national level (Nguyen and Pham, 2014). Since 1990s, local water companies in Indonesia have paid farmers for protecting environmental services for the Cidanau rivers´ watershed. In Cambodia, the Seima Biodiversitz Conservation Area project has paid the locals to conserve bird´s nest of endangered species since 2002. In the Philippines, payment for watershed rehabilitation has been made since 1995 to support local farmers to reforest and apply sustainable agroforestry farming techniques. In Vietnam, a PES experimental study supported by the Economy and Environment Program for Southeast Asia (EEPSEA) was first adopted in the upland central region since 2003. Volunteer local farmers were paid for implementation of proposed forest management approach. From 2008 to 2010, PFES was introduced as a national scheme and was piloted in Lam Dong province in the Central Highlands and Son La province in the north.

Several challenges are obstacles that developing countries have to face when implementing PES. Wunder (2005a) presented several difficulties. Firstly, in some countries, land owned by the state, land held commonly, and without legal titles make negotiations and contracting more difficult and complicated. Secondly, cash is used as an incentive tool instead of tax relief due to the lack of effective taxation mechanism in developing countries, especially in remote mountainous areas. Thirdly, periodical payments are used rather than long term payments due to the weaknesses of law enforcement and monitoring systems. Last but not least, PES is minor and does not fully compensate costs of services management. The minor contribution of PES to total family´s income does not motivate the locals to take part in the protection program (Pagiola et al., 2005).

3.1.4. PES in Vietnam

Program 327 and Program 661 were two national programs for forest rehabilitation in Vietnam having aspects relating to the concept of PES. Under these programs, cash was used as an economic incentive for reforestation and forest protection. Households, individuals, villages and communities living adjacent to forests were paid directly through rehabilitation or protection contracts. Pham et al. (2013) and Wunder (2005a) argued that PES in Vietnam was in the strict sense because of the lack of a real land use choice, seldom fulfilled conditionality, and too little money involved. According to Sikor (1998), only barren land and non-forest land were allocated to households for reforestation. In other words,

these forest lands were critical for providing ES. Fast-growing species such as Acacia and Eucalyptus were commonly planted for rapid achievements of the government´s forest cover target and for timber production purpose. Hence, economic incentives might be more attractive than ES motives that limit the land use choices. Households and individuals living adjacent to natural forests were contracted to protect existing forests and received regular payments by the government. The levels of payments to individuals were low and used as a CAC instrument rather than economic incentives to compensate the opportunity costs of alternative land use choices. Wunder (2005a) also indicated that there were seldom punishments or land use right withdrawal in case of non-compliance with contracts.

In 2003, a project relating to PES concept was carried out in two years in Thua Thien Hue, central Vietnam. In this project, farmers, who manage production forests, were paid for afforestation and reforestation in a sustainable way to eliminate soil erosion, biodiversity conservation, and increase carbon sequestration. The payment levels were based on farmers' wishes, so-called willing-ness-to-accept prices. In total, 134 ha of production forest under 85 contracts were involved (Nguyen and Pham, 2014). There are several constraints that remained in this project. Firstly, production forests allocated to households, individuals, and village communities are possible to apply the PES concept while special-use and protection forests owned by the state are more complicated to implement PES because of the property rights. Secondly, production forests are managed for economic purposes rather than ES motives. Therefore, policy makers seem to pay less attention to ES and might be not interested in PES. Thirdly, as the average forest land per household is very small, and forest areas spatially scattered, practical implementation and monitoring are difficult.

The foundation of a nationwide PES program was firstly included in the revised Law of Forest Protection and Development in 2004. In 2008, a pilot program for PFES was carried out pursuant to Decree 380/QD-TTg, following by five documents that provided legal guidance on the establishment, organization, and management of Vietnam Forest Protection and Development Fund (VNFF) at national level and provincial Forest Protection and Development Fund (FPDF) at province level. Further general guidance on implementing was provided by 11 additional documents (Pham et al., 2013). Lam Dong province in the Central Highlands and Son La province in the Northwest were involved in a pilot phase. In 2010, Decree 99/201/ND-CP provided the legal framework for provinces to implementation

of PFES nationwide. In provinces where PFES was implemented, companies active in the water, hydropower, and tourism sectors were required to pay a payment level, which was set by government (Table 3). PFES covered all three forest utilization categories, i.e. production, protection, and special-use.

Table 3: Payment level for PFES, from Pham et al. (2013) and Vietnam Government (2010)

Forest environmental services	Service Users	Payment level
1/ Protection and prevention of soil erosion and sedimentation in reservoirs, rivers, and stream beds; regulating and maintaining water resources	Hydropower companies Clean water companies	VND 20/kWh (US$ 0.001) VND 40/m^3 (US$ 0.002)
2/ Protection of natural landscape and conservation of biodiversity	Tourism companies	1-2% of profits
3/ Forest carbon sequestration and retention, reduction of greenhouse gas emissions through prevention of forest degradation and loss, and forest sustainable development (carbon sequestration)	To be decided	To be decided
4/ Provision of spawning grounds, sources of feeds and natural seeds, and use of water from forest for aquaculture	To be decided	To be decided

At the end of 2012, 27 out of the 63 provinces in the country established and managed provincial FPDF. In the period from 2009 to 2012, the total PFES revenue was VND 1,782 billion, equivalent to US$ 85 million. This revenue included 98% from hydropower companies, nearly 2% from clean water companies, and 0.1% from tourism companies.

Several studies on the implementation of PFES were conducted in Vietnam by Dam et al., (2014), Hess and To (2010), Hoang et al. (2008), Kolinjivadi and Sunderland (2012), McElwee (2012), Nguyen (2011), Nguyen and Pham (2014), Nguyen (2013), Pham et al. (2013), To et al. (2012), and To and Laslo (2009). Several lessons were identified:

- Only payments from hydropower and clean water companies are implemented. Tourism companies do not fully appreciate the payments for protection of natural landscape and conservation of biodiversity, and their willingness to pay increases when higher revenues are realized.

- Clear guidance for forest carbon sequestration, spawning and aquaculture services is lacking. With the support of the United Nations Program on Reducing Emissions from Deforestation and Forest Degradation (UN-REDD), Vietnam completed the first phase of REDD+ and moved to the second phase (2013-2016). An appropriate payment scheme for carbon sequestration will be tested in order to develop a payment framework for this service. Policies for payment for spawning and aquaculture services have being evaluated under the support of the German Agency for International Cooperation (GIZ), the International Union for Conservation of Nature (IUCN) and the Center for International Forestry Research (CIFOR).

- The level of payments to forest protectors is low and insufficient for compensating the opportunity costs of foregone benefits, such as forests conversion to crop fields. Hence, the local population is not much interested in this program.

- Transaction costs are high due to the complicated administration system from nation, provinces, districts, communes to villages and the large number of forest owners (scattered and small forest area per owner). The low disbursement due to slow processes of FLA, weak technical and financial capacity at both central and local levels, and weak coordination among agencies also contribute to high transaction costs.

- PFES in Vietnam differs from the classic concept of PES because the level of payment is fixed by the government rather than the result of a voluntary transaction between providers and buyers. In addition, buyers and suppliers are not well defined. In Decree 99, buyers are hydropower and clean water companies. They receive benefits from forest protection but instead of paying for these benefits as a cost of their business activities, they simply pass PFES to their customers, who are not aware of the source of the additional costs. Tourism companies and tourism organizations show the same behavior: they act as brokers rather than buyers and derive benefits from selling tourism services but keep 10% of PFES for management costs when they contract to households, individuals, and village communities for forest protection.

- For the reason that the state owns natural forests, contracted households and village communities do not participate in the decisions of PFES agreement and thus, are not encouraged in forest protection.

- Guidelines on monitoring and evaluation of contract compliance are not well prepared. Lack of baseline data and quantity records, the monitoring system cannot provide proper evidences of environmental services supply.

The discussion whether PFES in Vietnam is truly PES or not is not the main conversation of policy options. The advantage of PEFS program in Vietnam is the establishment of legal frameworks and institutions at national and provincial levels, which support for PFES and REDD+ scheme. Enhancing and strengthening governance as well as the effectiveness, efficiency, and the possibilities for the implementation of PFES schemes in Vietnam is an iterative process that needs to include the local level. In the period 2013-2016, the "National Forest Inventory Program period 2013-2016" is being implemented to support PFES payments.

In addition, Vietnam was one among a limited number of countries identified for country programming under the UN-REDD Program and was the first country approved for a Readiness Project Identification Note (R-PIN) under the WB´s Forest Carbon Partnership Facility (FCPF). These programs received the consensus of Vietnam government, the UN-REDD National Program, and the WB. Since 2009, many activities have been implemented in Vietnam to support the country to get ready for the future REDD+ mechanism (UN-REDD, 2009). One of three components of the UN-REDD program in Vietnam was to improve capacity to manage REDD and provide other PES at district level through sustainable development planning and implementation. Therefore, the REDD+ fund payment for carbon sequestration was established as a sub-fund of FPDF and provided by other countries, organizations, and individuals. In order to prepare decisions on the management of the REDD+ Fund as well as the acquisition and allocation of payments for carbon sequestration, numerous of policies will be pilot implemented in the next few years.

3.2. Economic valuation of forest ecosystem

3.2.1. Reasons for valuation

Economic valuation of forest ecosystems focuses on the understanding of their contribution to economy and society. For example, Bateman et al. (2011) calculates the contribution of outdoor recreational visits to be about £10 billion in the United Kingdom. Gallai et al. (2009) estimates the global contribution of insect pollination of crops to amount to US$ 190 billion in 2005. Economic valuation of forest ecosystem studies quantify the benefits and costs of changing ecosystem management (conservation investment, development project, and incentive), provide insight in the economic feasibility and financial sustainable of related benefits induced by a change in ecosystem, and support decisions on the optimization of conservation activities (Pagiola et al., 2004). Broadly, results of environmental valuation can be used to support sustainable management of natural resources (Barbier et al., 1997; Brander et al., 2007; Sterner, 2003).

3.2.2. The nature of economic valuation

Environmental changes obviously cause changes in human well-being. While natural scientists try to assess environment changes in physical units, economists are concerned about the level of human well-being in society changes (Mourato, 2014). In environmental economics, these changes are measured through cost-benefit analysis (CBA), comparing benefits of environmental changes to costs and other social impacts (Nyborg, 2014). Anything that increases human well-being is defined as benefit and anything decreases human well-being, conversely, is identified as cost**.**

In economic theory, the measurement of benefits and costs is explained by individuals´ preferences or individuals‘ choices on decision making (Bateman et al., 2002). The notion of trade-off is the basic concept of economic valuation (Swanson, 2002). Individuals gain benefits equivalent to something else they give up to get it. Therefore, to evaluate how large a benefit they receive, we measure how much they are willing to forgo to get it. On the contrary, individuals give up something if they receive compensation for the cost incurred. Hence, to measure the cost incurred, we evaluate how much they are willing to accept.

The benefit and cost measurement are emphasized by the concepts of economic efficiency or Pareto efficiency. An economic situation has Pareto efficiency when the circumstances of one individual cannot be improved without making the situation worse for another. In a competitive economy, resources are allocated in such a way that no further gain of economic efficiencies is possible. Any change in resources allocation would increase economic efficiency when the sum of benefits of the gainers is larger than the sum of costs of the losers. The Pareto efficiency improvement is expressed as

$$\sum_{i=1}^{n}(B_i - C_i) > 0$$

where B_i is benefit and C_i is cost of change in resources allocation.

Pareto efficiency is the final optimum solution beyond which any change would directly lead to a loss in resources allocation. Evidence shows that some people are always worse off after economic transactions because of lacking compensation payment (Sloman and Wride, 2009). As any policy and project includes losers and gainers (Lienhoop, 2004), the effect of actions on society and other people when an individual maximizes his benefits has to be taken into consideration (Bateman et al., 2002).

Economic evaluation of benefits and costs is commonly measured and expressed in terms of monetary units. When evaluating forest resources, economists use the Total Economic Value (TEV) approach as a framework.

3.3. Total economic value

Economists classify economic values of forests according to the way they are used. TEV framework includes two main components: use values and non-use values (Figure 5).

Use values are related to direct, indirect, or future uses of forest resources.

- Direct use values refer to goods and services directly consumed, such as timber, fuelwood, NTFPs, medicines, decorative plants, recreation, hunting, or grazing.

- Indirect use values related to benefits from ES such as nutrient cycling, soil conservation, carbon sequestration, watershed protection, and flood prevention.

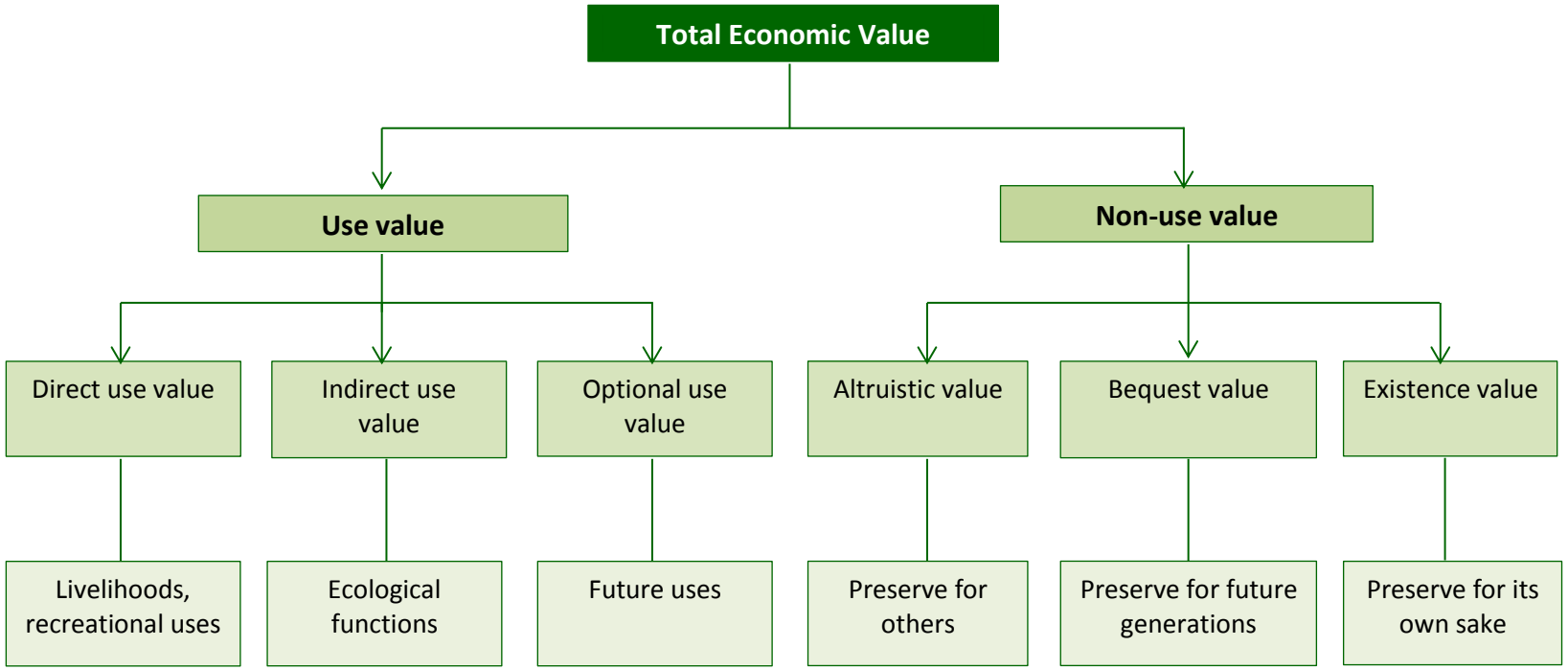


Figure 5: Total Economic Value framework, adapted from Mourato (2014) and Pagiola et al. (2004)

- Option value is generated from maintaining options for either direct or indirect consumption of commodities in the future even though it may currently not be used. For example, an individual is willing to pay for preserving a natural area for his visiting in the future.

Non-use or "passive use" values are values of forest resources that are currently not being used or consumed. Non-use values include altruistic values, bequest values, and existence values

- Altruistic value is the value an individual assigns to others for using or enjoying ES without relation to his own benefit.

- Bequest value is generated from the conservation of consumption opportunities for future generations. Hence, there is the WTP for the conservation of the environment for future generations.

- Existence value is generated from preserving the existence of biological resources for their own sake, even though individuals may never use it. Biodiversity, landscape, environmental condition affecting species habitats, and carbon storage are examples of existence values.

Measuring direct values is usually easier than indirect values because the quantity of goods can be measured and a market price is available (Pagiola et al., 2004). Indirect use values are more difficult to be assessed than direct use values as they involve complicated and complex assessments, such as the amount of carbon stored in biomass. Non-use values are significant to human well-being, as they relate directly to people´s behavior to contribute to the ecosystem conservation. But the "market" and "market price" for these environmental goods and services are not always available, and thus, the valuation of non-use values is difficult and complicated and renders non-market valuation methods necessary.

3.4. Economic valuation techniques

There are several studies thoroughly review economic valuation methods (Champ et al., 2003; Champ, 2003; Freeman et al., 2014; Hanley and Barbier, 2009; Pearce et al., 2006) as well as the application of those methods to ES (Bateman et al., 2011; Kareiva et al., 2011;

Pascal et al., 2010b). Figure 6 provides key methods of economic valuation applied to forest ecosystem valuation. If markets exist, market price (MP) and production function (PF) approaches are applied, otherwise non-market valuation techniques: revealed preference (RP) methods and stated preference (SP) methods are called for.

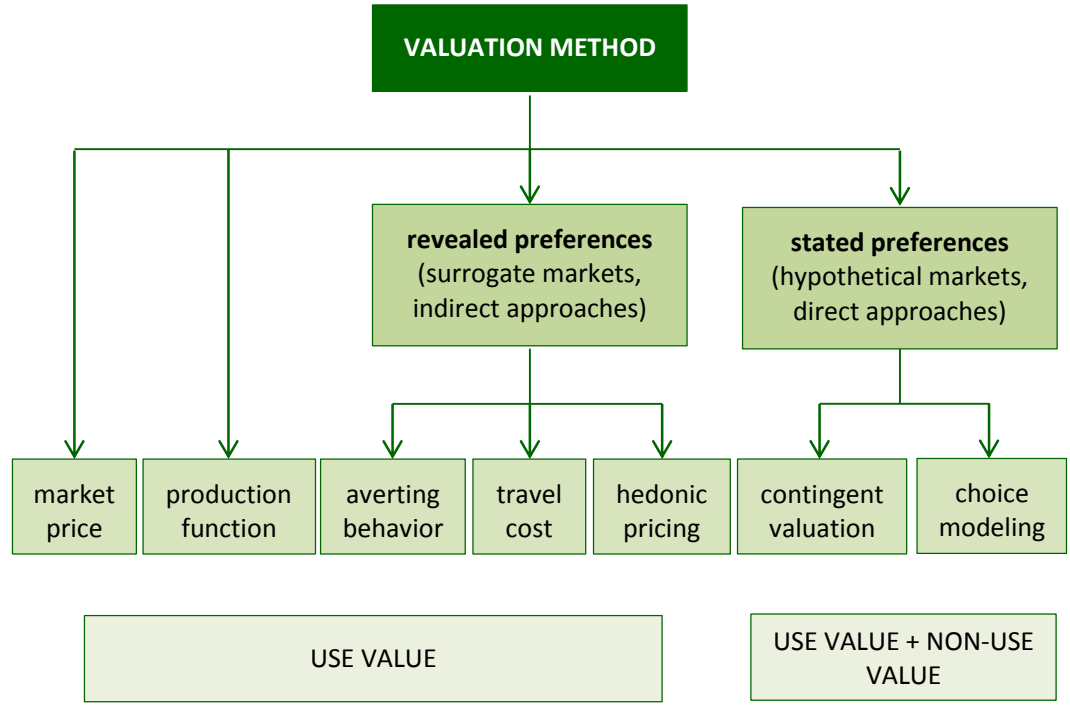


Figure 6: Economic valuation methods, adapted from Atkinson et al. (2012) and Garrod and Willis (1999)

3.4.1. Market valuation

3.4.1.1. Market price method

As markets exist, MP method is implemented to estimate the economic value of ecosystem products and services which are bought and sold in commercial markets. MP is the standard economic theory applied for any economic transaction, which ecosystem goods and services are not exclusive, but under natural sciences perspectives (Barbier, 2007; Heal, 2007; MA, 2005; Pagiola et al., 2004). When markets exist but are imperfect, adjusted market price is used for any distortion such as taxes, subsidies, and non-competitive practices (Atkinson et al., 2012; Mourato, 2014). MP method reflects an individual's WTP

for costs and benefits of goods and services that are bought and sold in the markets such as timber and NTFPs. MP method requires data to estimate consumer surplus and producer surplus. Consumer surplus estimation requires time series data on the quantity at different prices that might be affected by income and demographic and producer surplus estimation needs data reflects costs and revenues of goods and services. However, market data might be available for limited goods and services of natural resources and might not provide proper value of direct use services. Mostly, this method is applied to direct use values.

3.4.1.2. Production function method

The PF method is applied for any impact of changes in ES (as input) through the effects on the output of a marketed good (Atkinson et al., 2012; Mourato, 2014). For example, water quality affects the productivity of irrigated agricultural crops. Thus, increased revenue from greater agricultural productivity will be valued as result of water quality improvement. One limitation of PF method is the lack of data on change in services and the consequent impacts. Even though data are available, it is complicated and difficult to identify (Pagiola et al., 2004).

3.4.2. Non-market valuation

Non–market valuation methods are commonly categorized into RP methods and SP methods. RP methods are based on individuals´ actual decisions on which information related to goods and services can be inferred from the market while SP methods are based on individuals´ intended behavior in hypothetical or simulated markets (Mourato, 2014). In other words, RP methods examine actual expenditures and SP methods estimate expenditures which will be taken place in the future (Atkinson et al., 2012). Travel cost (TC) method, hedonic price (HP) method, and averting behavior (AB) are commonly used as RP techniques; and CVM and choice modeling (CM) are widely used as SP techniques.

3.4.2.1. Revealed preference method

RP methods have been applied based on individuals´ actual behavior. These valuations are appropriated to estimate the consumption of related market priced goods, using information from markets which goods are associated with (Atkinson et al., 2012). These methods require large data and complex statistical analysis, thus they are quite expensive

and time consuming (Pascal et al., 2010a).

a. Travel cost method

The TC method estimates how much money individuals spend for benefits from using ecosystems such as parks, woodland, beaches, lakes, etc., for recreational purposes. These natural areas commonly do not have market prices for their services, and thus an alternative price is required to estimate those values. The value of recreational sites is assumed to manifest individuals´ WTP to visit, which is estimated by number of trips that individuals make at different travel costs. It is possible to derive a demand curve at different actual travel costs for a recreational site, and estimate the amount of consumers' surplus and the net value of the recreational site.

To estimate the TC, actual survey would be carried out in a recreational site to collect information about number of trips individuals take to the particular recreation site per year and costs of travelling to the site which include actual costs and opportunity costs of time spend for travel instead of other alternative uses.

TC method assumes to use models for a single trip or to visit a specific recreational site. In case the trip is multiple destinations, the value of the site is difficult to evaluate and might be overestimated (Pagiola et al., 2004). Besides, how to calculate opportunity cost of time, person´s wage rate or some fractions of the wage rate is still controversial (Mourato, 2014). Additional, the changing of site quality, which is difficult to observe, and substitute sites also affect the value of the site. TC method is solely used to evaluate use values.

b. Hedonic pricing method

The HP method estimates the value of environmental amenities that affect prices of marketed goods. It is mostly applied to evaluate the attribution of environmental conditions to house and property values. For example, the price of a house might depend on a bundle of factors: structure of the house, location, neighborhood, and environmental conditions such as scenic beauty, air quality, cultural benefits, etc. Hence, the change in biodiversity or ecosystem might affect the change in value of the property. HP identifies how much a property differs from others due to environmental conditions and how much people are willing to pay for an improvement in environmental quality (Garrod and Willis, 1999).

Data requirements for the HP method are all factors determine property price. Thus, large amounts of data must be gathered and manipulated (Mourato, 2014). A limitation of the HP method is that it is very sensitive to specification (Pagiola et al., 2004), i.e., the value of environmental amenities might not be reflected in property´s price if individuals are not aware of the benefits of those environmental attributes and their contributions to the property.

c. Averting behavior method

The AB method is applied when marketed goods are substitutes. Individuals might change their behavior in costly manner to avoid negative impacts on their well-being by ecosystem goods and services. The cost of providing market substitute goods might provide an estimate for the value of ecosystem goods and services. For example, flood protection service of a wetland can be estimated by calculating the cost of building a wall or levee.

3.4.2.2. Stated preference method

When information on goods and services is not relevant or not generated by markets, SP methods are necessary (Bateman et al., 2002). SP methods estimate WTP directly by asking respondents to address their preferences among alternative choices. These techniques use questionnaires to simulate individuals´ behavior in the market place. In case of public goods, information related to costs and benefits of public goods is impossible to infer from markets. For example, we might evaluate a recreational site by studying the cost people are willing to pay to visit. Even if they are not visiting at the moment, they might want to keep it available to visit in the future. Some people might pay even if they have no intention to visit or want to preserve the site itself. We call them option users or non-users. In case the proxy market is available, the market information might not reflect appropriate cost and benefit. For example, the cost of entering a park is US$ 10. If an individual decides to pay the entrance fee, it is inferred that the benefit of the trip is equal to US$ 10. If he does not pay, it is inferred that the benefit of the trip is less than US$ 10. Therefore, it is useful to have a cross-section data of a sufficient range of prices so that similar individuals might reveal their preferences in order to infer actual value of goods and services. SP techniques provide substantial original data for those evaluations.

a. Choice modeling method

The CM method has been increasingly used in environmental valuations in recent years (Atkinson et al., 2012; Pearce et al., 2006). CM is a survey-based method for modeling individuals´ preferences for goods. It is assumed that the value of a good is a function of its attributes. Respondents are asked to choose their preferred alternative among scenarios. Each scenario has various attributes, and each attribute varies at different levels, including a hypothetical price. Respondents are asked to rank, rate, and choose between different levels of environmental goods at different price levels to reveal their WTP.

The advantage of CM is that any environmental service can apply this technique (Pagiola et al., 2004). In fact, it is most useful to apply CM to evaluate a complex environmental good which is multidimensional (Mourato, 2014; Pearce et al., 2006). CM evaluates both individual attributes and the whole scenario, and thus can be useful to design optimal policies or projects with numerous combinations of multiple dimensions. Respondents, however, face the multiple complex choices or ranking among a bundle of attributes and levels, which might affect the meaningfulness and precision of their decisions (Pearce et al., 2006). The experimental design and data analysis are quite complex (Adamowicz et al., 1998).

b. Contingent valuation method

CVM is a simple, flexible method which can be used to estimate economic values for all kinds of ecosystem and environmental services (Atkinson et al., 2012; Pagiola et al., 2004). CVM can be applied for both use and non-use values and is the most widely used method for estimating non-use values (Alberini and Kahn, 2006).

Forest ecosystems generate a wide variety of important use values, option values, and non-use values. While use values can be estimated by RP methods, non-use values or passive values can be only measured by SP methods. CVM is an important tool for forest economists and is useful for evaluating particle attributes of forests. Forests provide a bundle of goods and services which cannot be easy to evaluate particularly. For example, forests with higher level of biodiversity might have better quality of wildlife habitat, higher watershed services, and aesthetic values. Hence, CVM is an appropriate tool to evaluate

complex values of forest ecosystem as a whole rather than focusing on individual component of forest values.

In addition, one aim of this study is to examine paying for forest protection to gain non-use values, including existence value, option value, and bequest value. The second aim is to estimate the compensation for local loss in term of labor cost for forest protection and management. To evaluate welfare change for both gainers and losers, WTA and WTP measures fit the context.

3.5. Contingent valuation method

3.5.1. Introduction

Based on a monetary (Hicksian) measure of welfare, CVM estimates the maximum WTP for improving the quantity and quality of environmental goods and minimum compensation an individual is willing to accept for a decrease in environmental quantity and quality. Contingent valuation surveys distinguish from other surveys because of their particular description of the public goods of interest and more intensive elicitation. CVM is widely used in environmental economics, health economics, transportation safety, cultural economics, CBA, environmental impact assessment, water and air quality issues, outdoor recreation, biodiversity conservation, species preservation, forest protection, waste management, natural resource damage, and environmental risk reduction (Carson and Hanemann, 2005).

Bowen (1943) and Ciriacy-Wantrup (1947) proposed an original CVM when they used survey methods to elicit an individual´s WTP for social goods such as beautification of the landscape and some extra market benefits for the prevention of soil erosion. Davis (1963) was the first researcher to use CVM to estimate the benefits of goose hunting through a survey among goose hunters. CVM gained popularity in the 1960s for option and existence values which were recognized as important parts of the total economic value in environmental economics (Krutilla, 1967; Venkatachalam, 2004). Since then, CVM has been widely applied to non-market goods and services.

Earliest contingent valuation studies were mostly from developed countries such as the United State, United Kingdom, and European countries. By the 1990s, 2,135 studies from

40 countries implemented CVM (Carson et al., 1995). In developing countries, water supply, sanitation, recreation, tourism, and national parks were primarily areas applying CVM (Whittington, 1989, 1990; Whittington et al., 1993; Whittington, 1998). Recently, CVM has been applied to studies on surface water quality, health, and biodiversity conservation (Whittington, 1998). Carson (2011) noted over 7,000 papers and studies from 130 countries (30 developed and over 100 developing countries) over 50 years.

3.5.2. Definition of contingent valuation method

Mitchell and Carson (1989) defines CVM as a method using surveys to find out the amount customers would be willing to pay in cash for specific environmental services. In some cases, individuals are asked for the amount of compensation they would be willing to accept to give up specific environmental services. The method is "contingent" valuation because respondents state their WTP, contingent on a specific hypothetical scenario description of the goods and services.

According to Carson and Hanemann (2005), a contingent valuation interview consists of five parts:

1) An introductory section to identify the topic;
2) A section asking prior knowledge about the good and attitudes towards it;
3) Description of scenario: This part describes in detail the good and hypothetical circumstance including baseline provision level, the structure under which good is to be provided, the range of available substitute, method of payment, and what will happen to current status if the project is not implemented;
4) Questions elicit respondents´ WTP or WTA for goods;
5) Questions about respondents´ demographic characteristics.

3.5.3. Theoretical background of the contingent valuation method

3.5.3.1. Demand curve and willingness to pay

The environmental changes obviously cause the human welfare changes, and economists try to measure how much the level of human welfare in society changes (Mourato, 2014). The change of human welfare reflects the change of individual satisfaction or utility for the

change in level of environmental goods. Individual satisfaction or utility is possible to be measured through the amount of money people prepare to pay.

Duipuit in 1844 explained consumer´s utility as the difference between actual price of a good and the amount of money the customer would prepare to pay for it (Lienhoop, 2004; Sloman et al., 2012). In 1879, Marshall measured consumer´s benefits through consumer surplus (Mitchell and Carson, 1989). Suppose that an individual has a demand curve for a good represented in Figure 7. The horizontal axis measures the total quantity of a good available for purchase and the vertical axis measures price per unit. Points on the individual´s demand curve show how much a consumer is willing to pay for each quantity purchased and reflect marginal WTP, holding income effects constant. The total WTP is given by the area under demand curve up to the amount purchased (Q_0) or equal to the area of (a + b). Consumer surplus is the difference between the maximum price a consumer is willing to pay and the actual price (P_0) they do pay.

Consumer´s surplus = Total WTP - Total expenditure = (a + b) – b = a

Total WTP measures the total the gross change and consumer surplus measures the net change in an individual´s welfare (or utility) from buying Q_0 units of the good.

