ECONOMIC ANALYSIS OF DEFORESTATON IN ETHIOPIA:

EVIDENCE FROM WILD COFFEE ARABICA IN THE AFROMONTANE RAIN FOREST OF SOUTH WEST ETHIOPIA.

BY

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"Economic Analysis of Deforestation in Ethiopia: Evidence from Wild Coffee Arabica in the Afromontane Rain Forest of South West Ethiopia."

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Abbreviations

ARDO = *Agricultural and Rural Development Office*

CFM = *Collaborative Forest Management*

CIFOR = *Center for International Forestry Research*

EEA = *Ethiopian Economic Association*

FAO = *Food and Agricultural Organization*

NFPA = *National Forest Priority Area*

PFM = *Participatory Forest Management*

WRI = *World Resource Institute*

WTP = *Willingness to Pay*

WTA = *Willingness to Accept*

Abstract

Cloud forests in highlands of south west Ethiopia are the last refuges to the wild population of Coffea Arabica. Global community is benefiting from the forests, but all conservation costs are imposed on subsistence farmers that are unable to afford. This in turn results in divergence between benefits and high rate of deforestation. This paper attempts to identify area specific factors that induce small holders to deforest, factors that determine profitability of competing land use options and seeks incentives available to reconcile conflicting interests. To do this, primary data is collected from 151 households. The regression results firstly, indicated the trade off between deforestation and maximization of the livelihood of the poor. Secondly, institutional interventions have possibilities to achieve sustainable development. Thirdly, there are some opportunities to cooperate conflicting interests by extending benefits. Therefore, the results suggest the importance of functional institutions firstly, to compensate the forest users through global transfer payments for the revenue they forgone due to strict conservation. Secondly, institutions are important to realize premium for environmental friendly production, in so doing to increase the value of remaining forest. Thirdly, institutions are required to increase productivity of already cleared land via agricultural intensification, to invest on family planning and to reduce value chain by greater farm level processing of primary products.

Key words: Ethiopia, deforestation, sustainable use, coffee Arabica, fair trade

CHAPTER ONE: INTRODUCTION

Forests vanish either naturally as consequence of huge climate change or most commonly due to human activities. This results in loss of biodiversity. Deforestation is the predominant cause of the forested land and biodiversity loss. It can be defined as the reduction of ecosystem functions or removal of forested land either permanently or temporarily to field to increase the economic value of land from diversification such as pasture, logging, and crop production, with or without sufficient afforestations.

The loss of tropical forest is greatest in Africa and threatens food security. More demand for arable land and fuel wood owing to population explosion is the fundamental causes of deforestation in Ethiopia. The trade off between forest area loss and economic growth must challenge endeavors to reduce recurrent poverty in Ethiopia unless the rate of deforestation is not reduced by large.

Highlands in south west Ethiopia are covered by cloud forest with high level of endemism, refuges to the wild population of Coffee Arabica. Nevertheless these forests are being replaced at rapid rate and given the deforestation constant at current rates, wild Coffea Arabica populations will be completely vanished within almost three decades.

This study focuses on identifying area specific causes of deforestation and tries to suggest specific remedies. Attempt is made to identify factors that determine sustainable forest management and incentive mechanisms that reconcile conflicting interests. In connection to this, the study examines whether price premium is incentive for deforestation or it enhances

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sustainable use. To achieve desired objectives, 151 households are interviewed. The survey result has indicated that shortage of land is the main reason that forces small holders to expand their land into primary forest. Nevertheless majority of the households preferred sustainable use of forest over conversion and willing to pay for extra use of core zone.

1.2 Problem Statement

The broad definition of deforestation is not only limited to conversion of forested area to arable land but also degradation that reduces forest quality, density and biodiversity; and ecosystem functions of the forest. The narrow definition refers to removal of the forested land and then shifting of land to alternative use, most often agriculture (van Kooten, 2000). Commonly it occurs when in short run financial benefits of wood and cleared land to local people adjacent to the forest outweigh total economic values of forest to global community. Farmers vulnerable to poverty and food insecurity prefer a short horizon planning over sustainable practices so as to avoid subsequent costs of sustainable use (Mink, 1993). Sustainable forest use can be more costly for these farmers. It involves costs of management of the commons, market externalities, and less availability and low value of non timber forest products (NTFPs).

The rates of forest land lose and its global costs have been a topic of scholarly literatures and heated discussion. However, despite the fact that consciousness of the problem has increased, the rate of forest lose is considerable. Forest area annual percentage change in low income countries is high relative to middle and high income countries and keeps on increasing. It was 0.1, 0 and -0.8 per annum in high, middle, and low income countries respectively between 2000 and 2005 (WRI 2007). In the typical year -0.6 was average annual percentage change in forest area of SSA.

From years 1990 to 2005 Africa accounted for more than half of global forest area damaged by wild fire and lost more than 9% of its forest area (FAO 2007).

There are ample of causes that are suggested by analysts which leads to forest land lose. However identification of the causes of deforestation is a challenge because it involves chain of causes and effect relationship overtime. By and large, it is very complex combination of market failures, polices and institutional failures and some basic features of societies such as the distribution of political and economic factors, that lead to forest land decline. Hence, it is not possible to find unambiguous cause-effect linkages that would have a universal application. Rather, specific situations must be studied in detail and remedies must also be highly specific (Contrersas 2000). Aside from a general agreement that deforestation occurs to increase the economic value of the land, there is no agreement on what causes deforestation at specific situation or area.

So far studies associated deforestation in Ethiopia to underlying causes. Namely, Institutional changes, tenure and food insecurity, improved transportations, agricultural expansion, population and resettlement are causes of forest land decline in Ethiopia (Dereje 2007, EEA 2002). However empirical evidences on immediate causes are scarce. For this motive, here emphasis was given to household level socioeconomic, market, and institutional factors that increase economic value of unsustainable forest use.

Afromontane rain forest of South West Ethiopia is the birth place for world's finest coffee- *Coffea Arabica* - and currently refuge for its genetic resource. This coffee forest providing environmental functions such as water shade and carbon sequestration to local people and global community as well. It is also source of livelihood to local people and genetic reserve and other

potential benefit to international society. However the use global community makes of this resource is heavily unsustainable. Currently the cloud forests are being removed at rate of 8% per year (FAO 2003b). Actually we all are benefiting from the cloud forests, but conservation responsibilities and burdens are left and imposed on subsistence farmers who are unable to afford costs of sustainable management except for future hopeful initiatives, if implemented. Making these incentives available to local people will narrow the existing divergence between private and social benefits and costs associated with the use of forest resource.

The interest of coffee companies, but not sufficient; consumers and donors can be cited as role model. Coffee companies have found the niche market for forest coffee from Ethiopia and are willing to pay higher prices to the farmer cooperatives in coffee forest areas. Similarly consumers promised to pay higher prices to promote farmers for sustainable use of forest coffee, but they lacked institutions. Traditionally farmers have abandoned wild coffee collection when coffee prices were too low. Also relatively less availability and productivity of wild coffee limits the distribution of biodiversity. Currently we have scant evidence on whether higher prices for forest coffee are an incentive for sustainable use. Rojah (2006) argued against low current price premium to ensure sustainable management of forest. Indeed, even evidences on volume of wild coffee that can be collected in a sustainable way are scarce.

Meanwhile to respond the threat, the government of Ethiopia called for participatory forest management (PFM). The government and European commission converted the cloud forests in Yayu into National Forest Priority Areas (NFPAs). However, PFM requires involvement of stakeholders with varying interests. The interest of aid agencies- in situ conservation of biodiversity- conflicts with the interest of local resource users. To illustrate, around 69.1% of the

territory is covered by forest and the forest is a livelihood for subsistence farmers around it. They harvest NTFPs such as forest coffee, corrorima, gesho, medical plants and others in buffer zone, but not allowed to extract timber, fuel wood and wood. The conservation motives of the government imposed high opportunity cost on local community. They have forgone Arable land that is quite scarce for subsistence production thus sometimes farmers forced to clear forest to find space for semi- forest coffee and cereal crop production.

1.3 Objectives of the Study

Determination of the causes of deforestation is a challenge because it involves chain of cause and effect relationship over time. For example, operation of different agents in the same spot, interrelated effects of underlying and immediate causes of deforestation making the isolation of individual effects difficult. Generally forest loss originates from complex combination of interrelated variables and thus impossible to find unambiguous cause-effect chains that would have global application. The first general objective of the study is to identify the area specific household level factors that promote the transformation of forested land into agricultural land.

Conventional economic theory portrays environmental degradation as a form of disinvestment, but in homesteading situations the logic is reversed. To put differently, when forest clearing is prerequisite for ownership rights (homesteading), deforestation becomes an investment in the future for the farmer. This can lead to unexpected results such as lower discount rates and higher tenure security actually increasing deforestation. Moreover, it may be useful to consider either deforestation or sustainable forest management to be long-term investments in various tenure arrangements for example, when farmers are granted use right only. Hence the second objective

is to generate analytical or empirical conclusions about which option small holders chose either conversion or sustainable forest management in the existing tenure system of Ethiopia.

Forest conservation must compete economically for scarce land in rural Ethiopia, if it is to be accepted as alternative land use. Since agriculture is the main source of rural household livelihood. From farmers' perspective, conversion into agricultural land may be more profitable than sustainable use. While from society point of view by taking all values into consideration (i.e. including all environmental services) sustainable management achieves higher net benefit. Thus sustainable use of forest coffee depends on net income generated from two land use alternatives to local people. Then the third object seeks to investigate factors that determine profitability of sustainable forest or buffer zone management.

Fourth, Sustainable forest management requires the involvement of all stakeholders with different interests such as the government, NGOs, private institutions and local communities. But to conserve the biodiversity the government of Ethiopia established Protected Forest Priority Areas (PFPAs) and get involved foreign aid agencies in participatory forest management to conserve the remaining forest. While donors are carrying out their project on behalf of the government however not participatory and economically less viable in the case of Yayu, the study district. Hence the initiatives are conflicting with the interest of local communities. What incentive structures are must be extended to create competent and trust worthy relationship between local resource users and the government?

1.4 The Research Questions

To achieve the above research objectives the study has designed the following research questions:

- What induces small holders to expand their land into forests in perfect/imperfect labor market?
- What incentive mechanisms are there to reconcile conflicting interests and to benefit farmers more from sustainable forest management?
- Is total economic value of sustainable forest management outweighing the incentive from alternative economic activities from forest conversion to rural household?
- Can local community be trusted with the forest conservation efforts of the government?
- Does higher price (premium) for forest coffee are an incentive to either over-harvest or harvest more sustainably?

1.5 Significance of the Study

The paper is looking for options of forest management other than strict management by extending incentive from sustainable use to local people. Which might benefit stakeholders by converging their interest and then to cooperate efficiently. Finally, it provides inputs and information about trade offs and complementarities among development goals to development policy makers.

1.6 Scope and Limitation of the Study

This study has a finite scope. It is limited to a district and equally possible solutions may note have global implication. Virtually the shortages related with time and budget constraint associated with training data collectors, to undertake pilot test, and to gather all relevant information precisely were inevitable. Moreover some of deforestation variables need time series data, but we unable to obtain these data at local level thus our survey is limited to cross sectional data. However all possible endeavors were made to minimize problems and associated effects on the quality of the research.

1.7 Organization of the Paper

The rest section of the paper is organized as follow. Chapter two presents the theoretical underpinnings and empirical background of the study. Chapter three concerned with methodology of the study that comprises description of study area, data collection and economic models used. Chapter four presents descriptive statistics and econometric analysis. Chapter five, the last chapter, deals with the conclusion and policy implications.

CHAPTER TWO: LITERATURE REVIEW

The literature review part deals with both theoretical and empirical underpinnings on the issues related to deforestation, valuing environmental resources and competing land use options.

2.1. Theoretical Underpinnings

The theoretical framework gives emphasis to three important sources of confusions that have been suggested by studies when analyzing the causes of deforestation. The doubts associated with modeling agricultural expansion and deforestation, causation chains, inconsistence between economic theories and empirical evidences for instance how tenure systems induce deforestation. Next to that, it focuses on economic value and valuation of environmental resources using contingent valuation.

2.1.1 Modeling Agricultural Expansion

Different assumptions of modeling agricultural expansion and deforestation often complicate the identification of causes and remedies of tropical deforestation (Angelsen 1996). Since the impact direction of exogenous variables on land expansion depends on the assumptions in each model (see table 2.1 below). We have two major models of land expansion in agricultural economics. These are population approach, and the market approach models.

Table 2.1: The effects of selected explanatory variables: on deforestation in open economy, subsistence and chayanovian models.

Variable	Subsistence model	Chayanovian model	Open economy model
Higher agricultural prices	Reduce	Intermediate	Increase
Population growth	Increase	Increase	No effect
Higher transportation cost	No effect/fall	Increase	Increase
Higher agricultural productivity	Reduce	Intermediate	Increase
Higher wages	Na(Reduce)	Na(Reduce)	Reduce

Source: (Kaimowitz and Angelsen 1998)

Na = not applicable

2.1.1.1 Population Approach

The population based approach consists of subsistence and chayanovian agricultural expansion models. *Subsistence* approach assumes the extreme case, complete absence of markets. It conjectures that a rural household objective is to satisfy his subsistence requirements by producing agricultural commodities. The economic problem is to minimize the labor efforts given a subsistence target, indicates that consumption beyond predetermined level is unimportant (Scrieciiu 2003; Kalmowitz and Angelsen 1998).

The subsistence level of output is a function of:

$$X = Af\left(L, H, F\right) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 2.0$$

Where X is subsistence level of output, A denotes the technology, L labor input, H is total land area supposed to be homogenous and F is fertilizer input. The production function assumed to be concave with decreasing marginal productivity of all inputs. Any pair of inputs is complementary

and normal. It assumes that no market for land implies that forests are deforested on first come first served basis (Angelsen et al. 1999). Additional costs associated with bringing new land under cultivation and transportation of inputs and outputs can be denoted by a concave function $h(H)$. Hence we minimize $L+h(H)$ subject to constraint $yN=pX+qF$. Where yN denotes subsistence consumption which is equal to total population N multiplied by per capita income y. Finally, p and q are output and input price respectively.

The Lagrangian of minimization problem can be given as:

$$\Gamma = L + h(H) - \lambda\left[pAf(L,H,F) - qF - yN\right] \quad \text{.....2.1}$$

Γ With respect to inputs and λ yields the following first order conditions (FOCs):

$$\left.\begin{aligned} FOC1: pA &= \frac{1}{\lambda f_L} = \frac{h_H}{\lambda f_H} = \frac{q}{f_F} \\ FOC2: pAf(L,H,F) - qF &= yN \end{aligned}\right\} \quad \text{.....2.2}$$

The constant λ^{-1} in the first order condition can be interpreted as the shadow wage of labor (social opportunity cost of labor) which is endogenous in the subsistence model. Thus at the optimum the marginal cost per output unit of three inputs equals the price of output (p) multiplied by the technological level (A) (Angelsen et al. 1999).

The effects of exogenous variables on land expansion are straightforward. Increase in productivity or output price allows farmers to meet subsistence need easily by producing in smaller plot of land and thereby reduce burden on forest. Since farmers expand land until they meet their subsistence needs (Kalmowitz and Angelsen 1998). Empirical evidences depict native farmers in Honduras with higher rice yields remove less forested land (Godoy et al 1997). However, when farming becomes more risky more land is required to meet the desired target.

The drawbacks of subsistent approach is that households look to meet pre-determined consumption target and lose all interest in clearing once they have achieved that aim, seem quite unrealistic. Nevertheless, most studies regarding deforestation focus on these assumptions, since these models are relevant in areas where producers isolated from market and social norms govern production beyond subsistence level (Kaimowitz and Angelsen 1998).

