ADDIS ABABA UNIVERSITY
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INTRA – HOUSEHOLD PREFERENCE AND WILLINGNESS TO PAY FOR IMPROVED MALARIA PREVENTION

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"Intra – Household Preference and Willingness to Pay for Improved Malaria Prevention."

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Acronyms

CS	Consumer Surplus
CV	Compensating Variation
CVM	Contingent Valuation Method
DBDC	Double Bounded Dichotomous Choice
DC	Dichotomous Choice
EV	Equivalent Variation
FDRE	Federal Democratic Republic of Ethiopia
GoE	Government of Ethiopia
HH	Household
ITNs	Insecticide Treated Bed Nets
MoFED	Ministry of Finance and Economic Develeopment
MoH	Ministry of Health
WHO	World Health Organization
WTP	Willingness to Pay

Abstract

Health is one of the most important things which affect human well-being. Due to its strong relation with well-being, health often treated as an economic good which has some value. But, in most of the cases due to lack of market for health goods different health programs face a serious obstacle in identifying the economic benefits of health provision or economic cost of lack of access for such services.

This study applies the double bounded contingent valuation method to elicit the individuals' WTP for improved malaria prevention by constructing a hypothetical market. Two scenarios, a hypothetical drug and environment cleaning program were presented for 271 respondents. The aim of the study was to estimate WTP between two groups of respondents having different proximity to Koka Dam. Those respondents from within three kilometer radius of the Dam considered as intervention group and the rest far away from the dam above 8 kilometers were considered as control group.

The econometrics results indicate that, variables like female, yearly income, home ownership and being in intervention site are quite significant variables in explaining the individuals probability of 'voting' for the programs and the amount for WTP. The study also revealed that there is a starting point bias when the follow-up bid is introduced. Annual Mean willingness to pay for the hypothetical drug scenario is estimated at Birr 86 for intervention site, Birr 85 for control site, Birr 108 for husbands, and Birr 92 for wives.

On the basis of the findings, the following policy recommendations were forwarded. Existence of expressed demand for improved malaria treatment calls for Supply-side policy interventions. Strategies should be designed to motivate those who can pay for Cost sharing but not marginalizing the poor. Considering environment correction as one means to reduce the malaria burden is also suggested.

CHAPTER ONE: INTRODUCTION

1.1 Background

Adequate health is key to fulfilling a human's well-being. Good health influences an individual's psychological satisfaction, ability to work, health care expenses and social interactions. As such, individuals in better health are thought to be more satisfied and those possessing worse health are thought to be less satisfied with their condition. The overall utility of an individual is usually determined by comparing that individual's current health status relative to their previous condition. An improvement to one's health signifies/triggers a utility gain, derived from being in a better health state. Conversely, an individual whose health condition deteriorates from some better level will incur a utility loss.

Maintaining a healthy life is not an easy task that can be fully captured by the individual. It is subject to different inherent natural disorders of the individual himself and external factors. Among external factors, environmental related problems clearly affect the individual's health. Furthermore, the environment as a cause of health problem is mainly due to natural factors like climatic and topographic conditions which sometimes intensified by externality factors associated with economic development activities. When such economic

activities are conducted in areas where environmental health problems exist, it can exacerbate existing environmental health problems.

Malaria is one of the deadliest diseases in Africa generally and Ethiopia in particular. Transmission of the disease is affected by water development activities. Water related development activities often create new breeding sites for mosquitoes, which transmits malaria to human beings. Construction of dams for irrigation or hydropower generation is the most common form of water development. The ecological transformation that accompanies such water related projects particularly the dams' development change the nature of malaria risk for the surrounding localities (Keiser, Singer & Utzinger, 2005.)

Malaria is one of the top diseases in Ethiopia. The disease is also one of the leading in morbidity as measured by outpatient visits and inpatient days for the year 2002/03 (CSA, 2003). The disease is affecting the country's economy by directly attacking the labor force and indirectly through time spent for caring the patient, expenditure for medication and school absenteeism (ibid). The Awash valley basin is known as one of malaria endemic area in Ethiopia (UNESCO 2004). The Koka dam, which was completed in late 1960s, is located in the middle of this basin. Apart from hydropower generation, the dam provides irrigation service for around 70,000 ha of land downstream. The dam creates favorable conditions for increased malaria incidence in the surrounding communities (Lautze et al., 2007.)

There are four species of parasites that cause malaria to humans. These are Plasmodium malariae, Plasmodium Ovale, Plasmodium vivax, and Plasmodium falciparum. Malaria is endemic in areas where mean altitude is less than 1500 meteres above sea level and annual average total rainfall less than 900mm and mean temperature of 20 to 30^{0}c. Plasmodium falciparum and Plasmodium vivax are the most common in Ethiopia with 60% and 40% occurrence respectively (MOH, 2004/05). Plasmodium falciparum causes the worst type of malaria that mainly results in death of the infected person if timely treatment is not sought. It is also resistance to chloroquine and anti-malarials.

Fighting malaria could be addressed in two stages according to IRIN, 2006. The first is a vector control which aims in avoiding the disease before a mosquito – human contact occurred. Further this accomplished in two stages. Protection tools at mosquito's adult stage include insecticide treated bed nets, indoor residual spray, and improvements to house design. The other is the aquatic stage where the mosquito exists as larvae. Among the different ways to mitigate the problem at larvae stage, environmental management tool of draining the breeding sites and systematic removal of standing waters found the best strategies (Keiser, Singer & Utzinger, 2005). The second method to fight malaria is after the contact is made. Once the infection is happened early diagnosis and treatment are measures that determine the individual to remain in life.

The effort to combat malaria stretches from country level to Continental and Global levels. The Roll Back Malaria (RBM) Initiative which launched by WHO, UNICEF, UNDP and the World bank is the major Global and Continental strategy that targets in reducing death due to malaria by half by 2010. The reduction of the disease burden is also one of the Millennium Development Goals (MDGs). Nevertheless, the rapid development of drug and insecticide resistant malaria is making the effort more challenging.

1.2 Statement of the Problem

Malaria is one of the major public health problems in poor countries like Ethiopia. Environmental degradation and high rainfall recently becomes major causes of epidemic malaria in addition to endemic areas (UNICEF, 2000). In Ethiopia malaria incidence is estimated at 635 cases per 100,000 people (ADF, 2005). Also According to UNESCO 2004 report, three-quarters of the total area of Ethiopia is estimated to be malarious. The disease with high concentration and wide area coverage throughout the country has serious impact on the well-being of majority of the people. Fighting such a public health problem requires collaborative effort of the community, government and humanitarian organizations.

Public intervention programs like vector control and eradication are common in most developing countries like Ethiopia. Among other health

prevention programs, reduction of Malaria prevalence is one of the major components of health sector program by the government (Ethiopia SDPRP, 2002). According to World Development Index as cited by World Bank 2005, Ethiopia's public health spending as a percentage of GDP (1.8 percent) is less than from the Sub-Saharan African average in year 2000. Where as, the private health expenditure is relatively better when compared to different measures[1,2]. Furthermore, the report revealed public expenditure for primary health cares, where the major health problems concentrates is too low. More than 40% of the public spending goes to hospitals where HHs are subsidized for pharmaceuticals and medical supplies up to 74%.

The misdirection of resources targeted for health care in general is basically due to lack of market signal (price) for these kinds of goods and services. This inefficient allocation of resources due to market failure for health cares calls for some correction mechanism. In addition to the problem, estimation of the per head value of resources or opportunity cost for such intervention programs is weakly practiced. Market failure (when markets do not reflect true price signals) in the health sector and the nature of public intervention programs are the major reasons for such drawbacks.

There is no doubt that improved health has economic value. This is simple derivation from economic principle that a good has an economic value as

[1] The private expenditure comprises the sum of health expenditure by Private enterprises, NGO's and non profit institutions and Net out of pocket Spending.
[2] In year 2000, Ethiopia's private health expenditure was 2.8 percent of the GDP which was higher from the Sub-Saharan Africa average and Low income Countries of 1.1 percent. Net of out of pocket represent around 70%.

long as it positively affects the individual's well-being. The benefit derived from consuming a good that has economic value is estimated by the individual's expressed demand. In the presence of market the individual's preference for goods and services is disclosed by the Price the individual is willing to pay (WTP). Where there is no market for goods and services or market failure it needs to look for other alternative techniques.

1.3 Objective of the Study

The following are the objectives of this study

- To estimate individual's WTP for improved malaria prevention and treatment.
- To identify the determinants of individual WTP.
- To identify the preference gap between husband and wife on WTP for improved malaria treatment if any.
- To identify the difference in WTP estimate between the intervention and a control site.

1.5 Significance of the Study

The study produces several important findings. First, it identifies the individual's demand level and preference for improved health states, which can play a significant role in participatory and sustainable oriented health programs. Second, it investigates whether existence of dam has relation with malaria prevalence and effect on individuals' WTP taking two groups of communities differ in proximity to dam but with similar climatic and topographic conditions. Third, it discuses gender preference by taking both husband and wife from the same house.