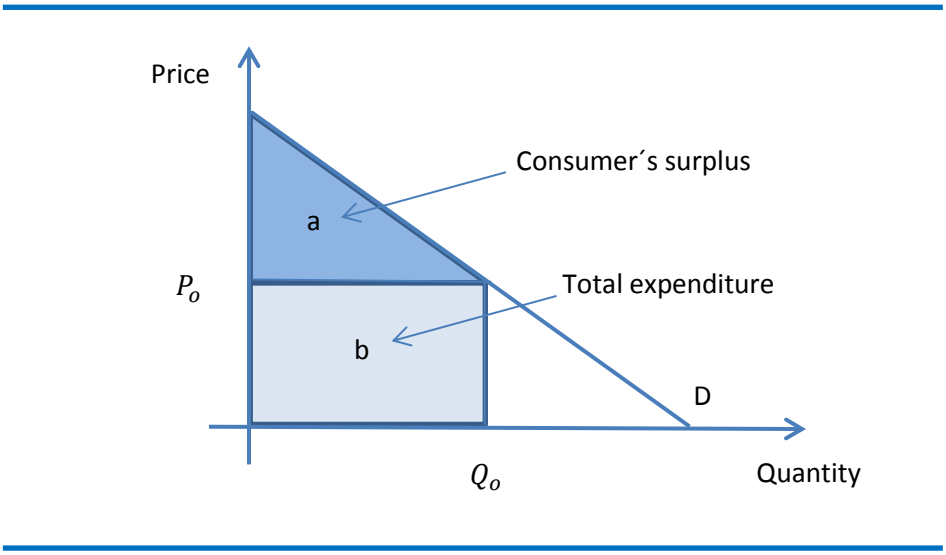


Figure 7: Demand and willingness to pay, adapted from Bateman (2004)

But the demand curve does not hold the level of utility constant, and the assumption that income effects are constant causes problem (Mitchell and Carson, 1989). In fact, the quantity of goods consumed mostly changes together with changes in individual´s income (Hanley and Spash, 1993). In 1941, Hicks introduced two different consumer surplus measures, namely, compensating variation holding utility constant at the initial level and the equivalent variation holding utility constant at an alternative level (Mitchell and Carson, 1989). The CVM estimates Hicksian consumer surplus, either compensating variation or equivalent variation due to the change in provision of environmental goods and services.

3.5.3.2. Hicksian welfare measures

Each consumer has a bundle of indifference curves that express different levels of utility. Each indifference curve reflects a bundle combination of good x and y that yields the consumer the same amount of utility. The further curves provide higher utility level than the lower curves in the left (Figure 8). According to Hicks, people always aim to maximize their utility with a constrained income. Point A is the maximum consumption of a consumer where the indifference curve is tangent to the budget constraint line (Sloman et al., 2012). The choice of consumer between good x and y will change if there is a change in the consumer income or a change in price of good x or good y.

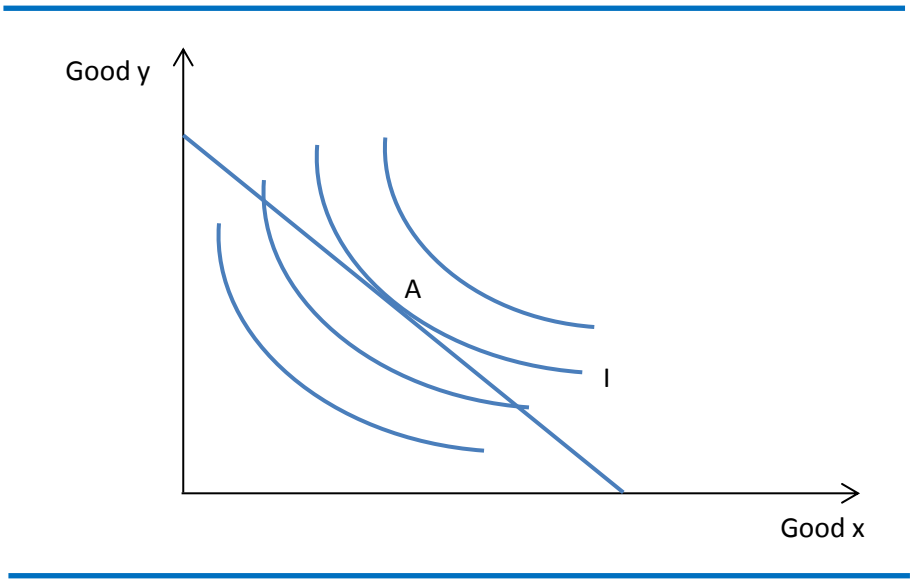


Figure 8: Indifference curves and the budget constraint, from Sloman (2009)

There are four measures of the value of a change in quantity of an environmental good. Suppose that an individual´s preference is represented in Figure 9. The horizontal axis measures the total quantity of an environmental good (x) and the vertical axis measures the individual´s expenditure on a private good (y) in term of money unit. Suppose that the indifference curve (I) moves to the right (I´), the customer´s utility or well-being increases.

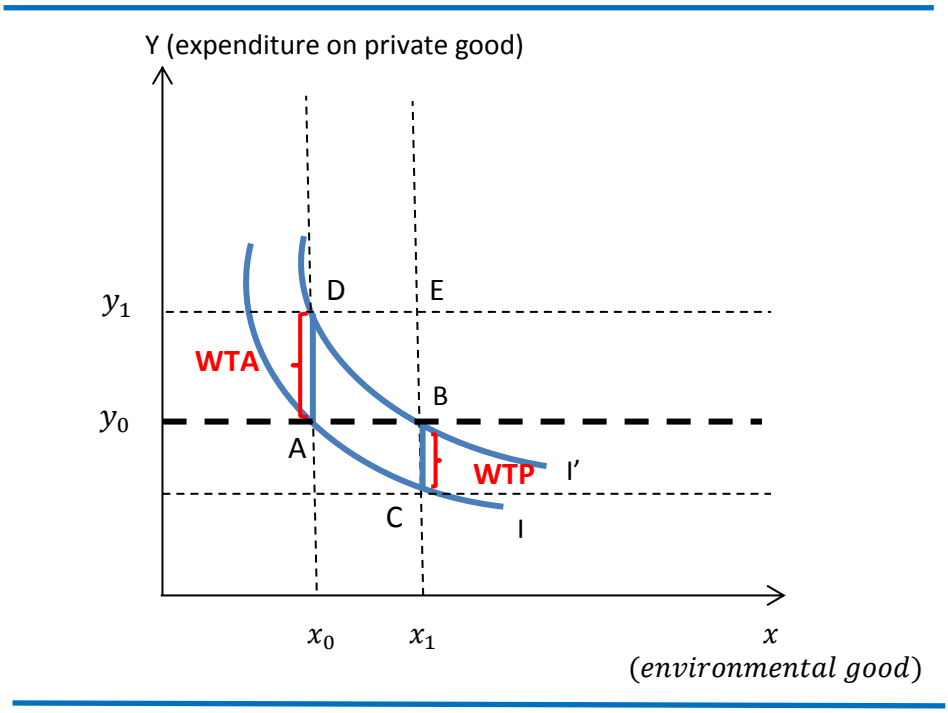


Figure 9: Measure of change in human welfare, adapted from Bateman et al. (2002)

Firstly, the consumer starts with the initial consumption at A(x_0, y_0). When the indifference curve moves from I to I´, the quantity of the environmental good increases from x_0 to x_1; and the expenditure on the private good y reduces by an amount of BC. As A and C are on the same indifference curve I and have the same utility, BC can be identified as consumer´s WTP for the increase of quantity in the environmental good. The loss of BC in the private good consumption compensates the increase in the environmental good. In economic welfare, it is called the compensating variation for the *increase* in the environmental good.

Secondly, the consumer starts with the initial consumption at B(x_1, y_0). The decrease in quantity of the environmental good from x_1 to x_0 leads to the increase in the expenditure in the private good, which is equal to DA. Since D and B have the same utility, it is possible to

infer that DA is the consumer´s WTA for the decrease in the environmental good. It is called the compensating variation for the *reduction* in the environmental good.

Thirdly, we may ask what additional amount of private consumption would be as preferable as an increase in the environmental good from x_0 to x_1. This is called equivalent gain measure of the value of the change in the environmental good. The consumer starts the consumption at A(x_0, y_0). The environmental good increases from x_0 to x_1. As B and D have the same utility, equivalent gain is equal to DA. DA, in welfare economic, is the equivalent variation for the *increase* in the environmental good.

Fourthly, the consumer starts with the initial consumption at B(x_1, y_0) and we may ask what private consumption loss would be as preferable as a decrease in the environmental good from x_1 to x_0. Since B and C have the same utility, equivalent loss is equal to BC. BC, in welfare economic, is the equivalent variation for the *decrease* in the environmental good.

In summary, for a welfare gain, the compensating variation measure refers the amount of money that the customer is willing to give up to gain an increase in environmental quantity or quality, i.e., WTP measure; whereas the equivalent variation measure refers the compensation that the consumer demands of utility improvement in case the increase in provision of environmental goods and services does not happen, i.e., WTA measure. For a welfare loss, the compensating variation measure refers the amount of money that the customer requires to compensate his welfare loss, i.e., WTA measure; while equivalent variation measure refers the amount of money that the customer forgoes to prevent the loss in the future, i.e., WTP measure (Bateman and Turner, 1993). The compensating variation and equivalent variation measurements for welfare changes are presented in Table 4.

Table 4: Welfare measures for an environmental gain and loss

	Increase in environmental quantity/quality ($\Delta U > 0$)	**Decrease in environmental quantity/quality** ($\Delta U < 0$)
Compensating variation	WTP	WTA
Equivalent variation	WTA	WTP

Formally, WTP is defined as the amount of money that must be taken away from the individual's income while keeping his utility constant:

$V(y, p, q_0, z) = V(y - WTP, p, q_1, z)$

where V denotes the indirect utility function, y is income, p is vector of prices faced by the individual (including price of substitutes), q_0 is the initial level of the environmental good in quantity or quality, q_1 refers to an improvement of the environmental good in quantity or quality ($q_1 > q_0$), and z is vector of individual's socio-economic characteristics influences the individual's trade-off preference between income and environmental quantity or quality.

WTA is defined as the amount that must be given to the individual while keeping his utility constant

$$V(y, p, q_0, z) = V(y + WTA, p, q_1', z)$$

where q_1' refers to an decrease in environmental quantity or quality ($q_1' < q_0$).

Internal validity of WTP and WTA are checked by regressing WTP and WTA on those variables. The regression results show the correlation between WTP, WTA and socio-economic variables in predictable ways.

3.5.3.3. Willingness to pay or willingness to accept

Theoretically, we can use either WTP or WTA measure to estimate an individual´s preference for a change in the level of the environmental goods and services and it is assumed that they would not vary much. Many theoretical and practical studies show that WTA is always greater than WTP, as people tend to overestimate compensation. The disparity between WTP and WTA are explained by a number of factors.

Diamond et al. (1993) suggests "income effect" and interprets that WTA is not as constrained by one´s income as WTP is. Therefore, the WTA value is always higher than the WTP value for the same item. Hanemann (1991) states that the divergence between WTP and WTA depends not only upon income effects but also the availability of substitutes. The fewer substitutes for environmental goods and services are, the greater the disparity is, holding income effects constant. Kahneman and Tversky (1979) explain the difference by "prospect theory". According to Kahneman and Tversky, people value losses steeper than

gains, thus they give greater weight to losses than to gains. Mitchell and Carson (1989) mention the property rights as the reason of the difference. Individuals with property rights to the goods can refuse to sell or may want an extraordinarily large compensation for agreeing to this, and thus WTA elicits a large protest response. Zhao and Kling (2001) give another explanation based on the presence of uncertainty. The respondent is unsure about the value of goods in question and prefers to gather information before offering or accepting a payment level. Hence, to be on the safe side, WTA is higher and WTP is lower.

It is clear that there are many factors influencing the disparity between WTP and WTA. The question is: which measure formats, WTP or WTA, should be used in contingent valuation survey to evaluate the changes in provision of environmental goods and services? The choice between WTP and WTA is a question of property rights. If the individual has the right to sell the good, then WTA will be the relevant measure. On the contrary, if the individual has to buy the good to enjoy it, WTP will be appropriate. The problem is, in many cases, the property rights to environmental goods and services or public goods are not clear (Ninan, 2009), and it is more effective to link to the rights to the status quo (Pearce et al., 2006). The WTP format is appropriate for an improvement to the status quo, and WTA is relevant for a loss to the status quo. Since large policies mainly focus on gains rather than losses in environment, WTP is the correct measure and widely used in contingent valuation surveys (Pearce et al., 2006).

NOAA (1993) also suggests that WTP is a suitable value measure compared to WTA, and therefore should be used in contingent valuation studies. In the context of developing countries where the impacts of environmental policies tend to be negative in terms of damage costs to the poor population, WTA is considered an appropriate measure rather than WTP format (Venkatachalam, 2004).

3.5.4. Contingent valuation surveys in developing countries

To carefully design and conduct contingent valuation surveys in developing countries, economists need to understand the obstacles to such surveys. This helps researchers minimize difficulties, overcome misunderstandings, and conduct reliable studies. Whittington (1998 & 2010) discusses administering CVM in developing countries. He summarizes several important lessons after 20 years studying how contingent valuation surveys are conducted in developing countries. Conducting the CVM in developing

countries is believed easier and straightforward compared to developed countries. The response rates are relatively high and people tend to cooperate by listening and considering the questions. The in-person survey costs in developing countries are obviously lower than in developed countries, and thus allow a larger sample size and more experiments. There are also numerous issues that researchers and policy analysts should consider when administering a contingent valuation survey in developing countries.

- Firstly, most contingent valuation studies rely on in-person interviews because it is difficult to conduct mail and telephone surveys, particularly in rural areas. Even when mail or telephone surveys are possible to access, the low literacy and education level in many developing countries are obstacles for them to perceive the aim and the content of the survey.

- Secondly, the lack of resident lists prevents researchers from designing random and stratified samples. For example, some researchers have to use income level as criterion for choosing a fixed number of high-, medium-, and low-income respondents to take part in the interview. Interviewers, in some cases, have to randomly ask any household in a certain district. The absence of official statistics is another difficulty and prevents researchers from being able to compare the socio-economic characteristics of the sample with population in the same area. For this reason, the samples are often designed for relatively small areas.

- Thirdly, the cooperation of local officials and authorities is very important. Sometimes, they place pressure on respondents and try to influence the survey outcomes. The aim and the content of the survey must be clearly explained to officials, authorities, and respondents to minimize this obstacle.

- Fourthly, the notion of maximum WTP and minimum WTA is not easy to explain to rural people who have low literacy or education levels and are unfamiliar with environmental values. They might misunderstand and provide incorrect answers to difficult and abstract questions. Some of respondents say “Yes” to all questions in questionnaires, regardless the level of monthly fee or tariff offered to them. In some cases, respondents say “Yes” to anything just to satisfy the interviewers. To minimize these obstacles, a careful questionnaire with follow-up questions is required.

- Fifthly, the most appropriate WTP and WTA elicitation format used in developing countries is a referendum, or so-called take-it-or-leave-it or dichotomous choice. This allows for an avoid strategy bias and is suitable for remote rural people who are unfamiliar with environmental valuation. The problem is, some studies design price ranges that are too limited, i.e., the highest referendum price is too low and the lowest referendum price is too high. The too low or too high prices also do not secure the credibility of the contingent valuation scenario.

After 20 years of research in developing countries, Whittington (2010) concludes that WTP is typically low in terms of payment level and as a percentage of income. Poor households in developing countries spend most of their income on food, energy, etc., for subsistence purposes. When the income increases, payment for environmental goods and services are expected to be higher.

CHAPTER 4: DATA AND METHODS

4.1. Study site

4.1.1. Thai Nguyen province

Thai Nguyen is a mountainous, midland province in the Northeast region of Vietnam and borders six provinces of which one is Hanoi capital to the south. The province covers an area of 353,000 ha and comprises of one city, one town, and seven districts. Thai Nguyen has a total population of 1.1 million people with 25% living in Thai Nguyen city, the capital of the province (TSO, 2012). Thai Nguyen is a multiethnic province with 46 ethnic groups, and each ethnic has its own language, lifestyle, and cultural heritage. “Kinh” ethnic is the largest group representing of 73% of the total population, and populates mainly in the city, the towns, and the district centers (GSO, 2010). Thai Nguyen is famous for its rich mineral resources and tea products and is recognized as an education center in the mountainous regions in the north of Vietnam.

In 2011, Thai Nguyen´s GDP, at current prices, was VND 25,000 billion, generating GDP per capital of VND 17 million/year (TSO, 2012). Although 65.5% of the employed labor force is engaged in the agriculture, forestry, and fishing sectors, the contributions of these economic categories account for 21.3% of the province´s GDP (TSO, 2012). 28% of total households of the province are classified as poor and pro-poor households[4] (TSO, 2012).

[4] According to poverty line in Vietnam applied for the 2010-2015 period:

- The poor households in rural areas are households with average income under VND 400,000 (US$ 19) per capita per month or VND 4,800,000 per capita per year.
- The poor households in urban areas are households with average income under VND 500,000 (US$ 24) per capita per month or VND 6,000,000 per capita per year.
- The pro-poor households in rural areas are households with average income from VND 401,000 (US$ 19) to VND 520,000 (US$ 25) per capita per month.
- The pro-poor households in urban areas are households with average income from VND 501,000 (US$ 24) to VND 650,000 (US$ 31) per capita per month.

Thai Nguyen has many mountain ranges running from the north to the south. Three main surrounding mountain ranges Tam Dao, Ngan Son, and Bac Son prevent the province from heavy winter monsoons and regulate the flow of water to the plain area in the center and the south. 82% of the province area is mountainous and hilly land and 12% is field land, which are generated by the terrain slopping from the high mountains to the low zones and the midlands. Thai Nguyen has two seasons: the rainy season from May to October and the dry season from November to April. The average temperature is about 23^0c; the average sunny hours is around 1,600; and the average rainfall ranges between 1,400 to 2,000 mm annually. The characteristics of topography and the climate of the province favorably affect the development of agriculture and forestry (FIPI, 2010). In 2010, the total forest area was approximately 155,000 ha, of which 60% were natural forests. Production, protection, and special-use forests make up about 84,000 ha, 41,000 ha, and 30,000 ha, respectively (FIPI, 2010).

4.1.2. Dinh Hoa district

Dinh Hoa district is located in the north west of Thai Nguyen province and covers 51,000 ha of land area (Figure 10). The district consists of one town and 23 communes with a population of 87,000 people (TSO, 2012). As forestry and agriculture land accounts for 73% of the total area, forestry and agricultural sectors dominate the district economy. Dinh Hoa district is characterized by its rich social and cultural diversity as well as its important role in the region´s economic development. Dinh Hoa forest is an especially important part of Dinh Hoa Safety Zone, a national historical site including 109 relics from revolutionary era (Prime Minister, 2008).

The forest area is about 30,000 ha representing 58% of the total land. Half of forest area is covered with natural forests which are degraded and fragmented (ATKFMB, 2013). Table 5 presents the three types of forests in the area. Dinh Hoa forest has 316 plant species including 76 rare species, 31 mammal species, 80 bird species, 38 reptile species, and 80 amphibian species (ATKFMB, 2013; Thai Nguyen Province Committee, 2007). The district, like those in other mountainous regions in northern Vietnam, suffers from serious environmental problems such as deforestation, soil degradation, and biodiversity loss. As a result, the number of flora and fauna species has decreased dramatically over the years (Thai Nguyen Province Committee, 2007).

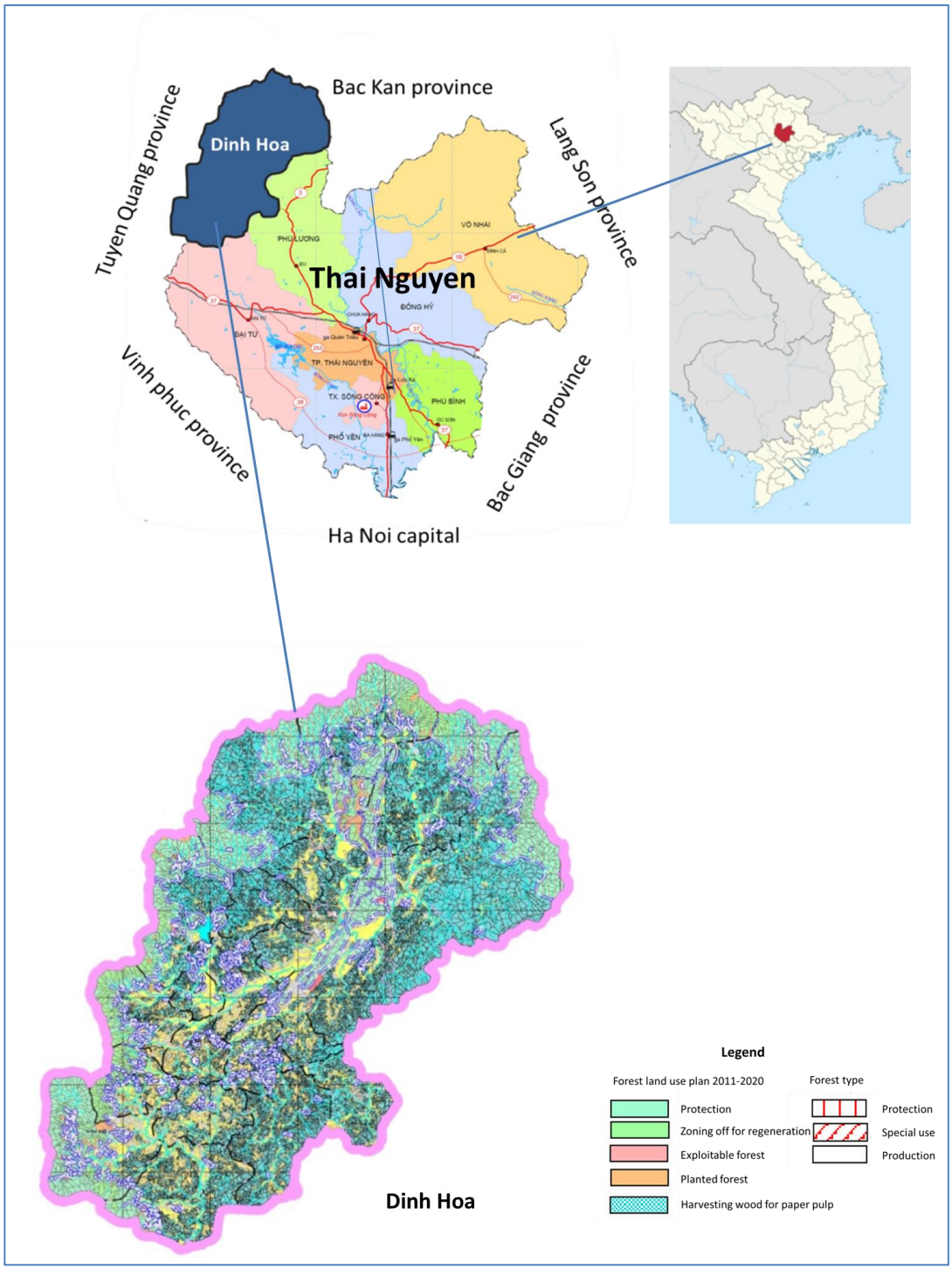


Figure 10: Map of forest types in Dinh Hoa district, adapted from FIPI (2010)

The main products from Dinh Hoa forest are timber and fuelwood. In 2007, the local population harvested 5,271 m^3 round wood, 3,500 m^3 fuelwood, and 4,500,000 bamboo culms. The demand of round wood and fuelwood per household for self-consumption remains stable. On average, each household consumes 10 m^3 round wood for house

construction and 20 m^3 fuelwood for cooking and heating annually. Medical plants and palm trees are less significant. The total forest gross output was estimated to be VND 8,900 million (Thai Nguyen Province Committee, 2007).

Table 5: Forest area in Dinh Hoa district, from FIPI (2010)

Type of forest	Total area (ha)	Special-use (ha)	Protection (ha)	Production (ha)
Forest area	30,230	8,404	7,010	14,816
- Natural forest	15,732	3,292	5,316	7,124
- Planted forest	8,380	1,020	852	6,508
- Non-forest area	4,274	2,293	808	1,173
- Others	1,844	1,799	34	11

Local households in Dinh Hoa district were allocated and contracted forests for management and protection since 1992. About 7,400 households held approximately 21,000 ha (70% of the forest land), of which natural forest accounts for about 12,000 ha (Thai Nguyen Province Committee, 2007). 23% of the remaining forests were under the management of village communities, commune people's committees, and the FMBs (Appendix 2). Even though the forest allocation policy creates jobs and improves livelihoods, the local people face many difficulties as 54% of the total households are classified as poor and pro-poor households (TSO, 2012). Since two third of the forest land is under the management of local households, it is possible to conduct a survey to understand the local perspective and choice of payment policy.

4.2. Sample size

To conduct a contingent valuation survey, Mitchell and Carson (1989) provided a formula to calculate sample size based on the simple random sampling. They suggested that sample sizes between 200 and 2,500 observations are probably appropriate, assuming a coefficient of variation of 2.0. Calia and Strazzera (1998) classified 100 observations or less into the "small size sample", 250-400 observations into the "medium size sample", and more than 1,000 observations into the "large size sample" for a dichotomous contingent valuation model. They came to conclusion that the medium size sample is efficient for both single-bounded dichotomous choice (SBDC) and double-bounded dichotomous choice (DBDC). Bateman et al. (2002) argued that researchers might design sample size by the expected

number of non-respondents and protest responses, and hence, an open-end contingent valuation survey needs about 250-500 observations and a closed-ended contingent valuation survey requires about 500-1,000 observations. Many economists accept the sample size of 100-1,000 observations in a cost-benefit analysis.

Data collection costs and a project´s time frame also decide the sample size (Bateman et al., 2002). Contingent valuation survey costs depend on survey modes: mail surveys, telephone interviews, web-based surveys, or in-person interviews. In-person interviews are the most effective for complex questions, the most time consuming, and the most expensive type of surveys.

Given the limited time and budget constraints, 600 respondents were chosen to conduct the surveys in this study, 300 for WTA survey and 300 for WTP survey.

4.2.1. WTP survey

The in-person WTP survey was conducted from June to July 2012 and included 300 randomly chosen residents (households without forests) from two districts and one city in Thai Nguyen province. The first reason for choosing these districts and city were the distance to forest in Dinh Hoa: Dinh Hoa district (0-10 km), Thai Nguyen city (50 km), and Phu Binh District (80 km) (Figure 11). Secondly, the research tended to compare the differences in attitudes towards forest protection of the residents between urban and rural areas. In this case, Thai Nguyen city represented urban residents, while Dinh Hoa and Phu Binh districts represented rural residents.

The WTP survey was conducted in four communes and one ward: two communes in Dinh Hoa district, two communes in Phu Binh district, and one ward in Thai Nguyen city. The total number of households of the four communes and one ward was 12,367. The distribution of total sample was determined equivalent to the proportion of the size of households in each commune or ward. For example, given that Diem Thuy commune represents 16.3% of the population, then 16.3% of total sample of 300 would be 49 households (Table 6).

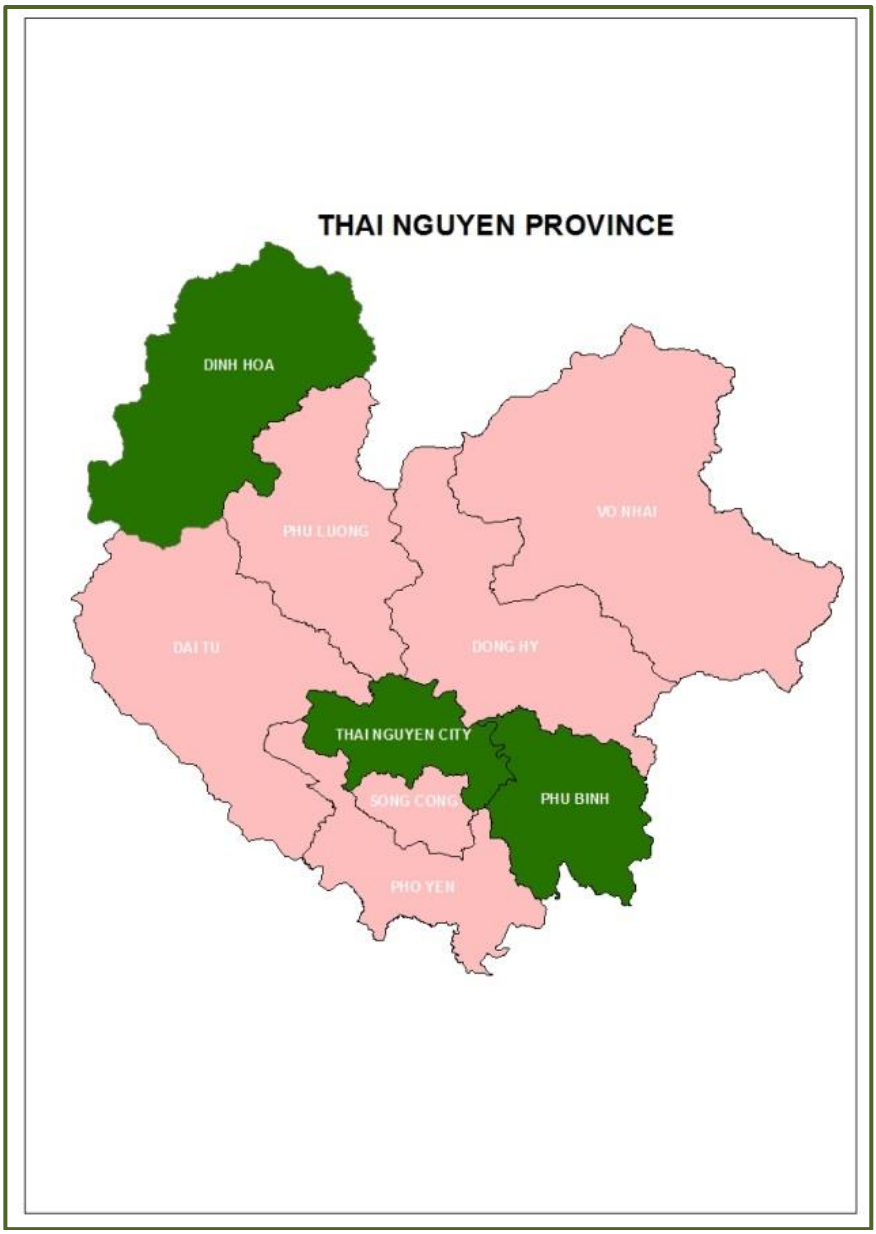


Figure 11: Sample site of WTP survey

Table 6: Distribution of sample in WTP survey

District/city	Ward/ commune	Total households	Ratio (%)	No. of households in the survey
Phu Binh district	Diem Thuy	2,022	16.3	49
	Huong Son town	2,200	17.8	53
Dinh Hoa district	Cho Chu	1,798	14.5	44
	Binh Yen	891	7.2	22
Thai Nguyen city	Phan Dinh Phung	5,456	44.1	132
	Total	**12,367**	100	**300**

4.2.2. WTA survey

The in-person WTA survey was carried out from May to June 2012 in Dinh Hoa district. The sample included 300 natural forest contracted households randomly chosen from five communes where forests were contracted for protection. The criteria for selecting these five communes were the representation of three types of forests and the geographical distribution. The communes were: Linh Thong located in the north, representing protection forests; Bao Cuong and Phu Tien located in the middle, representing production forests; and Thanh Dinh and Diem Mac located in the south, representing special-use forests (Figure 12). Lam Vy commune, representing protection forests, was involved in group discussion and pre-test.