The *chayanovian* model assumes that off-farm employment exists but utility maximizing household constrained in the labor market. The household's utility maximization is constrained by trade-off between consumption and leisure. In chayanovian models, output prices have income and substitution effects. When the latter effect dominates, deforestation increases as in the open economy model. Lower transportation cost stimulates conversion since both effects move in the same direction.

In sum, the two models have imperfect labor markets in which off farm wage rates not fully determined by farm household's allocation of time between labor and leisure rather it determined by subjective first choice of farmers (Kalmowitz and Angelsen 1998). On the other hand, in well developed stages of assimilation to market the opportunity costs of labor in subsistence agriculture rises and forest conversion fall (Homma 1992). Similarly the assimilation reduces dependence on forest to finance household economic activities; households rely on formal financial institutions (Smith and Taput 1995).

2.1.1.2 The Market Approach

This approach comprises open economy private property and open economy open access agricultural expansion models. *Open economy, private property* approach assumes unconstrained off-farm employment at fixed wage; hence production can be studied as land rent maximization. In the open economy, *open access* approach the market assumption is similar to the preceding one i.e. perfect labor market where labor be sold or hired at a fixed exogenous wage which determines the opportunity cost of labor used in the agriculture, but forest clearance gives property right (Angelsen 1996, Kalmowitz and Angelsen 1998).

Unlike population approach in market approach labor can be sold at fixed exogenous wage rate (w) that determine opportunity cost of labor used in agriculture. This, in turn, implies that the level of population is endogenous (the reverse is true for subsistence model) because labor moved freely between farm and off farm jobs to ensure the convergence between labor supply and demand at fixed competitive wage. Thus land expansion decision is made in response to profit maximization but not for subsistence requirement. Hence the profit maximization problem is given by:

$$Max\,mize: pAf(L,H,F) - qF - w\left[L + h(H)\right] \quad \text{.....2.3}$$

First order conditions (FOCs) with respect to input give us:

$$pA = w/f_L = wh_H/f_H = q/f_F \quad \text{.....2.4}$$

Though the FOCs are similar in both subsistence and market approaches the interpretation of impact of exogenous changes on deforestation are not similar. This is because the assumption that shadow wage is endogenous and population is exogenous in subsistence model and the opposite holds for market model. That is to say agricultural production and land use in the market

approach are determined by the relative profitability of agriculture but not by any subsistence requirement.

In small open economy, unlike subsistence approach, higher agricultural prices increases burden on forest while deforestation fall when the cost of land or transportation rises (Angelsen, 1996; Southgate 1990; Deshezo and Deshezo 1995). When the markets enclose isolated settlements- the expansion of demand of crops by outside world- and increasing labor productivity (Behrens 1992; Ehui et al. 1990); house holds demand for additional manufactured goods and to own more domestic animals (Hecht 1993); and to finance business with short payback period (Cancian 1997) increase forest loss. Cheaper access to markets raises deforestation (Angelsen 1996; Holden 1997). Proximity to market towns reduce deforestation because farmers can get employed in near by towns and easily adopt new farm inputs which increases productivity of existing farm land (Mann 1989). The main limitation of market approach is the existence of perfect labor market assumption. In many cases it may not exist, especially in short run where there is no migration (Scerieciu 2003)

By and large, the main purpose of this paper is not to show some basic differences between models of agricultural expansion but to identify which modeling assumptions/combination of assumptions are more relevant to describe rural household in the study area. Since each model differ with respect to which variable is crucial for deforestation and the direction of the effect (Angelsen 1996). For many variables, the results obtained from subsistence model assumption differ considerably from the open economy models (see table 2.1 above). In subsistence approach, farmers need less land to achieve the target need and hence clear less forest when they become more productive and higher prices for their produce (Kalmowitz and Angelsen 1998).

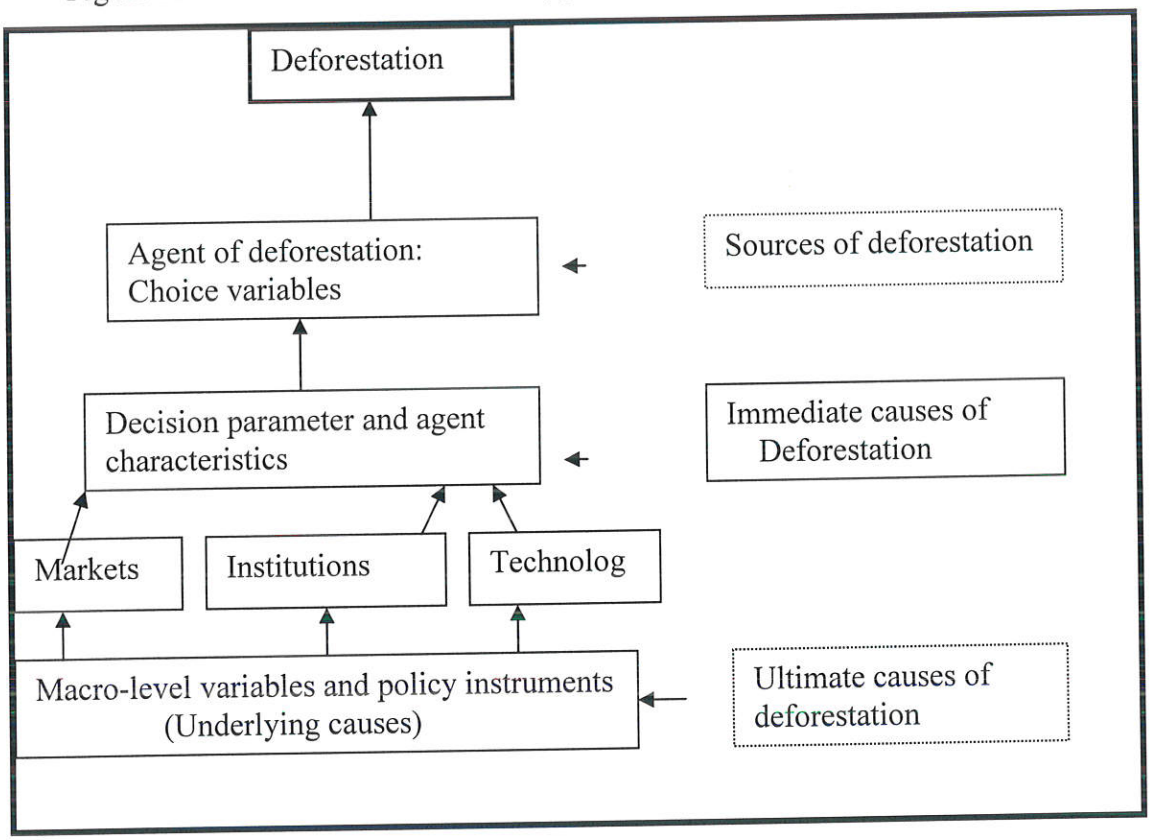
Similarly in this approach, an increase in output price/decrease in input prices (i.e. fertilizer prices) induce small holders to use more fertilizers and less labor and land inputs to meet subsistent target in situation where producers are virtually isolated from markets, and there by reduce pressure on forests. While agriculture and land use within the market approach are determined by the relative profitability of agriculture, for instance higher product prices, ceteris paribus, puts pressure on forests through an increase in land cultivation (Scrieciu 2003; Angelsen 1996; Kaimowitz and Angelsen 1998).

2.1.2 Hierarchical Nature of Deforestation Variables

Hierarchical natures of deforestation variables often complicate the determination of the causes of deforestation that would have global implications. Individuals, institutions and business firms commonly that remove or reduce forest cover are called deforestation agents (Contrersas-Hermosilla 2000). Immediate factors (such as off farm job, productivity, etc) directly influence agents' (sources of deforestation) decision with respect to choice variables, activities about which agents make decisions (Kaimowitz and Angelsen 1998). These choice variables are labor allocation for instance between leisure and labor, on and off farm labor, between intensification and clearing; capital allocation such as land purchase and forest right purchase; and land allocation between forest and cultivation, etc.

Immediate factors sequentially affected by underlying causes or policy instruments and/or macro-level variables that affect forested land through their influence on decision parameters but not affect agent decision directly, see figure 2.1 below (Kaimowitz and Angelsen 1998; Contrersas-Hermosilla 2000).

Figure 2.1 A framework of different types of variables affecting deforestation



Source: Kaimowitz and Angelsen 1998

Regardless of their origin underlying causes like macroeconomic polices and world market prices change the economic and political power of agents and induce new linkages between forest and local community (Contrersas- Hermosilla 2000). In general underlying causes are wider political economic, cultural, demographic, technological forces that determine the agents' characters, choice and decision parameters (Kaimowitz and Angelsen 1998).

By and large, causes are hierarchical. Therefore problems associated with mixing of immediate causes and ultimate causes results in high level of multicollinearity in regression models necessitates identification of immediate and ultimate causes (Angelsen et al 1999). Other motivations of distinction made by (Kaimowitz and Angelsen 1998) are first to pick out

parameters that are directly relevant to decision makers. Secondly, methodologically micro-level models handle the immediate causes better where as macro-level models focus more on ultimate causes. Lastly, one obtains much conclusive results for the immediate causes than for the underlying causes.

In sum, these sequential factors impose difficulty to theorize and identify causes of tropical deforestation at a global level and hence it should be analyzed at a more disaggregated level and situation (Scrieciu 2003). Impossibility of finding doubtless causes and effect relationships that would have global use necessitate to study specific situations in depth and to suggest remedies accordingly (Contrersas- Hermosilla 2000). Recent policy reforms of economic liberalization and adjustment efforts may increase burden on forests, however; it is not simple to find straightforward relationship between macro variables and polices and deforestation (Kaimowitz and Angelsen 1998). Kaimowitz and Angelsen (1998) suggested that future researches will be more productive, if they focus on household and regional level instead of national and global studies. It criticized and placed limited value for multi-country regression models since they make use of very poor forest data quality among other things.

Due to these and other reasons like time and budget constraints this paper is limited to area specific causes, however; the findings may or may not have universal implications. Moreover most so far studies including Angelsen (1996) used analytical models which are abstract, theoretical constructs. In such models no empirical data, but they present theories in rigorous framework that helps researchers to verify the logical implication of their assumptions. Out of 33 household level models, only nine are empirical regression models (Kaimowitz and Angelsen

1998). Even if those used empirical models to quantify the relationship between variables using empirical data and statistical methods majority focused on global and national levels.

The so far underpinnings and classifications of variables highly linked with the issue of hierarchy. Investigation of different scales/levels lets us to answer distinct questions and to get complete image or representation of specific situations (Vosti et al 1996). The high level of aggregation of data hides variation between situations and relationships and then results in trivial averages (Lambin 1994). Lower scales may unable to capture course of action happening at higher level of totals, however; for this study household level variables or immediate causes of forest cover decline are the scale.

Also framing of rural households' decision making behavior is among sources of disputes on tropical deforestation. When removal of forest is a first step to claim ownership right agricultural expansion is an investment, title setting strategy, but not management of land already under possession (i.e. soil conservation). This may not be the case in conventional economic theories where property right is well defined, there is a market for forest environmental services, and then the future value of forest is taken in to decision making behavior. However the logic may not consensus with empirical evidences because in title establishing strategies lower discount rate and tenure secure certainly encourage unsustainable use of forest land. Even if property rights are complete, exclusive, enforced and transferable small holders have insignificant incentive to include protection and biodiversity benefits of forests in their decision making. This is mostly attributed to markets fail to reflect optimal social benefits and costs of tropical forest or inadequacy or complete absence of institutions to internalize externalities, and miss guided intervention or refuse to give legal support for traditional tenure systems.

2.2 Causes of Forest Land Conversion

Principal causes of deforestation are often controversial. Those analysts who travel a short distance back in the causation sequence argue that poverty is the core cause. Specialists, looking further back in the chain will explore that the main causes are unequal political and economic power structures rooted in the society; instead, poverty is nothing but the consequence of such power structures (Contrersas- Hermossila 2000).

Aside from a general agreement that deforestation occurs to increase the economic value of the forest land there is no agreement on what causes deforestation at global level. Alternatively if the economic value of converted forest land exceeds the economic value of sustainable forest use, we can hypothesize that market force will lead to the forest land being converted. In the subsequent section, we focus on socio-economic; preference and discount rates; market and institutional factors that affect household allocation of forest land to agricultural use.

2.2.1 The Impact of Socio-Economic Factors on Deforestation

The effect of income levels on deforestation is controversial. Some of empirical evidences make their cases at lower level income deforestation is low, it increases with middle income and reaches peak and then fall with higher level of income. Forest clearing gets worse with middle income households and falls after household attain threshold level of income. Hence the correlation between two is inverted u shape (Godoy et al. 1996). Higher non farm rural income in India tends to drop deforestation while higher income derived from agricultural productivity inclined to worse forest clear[1] (Foster et al 1997). Forest destructions among original house holds

[1] The result obtained from analytical open economy models.

in Bolivia and Honduras initially rises as income do, but then falls, because higher income groups switch to non farm job (Godoy et al. 1997). Higher wages and availability of off farm job opportunities decline burden on forests (Angelsen 1996; Holden et al 1996; Foster et al 1997; Godoy et al 1996).

When capital or labor is complement to land, increase in payment made to labor or capital drop deforestation. The same outcome is achieved with non farm wage (Angelsen 1996). Formal education decline burden on forest by making easier out migration (Godoy 1996 and Moran 1989) and adoption of modern farm technologies that raise productivity of both land and labor (Schulz 1998; Jamison and Moock 1984). Evidences from Asia indicated that a household with more than four years of education easily adopt new farm technologies (Phillips 1994). Whether female education results in more forest loss or not relative to men it is not clear (Godoy et al. 1996).

Assuming open economy, analytical analysis made by Angelsen (1996) pointed out that existing population size do not influence forest clearing because people move about in response to earning variations. However Godoy et al (1996, 1997) noted expanded families convert more forest land. Forest conversion and number of children are positively related to meet food demand (Bilsborrow 1992).

2.2.2 Time Preference and Discount Rate

Conventional economic theories portrays higher discount rates less likely favor sustainable resource use, higher rate favors the early exploitation of resources. The higher the discount rate

the less market value is attached to yield in the future. Conventional logging will tend to be favored over sustainable timber management in such circumstances, as will slash-and-burn agriculture compared to agro-forestry and so on. Although we have little research on the subject, what exists suggests that local communities often have high discount rates, reflecting their urgent need to address subsistence and security needs now rather than in the future. This conclusion should not be exaggerated: there are many examples of poor communities investing in conservation practices. But the available evidence supports the traditional view that many have high discount rates and that these contribute to 'resource mining'.

However high discount rates among native farmers in Bolivia made them to remove less forest because keen farmers prefer off farm employment to remove forest, off farm job provides immediate cash incomes. Farmers around wild coffee forest in Ethiopia have very short time planning horizon. Strict conservation of the genetic pool of last wild coffee populations of Ethiopia magnify the gap between social and private benefits remarkably at current highest discount rate of local farmers[2]. Since the endemic has distinct resistance to potential future pests and diseases (Oerke et al 1994). In long term, at 2% discount rate, sustainable forest management is most feasible land use option. For higher discount rate, net present value (NPV) per hectare (ha) of conversion exceeds that of sustainable forest management (Rojahn 2006). Which is in line with conventional economic theory that is: the higher is the rate the less likely it is that sustainable land uses will be favored. Since the discount rate of farmers is high up to 53% maize production becomes more profitable than sustainable forest management even at 10% discount rate. Thus empirical results support the theory, the private and social values of forest diverge and results in forest loss (Gatzweiler et al 2007).

[2] The discount rate is highest up to 53% (Holden et al. 1998)

Even if social benefits of sustainable management outweighs agricultural use of forest area, subsistent and food vulnerable farmers unable to afford investments of conservation that needs long repayment period (Holden et al. 1998). For many developing economies, Poulos and Whittington (1999) suggested high discount rates based on contingent valuation study on various countries. It is very high for short horizons over which the contingent choice was offered. Even market interest rates are high in such economies.