1.6 Limitations of the Study

The scope of the paper is limited to measuring the willingness to pay for hypothetical improved malaria prevention by the sampled respondents in the surroundings of Koka dam. In other words, the study measures the benefits derived from improved health intervention but not the cost. The action of other agents in the health system like health facilities (private, government and NGOs), health personnel, and donors are not part of the study. The findings from the study will be interpreted based on the assumptions made and only for the specific area (targeted population).

1.7 Structure of the Study

This study is presented in five chapters. Chapter two presents a review of literature which is classified into theoretical framework and previous empirical works. Chapter three describes methods and materials of the study. Chapter four describes the descriptive and econometric results. Chapter five presents conclusion and recommendations.

CHAPTER TWO: THEORETICAL and EMPIRICAL REVIEW

2.1. Theoretical Framework

2.1.1. The Theoretical Model

Alternative utility models other than the 'unitary model' jointly termed as 'collective household model' (Browning and Chiappori, 2004). Unlike to a single decision maker in the household for unitary 'model' the 'collective model' considers the role of other members of the household in the decision making process. A 'collective model' expected to best explain the demand for health and expenditure allocation within the household (Ajakaiye & Mwabu, 2007).

The utility function for the household consisting of two individuals (a husband and a wife) can be represented as:

$$U=u\ (z,h_m,h_f) \qquad (1)$$

Where z denotes a composite consumption good;

h_m and h_f are flow of health services consumed by the wife and husband respectively.

For simplicity children are excluded from the model by assuming parents will decide for their health care consumption efficiently. Considering the limited household resources, the full budget constraint of the two-person household will be

$$P(z + h_m + h_f) \leq y_m + y_f \quad (2)$$

Where $P = (p_1, \ldots, p_n)$ is the price vector;

y_m and y_f are labor and non-labor income from both the wife and husband respectively.

The household's choice problem is

$$\text{Max } U(.) \quad (3)$$

subject to: $P(.) \leq Y$

Where U = total household utility

$Y = y_m + y_f$ = total household income

This representation is a simplistic general 'collective model' which considers the decision of more than one individual. The intra-household allocation decision will finally take different variant based whether members act cooperatively or non-cooperatively.[3]

[3] More on collective household model; Chiappori (1988), Alderman et al (1995), Browning & Chiappori (2004).

2.1.2. Money measure of non tradable goods

The value of a certain good or service is evaluated by the price consumers attached for it given the good or service is tradable. By tradable we mean the existence of market for the good or service. Of course all goods and services are not tradable but nothing is priceless. In this case the problem is addressed through behavioral methods. This study considers the utility based approach for estimating the value from the non-tradable good, health.

The primary task in search of price/value for a non tradable good or service is to identify how this good enters the individual's utility function. It is an important consideration since consumers derive utility from consuming the health good or service. The utility function encompasses all preference variables which affect the individual's consumption decision. In this regard in order to estimate the value of improved health care, it requires to understand clearly how the health component enters the utility function so as we can measure it.

2.1.3 Welfare (well-being) Measurement

A utility change attained by the individual can be analyzed by considering two periods or states for simplicity i.e. the initial period (period 0) and the new period (period 1). Monetary measure of a utility change can be the change of

two important variables i.e. price (P) and total household income (Y). The change in consumer's utility due to changes in these two variables say from (P^0, Y^0) to (P^1, Y^1) could be defined as:

$$\Delta U = V(P^1, Y^1, X^1) - V(P^0, Y^0, X^0) \quad (4)$$

Where ΔU = the change in utility;

$X = (z, y_m, y_f)$

Both the direct and indirect utility representation is in form of ordinal representation. The ordinal utility representation only forms a level ranking – like the first, the second etc. The problem with this form of representation is that we cannot directly drive the values of the level of changes in utility. But there is an alternative form of representing utility change to tackle the problem. For this we consider the concepts of consumer surplus, compensated variation and equivalent variation.

Consumer Surplus

The consumer surplus is an appealing measure of consumer benefits from price change because of its interpretation in terms of excess of willingness to pay over what is actually paid.

Monetary measure of welfare change requires simultaneous consideration of both changes of income and price, however. These changes are difficult to capture by the consumer surplus analysis.

Compensating and Equivalent Variations

Compensating and equivalent variations are also welfare measures and differ from the consumer surplus by overcoming the problem of what is known as path dependency. In other words, using these measures one can trace the change in utility by considering both price and income changes. The compensating variation (CV) is the amount of money income which, when taken from the individual together with the price fall, leaves the individual at his or her initial level of utility. Therefore, CV represents the maximum amount that the individual would pay to have the price fall occur.

The equivalent variation (EV) is the amount of money income which, if given to the individual without the price fall, would give the same level of utility as he or she would have attained if the price fall had occurred.

Compensating and Equivalent variations are related to what is called the compensated or Hicksian demand curve. A Hicksian demand function gives the demand for a commodity as a function of its own price for a constant level of utility, and not for a constant level of income as on the Marshallian demand curve.

The theoretical structure of CV and EV can be equally defined in terms of Willingness to Pay (WTP) and Willingness to Accept (WTA) for policy implications of changes in income and price. WTP is the maximum amount of

income a person will pay in exchange for an improvement in a given situation. WTA is the minimum amount of income a person will accept to forgo an improvement of the situation. If the interest is in measuring the utility increase due to some policy – induced intervention, EV bears the same meaning to WTA where as CV equals WTP. On the other hand if the interest is in measuring a decline in well – being due to the intervention, EV equals WTP and CV equals WTA. Most applied research measure monetary value of utility change in reference to WTP. The major reason for this is that WTP measure is not incentive – compatible (Haab & McConnell, 2002)[4]. For same reason, this study also use WTP as means to infer monetary measure for increase in well – being.

2.1.4 Non Market Valuation Techniques

The demand for goods and services is determined by the consumer's willingness to pay (expressed demand) given perfectly functioning market. All goods and services are not tradable. Thus, inexistence of market or failure of market if there exists for some goods and services make the determination of individual's demand cumbersome. Mostly those public goods and goods with externalities (positive or negative) require special empirical tools to estimate their value. Even though we cannot actually determine the 'effective demand'

[4] Incentive compatible problem occurs when respondents influence potential outcomes by expressing values which are not their true WTP.

for the goods, at least we can estimate the individual's expressed demand (WTP).

There are a number of economic valuation techniques that can be used in estimation of individual's WTP for a non-market good. These are contingent valuation method, choice experiment, hedonic price method, travel cost method, human capital approach, and cost of illness etc. These methods have their common/own advantages and disadvantage (or technically 'biases'). These methods are alternatively grouped into two broad categories. Those methods like hedonic price method which use proxies called reveled preference (RP) while those like CVM which do not use proxies are called stated preference (SP). Proxies are classified into direct proxy and indirect proxy. Direct proxies are those cost and price related information which help to approximate the value/price of the good. Indirect proxies are those observed individual characteristics with respect to related markets.

2.1.4.1 Contingent Valuation Method (CVM)

The Contingent Valuation Method (CVM) is used to estimate monetary measure of preference by directly asking respondents' Willingness to Pay for changes in quantity or quality of a good or service (Haab & McConnell, 2002). CVM is often preferred as a means of elicitation method due to the method's ability to capture both use and non – use values of the non-tradable goods.

CVM uses none of the direct or indirect proxies to elicit the value of a non tradable good. This method is applied by directly asking target groups through face to face interview, telephone interview, mail or internet based interview via questionnaire about their WTP for varying utility level with income as a trade-off through a hypothetically developed scenario (market). The preference information collected through the questionnaire then will be used to estimate the monetary benefits derived say, from reduction of malaria risk in monetary indicators.

CVM can be presented in open ended, bidding game, payment cards, and dichotomous choice form. Among these different approaches, the dichotomous choice preferred over the other in one important aspect. The approach is free from incentive compatible problem. Since the approach confronts the respective respondent to a pre assigned bid (price), there will be no chance for the respondent to affect the valuation for other purposes.

The Dichotomous Choice Contingent Valuation Method (DC–CVM) further can be presented in different forms. The single bounded DC–CVM is used if only we pose a single question for the respondent to answer YES or NO. The second method double bounded is used when we offer a follow-up price (bid) for the respondent after getting a response for the initial bid. The follow-up bid in double bounded take a higher value if the respondent's answer for the first bid was YES and a lower value if the answer was NO. The multiple bounded format, which is a higher level of double bounded method, uses iterative bidding after

the second bid. In all the closed ended formats, the usual approach is offering different bid levels (intervals) for different sub-samples of respondents.

There are basic steps to follow in application of CVM for deriving values from the hypothetical scenarios. The first step is to make the scenario understandable and meaningful to the respondent. Clear understanding must be created by the respondent regarding the health change he gains for the payment to be made. The change in health status as well as the goods to be valued should not be beyond imagination (too abstract). The second step is making the scenario more specific than a general one. It is inappropriate to ask the respondent like 'how much are you willing to pay for improved health status?'.