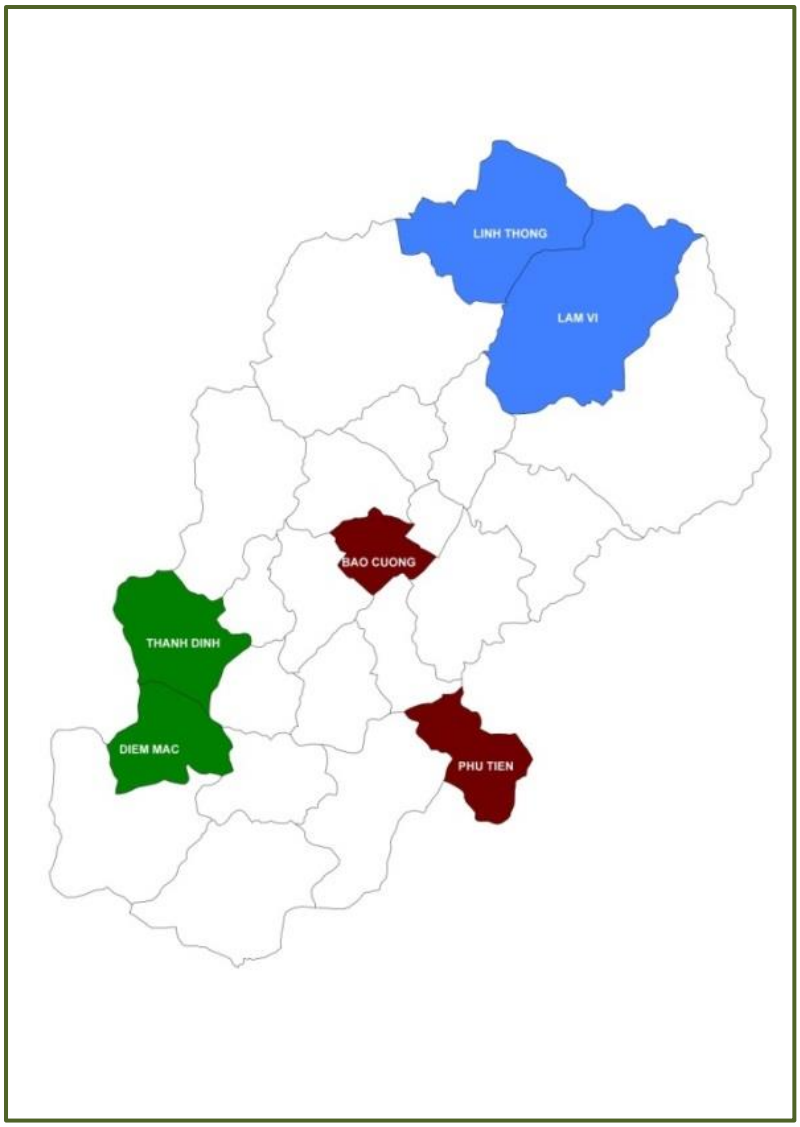


Figure 12: Sample site of WTA survey

Sample of WTA survey was identified using the similar approach of WTP survey which is presented in Table 7. The total number of households contracted forests for protection in five communes was 1,228. As Thanh Dinh commune represents 14% of the population, 42 households were chosen which were equal to 14% of total sample of 300. The calculation was repeated to determine the sample size in each commune.

Table 7: Distribution of sample in WTA survey

Type of forest	Commune	Total households contracted natural forest	Ratio (%)	No. of households in the survey
Special-use forest	Thanh Dinh	171	13.9	42
	Diem Mac	235	19.1	57
Production forest	Bao Cuong	153	12.5	37
	Phu Tien	260	21.2	64
Protection forest	Linh Thong	409	33.3	100
	Total	**1,228**	**100**	**300**

4.3. Data collection

4.3.1. Survey methods

Mail surveys, telephone interviews, and in-person interviews (i.e. face-to-face interviews) are traditional modes of contingent valuation surveys (Alberini and Kahn, 2006; Bateman et al., 2002; Champ, 2003). Recently, web-based surveys, i.e. internet surveys, have been developed as a survey mode of contingent valuation surveys (Fleming and Bowden, 2009).

- Mail surveys: researchers send questionnaires to respondents via mail; respondents complete questionnaires themselves and send them back to the researchers.
- Telephone surveys: researchers call respondents and interview them via telephone.
- In-person interviews: respondents are asked questions by enumerators, face-to-face.
- Web-based surveys: participants complete a self-administered electronic set of questions on the web.

Depending on the method used, survey costs, time consumption, responses rates, the quality and quantity of data, the complexity of questionnaires, and sample control are different (Bateman et al., 2002). Each survey method has advantages and disadvantages and decides the design of questionnaire. The advantages and disadvantages of data collection methods were discussed by Alberini and Kahn (2006), Bateman et al. (2002), Maguire (2009), and Mitchell and Carson (1989).

In-person interview is the most popular approach among contingent valuation survey methods and is recommended by Mitchell and Carson (1989) and the US National Oceanic and Atmosphere Administration panel (NOAA) (Arrow et al., 1993) rather than telephone and mail surveys. The NOAA panel argued that in-person surveys are better for the assessment for complex questions and questionnaire structures, which allow visual and demonstration aids such as photos and maps. The interviewers can assist respondents in understanding the context and elicitation scenarios correctly. In-person interview method permits larger quantity of data collection; and a quality face-to-face survey may achieve high response rate (70% or higher) (Bateman et al., 2002; Marta-Pedroso et al., 2007).

The disadvantages of in-person surveys are that they are more expensive and more time consuming than mail, telephone, and web-based surveys because of travel requirements and the logistic administration. In-person surveys may raise interview bias; especially in developing countries where the respondents prefer agreement to please the interviewers, i.e., yea-saying tendency (Whittington, 1998). Additionally, in face-to-face surveys, respondents have little time to think about valuation questions and have to answer immediately. A variety of methods were developed to reduce yea-saying tendency, such as cheap-talk script (Champ et al., 2009; Cummings and Taylor, 1999; Murphy et al., 2005; Silva et al., 2011), ballot boxes (Krosnick et al., 2001), time-to-think (Whittington et al., 1992), and drop-off protocols (Subade, 2007). The time-to-think and the drop-off method were successfully applied in developing countries (Whittington, 2010).

To reduce interview bias, a thorough training of interviewers is mandatory before the start of the surveys. The researchers should attend in the interviewer training and monitor the pre-test surveys to assure the surveys are conducted in line of their purposes.

In the evaluation of Dinh Hoa forest, mail surveys, telephone interviews, and web-based surveys are difficult to apply. Thai Nguyen province is a mountainous province in

northeastern Vietnam where the rate of poor households is relatively high. Many people have no access to the internet and thus, web-based surveys are impossible. Telephone surveys and mail surveys tend to be more popular in large cities like Hanoi and Ho Chi Minh City than a mountainous province like Thai Nguyen. Moreover, low levels of education in remote districts as Dinh Hoa or Phu Binh restraints the understanding of environmental scenarios, which are complex and unfamiliar to rural people in developing countries. For those reasons, in-person surveys are the most appropriate method.

4.3.2. Secondary data collection

Secondary data collection was carried out in province, district, and commune levels to provide an overview of natural, socio-economic, and institutional characteristics. In the WTA survey, six interviews with six forest wardens in six communes were conducted to gather general information about forest situation. Then, two lists of participants of the surveys were made: one for the WTA survey and one for the WTP survey. Households participated in the WTA survey were randomly chosen from the list of households who were contracted and allocated natural forests for protection and management in each commune. Households participated in WTP survey were randomly picked from the list of households which was available in administrative department of each commune and ward. The logistic conditions were pre-organized for the following steps.

4.3.3. Focus group discussion

This step aims to preliminarily assess the attitudes of local people towards forest protection and identify the compensation levels that forest contracted households wish to be compensated (WTA survey) and payment levels that residents in Thai Nguyen province would be willing to pay (WTP survey).

4.3.3.1. WTP survey

In order to identify the perception and attitudes of residents in Thai Nguyen province towards forest protection, three group discussions were made in April 2012 in Thai Nguyen city, Phu Binh district, and Dinh Hoa district. Each group included five to seven participants. People were asked about their preferences towards environmental problems and forest

protection (see Appendix 3). Maps, pictures, and description of forests in Dinh Hoa were introduced to provide comprehensive background information.

Overall, people worried most about air and water quality, which directly affects their daily life. Although they were aware of deforestation, which was mentioned frequently on broadcast media, they found forest to be less important among environmental issues. More than half the participants visited Dinh Hoa Safety Zone, a historical tourism attraction in Dinh Hoa forest. They agreed that forests in Dinh Hoa should be protected and they would pay if the state provides a transparent mechanism of distribution of the money. The payments suggested by participants ranged from VND 5,000 to VND 120,000 per household. Five initial bids were set up: VND 10,000, VND 20,000, VND 35,000, VND 50,000, and VND 80,000. People preferred a payment as a contribution rather than an increasing in income tax, electricity bill, or water bill. Eventually, cash was the optimum choice for payment.

4.3.3.2. WTA survey

Three focus group discussions were performed in March 2012 in Lam Vy commune (protection forest), Phu Tien commune (production forest), and Diem Mac commune (special-use forest). Each group represented one type of forest and consisted of five to 11 participants. Participants were selected from forest contracted households. The group discussions lasted between 90 and 120 minutes. The similar maps, pictures, and description of forests in Dinh Hoa used in WTP group discussion were also involved. The content of discussions (see Appendix 4) was to assess local´s attitudes towards the forest situation in Dinh Hoa and their satisfaction with the current payment levels of government.

Participants revealed that the payment levels were low and not sufficient to compensate alternative land uses and even working time losses. Participants in Lam Vy commune stated that they received VND 50,000/ha/year instead of VND 100,000/ha/year. In 2010 and 2011, they did not receive any payment from government for natural forest protection.

In focus group discussions, the proposal of average payment per household per year was rejected because the forest area contracted and allocated to each household and individual was different: several households hold large forest area (more than 20 ha), while many others hold half to one ha. The payment per ha per year was more reasonable. The value

range of payment suggested by those households in focus group discussions extended from VND 50,000 to VND 1,000,000 per ha per year. Households contracted production forests demanded the highest payment: VND 800,000 to VND 1,000,000 per household per year while households contracted special-use forests required the lowest price: VND 100,000 to VND 200,000 per ha per year. Some households contracted special-use forests even accepted VND 50,000 per ha per year. Households contracted protection forests asked for a moderate price: VND 400,000 to VND 500,000. After focus group discussions, five initial bids were set up: VND 100,000, VND 250,000, VND 400,000, VND 600,000, and VND 800,000. Rice was suggested as alternative compensation but they all refused because they could fulfill their demand themselves, and thus cash was preferred as compensation vehicle.

Information relating to forest products collected, forestry, cultivation, and domestic livestock was also discussed. The questionnaire was adjusted and shortened due to the actual products from forest, crops, and farm animals that participants mentioned.

After group discussions, the draft questionnaires were discussed with economic experts from several universities in Vietnam and revised where necessary[5]. Several unnecessary questions were eliminated, the order of several questions were changed. The sentences were shortened and clarified as far as possible.

4.3.4. Pre-test

Before doing the pre-test, ten interviewers were trained within three days. Those interviewers were fourth-year students at Thai Nguyen University of Agriculture and Forestry who studied agriculture and forestry. On the first day, they were introduced to the purposes of the surveys and were explained the content of questionnaires. On the second day, they were trained interview skills: how to read the questions, how to fill in the questionnaires, how to interact with the local people, how to control the interview time, and how to keep the interview consistently without providing other information which was not mentioned in the questionnaires. On the third day, the interviewers practiced

[5] Universities involved in the discussions: Thai Nguyen University of Agriculture and Forestry, Hanoi University of Agriculture, Vietnam Forestry University, University of Economics Ho Chi Minh City.

interviews independently by themselves, and then received the comments from supervisors. At the final stage, ten households were invited to take part in real interviews. Finally, five interviewers, who performed best, were chosen to conduct the main surveys.

20 forest contracted households in Dinh Hoa were chosen for conducting the WTA pre-test and 20 households in Thai Nguyen city and Phu Binh district were selected for the WTP pre-test. Feedbacks from pre-test were used to adjust both the questionnaire items and enumerators' way of asking to ensure the correct understanding of questionnaire, fit the local context and language, control time consuming, and improve the interview skills.

In general, respondents felt comfortable with the pre-test surveys. Pictures of Dinh Hoa forests were helpful to the WTP survey as people were far away from forests and were not informed of forests situation. On the contrary, pictures were not necessary in case of the WTA survey because forest contracted households were clearly aware of the forest condition in Dinh Hoa. We decided to eliminate supporting pictures in the WTA survey in order to save interviewing time and control the concentration of respondents.

4.4. Questionnaire design

4.4.1. Double-bounded dichotomous choice approach

In order to estimate maximum WTP and minimum WTA, four major elicitation techniques are used: the open-ended, bidding game, payment cards, and dichotomous choice (DC) approach.

- Open-ended: respondents are asked for their maximum WTP or minimum WTA, e.g. "How much are you willing to pay VND X for good A?" This elicitation method is simple, straightforward, easy to apply, and avoids an "anchoring"-effect (respondents influenced by a suggested starting value). This elicitation format becomes difficult if respondents are unfamiliar with the commodity in question. This might explain why this approach has high rates of non-responses, protest answers, and zero answers (Bateman et al., 2002). Strategic bias such as free riding and overbidding might happen with open-ended format (Garrod and Willis, 1999; Mitchell and Carson, 1989).

- Bidding game: interviewers deal with respondents until the final price is identified. Respondents reply to the question "Are you willing to pay VND X for good A?" by a "Yes" or a "No" answer. If respondents say "Yes", interviewers will increase the value until respondents say "No", and otherwise. This method allows respondents to consider their preferences thoroughly. The disadvantage of the bidding game method is that the respondent might be influenced by the starting value, and thus, a starting point bias or anchoring bias might occur. The bidding game is appropriate for in-person interviews and cannot be used in mail surveys, telephone interviews, and web-based surveys.

- Payment card: respondents choose a WTP point from a list of values. The payment card approach is considered an alternative method between open-ended and bidding game, avoiding starting point bias and strategic bidding. The range bias might occur if the true WTP or WTA of respondents does not lie in the value range offered. Range bias might be avoided by extending the value range without constraining respondents' preferences.

- Dichotomous choice, i.e. referendum format: Respondents reply to the question "Are you willing to pay VND X for good A?" by a "Yes" or a "No" answer. Compared to other elicitation formats, the DC is easier for respondents because they do not provide (as in open-ended format) or chose a specific value (as in payment card format). Instead, they simply agree or disagree with a given bid by answering "Yes" or "No" to the question. This approach is more realistic as respondents make decisions confronted with fixed prices. The use of the DC approach mitigates strategy bias and free riding (Mitchell and Carson, 1989), and minimizes non-responses and outliers (Carson and Groves, 2007). Furthermore, addressing each respondent to each price or bid offer would restrain value, which tends to be overestimated in WTA study and underestimated in WTP survey. The DC approach is further divided into two types: single-bounded dichotomous choice (SBDC) or take-it-or-leave-it and double-bounded dichotomous choice (DBDC) or take-it-or-leave-it with follow-up.

NOAA recommended DC method for a contingent valuation study, especially in developing countries (Arrow et al., 1993). In the early 1990s, experimental study results carried out by

Hanemann et al. (1991) and Kanninen (1993) illustrated that the DBDC was statically more efficient than the SBDC approach. This study used DBDC to evaluate the WTP and WTA.

Double-bounded dichotomous choice

In DBDC format, the total sample is divided into sub-samples of which each sub-sample is assigned a bid. Each respondent then has a chance to deal with two bids. In a WTP format, the initial bid ($BID_{i;WTP}$) will be reduced to the lower bid ($BID_{l;WTP}$) if respondent refuses $BID_{i;WTP}$, and increased one level ($BID_{h;WTP}$), if otherwise. The process will stop with a "Yes" or a "No" answer to the second bid (Figure 13).

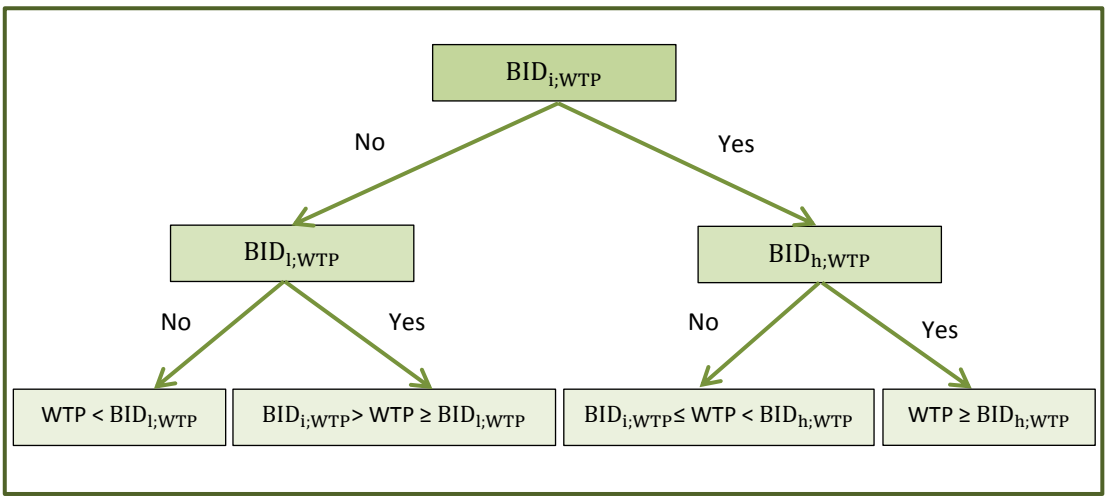


Figure 13: Double-bounded dichotomous format - WTP

DBDC could have four possible outcomes:

- yes/yes: "yes" to $BID_{i;WTP}$ followed by "yes" to $BID_{h;WTP}$
- yes/no: "yes" to $BID_{i;WTP}$ followed by "no" to $BID_{h;WTP}$
- no/yes: "no" to $BID_{i;WTP}$ followed by "yes" to $BID_{l;WTP}$
- no/no: "no" to $BID_{i;WTP}$ followed by "no" to $BID_{l;WTP}$

In this study, 300 respondents were randomly assigned into five sub-groups, each group included 60 respondents. Each sub-group was assigned one of the five initial bid levels: VND [10,000; 20,000; 35,000; 50,000; 80,000]. The bid design is presented in Table 8.

Table 8: Bid design – WTP survey

Sub-group	Number of respondents (N)	If "NO" Lower bid level ($BID_{l;WTP}$) (VND thousand)	Initial bid Level ($BID_{i;WTP}$) (VND thousand)	If "YES" Upper bid level ($BID_{h;WTP}$) (VND thousand)
1	60	5	10	20
2	60	10	20	35
3	60	20	35	50
4	60	35	50	80
5	60	50	80	120

In a WTA format, initial bid ($BID_{i;WTA}$) will be increased to higher bid ($BID_{h;WTA}$) if respondent refuses $BID_{i;WTA}$, and decreased one level ($BID_{l;WTA}$), if otherwise. The process will stop with a "Yes" or a "No" answer to the second bid (Figure 14).

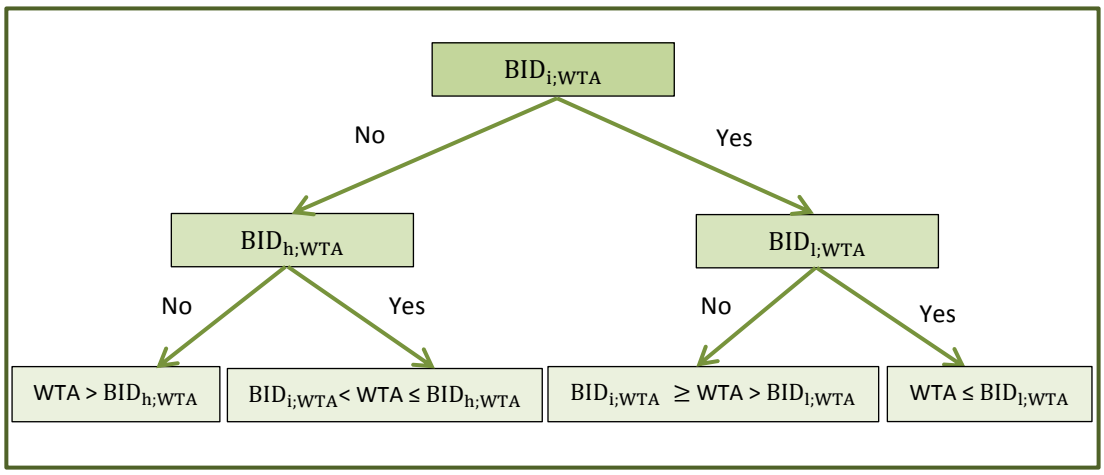


Figure 14: Double-bounded dichotomous format - WTA

DBDC could have four possible outcomes:

- yes/yes: "yes" to $BID_{i;WTA}$ followed by "yes" to $BID_{l;WTA}$
- yes/no: "yes" to $BID_{i;WTA}$ followed by "no" to $BID_{l;WTA}$
- no/yes: "no" to $BID_{i;WTA}$ followed by "yes" to $BID_{h;WTA}$
- no/no: "no" to $BID_{i;WTA}$ followed by "no" to $BID_{h;WTA}$

Similar to the WTP survey, 300 respondents in the WTA survey were randomly assigned into five sub-groups, each group included 60 respondents. Each sub-group was assigned

one of the five initial bid levels: [VND 100,000; 250,000; 400,000; 600,000; 800,000]. The bid design is presented in Table 9.

Table 9: Bid design – WTA survey

Sub-group	Number of respondents (N)	If "YES" Lower bid level ($BID_{l;WTA}$) (VND thousand)	Initial bid level ($BID_{i;WTA}$) (VND thousand)	If "NO" Upper bid level ($BID_{h;WTA}$) (VND thousand)
1	60	50	100	250
2	60	100	250	400
3	60	250	400	600
4	60	400	600	800
5	60	600	800	1000

4.4.2. Questionnaire structure

4.4.2.1. WTP survey

The questionnaire of the WTP survey included three sections (see Appendix 5). In the first section, respondents were asked about their attitudes and opinions about general environmental interests. Then several questions about perceptions, opinions, and preferences towards forest protection in the Dinh Hoa district were adopted. The second section debriefed the respondent's WTP. This section included a contingent valuation scenario, valuation elicitation questions, and follow-up questions to ensure the certainty of responses. The final section contained questions of demographic and socio-economic characteristics of respondents.

The scenario of the survey was formulated as

"*Forests provide a range of environmental, social, and economic benefits that improve our quality of life.*

- *Healthy forests clean and improve our air, store carbon, and moderate the climate.*
- *Forests conserve and purify water, prevent flood and drought, prevent soil erosion, and preserve the integrity of topsoil.*
- *Forests serve as homes and support wildlife.*

- *Forests enhance the beauty of landscapes, create and provide recreational and educational opportunities.*
- *People can enjoy economic benefits such as revenue from the processing and trade of forest products, reduction of energy costs, and employment opportunities.*

Dinh Hoa district is characterized by its rich social and cultural diversity as well as its important role in the region's economic development. Dinh Hoa forest is an especially important part of the Dinh Hoa Safety Zone, a national historical site including 109 relics from the revolutionary era. The forest covers about 30,000 ha representing 58% of the total land. Half of forest area is covered with natural forests. The district, like those in other mountainous regions in Northern Vietnam, suffers from forest loss, forest degradation, and biodiversity loss. As a result, the number of flora and fauna species has decreased dramatically over the years.

Forest protection not only benefits the people in Dinh Hoa district by preserving natural forests, it also increases environmental services, promotes tourism, and ensures historical preservation. Over the years, the government has made a significant effort to support afforestation and forest rehabilitation in Dinh Hoa district. Nevertheless, the protection of Dinh Hoa forest is threatened by limited financial support.

Suppose that a fund for Dinh Hoa forest development and protection was created to support natural forest management in Dinh Hoa district. The money collected would be given directly to foresters and farmers involved in managing and protecting forests in Dinh Hoa. The money would be paid to them twice a year: at the end of the first six months and at the end of the last six months. Payments would only be made if all terms in the protection contract were met. The payment would be withdrawn and a fine would be issued in the case of any forest loss.

Suppose that this program was implemented in the next five years and needed the support of all households in Thai Nguyen province. We are now going to ask how much your household would be willing to pay as a one-time contribution to the Dinh Hoa forest development and protection program. There is no right or wrong answer. Please keep in mind your household incomes and living expenses.

Suppose that your household, as well as all other households in Thai Nguyen province, were asked to contribute to the project as a one-time payment. Would you be willing to pay VND….. thousand per household as maximum payment?

If Yes, would you be willing to pay VND….thousand per household?

If No, would you be willing to pay VND….thousand per household?"

4.4.2.2. WTA survey

The questionnaire of the WTA survey included four sections (see Appendix 6).

Firstly, the households were asked about the current situation of local forests: General information about forests which were contracted or allocated to households; how the forests have changed over five years; how forests´ most significantly impact their daily life and agriculture activities; and their perspective on the forests´ future. These questions reminded the households of the forests´ condition and motivated them to think about their preferences. The second section debriefed the respondent's WTA. This section included the valuation scenario, the valuation elicitation questions, and the follow-up questions to validate the certainty of responses. Economic activities related to forest products collected, crops cultivated, and raising farm animals were mentioned in section three. The objective of this section was to calculate the total income and identify farmers´ livelihoods. In the last section, demographic characteristics of the respondents, such as age, gender, marital status, number of household members, education, and occupation were gathered.

The contingent valuation question was formulated as

"Suppose that the payment for natural forest protection is adjusted in the next five years. As a result, you would receive a new contract which clarifies your rights and your obligations to the forest. All benefit rights to the forest would remain, but any illegal logging, illegal agriculture cultivation, and uncontrolled grazing in the forest would be prohibited. The money would be paid out twice a year: at the end of the first six months and at the end of the last six months. You would only be paid if all terms in the protection contract were met. The payment would be withdrawn and a fine would be issued in the case of any forest loss.

Suppose that your household, as well as all other households in the Dinh Hoa district to which natural forest are contracted for protection, would be compensated VND..... thousand per ha per year from now on for next five years. Would you accept VND..... thousand as minimum compensation?

If Yes, would you accept VND..... thousand per ha per year?

If No, would you accept VND..... thousand per ha per year?"

4.5. Method

4.5.1. WTP model

4.5.1.1. Double-bounded logit model

Single-bounded format

The probability of a "yes" response to an initial bid is

$$\text{Prob(yes)} = P^{y}_{i;WTP} = \text{prob}(WTP_i \geq BID_{i;WTP})$$

where $BID_{i;WTP}$ is the value of the initial bid i offered, WTP_i is the true value of WTP of respondent i, and $P^{y}_{i;WTP}$ is probability of saying "yes" to the initial bid i.

The probability of a "no" response is (1 - $P^{y}_{i;WTP}$)

$P^{y}_{i;WTP}$ can be expessed as logit form:

$$P^{y}_{i;WTP} = G(\alpha + \beta BID_{i;WTP}) = \frac{1}{1 + e^{-(\alpha+\beta BID_{i;WTP})}}$$

where $G(\alpha + \beta BID_{i;WTP})$ is the logit function, α is the intercept, and β is the coefficient of $BID_{i;WTP}$.

The binary choice log-likelihood function (L^{SB}) is

$$L^{SB} = \sum_{i=1}^{n} y_i \log P^{y}_{i;WTP} + \sum_{i=1}^{n} (1 - y_i) \log(1 - P^{y}_{i;WTP})$$

where y_i $\begin{cases} = 1, \text{if response is “yes"} \\ = 0, \text{otherwise} \end{cases}$

Double-bounded format

DBDC could have four possible outcomes:

- yes/yes: “yes” to $\mathrm{BID}_{\mathrm{i;WTP}}$ followed by “yes” to $\mathrm{BID}_{\mathrm{h;WTP}}$
- no/no: “no” to $\mathrm{BID}_{\mathrm{i;WTP}}$ followed by “no” to $\mathrm{BID}_{\mathrm{l;WTP}}$
- yes/no: “yes” to $\mathrm{BID}_{\mathrm{i;WTP}}$ followed by “No” to $\mathrm{BID}_{\mathrm{h;WTP}}$
- no/yes: “no” to $\mathrm{BID}_{\mathrm{i;WTP}}$ followed by “yes” to $\mathrm{BID}_{\mathrm{l;WTP}}$

Probability of four responses are: $\mathrm{P}^{\mathrm{yy}}_{\mathrm{i;WTP}}$, $\mathrm{P}^{\mathrm{nn}}_{\mathrm{i;WTP}}$, $\mathrm{P}^{\mathrm{yn}}_{\mathrm{i;WTP}}$, $\mathrm{P}^{\mathrm{ny}}_{\mathrm{i;WTP}}$

$$\mathrm{P}^{\mathrm{yy}}_{\mathrm{i;WTP}} = \frac{1}{1+\mathrm{e}^{-(\alpha+\beta \mathrm{BID}_{\mathrm{h;WTP}})}}$$

$$\mathrm{P}^{\mathrm{nn}}_{\mathrm{i;WTP}} = 1 - \frac{1}{1+\mathrm{e}^{-(\alpha+\beta \mathrm{BID}_{\mathrm{l;WTP}})}}$$

$$\mathrm{P}^{\mathrm{yn}}_{\mathrm{i;WTP}} = \frac{1}{1+\mathrm{e}^{-(\alpha+\beta \mathrm{BID}_{\mathrm{h;WTP}})}} - \frac{1}{1+\mathrm{e}^{-(\alpha+\beta \mathrm{BID}_{\mathrm{i;WTP}})}}$$

$$\mathrm{P}^{\mathrm{ny}}_{\mathrm{i;WTP}} = \frac{1}{1+\mathrm{e}^{-(\alpha+\beta \mathrm{BID}_{\mathrm{i;WTP}})}} - \frac{1}{1+\mathrm{e}^{-(\alpha+\beta \mathrm{BID}_{\mathrm{l;WTP}})}}$$

The double-bounded log-likelihood function (L^{DB}) now has four parts

$$\mathrm{L}^{\mathrm{DB}} = \sum_{i=1}^{n} \mathrm{I}^{\mathrm{yy}}_{\mathrm{i;WTP}} \log \mathrm{P}^{\mathrm{yy}}_{\mathrm{i;WTP}} + \sum_{i=1}^{n} \mathrm{I}^{nn}_{\mathrm{i;WTP}} \log \mathrm{P}^{\mathrm{nn}}_{\mathrm{i;WTP}}$$

$$+ \sum_{i=1}^{n} \mathrm{I}^{\mathrm{yn}}_{\mathrm{i;WTP}} \log \mathrm{P}^{\mathrm{yn}}_{\mathrm{i;WTP}} + \sum_{i=1}^{n} \mathrm{I}^{\mathrm{ny}}_{\mathrm{i;WTP}} \log \mathrm{P}^{\mathrm{ny}}_{\mathrm{i;WTP}}$$

where $\mathrm{I}^{\mathrm{yy}}_{\mathrm{i;WTP}}$, $\mathrm{I}^{nn}_{\mathrm{i;WTP}}$, $\mathrm{I}^{\mathrm{yn}}_{\mathrm{i;WTP}}$, $\mathrm{I}^{\mathrm{ny}}_{\mathrm{i;WTP}}$ are binary-valued indicator variables.

$\mathrm{I}^{\mathrm{yy}}_{\mathrm{i;WTP}}$ $\begin{cases} = 1, \text{if the respondent i accepts both initial and the higher bids} \\ = 0, \text{otherwise} \end{cases}$

$\mathrm{I}^{\mathrm{nn}}_{\mathrm{i;WTP}}$ $\begin{cases} = 1, \text{if the respondent i rejects both initial and lower bids} \\ = 0, \text{otherwise} \end{cases}$

$\mathrm{I}^{\mathrm{yn}}_{\mathrm{i;WTP}}$ $\begin{cases} = 1, \text{if the respondent i accepts the initial but rejects the higher bid} \\ = 0, \text{otherwise} \end{cases}$

$$I_{i;WTP}^{ny} \begin{cases} = 1, \text{if the respondent i rejects the initial bid but accepts the lower bid} \\ = 0, \text{otherwise} \end{cases}$$

4.5.1.2. Model specification

The maximum amount of utility that respondent i, can get from his household income Y_{0i} regarding to socio-economic characteristic X_i is given by the assuming indirect utility function:

$$v(Y_{0i}, X_i)$$

It is assumed that a respondent will accept a proposed level of payment as a contribution to the forest protection program in the Dinh Hoa district and still maximize his utility under the following condition

$$v(Y_{0i}, X_i) + \varepsilon_{0i} \leq v(Y_{0i} - BID_{i;WTP},\ X_i) + \varepsilon_{1i}$$

where $BID_{i;WTP}$ is the payment level offered to the respondent i, ε_i is the stochastic term that represents for the part of the true direct utility that cannot be captured.

The WTP of respondent i can be expressed under the linear or logistic form as

$$Ln(\frac{WTP}{1-WTP}) = \beta_{0i} + \beta_{1i}BID_{i;WTP} + \beta_{2i}X_{2i} + \ldots + \beta_{ni}X_{ni} + u_i$$

where β_0 is the intercept, β_1 is the regression coefficient of the bid, β_2, …, β_{ni} represents the regression coefficients of motivation and socio-economic variables $X_2 \ldots, X_{ni}$, and u_i is disturbance term.

