Willingness to Pay for Insecticide-Impregnated Bed Nets: The Case of Selected Rural Kebeles in Ilu Woreda of Western Shoa Zone[1]

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Abstract

The use of insecticide impregnated bed nets is one of the available means to protect households against infective mosquito bites. This paper, therefore, is directed towards estimating households' willingness to pay for such bed nets in one of malaria prone areas of Western Shoa Zone. The empirical findings reveal that the mean willingness to pay for a medium size insecticide impregnated bed net is Birr 44.26 if sold in cash and Birr 65.05 if provided on credit basis. These figures, however, are much lower than the current price of bed nets, which ranges between Birr 100 and 130. Moreover, households are willing to buy only one bed net in the former case and two in the latter case. Households' characteristics, burden of malaria on households and income are among the major factors influencing the willingness to pay decisions. Particularly, as the extremely low income of the society highly limits the use of bed nets, it calls for a support scheme in order to reduce the burden of malaria on rural households

1. Introduction

1.1. Background

Malaria is a significant public health concern for many developing countries of Asia, Latin America, the Pacific and Africa. In sub-Saharan Africa, where mosquito vectors are abundant and where malaria transmission is very intense, malaria is one of the major killers responsible for nearly one million deaths and 300 to 500 million clinical

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cases every year. Of the global deaths due to malaria about 90 percent now occur in Africa (Martin, et al., 1998).

Malaria is a common parasitic disease in Ethiopia in almost all areas below 2500 meters altitude, covering nearly 75% of the area of the country. Malaria affects nearly 4 to 5 million people annually, and of the total 350 DLY's[3] per 1000 population lost annually, it accounts for 10.5 percent. This makes malaria the second largest killer disease in the country. Furthermore, on average 400,000 to 600,000 cases with positive blood film for malaria are treated annually. However, the number of cases seen at facilities with no microscopic diagnostic service and by community health workers is estimated to be 3 to 4 times higher than this figure (MOH, 2000). On the other hand, the 1999 MOH's report puts the risk of malaria infection as high as two-thirds of the country's population because of the assumption that quite a significant number of people suffering from the disease might not visit any formal health facilities due to lack of access to health services, socio-cultural and economic factors.

In Ethiopia the transmission of malaria is unstable and many areas are either epidemic prone or moderately endemic with marked seasonality. The main transmission seasons are closely linked with the rainy seasons, mainly occurring between September to December and April to May.

Though major epidemics of malaria occurred at intervals of approximately 5 to 8 years since 1958 (MOH, 1999), recent trend shows a frequent epidemic in different parts of the country. Since the outbreak of the first malaria epidemic in 1958, which was responsible for an estimated 3 million cases and 150,000 deaths in span of only 6 months, the epidemic has been expanding (MOH, 2000). Consequently, the government of Ethiopia has been committing itself to malaria control and eradication activities starting from 1959. But the problem seems not to have been resolved mainly due to, among others, increasing insecticide resistance of malaria vectors, financial constraints, institutional problems and the unstable and seasonal nature of its transmission. Moreover, important vector control supplies such as drugs, laboratory and medical supplies and bed nets are not available as required.

The decentralization of the national malaria control programme that followed the 1993 health sector reform has also exerted its own impact on the country's malaria control effort. For instance, the drastic reduction of manpower in the Federal Malaria Control

[3] DLY refers Disability Life Year.

Unit and lack of the necessary capacity at the Regional level coupled with ecological changes resulted in large-scale malaria epidemic in the country in 1998 (MOH, 1999).

Currently the government is working, in collaboration with the World Bank, WHO, UNICEF, UNDP and USAID, under the Global Roll Back Malaria Initiative which aims at reducing the burden of malaria by 50 percent within ten years. For the implementation of this objective, National Malaria Control Support Team was established and its activities are to be integrated to the National and Regional Health Sector Development Programmes. All these efforts depict the growing awareness to the burden of malaria, which in fact is one of the top priority development problems.

In light of this government concern on the one hand and serious resource constraint on the other, this study aims at estimating the willingness to pay for insecticide impregnated bed nets in selected rural Kebeles of Ilu Woreda. The study area is found in Western Shoa Zone of Oromiya Region, some 55 km away from Addis Ababa on the road to Jimma. The total population of the Woreda is 53,700, out of which 48,700 (90.7%) living in 18 peasant associations or rural kebeles and the rest residing in 2 rural town kebeles. Though it is a case study, the results obtained are hoped to serve as preliminary indicators of the implications of government health care financing schemes in rural Ethiopia.