2.1.4.2 Double Bounded CVM

The growing use of double bounded DC -CVM for measuring the value of non – tradable goods is attributed due to core factors than other CVM elicitation approaches. Hanemann et al (1991) argued that, first, the method has a better statistical efficiency in large samples and it allows correction for inappropriate choice of initial vector of bids. Second, responses from DBDC survey give narrower intervals for respondent's WTP, thus the model parameters and mean WTP are estimated more precisely. It is also much simpler to the respondent to express his decision when consecutive bids are offered than to a single bid (Johansson, 1995).

In the DBDC format there are four possible answers. Since each respondent is faced to two questions, we will have a response in one of the following ways.

(1) A Yes answer for the first and second bid; Yes-Yes

(2) A Yes answer for the first bid followed by a No answer; Yes-No

(3) A No answer for the first bid followed by a Yes answer; No-Yes

(4) A No answer for the first and second bid; No-No

The use of CVM in double bounded format is plausible in the Ethiopia n context. The society is highly accustomed to bargaining way of buying goods. Unlike the developed world, in our case we see tagged pricing only in metropolitan centers. This is totally non-existent in rural settings. The easiness of the method is also the other advantage in comparison with the other methods especially against the open-ended.

2.1.4.3 Biases of CVM in general and DBDC in particular

Deriving monetary values from hypothetically constructed market by using stated preference is criticized from different directions. A frequently raised criticism is on the validity of the response. But there is a strong belief from the proponents of CVM that with a well established questionnaire and proper survey, it is possible to extract a better estimate of expressed demand for the good under consideration. Hanemann (1994) argued the critics on hypothetical nature of CVM as *"answering surveys may be hypothetical, but no more than buying unfamiliar or infrequent commodities"*. Although the statistical

gain from follow up questions than the single question is supported by many empirical researches, there are some biases that could happen from using this approach. Among the biases some of them are under the researcher's control and some are not.

Information Bias

The most common bias in all CV studies and also in DBDC is a bias occurred due to the information respondents have about the goods to be valued. Lack of familiarity for the good is mostly the cause for information bias which resulted in unreliable WTP estimates. In this study, respondents are asked about their knowledge of malaria. Besides general knowledge of the disease, they were asked about their knowledge of ways of transmission, observed symptoms and treatment options. These questions help to evaluate whether there exist information gap (bias) or not.

Embedding Effect

Embedding effect occurs when we consider the valuation of more than one good for the same sample group. Measuring more than one goods at a time by itself has no any harm. But, the problem (embedding effect) occurred when there is possibility of correlation of responses among the goods to be valued. The correlation of responses basically occurs when there is a difficulty for

respondents to differentiate the scales of the programs presented for valuation. In this study two goods are presented for valuation. These are a 'hypothetical drug' that protects an individual from contracting malaria for one year and an 'environment cleaning'. It was assumed that, these goods are totally separable and one is a substitute to the other than being linked which will not lead to embedding effect (Bonato, Nocera & Telser, 2001).

Yea-Saying

The DBDC method which based on Yes/No alternative for elicitation purpose is also criticized for possibly generating a Yea-saying bias. Yea-saying bias is observed when respondents simply say 'Yes' for any amount of bid they confronted. The tendency of a 'Yes' response irrespective to their true preference and capacity to afford comes due to different reasons. However, the major reason is due to expressing their simple motivation than the true preference.

Anchoring / Starting Point Effect

This type of bias occurs when we introduce a second follow-up question. It is argued that, the follow-up question creates change in expectation on the respondent, which probably results in a systematically biased response. A respondent who answers 'yes' to the first bid may feel he is cheated when asked

again for the second bid (Haab & McConnell 2002). Thus, wondering with the follow-up question the respondent may adjust his response strategically with a suspect that further question will follow. Generally the effect comes when respondents anchor their follow-up response with the previous answer.[5] Different approaches to tackle the problem are developed with their varied level of strength to address the problem. Alberini (1995) supported the simple use of pooling the responses to the first and the second bids since the gain in efficiency from the model is significant than the inconsistency bias.

2.2 Empirical Review

There are a bulk of applied research works of CVM as to a means of eliciting the value of health intervention program and the value individuals attached for the change in utility due to improved health status. The application in the developed world is vast that ranges from private health issues like hypertension to Global health problems like respiratory complication due to air pollution. On the other hand most of the applied works in the developing nations concentrate on environmental related health problems like Malaria.

A study by Lampiett: et al (1999) in Tembien – Tigray looked for whether or not there exist differences in intra household decision regarding malaria prevention. In the survey, they considered one individual from a house either

[5] As cited by Whitehead, Cameron and Quiggen (1994) argued, the assumption of the interval regression model also artificially creates a starting point bias.

the HH head or their spouses for measuring WTP for two goods – bed nets and a hypothetical vaccine. For the investigation on gender preference, they make a comparison between married male respondents and married female respondents.

They used a health production function for measuring individual's choice of health inputs to a health output. The value of preventing a HH member from malaria is measured by WTP and they used the demand function for measuring the quantity of health goods purchased by the individual. In measuring WTP, a single bounded bid was applied that ranges from Birr 5 to Birr 200 for the hypothetical vaccine and from Birr 8 to 100 for bed net. They used count regression model to test the behavioral differences between husbands and wives, family composition and other socio economic and health characteristics to identify determinant factors of WTP.

Their findings show that there is preference difference on demand for malaria vaccine but no significant difference for bed nets between married husbands and wives. Family composition variables also found that preventing the adult member is significant both the husbands and wives.

For the hypothetical vaccine, the study found that mean WTP of Birr 219 (median WTP equals Birr 151) for married males and mean WTP of Birr 267

(median WTP equals Birr 181) for married females with a WTP function bounded at the upper by quantity of vaccine demanded.

Ersado (2005) studied the economic impact of small scale irrigation dams' development particularly with reference to negative health consequences in Tigray. The health problems considered are malaria and schistosomiasis. It was conducted around eight micro-dams with the surrounding 29 villages. Fifteen of the villages are considered as intervention (catchments) sites considering their proximity i.e. within 3 kilometer radius of the micro-dams. The agriculture HH decision making with the introduction of HH health decision is used for the theoretical model.

The study found that, the malaria prevalence in the intervention is 32% and 29% in the control site. caring time for sick HH member and medical expense due to malaria are significantly explained at 1% degree of confidence by micro-dam age, intervention site, annual precipitation, altitude and malaria sickness.

Belayneh (2006) studied WTP for insecticide impregnated bed nets in 5 rural kebeles of Ilu woreda of Western Showa Zone. The study applied an open ended CVM ON 300 HHs. Ordinary Least Square (OLS) regression estimation used to measure the WTP in this study. The HH income, cattle ownership (Oxen) and malaria incidence in the family members found the positive and

significant variables for respondents WTP. The research's other findings show that sex is taken as dummy female HH head is insignificant in explaining the WTP. The estimated WTP for ITNs which presented in form of immediate cash payment and on credit basis is Birr 44.26 and Birr 65.05 respectively.

Hagos et al (2006) also recently studied the impact of micro water harvesting on malaria incidence and HHs WTP for improved malaria treatment in selected villages of Tigray. They used the DBDC-CVM as elicitation procedure for estimating WTP. They found that altitude, proximity to Wells, housing condition and livestock ownership are found to significantly determine the prevalence of malaria. They also estimated an interval regression model and found that Sex (female), education, ownership of pond & wells, malaria sickness and wealth (oxen ownership) are significant in determining the amount of WTP. The estimated maximum mean WTP from this study is Birr 48 per annum.

There is a growing application of economic valuation tools for estimating the economic costs and benefits of public health problems in Ethiopia. Especially with the recent emergence of water collection projects for addressing the poverty problem throughout the country the contribution of such studies are valuable. It is noted that alleviating public health problems like malaria has great economic importance and it is found that such benefits can be estimated with monetary terms. Though the benefits estimated differs with the type of the goods to be measured, the measurement tool applied and the bid(s) assigned for

the goods. Most of the studies found that those HHs living around standing water are more vulnerable to malaria incidence and demand more health treatment/prevention than those living far from the water.

CHAPTER THREE: METHOD and ESTIMATION MODEL

3.1 Description of the Study Area

The study is conducted in three neighboring kebeles of the East Show Zone, Lome woreda. This area is known for high malaria prevalence. The two kebeles, 'Ejersa 01' and 'Bekele' are adjacent to koka dam reservoir. Residents of 'Ejersa 01' have a feature of semi urban with most of their livelihood based on wage earning from Ethiopian Leather Factory Sc., day labor in near by horticulture farms and petty trade. 'Bekele' is a rural kebele with agriculture as the main economic activity. 'Fatole' is the third kebele which found at 8 kilometers distance away from the koka dam with almost all residents' economic activity based on agriculture.

The WHO standard defines a given area is at risk of malaria, if we take dam with its water reservoir as a reference point is the flight range of mosquitoes. The mosquito's flight range is estimated to be within 3 km radius of the reservoir. This is the intervention (catchment) site in this study. With reference to the WHO definition, we focused on only those 'Ejersa 01' and 'Bekele' residents within 3 km radius of the dam in the catchments site. 'Fatole' kebele is taken as a control site.