4.5.1.3. Variables definition

The general logit model used in the study is presented as:

$$\begin{aligned} Ln(\frac{WTP}{1-WTP}) = {} & \beta_0 + \beta_1 BID + \beta_2 AGE + \beta_3 HOUSEHOLD.SIZE + \beta_4 GENDER + \beta_5 ETHNIC \\ & + \beta_6 EDUCATION + \beta_7 INCOME + \beta_8 EMPLOYMENT + \beta_9 SOCIO.ORGANIZATION \\ & + \beta_{10} FOREST.INFORMATION + \beta_{11} FOREST.BENEFIT + \beta_{12} FOREST.DEGRADATION \\ & + \beta_{13} PREVIOUS.VISIT + \beta_{14} FUTURE.VISIT + u. \end{aligned}$$

The model includes 14 independent variables, which are demographic, socio-economic, and motivation variables. The explanatory variables are defined in Table 10.

Table 10: Definition of the variables influencing WTP

Variable	Definition	Hypothesized direction of influence
BID	Bid offered (VND thousand)	-
AGE	Age of respondent (years)	+/-
HOUSEHOLD.SIZE	Household size (member)	-
GENDER	Dummy: Respondent´s gender (male = 1, female = 0)	+
ETHNIC	Dummy: Respondent´s ethnic ("Kinh" group = 1, other minority groups = 0)	+
EDUCATION	Respondent´s education level (none school = 1, primary school = 2, middle school = 3, secondary school = 4, college/university = 5, post graduate = 6)	+
INCOME	Annual household incomes level (less than VND 12 million = 1, from VND 12 million to less than 24 million = 2, … from VND 228 million to less than 240 million = 20, more than VND 240 million = 21)	+
EMPLOYMENT	Dummy: Employment (get employed by state institutions and enterprises, private enterprises = 1, unemployed = 0)	+
SOCIO.ORGANIZATION	Dummy: Member of socio organizations (yes = 1, no = 0)	+
FOREST.INFORMATION	Dummy: Had access of information of Dinh Hoa forest by communication media (yes = 1, no = 0)	+
FOREST.BENEFIT	Dummy: Awareness of benefits of forests to communities (yes = 1, no = 0)	+
FOREST.DEGRADATION	Dummy: Awareness of forest degradation in Dinh Hoa (yes = 1, no = 0)	+
PREVIOUS.VISIT	Dummy: Visited Dinh Hoa forest (yes = 1, no = 0)	+
FUTURE.VISIT	Dummy: Plan to visit Dinh Hoa forest in the next 3 years (yes = 1, no = 0)	+

The payment level is hypothesized to be negative in relationship to WTP. The higher payment level offered, the less willing to pay the respondent would be.

The size of household is hypothesized to negatively influence WTP. The increasing household size can increase household consumption demand. As a result, the larger households are assumed to pay less than the smaller households.

Older individuals may pay more attention to environmental issues than younger generations. However, older individuals have fewer opportunities to earn an income or gain employment compared to younger generations due to physical limitations. The influence of age of respondents to WTP, hence, is unpredictable.

The acceptance of payment offered may be different between men and women. As men typically earn higher incomes than women, men are expected to be more willing to pay than women. The gender of respondents is hypothesized to be positive in relationship to WTP.

Individuals of the “Kinh” group, who typically live in cities, towns, and district centers, have higher education and income levels, a better quality of life, and greater access to information than minority ethnic groups who live in mountainous areas and depend on crops cultivation. “Kinh” individuals are assumed to be more WTP than those of other ethnic groups.

Education level of respondents is hypothesized to be positive in relationship to WTP. Well-educated respondents are expected to have a higher awareness of and greater appreciation for natural resources. Higher educated respondents are expected to be more willing to pay than lower educated respondents.

Household incomes are expected to have positive relationship to WTP. The higher the incomes they earn, the higher the level payment they are willing to pay.

Respondents who are employed by state institutions, state enterprises, and private enterprises could be paid more regularly than those who are unemployed. The occupation of respondents is expected to have a positive relationship to WTP.

Members of social organizations typically join social activities. They interact with each other and share characteristics. They would be more flexible in behaviors to social and environmental issues. Respondents who are members of social organizations are hypothesized to pay higher than those who are not members of any social organization.

Respondents who have had access to information about forests through the media, have visited Dinh Hoa forest, are aware of the benefits provided by forests and are likewise aware of the degradation situation of Dinh Hoa forest, and plan to visit Dinh Hoa forest in the future have more motivation to pay for the protection of forests. They are, thus hypothesized to be more willing to pay.

4.5.1.4. Mean and median WTP

The mean WTP and the median WTP can be estimated using the formulas suggested by Hanemann et al. (1991)

$$\text{Mean WTP} = \frac{1}{|B_{1i}|} \ln[1+e^{(\beta_{0i} + \beta_{2i}\overline{X_{2i}} + \cdots + \beta_{ni}\overline{X_{ni}})}]$$

$$\text{Median WTP} = \frac{1}{|B_{1i}|}[\beta_{0i} + \beta_{2i}\overline{X_{2i}} + \cdots + \beta_{ni}\overline{X_{ni}}]$$

where $\overline{X_{2i}}$, …, $\overline{X_{ni}}$ are the mean values of socio-economic variables.

The variance of WTP in the population as suggested by Bateman et al. (2002) is given by

$$\text{var(WTP)} = \sum_{j=0}^{J}(B_j - \overline{WTP})^2(\hat{S}(B_j) - \hat{S}(B_{j+1}))$$

where $\overline{WTP}$ is mean WTP; B_j are Bid level (j = 1 to J); $\hat{S}(B_j)$ and $\hat{S}(B_{j+1})$ are the proportion of respondents saying "Yes" to bids offered which called survivor curves; and it is assumed that $\hat{S}(B_0) = 1$ and $\hat{S}(B_{j+1}) = 0$.

The variance of mean WTP is given by

$$\text{var}(\overline{WTP}) = \frac{\text{var(WTP)}}{N}$$

where N is the sample size.

The 95% confidence interval will be defined by:

$$\overline{WTP} - 1.96\sqrt{\text{var}(\overline{WTP})} \text{ and } \overline{WTP} + 1.96\sqrt{\text{var}(\overline{WTP})}$$

Using similar estimation, it is possible to identify the variance and the 95% confidence interval of the median WTP.

4.5.1.5. WTP aggregation

The WTP aggregation can be calculated by multiplying the mean WTP by the size of population N.

Total WTP for natural forest protection in Dinh Hoa district is given by

Aggregate WTP = $N.\ \overline{WTP}$

where N are the number of households in Thai Nguyen province.

4.5.2. WTA model

4.5.2.1. Double-bounded logit model

Single-bounded logit model

The probability of a "yes" response to an initial bid is

$$\text{Prob(yes)} = P^{y}_{i;WTA} = \text{prob}(WTA_i \le BID_{i;WTA})$$

where $BID_{i;WTA}$ is the value of the initial bid offered, WTA_i is the true value of WTA of respondent i, and $P^{y}_{i;WTA}$ is the probability of saying "yes" to the initial bid i.

The probability of a "no" response is $(1 - P^{y}_{i;WTA})$

$P^{y}_{i;WTA}$ can be expessed as logit form:

$$P^{y}_{i;WTA} = G(\alpha + \beta BID_{i;WTA}) = \frac{1}{1 + e^{-(\alpha+\beta BID_{i;WTA})}}$$

where $G(\alpha + \beta BID_{i;WTA})$ is logit function, α is the intercept, and β is the coefficient of $BID_{i;WTA}$.

The binary choice log-likelihood function (L^{SB}) is

$$L^{SB} = \sum_{i=1}^{n} y_i \log P^{y}_{i;WTA} + \sum_{i=1}^{n} (1 - y_i) \log(1 - P^{y}_{i;WTA})$$

where y_i $\begin{cases} = 1, \text{if response is “yes"} \\ = 0, \text{otherwise} \end{cases}$

Double-bounded logit model

DBDC could have four possible outcomes:

- yes/yes: “yes” to $BID_{i;WTA}$ followed by “yes” to $BID_{l;WTA}$
- no/no: “no” to $BID_{i;WTA}$ followed by “no” to $BID_{h;WTA}$
- yes/no: “yes” to $BID_{i;WTA}$ followed by “No” to BID_{l}^{WTA}
- no/yes: “no” to $BID_{i;WTA}$ followed by “yes” to $BID_{h;WTA}$

Probability of four responses are: $P_{i;WTA}^{yy}$, $P_{i;WTA}^{nn}$, $P_{i;WTA}^{yn}$, $P_{i;WTA}^{ny}$

$$P_{i;WTA}^{yy} = \frac{1}{1+e^{-(\alpha+\beta BID_{l;WTA})}}$$

$$P_{i}^{nn(WTA)} = 1 - \frac{1}{1+e^{-(\alpha+\beta BID_{h;WTA})}}$$

$$P_{i;WTA}^{yn} = \frac{1}{1+e^{-(\alpha+\beta BID_{i;WTA})}} - \frac{1}{1+e^{-(\alpha+\beta BID_{l;WTA})}}$$

$$P_{i;WTA}^{ny} = \frac{1}{1+e^{-(\alpha+\beta BID_{h;WTA})}} - \frac{1}{1+e^{-(\alpha+\beta BID_{i;WTA})}}$$

The double-bounded log-likelihood function (L^{DB}) now has four parts

$$L^{DB} = \sum_{i=1}^{n} I_{i;WTA}^{yy} \log P_{i;WTA}^{yy} + \sum_{i=1}^{n} I_{i;WTA}^{nn} \log P_{i;WTA}^{nn}$$

$$+ \sum_{i=1}^{n} I_{i;WTA}^{yn} \log P_{i;WTA}^{yn} + \sum_{i=1}^{n} I_{i;WTA}^{ny} \log P_{i;WTA}^{ny}$$

where $I_{i;WTA}^{yy}$, $I_{i;WTA}^{nn}$, $I_{i;WTA}^{yn}$, $I_{i;WTA}^{ny}$ are binary valued indicator variables.

$I_{i;WTA}^{yy}$ $\begin{cases} = 1, \text{if the respondent i accepts both initial and lower bids} \\ = 0, \text{otherwise} \end{cases}$

$I_{i;WTA}^{nn}$ $\begin{cases} = 1, \text{if the respondent i rejects both initial and higher bids} \\ = 0, \text{otherwise} \end{cases}$

$I_{i;WTA}^{yn}$ $\begin{cases} = 1, \text{if the respondent i accepts the initial but rejects the lower bid} \\ = 0, \text{otherwise} \end{cases}$

$$I_{i;WTA}^{ny} \begin{cases} = 1, \text{if the respondent i rejects the initial bid but accepts the higher bid} \\ = 0, \text{otherwise} \end{cases}$$

4.5.2.2. Model specification

The maximum amount of utility that household i can get from its household income Y_{0i} regarding to socio-economic characteristic X_i is given by the assuming indirect utility function:

$$v(Y_{0i}, X_i)$$

The cost of forest protection is the reduction in income from Y_{0i} to Y_{1i} ($Y_{0i} > Y_{1i}$). The compensation for benefits loss from protection of forest should be the amount of money that would leave household i at the same utility level as before. It is assumed that respondent i will accept a proposed level of compensation and still maximize his utility under the following condition

$$v(Y_{0i}, X_i) + \varepsilon_{0i} \leq v(Y_{1i} + BID_{i;WTA}, X_i) + \varepsilon_{1i}$$

where $BID_{i;WTA}$ is the payment level offered to household i, ε_i is the stochastic term that represents the part of the true direct utility that cannot be captured.

The WTA of respondent i can be expressed under the linear or logistic form as

$$Ln(\frac{WTA}{1-WTA}) = \beta_{0i} + \beta_{1i}BID_{i;WTA} + \beta_{2i}X_{2i} + \ldots + \beta_{ni}X_{ni} + u_i$$

where β_0 is the intercept, β_1 is the regression coefficient of the bid, β_2, …, β_{ni} represent the regression coefficients of socio-economic variables $X_2, \ldots, X_{ni}$, and u_i is disturbance term.

4.5.2.3. Variables definition

The general logit model used in the study is presented as:

$$\begin{aligned} Ln(\frac{WTA}{1-WTA}) = {} & \beta_0 + \beta_1 BID + \beta_2 AGE + \beta_3 HOUSEHOLD.SIZE + \beta_4 EDUCATION + \beta_5 GENDER \\ & + \beta_6 ETHNIC + \beta_7 INCOME + \beta_8 FORESTLAND + \beta_9 DISTANCE \\ & + \beta_{10} PLANTED.FOREST + \beta_{11} FUELWOOD + \beta_{12} BAMBOO + \beta_{13} PALM.TREE + u \end{aligned}$$

The levels of payment that forest contracted households are willing to accept is hypothesized to be influenced by three groups of factors: demographic characteristics (age, gender, education, ethnic, household size, and income), the characteristics of forest contracted (natural forest area, distance to the forest, and planted forest allocated), and the benefits from forest (fuelwood, bamboo, and palm tree). All the variables are hypothesized to explain changes in WTA function. Table 11 provides the definition of these variables.

Table 11: Definition of the variables influencing WTA

Variable	Definition	Hypothesized direction of influence
BID	Bid offered (VND thousand)	+
AGE	Age of respondent (years)	+
HOUSEHOLD.SIZE	Household size (member)	+/-
EDUCATION	Respondent´s education level (grade)	+
GENDER	Dummy: Respondent´s gender (male = 1, female = 0)	-
ETHNIC	Dummy: Respondent´s ethnic ("Kinh" group = 1, minority groups = 0)	-
INCOME	Household incomes (VND million)	-
FORESTLAND	Natural forest area contracted to household (ha)	+
DISTANCE	Distance from farmers´ houses to the border of nearest contracted natural forests (km)	-
PLANTED.FOREST	Dummy: Planted forest allocated to household (Yes = 1, No = 0)	+
FUELWOOD	Dummy: Fuel wood collected from the natural forests (Yes = 1, No = 0)	+
BAMBOO	Dummy: Bamboo collected from the natural forests (Yes = 1, No = 0)	+
PALM.TREE	Dummy: Palm tree collected from the natural forests (Yes = 1, No = 0)	+

The payment level is hypothesized to be positive in relationship to WTA. The higher compensation level is more likely influencing households to say "yes" to the bid offered.

Older farmers have less chance to earn non-farm incomes or gain none-farm employment compared to younger farmers because of their physical limitations. Older farmers are expected to be more involved in forest protection programs than younger one. The age of respondents is hypothesized to have a positive relationship to WTA.

Household size can influence WTA by resulting in an increase in potential labor supply that has an impact on household production and incomes. Respondents with more household members may earn higher farm and non-farm incomes; they will likely require less compensation. On the contrary, increasing household size can increase household consumption demand, hence a higher requirement of payment level for one ha of forest protection is proposed. The effect of household size on WTA is therefore unpredictable.

Well-educated farmers are expected to have better access to information and to be more aware of the importance of protecting natural forests. Respondents with higher education levels are expected to be more willing to accept or require lower payment levels than respondents with lower education levels. Hence, education level is assumed to have a positive relationship to WTA.

Gender of respondent is hypothesized to have a negative relationship to WTA. Women are more likely to accept the compensation than men because of the fact that women have less opportunity to earn non-farm incomes than men. Besides, men are paid more than women, i.e. opportunity cost of labor of men is higher than women. The demand by men for higher compensation levels is predictable.

Individuals from the “Kinh” ethnic group typically live father away from and are less dependent on forest resources than the other minority groups who live in mountainous areas and are closer to forests. “Kinh” individuals are assumed to be less WTA or require higher payment level than other minority ethnic people.

Households with higher incomes are assumed to require higher payment levels because of the higher opportunity cost of labor. Household income is hypothesized to have a negative relationship to WTA.

The forest land refers to the total forest land area that households were contracted to protect. Households contracted larger forest areas have a chance to receive higher payments than households contracted smaller forest areas, and thus they would be more willing to accept the compensation levels offered.

The distance from farmers´ houses to the border of forests is an important consideration to the households. The households, which their houses locate farther away from the forests,

are expected to be less WTA because of increase in time and higher expenses needed for forest management.

If farmers are simultaneously contracted natural forests for protection and allocated planted forests for planting, they normally invest time, capital, and labor on the forests. Therefore, taking more time to patrol the natural forests becomes manageable. Households, which were contracted natural forests and were allocated planted forests simultaneously, are assumed to be more willing to accept the payment levels offered.

Last but not least, benefits from forests directly affect households' decisions regarding payment levels. Households which collect fuelwood, bamboo, and palm tree products from natural forests are more motivated to patrol forests than households which do not. They are hypothesized to be more willing to accept the payment levels offered.

4.5.2.4. Mean and median WTA

The mean WTA and the median WTA can be estimated using the same method suggested by Hanemann et al. (1991).

$$\text{Mean WTA} = \frac{1}{|B_{1i}|} \ln[1+e^{(\beta_{0i} + \beta_{2i}\overline{X_{2i}} + \cdots + \beta_{ni}\overline{X_{ni}})}]$$

$$\text{Median WTA} = \frac{1}{|B_{1i}|}[\beta_{0i} + \beta_{2i}\overline{X_{2i}} + \cdots + \beta_{ni}\overline{X_{ni}}]$$

where $\overline{X_{2i}}$, …, $\overline{X_{ni}}$ are the mean values of socio-economic variables.

The variance of WTA in the population is:

$$\text{var(WTA)} = \sum_{j=0}^{J}(B_j - \overline{WTA})^2(\hat{S}(B_{j+1}) - \hat{S}(B_j))$$

where $\overline{WTA}$ is mean WTA; B_j are Bid level (j = 1 to J); $\hat{S}(B_j)$ and $\hat{S}(B_{j+1})$ are the proportion of respondents saying "Yes" to bids offered which called survivor curves, assuming that $\hat{S}(B_{j+1}) = 1$ and $\hat{S}(B_0) = 0$.

The variance of mean WTA is given by

$$\text{var}(\overline{WTA}) = \frac{\text{var(WTA)}}{N}$$

where N is the sample size.

The 95% confidence interval will be defined by:

$$\overline{\mathrm{WTA}} - 1.96\sqrt{\mathrm{var}(\overline{\mathrm{WTA}})} \text{ and } \overline{\mathrm{WTA}} + 1.96\sqrt{\mathrm{var}(\overline{\mathrm{WTA}})}$$

The variance of the median WTA and its 95% confidence interval are identified using similar estimation.

4.5.2.5. WTA aggregation

The WTA aggregation can be simply calculated by multiplying mean WTA by the size population N. Total WTA the compensation for natural forest protection in Dinh Hoa district is given by

$$\text{Aggregate WTA} = N.\ \overline{\mathrm{WTA}}$$

where N are the total ha of natural forest which are contracted to households for protection in Dinh Hoa district and $\overline{\mathrm{WTA}}$ is the mean value of WTA.

4.5.3. Goodness of fit

To measure the goodness of fit for dichotomous choice model, McFadden's pseudo R^2 is widely used, which displays how well the variation in the dependent variable can be explained by the independent variables. R^2 can be written as:

$$\mathrm{R}^2 = 1 - \frac{\mathrm{L}_0}{\mathrm{L}_{\max}}$$

where L_0 is the log-likelihood in the null case (where all coefficients are assumed equal to 0) and $\mathrm{L}_{\max}$ is the log-likelihood at convergence. Kanninen and Khawaja (1995) proved that the standard goodness of fit measures for discrete choice models is inappropriate in the case of the double-bounded logit model. The null hypothesis that all coefficients are equal to zero implies that the bid value has no impact on the response probability. But, the conditional nature of the follow-up bid value in the double-bounded format assumes a bid value effect. To deal with this problem, Herriges (1999) suggested the variant on McFadden's pseudo R^2

$$\widetilde{R}^2 = 1 - \frac{\tilde{L}_0}{L_{max}}$$

where $\tilde{L}_0$ corresponds to maximum value of L when all slope parameters, except the one on bid values, are constrained to zero. The restricted likelihood function then is well defined.

CHAPTER 5: RESULTS

5.1. WTP survey

5.1.1. Response rate, protest and zero responses

Among 300 responses of the WTP survey, 260 responses (87%) were useable for analysis, including 92 responses from Thai Nguyen city (urban area) and 168 responses from Phu Binh district and Dinh Hoa district (rural area). Three protest responses and 37 zero-responses were eliminated from the sample.

Protest responses

Among respondents of the WTP survey, three respondents protested the program. One respondent felt that the program was nonsense. The other respondent thought the program did not relate to him at all. The last respondent revealed that he did not believe the money would be used for the purpose of forest protection.

Zero responses

Respondents who were in favor of the program but did not agree with any of the two payment levels were asked for reasons for refusing payments. They were asked if they would offer any payment by themselves. The follow–up question was: “If you do not agree with both payment levels offered, what would be the amount that you are willing to pay for natural forest protection program in Dinh Hoa?”. In cases where respondents offered a lower payment by themselves, their responses were kept in the final sample. In cases where respondents refused to provide any amount, their responses were identified as “zero” payment, and were eliminated from the sample. In the WTP survey, 37 responses were classified as zero responses. The three most frequent reasons for refusing to pay were: (1) they cannot afford to pay; (2) they have to pay for many things; and (3) they need to know the other opinions about the program (Table 12). Several respondents thought that money alone could not help solve problems and they suspected that their money

would not be used for the purpose of forest protection. Several respondents mentioned that forest protection was not worthwhile and that the government should pay for the program.

Table 12: Reasons for zero responses

Reasons	Number	%
I cannot afford that amount	21	56.76
I need to know other opinions about the program	20	54.05
I have to pay for many things	15	40.54
I do not think protection of Dinh Hoa forest is worth doing	2	5.41
I think money cannot solely help solve problems	8	21.62
The government should pay	3	8.11
I do not believe that the money will be used for the purpose of forest protection	11	29.73
N = 37		

5.1.2. Socio-economic characteristics of respondents

Table 13 summarizes demographic and socio-economic characteristics of the whole sample and two sub-samples. Characteristics of age, gender, and household size do not significantly differ between sub-groups. The percentage of male (43%) and female (57%) of the whole sample reflects similar distribution of gender of the population in Thai Nguyen province. The average age is 49 years. 80% of respondents are in the working age from 20 to 60 years and 20% are older than 60 years. On average, households compose of four members which represents for the average household size in Thai Nguyen province and Vietnam.

The “Kinh” ethnic group accounts for 96% of the population in urban areas and 74% in rural areas. The “Kinh” ethnic group made up an average of 82% of total sample in the study and reflects the similar overall percentage of “Kinh” in Vietnam which was 86% (CIA, 2014).

Education level in urban areas is considerably higher than in rural areas. Respondents with college, university, and post graduate degrees account for 40% in Thai Nguyen city which is two times higher than in Dinh Hoa and Phu Binh districts. The percentage of respondents with primary school and middle school education in Thai Nguyen city is significantly lower than in Dinh Hoa and Phu Binh districts. In general, respondents in the WTP survey were found to be 100% literate.

Table 13: Demographic and socio-economic characteristics of respondents

Variable		Thai Nguyen city (N=92)		Phu Binh & Dinh Hoa district (N=168)		Total sample (N=260)	
		Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**
Age	Years	51.61	12.83	47.83	11.64	49.17	12.19
Household size	Member	4.20	1.76	3.96	1.18	4.04	1.41
		Number	**%**	**Number**	**%**	**Number**	**%**
Gender	Female	48	52.17	99	58.93	147	56.54
	Male	44	47.83	69	41.07	113	43.46
Ethnic	Other minority groups	4	4.35	43	25.60	47	18.08
	"Kinh" group	88	95.65	125	74.40	213	81.92
Education	None school	0	0.00	0	0.00	0	0.00
	Primary school	3	3.26	12	7.14	15	5.77
	Middle school	15	16.30	71	42.26	86	33.08
	Secondary school	37	40.22	49	29.17	86	33.08
	College/University	34	36.96	36	21.43	70	26.92
	Post graduate	3	3.26	0	0.00	3	1.15
Occupation	Stateinstitution/enterprise	20	21.74	37	22.02	57	21.92
	Private enterprise	10	10.87	2	1.19	12	4.62
	Self-employed	23	25.00	12	7.14	35	13.46
	Farmer	3	3.26	86	51.19	89	34.23
	Unemployed	36	39.13	31	18.45	67	25.77
Social organization membership	Farmers' Union	0	0.00	39	23.21	39	15.00
	Women´s Union	34	36.96	52	30.95	86	33.08
	Veterans Association	15	16.30	15	8.93	30	11.54
	Youth Union	6	6.52	4	2.38	10	3.85
	Other organization	19	20.65	22	13.10	41	15.77
	No membership	18	19.57	36	21.43	54	20.77

The distribution of occupations is remarkably different. In Phu Binh and Dinh Hoa districts, half of respondents are farmers; one fifth are unemployed (pensioners, students, and housewives). Self-employed and private enterprises account for 7% and 1% respectively. In Thai Nguyen city, unemployed respondents are the highest (40%), followed by self-employed (25%), private enterprises (10%), and farmers (3%). The respondents employed by state institutions and enterprises are similar between Thai Nguyen city and Dinh Hoa and Phu Binh district, representing 22% for both two sub-groups and the total sample.

80% respondents are members of at least one social organization. Membership in the Farmers´ Union is mainly observed in rural area, while membership of the Women´s Union is common in both urban and rural areas. Fewer respondents are members of the Veterans Association, Youth Union, and other organizations.

Figure 15 shows the distribution of household incomes and expenditures. The columns represent the share of household income while the lines expresses the distribution of household expenditure.

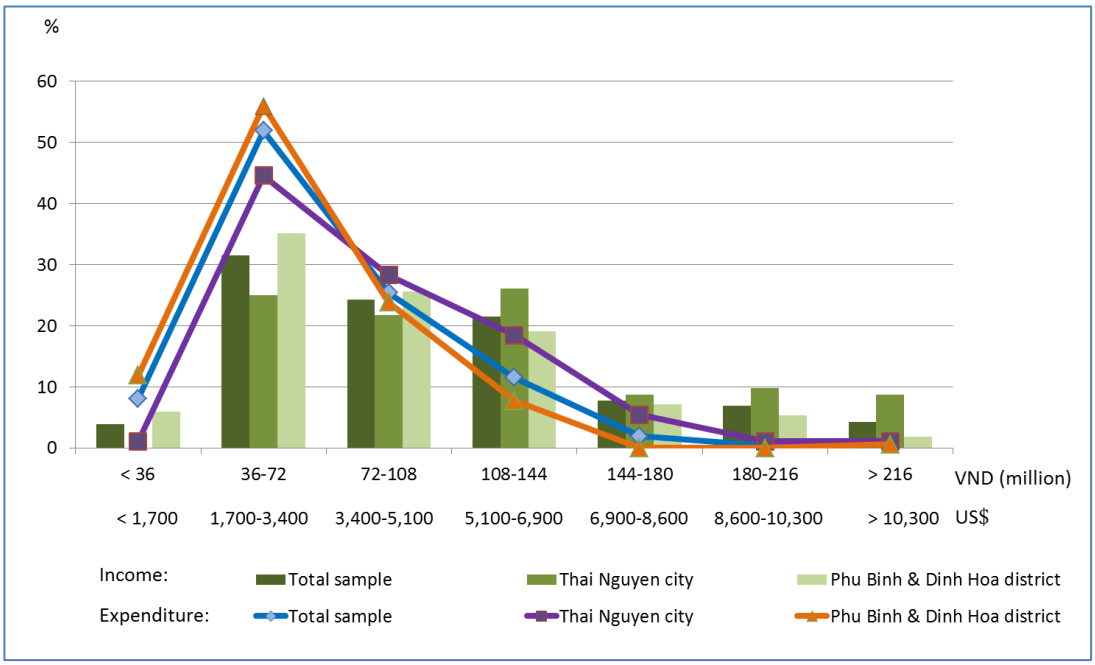


Figure 15: Distribution of household income and expenditure by selected income class

The largest group of household incomes ranges between VND 36 million and VND 72 million, which is equivalent to 35% of respondents in Phu Binh and Dinh Hoa districts, and between VND 108 million and VND 144 million, which is equivalent to 26% of respondents in Thai Nguyen city. From the income class between VND 108 million and VND 144 million to the upper end of distribution, the share of households at each income class in Thai Nguyen city are larger than in Phu Binh and Dinh Hoa districts. At the upper end of distribution, 8.7% of households in Thai Nguyen city and 1.8% of households in Phu Binh and Dinh Hoa districts have incomes exceeding VND 210 million.

The expenditure lines reach the peaks in both Dinh Hoa and Phu Binh districts (56% of respondents) and Thai Nguyen city (45% of respondents) at the expenditure class between

VND 36 million and VND 72 million. After the highest points to the end of expenditure lines, households in Phu Binh and Dinh Hoa districts have smaller shares than in Thai Nguyen city at each expenditure class.

The average household income and expenditure is displayed in Table 14. Households in Thai Nguyen city earn average incomes from VND 120 million to VND 132 million, while households in Phu Binh and Dinh Hoa districts earn from VND 84 million to VND 96 million. On average, expenditure ranged from VND 84 million to VND 96 million in Thai Nguyen city, VND 60 million to VND 72 million in Dinh Hoa and Phu Binh districts, and VND 72 million to VND 84 million for total sample. These findings are found to be similar to average household income in Thai Nguyen province which is VND 67 million VND (VND 97 million in urban areas and VND 56 million in rural areas) (TSO, 2012). This similarity allows a reliable extrapolation of WTP from the sample to the population of interest.

Table 14: Average household income and expenditure

	Unit	Phu Binh & Dinh Hoa district	Thai Nguyen city	Total sample
Income:	VND (million)	84 - 96	120 - 132	96 - 108
	US$	4,000-4,600	5,700-6,300	4,600-5,100
Expenditure:	VND (million)	60 - 72	84 - 96	72 – 84
	US$	2,900-3,400	4,000-4,600	3,400-4,000

Regarding income changes, 59% households noticed that their incomes increased slightly compared to previous years, 11% indicated a decrease, and the remaining households experienced no change. 45% of households stated that their household incomes were sufficient for daily expenses; 20% expressed that it covered expenses for food only; and 11% had a surplus. 49% of the respondents contributed more than 50% of the total household incomes.

With respect to living facilities, all households have access to electricity, health care services, schools, and communication media (radio, television). Approximately 50% of the respondents use clean drinking water; 50% have a refrigerator, a laptop, and a washing machine; 96% own motorbikes, 87% use gas for cooking; 20% have air conditioning; 97% have a cellphone; and 7% own an automobile. These numbers suggest that respondents in the sample have average living standards, and thus are reasonably representative for the

total population. The fact that 80% of respondents emphasized that they have similar living standards similar to others in the same areas supports the above argument.

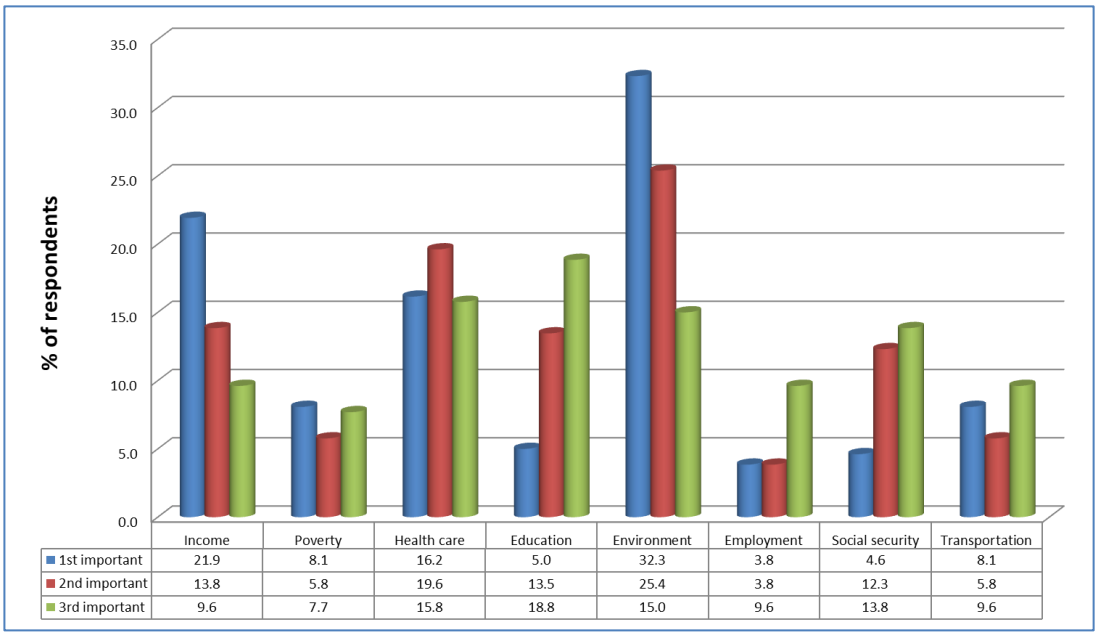
5.1.3. Attitudes and preferences towards forest protection

Figure 16 reports the respondents´ perception towards issues of general concern. Respondents were asked to rank the three most important issues among eight general issues: (1) the first most important issue, (2) the second most important issue, and (3) the third most important issue. As it can be seen, environment was voted the first and the second most important issue by 32% and 25% respondents and education was voted the third by 19% respondents. The issue with highest vote was ranked number 1, the second number 2, and so on, and issue with the lowest vote was ranked number 24.