1.2. Problems, significance and objectives of the study

As a leading cause of mortality and morbidity, malaria is one of Ethiopia's foremost health problems top ranking among communicable diseases. Assessment of the country's outpatient morbidly statistics reveals that malaria stands as the number one of the top 15 diseases (World Bank, 1999). From the 10 leading causes for hospitalisation malaria is the second diseases and the first for outpatient visits (MOH, 2000).

Apart from its mortality and morbidity consequences, malaria exerts immense adverse impacts on a country's economy. For instance, the recurrent infections and the associated attacks of fever could adversely affect productivity by causing loss of working time and efficiency. Particularly in the agricultural sector these could lead to late planting and harvesting. The loss in productivity, and hence the reduction in the overall household income, could be further exacerbated when some members of the family are forced to spend their time taking care of the malaria infected family

members. The rise in the costs of treatment resulting from the spread of drug resistant malaria is also the other negative impact of malaria (Jamison, et al, 1998).

Generally, the total costs borne by families and individuals include payments for treatment, time and transport costs in seeking treatment, time costs for family members who look after the patient, and time and money costs of preventive action taken by households and the community (ibid).

Beyond these short run costs, malaria impedes economic growth and long-term development in many ways. Malaria may impede the flows of trade, foreign investment, and commerce, thereby affecting a country's entire population. Malaria tends to hinder a child's physical and cognitive development, and may reduce a child's attendance and performance at school. It exposes individuals to chronic malnutrition and increased vulnerability to other diseases (Rwegasira, 2000).

Hence, it is this treat of malaria to human lives and its serious impact on the whole economy that have always necessitated the malaria prevention and control efforts. To this effect, insecticide impregnated bed nets have been proved by a range of trials in different countries to be one of the best malaria control measures available (Target and Brain, 1998).

In Ethiopia various malaria control and prevention actions have been in use, including residual insecticide house and aerial spraying, environmental management and chemoprophylaxis. However, the use of these chemical insecticides and biological agents is constrained by limited availability of human and economic resources, poor health infrastructure and resistance to drugs. The environmental management endeavour, though one of the available malaria preventive action, is not yet a fully utilized mechanism due to low awareness creation and community mobilization efforts.

Insecticide treated bed nets, on the other hand, have been introduced only on a trail basis in several areas of the country as part of a community-based malaria control endeavour. The scheme is reported to have shown some success notably in the Tigray Regional State. But the current combined tax rate of 62% levied on mosquito nets is reported to have limited its availability and affordability (World Bank et al, 1999).

In this situation where exposure to the use of insecticide impregnated bed[4] nets is limited and where it is highly taxed, the willingness and the ability to pay for them by most agricultural households need thorough assessment. This is thus the motivation to conduct the study at a randomly selected malaria endemic Woreda in Oromiya Regional State.

Therefore, in addition to investigating the attitude of rural households towards insecticide impregnated bed nets, the study estimates their willingness to pay for the bed nets, and identify the factors that determine the households' willingness to pay for the bed nets. Finally, attempt is also made to show the implications of the results obtained on health care financing scheme of the government.

2. Theoretical and empirical perspectives

2.1. Theoretical background

Malaria is a disease caused by the presence in the red blood corpuscles, or in the liver cells, of a unicellular parasite – a protozoon – belonging to the genus of plasmodium (Pampana, 1969).

There are four main species of human malaria parasites: *plasmodium falciparum, plasmodium vivax*, *plasmodium malariae* and *plasmodium ovale*. Of these four species *plasmodium falciparum* causes the severest type of malaria. These species together with *plasmodium vivax* account for more than 95 percent of malaria cases in the world. The rest two cause less severe symptoms (WHO 1992).

Malaria is transmitted through the bite of female *anopheles* mosquito, which sucks blood from an infected person and eventually transmits it to other human beings. Once the *sporozoite* is inoculated into man, it remains undetectable hidden in the liver cells, where the parasites grow and divide their *nucleus* and their *cytoplasm*. After few days hundreds of daughter forms escape from the remains of the mother cell and red blood *corpuscles* and invade new red blood *corpuscles*. This cycle repeats unless interrupted by drugs or immunity developed in the body. It is estimated that malaria parasites can multiply 10 times every 2 days, destroying the red blood cells and infecting new cells throughout the body (UNICEF, 2000)

[4] Note that bed in the context of the majority of the rural households in Ethiopia refers to any space or material used for sleeping.