According to Lome woreda Agriculture and Rural Development Office, the intervention and the control sites are within the same agro – ecological

condition. The annual average rainfall for both sites is 850mm and the annual average temperature is between 18^0c and28^0c. All the three kebeles are within the altitude range of 1600 to 1700 above sea level.

3.2 Sample Selection

The Sample frame consists of different households classified geographically. The selection is designed in such a way to interview both a husband and his wife from each household. The study was planned to conduct the survey on 160 households. To make the selection representative (with weighted average) 42.5% from Ejersa 01, 31.8% from Bekele and 25.6% from Fatole are considered which have a total household size of 701, 525 and 422 respectively. The final selection was resulted in 68 HHs from Ejersa 01, 51 HHs from Bekele and 41 HHs from Fatole. The selection is made from each kebeles list of total households prepared for bed-net distribution in July 2006, which was being fortunate to get the latest list in Ethiopia. In this study, individuals were taken as the unit of analysis. When a household is from the selected sample both spouses are interviewed unless the house is single headed, and one or both of them is absent.

3.3 Study Design and the Survey

Before conducting the survey, a pre – test was conducted on ten (10) individuals within the study area. The pre – test was conducted by using a draft

questionnaire and a checklist few days ahead of conducting the survey. During the pretest, it was observed that the goods to be valued i.e. improved hypothetical drug and cleaning the environment to avoid good situation for mosquito, were found clear among respondents. Regarding the payment vehicle, a pay and receive for the drug and a voluntary contribution for environment correction were also recognized clear and easily understandable. The researcher also learned that, majority of the wives are only speaking the local language, Oromiffa. Additional information gathered was incorporated and correction of wordings was made in the process of preparing the final questionnaire.

The questionnaire is prepared in two local languages; Amharic and Oromepha. It is classified into three parts. Following a brief introduction about the research, the first part asks individual's socio-economic and demographic issues. The second part contains questions that ask respondents malaria awareness, preference on alternative health cares and malaria history of the household. The third part contains the valuation questions. In this part, respondents are asked their WTP for the stated bid amounts for both two programs, i.e., improved hypothetical drug and environmental cleaning program. There were five bid intervals for the drug ranging from Birr 10 to Birr 150 and also five bid intervals for environmental cleaning program ranging from Birr1 to Birr 75. See Annex II.

The data collection is conducted by five individuals including the researcher. Two of the enumerators were diploma holder agriculture development agents (DAs) working in Bekele kebele, and the other two were third year university students who were at the summer vacation. Three of the enumerators are Oromeffa speakers and it is their first language. A one-day training was conducted for the enumerators.

3.4 Definition of Variables and Hypothesis

Income of the Household

Income of the household comprises annual income from agriculture, wage, or other sources by both a husband and a wife. Since income and demand for health have positive relationship we expect income is expected to positively affect the WTP.

Sex

Sex refers gender of the respondent. Sex of the respondent can either positively or negatively affect WTP.

Education

This refers the educational status of the respondent. Education has positive and significant role in creating health awareness, thus to have positive relationship with WTP. Education is treated as categorical variable.

Family size

Family size defines both spouses, children, any relatives and maids reside in the same home for some long period of time in the past. Those with more family size are expected to demand more health than those with lesser family size.

Location

This variable serves to define whether the respondent is from the intervention site or the control site. Existence of the dam in the intervention site is supposed to have impact on high malaria prevalence than the control site. Those who are from the intervention is expected to have higher WTP.

Age

The variable refers age of the respondent. The younger ones are hypothesized to demand more health and also more WTP than the older ones.

Home ownership

The study classifies home ownership as private and non-private (government rent, private rent and living in factory campus). As part of wealth of the household, the variable expected to positively affect the WTP.

Malaria infected

This defines whether the respondent had been infected of malaria at least once in life time or not. Those who had malaria infection in their lifetime are expected to demand health and more WTP than those who had no malaria infection in lifetime.

Infection in past five years

This variable serves to define those respondents who had sickness of malaria in the past five years. Again this variable is expected to positively affect WTP.

Sick days

A sick day is the largest sickness days experienced by the malaria infected respondent. The expected relation between number of sick days and the respondent's WTP is positive.

Frequency of sickness

Frequency of sickness refers the number of repetitive malaria occurrences in the respondent's malaria sickness history. Those repetitively sick of malaria is expected to demand more health, and therefore more WTP.

Bed net use

This variable describes those households using a bed net during the survey irrespective of the number of bed nets. The variable is expected to negatively affect the WTP in both the hypothetical drug and environment cleaning scenarios.

Money expense for malaria treatment

This refers 'out of pocket' money expense incurred by the household for malaria infected household member in health institutes. It expresses only fees paid for treatment. The variable expected to take positive value with WTP.

Bid

This refers the initial bid value offered for the respondent. It expected to affect WTP negatively. That is, the probability of a 'Yes' response and the amount of WTP decreases with increase in the initial bid for respondents behave rationally.

Malaria HH problem

The variable illustrates the respondent's perception whether he/she believes that malaria is a problem for their household.

3.5 Model Specification

3.5.1 The Probit model

The interest in the Probit model is to identify factors that determine the probability of a positive 'vote' (in this context a 'Yes' response) for some bid amount offered. If we represent the Probit regression model as

$$y^*_i = X_i\beta + \varepsilon_i \qquad (5)$$

Where Y^*_i is unobservable latent variable. But the researcher can observe variable Y that defines the value of Y^*_i (maddala, 1983)

$$Y^*_i = 1 \text{ if } Y \geq t_i \qquad (6)$$

$$Y^*_i = 0 \text{ if } Y \leq t_i$$

Where t_i is the initial bid offered for the respondent. The observed dummy variable Y in this case is a positive 'vote' to the program. Which means we get a 'yes' response from the respondent if he value the change more than the current level of consumption. Therefore, we have

$$\Pr\{\text{response is "yes"}\} = \Pr\{v(p, X^1, y-A, \varepsilon) \geq v(p, X^0, y, \varepsilon)\}. \quad (7)$$

Where A is the initial bid level;

ε is the unobserved error term

If the respondent is willing to commit the price for the higher level of the good, we can at least say that his WTP amount, which is the probability of 'yes', is equal or less than to the bid level.

$$\Pr\{\text{response is "yes"}\} = \Pr\{\text{Max WTP} \leq A\} \quad (8)$$

3.5.2 Interval data model

Estimation of the double bounded willingness to pay data with the interval data econometric model is expected to improve the statistical efficiency (Hanemann et al, 1991). The dependent variable takes a form y= (depvar1, depvar2) where it takes value of interval for Yes-No and No-Yes responses; left–censored for No-No responses; and right – censored for Yes-Yes responses.

The interval data model has some similarity to that of ordered probit model but differ in one aspect. In the latter case, the cut–point values are known to form the boundaries of the interval. This means assignment of the interval values is made exogenously. The model assumes the means and variances of the initial and follow up responses are equal (Haab & McConnell: 123). This will result in efficiency gain from the responses since we consider both the first and the second responses.

$$y^*_i = X_i\beta + \varepsilon_i \qquad (5)$$

Where ε_i = iidN $(0, \sigma^2)$

Here the observed information is responses for the initial and follow-up bid which forms the interval. Thus, the interval data model states the probability of WTP falling between the lower bound and the upper bound (Whitehead, 2000.)

Pr (WTP $\subseteq$ (Lower bound, Upper bound)

Each respondent will bear one of the following values:

Yes-Yes = higher bid < WTP <+∞

Yes-No = initial bid < WTP < higher bid

No-No = -∞> WTP > lower bid

No-Yes = lower bid < WTP < initial bid

3.5.3 Mean Willingness to Pay Estimation

The willingness to pay result is recoverable from the intercept and the bid coefficient of the regression models. Therefore j^{th} respondent contribution with interval model representation could be written as

$$L(\mu \mid \text{initial bid}) = \Pr(WTP_j \geq \text{higher bid})^{YY} \Pr(\text{higher bid} > WTP_j \geq \text{initial bid})^{YN}$$
$$\Pr(\text{initial bid} > WTP_j \geq \text{lower bid})^{NY} \Pr(\text{higher bid} > WTP_j)^{NN}$$

Where YY is an indicator variable takes a value 1 if the response for both the initial and the follow-up bid are 'Yes' and 0 otherwise. The same definition applies for the rest YN, NY, and NN responses.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Descriptive Data Result

General

A total of 271 individual respondents are involved in this study. From this amount 263 fully recorded questionnaires are considered for the analysis. 8 questionnaires dropped of which 5 questionnaires were incomplete and 4 questionnaires were protest response for the valuation part. The average duration for completing a questionnaire was 30.49 minutes. The maximum age of the sample respondents is 84 years with minimum age of 15 and the average age equals 38. From the total respondents 24 are single female household heads. 122 (45.2%) of the respondents are illiterate, 57 (21.1%) are can read and write, 25 (9.3%) are grade level of 1 – 4, 41 (15.2%) are grade level of 5 – 8, 24 (8.9%) are grade level of 9 – 12, and 1 respondent above grade level 12.