On average, environment was identified as the most important issue with a ranking of 3.7, followed by health care, and income which were ranked second and third. Transportation, poverty, and employment were ranked last. Additionally, half of the respondents acknowledged that they had regular access to information about environmental issues by communication media, while one third obtained information occasionally. About 98% of respondents had donated at least once to support environmental incidents such as floods or storms. The results confirmed that the respondents in Thai Nguyen province were aware of the importance of environment issues.

Among environmental issues, respondents were required to rank the three most important problems in Thai Nguyen province that need to be taken care. Figure 17 shows that respondents gave water pollution the highest vote (46%), air pollution the second (32%). Deforestation and climate both got the third highest vote (20%). As a result, water pollution (ranked 4.3), air pollution (ranked 5.7), and deforestation (ranked 6.0) were the first, the second, and the third most important environmental issues, respectively.

Concerning the question related to the management of environment, 82% of respondents indicated that environmental problems in Thai Nguyen province were not well managed.



	Income	Poverty	Health care	Education	Environment	Employment	Social security	Transportation
1st important	21.9	8.1	16.2	5.0	32.3	3.8	4.6	8.1
2nd important	13.8	5.8	19.6	13.5	25.4	3.8	12.3	5.8
3rd important	9.6	7.7	15.8	18.8	15.0	9.6	13.8	9.6

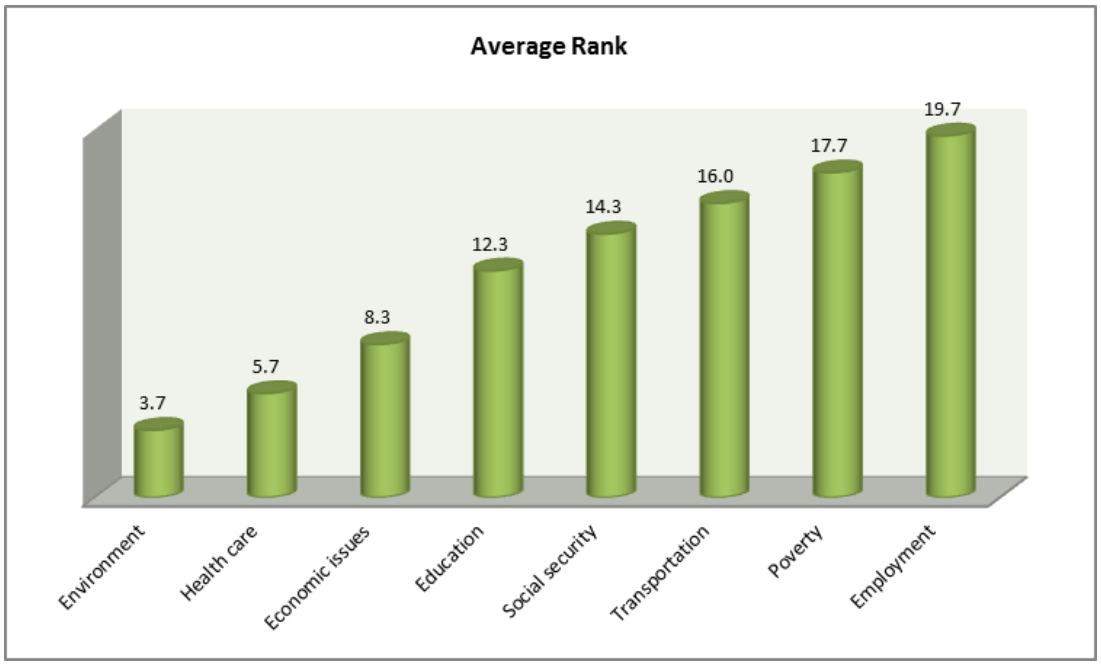
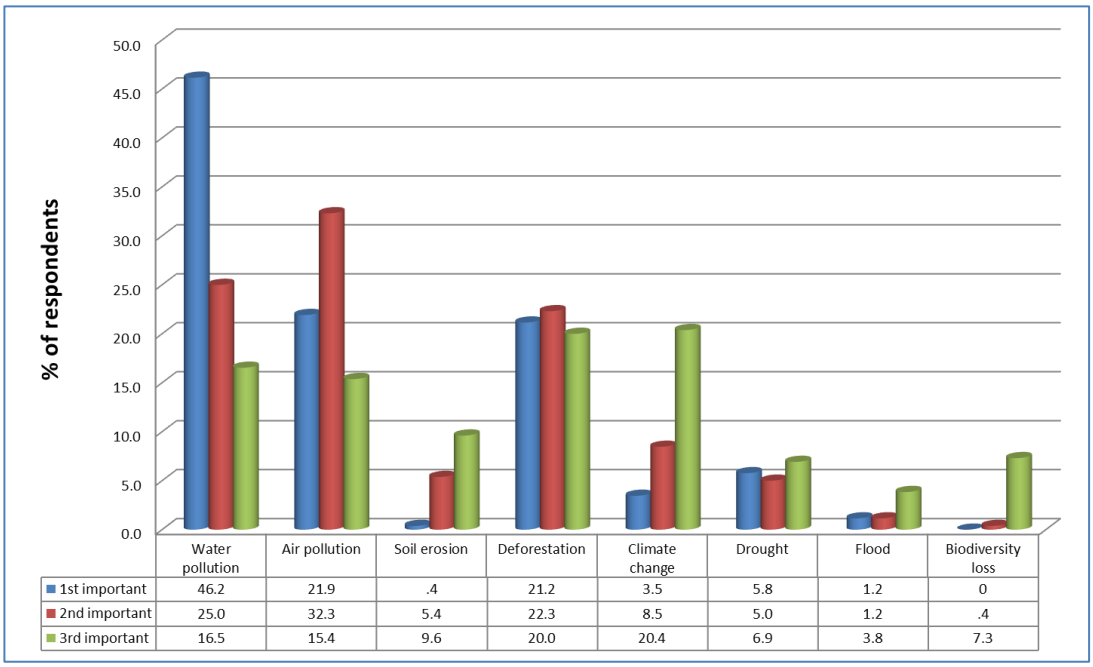


Figure 16: Ranking of general issues

Half of respondents stated that everyone should protect the environment; one third mentioned that it was the government´s responsibility to take care of environmental issues; and one third claimed that enterprises which caused environmental problems, should be responsible for resolving environmental problems.



	Water pollution	Air pollution	Soil erosion	Deforestation	Climate change	Drought	Flood	Biodiversity loss
1st important	46.2	21.9	.4	21.2	3.5	5.8	1.2	0
2nd important	25.0	32.3	5.4	22.3	8.5	5.0	1.2	.4
3rd important	16.5	15.4	9.6	20.0	20.4	6.9	3.8	7.3

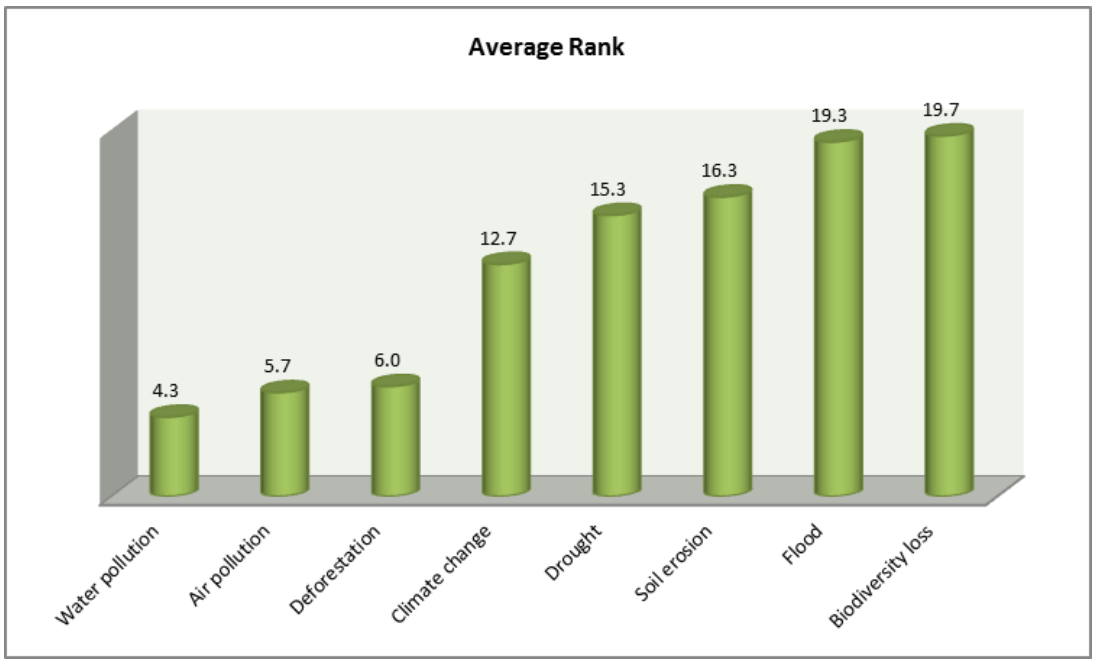
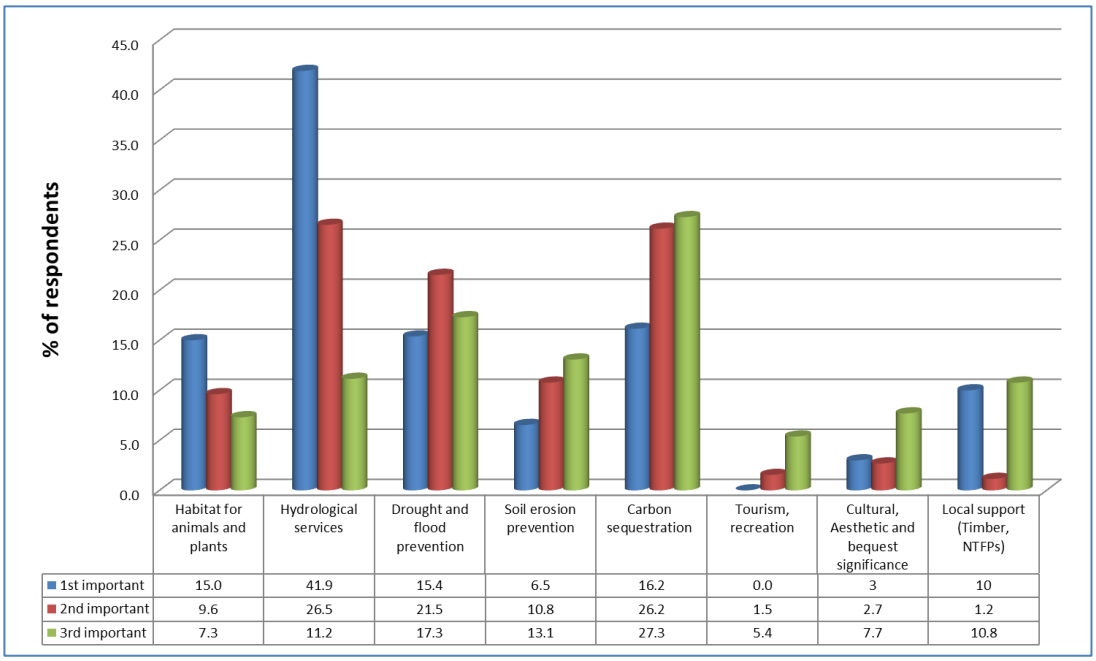


Figure 17: Ranking of important environmental issues

Regarding benefits provided by forests to humans, 41% of respondents voted hydrological services the first, 26% voted hydrological services and carbon sequestration the second, and 27% voted carbon sequestration the third most important functions. On average, carbon sequestration (ranked 4.3), hydrological services (ranked 5.0), and drought and flood prevention (ranked 6.3) were the first, second, and third most important functions (Figure 18).



	Habitat for animals and plants	Hydrological services	Drought and flood prevention	Soil erosion prevention	Carbon sequestration	Tourism, recreation	Cultural, Aesthetic and bequest significance	Local support (Timber, NTFPs)
1st important	15.0	41.9	15.4	6.5	16.2	0.0	3	10
2nd important	9.6	26.5	21.5	10.8	26.2	1.5	2.7	1.2
3rd important	7.3	11.2	17.3	13.1	27.3	5.4	7.7	10.8

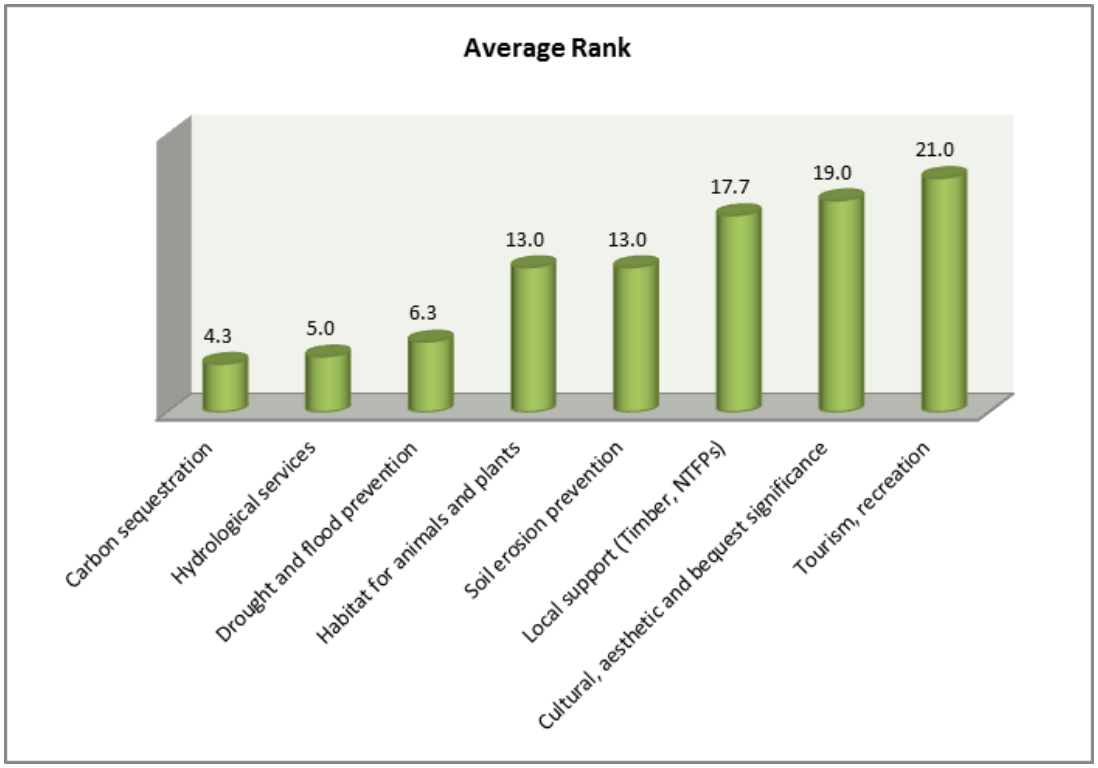


Figure 18: Ranking of forest functions

Respondents´ motivation to protect Dinh Hoa forest was reflected through questions on how frequently they access information on Dinh Hoa forest (Table 15). 85% of respondents got information on Dinh Hoa forest by communication media. Although 79% of

respondents were aware of the benefits of Dinh Hoa forest to communities, just slightly more than half of the sample was aware of the degradation situation of forests in Dinh Hoa district. Approximately 70% of the respondents had visited Dinh Hoa forest, and about 87% planned a visit in the next three years.

Table 15: Awareness of respondents towards Dinh Hoa forest situation

		Thai Nguyen city (N=92)		Phu Binh & Dinh Hoa district (N=168)		Total sample (N=260)	
		Number	**%**	**Number**	**%**	**Number**	**%**
Get information of Dinh Hoa forest	Never	15	16.30	24	14.29	39	15.00
	Several times	52	56.52	85	50.60	137	52.69
	Many times	25	27.17	59	35.12	84	32.31
Awareness of benefits of Dinh Hoa forest	No	20	21.74	35	20.83	55	21.15
	Yes	72	78.26	133	79.17	205	78.85
Awareness of the degradation of Dinh Hoa forest	No	50	54.35	59	35.12	109	41.92
	Yes	42	45.65	109	64.88	151	58.08
Previous visit	Never	34	36.96	45	26.79	79	30.38
	Several times	39	42.39	77	45.83	116	44.62
	Many times	19	20.65	46	27.38	65	25.00
Future visit	No	15	16.30	19	11.31	34	13.08
	Yes	77	83.70	149	88.69	226	86.92

Finally, a series of questions focused on respondents' preferences towards forest protection in Dinh Hoa district. As it can be seen in Table 16, the proportion of respondents in support of forest protection and development programs was significantly high. For example, nearly 96% of respondents agreed to contribute to protection programs and the similar number agreed to offer money or labor as contribution.

In conclusion, the respondents in the survey are concerned about both environmental problems and the deforestation situation in Thai Nguyen province. Their perception towards the importance of forest protection is well recognized. Overall, the respondents agree that the Dinh Hoa forest should be protected. These positive preferences and attitude towards forest protection can be seen as a motivation for local residents to support the forest protection programs.

Table 16: Respondents´ perspective on Dinh Hoa forest protection (%)

Statement	Completely do not agree	Do not agree	Neutral	Agree	Completely agree
(1) Other environmental problems are more important	26.15	58.08	0.38	15.00	0.38
(2) Utilization of natural resources is needed to increase jobs and incomes no matter how harmful it is to environment	39.62	58.85	0.38	0.77	0.38
(3) It´s the government duty to protect natural forests	6.15	62.31	2.31	28.08	1.15
(4) Natural forest resources should be protected even if I am not directly benefited	-	0.77	1.15	65.38	32.69
(5) Thai Nguyen citizens should contribute to protect forests for later generations	-	0.77	2.69	63.85	32.69
(6) If I am asked to contribute money or labor to forest protection programs, I will	-	0.38	3.46	68.85	26.92
N = 260					

5.1.4. Certainty of responses

Respondents were sensitive to having to agree or disagree to an amount of payment during the short time of the interview. They may neither be familiar with the environmental goods that are offered to them nor have enough time to have a thorough answer. Therefore, several follow-up questions were used to ensure the certainty in the responses to the valuation questions.

Firstly, the respondents were asked how certain they were about their “Yes” or “No” responses to the valuation question. There were five scales offered to them to choose: [100%; more than 50% to less than 100%; 50%; more than 0% to less than 50%; 0%]. Answers equal or higher than 50% of certainty were accepted. Out of the total, 55% of the respondents were 100% certain, 39% of the respondents were in the range of “more than 50% to less than 100%” certain, and 5% of the respondents were 50% certain. Only two respondents (1%) were unsure about their responses (< 50%). These two respondents were asked if they want to change their answers to the valuation question or not. After several

minutes of thinking, they decided to keep their responses unchanged. Because of the uncertainty, the responses of these two respondents were switched to opposite site: “Yes” response was changed to “No” response, and vice versa.

Secondly, the respondents who agreed with one or two of the bids offered were asked for the reasons for their WTP for the program. The responses “yes, but the current situation is satisfactory” and “yes, but only when the payment is mandatory” were classified as protest responses and were eliminated from the sample. Table 17 reported no respondent chose these answers. Two responses “Yes, but still too much” were adjusted as saying “No” to the bids offered.

Table 17: Reasons for accepting to bids offered – WTP survey

Reasons	Number	%
Dinh Hoa forest is currently so degraded that it should be protected	179	82.87
I´d like later generations to be able to enjoy the benefits of forests in the future	202	93.52
I believe that the program can be implemented if everyone supports	171	79.17
Yes, but the current situation is satisfactory	0	0.00
Yes, but only when the payment is mandatory	0	0.00
Yes, but still too much	2	0.93
Others:	10	4.63
N = 216		

Thirdly, respondents were asked to indicate which expenses they would reduce in order to contribute towards the program. This kind of question provides respondents another chance to reconsider their answer. 23.5% of them stated that they would reduce pocket money, 19.2% said they would restraint telephone costs, 8.5% would cut down food and beverage expenses, and 24.6% would reduce all living expenses.

5.1.5. Results of regression analysis

Table 18, Table 19, and Table 20 present results of binomial logistic regression for two sub-groups: Phu Binh and Dinh Hoa districts (Model 1), Thai Nguyen city (Model 2), and the whole sample (Model 3). The estimated maximum likelihood coefficients indicate the effects of explanatory variables on the WTP, i.e., the probability of accepting a certain bid amount. From these tables we can see that WTP has negative relationship to the levels of

payment and previous visits; and positive relationship to household incomes and awareness of respondents of benefits of forests to communities.

Table 18: Parameter estimate – Phu Binh and Dinh Hoa districts (Model 1)

Variables	Coefficient	S.E.	Sig.
INTERCEPT	-2.761	1.736	0.112
BID	-0.044***	0.011	0.000
AGE	0.012	0.017	0.479
HOUSEHOLD.SIZE	0.244	0.168	0.147
GENDER	0.581	0.419	0.166
ETHNIC	0.191	0.465	0.681
EDUCATION	0.139	0.293	0.635
INCOME	0.108**	0.055	0.050
EMPLOYMENT	0.250	0.572	0.662
SOCIO.ORGANIZATION	0.435	0.470	0.355
FOREST.INFORMATION	0.814	0.684	0.234
FOREST.BENEFIT	0.676	0.630	0.283
FOREST.DEGRADATION	0.261	0.538	0.627
PREVIOUS.VISIT	-1.377**	0.629	0.029
FUTURE.VISIT	0.533	0.678	0.433
χ^2	47.491***		
Log likehood function	-92.596		
Restricted Log likehood	-116.342		
McFadden's Pseudo R^2	0.204		
Adjusted McFadden's Pseudo $\tilde{R}^2$	0.102		
N	168		

*** significant at p ≤ 0.01
** significant at p ≤ 0.05

At the 1% level, the coefficients of variable BID are statistically significant in all three models. The weak negative coefficients explain that the higher the payment levels offered, the less willingness of the respondents to pay. This result properly reflects the downward trend of the demand curve in line with economic theory. The coefficient of variable PREVIOUS.VISIT is statistically significant at the 5% level in Model 1. The strong negative relationship between WTP and previous visits expresses that respondents in rural areas, who visited Dinh Hoa forest in the past, are less willing to pay for forest protection than those who have never visited Dinh Hoa forest. The finding is in contradiction with the hypothesized relationship between WTP and previous visits, which was predicted to be

positive. Previous visits are not significant in Model 2, i.e. previous visits have no influence on WTP of respondents in the urban area.

At the 5% level, the coefficients of variable "INCOME" are statically significant in Model 1 and 3. The weak positive relationship between WTP and incomes reflects the higher income the respondents earn, the more willing they are to accept the bids offered. While income is not an important factor to respondents in the urban area, the awareness of benefits of forests to communities is significant to them. The awareness of benefits of forests to communities, which has strong and positive relationship to WTP in Model 2 and 3, implies that respondents who are more aware of benefits of Dinh Hoa forest are willing to pay higher.

Table 19: Parameter estimate – Thai Nguyen city (Model 2)

Variables	Coefficient	S.E.	Sig.
INTERCEPT	3.094	2.857	0.279
BID	-0.039***	0.013	0.002
AGE	-0.026	0.025	0.298
HOUSEHOLD.SIZE	-0.261	0.181	0.150
GENDER	-0.505	0.581	0.384
ETHNIC	0.118	1.232	0.924
EDUCATION	-0.081	0.361	0.823
INCOME	-0.007	0.065	0.914
EMPLOYMENT	0.846	0.686	0.218
SOCIO.ORGANIZATION	-0.282	0.719	0.695
FOREST.INFORMATION	0.473	0.764	0.536
FOREST.BENEFITS	1.423**	0.688	0.039
FOREST.DEGRADATION	0.509	0.556	0.360
PREVIOUS.VISIT	0.155	0.653	0.813
FUTURE.VISIT	-0.860	0.712	0.228
χ^2	24.737**		
Log likehood function	-50.332		
Restricted Log likehood	-62.700		
McFadden's Pseudo R^2	0.197		
Adjusted McFadden's Pseudo $\tilde{R}^2$	0.100		
N	92		

*** significant at p ≤ 0.01
** significant at p ≤ 0.05

The McFadden's Pseudo R^2 implies how well the independent variable can explain the variance of explanatory variables. The McFadden's Pseudo R^2 for Model 1, 2, and 3 are estimated to be 0.20, 0.20, and 0.15 respectively. To the double bounded dichotomous format, adjusted McFadden's Pseudo R^2 for Model 1 and 2 are estimated to be 0.1, and Model 3 is to be 0.03. The findings are adequately acceptable for cross-sectional data. The likelihood ratio χ^2 test is alternative test of goodness-of-fit. As the likelihood ratio χ^2 of three models is significant at the p_value ≤ 0.01 and ≤ 0.05, this offers evidence that there is a significant relationship between the WTP and the explanatory variables, i.e. the models adequately fit the data.

Table 20: Parameter estimate – Total sample (Model 3)

Variables	Coefficient	S.E.	Sig.
INTERCEPT	0.817	1.189	0.492
BID	-0.041***	0.008	0.000
AGE	-0.010	0.013	0.411
HOUSEHOLD.SIZE	-0.066	0.101	0.514
GENDER	0.172	0.312	0.580
ETHNIC	0.146	0.382	0.703
EDUCATION	-0.064	0.202	0.753
INCOME	0.074**	0.037	0.048
EMPLOYMENT	0.301	0.399	0.452
SOCIO.ORGANIZATION	0.176	0.366	0.630
FOREST.INFORMATION	0.375	0.475	0.429
FOREST.BENEFITS	0.930**	0.425	0.029
FOREST.DEGRADATION	0.169	0.344	0.623
PREVIOUS.VISIT	-0.394	0.391	0.313
FUTURE.VISIT	-0.181	0.456	0.691
χ^2	52.542***		
Log likehood function	-153.824		
Restricted Log likehood	-180.095		
McFadden's Pseudo R^2	0.146		
Adjusted McFadden's Pseudo $\tilde{R}^2$	0.032		
N	260		

*** significant at p ≤ 0.01
** significant at p ≤ 0.05

The final logit models are:

Rural areas: $\text{Ln}(\frac{\text{WTP}}{1-\text{WTP}})$ = - 0.044 BID + 0.108 INCOME – 1.377 PREVIOUS.VISIT

Urban areas: $\text{Ln}(\frac{\text{WTP}}{1-\text{WTP}})$ = - 0.039 BID + 1.423 FOREST.BENEFITS

The whole sample: $\text{Ln}(\frac{\text{WTP}}{1-\text{WTP}})$ = - 0.041 BID + 0.074 INCOME + 0.93 FOREST.BENEFITS

5.1.6. WTP curves

In DBDC format, respondents face two bids: the first bid (the initial bid) and the second bid (the follow-up bid). The proportion of acceptance to the first bid and the second bids offered are listed in Table 21. As it can be seen from the table, the probability of acceptance decreases along with the increasing of bid level in both first and second bids. The lowest level of the first bid (VND 10,000) and the second bid (VND 5,000) got the highest probability of "yes" responses and the highest level of the first bid (VND 80,000) and the second bid (VND 120,000) got the lowest probability of "yes" responses. In total, the proportion of acceptance of respondents to the second bids is lower than the first bid offered. The proportion of acceptance decreases from 0.64 to 0.52 for respondents in Phu Binh and Dinh Hoa districts, from 0.73 to 0.42 in Thai Nguyen city, and from 0.67 to 0.49 for the whole sample.

Table 21: Proportion of acceptance to the first and the second bid offered (WTP)

First Bid				Second Bid			
Bid (VND 1,000)	**Phu Binh & Dinh Hoa district** (N=168)	**Thai Nguyen city** (N=92)	**Total sample** (N=260)	**Bid** (VND 1,000)	**Phu Binh & Dinh Hoa district** (N=168)	**Thai Nguyen city** (N=92)	**Total sample** (N=260)
				5	1.00	1.00	1.00
10	0.85	0.95	0.89	**10**	0.75	0.67	0.73
20	0.82	0.84	0.82	**20**	0.80	0.67	0.75
35	0.71	0.74	0.72	**35**	0.42	0.26	0.38
50	0.43	0.81	0.55	**50**	0.43	0.39	0.42
80	0.26	0.24	0.25	**80**	0.20	0.31	0.25
				120	0.17	0.00	0.10
Total	0.64	0.73	0.67	Total	0.52	0.42	0.49

Figure 19 presents the probability of acceptance of respondents to the first and the second bids. The blue lines display the WTP of the respondents of Phu Binh and Dinh Hoa district sub-group; the red lines express the WTP of the respondents of Thai Nguyen city sub-group; and the green lines present the WTP of the whole sample. The graphs show a

downward trend from the left to the right, which illustrates the negative relationship between bid levels and the WTP of the respondents. In other words, the probability of acceptance decreases along with the increasing of the bid levels.

To the first bids offered, respondents of Phu Binh and Dinh Hoa district sub-group get lower probability of acceptance than those of Thai Nguyen city sub-group. At each amount of bid offered, respondents in Thai Nguyen city tend to be more willing to pay than those in Phu Binh and Dinh Hoa districts. Especially, at the amount of VND 50,000, the proportion of acceptance of respondents of Thai Nguyen city sub-group is double compared to Phu Binh and Dinh Hoa districts. Those divers in responses of two sub-groups lessen in the second bids. To the second bids offered, the WTP lines of the two sub-groups are closed that indicate the consensuses in responses of the respondents of the whole sample. The similarity of mean WTP values of two sub-groups in the next section agrees with this finding.

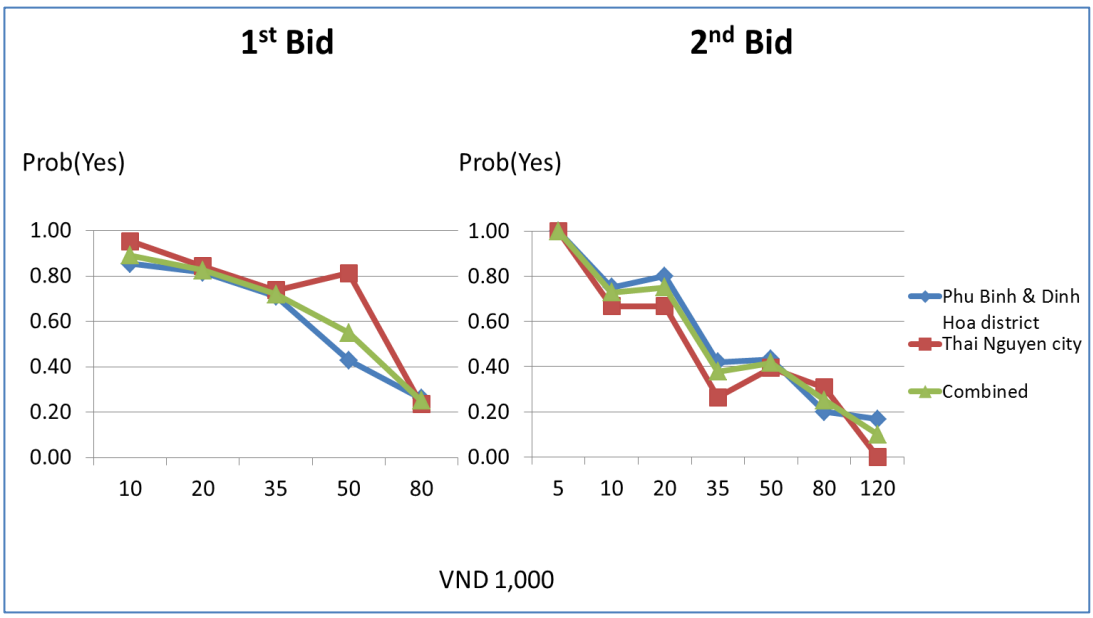


Figure 19: Probability of WTP the bids offered

5.1.7. Mean and median WTP

Table 22 shows the estimated mean and median WTP and their upper and lower values. The mean and median WTP are calculated by parametric approach, using logit model. The residents in Thai Nguyen city are willing to pay about VND 39,000 (US$ 1.9) per household

while the residents in Phu Binh and Dinh Hoa districts are willing to pay approximately VND 45,000 (US$ 2.1) per household as one-time payment for natural forest protection in Dinh Hoa. The mean WTP value is not significantly different between residents in the rural areas and urban areas. These findings show that respondents in Thai Nguyen province support payment for natural forest protection in Dinh Hoa, regardless of how far away the Dinh Hoa forests are or where the respondents live; rural or urban areas.