Schneider (1995) cites annual real rates of interest on low risk bonds in Brazil of 27-43%, suggesting that risky rates, which would be relevant to land use, would be higher still. He notes that such rates highly disfavor the sustainable use of forested land. It is also important to point the inverse relation between income and time preference that suggested by both economic theory and empirical studies (Pender 1993; Hausman 1979; Gately 1980).

2.2.3 The Impact of Market Conditions on Deforestation

Market variables that affect the incentive to convert forest land and responsible for next higher opportunity costs are: commodity value chain, coffee price crisis and price premium. The wholeness of biodiversity handed down to the subsequent generation by poor farmers constrained by job opportunities and income sources of today. Maximization of returns to the Primary producers-the farmers who makes the management decisions- on which the completeness of biodiversity depends is obvious. This is possible through value added to primary products. The processing of raw materials in to higher value end products is the means to do so.

However this added value may not be maximized by primary rational rural households. The so called coffee paradox, the co-occurrence of coffee boom in consuming countries and a coffee crisis in producing countries can be persuasive evidence. In consuming countries, coffee demand expanded while global coffee prices are decreased markedly and producers receive the lowest price in decades. The producer price is 1% of retail price (Osorio 2002). The reason for paradox is coffee at farmer gate and at retail is significantly different. It is not material quality difference that contemporary consumers pay for, but it is non material or mostly symbolic and in- person services (Daviron and Ponte, 2005). Soon in 1990s coffee producer countries were earning 10-12 billion US$ while total sales revenue was 30 billion US$. Currently producer countries gain purely 5.5 billion US$, but value of retail sales is over 70 billion US$(Osorio, 2002).

Today green (unroasted) coffee values have been ever depressed and even by far below input prices. Liberalization followed by termination of International Coffee Agreement and subsequent increase in supply of existing producers and emergence of new suppliers have been the core cause of coffee crisis (Oxfam 2000b). In reaction global society decided to promote development of certification programs that allow farmers to get higher prices for their coffee as long as they meet environmental standards. However some argue that certification results in expansion of coffee on cost of native forests while others claim that price premium may provide stability for farmers and making expansion less important.

However in the product certification process weight is given for environmentally or socially sustainable production methods. A ton of coffee produced under shade in small farm has greater environmental value than equal amount of coffee produced in huge mechanized plantations.

Developing favorable taste towards small-scale shade coffee has more benefit from perspective of society or environment (Tadesse 2003).

We all benefit from the various environmental services which are public goods in nature. Thus protections and sustainability of genetic diversity in forest coffee should not left to subsistent coffee producers. Indeed at policy level, there are various opportunities to ensure sustainable use of genetic resources through global funding schemes but it will take long time to reach producers at grass root level to solve the existing problems. Initiatives to settle the problems at global level and environmental losses at ground level happen in different time frames; often the former response is late. Nevertheless it can be encouraging for future, if implemented (Tadesse 2003). However interestingly but not sufficient, consumers started to force the giant coffee companies to buy coffee directly from producers with high price (Fritsh 2002).

Similarly cooperatives have an opportunity to maximize net gain of producers. Since certification costs are affordable for cooperatives but not for individual farmers. For example Oromia Coffee Farmers Cooperatives Union (OCFCU) has good experience. It includes 23 members, producing coffee on 35051 hectares of land and has got license to export quality coffee directly to US markets with organic and fair trade certification without going through auctions in local markets. Members of the union benefited and slightly affected in coffee crisis. They got US$1.21/1b – US$1.41/1b from exporting labeled coffee vis-à-vis market price of 43-38 US cents /1b. However the benefit should be extended to millions of coffee farmers in the country. Alternatively conservation and sustainable use of biodiversity can be optimized by extending coffee markets into currently expanding economies of China and Korea. Since demand of this economies are rising and potentially big markets (Tadesse 2003).

2.2.4 Institutional Factors and Policy Interventions

The main conceptual reason why agents engage in deforestation is an economic incentive difference between forest land and agricultural land. Agricultural production and land use in the market approach as stated so far determined by the relative profitability of agriculture but not to meet subsistent requirements (Colfer and wadley 1996). The discrepancy in private and social benefits attributed to missing markets, the absence of market forces to send an appropriate price signals to users of forest land. This fact necessitates policy interventions.

Policy intervention often recommended to rectify market failure and to achieve macroeconomic goals. However government efforts may results in unsustainable use of natural resource. Governments basically promoting and devoted to wise use of natural resource but unintended results of mistaken policies may worse forest loss. Such policies fundamentally are introduced to stimulate agricultural or industrial growth, and to curve unemployment or poverty (Repetto 1993).

Mistaken polices may lead to forest cover loss in many ways. Governments are responsible for the high way facilities to promote agriculture or to encourage investment. But many roads pass through within or near forests. Apart from connecting communities physical infrastructure facilities (such as roads) change economic values and raise incentives to convert forest land to agricultural production. Moreover roads raise land prices and results in attraction of illegal colonies. Linking villages with roads is likely to increase value of land and stimulate the

indigenous owners to sell and move into frontier forested lands (Schnider 1995). Often subsidies (lower forest charge by timber holders) to forest or related sector are purposeful cause of forest loss, promotes more forest loss than would otherwise take place (Repetto 1993).

Credit availability has different correlation with deforestation in various areas. Native inhabitants in Bolivia and Honduras remove less forest when they access to credit (Godoy et al 1996). Studies from Tanzania and Brazil revealed that access to credit letting farmers to expand land for grazing and crop production (monela 1995; Ozorio de Almeida and campari 1995). Godoy et al. (1996) claimed that household access to credit may be less relay on forest related activities to smooth their earnings rather they concentrate on off farm jobs to pay their loans, they remain with few time to work in their garden. Also Morduch (1995) argued credit availability decreases deforestation by creating broader options to earning and smoothing income.

Government and indirect subsidies to agriculture rise burden on forests. Subsidies and other equivalent polices boost agricultural profitability may result in intensifications that expand into forests. All subsidies may not lead into forest loss. Whether subsidies lead to intensification (i.e. declining burden on forest) or extensification (forest loss) depends on technologies used, availability of land and the nature of subsidy (Contreras-Hermosilla 2000). For example subsides to irrigation may not result in forest loss as it is not possible to provide irrigation facilities to remote forest frontiers. But subsidies to rural roads lead to forest loss because it increases the profitability of rural land.

To deforest may be a good way to demonstrate occupation. Deforested land supposed to be better sheltered from confiscation. For example, forest area may be declared as protected area and, if

this occurs, confiscation results. In Costa Rica, government declaration to increase protected area resulted in rapid deforestation (World Bank 1996). Weak ownership rights weaken the sustainable use of forest. Weak ownership in many areas results in rapid deforestation (World Bank 1991).

Land titling strategies are worsening forest conversion. If it is not prerequisite for claiming ownership and private environmental services of forest are small enough, equal amount of forest is cleared in both private property and open access regime (Angelsen 1996). If it is first step to claim ownership and rent of land expected to raise open access results in worse situation.

2.3 Valuation of Environmental Capital

Generally growing populations in developing economies and rising incomes in developed nations are increasing the demands on the environmental resources. But environment is seldom considered in policy appraisal. The reason is that environmental goods and services are not marketed. Therefore, they do not have prices that can be comparable with development costs and benefits. The main reason for this absence of markets is market failure.

Market work well when prices reflect all values. 'Market Failure' occurs when some costs and/or benefits associated with use of natural resources are not fully reflected in market price. Price often understate the full range of services provided by an asset, or do not exist to send a signal to the market place about the value of asset. Hence unlike private goods problem exists to attach monetary value for environmental goods.

When confronted with the task of placing a monetary value on ecosystem function, for example conservation benefits of forest in our case, economists have two types of instruments to fill the gap. Indirect or revealed preference methods, and direct or stated preference methods. The former methods derive the individual's monetary value for a particular non-market good by observing his economic behavior in actual markets related to the non-market good in question. These methods include hedonic pricing, travel cost and averting cost analyses. While in the latter method no actual market behavior is observed in the estimation of the individual's economic value for a specific non-market good.

The approach asks people to directly report their willingness to pay (WTP) to obtain a specified good, or willingness to accept (WTA) to give up a good, rather than inferring them from observed behaviors in regular market places. Because it creates a hypothetical market place in which no actual transactions are made, contingent valuation has been successfully used for commodities that are not exchanged in regular markets, or when it is difficult to observe market transactions under the desired conditions. Here we apply contingent valuation to estimate small holder's willingness to pay for extra use of national forest priority area- loss of in situ biodiversity conservation- in Yayu.

2.3.1 The Contingent Valuation Method

2.3.1.1 Conceptual Frameworks

The goal of contingent valuation is to measure the compensating or equivalent variation for the good in question. Compensating variation is the appropriate measure when the person must purchase the good, such as an improvement in environmental quality. Equivalent variation is appropriate if the person faces a potential loss of the good, as he would if a proposed policy

results in the deterioration of environmental quality or service. Both compensating and equivalent variation can be elicited by presenting a hypothetical market for a particular environmental good. In which sample of individuals are asked to report their willingness to pay amount. For instance, the person may be asked to report his WTP to obtain the good, or to avoid the loss of the good. Formally, WTP is defined as the amount that must be taken away from the person's income while keeping his utility constant.

A detailed description of the good the economist seeks to value is presented in the ideal market, along with the means for provision of the good, and the quality and quantity of the good. The description must specify the payment vehicle by which the consumer would pay for provision of the good. For example, the payment vehicle may take the form of a donation, a user fee, or an increased tax payment. Valuation of the good in question is achieved by asking the selected sample of individuals to indicate their maximum willingness-to-pay for the hypothetical good.

As mentioned above compensating variation is the appropriate measure when the person must purchase the good, such as an improvement in quality or quantity of environmental services. Equivalent variation is appropriate if the person faces a potential loss of the good, as he would if a proposed policy results in the deterioration of environmental quality. It is well known that the concepts of WTP and WTA can be derived from the Hicksian welfare measures of the compensating variation (CV) and the equivalent variation (EV). The compensating variation can be interpreted as the maximum willingness to pay. The Hicksian equivalent variation is defined as the minimum amount of money a household would require without a change in environmental quality.

For instance, the person may be asked to report his WTP to obtain the good, or to avoid the loss of the good. Formally, WTP is defined as the amount that must be taken away from the person's income while keeping his utility constant:

$$V(y-WTP, p, q_1 : Z) = V(y, p, q_0 : Z) \text{.....2.5}$$

Where V denotes the indirect utility function, y is income, p is a vector of prices faced by the individual, and q_0 and q_1 are the alternative levels of the good or quality indexes (with $q_1 > q_0$, indicating that q_1 refers to improved environmental quality).

Willingness to accept for a good is defined as the amount of money that must be given to an individual experiencing deterioration in environmental quality to keep his utility constant:

$$V(y+WTA, p, q_0 : Z) = V(y, p, q_1 : Z) \text{.....2.6}$$

In equations (2.5) and (2.6), utility is allowed to depend on a vector of individual characteristics influencing the trade-off that the individual is prepared to make between income and environmental services. An important consequence of equations (2.5) and (2.6) is that WTP or WTA should, therefore, depend on: first the initial and final level of the good in question (q_0 and q_1); second respondent income; third all prices faced by the respondent, including those of substitute goods or activities; and fourth other respondent characteristics. Internal validity of the WTP/WTA responses can be checked by regressing WTP/WTA on variables one to four, and showing that WTP/WTA correlates in predictable ways with socio-economic variables.

The purpose of the payment question is to obtain information about the respondent's WTP amount. WTP responses must be statistically analyzed to obtain an estimate of mean WTP, which is multiplied by N, the size of the population affected by the proposed policy, to produce total

WTP. Total WTP can then be compared with the cost of implementing the policy to determine whether the proposed policy passes a benefit-cost test.

If the payment question is open-ended, the WTP figures reported by the respondents can simply be averaged to produce an estimate of mean WTP:

$$MWTP = \frac{1}{n}\sum_{i=1}^{n} y \quad \text{.....2.7}$$

Where n is the sample size and each y is a reported WTP amount.

Average WTP may be deceivingly high if few individuals report very high WTP amounts. That averages can be "dominated" by few very large observations is a well-known problem in statistics, and the statistical literature has proposed a number of ways for identifying such observations and reduce their impact on the sample mean.

If the distribution of the population is not a normal, the sample average remains a valid way to estimate the true population mean, but the maximum likelihood estimate of mean WTP is more statistically efficient.

2.3.1.2 Application of the Contingent Valuation Method

This method has been applied widely to the valuation of environmental quality and to a variety of community programs in developed and developing nations. Doubert and Young (1981) adopted Contingent valuation (CV) to impute instream flows a shadow price from a sample of a recreationists on the Cache la Poudre River in northern Colorado. Loomise et al. (1994) used CV to test the consistency of an individual WTP for increase in quantity of an environmental public good. It also applied to measure recreational demand for trees in national forests (Walsh et al.

1989); to determine whether distance affects WTP for public goods (Pate and John 1997) and to place a value to the conservation of state parks in Kenya (Navrud and Mungatana 1994). In India (Hadker et al. 1997), used contingent valuation to investigate setting of gate charges to national parks; in Costa Rica (Shultz et al. 1998), explore setting of entrance fees to national parks; and to find out priorities for tropical forest protection (Shyamsundar and Kramer 1996).

CV investigations have been made to get residents' WTP for improved water supply in Burkina Faso (Altaf and Hughes 1994), Ghana (Whittington et al. 1993a) and the Philippines (Choe et al. 1996). Muchapondwa et al. (2006) adopted CV to assess possibilities that enhance forest conservation through devaluation of user right to the local community. Also it was used to estimate willingness to pay for a public health projects were conducted in Ethiopia by Swallow and Woudyalew (1994).

2.4 Economic Value Analysis of Wild Coffee Populations

Traditional economic theory states that land users allocate land in favor of competing alternative options that generate relatively more net benefit. Whether to conserve or convert forest land relays on benefits derived from alternative uses of forestland. Whenever private net gains of forest loss are rising individuals optimize their benefits on expense of total economic values[3] of global community. Alternatively forest conservation at local level may be enhanced when these values of forest exceeds the private gains from the land conversion. The land conversion values of forest includes incomes from expansion of agricultural activities while total economic value

[3] Use and non use values of forest such as habitat, biodiversity, etc

includes direct values obtained from forest, indirect values of forest such as ecosystem functions, optional and existence values.

The total use vale of an environmental good and service to an individual can be mathematically represented as:

$$TEV = DUV + IUV + OV + EV + BV \ldots\ldots\ldots\ldots\ldots 2.8$$

Thus the total economic values (TEV) of forest in equation (2.8) comprised of direct use value (DUV) of the forest such as timber and none timber forest products (NTFPs); indirect use values (IUV) namely carbon storage and water shade functions; optional values (OV) and existence values (EV). Optional values refers to some once willingness to pay to conserve forest so that they or their offspring's may make some use of it in future while existence values deals with individuals interest to pay for mare existence of forest regardless of their use. In case of bequest value (BV), someone expresses a willingness to pay to conserve forest for use of their offspring's only.

According to Hein and Getzweiler (2006) net present value[4] of Ethiopian coffee genetic resource excluding the value of yet unknown potential disease resistance and demand cup qualities of coffee its value is significant. Rojahn (2006) compared total net present benefits of three competing land use options for montane rain forest in Ethiopia, taking into consideration national and global values. She suggested that in long run at lower discount rate among three competing land use options sustainable forest management was most feasible land use option than maize production. These competing land use options include: maize production, strict conservation, and buffer zone use. Conversion of forest into arable land or maize production in transitional zone

[4] NPV 1458&420 million per ha at 5%& 10% discount rates respectively for discount periods of 30 years.