It is observed that 205 of the respondents (78 %) have been infected of malaria at least once in their life time. A maximum of 11 individuals were infected from a single household. A maximum expenditure of Birr 2,090 for treatment of malaria for a single individual is reported in the intervention site. This figure excluded from econometric estimation due to a suspect of outlier response. The maximum expenditure for malaria treatment is Birr 650 in the

control site. Three households lost one member of their family due to malaria. 89 of the respondents state some of the malaria control interventions as a personal cost. DDT is the one disliked by most of the respondents. Ineffectiveness of DDT, its bad smell and the marks it leaves on the wall were mostly mentioned. Most respondents didn't know what larvaciding is.

Almost all the respondents know what malaria is. They also know at least one of the transmission ways and the observed symptoms. Around 95%of the respondents believe that environment cleaning will reduce malaria burden. Off course we had unexpected answers (few in number) regarding the transmission mechanism and how to cure. Sleeping a child with malaria sick child, drinking cold milk, eating maize stem, working in the farm land early in the morning, not taking proper diet were mentioned as causes of getting malaria. Taking home made alcohol (*Areki*), drinking boiled papaya leaf, eating garlic was named for timely cure.

Gender specific personal, health characteristics and WTP responses

A comparison among males and females regarding malaria infection at least once in life time shows that 83% of the males had been infected where as for the females the ratio is 73%. Regarding the rate of malaria sickness in the past five years, it is observed that on 43 (31.2%) of the females and 54 (42.8%) of the males the disease occurred at least once from year 2001 - 2005.

Educational level of the females is by far low when compared to the males. 90 of the females (65 %) are illiterate. On the other hand from the males group 29 (23%) are illiterate.

Regarding the CVM response pattern among females and males from, the cross tabulation shows a mixed result. Tough, we can trace from the table that females dominate over males in No-No response particularly in the intervention site. But with the presence of at least one yes answer, i.e., YES-YES, YES-NO, NO-YES we have a mixed response rate with minimum variation (See table 2.)

Malaria Incidence Comparison between Intervention and Control Site

From the total household heads 34% of them had malaria infection in the past five years. When we examine the prevalence rate, we have 35.4% in the intervention site and 31.8% in the control site. When we compare malaria occurrence on the rest of the household members, we found that, in the intervention site 66.4% of the households experience malaria infection at least on one of the family member. This rate is a little bit higher in the control site that scores 68% (Table 3.)

Internal consistency of Responses

For checking the validity of responses collected we approached it from two directions. First we compare the proportion of different response

possibilities with the bid intervals offered. The second approach used is simple extrapolation of amount of bid with quantity of drugs demanded by the respondent. Table 4 shows the response pattern of household heads in both the control and the intervention site. Since in both scenarios the WTP question is asked 'on behalf of the household' it needs to exclude double representation from the household. With almost equal distribution of different bid levels, we can observe that the response of saying 'No' for both the initial and the follow up bid increases as the bid increases. This phenomenon is persistent with the basic relationship between demand for goods and services and its price.

The comparison of the quantity of hypothetical drug demanded with initial bid made by tabulation and by running a demand curve. In the survey, for the drug scenario respondents were asked for the quantity of drugs they would buy at the offered price level after getting their Yes response either at the initial bid or at the follow-up. Again the result observed is similar to the aforementioned discussion (See Table 5 and Fig. 3). The quantity of drug demanded increases as the bid amount decreases.

4.2 Econometrics Estimation Results

4.2.1. Probit regression result

A Probit regression model is estimated to analyze the determinant factors for getting a 'Yes' response at the initial bid by controlling location, sex, age,

(B) Environment Cleaning Scenario

Location is again positive in the single bounded but with weak level of significance, i.e. at 10%. Age of the respondent is found to have lower probability of answering 'Yes' with 10% level of significance. It means aged people have lower tendency of WTP. Income is significant at 5%. Respondents who perceive malaria as the community problem have positive WTP at 5%. The initial bid again maintained the relationship at 1% level of significance. Other variables sex, family size, home ownership, sickness in the past five years and frequency of sickness are insignificant in explaining a 'Yes' response at initial bid(See Table 7.)

4.2.2. Interval regression result

Estimation of a maximum likelihood interval regression (using Stata's intereg command) model to derive the determinant factors of individual WTP amount is also made. Test for multicollinarity among explanatory variables considered before estimation and the estimation also made with hetroscedastic consistent standard errors. The estimation result is shown in Tables 8 and 9 for environment cleaning scenario and hypothetical drug scenario respectively.

(A) Environment Cleaning Scenario

The coefficient for the initial bid is positive and statistically different from zero at 1% level of significance. The result indicates there is a starting point bias. The estimation result shows that WTP is significantly higher (5% level of significance) in the intervention site in contrast to the control site. Since it bears a positive sign, those who live around the intervention site are more willing to pay than the control site. Household age significantly negatively affect the amount of WTP. Aged peoples have less WTP than their less aged categories. Both income and private home ownership positively affect WTP at 1% and 5% level of significance. The result is consistent to positive relationship between purchasing power and WTP. The result also shows health is a normal good. Those who are in better wealth status (considering homeownership as indicator of relative wealth) and better income demand and ready to pay for improved health. Other variables particularly those health characteristics indicators sicknesses in the past five years, long sick days and malaria as a household problem have no role in describing the individual WTP. Education and bed net use have no significant role in explaining WTP. There is no significant difference between females and males on their WTP for voluntary contribution for environment cleaning.

(B) Drug Scenario

Again the starting point bias is occurred in this scenario but with weak level of significance, at 10%. As one of major malaria disease burden indicator, frequency of sickness due to malaria is significant at 5% and positively affects the individual's WTP. Those who repetitively affected by the disease have high demand for improved health care (prevention) by trading off their income for prevention than something else. Again like the environment cleaning scenario, living in the intervention site and having a private home are significant positive in explaining the amount of WTP but both at 10% level of significance. An interesting result from this estimation is that, the coefficient for female bears negative sign and significant at 5% level of significance.

4.2.3 Mean Willingness to Pay (MWTP) result

Calculation of mean WTP from the DBDC WTP data involved use of a maximum likelihood approach applied to with the assumption of a logistic distribution function. Estimation of WTP for intervention and control sites is made separately. For the interest of gender preference investigation estimation of WTP for males and females made separately for those households where both of the couples are interviewed. Table 10 shows that there is significant difference in MWTP among males and females from the same home for both the hypothetical drug and environment cleaning scenarios.

Table 10; Estimates of Mean Willingness to Pay

	Amount in Birr			
Program	**Intervention site**	**Control site**	**Males**	**Females**
Hypothetical Drug	86	85	108	92
Env't Cleaning	40	32	42	34

4.3 Discussion

The study revealed that there is substantial demand for malaria prevention in the study sites. Both the cross tabulation discussion and the regression estimations made with this regard are consistent to the respondent's economic status, which is the major factor in determining expressed demand (WTP). Reducing the burden of malaria in the study area is very important. The prevalence of malaria in both the intervention and the control site does not vary widely as discussed descriptively. This could attribute to the major reason of similarity in altitude, temperature and precipitation between the two sites. Interestingly, the regression result from both the Probit and Interval regression models showed that intervention site is significant in describing WTP. It is difficult to interpret this result as solely due to malaria burden. Since there is no significance prevalence rate between the sites, the result could be due to other factors like better formal education (Illiteracy rate in control site is 62% and intervention site 39%).

Malaria prevalence among females is lower than males. Furthermore, the coefficient for females in both the Probit and Interval regression models for both scenarios are negative. The coefficient is also significant for drug scenario in both the Probit and interval regression model. Thus, the study rejects the null

hypothesis that there is no difference in WTP between males and females. Females have less probability of saying 'Yes' to the initial bid and low WTP amount. First, low level of the disease occurrence among the females is one of the reasons. Second, with no full information on the household's total income and less power of expenditure ordering it may result in females' low level of WTP. The difference in estimated WTP is also due to these facts. The important implication of these results is that it necessitates relating the goods to be valued and who should represent the house in order to estimate the household WTP.

The interval regression result in both scenarios gets starting point bias. The bias in the drug scenario is at weak significance level of 10% and in the environment scenario strongly significant at 1 %. For the environment cleaning scenario the coefficient of the initial bid is 0.79 that indicates more than 75 percent of the WTP amount is due to the information from the initial bid. The coefficient of income elasticity of WTP for environment cleaning scenario is 0.21 from interval regression model and 0.13 from the Probit model. Furthermore, the coefficient of income elasticity of WTP for the drug scenario from interval regression model is 0.06 and 0.07 from the Probit model. Thus, the effect of starting point bias is not much debatable since respondents attach their true economic status for their response in both the initial and follow-up bids.

CHAPTER FIVE: CONCLUSIONS and RECOMMENDATIONS

Health is one of the major determinants of human well-being. Human life experience different health states due to occurrence of disease. An individual in health state say 'A' is better than say in stat 'B' if state 'A' provides the individual with a higher satisfaction (therefore higher well-being than state 'B'). The individual's well-being in this case is maintained by either prior prevention from disease occurrence or proper and timely treatment once he/she is affected by the disease. These measures involve cost which is covered either by private out of pocket expenditure or through public health expenditure programs. However, in most cases we do not have the correct indicator of the economic benefits of health prevention and treatment due to lack of appropriate market structure that provide a true value of these services.