The mean WTP of total sample is estimated to be VND 43,000 (US$ 2.1), ranging from VND 39,000 (US$ 1.9) to VND 48,000 (US$ 2.3) for a 95% confidence interval. The median WTP is VND 39,000 (US$ 1.9), which is slightly lower than the mean WTP. The median WTP ranges between VND 34,000 (US$ 1.6) and VND 44,000 (US$ 2.1) for a 95% confidence interval.

Table 22: Mean and median WTP

	Unit	Mean	95% CI		Median	95% CI	
			Lower	Upper		Lower	Upper
Phu Binh & Dinh Hoa	VND	45,000	39,000	49,000	41,000	39,000	49,000
district (N= 168)	(US$)	(2.1)	(1.9)	(2.3)	(2.0)	(1.9)	(2.3)
Thai Nguyen city (N=92)	VND	39,000	28,000	48,000	33,000	21,000	43,000
	(US$)	(1.9)	(1.3)	(2.3)	(1.6)	(1.0)	(2.0)
Total sample (N=260)	VND	43,000	39,000	48,000	39,000	34,000	44,000
	(US$)	(2.1)	(1.9)	(2.3)	(1.9)	(1.6)	(2.1)

5.1.8. Total WTP for natural forest protection in Dinh Hoa

The total WTP is estimated by multiplying the mean WTP by the total number of households in Thai Nguyen province, which amounts to 290,000 (TSO, 2012). If each household is willing to contribute VND 43,000 (US$ 2.1) as one-time payment, Thai Nguyen province could raise VND 12.47 billion (US$ 593,810) to protect natural forests in Dinh Hoa as total benefits transfer. The upper and lower bound for a 95% confidence interval around the estimated total value is VND 11.31 billion (US$ 538,571) and VND 13.92 billion (US$ 662,857), respectively.

5.2. WTA survey

5.2.1. Response rate and protest responses

Of the total 300 households in the WTA survey, 23 households agreed to participate in the survey but refused to answer the valuation question of the questionnaire. Eight of the 23 households stated that they would want to know other opinions about the program, and 15 households refused any payments to stop utilizing forest resources. These responses then were identified as protest responses and were eliminated from the sample.

The remaining 277 responses (92%) were kept in the sample and were assigned to three sub-groups in accordance with three types of forests that the households were contracted: production forest sub-group (85 responses), protection forest sub-group (97 responses), and special-use sub-group (95 responses).

5.2.2. Demographic and socio-economic characteristics

Table 23 summarizes the demographic and socio-economic characteristics of the total sample and sub-samples. It is evident that the demographic composition of the sub-samples is similar, except for a minor variation in ethnic group. Therefore, the discussion is not presented for the three sub-groups separately, but for the total sample as a whole. The respondents mainly work in agriculture, have comparatively low education levels, on average 7th grade, and a mean age of 48. About 62% of them are male, and 80% belong to minority ethnic groups. Each household has an average of four members.

Each household has more than three ha of contracted natural forest, and 73% of the households have been contracted and allocated both natural forests and planted forests. Of the total forest area per household, households contracted protection forests occupied the highest share (6.4 ha) and the production forests the lowest (0.8 ha). The average forest land of the whole sample of three ha per household accessed by this survey is similar to the findings of several studies conducted in different provinces of the country: Lam Dong, Bac Kan, Son La (Dam et al., 2014; Pham et al., 2013; Trinh and Roberto, F. Rañola Jr., 2011), Hue, Ha Giang, Quang Nam, and Yen Bai (Wunder, 2005a). The average distance from the respondents´ houses to the border of nearest natural forests is more than two km. All households stated that their natural forest was degraded with low growing stock.

98% of the households collected fuelwood, 74% collected bamboo, and 46% collected palm tree products; and none of them collected timber from the natural forest over the last 12 months.

Table 23: Demographic and socio-economic characteristics of forest contracted households

Variable	Unit	Special-use (N = 95)		Protection (N = 97)		Production (N = 85)		Total sample (N = 277)	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
Age	Years	50.64	10.89	46.16	12.23	46.93	11.19	47.94	11.59
Household size	Member	4.08	1.46	4.48	1.58	4.24	1.35	4.27	1.47
Education	Class	7.08	2.13	7.85	2.52	7.35	2.14	7.43	2.29
Natural forest land	ha	2.81	2.64	6.37	7.00	0.75	0.41	3.43	4.99
Distance to forest	km	2.11	1.73	2.79	2.52	2.07	1.55	2.34	2.02
		Number	%	Number	%	Number	%	Number	%
Gender	Female	35	36.84	34	35.05	37	43.53	106	38.27
	Male	60	63.16	63	64.95	48	56.47	171	61.73
Ethnic	Minority group	84	88.42	65	67.01	74	87.06	223	80.51
	"Kinh" group	11	11.58	32	32.99	11	12.94	54	19.49
Planted forest allocated	No	43	45.26	18	18.56	13	15.29	74	26.71
	Yes	52	54.74	79	81.44	72	84.71	203	73.29
Fuelwood collection	No	1	1.05	0	0.00	4	4.71	5	1.81
	Yes	94	98.95	97	100.00	81	95.29	272	98.19
Bamboo collection	No	20	21.05	13	13.40	40	47.06	73	26.35
	Yes	75	78.95	84	86.60	45	52.94	204	73.65
Palm tree collection	No	54	56.84	63	64.95	34	40.00	151	54.51
	Yes	41	43.16	34	35.05	51	60.00	126	45.49

Among 277 households, 90 households inherited forest from their family before their forests were centralized under the management of the state and returned back to them in terms of the protection contract. On average, these households have managed forests for 21 years. 206 households were contracted natural forests and allocated planted forests from 1998 under the implementation of Program 661. Of the whole sample, the head of

the household has had 19 years of experience in the forest sector. They work approximately 69 days per year, three times per week, and four hours per time in planted forest. With respect of the natural forests, they visit them only to collect NTFPs such as fuelwood, bamboo, and palm tree products.

Table 24 lists the forest products collected from forests over the last 12 months. 99% of households collected forest products. Approximately 90% of the fuelwood, timber, and bamboo was collected for self-consumption. On average, each household consumed about 26 m^3 of fuelwood for cooking, boiling water for bathing, heating, and warming their animals, especially in the winter season. 20% of the households harvested timber from planted forests. Bamboo was collected for constructing houses or making fences. A significant quantity of palm tree products were collected; such as palm leaf for house roof constructing, palm vein, and palm stem for sale.

Table 24: Forest products collected

Products	Unit	Min	Max	Mean	SD
Timber	m^3	0	100	3.18	11.75
Fuelwood	m^3	0	520	26.84	44.84
Bamboo					
Bamboo shoot	Kg	0	3,000	110.16	350.92
Bamboo (*Dendrocalamus latiflorus*)	Culm	0	400	17.18	42.99
Bamboo (*Bambusa nutans*)	Culm	0	12,000	162.53	845.19
Bamboo (*Schizostachyum aciculare*)	Culm	0	1,000	26.75	94.21
Palm tree products					
Palm leaf	Leaf	0	4,000	131.01	505.23
Palm vein	Kg	0	7,000	146.92	551.30
Palm stem	1000 pcs	0	300	11.44	38.16
N = 277					

The crops harvested per household over the last 12 months are presented Table 25. The main crops harvested were rice, maize, cassava, and tea. Entire households cultivated rice, while 40% cultivated maize, 43% cassava, and 54% tea. The mean rice production of 2.3 tons per household was enough for self-consumption, and maize and cassava harvested were used for livestock. As the average agriculture land holding was as small as 0.27 ha per household, the local people cultivated maize, cassava, and tea in the lowland forests. Tea is a traditional cash crop in this region and considerably contributes to the household incomes.

Table 25: Main cultivated crops

Crop	Unit	Min	Max	Mean	SD
Rice	Kg	300	7,500	2,303.94	1,236.52
Maize	Kg	0	4,000	133.30	377.03
Cassava	Kg	0	17,000	332.22	1,311.57
Tea	Kg	0	5,000	213.99	433.80
N = 277					

Livestock husbandry contributes an important share to household incomes and is practiced by most lowland farmers and ethnic minorities in the mountainous areas of Vietnam (Nguyen, 2008). Table 26 summarizes the domestic livestock raised by households included in the survey. On average, each household kept about 8 pigs, 55 chickens, and 8 ducks. Cattles such as buffalos, cows, horses, and goats were raised in small quantity. These domestic livestock and their products were enough for self-consumption and for sale.

Table 26: Number of domestic livestock

	Minimum	Maximum	Mean	SD
Pig	0	160	7.64	17.61
Chicken	0	500	54.93	53.88
Duck	0	140	7.55	15.41
Buffalo	0	7	0.83	1.43
Cow	0	6	0.07	0.50
Horse	0	1	0.01	0.10
Goat	0	30	0.62	3.40
N = 277				

The estimated average annual total household income was VND 50 million, equivalent to US$ 2,400. Crops contributed the highest share to total household incomes, followed by non-farm incomes such as remittance, pension, and small household enterprise etc., forest income, and livestock income (Figure 20). The average income per capita was approximately US$ 500.

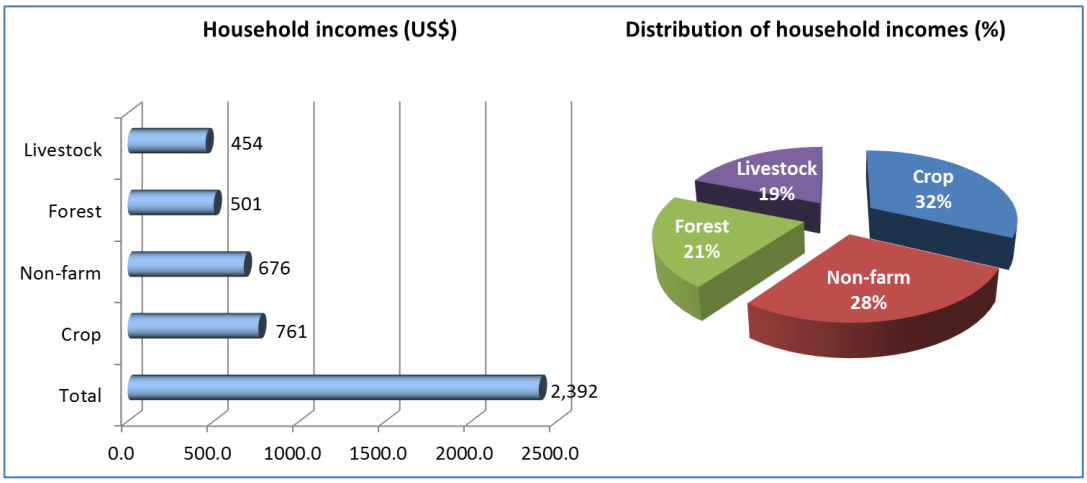


Figure 20: Distribution of household incomes

Households contracted protection forests show the highest average income, while households contracted special-use forests show the lowest (Table 27). The large share of income from domestic livestock of households contracted protection forests explains the divergence in household income observed in the survey. Several households in Linh Thong commune (protection forest) got VND hundred million per year from domestic livestock.

Table 27: Household incomes, separated by forest types

Forest type	N	Unit	Mean	95% CI	
				Lower	Upper
Special-use	95	VND million	40.5	35.4	45.6
		(US$)	(1,930)	(1,685)	(2,173)
Protection	97	VND million	58.5	49.4	67.7
		(US$)	(2,787)	(2,351)	(3,222)
Production	85	VND million	51.6	44.9	58.3
		(US$)	(2,458)	(2,138)	(2,778)
Total sample	277	VND million	50.2	46.0	54.5
		(US$)	(2,392)	(2,190)	(2,594)

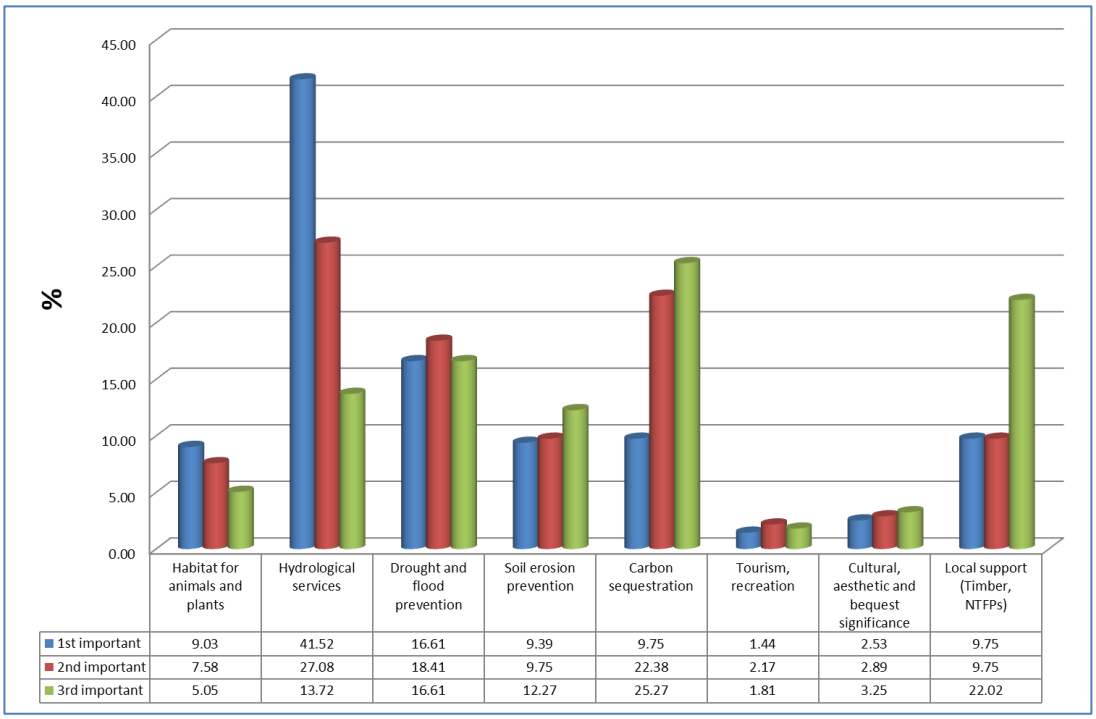
In conclusion, households which were contracted and allocated forest in Dinh Hoa are considered poor and heavily rely on agriculture cultivation. The average income per capital is estimated to be US$ 500 which is equal to average income of people in Dinh Hoa district and significantly lower than average income of people in Thai Nguyen province (TSO, 2012). On a whole, income from forests is low, but significant to total household incomes (21%). Nearly all households use fuelwood for cooking, boiling water, and heating in the winter season. Other commercial energy resources such as electricity and gas are less affordable

for the rural people because of high prices. Most of the agricultural and forest products are used for subsistence purposes. The demographic and socio-economic characteristics of households accessed by this study resemble the characteristics of the minority ethnic groups in other mountainous regions of Northern Vietnam.

5.2.3. Forest situation and households´ perception towards forest protection

Considering the awareness of the current forest situation, 90% of households are aware of benefits achieved from forests. Hydrological services get the highest vote as the first and the second, followed by carbon sequestration as the third most important functions of the forest. The ranking of forest functions is similar to the process of WTP survey: the issue receiving the highest vote is ranked number 1 and the lowest vote number 24. On average, hydrological services, carbon sequestration, and flood and drought prevention are the first, second, and third most important functions (Figure 21). The WTP survey found similar results.

These findings confirm the consensus in perception of the households contracted natural forest for protection in Dinh Hoa and the rest of the population in Thai Nguyen province towards the roles of forests in communities. Providing timber and NTFPs, which are important to local livelihoods, was ranked the fourth most important function of the forest by households in the WTA survey and the sixth by respondents in WTP survey.



	Habitat for animals and plants	Hydrological services	Drought and flood prevention	Soil erosion prevention	Carbon sequestration	Tourism, recreation	Cultural, aesthetic and bequest significance	Local support (Timber, NTFPs)
1st important	9.03	41.52	16.61	9.39	9.75	1.44	2.53	9.75
2nd important	7.58	27.08	18.41	9.75	22.38	2.17	2.89	9.75
3rd important	5.05	13.72	16.61	12.27	25.27	1.81	3.25	22.02

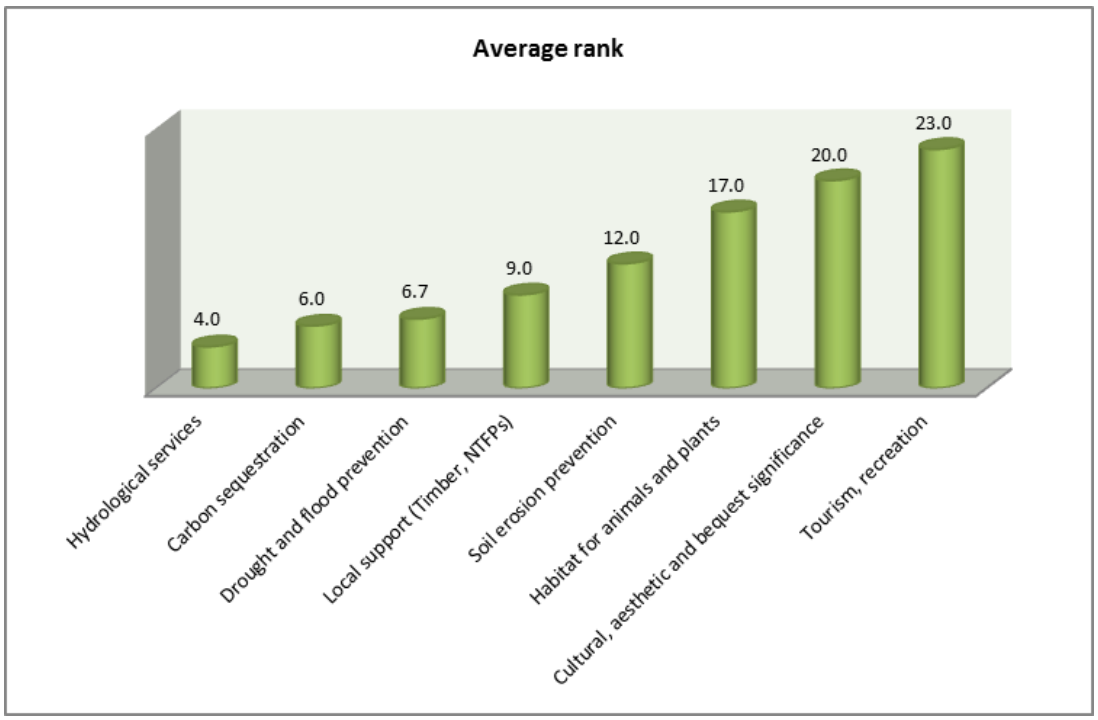


Figure 21: Three most important roles of forests to the communities in Dinh Hoa

Additionally, 79% of the forest contracted households are aware of the forest´s degradation situation. 86% of the households stated that the current procurement situation is more difficult compared to five years ago and is anticipated to get worse in the next five years. They implied that the amount of tree species, wildlife, fertile soil, and

availability of timber and NTFPs in Dinh Hoa forest has declined considerably due to years of deforestation and illegal logging (Table 28). 74% of the households consider drought as the most serious consequence of deforestation, affecting agricultural activities and the daily life negatively. This situation is appraised to become worse in the near future if the forests are not managed sustainably.

Table 28: Appraisal of changes of forest related issues (%)

	Increase	Stay the same	Decrease	Do not know
Tree species	7.22	5.78	86.64	0.36
Wildlife	2.53	2.53	93.86	1.08
Frequency of flood	18.77	41.52	39.35	0.36
Frequency of drought	97.11	1.44	1.44	-
Temperature	99.64	-	0.36	-
Air pollution	87.00	10.47	0.72	1.81
Soil fertile	6.86	7.58	85.56	-
Tourists	87.00	10.47	0.72	1.81
Timber harvested	33.57	5.42	58.48	2.53
NTFP harvested	7.94	4.69	86.64	0.72
Deforestation	39.35	4.69	53.79	2.17
N = 277				

In summary, households contracted natural forests in Dinh Hoa are aware of the important role of forests in their communities and recognize how degraded forests in Dinh Hoa are. Most of them agreed that people should reduce the use of timber and NTFPs to improve the current situation and put more efforts on the protection of forests (Table 29). Nevertheless, 87% of the households disagreed to protecting the forest without any compensation. Labor skill training courses were referred to as an alternative to compensation so that local people could be acquired labor quality for jobs outside forestry. Half of households refused training courses because they believe that they are too old to start studying again. The limited availability of jobs in the small number of manufactures and companies in Dinh Hoa is another challenge. 100% of the respondents stated that the current payment levels paid by government (provincial FPDF) are not reasonable. They would support the program if they could get a higher payment. In conclusion, payment levels made by government for natural forest protection are needed to be adjusted to compensate forest protection and management costs.

Table 29: Forest contracted households´perspective on Dinh Hoa forest protection (%)

Statement	Agree	Neutral	Disagree
Forest should be utilized to increase jobs and income	3.25	2.53	94.22
Forest are protected enough already	1.08	0.72	98.19
Forests will be the same with or without exploitation	5.05	1.81	92.78
Loss of several forest hectares is no matter what	2.53	4.33	93.14
Everyone has to protect forests	100	-	-
People should do concrete things to protect forests	100	-	-
People should reduce harvesting forest products	97.47	2.17	0.36
Households contracted forests can protect them without compensation	13.00	-	87.00
N = 277			

5.2.4. Certainty of responses

To validate the certainty of responses to the valuation questions, several follow-up questions were structured similar to the WTP survey. Respondents were asked to specify their certainty in responses. Out of the total respondents, 29% were 100% of certain, 63% were in the range of more than 50% to less than 100%, 8% are 50%, and only 0.4% (1 respondent) was lower than 50% certain. Because of the uncertainty, “Yes” response to the valuation questions of this respondent was changed to “No” response. A follow-up question to address the reasons for accepting the payment was adopted. Table 30 lists reasons and the frequency of responses. 41% of the respondents stated that the payments offered by the study are reasonable. Preventing the degradation of the forest and saving forest resources for future generations both get votes of 27% of the respondents.

Table 30: Reasons for accepting the bids offered – WTA survey

Reasons	Frequency	%
The compensation is reasonable	95	40.6
Dinh Hoa forest is currently so degraded that it should be specially protected	64	27.4
Our future generations will be able to enjoy the benefits of the forest	64	27.4
I believe that the program can be implemented if everyone supports	11	4.7
N = 234		

5.2.5. Results of regression analysis

The parameter estimates of logit models for three sub-groups and total sample are presented in Tables 31, 32, 33, and 34. These four models represent for sub-groups of

special-use forest (Model 4), protection forest (Model 5), production forest (Model 6), and the whole sample (Model 7).

Table 31: Parameter estimates – Special-use forest (Model 4)

Variables	Coefficient	S.E.	Sig.
INTERCEPT	14.405***	3.328	0.000
BID	0.007***	0.002	0.000
AGE	-0.022	0.034	0.512
HOUSEHOLD.SIZE	-0.298	0.248	0.229
EDUCATION	-0.246	0.161	0.127
GENDER	-0.049	0.617	0.937
ETHNIC	-0.804	1.070	0.452
INCOME	0.037**	0.016	0.020
FORESTLAND	0.096	0.125	0.440
DISTANCE	-0.526***	0.201	0.009
PLANTED.FOREST	1.021	0.590	0.083
FUELWOOD	-13.586	0.000	-
BAMBOO	0.293	0.786	0.709
PALM.TREE	-1.204	0.630	0.056
χ^2	48.829***		
Log likehood function	-41.387		
Restricted Log likehood	-65.802		
McFadden's Pseudo R^2	0.371		
Adjusted McFadden's Pseudo $\tilde{R}^2$	0.197		
N	95		

*** significant at p ≤ 0.01
** significant at p ≤ 0.05

The estimated maximum likelihood coefficients indicate the effects of explanatory variables on the WTA. The regression results show that the WTA is influenced by the levels of payment, household incomes, the distance from respondents´ houses to their nearest natural forests, the natural forest land area contracted to households, the allocation of planted forests, and the collection of fuelwood, bamboo, and palm tree products. The WTA has positive relationship to the levels of payment, natural forest land area, the planted forest holding, the collection of bamboo, and has positive relationship to the distance and the collection of palm tree products. Income affects the WTA in both directions, positively in Model 4 and negatively in Model 6.

At the 1% level, the coefficients of variable "BID" are statically significant in all models. The positive and small coefficient implies the positive and weak relationship between bid levels offered and WTA which was hypothesized: the higher the compensation offered, the higher the willingness to accept is. This finding reflects precisely how bid level would affect WTA in line with the economic theory.

At the 5% and the 1% level, variable "ETHNIC" is statically significant in model 5 and 7. The negative coefficient implies that the "Kinh group" people are less willing to accept the payment than the other minority groups.

Table 32: Parameter estimates – Protection forest (Model 5)

Variables	Coefficient	S.E.	Sig.
INTERCEPT	-3.127	1.924	0.104
BID	0.005***	0.002	0.001
AGE	0.037	0.021	0.077
HOUSEHOLD.SIZE	0.100	0.160	0.533
EDUCATION	0.022	0.099	0.826
GENDER	-0.940	0.556	0.091
ETHNIC	-1.582***	0.593	0.008
INCOME	0.005	0.006	0.406
FORESTLAND	0.015	0.039	0.702
DISTANCE	-0.029	0.099	0.770
PLANTED.FOREST	0.318	0.713	0.656
FUELWOOD	0.000	-	-
BAMBOO	-0.072	0.756	0.924
PALM.TREE	0.038	0.536	0.943
χ^2	24.716**		
Log likehood function	-53.713		
Restricted Log likehood	-66.071		
McFadden's Pseudo R^2	0.187		
Adjusted McFadden's Pseudo $\tilde{R}^2$	0.087		
N	97		

*** significant at p ≤ 0.01
** significant at p ≤ 0.05

The coefficients of variable "INCOME" are statically significant in Model 4 and Model 6. This variable affects WTA on contrary directions: negative influence in Model 6 and positive influence in Model 4. At the 5% level of significance, the negative coefficient in Model 6 expresses that contracted production forest households, which have higher income, are

less willing to accept the bids offered; whereas the positive coefficient in Model 4 implies that contracted special-use forests households, which have higher income, are more willing to accept.

Table 33: Parameter estimates – Production forest (Model 6)

Variables	Coefficient	S.E.	Sig.
INTERCEPT	-20.859***	2.999	0.000
BID	0.007***	0.002	0.001
AGE	0.003	0.031	0.934
HOUSEHOLD.SIZE	0.122	0.277	0.661
EDUCATION	-0.047	0.147	0.750
GENDER	0.555	0.669	0.406
ETHNIC	1.127	0.934	0.228
INCOME	-0.038**	0.016	0.015
FORESTLAND	0.649	0.713	0.362
DISTANCE	-0.756***	0.244	0.002
PLANTED.FOREST	1.390	1.006	0.167
FUELWOOD	19.424	0.000	-
BAMBOO	0.805	0.663	0.225
PALM.TREE	-2.194**	0.859	0.011
χ^2	47.265***		
Log likehood function	-34.997		
Restricted Log likehood	-58.629		
McFadden's Pseudo R^2	0.403		
Adjusted McFadden's Pseudo $\tilde{R}^2$	0.254		
N	85		

*** significant at p ≤ 0.01
** significant at p ≤ 0.05

The coefficients of variable "DISTANCE" have statistical significance at the 1% level in model 4 and 6 and at the 5% level in model 7. The negative sign of the coefficients shows the negative influence of distance on WTA. The coefficient of variable "FORESTLAND" is significant at the 5% level in Model 7. The positive sign of coefficient expresses the larger forest area they are contracted, the more compensation they would receive; hence they are more willing to accept the bids offered. The coefficient of variable "PLANTED.FOREST" has a positive sign level in model 7. The result suggests that the households which are contracted natural and allocated planted forests are more motivated to accept the bids than those who are solely contracted natural forests for protection.

Table 34: Parameter estimates – Total sample WTA (Model 7)

Variables	Coefficient	S.E.	Sig.
INTERCEPT	-5.321***	1.840	0.004
BID	0.005***	0.001	0.000
AGE	0.018	0.013	0.185
HOUSEHOLD.SIZE	0.037	0.102	0.720
EDUCATION	-0.016	0.064	0.808
GENDER	-0.013	0.303	0.967
ETHNIC	-0.948**	0.386	0.014
INCOME	0.001	0.004	0.874
FORESTLAND	0.083***	0.032	0.010
DISTANCE	-0.165**	0.072	0.022
PLANTED.FOREST	0.746**	0.337	0.027
FUELWOOD	2.064	1.236	0.095
BAMBOO	0.727**	0.332	0.028
PALM.TREE	-0.621**	0.295	0.036
χ^2	73.129***		
Log likehood function	-155.219		
Restricted Log likehood	-191.783		
McFadden's Pseudo R^2	0.191		
Adjusted McFadden's Pseudo $\tilde{R}^2$	0.062		
N	277		

*** significant at p ≤ 0.01
** significant at p ≤ 0.05

The last but not least important factor affecting WTA is the benefits derived from natural forests. While the coefficients of variable "PALM.TREE" are negatively significant at the 5% level in Model 6 and 7, the coefficient of variable "BAMBOO" is positively significant at the 5% level in Model 7. Households collecting palm tree products are less willing to accept, whereas households collecting bamboo are more willing to accept.

The McFadden's Pseudo R^2 is estimated to be 0.37, 0.19, 0.40, and 0.19 for Model 4, 5, 6, and 7 respectively, which are reasonably good for cross-sectional data. The adjusted McFadden's Pseudo R^2 is estimated to be 0.2, 0.19, 0.25, and 0.06 which are adequately acceptable. As the likelihood ratio χ^2 of four models is significant at the level of 1% and 5%, we conclude that there is a significant relationship between the WTA and the explanatory variables, i.e., the models adequately fit the data.

The final logit models are:

Special-use forest: $\text{Ln}(\frac{\text{WTA}}{1-\text{WTA}})$ = 14.405 + 0.007 BID + 0.037 INCOME - 0.526 DISTANCE

Protection forest: $\text{Ln}(\frac{\text{WTA}}{1-\text{WTA}})$ = 0.005 BID - 1.582 ETHNIC

Production forest: $\text{Ln}(\frac{\text{WTA}}{1-\text{WTA}})$ = -20.859 + 0.007 BID - 0.038 INCOME - 0.756 DISTANCE
- 2.194 PALM.TREE

The whole sample: $\text{Ln}(\frac{\text{WTA}}{1-\text{WTA}})$ = - 5.321 + 0.005 BID - 0.948 ETHNIC + 0.083 FORESTLAND
- 0.165 DISTANCE + 0.746 PLANTED.FOREST
+ 0.727 BAMBOO - 0.621 PALM.TREE

5.2.6. WTA curves

The proportion of the acceptance to the first and the second bids is presented in Table 35. As it can be seen from the table, the proportion of acceptance increases together with the increasing of bid levels. To the first bids, the proportion of the acceptance of the households contracted special-use forests is highest (0.70), production forest lowest (0.53), and protection forests is in between (0.63). To the second bids, the proportion of the acceptance of the households in all type of forests decreases. Households contracted protection forests have the highest agreement to the bids offered (0.58), production forests the lowest (0.46), and special-use forests is in between (0.52). Out of the total sample, 62% of households accept the first bids and 52% accept the second bids offered.

Table 35: Proportion of acceptance to the first and second bid offered (WTA)

First Bid					Second Bid				
Bid (VND 1,000)	**Special-use**	**Protection**	**Production**	**Total sample**	**Bid** (VND 1,000)	**Special-use**	**Protection**	**Production**	**Total sample**
					50	0.14	0.00	0.00	0.08
100	0.37	0.14	0.15	0.23	**100**	0.09	0.22	0.33	0.19
250	0.55	0.45	0.38	0.46	**250**	0.46	0.54	0.30	0.46
400	0.78	0.85	0.47	0.70	**400**	0.52	0.68	0.32	0.51
600	0.78	0.82	0.63	0.74	**600**	0.79	0.67	0.69	0.72
800	1.00	0.95	0.89	0.95	**800**	1.00	1.00	0.57	0.79
					1000		1.00	1.00	1.00
Total	0.70	0.63	0.53	0.62	**Total**	0.52	0.58	0.46	0.52

The shape of WTA curves can be used to examine the contingent valuation responses. To compare the divers in accepting the bids offered of households regarding the different types of forest, Figure 22 combines the WTA curves of respondents contracted special-use forest (blue lines), protection forest (red lines), and production forest (green lines).The graphs show an upward trend from the left to the right which expresses the increasing of probability of acceptance as the bids offered increase from VND 50 thousand to VND 1,000 thousand. The trend of these graphs shows the positive relationship between the bids offered and the WTA.