(i.e. zone enclosing buffer zone) among the land use options that involves economic activities such as cutting trees from the forest, selling tree and growing maize. Sustainable management involves the growing of coffee and collecting other non-timber forest products such as spices, medical plants, aframmum korrorima, or honey in buffer zone that surrounds core zone. Strict conservation involves complete restriction of any use right by law from National Forest Priority Areas (NFPA) or core zone. The economic values that computed from three land use alternatives only strict forest conservation has negative value. The negative value attributed to missing data on the value of society from biodiversity conservation (Rojahn 2006). Moreover national/global communities attach higher value to genetic resources they lacked institutions to translate incentives for local resource users and allow them to invest into conservation and sustainable forest management.

2.5 Participatory Forest Management

PFM can be defined as operational cooperation between the key participants with diverse interests. It involves the management of land and other natural resources by group of people through their local institutions. Broadly to distinct we have conventionally professional forest management that deals with centralized forest resource management. It ignores the second indigenous type of forest management that concerned with inclusion of traditional institutions and their knowledge in forest management (Carter and Gronow 2005). The later strategy has developed in response to inadequacies in centralized conservation and development efforts. There is an increasing awareness in many countries centralized system unable to carry out management in its own. A solution has been to turn to local communities for support and guidance (Carter and Gronow 2005). Many critics of the current system of forest management are calling for

devolution of decision-making power to communities (Burda et al 1997). The main argument for devolution is that those affected by a decision should participate directly in the decision-making process. Arguments against decentralization states that if groups of resource users unregulated by central government they act in a way to maximize personal short run gains at the cost of sustainability (Berkes and Farvar 1989).

Decision made by local people can result in locally sound decision and enhance the incentives to take into accounts long run advantage of sustainable management (Notzke 1994). For instance local community stewardship of forest is more suitably addressed if forest is managed by local communities than institutions that manage from a distance. Native people have the greatest knowledge of the local ecology and long term effects of their actions on environment. Centralized management lack flexibility and responsiveness while community based management respond quickly to changing conditions and those most affected by the decisions made decisions for their benefit (Burda et al 1997). Efficiency, equity and sustainability are often optimized by rural communities that are relay on collectively managed renewable resources (Gibbs and Bromley 1989).

2.6 The Need of Collaboration

We have various and potentially conflicting stakeholders or interest group for a given forest resource such as users, government (policy makers, education and training institution, etc), development agents (NGOs, donors, etc) and private sector. Bringing together the strengths of interest groups is a solution for current problem set of sustainable forest management. Collaborating and working with different participants that demanding various interests and rights

for a given resource, and managing unavoidable conflicts involved, is superior approach for CFM today even if it may discourage a few section of interest group (Carter and Gronow 2005). Collaborative approach is the logical approach for sophisticated problems associated with sustainable management of commons. In such situations, the reason for the government to collaborate can be to settle disputes associated with injustices that weaken sustainable development. Local people have indigenous knowledge about the forest and respond immediately to threats such as fire risk. Donors can provide expertise and technical support. Private sectors engage in investment and connect to markets (Carter and Gronow 2005).

Management decentralization is the means to secure grass root level community with decision making power over use and fate over tropical forest. However these polices fail to bring the intended result in some situations they worse the discrimination of the poor, overexploitation and conflict. These problems exist when forest communities with cultural isolation and low literacy rate and lack experience in negotiation and formal planning and are unprepared for their new opportunities and disadvantaged when interacting with local government (Evans et al. 2008).

2.7 Forest Cover Change in Ethiopia

Ethiopia is abundant in cultural and biological variety. It is home to vital biodiversity hot spots and inter alia. Nevertheless this rich cultural and natural legacy is threatened. FAO (2007) estimated the deforestation rate of Ethiopia 141,000 ha per year. Nevertheless Vis-à-vis other east African countries Ethiopia's deforestation rate is about average.

Afromontane rain forest of south west Ethiopia is the birth place for Coffee Arabica and refuge for last wild coffee populations that have unique resistance to diseases (Hindorf 2006, Beining 2007). These forests are important for the conservation of genetic diversity of wild *Arabica Coffea*, and for the subsistence coffee production (Tadesse and et al. 2007). The economic loss of this genetic resource ranges between 0.4 and 1.5 billion USD/ year (Hein and Gatzweiler 2006).

Moreover forests have potential value as ecosystem functions or biodiversity reserves but these benefits are insufficient to balance the loss of income from strict conservation of forests to resource users. Nevertheless, cloud forests are being removed at an alarming rate of 8% per year (FAO 2003b). Despite of slight variations in estimation of deforestation across regions, given deforestation rates remain constant; Ethiopia will have lost its forest including wild coffee populations within about 27 years. The forest land declined and especially between 2001 and 2005 considerable amount of forest land is distributed to coffee producer firms and rubber plantations (Dereje 2007).

2.8 Forest and Land Tenure in Ethiopia

To achieve allocation of forest land to its social optimum use, the presence of complete property right is first step. Still it requires compensation for non marketed ecosystem functions of forest to be used sustainable. By default, the ownership of forest and land skewed to the state since emperor regime when the first modern forest legislation started in 1965 (Sisay 2008). In the typical regime, existing tenure polices are marginalized farmers and are privileged a few northern land lords and political elites (Jemma 2008). The regime recognizes three forms of forest viz.

protected, private and state forest; and set protection, exploitation and management rules (Sisay 2008).

Following the down fall of the feudal regime in 1974 military government nationalized the ownership of these resources. Use rights of land given initially are undermined latter by forced villegization (Jemma 2008). State, farmers association and urban dwellers association ownership of forest is declared (Sisay 2008). Just after collapse of military government in 1991, the current government retained the state ownership of land, but repelled collectivization. It has been promoting small holders and currently started land certification. It recognizes three types of forest ownership namely state, regional and private forest ownership and set conservation and development objectives of forest. Also the current government has a forest policy that aim to raise forest cover to 9% within five years. However, despite the efforts forest cover is falling in regions (Sisay 2008).

CHAPTER THREE: METHODOLOGY

3.1 Description of the Study Site

The study was carried on Yayu district. The district is located in Illu Aba Bora administrative zone of Oromia region, at a distance of 550 km from Addis Ababa.Yayu district comprises part of yayu forest that is among the refuges of wild coffee population. According to 2007 census, population size of Yayu is 52,829. Oromo is the major ethnic of population followed by Amhara and Tigre respectively. Agriculture is the dominant source of employment in the area. Maize is the most commonly produced cereal crop for consumption followed by sorghum. Semi-forest coffee production is the main source of income. Coffee bean collection, processing and marketing are seasonal sources of employment.

3.2 Survey Design and Data

To complement and substantiate primary data, secondary data was collected from various sources. The data collection was made from February five to March three 2009. Yayu was selected purposefully for two reasons. Firstly, Rojahn (2006) indicated that the price premium is not sufficient enough to reduce high deforestation of cloud forest in the district. Secondly, the district is the most forested area in the country and characterized by three competing forest land uses. A majority of the forest area has demarcated as National Forest Priority area. However there is heavy dependence of local people on forest mainly for coffee, spices and honey production.

Yayu is administratively divided in to 17 peasant associations. First five Peasant Associations (PAs) or kebeles which are adjacent to National Forest Priority Area were purposefully identified based on the information provided by extension workers. They justified that non adjacent PAs do

not have an access and not clear the forest since they have no bordering land or their land have not demarcated as core or buffer zone. Hence we selected 12 villages randomly from respective PAs. Each PA comprises 3 villages. To pick out 151 male and female headed households randomly, extension workers farmer follow up roster was used. To gather primary data, 16 extension workers who has college diploma were trained and employed. Thus in each PAs the data collection was conducted by 3 enumerators and a supervisor. Secondary data was collected from Agriculture and Rural Development Office (ARDO), two microfinance institutions, and Geba Dogi Forest Conservation Project at district level. Offices located in Addis Ababa such as Oromia Coffee Farmers Cooperative Union (OCFCU), and Central Statistical Agency (CSA) were also important sources of secondary data.

Interviews comprised demographic variables such as age, sex, ethnic group of household head and family size. Information about economic variables namely income and wealth indicators, such as farm and coffee land size; hectare of land cultivated; roof type; number of hives owned by household; employment and income composition. To elicit, small holder willingness to pay for loss of in situ conservation of biodiversity scenario[5] was presented. The scenario can not be too hypothetical since farmers are familiar with three competing land use options. Next to description of the scenario, household head was asked about whether a hectare of forest land is more profitable in sustainable forest management or arable land use (such as maize production). Based on their responses, they were provided with open-ended questionnaire. For example, those preferred sustainable use asked WTP question- What is the maximum extra tax you pay for per a hectare of core zone converted in to buffer zone? The preceding type of open ended question was followed by check up questions for protest zero responses. Before the questionnaire was

[5] See appendix I

administered, it was pre-tested in one of the study villages, in Wabu, to give exercise for enumerators and to check clarity and sequence of the questionnaire. After pilot test, questions on variables such as core and buffer zone were included to capture the effect of the size of demarcated plots on small holders WTP. In addition to that, some variables which can be more efficiently collected from secondary sources were dropped from the survey question.

Market and institutional factors that affect small holder's expansion decision such as input and output price, credit facilities, intensification of agriculture, coffee export price and village variable namely village distance from nearest market town were collected from secondary sources.

3.3 Data Analysis

Both descriptive and econometric analyses were used so as to achieve objectives set and to test hypotheses designed. Econometric models are important to identify the socio-economic characteristics of small holders and institutional factors that affect incentives to deforest cloud forests, land use options and WTP. Further these models may be helpful to answer policy questions for instance whether in situ conservation is enhanced through organic fair trade.

Tobit and probit econometric models were used for this study. Tobit model was preferred to identify factors that motivate farmers to expand their land into forest because the dependent variable was censored at zero; 25.17% of small holders in sample did not clear cloud forests. We also used Tobit model to estimate factors that determine household WTP. We employed probit model to determine factors that increase profitability of sustainable forest management. The

dependent variable, profitability of land use option is dichotomous such that: $y_i = 1$ if the farmer prefers sustainable forest management and $y_i = 0$ if conversion was preferred. We were interested in the probability that the farmer is in favor of sustainable use, $p(y_i = 1/x)$. Where x is used to denote the full set of explanatory variables, farm household socio-economic characteristics and institutional factors that affect land use change.

3.4 The Variables: Definition and Measurement

Table 3.1 contains definitions and measurement of three dependent variables namely deforestation (DEFO), profitability of forest land use option (PRO) and WTP respectively and explanatory variables. A + or a - sign next to the sub-headings in each column namely DEFO, PRO and WTP shows the expected marginal effect of explanatory variables on corresponding dependent variables holding constant all other explanatory variables. In each of the columns, explanatory variable takes on a positive sign, if an increase in the variable positively affects the dependent variable. For instance, education takes on negative value on first column since it supposed to decrease the area of a cloud forest the household has clear by increasing opportunity cost of clearing forest or by easing out-migration of labor.

Table 3.1: definition and measurement of the dependent and explanatory variables

Variable Code	Description of Variables	*Expected sign of explanatory variables*		
	1. Dependent Variables			
DEFO	Hectare of cloud forest cleared (in year 2008)	DEFO	PRO	WTP
PRO	Profitability of forest land use option: 1 if sustainable forest use is more profitable and; 0 if maize production was preferred,			
WTP	Small holder's willingness to pay for biodiversity loss or demand for a hectare of core zone for sustainable forest management.			
	2. explanatory variables			
SEX	Sex of household head: 1 if male and; 0 or else	?	?	
AGE	Age of respondent (in year)	?	?	?
FAMSIZ	Number of household members	+	+	+
POP	Village population size in year 2008	+	?	
EDU	Household head formal years of education	-	+	+
INC	Income groups: 1 if household is poor and 0 or else; 1 if middle and 0 or else; 1 if rich and 0 or else; 1if very rich and 0 or else.	+/-	?	?
CORR	Roof type: 1 if household has corrugated roof ; 0 otherwise	-	+	+
OFFIN	Off-farm income in year 2008 (in birr)	-	+	
ANCOFF	Annual income from sell of organic semi-forest coffee in 2008	-	+	+
ANHONY	Income from honey sell in 2008	-	+	+
CEROUP	Productivity of land (yield of maize per hectare) in year 2008	+/-	-	-
BUFFER	Hectare of respondent tenure demarcated as buffer zone			+
FARMSIZ	Household farm size in hectare (in year 2008)	-	+	+
TENR	Title (use right) setting strategy: 1 if forest clearing is first step to claim ownership ; 0 or else	+	-	-
INTNS	Intensification package (indexes where intensification packages are aggregated using following weighing factors: fertilizer=0.5, and quality seed=0.5)	+/-	+	+
CR	Credit used (total amount of birr borrowed in last 3 years)	-	+	+
MEMB	Membership to union: 1 if the house head is a member of OCFCU; 0 otherwise	-	+	+
DECM	Distance from market town in km	-	-	

CHAPTER FOUR: RESULTS AND DISCUSSION

Empirical findings discussed in the chapter consist of both descriptive and regression results on deforestation, options of land use, and WTP variables. We have split the discussion of descriptive part into two – description of forest land decline; competing land use option and respondents' willingness to pay. The regression results have been discussed in three different sections. First we discussed the explanatory variables that explain variations in deforestation. Next we analyzed profitability of land use options. Finally, the regression results of WTP were discussed.

4.1. Descriptive Statistics

The questionnaire was designed in two sections. The aim of the first part was to gather cross-sectional data on factors that affect small holder's decision to expand their land into primary and secondary forests. Part two collected data on small holder's preference between competing land use options and responses to WTP based on their preferences. Summary statistics and frequency distributions were employed to analyze the survey responses collected.

4.1.1 Description of Forest Land Decline

The survey collected data from 44 female and 107 male headed households. It focused on the deforestation decisions of households expected to depend on socio-economic characteristics of individuals and institutional factors. Table 4.1 contains summary statistics of variables used in deforestation analysis. The dependent variable is area of cloud forests cleared by household in year 2007/08 (2000 E.C). The average deforestation was 0.65 hectare. It ranges from 0 to 4.375 hectare. The main reason for deforestation was to free bushes under shade trees in the primary forest for growing coffee. Since semi-forest coffee is organically produced and grown in the forest under the canopy of shade tree. Over 71% of survey responses indicated that farmers grew coffee seedlings in the NFPAs. Majority of the respondents, almost 80%, pointed that individual

decision to deforest was made to meet shortage of farm land including coffee land. This response is consistent with land use data from ARDO in Yayu because 69.1% of the land was forested area in year 2008 and the remaining land was allocated for croup production, grazing, and other activities including unproductive land.

Table 4.1: Definition and summary statistics of deforestation variables

variable code	Variable definition	Mean	Std. Dev.	Min	Max
SEX	Sex of the household head	.7086093	.4559153	0	1
AGE	Age of household head	45.23179	13.7125	18	93
FAMSIZ	Family size	4.768212	2.21944	1	11
POP	Village population size	2777.887	396.5829	2133	3288
EDU	Formal education level of respondent	3.576159	3.804273	0	12
INC	Income group of household	1.794702	.9260517	0	4
CORR	Roof type	.7549669	.4315381	0	1
OFFINC	Off farm income (in birr)	269.2053	1388.667	0	10000
ANCOFF	Annual income from coffee sell	13965.67	13757.03	0	101052
ANHONY	Annual income from honey sell	285.4305	738.6833	0	3800
CEROUP	Yield of maize per hectare	1517.848	1666.43	0	5440
FARMSIZ	Farm size in hectare	1.629139	1.551841	0	12
TENR	Title setting strategy	.6821192	.4672025	0	1
INTNS	Agricultural intensification	18.62368	24.90726	0	169
Cr	Amount of credit in birr	700.4636	916.632	0	5200
MEMB	Membership to OCFCU	.218543	.414633	0	1
DECM	Distance from market town	5.622517	6.345331	1	18

Source: survey result, Number of observations 151

Almost 98% of households responded that they had not left fallow lands in year 2008. It indicates that farmers reduced fallow periods by cultivating continuously to cope with shortage of land or sometimes they forced to expand their lands into forest.