The incubation period, which is the interval between mosquito bite and the appearance of fever, varies from a minimum of 6 to a maximum of 25 days for *plasmodium falciparum* and from 8 to 27 days for *plasmodium vivax* infections (Pampana, 1969). Malaria is mostly a disease of hot climate. The *anopheles mosquito* which transmits the malaria parasite thrives in warm and humid climate where a pool of water provides perfect breeding grounds. Hence, the transmission intensity of malaria varies depending on altitude, amount of rainfall, temperature, humidity and other human factors. It is based on these factors that the disease is classified as endemic or epidemic.

While endemic malaria refers to a constant measurable incidence both in terms of cases and natural transmission over a succession of years, endemic malaria indicates a periodic or occasional sharp increase in morbidity or mortality, or acute exacerbation of the disease in unusual proportions, compared to what a particular community is used to face.

The chief symptom of malaria is fever, periodic bouts of which tend to alternate with days of less or no fever. The classical *paroxysm* of fever lasts eight to twelve hours, typically in three stages: cold shivering rigor, burning dry skin and drenching sweat that lowers the temperature (Jamison et al, 1998). Children and adults infected with malaria commonly suffer from severe headache, cough, nausea, vomiting, abdominal pain, poor appetite, thirst and diarrhea in addition to high fever.

Malaria may become complicated unless treated in time. The symptoms for complicated malaria include: very high body temperature, drowsiness, convulsions, shock and coma indicating heavy *parasitaemia*, severe anemia, *hemoglobin urea* (black water fever), *jaundice*, renal failure and respiratory distress. Unless timely treated, *plasmodium falciparum* can also lead to death (WHO 1992).

The risk of severe malaria is almost exclusively limited to those who are not immune. In highly endemic areas, this risk affects children from the age of three to six months up to the age of five years. Because those who lose the immunity acquired from their mothers will develop their own immunity after this period of time (Jamison et al, 1998). Moreover, pregnant women are more easily infected mainly because their placenta is a preferential site for parasite development. Consequently, *plasmodium falciparum* could lead to death, abortion, premature delivery or low birth weight. Particularly, malaria is an important cause of low birth weight and high neonatal mortality in first and second born children in endemic areas.

Therefore, treatment of malaria should aim at preventing the disease from developing into a severe condition, which could be fatal. However treatment alone could not solve the incidence and prevalence of malaria since repeated bites by the vector is still possible. In addition, treatment of malaria should be based on the severity of the cases, parasite species, and pattern of drug resistance.

In general, there is no single appropriate intervention for all cases of malaria. Interventions are case and place specific. But the most general intervention for the prevention of malaria infection should aim at protecting individuals against infective mosquito bites and transmission control so as to reduce the risk of malaria to entire population.

Personal protection can be exercised in a variety of ways: using protective clothing, repellents, screening of houses, insecticide-impregnated bed nets, etc. On the other hand, the measures available for the control of malaria transmission include: residual insecticide house and aerial spraying, larviciding, drying of water containers and pools, draining of swaps, environmental sanitation and *chemoprophylaxis*. These control measures are broadly categorized into two: use of chemical insecticides and biological agents and environmental management (WHO, 1993).

2.2. Empirical literature review

This sub-section reviews empirical findings of some previous studies conducted on estimating the economic cost of malaria and the willingness to pay for insecticide-impregnated bed nets.

2.2.1. Burden of malaria

Malaria is a classic example of a debilitating disease that impairs productivity. As the most prevalent disease in the poorest rural areas, malaria produces recurrent infections with attacks of fever in the warm and rainy seasons, when most workers are needed to collect crops. Often the malaria vulnerable people could also be those who already suffer from malnutrition and other infections and lack of medical care. In areas subject to epidemics, these also tend to strike at times of peak demand for agricultural work (Jamison et al, 1998).

Though the impact of malaria on economic growth and development remained immense, studies made on the area are few and did not concentrate on rural

households. Moreover, the studies conducted so far are heterogeneous in their purposes, design and result (Abdulhamid, 1995). Nevertheless, this paper tries to briefly review some of the studies conducted on the economic impact of malaria and the extent to which insecticide impregnated bed nets contribute to its control.

During the period 1965 - 1990, highly malarious countries suffered a growth penalty of more than one percentage point per year (compared with countries without malaria), even after taking into account the effects of economic policy and other factors that also influence economic growth. The annual loss of growth from malaria is estimated to range as high as 1.3 percentage points per year. Compounding the loss over the fifteen years period of analysis reveals that the GNP level in the fifteenth year would be reduced by nearly a fifth, and the toll would continue to mount with time (Rewagasira, 2000). For instance, in 1995 the estimated direct and indirect costs of malaria in Africa were US $ 1.8 billion (African Development Report, 1998).