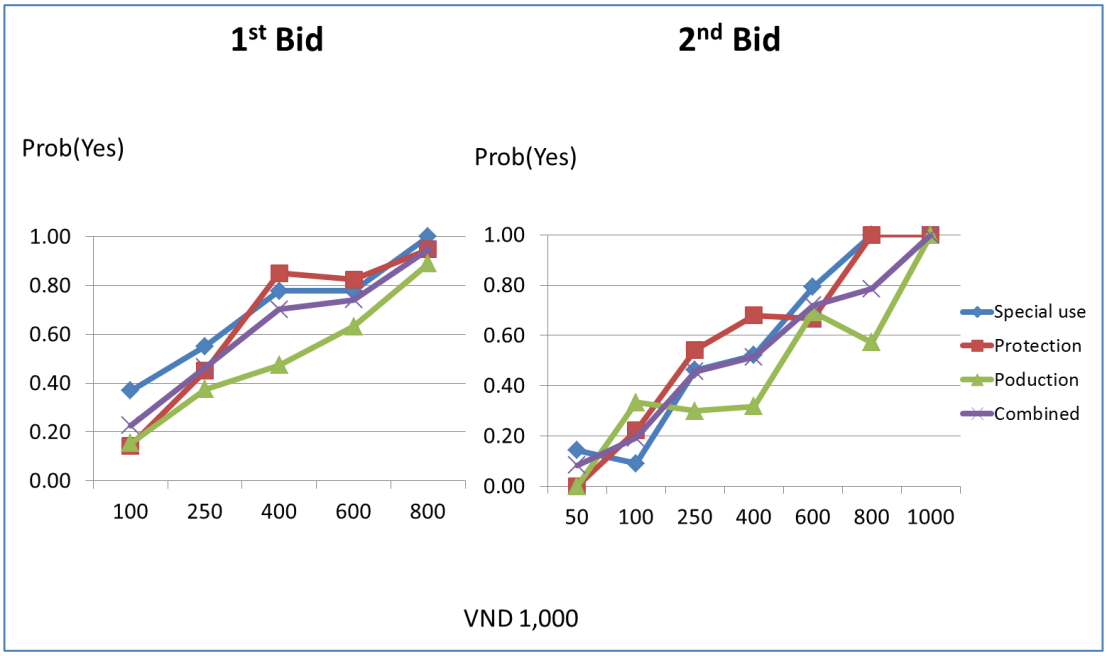


Figure 22: Probability of WTA the bids offered

To the first bids offered, the green line is under the blue and the red line at every amount of bid, i.e., the households contracted production forests require higher payment than those who are contracted protection and special-use forests.

To the second bids offered, the position of WTA curves tend to be similar to the first bids as the green line is lowest, the red line highest, and the blue line is in between. At each bid offered, the probability of acceptance of the households contracted production forests tends to be lower than those which are contracted protection and special-use forests, except the level bid of VND 100,000. At the bid level of VND 400,000 and VND 800,000, the distance between the WTA line of production forest and the WTA lines of protection and

production are farthest, which implies the largest difference in proportion of accepting the bids offered.

Overall, the WTA line of production forest has the lowest position which explains the less willingness to accept at each bid level offered. On the contrary, the WTA line of protection forest is slightly higher than the others, i.e., the probability of accepting at each price is higher.

5.2.7. Mean and median WTA

The mean WTA per ha per year estimated are quite different between three types of forest (Table 36). The mean WTA of households contracted production forest is estimated to be VND 592,000/ha/year (US$ 28), nearly two times higher than the mean WTA of households contracted protection forest of VND 327,000/ha/year (US$ 16) and households contracted special-use forest of VND 338,000/ha/year (US$ 16). Overall, the annual mean WTA of households contracted natural forest in Dinh Hoa is VND 398,000 (US$ 19). The mean WTA ranges between VND 366,000 (US$ 17) and VND 430,000 (US$ 21) for a 95% confidence interval.

The median WTA of the households contracted special-use forest, protection forest and production forest are VND 325,000 (US$ 16), 283,000 (US$ 14), and 591,000 (US$ 18) respectively. The median WTA of total sample is VND 369,000 (US$ 18), ranging from VND 337,000 (US$ 16) to VND 402,000 (US$ 19).

Table 36: Mean and median WTA

Forest type	N	Unit	Mean	95% CI		Median	95% CI	
				Lower	Upper		Lower	Upper
Special-use forest	95	VND	338,000	302,000	374,000	325,000	289,000	361,000
		(US$)	(16.1)	(14.4)	(17.8)	(15.5)	(13.7)	(17.2)
Protection forest	97	VND	327,000	278,000	375,000	283,000	236,000	330,000
		(US$)	(15.6)	(13.3)	(17.9)	(13.5)	(11.2)	(15.7)
Production forest	85	VND	592,000	517,000	667,000	591,000	516,000	665,000
		(US$)	(28.2)	(24.6)	(31.8)	(28.1)	(24.6)	(31.7)
Total sample	277	VND	398,000	366,000	430,000	369,000	337,000	402,000
		(US$)	(19.0)	(17.4)	(20.5)	(17.6)	(16.1)	(19.1)

5.2.8. Costs of natural forest protection in Dinh Hoa

The total costs of natural forest protection in Dinh Hoa takes into account the total natural forest area which is contracted to households for protection. Multiplying the average WTA of VND 398,000/ha/year with total natural forest land of approximately 12,000 ha, which are contracted to local households, the annual cost of natural forest protection in Dinh Hoa district is estimated to be VND 4.78 billion (US$ 227,475). The upper and lower boundary of the 95% confidence interval around the estimated total value is VND 4.39 billion (US$ 209,005) and VND 5.16 billion (US$ 245,944), respectively. Assuming a discount rate of 5%, the total net present value of a five-years project costs VND 18.71 billion (US$ 891,162), ranging between VND 17.19 billion (US$ 818,805) and VND 20.23 billion (US$ 963,519) for a 95% confidence interval.

CHAPTER 6: DISCUSSION

The study attempts to identify perception and attitudes of the local residents towards natural forest protection, their WTP, and factors influencing their WTP; assess the livelihoods of rural households who are contracted and allocated natural forest for protection, their WTA compensation for natural forest protection, and factors influencing their WTA; evaluate costs of protection of natural forest; and provide possible suggestions for strengthening the policy of payment for forest protection related to PFES, REDD+, poverty alleviation, equity, local involvement in decision-making, conditional payment, capacity building, and technical support.

6.1. Perception and attitudes of local residents towards natural forest protection

The perception and attitudes of the local residents towards the role of forests in communities and their WTP for forest protection show the possibility of increasing social and financial support, which play an important role in the success of a protected area. The study showed that the local residents are concerned about environmental quality in the area. They perceived that reducing deforestation and protection of natural forests could be efficient ways to improve environmental quality. They are willing to contribute finance to support the protection program. However, they are uncertain about the equity of the mechanism of incentives distribution and problems related to forest management could be resolved. The lack of a transparent, proper distribution mechanism and a sufficient control system makes it possible to misuse forest protection funds, generates corruption (Pham, 2014), and increases transaction costs, which raises the concern of donors. Without strict compliance to a protection contract and strong law enforcement, the forest services´ users become less willing to pay for the services.

The study results proved that understanding local perception and attitudes towards natural forest protection and using it as a starting point to develop economic tools to evaluate the WTP for environmental services is necessary to increase public support for forest protection at a local scale.

6.2. WTP and factors influence WTP

The local residents in Thai Nguyen province are willing to pay VND 43,000 (US$ 2.1) as a one-time payment for Dinh Hoa forest protection. This amount is equivalent to about 0.04% of annual income of households in Thai Nguyen province and 0.03% of annual income of households in Vietnam. The amount estimated by our study is slightly lower than the amount of recent studies in Southeast Asian related to payment for forest protection and conservation. Vincent et al. (2014) estimated the WTP of households in Malaysia for the protection of Belum-Temengo park to be about US$ 12 from logging and about US$ 8 from poaching (0.1% of annual household income). Yoeu and Pabuayon (2011) found the WTP of households in the Tonle Sap Biosphere reserve, Cambodia for the conservation of flooded forest to be about US$ 7 (1% of annual household income).

The payment estimated by our study seems low, but it is understandable in an area where there has never been any payment for forest protection or payment for environmental services in the past. Our study found similarity with Truong (2008) who estimated the WTP of households in Hanoi and Ho Chi Minh city for the conservation of Vietnamese Rihno to be US$ 2.5 (0.05% of annual household income in Vietnam). As Vietnamese are unfamiliar with payment for environmental services and biodiversity protection, the amount evaluated in our study is considered affordable. The payment for natural resources protection is expected to increase in the future when household incomes increase.

The result of this study showed no significant difference in payment level between residents in urban areas and rural areas. Even though urban residents have higher incomes, higher education levels, better access to information, greater awareness of environmental problems, and more appreciation for natural resources, they are unlikely to be willing to pay more than rural residents for forest protection.

Several factors were found to be significant in the WTP study. Payment level, previous forest visits, an awareness of the forests´ public benefits, and household income are the factors which influence the WTP. Demographic characteristics such as age, gender, household size, education, ethnic, and employment have no significant relationship to WTP. While payment level and previous forest visits negatively affect WTP, the awareness of the forests´ public benefits and household income influence the WTP positively. It is clear that a lower payment level for forest

protection, a higher awareness of the forests´ public benefits and a higher household income increases the probability of acceptance the payment offered.

The negative relationship between previous forest visits and the WTP reflects that the respondents, who visited Dinh Hoa forest, tend to be less willing to pay than those never visited before. These findings contrast with the hypothesis that people who had visited Dinh Hoa forest might be aware of the forests´ situation and appreciate the forests´ public benefits, and thus be more willing to pay than those who had never visited. One potential reason might be that people consider Dinh Hoa forest as a recreational site (Dinh Hoa Safety Zone, a national historical site, is one part of Dinh Hoa forest) rather than a source environmental services. Since they already visited Dinh Hoa forest once to several times, instead of paying for Dinh Hoa forest protection, they might be interested in paying for other places for future visits.

6.3. Livelihoods of forest dependent households

The rural households in Dinh Hoa district are poor, mainly belong to minority ethnic groups (more than 70%), and rely on agricultural activities for self-consumption, i.e., most agricultural and forest products are used for subsistence purposes. Each household manages and protects small (3 ha) and scattered forest land; and few of them have received payment for forest protection for several years. Forest products such as fuelwood, timber, bamboo, and palm tree products are important to local households. The share of forest income to total household incomes (21%) is significant. These findings are similar to the results found by Neupane (2015) who conducted a survey in Dinh Hoa district to assess the jurisdictional reduced emissions from deforestation and forest degradation implementation. A forest dependent household in Indonesia earned a similar proportion of forest income between 20% to 30% (Purnamasari, 2008). Early studies by Vedeld et al. (2007) and Vedeld et al. (2004) estimated average forest income contribution was 22%, the third most important income after off-farm income and agricultural income (crops and livestock). Our findings are consistent with previous results.

The average income per capital of forest dependents estimated by the study (US$ 500) is significantly lower than average income of Thai Nguyen province (US$ 1,400) (TSO, 2012) and Vietnam (US$ 1,800) (FAO, 2015a). Hence, an additional income from forest protection is needed to improve local livelihoods and increase their contribution to poverty alleviation.

6.4. WTA and factors influence WTA

The mean WTA of the households allocated and contracted natural forest in Dinh Hoa estimated by this study of US$ 19/ha/year is four times higher than the current payment level paid by provincial FPDF for forest protection and development (US$ 4.8), and two times higher than average level of the PFES in Vietnam (USD$ 11) (Pham, 2014).

The PFES program pays between US$ 14 and US$ 21 per ha per year to forest owners and forest-contracted households in Lam Dong, US$ 11 in Son La (Pham et al., 2013), US$ 10 in Bac Kan (Dam et al., 2013), between US$ 0.1 (for landscape protection) and US$ 10 (forest protection) in Gia Lai, and between US$ 1 (for landscape protection) and US$ 22 (forest protection) in Yen Bai (Pham, 2014). Trinh and Rañola (2011) conducted a contingent valuation survey in Son La province and found the WTA for participation in forest management of upland farmers in the Northwest mountainous region of Vietnam to be US$ 14. Compared to the amount paid by PES programs in Costa Rica and Ecuador (about US$ 60/ha/year) (FONAFIFO, CONAFOR and Ministry of Environment, 2012; Porras et al., 2013), the payment of US$ 19/ha/year estimated by our study is three times lower. But this amount affordably fit the local context and is in line with the range of payment levels of PFES program in Vietnam.

The level of payments expected by the households depends upon the types of forests contracted and allocated to them. Households who are contracted and allocated natural production forests require payments two times higher compared to the households contracted protection and special-use forests. Two plausible reasons might explain for this divergence: i) the area of forests they were contracted and allocated, and ii) the differing use rights over the forest types. Firstly, the average area of production, protection, and special-use forests contracted to the households are 0.8 ha, 6.7 ha, and 2.8 ha, respectively. The possession of smaller area of the production forest resulted in the higher monetary expectation. Secondly, there are higher restrictions on the use of protection and special-use forests compared to the use of production forests (Dang et al. 2012). Due to the right to access to the forests, households contracted production forests enjoy greater benefits compared to other forests. The greater benefits imply the higher opportunity costs for forest protection, and thus households contracted and allocated production forest demand higher compensation.

The WTA is influenced by the level of payment, the ethnic group, income, natural forest land

area, plantation forest allocated, distance to the forests, and the NTFPs. The WTA has a positive relationship to the level of payment, forest land area contracted, and plantation forest allocated and a negative relationship to the ethnic group and distance to the forests. The effects of these factors are constant with the findings of Bush et al. (2013), Minten (2003), Shyamsundar and Kramer (1996), and Trinh and Rañola (2011).

Income is an important variable to many WTA and WTP studies. Ma et al. (2009) found that lower income respondents are more likely willing to accept the compensation than higher income respondents as they consider that amount of payment as an additional income. On the contrary, Dolisca et al. (2006) concluded that higher income respondents, who are more aware of the consequences of deforestation, are more willing to accept. In the case study of Dinh Hoa district, income has an opposing influence on the WTA: positive in special-use forest model and negative in production forest model. Two reasons mentioned above might explain why income variable has an opposing influence on the WTA. In our models, opportunity cost of labor might be another reason. If we look at the income proportion, the non-farm incomes of households allocated and contracted production forest is nearly three times higher than those allocated and contracted special-use forest. Hence, it is understandable that higher income households which are allocated and contracted production forest tend to be less willing to accept payments offered than those allocated and contracted special-use forest.

The types of the forest products, i.e., bamboo, palm tree products etc. collected by the households also affect the acceptance of the bid in opposite direction. Households which collected bamboo require lower payment level, while households which collected palm tree products demand higher compensation. Bamboo is commonly collected for self-consumption, and thus contributes less to the total household cash income, whereas palm tree products such as palm vein, stem, and leaf are used for commercial purposes. The different purposes for using NTFPs might explain the different effects of NTFPs on the WTA of households in the WTA survey.

6.5. Costs of natural forest protection

If the project is implemented, the five-year natural forest protection project in Dinh Hoa district would cost VND 18.7 billion (US$ 891,162). As a whole, the population in Thai Nguyen province could contribute VND 12.5 billion (US$ 593,810) in a one-time payment. It is evident that residents in That Nguyen province can afford to finance two thirds of the total project costs

(Figure 23). As forests are protected, the ES are improved, and thus the environmental quality will increase. The remaining costs (US$ 300,000) could be funded by the government (provincial FPDF, PFES program), private investors (ecological tourism companies, irrigation providers), and international funds (international donors, REDD+ payment). As Dinh Hoa Safety Zone, a national historical site, is a part of Dinh Hoa forest, state or private investment in developing ecotourism combined with historical and cultural visits is a potential source of increasing finance support for the forest protection program.

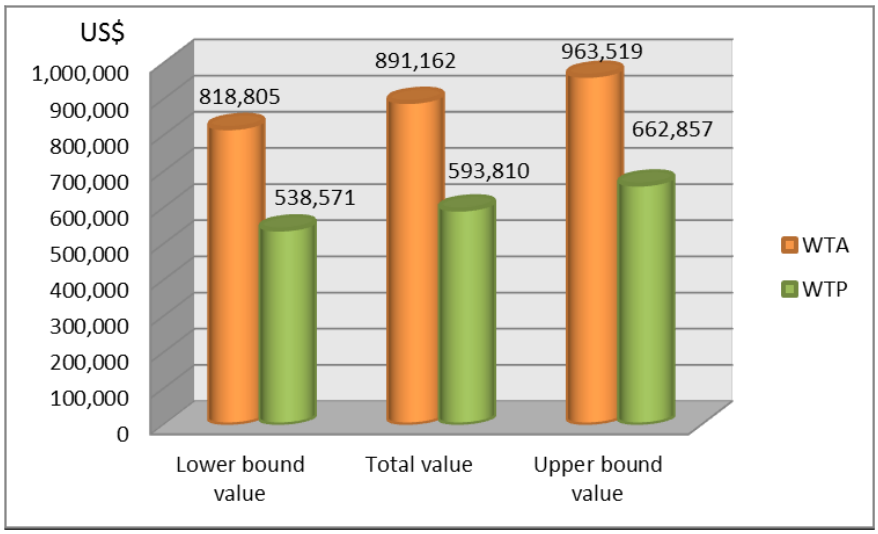


Figure 23: Total value WTA and WTP

6.6. Payment for forest protection and PFES

In Asia, Vietnam is the first country to implement a PFES scheme nationwide (Pham et al., 2013). The payments are implemented between users such as hydropower, water supply, and tourism companies and providers who are forest owners and forest contracted and allocated households. The successful first pilot phase in Vietnam has the potential to scale up to develop a similar PES policy in other countries in Southeast Asia.

The flat payment per ha per year is simple and transparent with low transaction costs. Several studies found that a differential payment generates more environmental benefits than a flat payment (Chen et al., 2010; FONAFIFO, CONAFOR and Ministry of Environment, 2012). In Vietnam, payment for PFES applied due to K-coefficient which categorizes the status into the forest-rich, average, and poor forests. The application of K-coefficient is appropriate but does not reflect the rights and obligation of households which own or are allocated and contracted

forests among three types of forests in benefit sharing. In the case of Vietnam, the rights and the obligations of the forest land holders depend on the type of forest. As our study shows that households allocated and contracted different types of forest require different payment level, the PFES should consider different payment levels due to different types of forest to compensate opportunity costs, and thus satisfy and encourage the local participation.

The levels of payment for PFES (US$ 11/ha/year) and of provincial FPDF (US$ 5/ha/year) are not realistic for forest owners and forest allocated and contracted households in many provinces. As the payment is not equal to opportunity costs, the providers are not interested in providing the ES. Our study is a PES-like experiment to identify the opinions and preferences of the local public towards the policy implementation and decision-making. The WTA estimated by the study strengthens the argument that the level of payment currently made by the government needs to be raised to meet local expectations.

The PFES in Vietnam comes from hydropower, water supply, and tourism companies. When the forests are protected, ES are increased and improved in both quality and quantity, and thus residents in a particular area where forests are protected can enjoy larger benefits from ES. Additionally, the amount of payment by the state is limited because of many other competing priorities. Our study shows that residents in a province are willing to voluntarily contribute to forest protection, if and only if the benefits distribution mechanism and monitor system are transparent, effective, and equitable. Diversity funding sources can contribute to sustainability of the transaction. A legislative framework to enable private investment (NTFPs enterprises, tourism enterprises) is necessary. To involve the public in these transactions, environmental education and an information campaign on PES are necessary to gain public awareness.

6.7. Payment for forest protection and REDD+

Payment for forest protection creates economic incentives and rewards land managers for implementing practices that enhance forest resources. REDD+ pursues rewards to governments, companies, or forest owners in developing countries for keeping tropical forests (Namirembe, 2011). Payment for forest protection motivates communities to protect and conserve forest areas, and thus addressing REDD+ objective. Protection of forest that reduces deforestation and forest degradation is enabling to receive REDD+ payment. As payment from developing government is restricted, REDD+ payment is able to be substantial financial resources. Vietnam

has finished the first phase of the UN-REDD program (2009-2011) to establish a national REDD+ network and moved to the second phase (2012-2015) to test the scheme of payment for carbon sequestration to development payment legal frameworks. Our experiment of payment for forest protection provides an economic rationale for implementing REDD payment in Vietnam, presents a tool for REDD+ to minimize participation costs and time, and allows productive activities to work alongside REDD+.

6.8. Payment for forest protection and poverty alleviation

Forest protection generates incomes, capital, and employment opportunities for forest dependents who are often poor and vulnerable. The protection program will be a success if focus is placed on balancing ecosystem and societal outcomes and harmonizing community livelihoods and ecosystem conservation. A forest protection program should be designed with attention to poverty reduction and food security.

Our study found that households allocated and contracted forests for protection are poor and rely heavily on agricultural cultivation. The current payment to households and individuals for forest protection accounts for 0.6% of the total household incomes. This finding is similar to the contribution of income from forest protection estimated by Wunder (2005), which is around 1-2% of the household incomes. Increased forest protection may improve the livelihoods of poor farmers. A problem, however, is that the forests they have been contracted and allocated are too small and scattered, which increases the management costs. In this context, the current payment for protection of forests made by provincial FPDF is unreasonable in terms of poverty alleviation.

Lessons from successful pilot phase of PFES in Lam Dong province in the Central Highlands, Vietnam and PES implementation in Latin America prove that local farmers are interested in PES programs if their protection land is equal to or larger than 20 ha/household (Chiramba et al., 2011; FONAFIFO, CONAFOR and Ministry of Environment, 2012). To improve the equity between farmers, Ecuador´s Socio Bosque conservative program pays highest payment level per ha for 20 ha forest or less. For the following forest land more than 20 ha, the payment levels are lower (FONAFIFO, CONAFOR and Ministry of Environment, 2012). Reallocation of higher forest land to rural households to ensure forest protection contributes to household incomes is a possible way to create higher income and more incentives for local participation.

Forest protection should be combined with rural development (agroforestry) to realize other business opportunities. Better quality forests support soil fertility to improve productivity of agroforestry. In the case study in Dinh Hoa district, besides main crops, tea plants, which contribute considerably to household incomes, are integrated in the lowland forest areas. However, poor rural households lack access to stable markets and prices, which are controlled by middlemen. Because of low volumes produced, they are unable to market their products. Organizing farmers into marketing groups with technical support is one solution to link with niche markets and stabilize the markets for agricultural outputs.

Allowing NTFPs collection, establishing agroforestry systems, intensifying agricultural and livestock on non-forest land along with incentives for forest protection, setting up producing NTFPs and ecotourism enterprises to generate employment and incomes for the local population are options for gradually alleviating poverty.

6.9. Payment for forest protection and equity

Payment for forest protection projects seek for the equity of policies affecting the most vulnerable stakeholder groups such as poor, women, ethnic minorities (FONAFIFO, CONAFOR and Ministry of Environment, 2012). They seem to have lower WTA due to low opportunity costs. Our study shows two thirds of participant belongs to minority ethnic groups; half of them are women responsible for working in the forest; most are poor and rely heavily on agricultural activities. To encourage these vulnerable groups to be more involved in forest protection projects, special contracts with indigenous, poor, and women may give them more access. Because of the small area of forest landholdings and low payment per ha, the payment mechanism with higher payment per ha for smaller landholdings may bring more incentives to poor and small-scale farmers.

6.10. Payment for forest protection and local involvement in decision making

Households in our study which have been allocated and contracted forests for protection mostly belong to minority ethnic groups. Few households are aware of contract terms though these contracts directly affect their rights and obligations and all communities. Local people do not know and do not fully understand their rights. Their complaints about delayed payments are not

forwarded to higher-level officials. Consequently, communities and households are kept out of direct decision-making.

To date, payment for forest protection in many regions is used as a command-and-control instrument rather than an economic incentive (Wunder, 2005a). The lack of voice and choice of the locals explains the unreasonable and unrealistic payment policy. Compensation expected for natural forest protection is far higher than the current payment made available by the government. Their suggestions and comments must be strongly considered, otherwise, it will be impossible to change the local behavior towards sustainable forest management. In the long term, payments for the forest protection need to combine with capacity development, knowledge sharing, and risk alleviation. All stakeholders should be involved at all levels of governance and administration to strengthen cooperation. Policymakers must understand, evaluate, and manage within this framework.

6.11. Conditional payment for forest protection

In the PES surveys conducted in several provinces in Vietnam, Wunder (2005a) found no evidence of punishment or withdrawal of forest land use right in cases of incompliance with contract terms. Our study found similar results. The complex and complicated administrative management, the poor implementation of monitoring, report, and verifying, and the poor understanding of contract terms are the main reasons causing contract incompliance. Only a small portion of households allocated and contracted forests actual receive payment from the government, and thus they have no motivation to comply with the contract terms. As current payment for forest protection made available by the government is considered as an instrument of command-and-control system rather than an economic incentive, the monitoring, report, and verifying of contract compliance are very weak or ignored.

To ensure the sustainability of the payment for the long term and encourage payment from public ES users, the conditional payment is a must. A regularly communicated management plan is required for patrolling the forest, managing forest fires, and tracking the condition of the forests. In order to achieve the protection targets, the monitoring and verification system should be clear, baselined, and flexible. Setting up relevant criteria and indicators of measurement and inspection ensures that evaluations can be made efficiently. The payment should be made along with the verification that no land use changes have taken place. Participants who terminate,

cancel, or fail to comply with the forest protection contract will have to return a portion of the incentives received. Beneficiaries should have a plan for how they will use payments, including for family consumption. A payment level equal or above opportunity costs may bring a high level of contract compliance.

6.12. Payment for forest protection and capacity building and technical support

Poor participants of forest protection projects may face obstacles such as high transaction costs, complicated procedures, poor understanding of contract terms, and limited education and literacy. Given the very low amount of payment for forest protection, the locals have fewer opportunities for capacity building and technical support. Our findings provide not only rationale of economic incentives for households allocated and contracted forest land, but also potential financial support from the public. These contributions from the public can be a supplemented resource for capacity building and technical support. Payments alone, however, cannot solve problems. Cash payments should be combined with nonmonetary benefits of improving the efficiency of protection projects. Investment in human capital and capacity building is an important target of a forest protection project. Forest protection programs contribute to the development of rural areas by providing a clear legal and institutionalized framework, offering technical assistance, investing in infrastructure, providing bank loans for agricultural production, training and support to implement participants´ investment plan, and improving the negotiation power of the local population.

CHAPTER 7: CONCLUSION

The global deforestation rate has decreased in recent years due to improvements in forest management and greater government protection (FAO, 2015b). Payments for forest management and protection aim to promote sustainable forest management by compensating farmers and landowners for their efforts to protect the forest and by collecting payments from ecosystem services users. The majority of PES programs is funded by the governments and involves non-government organizations. To date, there has been no comprehensive study to assess and identify the preferences towards natural forest protection on the part of both ecosystem services providers (i.e., forest farmers and landowners) and ecosystem services users (i.e., the rest of the local population).

This study was conducted to understand the preferences and attitudes of the local population towards the protection of natural forests from both the ecosystem services provider´s and user´s point of view. The object was to find a consensus between ecosystem services providers and users to ensure sustainable forest management. Since PFES scheme are being implemented nationwide in many provinces in Vietnam, including Thai Nguyen province, this study provides useful information from both local forest farmers, who are contracted and allocated forests for protection, and the local population in general. Our study is a PES-like experiment to identify the opinions and the preferences of the local population towards policy implementation and decision-making. The results of this study confirm that the payment level expected by local households and individuals as compensation for their forest protection is much higher than the current payment level. The study suggests that raising the level of compensation will positively influence local behavior towards sustainable forest management. The effective level of compensation estimated by the study supports the argument that in order to meet local expectations, the level of payment currently made for forest protection by the government needs to be increased.

Tropical deforestation and forest degradation accounts for approximately 17% of global greenhouse gas emissions (Metz et al., 2007). Reducing emissions from tropical deforestation and forest degradation is widely accepted to be the key and least expensive way to fight against global warming. PES and PES-like approaches can be used as economic tools to help inform the design and implementation of REDD+ programs (Bond et al., 2009). PFES and REDD+ are complex and have a potential conflicting framework of social, environmental, and economic issues. They require regular economic and social surveys to assess the impacts of payment policy on local livelihoods to determine incentives for sustainable forest protection in the long term.

The study provides an economic rationale and builds the foundation for implementing PFES and REDD payment in Vietnam that will minimize participation costs and time investments, and allow productive activities to be carried out alongside REDD+. These findings empirically suggested a maximum payment level for forest environmental services users and a minimum compensation level for forest environmental services providers that match local expectations, considering to the variance in use-rights of the different forest types.

The study shows possible applications of the contingent valuation method to identify economic incentives for forest protection in a developing country. The study reflects a theoretical approach that can be implemented in various contexts, paying attention to cultural dimension, complexity of local populations, and environmental systems. WTA and WTP are used as market-based approaches to measure the price of protection of natural resources and assess structure of households´ livelihoods to understand the underlying factors that influence the local behaviors. WTA and WTP are used as a proxy to develop incentive systems that are not only giving money but also building capacity through education and training skills.

Focusing on individual households provides a better fit to the diverse socio-economic, cultural, and geographic character of the region. Payments for forest protection motivate local households to the direction of PES, provide additional income by compensating their protection efforts, create jobs, and contribute to the livelihoods of local communities. A good forest protection and management program would enhance the efficiency of natural resources conservation, contribute to poverty alleviation, enable community capacity

building, and influence local decision making. This approach should be further developed focusing on creating economic incentives for the willingness to protect forests.

The study shows the possible estimation of WTA and WTP in a small scale case study in Dinh Hoa district, Thai Nguyen province. Replication of a similar approach under different circumstances allows scaling up experience to address problems and understand payment system in general.

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Appendix

Appendix 1: Important products and economic value of several priority species, from Luoma-aho (2004)

Scientific name of species	Important products	Economic value
Aquilaria crassna	Agarwood	Very high
Calamus platyacanthus (rattan)	Stem	Very high
Canarium spp.	Timber, fruit	High
Chukrasia tabularis	Timber	High
Cinnamomum cassia	Bark, essential oil	High
Cunninghamia lanceolata	Timber	Average
Dendrocalamus membranaceus (bamboo)	Stem	Very high
Dipterocarpus alatus	Timber, resin	High
Erythrophleum fordii	Timber	High
Hevea brasilienis	Resin, timber	High
Hopea odorata	Timber, resin	High
Illicium verum	Fruit	High
Manglietia glauca	Timber	High
Melaleuca cajuputi	Wood, essential oil	High
Michelia mediocris	Timber	High
Phyllostachys pubescens (bamboo)	Stem	Very high
Pinus kesiya	Timber	Average
Pinus massoniana	Timber	Average
Pinus Merkusii	Resin, timber	Average
Rhizophora apiculata	Wood	High
Styrax tonkinensis	Timber	Average – high

Appendix 2: Dinh Hoa forest allocation, from ATKFMB (2013)

Year	Forest area (ha)		Forest user			
			Households		Organizations	
	Allocated	Unallocated	Area (ha)	Number of households	Area (ha)	Number of organizations
1992	3,550.02	26,680.91	3,550.02	1,241	-	-
1993	1,428.88	25,252.03	1,428.88	577	-	-
1996	1,219.40	24,032.63	1,219.40	482	-	-
1997	8,429.97	15,602.66	8,429.97	1,378	-	-
1998	4,208.21	11,394.45	4,208.21	1,968	-	-
1999	111.73	11,282.72	111.73	230	-	-
2002	2,116.18	9,116.54	2,116.18	1,495	-	-
2013	5,535.8	3,630.74	-	-	5,535.8	1
Total	**26,600.19**	**3,630.74**	**21,064.39**	**7,371**	**5,535.8**	**1**

Appendix 3: Structure of WTP focus group discussion

A, Introduction:

- Participants
- The purpose of the discussion

B, Discussion questions

- Participants 'awareness of environmental issues and the forest´s benefits
  - What environmental issues are you concerned about?
  - How does the forest benefit communities?
  - What are the benefits of Dinh Hoa forests? Which are the most important roles of the forests?
  - Have you ever been to forests in Dinh Hoa?
  - Do you plan to visit forests in Dinh Hoa in the future?
  - What are the threats of deforestation/loss of forests in Dinh Hoa?
  - Should natural forests in Dinh Hoa be protected?