We measured demographic variables such as age, family size, residence duration in the village and population. Some of these variables have relatively high variation at household level. The data shows that nearly 45 years were the average age of the respondents which ranges from 18 to 93. The average family size was 4.77 with a range of 1 to 11. The average village population was nearly 2777.9. Also we collected data on human capital variable of household head, education. The average formal education level of respondents was 3.5 years. It ranges from 0 to 12.

We categorized survey respondents into five income groups based on their resource endowments or wealth indicators. These indicators include holder's coffee land in hectare, whether household has corrugated roof, number of modern hives and hectare of cultivated land that have been owned. Based on the field survey 74.5% of households have semi- forest coffee land and the average holding was 1.2 hectare and it ranges from 0 to 11 hectare. Majority of farmers coffee forest lands were demarcated by the government as the NFPA either buffer or core zone. Firstly, the buffer zone comprises 75% of semi- forest coffee land of farmers but farmers or the former owners of the coffee forest have granted right to grow organic coffee, collect other NTFPs and hang beehives in buffer zone . But they have not allowed to graze, growing crops and inorganic coffee in buffer zone; and have not taxed for the sustainable use in buffer zone. The share of farmers land included in core zone is relatively a few, but any economic activity in core zone has been completely avoided. The survey result pointed out that on average 0.88 hectare of respondents' coffee forest land was demarcated as buffer zone and 0.38 hectare demarcated as core zone.

The other types of indicators used to categorize households in different income group were the type of house and cultivated land in hectare. The dummy variable shows whether or not the roof of house is made from corrugated iron. Almost three fourth of households have owned houses

with corrugated iron roof. Average area cultivated was 0.57 hectare with range of 0 to 2 hectare. The number of modern hive owned was also among the indicators. Nearly 73% households do not have either traditional or modern hives. On average households owned 2.5 hives with range of 0 to 38 hives. Hence we identified 8.6% and 26.5% very poor and poor households; 44.4%, 17.9% and 2.65 % lower middle income, middle income and higher income groups respectively based on indictors mentioned. Off farm income is the variable supposed to affect deforestation. The mean off farm income of households that derived mainly from petty trade, handcrafts, non wage income and off farm wage income was 269 birr and it ranges from 0 to 10,000 Birr[6].

We estimated representative incomes from sustainable forest use such as semi-forest coffee and honey production to know how these private benefits shape the use of forest. In the semi-forest coffee production, nearly 450 kg per hectare can be harvested (Agrisystems 2001). The average local market price of conventional coffee was around 22.5 Birr per kg. While for certified organic fair trade coffee a minimum price is set by fair trade market for several years (Rojahn 2006). Own calculation and the data from OCFCU indicated that on average export price of fair trade organic coffee was 33.95 Birr per kg. Members of the OCFCU directly supply their product to the union through their cooperatives at local level. The coffee exported by OCFCU is exempted from tax. The union members (cooperatives) buy share from the union and dividends are disbursed to members. Honey production is an other important NTFP that supposed to enhance sustainable use. Ethiopia has long tradition of beekeeping and tenth in honey production in a world, but still the production method is traditional (Deffar 1998). Similarly the productivity of honey bee is low in Yayu and on average 5 kg per hive from traditional hive and 15 kg per hive in a year can be harvested from modern hive (Rojahn 2006). The total production of honey was

[6] 1 USD = 9.2882 Birr

valued with the average local price of 20 birr per kg based on evidence collected from agricultural experts at local level.

Normally, farmers harvest timber and non timber forest products other than coffee such as brown cardamom ("kororima"), "gesho" a condiment for making a local drink, and medical plants. However, the survey only estimated income generated from sustainable coffee and honey production due to problems associated with obtaining data. For instance, it is difficult to estimate timber production per year by each respondent since timber production in demarcated zone is illegal. Even producers who own their own forest or grow their own tree typically face prohibition on commercial use and marketing that impose high economic and welfare costs on local people. In addition, traditional health practitioners collect medical plants from buffer zone, but their average size is two per village (Rojahn 2006). Also they may hardly recall income generated from those activities.

To determine the effects of productivity on deforestation, we collected yield of maize per hectare. As said by ARDO, 1800kg per hectare output of maize can be produced traditionally. From intensified production, 3200 kg per hectare can be obtained in a year. The intensified production includes use of quality seed and fertilizer. The average yield[7] of maize per hectare was 1025.14 Birr for traditional and 1991.36 Birr for intensified production.

To find burdens that have placed or taken away from remaining forests by institutional interventions, data were gathered on institutional variables. These encompass provision of credit and marketing services (such as services provided by OCFCU); agricultural intensification and title setting strategies (such as use right). To measure the effect of union membership on

[7] Yield = product of average price and output of maize

deforestation, we estimated dummy whether a respondent is member to OCFCU or not. The union has provided credit services to members with interest rate of 10.5%. The aim is to protect members from high cost of borrowing money from informal institutions at local level and coffee market value chains that result in lower farmer gate prices. Often borrowing from local informal institutions, supposed to result in unbalanced bargaining power between buyer and seller. On average, 25,000 Birr was supplied to members in each of our sample villages. In sum, average income from sell of differentiated coffee for 22% union member households was 24073.67 Birr while the mean income of the remaining 49% of traditional coffee sellers was 16226.97 Birr in year 2007/08.

We estimated agricultural intensification by attaching weight to components of intensification package (such as quality seed and fertilizer). According to information collected from field work, 51% of respondents have employed at least one of intensification packages. Title or use right setting strategies are important variables to determine to deforest is ether investment or not in remote societies. Majority of small holders, 68%, responded that forest clearing ensures use right. We estimated distance of the villages from market town and from highways or main transportation route which are expected to affect agricultural expansion. On average, villages are 5.6 km from market town and 1.6 km from main transportation route.

4.1.2 Competing Forest Land Use and WTP Responses

In the following section, we discuss the respondent's preference of land use options and WTP for sustainable forest land use. In Yayu, we have three competing land use options as we mentioned so far. These are strict forest conservation; semi-forest coffee production and bee keeping in

buffer zone; and agricultural production, for instance growing maize in area enclosing buffer zone.

Prior to value elicitation question a respondent was clearly presented with contingent valuation scenario. In the scenario, we clearly described the total economic values of forest and associated costs of sustainable forest management. The benefits comprise income to local household from production of timber and NTFPs. Benefits derived from higher yield; disease resistance quality of Arabica Coffee and avoidance of associated costs; and ecosystem functions of forest to global and local community. Also benefits from research, biodiversity and tourism were described. Costs attributed to buffer zone management are management costs such as costs of equipment, wage, running costs; costs to other livelihood activities in the form of crop distraction by wildlife; opportunity cost in the form of alternative use such maize production.

Following the description of scenario, households were asked about in which land use option (semi-forest coffee or maize production) forested area is more profitable for them. The dummy variable, profitability of land use option, used to estimate whether semi forest coffee production is superior to complete conversion. Interestingly, 70.86% of households indicated that the net benefit of former use option exceeds the latter. Households who preferred semi- forest coffee production to maize growing provided with WTP question. Those preferred the unsustainable use were skipped.

We were dealing with household data and household characteristics such as sex, age, education of household head, household size, and farm size are expected to be important in explaining households' WTP and profitability of alternative land use options. Household income from representative household income sources such as semi-forest coffee, honey, and maize production

were also expected to affect forestland use and WTP decisions of household. The survey respondents' choices among WTP category for transformation of a hectare of forest land in core zone to buffer zone is presented in table 4.2 below.

Table 4.2: Distribution of respondents' willingness to pay for transforming a hectare of forest land from strict conservation to sustainable use

Payment interval per ha (in birr)	Distribution of respondents	
	Frequency	Percent
0	5	4.67
1-10	18	16.83
11-50	61	57
51-100	15	11.22
101-500	7	6.57
Above 500	1	0.93

Source: survey result

Actually we collected complete and usable surveys from 151 household heads, however; based on their preferences of alternative forest land use, 70.86% observations used to estimate mean and median WTP for conversion of forest land.

4.2 Econometric Analysis

In this section, we have explained the three regression results separately. For each of the regression results, we have reported estimated coefficients, the impact of each explanatory variable on corresponding dependent variables and associated statistics. For continuous variables, we have reported their marginal effects on corresponding dependent variable. Also for discrete binary variables discrete effects were estimated.

4.2.1 Deforestation Results

The equation below represents small holder's decision to expand their lands into forest where y^* denotes the dependent variable (area of forest land cleared in hectare).

$$y^* = \beta_0 + \beta_1 sex + \beta_2 age + \beta_3 famsiz + \beta_4 pop + \beta_5 edu + \beta_6 inc + \beta_7 corr + \beta_8 offinc + \beta_9 ancoff + \\ + \beta_{10}\text{anhony} + \beta_{11}\text{ceroup} + \beta_{12} farmsiz + \beta_{13} tenr + \beta_{14}\,\text{int}\,ns + \beta_{15}\text{cr} + \beta_{16}\text{memb} + \beta_{17}\text{decm} + u \quad \ldots\ldots 4.1$$

The results shown in the second column of table 4.3 suggests that sex, age of the household head and family size (FAMSIZ) have no significant effect on deforestation. The empirical literature reviewed yielded mixed results on the relationship between population size and deforestation. Previous studies argue that in perfect labor markets, societies replay to earning differentials and the initial population has left the forest unaffected while in the imperfect labor markets the opposite holds. Our Tobit estimation showed that the relationship between village population size (POP) and deforestation was positive and significant. We may have two arguments for the outcome as expected. Firstly, larger population has higher capacity and greater need for environmental resources (such as forest). Population growth rises over all production and consumption requirements. Secondly, off farm employment opportunities are quite rare in isolated economies hence land use decisions are not made based on relative profitability of agriculture. Therefore, initial population levels increase deforestation in subsistence approach since labor force does not migrate in response to regional income differences. Even in the market approach population may increase deforestation when off farm wages are low and food prices are high. Formal education level (EDU) supposed to have negative effect on deforestation but the result suggests it has no significant effect. This is contradicting with previous works. Most of previous works argue that in perfect labor markets it reduces burden on the forest by easing out

migration. For our study site, the labor market is not perfect thus it is not surprising, if our regression result has such an outcome.

Household income has significant effect on deforestation. We used dummy for household income (INC) since it is difficult to estimate income of rural household. The sample households classified into five income groups and the income level has found to be significant and positive. However studies hitherto have not indicated straightforward relationship between deforestation and income levels. Most of so far investigations including environmental Kuznets curve suggests inverted u-shape association between two and so does our expectation. Forest loss increases in the early stage of economic development and then decreases when income reaches threshold level and people concerned about natural capital. But some findings argue for positive relationship between the two. It is indicated that relatively the richest households deforest more forest. Firstly, demand for shade trees to grow coffee plant (the main income source) peaking among rich households due to prestige motives and more demand for commodities. Secondly, the mean share of buffer zone holding increases with income level, therefore; the rich families have more opportunity to expand coffee lands into adjacent core zone. Thirdly, some previous findings pointed out that higher non farm rural income tends to drop destruction while higher income[8] from agriculture leans towards more deforestation. Corrugated roof (CORR) has no significant effect on deforestation.

[8] See appendix III table 4.3.1 INC become significant at 10% when we consider it as continuous variable.

Table 4.3: The Tobit model result for deforestation (deforestation as a dependent variable)

VARIABLES	Coefficient	Robust S.E	Z value	P-value	Marginal effect
SEX	.0582217	.0684795	0.85	0.395	.0582217
AGE	-.0001434	.0027394	0.05	0.958	-.0001434
FAMSIZ	-.0162254	.015961	1.02	0.309	-.0162254
POP	.0001718**	.0000872	1.97	0.049	.0001718
EDU	.007935	.0091962	0.86	0.388	.007935
INC1	-.0012297	.1065735	0.01	0.991	-.0012297
INC2	.0046688	.092064	0.05	0.960	.0046688
INC3	.1697384	.1083715	1.57	0.117	.1697384
INC4	.3374562	.2835777	1.19	0.234	.3374562
CORR	.0872176	.0856271	1.02	0.308	.0872176
OFFINC	.0000347**	.0000163	2.13	0.033	.0000347
ANCOFF	.0000288*	0.0000043	6.75	0.000	.0000288
ANHONY	-.0000352	.0000314	1.12	0.262	-.0000352
CEROUP	-0.00000106	.0000273	0.04	0.969	-0.0000011
FARMSIZ	.0908854**	.0370953	2.45	0.014	.0908854
TENR	.002041	.0804448	0.03	0.980	.002041
INTNS	-.0033337*	.001223	2.73	0.006	-.0033337
CR	.0000539**	.0000242	2.23	0.026	.0000539
DECM	.0052918	.0075396	0.70	0.483	.0052918
MEMB	-.3389926**	.077916	4.35	0.000	-.3389926
CONS	-.3981152	.2344087	1.70	0.089	
Wald chi2(20)					964.21
Prob > chi2					0.0000
Log pseudo likelihood					-42.206799
Number of observation					151

* Significant at the α= 0.01 level ($p<0.01$)
** Significant at the α= 0.05 level ($p<0.05$)
*** Significant at the α= 0.10 level ($p<0.1$)

Previous findings confirm that improved off farm job opportunities decline burden on forests. When households becomes part of market economies demand for their labor increases, and increases opportunity cost of agriculture. Contrary to the reviews and our expectation, off farm

income (OFFINC) has significant and positive effect on forest land decline. This is because, labor supply of people in Yayu quite limited by scant off farm jobs and earn small share of their income from off farm self-employed petty business. Thus the incentives from off farm work have not adequate enough to increase opportunity cost of remaining in the semi-forest coffee or growing maize. Rather it has done the opposite very well. Perhaps it may be a source of income to finance purchase of tools to clear forest such as saws for timber extraction, pruning hook to prune coffee trees, shade trees and bushes for forest coffee production.

The effect of representative income source, income from semi-forest coffee production (ANCOFF) has positive sign and is significant below one percent indicating that deforestation increases as annual revenue from coffee production rises. The result may be due to the fact that the international community attaches less value for stainable coffee production. When we pay competitive prices it encourages them to produce more. As long as coffee markets are concerned prices at household level are competitive. Therefore the only option to farmers to increase revenue is to increase production by clearing primary forests. Even in the global markets coffee produced under shade tree by small farmers paid as equal as commercial plantations. The former one is environmental friendly way of production, but the later one is not. Thus farmers have no incentive to reduce deforestation. Annual income from sell of honey (ANHONY) and yield of maize (CEROUP) is not significant in our study. While Jones et al. (1995) argued that productivity results in less forest loss because farmers who have successfully avoided soil degradation have more productive land and thus have no need to compensate for lost productivity on degraded lands by clearing forests.

Farm size is found to be significant and increases deforestation. It has mixed effects in previous studies. Farm size does not affect annual clearing by settlers in Brazil (Jones et al. 1995) while colonists with larger farm tend to have a higher percentage of their total land in forests in Ecuador (Pichón 1997). Since it provides farmers an opportunity to diversify production to cope with problems associated to crop failure. However, the regression result is due to the fact that farm size is proportional to coffee land size (i.e. farm size is coffee land size plus land allocated for other alternative uses). Farmers clear forest mainly to grow semi-forest coffee under shade tree in the secondary forest that provides broader product diversification options. It implies that farmer who has large coffee farm (large farm size) has cleared more forest area.