This study estimated the economic benefit of reducing the burden of environmental health problem, i.e. malaria, by constructing a hypothetical market. The economic benefit of intervention programs are approximated by a WTP estimate. The study was conducted by a survey based approach called Contingent Valuation Method, with a Double Bounded format. Data are collected by classifying two sites one as an intervention site which is within 3 Km radius of the Koka dam, and the other as a control site which is far away from the dam by more than 8 Kms. A total of 263 valid responses were collected of which 212 are husbands and wives who represent 106 households.

Regarding the study's first objective, comparison of results among the intervention and control site shows differences in malaria incidence concentration, positive response to WTP, and WTP amounts. It is found that sickness among respondents in the past five years due to malaria is relatively higher in the intervention site than the control site (35.4% vs. 31.8%). On the other hand, the rate of malaria infection among HH members is higher in the control site (73%) than the intervention site (66.4%). The regression estimation also shows that, the intervention site is positive and significant in determining probability of a 'Yes' response and the amount of WTP for both hypothetical drug and environment cleaning scenarios. The estimated Mean WTP in the intervention site is found to be Birr 86 for the drug and Birr 40 for the environment cleaning contribution. For the control site, we found Birr 85 for drug and Birr 32 for environment cleaning contribution.

In the assessment of intra-household preference, the results show that there is quite difference in WTP between wives and husbands. The different cross tabulation and mean variation also shows that the proportion of 'Yes' responses by males is higher than by females. This is further supported by the Probit and interval data regression models for the drug scenario. The first reason for this could be females' lower rate of infection by the disease than their male counterparts. Second, lesser knowledge of the total HH income, being not engaged in income generating activities and low command over the HH income is identified as the possible reasons for the outcome. The calculated mean WTP

for males and females also differ substantially. For the drug scenario, females mean WTP is Birr 92, and it is Birr 108 for males. In the environment cleaning contribution, females WTP is Birr 34 and males mean WTP equals Birr 42.

Based on the findings from this study the following recommendations and policy implications are forwarded.

1. The study revealed that there is a demand for malaria prevention. The benefits derived from reducing the disease burden are indispensable. Thus, supply-side intervention will have more impact. Policies need to be directed in channeling resources to primary health cares like malaria in order to reduce the disease burden.

2. Income and home ownership are among those explanatory variables significantly explain the WTP. Those in a relatively better economic status are ready to pay for improved health service. Thus, motivating those who can pay for cost sharing to certain extent could be revised as one strategy. Conversely those poorest segments of the population are constrained by their economic status to demand improved health cares. Therefore, it necessitates gauging public health interventions by giving priority to the poorest of the poor community.

3. There are alternative ways to mitigate the burden of malaria. Environment correction is one of the methods which become more preferable today probably for two basic reasons. Not harming the ecosystem and long-term effect in protecting the disease. There is awareness among the target population about the relationship between environmental factors and malaria expansion. Approaching the malaria eradication program through managing the environment, thus, could result in winning the community's participation.

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ANNEX I Result Tables

Table 1: General description of variables

Variables	**Mean**	**Standard Deviation**	**Min**	**Max**
Sex (dummy, Female = 1)	.5209	.5005	0	1
location	.7528	.4321	0	1
Age	37.653	14.164	15	84
Family size	5.429	2.5862	1	13
Home ownership	.7528	.4321	0	1
Annual household income	4981.9	3662.595	240	26970
Malaria infection once in life time (dummy)	.7794	.4153	0	1
Malaria sickness	.3716	.4841	0	1
Frequency of sickness	2.203	2.8204	0	15
Number of malaria infected	1.722	1.9776	0	11
HH bed net user (dummy)	.9733	.1612	0	1
Money expense for malaria	130.243	225.579	0	2090
Illiterate	.45	.50	0	1
Read and Write	.21	.41	0	1
Grade 1 up to 4	.09	.29	0	1
Grade 5 up to 8	.16	.36	0	1
Grade 9 up to 12	.08	.28	0	1
Grade 12 and above	.0038	.006	0	1

Table 2: Observed behavior comparison between males and females

Description	Intervention		Control	
	Female*	Male	Female	Male
Health & Personal Characteristics				
infected in life time	77	72	28	28
Sick in past five years	32	40	11	14
Illiterate	62	17	28	12
Response Pattern (for environment cleaning scenario)				
Yes - Yes	54	59	17	13
Yes - No	26	22	6	9
No – Yes	7	6	3	2
No - No	17	7	7	8
Response Pattern (for hypothetical drug scenario)				
Yes - Yes	26	39	6	8
Yes - No	11	9	2	1
No – Yes	9	5	5	1
No - No	57	39	19	22

****137 females and 126 males***

Table 3: Malaria sickness between intervention and control sites in the past five years

Malaria sickness	**Intervention**	*Relative percentage*	**Control**	*Relative percentage*	**Total**	*Relative percentage*
HH heads*	40	*35.4%*	14	*31.8%*	54	*34.3%*
Other HH members						
None	38	*33.6%*	12	*27%*	50	*31.8%*
Only 1	25	*22%*	10	*22.7%*	35	*22.3%*
2 - 4	37	*32.7%*	20	*45.5%*	57	*36.3%*
≥ 5	13	*11.5%*	2	*5%*	15	*9%*
Total	113	*100%*	44	*100%*	157	*100%*

* Number of household head respondents from the intervention = 113 and from control = 44

Table 4: WTP Response pattern for bid intervals in both scenarios

Program	*Bid Value Sets*	*Observation*	*YY*	*YN*	*NY*	*NN*	*YY%*	*YN%*	*NY%*	*NN%*
Environment Cleaning scenario	V1 (1,5,10)	35	23	10	1	1	*65.8*	*28.6*	*2.8*	*2.8*
	V2 (10,12,15)	34	18	11	1	4	*52.9*	*32.4*	*2.9*	*11.8*
	V3 (15,20,25)	29	19	4	3	4	*65.5*	*13.7*	*10.34*	*13.7*
	V4 (25,30,40)	30	15	5	4	7	*50*	*16.7*	*13.3*	*23.3*
	V5 (45,50,75)	29	10	8	2	9	*34.5*	*27.6*	*6.9*	*31*
	Total	**157**	**85**	**38**	**10**	**24**	**54.1**	**24.2**	**6.4**	**15.3**

	Bid Value Sets	*Observation*	*YY*	*YN*	*NY*	*NN*	*YY%*	*YN%*	*NY%*	*NN%*
Hypothetical Drug Scenario	V1 (10,15,20)	35	21	5	3	6	60	14.3	8.6	17.1
	V2(40,50,60)	34	12	4	3	12	35.3	11.8	8.8	35.3
	V3 (50,70,85)	29	8	0	1	20	27.6	0	3.4	68.9
	V4 (90,80,100)	30	9	1	3	17	30	3.3	10	56.7
	V5 (100,120,150)	29	8	1	0	20	27.6	3.4	0	68.9
	Total	**157**	**58**	**11**	**75**	**10**	**36.9**	**7**	**47.8**	**6.4**

Table 5: Number of hypothetical vaccine demanded by the initial bid level

Bid (Birr)	**0 drug**	**1-3 drugs**	**4-6 drugs**	**≥ 7**
10	12.5%	25%	50%	12.5%
15	29.6%	29.6%	29.6%	11%
50	52.9%	29.4%	8%	8%
70	72.4%	17.2%	10.3%	0%
90	66.7%	33.3%	0%	0%
120	68.9%	24.1%	6.8%	0%

Table 6 Probit model: Determinants of a Yes answer at initial bid - hypothetical drug scenario

Explanatory Variables	**Coefficients**	**Marginal effect**
Location (intervention=1)	.485** (.215)	.173 (.071)
Sex (Female=1)	-.459*** (.178)	-.172 (.066)
Family size	-.029 (.037)	-.011 (.014)
age	-.007 (.006)	-.002 (.002)
Yearly income	.00001 (.00002)	0.00005(0.00009)
Initial bid	-.013*** (.002)	-.005 (.0009)
Bed net use	-.381 (.551)	-.149 (.219)
Home own	.446** (.222)	.160 (.074)
Frequency of sickness	.089*** (.033)	.033 (.012)
Malaria past five years	-.007 (.187)	-.002 (.070)
Intercept	.656 (.672)	
LN Yearly income (η)	.0747	
LN home own	.343	

Number of obs = 261

Wald chi^2 (10) = 51.45

Prob > chi^2 = 0.0000

Log likelihood = -148.46167

Pseudo R^2 = 0.1477

Marginal effect is discrete for dummy variables.

Standard error values in parenthesis.

***, **, * variables significant at 1%, 5% and 10% level of significance respectively.

η is elasticity of income.