- WTP debrief:
  - How much should be paid per household per year to protect Dinh Hoa natural forests?
  - Which way of paying do you prefer? e.g., an increase in income tax, electricity bill, water bill, or a donation?
  - Is it possible to conduct an in-person survey, telephone survey, mail surveys?

Appendix 4: Structure of WTA focus group discussion

A, Introduction:

- Participants
- The purpose of the discussion

B, Discussion questions

- Participants 'awareness of the Dinh Hoa forest's situation
  - How has the Dinh Hoa forest changed in recent years?
  - How does the Dinh Hoa forest benefit local inhabitants? What are its most important roles?
  - Is the deforestation in your area serious?
  - What are the threats of deforestation/loss of forests?
  - How often do you go to patrol natural forest?
  - Should natural forests in Dinh Hoa be protected?
  - Are you satisfied with the government's current payment for natural forest protection?

- WTA debrief:
  - How much should be paid per ha per year to protect natural forest in Dinh Hoa?
  - Do you prefer another way of paying? e.g., rice?
  - Is it possible to conduct an in-person survey, telephone survey, mail surveys?

- Forest products:
  - What did you collect from the forest?
  - If you had sold those forest products on the market, what price would you have got for products that you sold?
  - What were the costs of forest products collection?
  - What were the other costs?

- Crops
  - What did you harvested?
  - If you had sold those products on the market, what price would you have got for products that you sold?
  - What were the costs of crops cultivation?

- Livestock
  - What type of farm animals did you have?
  - If you had sold those farm animals or their products on the market, what price would you have got for products that you sold?
  - What were the costs of raising farm animals?

Appendix 5: Questionnaire – WTP survey

DINH HOA FOREST SURVEY

Hello, we are researchers from University of Hamburg and Thai Nguyen University. We are working on issue of natural forest management in the district of Dinh Hoa, particularly on payment for natural forest protection. This survey is being conducted to find out the awareness and attitude of the residents in Thai Nguyen province about natural forest protection and how they value Dinh Hoa forest. First, let me begin by saying that and there is no right or wrong answer; we would like to know your opinions and your responses are appreciated. The discussion should last around one hour and should be on a voluntary basis. The data collected from this survey will be used solely for research on environmental economics and will never be used for other purposes. This interview is completely confidential; your name will never be associated with your answers.

Address: …… Village/Group …… Commune/Ward…….. District/City

Date: …… Time: …… Interview length: …… (Minutes)

SECTION 1
INDIVIDUAL´S AWARNESS AND ATTITUDE ON ENVIRONMENTAL ISSUES AND NATURAL FOREST PROTECTION

1. In your opinion, what are three most significant problems that Thai Nguyen province has faced in the past years (1_ most significant, 2_ second most significant, 3_ third most significant)?

- ☐ 1) Economical issues
- ☐ 2) Poverty
- ☐ 3) Health care
- ☐ 4) Education
- ☐ 5) Environment
- ☐ 6) Employment
- ☐ 7) Social security
- ☐ 8) Transportation
- ☐ 9) Other: ……

2. Have you received any information on environmental issues from communication media (TV, radio, newspapers, magazines, or by community groups) for the past 12 months?

- ☐ 1) No, never
- ☐ 2) Yes, several times
- ☐ 3) Yes, many times

3. If yes, which environmental issues are most important?.....

4. In your opinion, what are three most important environmental issues in Thai Nguyen province (1_ the first most important, 2_ the second most important, 3_ the third most important)?

- ☐ 1) Water pollution
- ☐ 6) Drought

- ☐ 2) Air pollution
- ☐ 3) Soil erosion
- ☐ 4) Deforestation
- ☐ 5) Climate change
- ☐ 7) Flood
- ☐ 8) Biodiversity loss
- ☐ 9) Other: ……

5. Do you think environmental issues in Thai Nguyen province are well managed?

- ☐ 1) Yes
- ☐ 2) No

6. Which three entities are the most responsible for environmental problems (1_ most responsible, 2_ second most responsible, 3_ third most responsible)?

- ☐ 1) Government
- ☐ 2) Social organizations
- ☐ 3) Enterprises causing environment problems
- ☐ 4) Everyone

7. In your opinion, what are the forest's three most important roles (1_ most important, 2_ second most important, 3_ third most important)?

- ☐ 1) Habitat for animals and plants
- ☐ 2) Improve hydrological services: Purification of water; capture, storage and release of surface and ground water
- ☐ 3) Moderation of flood and drought
- ☐ 4) Controlling soil erosion
- ☐ 5) Carbon sequestration, climate change mitigation
- ☐ 6) Tourism
- ☐ 7) Restoration of landscape and cultural, aesthetic and bequest significances
- ☐ 8) Support local people *(Timber products, NTFPS)*
- ☐ 9) Other: ……

8. Do you agree or disagree with following statements:

Statement	Completely do not agree	Do not agree	Neutral	Agree	Completely agree
1) Other environmental problems are more important					
2) Utilization of natural resources is needed to increase jobs and incomes no matter how harmful it is to environment					
3) It´s the government duty to protect natural forests					
4) Natural forest resources should be protected even if I am not directly benefited					
5) Thai Nguyen citizens should contribute to protect forests for later generations					
6) If I am asked to contribute money or labor to forest protection programs, I will					

9. Have you received information on Dinh Hoa forest from communication media (TV, radio, newspapers, magazines, or by community groups) in the past 12 months?

☐ 1) No, never ☐ 3) Yes, many times
☐ 2) Yes, several times

10. Have you ever visited Dinh Hoa forest?

☐ 1) No, never ☐ 3) Yes, many times
☐ 2) Yes, several times

11. Are you aware of how Dinh Hoa forest benefits communities?

☐ 1) Yes ☐ 2) No

12. Are you aware of the degradation situation of Dinh Hoa forest?

☐ 1) Yes ☐ 2) No

13. Do you plan to visit Dinh Hoa forest in the future (in the next three years)?

☐ 1) Yes ☐ 2) No

SECTION 2
WILLINGNESS TO PAY FOR NATURAL FOREST PROTECTION IN DINH HOA DISTRICT

Forests provide a range of environmental, social, and economic benefits that improve our quality of life. Healthy forests clean and improve our air, store carbon, and moderate the climate. Forests conserve and purify water, prevent flood and drought, prevent soil erosion, and preserve the integrity of topsoil. Forests serve as homes and support wildlife. Forests enhance the beauty of landscapes, create and provide recreational and educational opportunities. People can enjoy economic benefits such as revenue from the processing and trade of forest products, reduction of energy costs, and employment opportunities.

Dinh Hoa district is characterized by its rich social and cultural diversity as well as its important role in the region's economic development. Dinh Hoa forest is an especially important part of the Dinh Hoa Safety Zone, a national historical site including 109 relics from the revolutionary era. The forest covers about 30,000 ha representing 58% of the total land. Half of forest area is covered with natural forests. The district, like those in other mountainous regions in Northern Vietnam, suffers from forest loss, forest degradation, and loss of biodiversity. As a result, the number of flora and fauna species has decreased dramatically over the years.

Forest protection not only benefits the people in Dinh Hoa district by preserving natural forests, it also increases environmental services, promotes tourism, and ensures historical preservation. Over the years, the government has made a significant effort to support afforestation and forest rehabilitation in Dinh Hoa district. Nevertheless, the protection of Dinh Hoa forest is threatened by

limited financial support.

Suppose that a fund for Dinh Hoa forest development and protection was created to support natural forest management in Dinh Hoa district. The money collected would be given directly to foresters and farmers involved in managing and protecting forests in Dinh Hoa. The money woul be paid to them twice a year: at the end of the first six months and at the end of the last six months. Payments would only be made if all terms in the protection contract were met. The payment would be withdrawn and a fine would be issued in the case of any forest loss.

Suppose that this program were implemented in the next five years and needed the support of all households in Thai Nguyen province. We are now going to ask how much your household would be willing to pay as a one-time contribution to the Dinh Hoa forest development and protection program. There is no right or wrong answer. Please keep in mind your household incomes and living expenses.

Suppose that your household, as well as all other households in Thai Nguyen province, were asked to contribute to the project as a one-time payment. Would you be willing to pay VND….. thousand per household as maximum payment?

14. Suppose that this program would cost nothing to your household. Would you vote in favor of the program?

☐ 1) Yes ☐ 2) No

15. Please specify reasons why you vote/ do NOT vote for the program?

……

16. Suppose that your household, as well as all other households in Thai Nguyen province, were asked to contribute to the project as a one-time payment. Would you be willing to pay VND…. thousand/household as maximum payment?

☐ 1) Yes (**go to question 16.1**) ☐ 2) No (**go to question 16.2**)

16.1. Would you be willing to pay VND …. thousand/ household?

☐ 1) Yes ☐ 2) No

16.2. Would you be willing to pay VND …. thousand/ household?

☐ 1) Yes ☐ 2) No

17. How certain are you of your answer to the previous question?

☐ 1) 100% ☐ 3) 50%

☐ 2) More than 50% to less than 100% ☐ 4) Less than 50%

Note: If the response is "Yes" to the first bid, or the second bid, or both first and second bid, go to Question 18 and 19. If the response is "No" to both first and second bid, go to Question 20 and 21.

18. Would you please specify the reason why you are willing to pay?

☐ 1) Dinh Hoa forest is currently so degraded that it should be specially protected

☐ 2) I´d like later generations to be able to enjoy the benefits of forests in the future

- ☐ 3) I believe that the program can be implemented if everyone contributes
- ☐ 4) Yes, but the current situation is satisfactory
- ☐ 5) Yes, but only when the payment is mandatory
- ☐ 6) Yes, but still too much
- ☐ 7) Other: ……..

19. Which of expenses would you reduce in order to contribute toward the program?

- ☐ 1) Phone/ telephone
- ☐ 2) Food
- ☐ 3) Pocket money
- ☐ 4) Electricity
- ☐ 5) Water
- ☐ 6) Gasoline
- ☐ 7) Petroleum
- ☐ 8) Clothing
- ☐ 9) Other: ……

20. Would you please specify the reason why you are NOT willing to pay?

- ☐ 1) I cannot afford that amount
- ☐ 2) I need to know other opinions about the program
- ☐ 3) I have to pay many things
- ☐ 4) I do not think protection of Dinh Hoa forest is worth doing
- ☐ 5) I think other environmental issues are more important than forest protection
- ☐ 6) I think money cannot solely help solve problems
- ☐ 7) The government should pay
- ☐ 8) I do not believe that the money will be used for the purpose of forest protection
- ☐ 9) Other: ……

21. If you do not agree with both of the payment levels which we offered, what would be the amount that you are willing to pay for a natural forest protection program in Dinh Hoa?"

VND …… thousand/household.

SECTION 3
SOCIO-ECONOMIC CHARACTERISTIC

26. Gender

- ☐ 1) Male
- ☐ 2) Female

27. Age: ……..years old

28. Household size: ……... member(s)

29. Ethnicity

- ☐ 1) Kinh
- ☐ 2) Other: ……

30. Marital status

- ☐ 1) Single
- ☐ 2) Married
- ☐ 3)) Divorced/Widow

31. Education

- ☐ 1) None school
- ☐ 2) Primary school
- ☐ 3) High school
- ☐ 4) Secondary school
- ☐ 5) College / University
- ☐ 6) Post graduate

32. Professional

- ☐ 1) Government staff
- ☐ 2) Private enterprise staff
- ☐ 3) Self-employed
- ☐ 4) Farmer
- ☐ 5) Unemployed (housewife, student, pensioners, unemployed)

33. Since when has your household been living here?.....

34. How far is it from your house to the district/city center?.....(km)

35. Have you ever donated to any environmental incident?

- ☐ 1) Yes
- ☐ 2) No

36. Do you belong to any environmental organization?

37. Do you belong to any association or organization?

- ☐ 1) Farmers´ Union
- ☐ 2) Women´s Union
- ☐ 3) Veterans Association
- ☐ 4) Youth Union
- ☐ 5) Other: ……..
- ☐ 6) No

38. Which facilities do you have access?

- ☐ 1) Electricity
- ☐ 2) Clean water
- ☐ 3) Asphalt roads
- ☐ 4) Health care services
- ☐ 5) School
- ☐ 6) Communication media (TV, radio, telephone, newspapers, magazines)
- ☐ 7) Other:……

39. Please indicate how many items your household own?

- ☐ 1) Automobile
- ☐ 2) Motorcycle
- ☐ 3) House/estate
- ☐ 4) Refrigerator
- ☐ 5) Washing machine
- ☐ 6) Computer/laptop
- ☐ 7) Air conditioner
- ☐ 8) Phone
- ☐ 9) Cell phone
- ☐ 10) Microwave
- ☐ 11) Television
- ☐ 12) Gas cooker
- ☐ 13) Water tank
- ☐ 14) Indoor bathroom/toilet

40. For your entire household, what were your total expenditures on average per month?

- ☐ 1) Less than VND 1 million
- ☐ 2) From VND 1 to 2 million
- ☐ 3) From VND 2 to 3 million
- ☐ 4) From VND 3 to 4 million
- ☐ 5) From VND 4 to 5 million
- ☐ 12) From VND 11 to 12 million
- ☐ 13) From VND 12 to 13 million
- ☐ 14) From VND 13 to 14 million
- ☐ 15) From VND 14 to 15 million
- ☐ 16) From VND 15 to 16 million

- ☐ 6) From VND 5 to 6 million
- ☐ 7) From VND 6 to 7 million
- ☐ 8) From VND 7 to 8 million
- ☐ 9) From VND 8 to 9 million
- ☐ 10) From VND 9 to 10 million
- ☐ 11) From VND 10 to 11 million
- ☐ 17) From VND 16 to 17 million
- ☐ 18) From VND 17 to 18 million
- ☐ 19) From VND 18 to 19 million
- ☐ 20) From VND 19 to 20 million
- ☐ 21) More than VND 20 million

41. How many people in your household earn an income? …… people

42. For classification purposes only, please tell us which category best describes the total gross income that you and all other members of your household earned last year. Please be sure to include each member´s wages and salaries, as well as income from any business, dividends, interests, tips, crops, livestock and other income.

- ☐ 1) Less than VND 12 million
- ☐ 2) From VND 12 to 24 million
- ☐ 3) From VND 24 to 36 million
- ☐ 4) From VND 36 to 48 million
- ☐ 5) From VND 48 to 60 million
- ☐ 6) From VND 60 to 72 million
- ☐ 7) From VND 72 to 84 million
- ☐ 8) From VND 84 to 96 million
- ☐ 9) From VND 96 to 108 million
- ☐ 10) From VND 108 to 120 million
- ☐ 11) From VND 120 to 132 million
- ☐ 12) From VND 132 to 144 million
- ☐ 13) From VND 144 to 156 million
- ☐ 14) From VND 156 to 168 million
- ☐ 15) From VND 168 to 180 million
- ☐ 16) From VND 180 to 192 million
- ☐ 17) From VND 192 to 204 million
- ☐ 18) From VND 204 to 216 million
- ☐ 19) From VND 216 to 228 million
- ☐ 20) From VND 228 to 240 million
- ☐ 21) More than VND 240 million

43. Is your household income enough for your family needs?

- ☐ 1) No, far from enough
- ☐ 2) Enough for food
- ☐ 3) Enough for food and clothing
- ☐ 4) Enough for a good quality of life
- ☐ 5) Have a surplus

44. How did your household income change compare to the last year?

- ☐ 1) Significantly decrease
- ☐ 2) Slightly decrease
- ☐ 3) No change
- ☐ 4) Slightly increase
- ☐ 5) Significantly increase

45. How much of household income that you personally contribute?

- ☐ 1) More than 75%
- ☐ 2) 50% - 75%
- ☐ 3) Less than 50%

46. How would you describe the quality of your household living condition compared to others in your village/ward?

- ☐ 1) Worse
- ☐ 2) Slightly worse
- ☐ 3) Average
- ☐ 4) Slightly better
- ☐ 5) Better

47. Is it easy to get a loan (from a bank or a non-relative)?

- ☐ 1) Yes
- ☐ 2) No

48. Would you like to make any comment?

……

CLOSING: Thank you for your time and cooperation!

Interviewer's comment:

……

I hereby certify that this is an honest interview taken in accordance with my instructions Interviewer´s signature

Appendix 6: Questionnaire – WTA survey

DINH HOA FOREST SURVEY

Hello, we are researchers from University of Hamburg and Thai Nguyen University. We are working on issue of natural forest management in the district of Dinh Hoa, particularly on payment for natural forest protection. This survey is being conducted to find out the awareness and attitude of the residents in Thai Nguyen province about natural forest protection and how they value Dinh Hoa forest. First, let me begin by saying that and there is no right or wrong answer; we would like to know your opinions and your responses are appreciated. The discussion should last around one hour and should be on a voluntary basis. The data collected from this survey will be used solely for research on environmental economics and will never be used for other purposes. This interview is completely confidential; your name will never be associated with your answers.

Address:…… Village …… Commune, Dinh Hoa district

Date: …… Time: …… Interview length: …… (Minutes)

SECTION 1
DINH HOA FOREST SITUATION: AWARENESS AND PERSPECTIVES

1. How long have you been working in the forest sector? ..... year(s)

2. How much land does your household currently own?

1) Forest: …… (ha) 3) Resident: …….. (m^2)

2) Agriculture: ……(sao, 1 sao = 360m^2) 4) Other: …….. (m^2)

3. How many ha of forest do you have regarding to the type of forest?

Type of forest	a. Natural forest		b. Planted forest	
	Area (ha)	Main trees	Area (ha)	Main trees
1) Special-use				
2) Protection				
3) Production				

4. How and when did your household acquire forest land?

1) Inherited, in ……

2) Allocated by the district, in ……

3) Contracted by the district, in ……

5. How often do you go to the forest? ..... (time/week), ... (hour/time)

6. How far is it from your house to

1) Commune center: ……(km)

2) Nearest forest: …….. (km), by walking……(minute), by motorbike……..……(minute)

7. In your opinion, how has the situation changed in the past 5 years

	1) Increased	2) Stayed the same	3) Decreased	4) Do not know
1) Number of tree species				
2) Number of animal species (wildlife)				
3) Frequency of flood				
4) Frequency of drought				
5) Temperature				
6) Air pollution				
7) Soil fertile				
8) Number of tourists				
9) Quantity of timber harvested				
10) Quantity of non-timber forest products (fuel wood, bamboo shoot, palm tree, etc.) harvested				
11) Deforestation				

8. Which one do you judge the most serious consequence of deforestation in your area?

☐ 1) Soil erosion
☐ 2) Drought and flood
☐ 3) Air pollution
☐ 4) Loss of biodiversity
☐ 5) Other: ……
☐ 6) Do not know

9. Do you collect forest products at all?

☐ 1) Yes
☐ 2) No

10. How much do forest products contribute to your household's annual income?

☐ 1) More than 75%
☐ 2) 50-75%
☐ 3) 25-50%
☐ 4) Less than 25%
☐ 5) Do not know

11. Since you have started collecting forest products, how easy is it to find them now compare to 5 years ago?

☐ 1) Easier
☐ 2) Unchangeable
☐ 3) More difficult
☐ 4) Do not know

12. In your opinion, in the next five years, is this situation going to

☐ 1) Improve
☐ 2) Stay the same
☐ 3) Get worse
☐ 4) Do not know

13. Do you know that forests benefit communities?

☐ 1) Yes ☐ 2) No

14. Please rank the three most important roles of the forest? (1- First most important, 2-second most important, 3-third most important)

☐ 1) Habitat for animals and plants
☐ 2) Improve hydrological services: Purification of water; capture, storage and release of surface and ground water
☐ 3) Moderation of flood and drought
☐ 4) Controlling soil erosion
☐ 5) Carbon sequestration, climate change mitigation
☐ 6) Tourism
☐ 7) Restoration of landscape and cultural, aesthetic and bequest significances
☐ 8) Support local people *(Timber products, NTFPS)*
☐ 9) Other: ……

15. Have you been aware of forest degradation in Dinh Hoa recent years?

☐ 1) Yes ☐ 2) No

16. Do you agree or disagree with following statements:

Statement	1) Agree	2) Neutral	3) Disagree
1) No matter what the environment costs are, today, the Dinh Hoa district needs to utilize its natural forests to increase jobs and incomes.			
2) Thai Nguyen and Dinh Hoa have made enough progress on afforestation, reforestation, and natural forest protection.			
3) The quality of Dinh Hoa forest would be the same, with or without exploitation.			
4) The Dinh Hoa forest is around 30,000 ha large. It does not matter if several thousand ha of forest are lost due to over utilization.			
5) Everyone in Dinh Hoa district and Thai Nguyen province has to protect forest resources.			
6) It´s time people in Thai Nguyen province and Dinh Hoa district did concrete things to protect natural forest to reduce effects of deforestation on environment.			
7) People should reduce forest resource exploitation and sacrifice some of their forest income to protect natural forests so that later generations may enjoy their benefits.			

SECTION 2
WILLINGNESS TO ACCEPT COMPENSATION FOR FOREST PROTECTION

Suppose that the payment for natural forest protection is adjusted in the next five years. As a result, you would receive a new contract which clarifies your rights and your obligations to the forest. All benefit rights to the forest would remain, but any illegal logging, illegal agriculture cultivation, and uncontrolled grazing in the forest would be prohibited. The money would be paid out twice a year: at the end of the first six months and at the end of the last six months. You would only be paid if all terms in the protection contract were met. The payment would be withdrawn and a fine would be issued in the case of any forest loss.

1. Suppose that your family does NOT receive any compensation for forest protection. Would you vote for this program?

☐ 1) Yes ☐ 2) No

2. Please specify reasons why you vote/ do NOT vote for the program?

……

3. Suppose that your household, as well as all other households in the Dinh Hoa district to which natural forest are contracted for protection, would be compensated VND **….** thousand/ ha/ year from now on for next five years. Would you accept VND …. thousand as minimum compensation?

☐ 1) Yes (**go to question 3.1**) ☐ 2) No (**go to question 3.2**)

3.1. Would you accept VND …. thousand/ ha/ year?

☐ 1) Yes ☐ 2) No

3.2. Would you accept VND …. thousand/ ha/ year?

☐ 1) Yes ☐ 2) No

4. How certain are you of your answer to the previous question?

☐ 1) 100% ☐ 3) 50%

☐ 2) More than 50% to less than 100% ☐ 4) Less than 50%

Note: If the response is "Yes" to the first bid, or the second bid, or both first and second bid, go to Question 5. If the response is "No" to both first and second bid, go to Question 6.

5. Would you please specify the reason why you are willing to accept the compensation?

☐ 1) The compensation is reasonable

☐ 2) Dinh Hoa forest is currently so degraded that it should be specially protected

☐ 3) Our future generations will be able to enjoy the benefits of the forest

☐ 4) I believe that the program can be implemented if everyone contributes

- ☐ 5) Yes, but the current situation is satisfactory
- ☐ 6) Yes, but only when the payment is mandatory
- ☐ 7) Other: ……..

6. Would you please specify the reason why you are NOT willing to accept the compensation?

- ☐ 1) The compensation is not reasonable
- ☐ 2) The forest has belonged to my family for many years, we do not want to trade it for any compensation
- ☐ 3) I need to know other opinions about the program
- ☐ 4) Our family cannot live without forest products
- ☐ 5) I do not think it is worthwhile to stop exploiting the forest
- ☐ 6) Stopping companies that cause pollution is more effective in reducing environment damages than protecting the forest
- ☐ 7) I think the forest is protected enough
- ☐ 8) Other: ……

7. Do you agree to be compensated for forest protection by a professional training course instead of cash?

☐ 1) Yes (**go to question 8**) ☐ 3) No (**go to section 3**)

8. Which professional training course would you prefer?

……

SECTION 3
FOREST PRODUCTS AND AGRICULTURE PRODUCTS IN THE LAST 12 MONTHS

A. Forest products collected

Product	Unit	Quantity /year	Quantity /day	Which forest? 1=planted forest 2=natural forest	Tool 1=knife, ax 2=saw 3=saw machine	Transportation			
						Vehicle		How far from forest?	
						1=self-carry 2=horse, buffalo 3=lorry	Price (VND 1000)	Km	Minute
1) Fuel wood	m^3								
2) Timber	m^3								
3) Bamboo shoot	kg								
4) Bamboo (Dendrocalamus latiflorus)	Culm								
5) Bamboo (Bambusa nutans)	Culm								
6) Bamboo (Schizostachyum aciculare)	Culm								
7) Palm leaf	Pcs								
8) Palm vein	Kg								
9) Palm stem	1000 Pcs								
10) Medicine plant	Kg								

B. Forest products self-consumed, sold and bought

Product	Unit	CONSUMED		SOLD							PURCHASE						
		Quantity	If sold, which price? (VND 1000)	Quantity	Price (VND 1000)	Place 1=village 2=commune 3=district	Transport to business place				Quantity	Price (VND 1000)	Place 1=village 2=commune 3=district	Transport from business place			
							Vehicle 1=self carry 2=horse, buffalo	Price (VND 1000)	How far					Vehicle 1=self carry 2=horse, buffalo	Price (VND 1000)	How far	
									Km	Minute						Km	Minute
1/ Fuel wood	m^3																
2/ Timber	m^3																
3/ Bamboo shoot	kg																
4/ Bamboo (Dendrocalamus latiflorus)	Culm																
5) Bamboo	Culm																
6) Bamboo (Schizostachyum aciculare)	Culm																
7/ Palm leaf	Pcs																
8/ Palm vein	Kg																
9/ Palm stem	1000 Pcs																
10/ Medicine plant	Kg																

C. Costs and supports of government for protection and afforestation

	Forest Type 1=Production 2=Special-use 3=Protection	Seedling		Fertilizer		Tool		Hire labor		Cash (VND 1000)	Other cost (VND 1000)
		Quantity (tree)	Unit price (VND 1000)	Quantity (kg)	Unit price (VND 1000)	Quantity (Pcs)	Unit price (VND 1000)	Working time (day)	Unit price (VND 1000)		
C1/ Cost											
C2/ Government support											

D. Crops harvested

Crop	Unit	Harvested quantity		Consumed quantity		Store		Sold				Purchased			
								Quantity		Price (VND 1000)		Quantity		Price (VND 1000)	
		Winter-spring	Summer-autumn	Winter-spring	Summer-autumn	Quantity	If sold, which price (VND 1000)	Winter-spring	Summer-autumn	Winter-spring	Summer-autumn	Winter-spring	Summer-autumn	Winter-spring	Summer-autumn
1.Rice	100 kg														
2. Maize	100 kg														
3. Cassava	100 kg														
4. Tea	Kg														

E. Crop inputs

Crop	Seedling		Fertilizer						Pesticide		Irrigation	Working time (day)							Other costs (VND 1000)
	Quantity (kg)	Price (VND 1000)	P		N		K		Quantity (bag)	Price (VND 1000)	Cash (VND 1000)	Plow	Sow	Apply pesticide	Weed	Harvest	Transport	Dry	
			Quantity (kg)	Price (VND 1000)	Quantity (kg)	Price (VND 1000)	Quantity (kg)	Price (VND 1000)											
1.Rice																			
2. Maize																			
4. Cassava																			
4. Tea																			

F. Livestock

Livestock	Quantity	Consumed	Died	Sold		Livestock products				Cost							
				Quantity	Price (VND 1000)	Quantity	Consumed quantity	Sold	Price (VND 1000)	Food		Young livestock		Labor			Other costs (VND 1000)
										Purchased quantity (kg)	Price (VND 1000)	Purchased quantity (kg)	Price (VND 1000)	Months /year	Days/ month	Hours /day	
1. Pig																	
2. Chicken																	
3. Goose, duck																	
4. Buffalo																	
5. Cow																	
6. Horse																	
7. Goat																	
8. Fish																	
9. Honey																	
10. Dog																	
11. Other																	

G. None-farm income and consumption

1. Did you lend/rent agriculture land?

☐ 1) Yes ☐ 2) No

Lent: get……..……kg rice/year, or……..VND thousand/year

Rent: pay…….…… kg rice/year, or……..VND thousand/year

2. Did you earn any other income?

☐ 1) Yes, …….. VND million, from…… ☐ 2) No

3. For your entire household, what were your total expenditures on average per month?

☐ 1) Less than VND 1 million
☐ 2) From VND 1 to 2 million
☐ 3) From VND 2 to 3 million
☐ 4) From VND 3 to 4 million
☐ 5) From VND 4 to 5 million
☐ 6) From VND 5 to 6 million
☐ 7) From VND 6 to 7 million
☐ 8) From VND 7 to 8 million
☐ 9) From VND 8 to 9 million
☐ 10) From VND 9 to 10 million
☐ 11) From VND 10 to 11 million
☐ 12) From VND 11 to 12 million
☐ 13) From VND 12 to 13 million
☐ 14) From VND 13 to 14 million
☐ 15) From VND 14 to 15 million
☐ 16) More VND than 15 million

4. How did your total household income change from the year before?

☐ 1) Significantly decrease
☐ 2) Slightly decrease
☐ 3) No change
☐ 4) Slightly increase
☐ 5) Significantly increase
☐ 6) Do not know

5. How much of this total household income did you personally contribute?

☐ 1) More than 75%
☐ 2) 50% - 75%
☐ 3) Less than 50%
☐ 4) Do not know

6. How would you describe the quality of your household living condition compare to others in your village and commune?

☐ 1) Worse
☐ 2) Slightly worse
☐ 3) Average
☐ 4) Slightly better
☐ 5) Better
☐ 6) Do not know

7. Did you borrow any amount of money last year?

☐ 1) Yes, …….. VND million, interest: …… ☐ 2) No

SECTION 4
DEMOGRAPHIC CHARACTERISTICS

1. Ethnicity:
☐ 1) Kinh ☐ 2) Other: ……

2. Gender:
☐ 1) Male ☐ 2) Female

3. Marital status:
☐ 1) Single ☐ 3) Divorced/Widow
☐ 2) Married

4. Household size: …… member(s)

5. Age: ……years old

6. Education: ……grade

7. Professional: ……

8. Do you belong to any association or organization?
☐ 1) Farmers´Union ☐ 3) Veterans Association
☐ 2) Women´s Union ☐ 4) Other:……

9. How long has your household been living here? ……
(year)

10. Which facilities do you have access:
☐ 1) Electricity ☐ 5) School
☐ 2) Clean water (**if No, go to question 11**) ☐ 6) Media: Internet, TV, radio, telephone, magazine (circle)
☐ 3) Asphalt road
☐ 4) Health care service ☐ 7) Other, please specify:……

11. Where do you collect water?
☐ 1) Forest ☐ 3) Lake, pond
☐ 2) Well ☐ 4) Other, please specify:……

12. Do you have any constraint on forest activities?
……

13. What is the main constraint on agriculture activities?
……

14. Would you like to make any comment?
……

CLOSING: Thank you for your time and cooperation!

Interviewer's comment:

……

I hereby certify that this is an honest interview taken in accordance with my instructions
Interviewer´s signature

Appendix 7: Percentage of saying "Yes/Yes", "Yes/No", "No/Yes", "No/No" - WTP survey

	Phu Binh and Dinh Hoa district		Thai Nguyen city		Total	
	Number	%	Number	%	Number	%
Yes/Yes	56	33.33	31	33.70	87	33.46
Yes/No	52	30.95	36	39.13	88	33.85
No/Yes	31	18.45	8	8.70	39	15.00
No/No	29	17.26	17	18.48	46	17.69
N	168		92		260	

Appendix 8: Percentage of saying "Yes/Yes", "Yes/No", "No/Yes", "No/No" - WTA survey

	Special use		Protection		Production		Total	
	Number	%	Number	%	Number	%	Number	%
Yes/Yes	31	32.63	33	34.02	18	21.18	82	29.60
Yes/No	35	36.84	28	28.87	27	31.76	90	32.49
No/Yes	18	18.95	23	23.71	21	24.71	62	22.38
No/No	11	11.58	13	13.40	19	22.35	43	15.52
N	95		97		85		277	

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