On the other hand, an institutional factor such as being membership to OCFCU (MEMB) has negative effect on expansion as opposed to our expectation. We hypostasized so because some argue that premium results in expansion of coffee on cost of primary forests while others claim it may provide stability for farmers and making expansion less important. It is also contrary to finding of Rojahn (2006). She observed that price premium for organic coffee in south west Ethiopia was not sufficient to reduce deforestation. Perhaps the interesting effect of union membership was attributed to relatively higher prices paid for union coffee. Since prices of the union, fair trade organic coffee was nearly double of conventional coffee price in 2007/2008. This suggests that in areas like Yayu where non timber forest products are abundant there is room to save forests by appreciating the value of these products and persuading small holders not to deforest. Since the fair trade promotes the inclusion of poor farmers in global primary product markets through trade. The union was acting in a way to set minimum welfare enhancing prices for producers. It has been playing well the local antitrust action, breaks the monopoly power of local informal money lenders. As it is well known, the price paid by monopsony is below perfect

competition. Therefore, the intervention of the union is crucial for poverty alleviation and then to promote sustainable use of the forest. The intervention has more significant effect especially in Yayu where farmers borrow money from informal lenders with higher interest rate to pay off coffee.

The effect of title setting strategies (TENR) on deforestation is our area of interest. We have clear economic theory on relationship between two but empirical findings were controversial. Moreover analyzing the relationship in Ethiopian context is important to compare with countries to which research finding are belong. Since in Ethiopia, in all of the regimes government is by default sole owner of the land. Farmers granted use right only. During emperor regime majority of the farmers were tenants and exposed to highest tenure insecurity. In the military government, collectivization was the core motto and private small holders were highly discriminated. Currently for the last 2-3 years there has been land certification, but still farmers are not owners of land. For this reason, we have not hypothesized the correlation between title setting strategies and deforestation, but we can hypostasize the effect of securing land use right on deforestation. It may have positive effect on deforestation, considering the current low tenure security and high discount rate. When forest clearing guarantee use right, deforestation become an investment. However our regression result indicates that the use right setting strategies have no significant effect on deforestation. It deviated from both the traditional theory and empirical findings. The result may be due to the fact that title setting strategy is not synonymous to ensuring use right.

Agricultural intensification (INTNS) and credit supply (CR) are other intervention areas that have significant effect on forest conservation. The intensification has decreased burden on forest as expected and consistence with empirical findings. When we think thoroughly agricultural expansion in Yayu is mostly characterized by subsistence nature. Hence intensification increases

productivity and decreases deforestation by making possible to meet subsistence requirement by already cleared land. As far as credit availability is concerned empirical studies are controversial. Some make a case for its negative effects on deforestation. They argue that access to loan reduce household dependence on forest related activities to smooth their earnings rather they concentrate in off farm jobs to pay their loans, they remain few hours to work in the garden. Similar to our findings others argue for the positive relationship between two. Credit availability promotes forest clearing by allowing small holders to expand their cropped area and pastures. Reducing distance to local markets (DECM) has no significant effect on deforestation. Finally our model has significant chi-square statistics indicates that at least one of the regression coefficients is not equal to zero.

4.2.2 Competing Land Use Options

For venerable natural resource dependent farmers', sustainable forest management is in most cases especially in the short run less profitable than conventional forest land use. However in study area majority of the sample farmers responded that sustainable coffee production is superior to maize production. The choice of farmers was consistent with the findings of Rojahn (2006). Rojahn's cost-benefit analysis of three alternative uses suggested that sustainable semi-forest coffee production is the most beneficial land use option for Ethiopia, even if international transfers for production of global public goods are not included. The model below represents small holders land use option where y^* denotes the dependent variable, dummy for profitability of alternative land use (i.e. choose between semi-forest coffee and maize production). The explanatory variables are factors that increase or decrease probability of sustainable use.

$$y^* = \beta_0 + \beta_1 sex + \beta_2 age + \beta_3 famsiz + \beta_4 pop + \beta_5 edu + \beta_6 inc + \beta_7 corr + \beta_8 \text{ancoff} + \beta_9 anhony + \beta_{10} \text{offinc} + \beta_{11} \text{ceroup} + \beta_{12} farmsiz + \beta_{13} tenr + \beta_{14} \text{int} ns + \beta_{15} cr + \beta_{16} \text{memb} + \beta_{17} \text{decm} + u \quad \text{.....4.2}$$

In table 4.4 below, the probit estimation result indicated that some variables such as family size (FAMSIZ), farm size (FARMSIZ), title setting strategy such as use right (TENR), intensification of agricultural production (INTNS) and membership to OCFCU (MEMB) increases the probability of sustainable use of forest land or buffer zone management. While variables such as village population size, age and years of education (EDU) of household head, income of household (INC3), income from coffee sell (ANCOFF) and yield of maize production (CEROUP)[9] take away incentives to sustainable use option, semi-forest coffee production.

From probit estimate, the variable age is negative and significant at less than 5% implies that the probability of semi-forest coffee production decreases with the age of household head. Family size (FAMSIZ) is significant and increased probability of sustainable allocation. The intuitive implication is that coffee is dominant source of income in Yayu thus larger families may depend on coffee production which has relatively higher price so that allow households to meet subsistence needs easily. Also coffee is the main source of income and seasonal employment in coffee producing areas of Ethiopia therefore they prefer to allocate their land for coffee to maize production.

Village population size (POP) decreases the probability of sustainable use. As long as village population is concerned, majority part of the population are not the owners of the coffee forest land. Thus as population increases number of non owner group increase and places more burden on the forest. Education of the household head was negative and significant. It implies that years

[9] See appendix III table 4.4.1 it is significant

Table 4.4: Binomial probit model estimation for Profitability of land use option

Variables	Coefficient	robust S.E	Marginal effect	z-value	P-value
SEX	.2878268	.3045091	.0844645	0.95	0.345
AGE	-.0309147*	.0114275	.008652	2.71	0.007
FAMSIZ	.1463429***	.0806884	.0409566	1.81	0.070
POP	-.0010098**	.000519	.0002826	1.95	0.052
EDU	-.1470277*	.0458025	-.0411483	3.21	0.001
INC1	-.2476783	.4842451	-.0726054	0.51	0.609
INC2	-.6102773	.4550888	-.1747518	1.34	0.180
INC3	-1.307702*	.543674	-.4506762	2.41	0.016
CORR	.387675	.3846805	.1170106	1.01	0.314
OFFINC	.0000182	.0000684	0.0000051	0.27	0.790
ANCOFF	-.0000297	.0000184	-0.00000832	1.62	0.105
ANHONY	.0001262	.0001838	.0000353	0.69	0.492
CEROUP	-.0002039	.0001213	-.0000571	1.68	0.093
FARMSIZ	.3644108**	.1630794	.1019867	2.23	0.025
TENR	.4849109***	.2865047	.1450015	1.69	0.091
INTNS	.0287025*	.0090557	.0080329	3.17	0.002
CR	.000146	.0001745	.0000409	0.84	0.403
DECM	-.0539406	.0342866	-.0150962	1.57	0.116
MEMB	.9676512*	.4019941	.2091686	2.41	0.016
CONSTANT	4.185553*	1.551718	-	2.70	0.007

Wald chi2(19)	50.53
Pseudo R2	0.3236
Prob > chi2	0.0001
Log pseudo likelihood	-61.630626
Number of observation	151

Asterisks indicate level of significance.
*, 1% level; **, 5% level; and ***, 10% level.

of education of household (EDU) decrease the probability of allocating forested area for semi-forest coffee production. Considerable number of research findings conclude that education

reduce burden on forests as it should ease out-migration and adoption of modern technologies that raise the productivity of labor and land. This might not be the case for study area where off farm job opportunities are quite scant.

Annual income from semi- forest coffee production (ANCOFF) decreases the probability of sustainable land use. A research summary has suggested that extraction of non-timber forest product (NTFPs) has not been a forest-saving money maker because product availability is limited and often seasonal and product value is low (Vosti et al. 2002). However equivalent conclusion may not applicable for south-west Ethiopia (such as Yayu). Production of coffee, korrorima and beekeeping can be seasonal and often low value for these products, but the availability of products can not be low. Since farmers are growing considerable amount of organic coffee in buffer zone. It is the main source of their income. However our results indicate that the negative effect of low value of NTFPs outweighs the positive effect of availability of these products on probability of sustainable use. The rise in income from maize production (CEROUP) is significant and decreases the probability of buffer zone management. This is opposite to our expectation. In subsistence model, agricultural productivity lets farmers easily to meet their target level of production and allocate remaining land for forest. However the result is due to the fact that maize production competes with coffee production.

The positive and significant effect of farm size on the probability of sustainable use of forest land can be explained from theories of imperfect labor market. In imperfect labor market, farmers expand their farm land until they meet their subsistence target thus any excess land can be allocated for sustainable use. Title setting strategy (TENR) increases the probability of sustainable forest management because often farmers expand their share in buffer zone into core zone and ensure use right. To put differently, they gradually increase the area of buffer zone by

clearing the periphery of core zone bit by bit and secure the said right. Agricultural intensification (INTNS) has found to be positive and significant effect on probability of buffer zone management. It has similar effect as an increase in output price on forest land use in isolated economies and has important implications. It allows producers to meet subsistence target by producing from smaller land areas hence the remaining land is used for organic forest coffee production. Opposite to income from sell of coffee being member of union (MEMB) has shown positive effect and significant. The result implies that membership increases probability of adoption of sustainable use since the union price is nearly as twice as non union price.

4.2.3 The Contingent Valuation Method Results

We used Tobit model, to estimate the small holders' willingness to pay for transformation of a hectare of core zone to buffer zone. The estimation was made for two reasons. Firstly, to estimate the welfare effects of economically viable use of forest land. Secondly, to examine the extent to which sustainable use of NTFPs and management of the resource will be reinforced by actual users with more local knowledge about forest rather than outsider at distant. In addition to that, to seek alternative efficient local financial sources to substitute high annual implementation costs of strict conservation. It costs 6.83 million Birr for total investment cost and 0.256 million Birr for recurrent budget (Agrissyastems 2001). Currently these implementation costs are financed by European commission and the project is going to be phase out in December 2009. The environmental effect of conversion is it may be not as comfortable as strict conservation for in situ conservation of biodiversity. However farmers decided to persist with polluter's pays principle- those who use or damage biodiversity should pay at least part of the cost of resource use. The variables included in the estimation of the model were given in the equation below. Where y^* denotes maximum WTP for proposed use option.

$$y^* = \beta_0 + \beta_1 sex + \beta_2 age + \beta_3 famsiz + \beta_4 farmsiz + \beta_5 edu + \beta_6 \text{int}ns + \beta_7 anhony + \beta_8 ceroup + \beta_9 \text{corr} + + \beta_{10} \text{buffer} + \beta_{11} \text{ancoff} + \beta_{12} \text{offinc} + \beta_{13} inc + \beta_{14} core + \beta_{15} \text{memb} + \beta_{16} \text{decm} + u \quad \ldots\ldots\ldots\ldots 4.3$$

Some of these variables have a significant effect on individuals' decision while others not. Age of the household has negatives influence and significant at less than 5%. Education (EDU) of household negatively correlated with household demand for buffer zone.

Size of respondent's demarcated coffee forest land (BUFFER) has negative and significant effect on willingness to pay. Buffer zone includes the largest share of holders' coffee forest land in Yayu. If farmers have enough buffer zone, they may have relatively low demand for additional buffer zone since an individual willingness to pay increases with the scarcity of the resource. The other plausible interpretation is that farmers are uncertain about the continuity of current use and management of buffer zone because they have not taxed for the use thy make of in buffer zone. They normally speculate that the government may resettle them in future to keep NFPA away from any encroachment. Low household income level (INC1) and adjacent land holding positively affects the WTP.

Income from sustainable uses such as from production of semi-forest coffee (ANCOFF) and honey (ANHONY) is found to be statistically significant and positive as expected. The deriving force behind the result is that coffee is the main source of income to coffee growing areas in Ethiopia. Farmers grow coffee under shade in south-west Ethiopia.

Table 4.5: estimated willingness to pay function (WTP as a dependent variable)

Variables	Coefficient	Marginal effect	Robust SE	z- value	P-value	Mean
SEX	5.977055	-5.977055	16.25298	0.37	0.713	.728972
AGE	-1.83129**	-1.83129	.7863169	2.33	0.020	43.9626
FAMSIZ	11.07455	11.07455	9.16269	1.21	0.227	4.88785
EDU	-5.955399**	-5.955399	2.900318	2.05	0.040	3.36449
INC1	37.65525**	37.65525	19.11083	1.97	0.049	.280374
INC2	34.88125	34.88125	21.1646	1.65	0.099	.439252
INC3	-6.330444	-6.330444	36.64969	0.17	0.863	.149533
INC4	13.6234	13.6234	61.73462	0.22	0.825	.037383
CORR	-45.19835	-45.19835	28.35661	1.59	0.111	.757009
OFFINC	.0122879**	.0122879	.0051464	2.39	0.017	225.234
ANCOFF	.0064604**	.0064604	.0033312	1.94	0.052	13692.6
ANHONY	.0327295*	.0327295	.010731	3.05	0.002	289.72
CEROUP	-.0096162	-.0096162	.0074037	1.30	0.194	1621.64
TENR	13.59337 21	13.59337	.93187	0.62	0.535	.747664
ADJC	46.18608 21**	46.18608	.87806	2.11	0.035	.411215
INTNS	.5903977	.5903977	.4679489	1.26	0.207	20.2528
CR	.0107974	.0107974	.0103283	1.05	0.296	708.131
FARMSIZ	2.492389	2.492389	7.913345	0.31	0.753	1.71963
BUFFER	-62.07718**	-62.07718	28.63799	2.17	0.030	.878505
MEMB	-11.23834	-11.23834	20.96658	0.54	0.592	.214953
DECM	.2318741	.2318741	1.482113	0.16	0.876	4.02804
CONS	33.48546		48.32352	0.69	0.488	

Number of observations	107
Wald chi2(21)	37.18
Prob > chi2 =	0.0160
Log pseudo likelihood	-630.25797

Asterisks indicate level of significance.
*, 1% level; **, 5% level; and ***, 10% level.

The diversification motives, and thereby to meet land shortages they were willing to pay more.

They hang hives on indigenous shade tree and harvest coffee, korrorima and other NTFPs. Hence

the multiple cropping strategies give an opportunity to farmers to cope with shortage of agricultural land. Off farm wage earning has also positive effect on willingness to pay.

Using the coefficients and mean values of significant variables on table 4.5, we estimated WTP per a hectare for a conversion of strict conservation (core zone) to sustainable management (buffer zone). Thus the estimated mean WTP for additional use of a hectare of core zone is 41.08 Birr (4.42 USD) for households who preferred sustainable forest use over conversion. The estimated WTP is 25.3% and 17.1% of annual income generated from a hectare area of semi-forest coffee production to nonunion member and union member household respectively.

We calculated Aggregate welfare effects of extra sustainable use by multiplying total area of core zone belongs to Yayu district with 2,553 household heads in 12 villages whose welfare supposed to be affected by proposed change. Then we multiplied the product with mean WTP amount for each hectare of primary forest. Accordingly, total WTP for transfer of 5,638 hectare of core zone into buffer zone is 63.6 million USD. This is by far greater than the sum of total budget for initial investment cost and annual recurrent budget for strict conservation in a given year. It implies firstly, there is possibility to enhance sustainable forest use using local financial source. Secondly, there are some opportunities to cooperate conflicting interests by extending benefits. Without including, annual income from sells of timber, fuel wood and other NTFPs the loss to local community from the organic fair trade and conventional coffee production in core zone estimated to be more than 9.3 and 6.1 million USD respectively. Therefore the resource conservation effort of the government as well as international donor agencies is Pareto inefficient and thus conflicts with the interest of local users. It calls for international compensation.

CHAPTER FIVE: Conclusion and Policy Implications

Unlike man made capitals environmental capitals are irreversible in nature. Trial and error allocation of environmental resources are too costly for generations since mistakes can not be corrected with the benefit of hindsight. Commonly uncertainty tends to discriminate investments designed to enhance the sustainability of environmental resources (such as forest conservation) and leads to overexploitation of commons. Market fails to incorporate in the price all the costs and benefits to the society of using forests. It leads to divergence between private and social optimum level of forest use. Further it is important to note that sustainable forest management is costly for subsistence farmers around the forest and they prefer arable land use to conservation when economic benefits of conversion are relatively higher. Therefore development policy makers must be benevolent and skillful to co-operate these conflicting and diverging interests. Forest management calls for holistic approach that deals with concern for environmental protection, social equity, and in the same time poverty reduction, making the livelihood of poor functional from use of natural resources. Social equity refers to justice and equal opportunities, participation, exploitation of market power and elimination of restrictions of market access and subsequent reduction of value chains. Also it involves with investment in the human resource of coffee farmers such as in the health, education, infrastructure provision and family planning.