Table 7 Probit model: Determinants of a Yes answer at initial bid for environmental cleaning scenario

Explanatory Variables	**Coefficients**	**Marginal effect**
Location (intervention=1)	.405* (.237)	.112 (.071)
Sex (female = 1)	-.289 (.200)	-.072 (.050)
Age	-.014* (.007)	-.003 (.001)
Family size	-.034 (.043)	-.008 (.011)
Home own	.393 (.256)	.108 (.075)
Yearly income	.00009** (.00003)	.00002 (0.00009)
Malaria community problem	.596** (.247)	.177 (.082)
Malaria past five years	.071 (.223)	.017 (.055)
Frequency of sickness	.017 (.037)	.004 (.009)
Initial bid	-.034*** (.006)	-.008 (.001)
Intercept	.979 (.458)	
LN Yearly income (η)	.137	
LN home own	.09	

Number of obs = 261

Wald chi^2 (11) = 47.15

Prob > chi^2 = 0.0000

Log likelihood = -112.17532

Pseudo R^2 = 0.1797

Marginal effect is discrete for dummy variables.

Standard error values in parenthesis.

***, **, * variables significant at 1%, 5% and 10% level of significance respectively.

Table 8: Interval Regression Model - WTP for environment cleaning scenario

Number of obs = 261

LR chi^2 (11) = 81.79

Log likelihood = -301.92722

Prob > chi^2 = 0.0000

Variables	**Coefficients**	**Marginal effects**
Sex (female = 1)	-3.893(2.506)	-.008(.006)
Age	-.154(.0854)*	-.0003(.0002)
Education	-.451(.980)	-.0009(.002)
Home own	6.548(2.932)**	.018(.011)
Yearly income	.0013(.0004)***	0.000029(.000)
Malaria past five years	.464(2.387)	.0009(.005)
Sick days	-.0429(.091)	-.00009(.0002)
Bed-net use	-11.244(7.351)	-.011(.005)
Malaria HH problem	3.049(2.545)	.007(.007)
Initial bid	.792(.0771)***	.001(.0005)
Location (intervention=1)	6.554(2.795)**	.018(.012)
Intercept	16.026(9.354)	
LN Yearly income (η)	.21	
LN home own	.15	

39 left-censored observations; 0 uncensored observations; 140 right-censored observations; 82 interval observations.

***, **, * variables significant at 1%, 5% and 10% level of significance respectively.

Marginal effect is discrete for dummy variables.

Standard error values in parenthesis.

Table9: Interval Regression Model - WTP for Hypothetical drug scenario

Number of obs = 260

Wald chi^2 (9) = 29.10

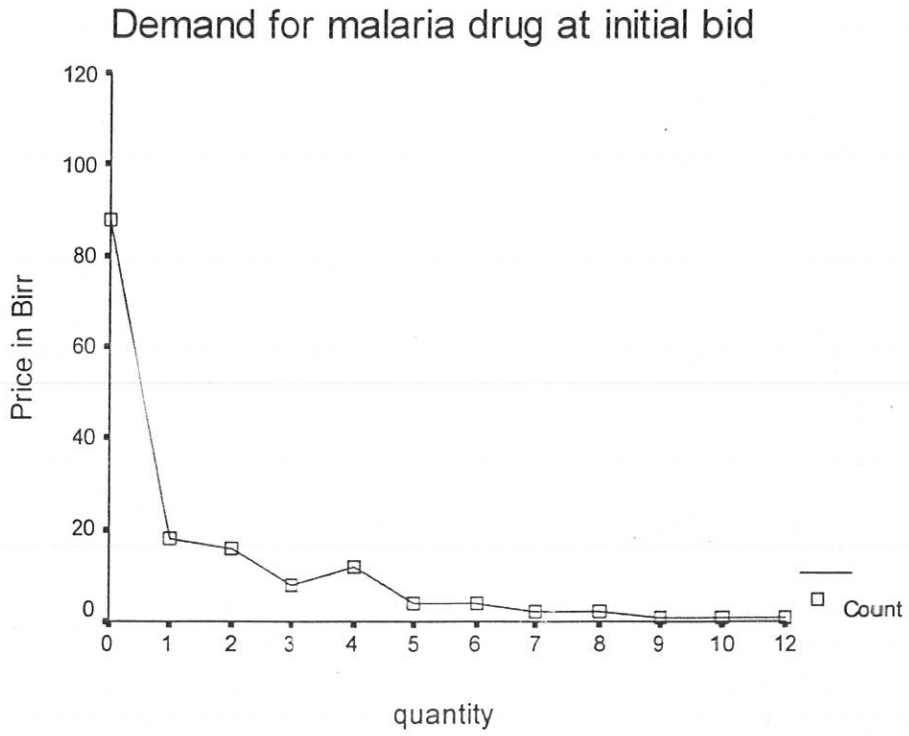
Log pseudolikelihood = -281.60295

Prob > chi^2 = 0.0006

Variables	**Coefficients**	**Marginal effects**
Sex (female = 1)	-23.080(9.397) **	-.114(.046)
Age	-.326(.297)	-.001(.001)
education	-.575(3.583)	-.002(.018)
Family size	-1.967(1.892)	-.009(.009)
Home own	20.441(10.692) *	.111(.062)
Yearly income	.0005(.001)	0.000028(.00001)
Initial bid	.269(.139) *	.001(.0006)
Location (intervention=1)	17.737(10.877) *	.095(.063)
Frequency of sickness	3.02(1.369) **	.015(.006)
Intercept	34.493(33.09)	
LN Yearly income (η)	.058	
LN home own	.323	

136 left-censored observations; 0 uncensored observations;
79 right-censored observations; 45 interval observations.
***, **, * variables significant at 1%, 5% and 10% level of significance respectively.
Marginal effect is discrete for dummy variables.
Standard error values in parenthesis.

Figure 3


Demand for malaria drug at initial bid
Price in Birr
120
100
80
60
40
20
0
0
1
2
3
4
5
6
7
8
9
10
12
quantity
Count

Annex II QUESTIONNAIRE

Name of Enumerator:
Date:
Time Start:
Time finished:
Village Name:

Introduction

My name is _____ and I am working on a survey about malaria in this village for educational purpose only. We are interested in learning how people feel about malaria in this area. This research is very important for us. In addition the result from it will give insight to the government and donor organization in prioritizing their program for the community. We are interviewing many different households here and the adjacent kebele.[1]

We would like you to participate in the survey. The interview will completely be confidential. If I ask you questions you do not like just tell me and we will jump it and proceed on the rest of the questions.

Are you willing to be interviewed?

No 0

Yes 1 [ ]

[Enumerator: if the answer is No stop interviewing the person]

Part I: Individual Background information

Respondent's Identification

1. Are you the head of the household?
   No 0
   Yes 1 [ ]
2. [Enumerator: What is the gender of the respondent?]
   Male 0
   Female 1 [ ]

[1] It is a lower level government administration setup

3. How old are you?

_____ years of old

4. What is your educational status?

Cannot read and write	1	
Read and write	2	
Grade 1 – 4	3	[ ]
Grade 5 – 8	4	
Grade 9 – 12	5	
Above Secondary level	6	

[Enumerator: Give the respondent a News paper and ask to read you a single sentence]

5. Is He / She

A. Unable to read it
B. Read with difficulty [ ]
C. Read easily
D. Not willing to read

6. Are you currently

A. Married
B. Unmarried [ ]
C. Divorced
D. Widowed

7. How many people live in this household, including yourself?

_____No. of individuals

How many are above 18 years of old?_____
How many children between 5 and 18?_____
How many children below 5? _____

8. Who is the decision maker in your household?

Husband	0	
Wife	1	[ ]
Both	2	
Other?	3	

Asset Ownership

9. Could you tell me the ownership status of the house you are live in?

Privately owned	1	
Government (Kebele) rent	2	[

]

Private rent 3

Other (.....) 4

10. Do you have your own farm land?

Yes 1 [ ]

No 0

[Enumerator: If the answer is No go to question No. 12]

11. How many acres of farm land do you own?

_____acre of land

12. How many of the following animals do this household own?

_____Chicken

_____Goats

_____Sheep

_____Oxen, Cow

_____Donkey

_____Camel

_____Horse

_____Mule

13. Which of the following appliances do you own?

	Yes	No	
TV set	1	0	[ ]
Radio (Tape recorder)	1	0	[ ]
Gas stove	1	0	[ ]
Motor vehicle	1	0	[ ]
Bicycle	1	0	[ ]
Refrigerator	1	0	[ ]

Household Income

14. What is your major source of income?

	Yes	No	
Wage from factory	1	0	[ ]
Agriculture	1	0	[ ]
Other (specify)_____	1	0	[ ]

[Enumerator: If the answer for this question is agriculture only go to question No. 17]

15. How much did you earn monthly from your major source of income activity?

_____ETB

[Enumerator: If it is difficult for the respondent to answer question No. 15 ask the next]

16 How much it costs you monthly to

Buying food items (like Teff, Wheat, and others) _____
Home rent _____
Utilities (water, electricity) _____
Saving _____
Other _____

17. How many quintals of the following grains did you produce last year?

_____Teff
_____Wheat
_____Maize
_____Barley
_____Tomato
_____Onion
_____Other
_____Other

18. Do you have any relatives supporting you by sending money?

No 0

[ ]

Yes 1

19. How much money did you receive last year?

_____ ETB

Part II: Knowledge of malaria, Perception and Individual's malaria History

20. Do you know what malaria is?

No 0

[ ]

Yes 1

21. How is malaria transmitted?

A. ____ Mosquitos
B. ____ Lack of sanitation
C. ____ Impure water
D. ____ Wet places
E. ____ Other:
F. ____ Don't know/Not sure

22. What are the major "risk factors" for malaria in this village? [Enumerator: let the respondent answer in such a way i.e. 1, most associated; 2, second most associated,...]