However in the case of Yayu, more concern has been given to environmental protection since core zone (10,000 hectares of coffee forest) has completely untouched by actual users, economically not functional. It implies that access right to forest products and livelihood diversification by local community (right to harvest and commercialize their commercially viable timber and NTFPs) have been denied for long time in favor of in situ conservation. Thus strict conservation in the study area that restricts local income earning opportunities carries a huge cost

to local people's livelihood and economic growth. For instance, without including annual income from sell of timber, fuel wood and other NTFPs the annual loss to local community from the organic fair trade and conventional coffee production in core zone estimated to be more than 9.3 and 6.1 million USD respectively. It implies that conservation efforts of government and international donors' conflicts with local resource users' interest. Since the allocation is Pareto inefficient that is at least one person in society prefers sustainable use of core zone but government opposes it. Moreover Farmers are growing coffee and harvesting other NTFPs in the buffer zone, zone surrounding core zone, but they are doubtful about the sustainability of economic activities in the buffer zone as well.

The Tobit estimation results of deforestation analysis indicated that increase in all socio-economic variables that are statistically significant raise burden on the forest. These variables are village population size (POP), income level of the household (INC), annual off farm income (OFFINC), income from semi-forest coffee production (ANCOFF) and household farm size (FARMSIZ). From the institutional and market related factors, amount of credit (CR) served by household has significant and positive effect on deforestation where as union membership dummy (MEMB) and agricultural intensification (INTNS) reduce pressure on forest.

The study is also found out that over 70.86% of households' preferred sustainable use over complete conversion. It suggests that for nearly three fourth of households economic benefit from semi-forest coffee production outweighs any other alternative use of forest land. The probit regression result reveals that the probability of sustainable use decreases as the age of household rises and village population increases. Larger family enhances probability of sustainable use, but education of household increase the probability of conversion into arable land. Probability of sustainable use of forest land increases as the farm size gets larger, but it falls with higher

revenue from organic coffee production and as yield of maize per hectare rise. The probability of allocating land for semi-forest coffee production increases with being member to union, higher agricultural intensification and when forest clearing ensures use right. Union membership dummy has important implication of institutional intervention. It implies that price premium is incentive to enhance sustainable use.

Simultaneously 95.33% of households' who preferred sustainable use have positive WTP for transformation of core zone into sustainable use. They are willing to pay extra tax of $4.42 per hectare for additional sustainable use of core zone. It indicates firstly, the existence of alternative local financial sources to substitute high annual implementation costs of strict conservation that financed by outsiders at a distance and that is going to be terminated in near future. Secondly, there are possibilities to cooperate conflicting interests. The small holder decision to pay for additional buffer zone use increases as annual income from sustainable coffee and honey production rises. Also holder WTP positively correlated with dummy of adjacent land holding. It decreases as the area of holder's coffee forest land included in buffer zone gets larger. Also it falls as household head formal education level and age rises.

By and large, from the regression results, we can derive two conclusions. Firstly, it indicated that trade off between environmental protections (such as reducing deforestation) and maximization of the livelihood of the poor. Household income level and revenue from semi-forest coffee production were inversely related with in situ conservation. Village population size places burden on cloud forests as larger population demands more resource to satisfy production and consumption needs. Communities in the study area are highly dependent in semi-forest coffee production. Secondly, institutional interventions have shown possibility to achieve sustainable development. For instance, institutional factors namely agricultural intensification programs

reduce burdens imposed on forest by meeting subsistence requirements in already cleared lands and membership to OCFCU increases the value of remaining forests through fair trade. The results suggest that the importance of strong and functional global or local institutions first to compensate the forest users through global transfer payments for the revenue they forgone due to strict conservation and thereby to increase the opportunity cost of clearing the forest. Secondly, institutional support is required to increase the productivity of already cleared land through intensification and to invest on family planning to ensure optimal population size. For instance, provision of health and agricultural extension services by the government are important interventions. Extension workers can easily convince farmers to plant indigenous trees on already cleared lands to substitute high demand of shade trees to grow coffee and then to reduce deforestation.

Thirdly, institutions have power to create local antitrust action. They break the monopsony power of local intermediaries by equalizing market power between buyer and seller and then reduce deforestation. Fourthly, institutions are important to realize fair trade (premium for environmental friendly production), and to reverse most of the value added that have been enjoyed by final retailers to producers at grass root level. This is possible primarily through value added to primary products and increasing the share of farmers in processing of raw materials into higher value end products. Secondly, by providing products with lower price for consumers without reducing the quality through generation of marketable by products and reduce value chain by greater farm level processing. Also it is possible by linking directly responsible and concerned consumers with primary producers to ensure fair trade. Thus promotion of fair trade by OCFCU is important and its efforts would be far reaching, if above mentioned options to realize benefits to local users will be optimized.

In our findings, income from sustainable coffee production in buffer zone induce farmers to expand their lands in to core zone, decreases probability of sustainable coffee production and increase households WTP for extra use of core zone. On the other hand, experts argue for strict conservation. Since the current use of buffer zone is not as comfortable as core zone for in situ conservation. It suggests that the interest of farmers', conflict with the interest of experts for in situ conservation. However the adverse effects of income from coffee sell to protection of the forest is due to the fact that markets fail to charge prices for all economic values of forest (such as value of timber stored in the forest and ecosystem functions). Moreover uncertainty of future use rights of buffer zone is, by and large, contributed to the outcome. However it does not mean we have no opportunity for converging conflicting interests, if we able to establish strong institutions. As noted above, functional institutions can make operational consumers' interest to pay price premium for environmental friendly coffee production. They can extend the project (organic fair trade) for timber, honey and other NTFPs and there by increase value of remaining forest or farmers' willingness to pay for sustainable use. Also it is possible to increase the value of remaining forest by including majority of farmers not included in the organic fair trade coffee. Institutions can increase a bargaining power of producers for fair trade and easily finance certification costs that are unaffordable for single farmer.

Instead of complete restriction, sustainable extraction of timber from buffer and core zones could slow down deforestation by increasing the value of remaining forest. However the government had not encouraged its use since the cost of ensuring sustainable extraction method would be expensive. However global institutions such as European Commission currently involving in Geba-Dogi Forest Conservation Project can take the advantage by shifting their resource to ensure sustainable use and PFM rather than strict conservation. Also if newly emerged markets

for carbon are extended to include farmers within or around cloud forests, it would slow down deforestation by adding the value of standing forests. By nature, opportunities available for multiple cropping within the forest such as growing coffee, beekeeping and other sustainable NTFPs under single shade tree reduce deforestation. Thus opportunities for multiple cropping strategies increase sustainable use more than currently achieved, if institutions able to create organic fair trade for majority of timber and NTFPs.

Therefore to respond to deforestation in south west Ethiopia international founding or market creation is important to give incentive to avoid further deforestation. Rather than paying this areas to cut their forest (when we place low value for NTFPs), the world would pay them to conserve their biodiversity and to sequester the carbon in the forest. Under the Kyoto Protocol, rain forest countries can get carbon credit for reforestation and for afforestation (creating forests where they did not previously exist), but not for avoiding deforestation. If the Kyoto Protocol is committed to reduce deforestation, it must extend or relax its carbon trade for not only afforestation but also for avoiding deforestation. As far as the study area is concerned almost 69.1% of the district land is occupied by forest and still mountains of south west Ethiopia are covered by cloud moist forests, therefore; relaxation of the Kyoto Protocol to maintain the current forest size is not less worth than paying to increase plantations in less forested area elsewhere.

Finally, the results suggest that markets may not able to do the entire job of conserving the forest and then ecosystem services. Thus direct regulation that has currently undertaken by Geba-Dogi Forest Conservation Project which is financed by European Union should not be undermined, but it should not limited to regulation only. Because the regulation efforts that have been made almost for two decades, resulted in divergence of benefits and have not been successful enough in

combating deforestation. Further they had better extend their efforts to create markets for NTFPs, introduction of community based natural resource management and seek to find possibilities to make core zone economically viable. These can be achieved through exploitation of current ecotourism and carbon market opportunities; and even to the extreme by reducing the size of the core zone.

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Appendix I: A Survey Questionnaire

Interviewer code_____ Date_____

Interview started_____ Interview ended_____

Supervisor_____

INTRODUCTION TO THE RESPONDENT

Hello I am a student from Addis Ababa University. The main aim of collecting data from sample households is to identify causes of deforestation in Yayu. Luckily you are among my sample households. Your authentic view could be used to help policy makers to make pre-informed decision about forest land use in Yayu. The interview will take a few minutes and your response will only for academic purpose and will not be disclosed at all.

Thank you in advance for your co-operation

Section A

Respondent's Personal Data

1) List respondent profile

Village	Household ID.	Household head sex		Household head age	Family size	Tick occupation other than farming		
_____		1= M	2= F			□Artesian, □apiculture, □petty cash	□Government employee	□other

2) Ethnic group:_____

3) Years of formal education:_____years

4) How long have you lived in this village:_____ years

5) Fill the holders land size in hectare (ha)

Year	Total land size (ha)	Size of coffee land in buffer zone (ha)	Total size of coffee land (ha)	Land occupied by all other crops land in (ha)
2007/08				
2008/09				

6) Holders land used for maize production: _____ hectare.

7) Holder's coffee forest land demarcated as core zone: _____ hectare.

8) Do you have a corrugated roof? 1= yes 2=no

9) Do you have an irrigated land? 1=yes 2= no

10) If yes for question #9, then_____hectare.

11) Do you have fallow land? 1=yes 2=no

12) If yes for question #11, then_____hectare.

13) Please list number of hives you have:_____modern and_____traditional hives.

14) Have you planted trees in your own land in last five years? 1= yes 2= no

15) If yes for # 14, then_____ trees in number/hectare.

16) Does the size of forest coffee in Yayu increasing? 1=yes 2= no

17) Have you noticed any forest clearing in your village? 1=yes 2= no

18) Do you think forest clearing is a first step to claim use right? 1=yes 2=no

19) Do you think forest management efforts of government conflicts with the interests of local people? 1=yes 2= no

20) Are you a member of OCFCU? 1= yes 2=no

21) Why do farmers expand their lands into coffee forest land?

1 = low Forest coffee return 2 = insufficient land

3 = others (specify)

22) Have you used quality seed or fertilizer in year 2008 1=Yes 2= No

23) If yes for question # 22, then fill the following table

Measurement	Fertilizer		Quality seed
Total amount used in kg	urea	dap	maize

24) Have you got credit service in last three years (2006-08)? 1= Yes 2= No

25) If yes for question #24, then total amount borrowed in birr from :

1= banks _____birr 2= microfinance institution_____birr

3= others (informal credit) _____birr

26) If you have got credit from informal sector/ individuals, then interest rate is:

_____ Birr per _____ or_____ % interest rate.

27) How much do you earn in a year from:

Work type	Weaving/ handcraft	Interest rate	Employment	Gift	Business	Other activities
Birr						

28) How much do you pay for tax? Birr _____per_____

29) Do you have land adjacent to forest area? 1= yes 2= no

30) Have you attended any environmental training? 1=yes 2=no

31) If yes for question # 30, then hours of environmental education attended:

_____

Section B

WTP Questions

In answering the questions in the next section, may you note that the benefits from sustainable forest management are (i) forest products that can be consumed directly, such as sales of coffee, honey, timber, and kororima (ii) benefits that derived from breading such as high yielding coffee varieties resistance to coffee pests and diseases so that yield losses and pesticide costs of coffee growers world wide reduced (iii) education/research, (iv) tourism, (v) ecological and environmental services such as flood protection, carbon storage and biodiversity, (vi) possible future uses such as pharmaceutical, industrial and agricultural applications, and (vii) intrinsic value such as religious, cultural, aesthetic, existence and bequest values. The costs of sustainable management include (i) management costs such as costs of, wages, low and order, etc, (ii) costs to other livelihood activities in the form of livestock losses, crop destruction and human injury by wild life and (iii) opportunity costs in the form of alternative land (such as crops), money, time or resource uses and profits forgone, including unsustainable use.

1. Considering those benefits and costs of sustainable forest management that are applicable to your household, how do you think the benefits of sustainable coffee forest management compare with the associated costs?

   (i) Benefits > costs (***go to question 2&3***)

   (ii) Benefits < costs (***stop interview here***)

2. Suppose that the government wants to transform strictly conserved forest area of 5638 hectare in your village to sustainable semi- forest management then you access to all

benefits associated with sustainable management and your community take over management based on contract agreements with the government. But the government does not have money to finance costs of organizing and training villagers for participatory management; wages and law enforcement. What is the maximum tax you pay for a hectare of forest land to support this effort of the government? _____Birr per year?

3. If zero response is given to question #2, then why? _____

Thank you for taking time to respond this questionnaire!

Appendix II: Tests of Multicollinearity and Homoscedasticity

1.1 Checking for Multicollinearity

The primary concern is that as the degree of multicollinearity increases, the regression model estimates of the coefficients become unstable and the standard errors for the coefficients can get wildly inflated. A variable whose VIF values are greater than 10 may merit further investigation. In our case, for all variables vif value is less than 10.

VIF test

Variable	VIF	1/VIF
ANCOFF	3.41	0.293152
FARMSIZ	3.18	0.314419
DECM	2.97	0.336735
POP	2.59	0.386003
CEROUP	2.29	0.437067
CORR	1.73	0.579337
ILAVEL	1.58	0.631451
EDU	1.55	0.645574
AGE	1.54	0.650259
FAMSIZ	1.52	0.656503
INTNS	1.50	0.664582
MEMB	1.49	0.670308
TENR	1.27	0.788136
ANHONY	1.20	0.835943
SEX	1.18	0.848857
OFFINC	1.17	0.851367
CR	1.16	0.863342
Mean VIF	1.84	

1.2 **Checking Homoscedasticity of Residuals**

1. estat imtest

Cameron & Trivedi's decomposition of IM-test

Source	chi2	df	P
Heteroskedasticity	151.00	150	0.4617
Skewness	14.41	17	0.6379
Kurtosis	3.98	1	0.0460
Total	169.39	168	0.4553

2. estat hettest

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

chi2(1) = 3.50
Prob > chi2 = 0.0615

The first test on heteroskedasticity given by **imest** is the White's test and the second one given by **hettest** is the Breusch-Pagan test. Both test the null hypothesis that the variance of the residuals is homogenous. Therefore, if the p-value is very small, we would have to reject the hypothesis and accept the alternative hypothesis that the variance is not homogenous. So here for deforestation we accepted the null as indicated in tables above and concluded that residuals are homoskedastic. But for land use option and WTP we rejected null, p-values are less than 5% for both models. However we used robust standard errors for three models.

Appendix III: MAXIMUM LIKELIHOOD ESTIMATES

In this section, we reported estimated results for Tobit and probit models using different income variables to compare the effect of income variable (INC) on results when it is estimated as dummy or continuous variable. Further, to see the effects on the results when we regress INC with other income variables or separately.

Table 4.3.1: The Tobit model result for deforestation (area forest land cleared in hectare as a dependent variable) and income (INC) of the house hold is continuous variable

Variable	Coefficient	Robust SE	Marginal effect
SEX	0.0427175 (0.68)	.063071	.0427175
AGE	0.0002269 (0.08)	.0027245	.0002269
FAMSIZ	-0.0209033 (1.40)	.0149731	-.0209033
POP	0.0001634*** (1.83)	.0000892	.0001634
EDU	0.0094339 (1.10)	.0085416	.0094339
INC	0.0639265*** (1.71)	.0374878	.0639265
CORR	0.0473828 (0.55)	.0858698	.0473828
OFFINC	0.0000302*** (1.84)	.0000164	.0000302
ANCOFF	0.0000293* (6.93)	.010485	.0000293
ANHONY	-0.0000203 (0.65)	.0000313	-.0000203
CEROUP	0.0029497 (0.05)	.0000263	.0029497
FARMSIZ	0.1058527* (2.86)	.0369584	.1058527
TENR	-0.0157928 (0.20)	.0772686	-.0157928
INTNS	-0.0028916* (2.52)	.001147	-.0028916
CR	0.0000432*** (1.76)	.0000246	.0000432
DECM	0.0049866 (0.66)	.0075259	.0049866
MEMB	-0.3517501* (4.52)	.0778461	-.3517501
CONSTANT	-0.4229655** (2.03)	.2079288	
Wald chi2			827.61
Prob > chi2			0.000
Log pseudo likelihood			-43.75
Number of observation			151

Values in bracket are z-value. Asterisks indicate level of significance.
, 5% level; *, 10% level.

Note: when we compare table 4.3 with table 4.3.1, all values are maintained, but only income of household (INC) become insignificant in former case.

Table 4.3.2 the tobit result of deforestation, deforestation as a dependent variable and income levels of households excluded from the equation

Variables	coefficient	Robust SE	Marginal effect	z-value	p-value
SEX	.025255	.0633733	.025255	0.40	0.690
AGE	.000718	.0026835	.000718	0.27	0.789
FAMSIZ	-.0107753	.0146214	-.0107753	-0.74	0.461
POP	.0001734***	.000089	.000173	1.95	0.051
EDU	.0108546	.0087976	.0108546	1.23	0.217
CORR	.0539289	.0854152	.053928	0.63	0.528
OFFINC	.0000374**	0.0000167	.0000374	2.24	0.025
ANCOFF	.0000291*	0.00000413	.0000291	7.04	0.000
ANHONY	-.0000148	.0000327	-.000014	-0.45	0.650
CEROUP	-0.0000085	.0000252	-0.0000085	-0.34	0.735
FARMSIZ	.1034536*	.0364167	.1034536	2.84	0.004
TENR	-.0106591	.0774901	-.0106591	-0.14	0.89
INTNS	-.0018659	.0011237	-.0018659	-1.66	0.097
CR	.0000515**	.0000255	.0000515	2.02	0.043
DECM	.0058852	.0073161	.0058852	0.80	0.421
MEMB	-.3420432*	.0784735	-.3420432	-4.36	0.000
CONSTANT	-.4262929	.2109542		-2.02	0.043

Number of observations	151
Wald chi2(16)	777.86
Prob > chi2	0.0000
Log pseudo likelihood	-45.143346

Note: when we compare table 4.3 with table 4.3.2 all values are maintained, but only INTNS become insignificant in latter case.

Table 4.3.3 the Tobit result of deforestation, deforestation as a dependent variable and all income variables other than income levels of households excluded from the equation

VARIABLE	coefficient	Robust S.E	Marginal effect	Z -value	p-value
SEX	.0629642	.0811404	.0629642	0.78	0.438
AGE	-.0031815	.0036769	-.0031815	-0.87	0.387
FAMSIZ	-.0243409	.0174649	-.0243409	-1.39	0.163
POP	.0002056***	.0001091	.0002056	1.89	0.059
EDU	.0157819	.0115687	.0157819	1.36	0.173
INC1	.2210106**	.1075964	.2210106	2.05	0.040
INC2	.2428042*	.0881775	.2428042	2.75	0.006
INC3	.3729038*	.108656	.3729038	3.43	0.001
INC4	.5988148**	.267342	.5988148	2.24	0.025
FARMSIZ	.2742037*	.0294067	.2742037	9.32	0.000
TENR	-.1055314	.0908435	-.1055314	-1.16	0.245
INTNS	-.0023582***	.0013698	-.0023582	-1.72	0.085
CR	-0000075	.000034	-0000075	-0.22	0.826
DECM	.0053202	.009869	.0053202	0.54	0.590
MEMB	-.0162253	.0869979	-.0162253	-0.19	0.852
CONSTANT	-.3602186	.3529963		-1.02	0.308

Wald chi2(15)	184.63
Prob>chi2	0.0000
Log pseudo likelihood	-74.964979
Number of observation	151

Note: when we compare table 4.3 with table 4.3.3, all income dummies are significant and MEMB is insignificant.

Inc1=1 if the household is poor and 0 or else

Inc2=1 if the household is middle 0 or else

Inc3=1 if the household is rich and 0 or else

Inc4=1 if the household is very rich and 0 or else

Very poor is the reference point

Table 4.4.1: Binomial probit model estimation for Profitability of land use option

Variable	Coefficient	Robust SE	Marginal effects
SEX	0.2808843 (0.95)	.2962112	0.0842715
AGE	-0.0311554* (2.77)	.0112597	-0.0089412
FAMSIZ	1415042*** (1.76)	.0804961	0 .04061
POP	-0.0009983** (1.99)	.0005024	-0.0002865
EDU	.1510955* (3.44)	.0439633	-0.0433626
INC	-0.1969098 (1.18)	.1661699	-0.0565107
CORR	0.3460942 (.93)	.3728098	0.1060321
FARMSIZ	0 .4054994* (2.67)	.1516393	0.1163734
ANCOFF	-0.0000299** (1.75)	.0000171	0.0212677
ANHONY	0 .0000724 (0.44)	.0001638	0.0000208
CEROUP	-0.0002402** (2.01)	.0001195	-0.0000689
OFFINC	-0.0000164 (0.23)	.0000723	0.0100885
TENR	0 .4621424*** (1.67)	.2771516	0.1409114
INTNS	0.0228232* (3.08)	.0073986	0 .00655
CR	0.0000929 (0.58)	.0001674	0 .0000267
MEMB	0.8307086** (2.18)	.3816932	0.1922823
DECM	-.0481298 (1.49)	.0323756	-0.0138127
CONSTANT	4.141615* (2.97)	1.3945	
Wald chi2			46.40
Prob > chi2			0.0002
Log pseudo likelihood			-63.348
Pseudo R2			0.3047
Number of observation			151

Values indicated in parenthesis are z-statistics. Asterisks indicate level of significance.
*, 1% level; **, 5% level; and ***, 10% level.

Note: when we compare table 4.4 with table 4.4.1, all values are maintained, but only income dummy (inc3) become significant and ANCOFF is insignificant in former case.

Table 4.4.2 bimodal probit model estimation for profitability of land use option, it excluded three income dummies

Variables	Coefficient	Robust SE	Marginal effect	z- value	P-value
SEX	.327693	.2844379	.100418	1.15	0.249
AGE	-.0325143*	.0109257	-.009481	2.98	0.003
FAMSIZ	.1070335	.0779889	.0312104	1.37	0.170
POP	-.0010198**	.0005017	-.0002974	2.03	0.042
EDU	-.1516108*	.0422787	-.0442089	3.59	0.000
CORR	.3497223	.3698955	.1087219	0.95	0.344
OFFINC	-.0000401	.0000689	-.0000117	0.58	0.561
ANCOFF	-.0000316***	.0000167	-0.0000092	1.89	0.059
ANHONY	.0000357	.000167	.0000104	0.21	0.831
CEROUP	-.0001799	.0001171	-.0000524	1.54	0.124
FARMSIZ	.3845735**	.1512054	.1121396	2.54	0.011
TENR	.4208597	.2722189	.1295477	1.55	0.122
INTNS	.0188785*	.0068735	.0055049	2.75	0.006
CR	.0000628	.000161	.0000183	0.39	0.696
DECM	-.0475033	.0320894	-.0138517	1.48	0.139
MEMB	.8149277**	.3991424	.1931558	2.04	0.041
CONSTANT	4.146319	1.37833		3.01	0.003

Wald chi2(16)	43.68
Prob > chi2	0.0002
Pseudo R2	0.2924
Log pseudo likelihood	-64.475453
Number of observation	151

Note: when we compare table 4.4 with table 4.4.2, all values are maintained, but only FAMSIZ become insignificant in latter case.

Table 4.4.3 bimodal probit model estimation for profitability of land use option, it excludes all income variables other than three income dummies

Variables	Coefficient	Robust S.E	Marginal effect	z-value	P-value	P-value
SEX	.3694327	.3058504	.115215	1.21	0.227	0.227
AGE	-.0284566*	.0111521	-.0084126	2.55	0.011	0.011
FAMSIZ	.0900441	.071876	.0266195	1.25	0.210	0.210
POP	-.0012305*	.0005086	-.0003638	2.42	0.016	0.016
EDU	-.1409718*	.0429686	-.0416751	3.28	0.001	0.001
INC1	-.1088286	.4855929	-.0327793	0.22	0.823	0.823
INC2	-.3872808	.4646143	-.1156923	0.83	0.405	0.405
INC3	-1.020761***	.5869337	-.3554455	1.74	0.082	0.082
FARMSIZ	.1352963	.1036524	.0399973	1.31	0.192	0.192
TENR	.5221825***	.2856446	.1643018	1.83	0.068	0.068
INTNS	.0234907*	.0083896	.0069445	2.80	0.005	0.005
CR	.0001107	.0001493	.0000327	0.74	0.459	0.459
DECM	-.0512188	.0340016	-.0151417	1.51	0.132	0.132
MEMB	.6449251***	.3393446	.1632616	1.90	0.057	0.057
CONSSTANT	4.758839*	1.491423		3.19	0.001	0.001

Wald chi2(14)	53.36
Prob > chi2	0.0000
Pseudo R2	0.2973
Log pseudo likelihood	-63.040937
Number of observations	147

Note: when we compare table 4.4 with table 4.4.3, all values are maintained, but only FAMSIZ and FARMSIZ become insignificant in latter case.

Table 4.5.1: Estimated willingness to pay function (WTP as a dependent variable) and income of household (INC) is a continues variable

variables	Coefficient	Robust SE	Marginal Effects	Mean
SEX	-1.227175 (0.08)	15.87585	-1.227175	0.728972
AGE	-1.891174** (2.3)	.8221633	-1.891174	43.9626
FAMSIZ	9.387921 (1.13)	8.331139	9.387921	4.88785
EDU	-6.013422** (2.18)	2.75296	-6.013422	3.36449
INC	-0.8957128 (0.07)	12.69475	-0.8957128	1.75701
CORR	-43.98027 (1.50)	29.3478	-43.98027	.757009
OFFINC	0.0092609*** (2.29)	.0040379	0.0092609	225.234
ANCOFF	0.0068071*** (1.94)	.003516	0.0068071	13692.6
ANHONY	0.0266565** (2.40)	.0111108	0.0266565	289.72
CEROUP	-0.0027875 (.49)	.0056442	-0.0027875	1482.57
TENR	26.3701 (1.08)	24.47531	26.37014	0.747664
ADJC	45.33525** (2.11)	21.53266	45.33525	0.411215
INTNS	0.2318467 (.62)	.3761651	0.2318467	20.2528
CR	0.009847 (.93)	.0105514	0 .009847	708.131
FARMSIZ	-3.134125 (0.42)	7.38624	-3.134125	1.71963
BUFFER	-59.0477 7** (2.10)	28.11069	-59.04777	0.878505
MEMB	-21.07054 (1.02)	20.67911	-21.07054	0.214953
DECM	0.2270363 (0.16)	1.434155	0.2270363	4.0280
CONSTANT	61.2998 (1.53)	40.10577		
Wald chi2 (18)			29.63	
Prob > chi2			0.0412	
Log pseudo likelihood			-632.19097	
Number of observations			107	

Values in bracket are z-value. Asterisks indicate level of significance.
, 5% level; *, 10% level.

Note: when we compare table 4.5 with table 4.5.1., all values are maintained.

Table 4.5.2: Estimated willingness to pay function, WTP as a dependent variable and income level of the household is excluded from the model

Variables	Coefficient	Marginal effect	Robust SE	z-value	p-value	Mean
SEX	-1.397711	-1.397711	14.73129	0.09	0.924	.728972
AGE	-1.88492**	-1.88492	.8027029	2.35	0.019	43.9626
FAMSIZ	10.48069	10.48069	7.648644	1.37	0.171	4.88785
EDU	-6.614063**	-6.614063	2.960334	2.23	0.025	3.36449
CORR	-40.81465	-40.81465	25.82165	1.58	0.114	.757009
OFFINC	.0097829**	.0097829	.0044993	2.17	0.030	225.234
ANCOFF	.0066498**	.0066498	.0033691	1.97	0.048	13692.6
ANHONY	.0273386*	.0273386	.010394	2.63	0.009	289.72
CEROUP	-.0082561	-.0082561	.0060612	1.36	0.173	1621.64
TENR	24.81446	24.81446	22.13214	1.12	0.262	.747664
ADJC	45.51941**	45.51941	21.5073	2.12	0.034	.411215
INTNS	.3502943	.3502943	.3173572	1.10	0.270	20.2528
CR	.0114307	.0114307	.01053	1.09	0.278	708.131
FARMSIZ	.4976904	.4976904	7.294995	0.07	0.946	1.71963
BUFFER	-60.62769**	-60.62769	29.38832	2.06	0.039	.878505
MEMB	-14.78423	-14.78423	20.86334	0.71	0.479	.214953
DECM	.519377	.519377	1.422454	0.37	0.715	4.0280
CONS	55.13386		43.36867	1.27	0.204	

Wald chi2(17)	22.72
Prob > chi2	0.00584
Log pseudo likelihood	-631.70381
Number of observation	107

Note: when we compare table 4.5 with table 4.5.2, all values are maintained.

Table 4.5.3: Estimated willingness to pay function, WTP as a dependent variable and all income variables are excluded from the model other than income level of the household

Variables	Coefficient.	Robust S.E.	Marginal effect	Z value	P-value	Mean value of X
SEX	-3.163584	15.01689	-3.163584	0.21	0.833	.728972
AGE**	-2.290357	1.009392	-2.290357	2.27	0.023	43.9626
FAMSIZ	10.28995	9.899863	10.28995	1.04	0.299	4.88785
EDU	-5.341607	3.162064	-5.341607	1.69	0.091	3.36449
INC1	26.5406	18.37833	26.5406	1.44	0.149	.280374
INC2***	39.42332	20.80092	39.42332	1.90	0.058	.439252
INC3	17.45761	35.90427	17.45761	0.49	0.627	.149533
INC4	50.22286	51.50076	50.22286	0.98	0.329	.037383
TENR	20.29729	26.04755	20.29729	0.78	0.436	.747664
ADJC***	49.4216	25.42739	49.4216	1.94	0.052	.411215
INTNS	.2624205	.3452269	.2624205	0.76	0.447	20.2528
CR	.0083166	.0110569	.0083166	0.75	0.452	708.131
FARMSIZ	6.743212	6.851202	6.743212	0.98	0.325	1.71963
BUFFER	-5.979822	8.92979	-5.979822	0.67	0.503	.878505
MEMB	40.55396	37.00748	40.55396	1.10	0.273	.214953
DECM	-1.924076	2.077996	1.924076	0.93	0.354	4.02804
CONSTANT	43.49844	44.8286		0.97	0.332	.728972

Wald chi2(16)	14.80
Prob > chi2 =	0.0439
Log pseudo likelihood	-643.67412
Number of observations	107

Note: when we compare table 4.5 with 4.5.3 still results are maintained.

Declaration

I, the undersigned, declare that this thesis is my original work and has not been presented for a degree in any other university, and that all source of materials used for the thesis have been duly acknowledged.

The examiners' comments have been dully incorporated.

Declared by:

Name: TESFAYE CHOFANA CHOLO

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Date: July 1, 2009

Confirmed by Advisor:

Name: Christine Fauvelle-Aymar

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Date: July 1, 2009

Place and date of submission: July 3, 2009.