A. Areas where they grow certain crops (if yes, which crops?)
B. Small pools
C. The Koka reservoir
D. A canal for transferring water
E. Areas where animals are
F. A near by river (like Gojei)
G. Other (specify)

23. Do you think if you live near certain areas your chances of getting malaria are higher?

Yes	1	
No	0	[ ]
Not Sure	98	

24. What are the symptoms of malaria? [Enumerator: Do not read list. Place tick marks next to all that apply.]

A. ____ Fever
B. ____ Shivering
C. ____ convulsion
D. ____ Headache
E. ____ Backache
F. ____ Anemia
G. ____ Stomachache
H. ____ Vomiting
I. ____ Diarrhea
J. ____ Joint pain
K. ____ Loss of appetite
L. ____ Other:
M. ____ Don't know/Not sure

25. If someone is sick with malaria, what are the best ways to cure this person? [Enumerator: Do not read list. Place tick marks next to all that apply.]

a. _____ No treatment is necessary
b. _____ Taking chloroquine
c. _____ Taking other medicine (please specify) _____
d. _____ Injections
f. _____ Fumigation
g. _____ Changing one's diet
h. _____ Cleaning house, environment, or body
i. _____ Religious healing: Holy water, Borenticha

j. _____ Herbal medicines
k. _____ Other: _____
l. _____ Don't know/Not sure

26. What are the best ways (i.e., most effective) to avoid getting malaria? [Enumerator: Let the respondent to rank his choice.]

A _____ There is no way to prevent malaria
B. ____Cleaning the house or Cleaning environment, including draining wet areas
C. _____ Sleeping under a bednet
D. _____ Taking chloroquine
E. _____ Spraying a house with chemicals like DDT

F. _____ Larvaciding
G. _____ another intervention, not medicine (please specify)
H. _____ Taking other medicine (please specify)

27. Do you think efforts to manipulate (or change) the environment (e.g. drying out puddles) might be a good way to reduce malaria?

Yes 1
No 0 [ ]
Don't Know 2

28. Do you think changes to dam operating schedules, such as using measures designed to dry out and strand mosquito larvae at the reservoir perimeter, can help to reduce malaria?

Yes 1
No 0 [ ]
Don't Know 98

29. Is malaria a big problem in your community?

Yes 1
No 0 [ ]
Don't Know 98

30. How do you rate the problem in this village?

High 1
Moderate 2 [ ]
Low 3

31. What is your opinion about government effort to control malaria?

High 1
Moderate 2 [ ]
Low 3

32. What is your opinion about health facilities treatment of malaria patients?

Good 1
Average 2 [ ]
Bad 3

33. Have you ever had malaria?

No 0

[ ]

Yes 1

34. Did you sick of malaria within the past five years?

No 0

[ ]

Yes 1

35. How many times?

_____times

36. How many days it lasts before you get well?

_____ days

37. How do you explain the severity of the illness?

Severe illness limiting all activities 1
Moderate illness limiting most activities 2 [ ]
Mild illness limiting only few activities 0

38. Did you get malaria in this village or somewhere else?

In this village 0

[ ]

Somewhere else 1

39. How did you know that you had malaria?

Medical test 1
Community health worker told me 2
Traditional healer told me 3 [ ]
The symptoms I feel are those of malaria 4
A family member told me 5

40. From where did you get medical care?

From work place 1
From clinic with payment 2
From clinic with free card 3[ ]
A malaria control center in the village, or Mojjo or Koka town 4

Buying drugs from market 5
Do nothing 0

41. How many individuals other than you affected by malaria in the household?

_____individuals

How many are above 18 years? _____
How many are below 18 years? _____

42. Did all of them get timely medical treatment?

All 1
Some 2 [ ]
None 0

43. Which is the malaria control strategy imposes the greatest personal cost on you?

A. _____ Cleaning the house or Cleaning environment, including draining wet areas
B. _____ Sleeping under a bednet
C. _____ Taking chloroquine
D. _____Spraying a house with chemicals like DDT
E. _____Larvaciding
F. _____ another intervention, not medicine (please specify)
G. _____ Taking other medicine (please specify)

44. Assuming equal benefits of an intervention, would you prefer

A. _____draining wet areas
B. _____bednet distribution [ ]
C. _____indoor chemical spraying
D. _____or something else (specify)

45. Given the costs you just mentioned (for example, maybe there is moderate discomfort sleeping under bednet or side effects associated with pills?) and your assessment of the benefits of the different measures, which would you prefer as a malaria control strategy? Please list in order (1 is the best, 2 second best.....)

A. ____cleaning the house or cleaning environment, including draining wet areas
B. _____ sleeping under a bednet
C. _____ taking chloroquine
D._____ spraying a house with chemicals like DDT
E. _____ another intervention, not medicine (please specify)
F. _____ taking other medicine (please specify
G. _____ taking other medicine (please specify)

46. Is malaria a big problem specifically for you or your household member?

Yes	1	
No	0	[ ]
Don't Know	98	

47. Why malria is a big problem in your household?

A.____ Many of them get sick of the disease
B.____ Lost member of a household due to the disease
C.____ Other (specify)

48. What does your household do at present? Do you

A. use bednets _____
B. allow the house to be sprayed_____
C. visit a malaria control centre when ill_____
D. visit a traditional healer when ill _____
E. buy medicine from a store _____
F. use herbs/traditional medicines _____
G. other (specify) _____

Part III: Valuation Questions

Environment Cleaning Scenario (Voluntary Contribution)

Malaria is a social disease which requires the effort of all citizens apart from government and donor organizations to prevent or control it in high endemic area like your village. It is believed that communities' participation and involvement in public decision making will have positive outcome in minimizing social health problems like malaria. This collaborative effort shall not be a one time task. It needs high commitment and continuous effort until the disease reaches the level of no more threat of the community.

Currently what is anything done in your community to deal with malaria?

A. indoor residual spraying
B. use of bednets
C. draining of puddles
D. individuals simply get treatment
E. other (specify)

E2. 1 Birr per year?

Yes 1
No 0 [ ]
Don't know (98)

E3. 10 Birr per year?

Yes 1
No 0 [ ]
Don't know (98)

[Enumerator: if the respondent answer is No for cooperation in the program ask the next question]

E.4 Why did you say No when you are asked to contribute for the program?

Very poor to contribute 1
I didn't support any of such program 2 [ ]
It is the duty of the government 3
Everybody should contribute 4

Drug Scenario (Malaria transmission blocking vaccine)

So far it was difficult for scientists to develop a drug which totally protect people from getting malaria in advance. Now I want you to assume a new drug that would protect you from getting malaria for a limited time period effectively. The drug works like this. If you take the drug, you will have no risk of malaria for one year. But after the end of the year it requires you to take another one. The other advantage of the drug is if every one takes the drug there will be no malaria transmission even if there is a chance of mosquito biting. In other words it means when an individual takes the drug he protects himself and also other persons since he is not positive in malaria. The drug will not have any side effects.

Since the risk of malaria is high in most parts of the country the government or any other donor organization will not cover the cost for everyone. This means if the drug is available some day in the future it will be supplied with payment.

Are you willing to accept such drug if you get the chance?

Yes 1

[ ]

No 0

[Enumerator: if the answer is No go to question no. V4]

Taking into consideration your household current and future budget, would you buy the drug with one time payment if it costs you

V1. 15 Birr per drug?

Yes	1	
No	0	[ ]
Don't know	(98)	

[Enumerator: if the answer is yes go to question no 3. if the answer is no go to question no. 2]

V2. 10 Birr per drug?

Yes	1	
No	0	[ ]
Don't know	(98)	

V3. 20 Birr per drug?

Yes	1	
No	0	[ ]
Don't know	(98)	

When I asked whether you buy the drug or not you told me that you will buy it. Now let me ask you the quantity of drugs you need at each price.

How many drugs with 15 Birr?
_____quantity

How many drugs with 10 Birr
_____quantity

How many drugs with 20 Birr
_____quantity

[Enumerator: if the respondent answer is No for cooperation in the program ask the next question]

V4. Why did you say No when you are asked to contribute for the program?

Very poor to pay any	1	
I didn't expect any vaccine which prevents me from malaria	2	[ ]
It is the duty of the government	3	
I did not have risk of malaria	4	

Declaration

I, the undersigned, declare that this 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.

Declared by:

Name Yordanos Gebremeskel

Signature Yordanos

Date 21/06/07

Confirmed by Advisor

Name Wassie Berhanu

Signature

Date 21/06/07

Place of Submission