A survey conducted on low income households in Malawi focusing on costs of malaria estimated the average annual expenditure on malaria treatment to be US $ 11.07, representing 9.6% of a household's income. The study also depicted that malaria morbidity accounts for a loss of 2 - 3 days of work and lower productivity, costing a household approximately US $2.70 per annum (Shepard et al in World Bank, 2000).

In Ethiopia, a case study made by Abdulhamid (1995) on two villages, with the aim of assessing the impact of malaria on peasant production, showed the occurrence of malaria affecting the total output of *teff*. In Ghana, a health assessment team found recurring disability from clinical attacks of malaria averaging 7 days of illness per year (Nimo et al, 1981). A study conducted in Pakistan using the human capital method revealed the annual economic cost of malaria to be 81 million Rupees (Khan, 1966). It can thus be concluded that as the burden of malaria is immense, it demands appropriate prevention and control measures.

2.2.2. Malaria prevention and control

As no single biological, economic or political reason can be adduced for the observed patterns and trends in malaria transmission, no single intervention, therefore, is appropriate in all contexts (Rewagasira, 2000). Interventions should be adapted to specific local ecological, epidemiological, economic and social conditions. Accordingly, timely care seeking, combined with a health system capable of

diagnosing and treating malaria cases, could significantly reduce the burden of malaria, and is essential to sustaining a reduction (World Bank, 1999).

There are various malaria control mechanisms including spraying of residual insecticides, the use of insecticide-impregnated bed nets, space or aerial spraying, larvaciding and source reduction. Insecticide-impregnated bed nets have been proved by a range of trials in different countries to offer one of the best malaria control measures available. Their use has contributed to substantial reduction in malaria in many parts of China. In Africa the number of clinical attacks of malaria on children protected by treated bed nets was reduced by 30% to 60%. In Gambia overall child mortality was reduced by more than 60%. In subsequent trials elsewhere in Africa mortality was reduced by between 15 and 33 % (Target and Brain, 1998).

The use of insecticide-impregnated nets substantially affects the frequency and severity of clinical episodes of malaria (Lengeler, et al, 1996). Below is the summary of the results of some studies that support the above view and depict the impact of insecticide-treated mosquito nets on malaria morbidity on African children based on selected trials.

Table 2.1: Impact of insecticide-impregnated bed nets on African children

Country	Morbidity reduction (%)	Year
Gambia	63	1988
Kenya	40	1993
Guinea Bissau	29	1994
Sierra Leone	49	1995
Tanzania	55	1995

Source: WHO 1992

Although insecticide-treated mosquito nets provide a cost effective means of ameliorating the effects of malaria, this protection measure will be expensive if large human population is to be protected (Rwegasira, 2000). In this regard, various studies revealed the problems relating to availability and affordability of insecticide-treated beds nets.

Bed nets are observed to be widely used in countries where they are produced, private markets for nets prevail and where government subsidy exists. For instance, a recent unpublished study by London School of Hygiene and Tropical Medicine (2000)

revealed that in Tanzania, Kenya and Zimbabwe, where active net market and large scale commercial production exist, there is high level of net ownership. It was estimated in 1993 that 62 and 35% of households in Dare Salaam and Burkina Faso, respectively, owned mosquito nets. The study also indicated that in China and Vietnam, where private markets exist, the coverage is high.

In Ethiopia insecticide-impregnated mosquito nets have been introduced on a trail basis in several areas of the country as part of community-based malaria control initiatives, with some notable success in the Tigray Regional State (World Bank et al, 1999).

A study conducted in Tigray in 1997 to examine the affordability and community willingness to buy bed nets on a sample of 100 households selected from a resettlement community residing in an area of highest malaria prevalence, estimated the mean amount a family could spend for one bed net to be only US $ 1.80 (about 13 Birr). In addition, only 22 % of the respondents stated that they would try to purchase nets if provided at a time when cash is available, while 17% responded that they were too poor to buy bed nets. On the other hand, 61% of the respondents are of opinion that they would buy the nets if only provided by the government at a balanced cost (WHO, 1999). It has to be noted that currently mosquito nets are taxed a combined rate of 62% in Ethiopia (World Bank et al, 1999).

3. Methodology

3.1. Method of analysis and data sources

The study focuses on estimating the willingness to pay for insecticide-impregnated bed nets using the contingent valuation method (CVM). This method, which was originally designed to elicit the value of non-marketable environmental amenities, is now being widely used even for marketed goods that have a substantial impact on the welfare of the society. Though a bed net is a good that has a market value, the serious impacts of malaria on production, productivity and investment make it a community good.

Hence, in this study an open-ended structured questionnaire is used to elicit values that rural households are willing to pay for bed nets and to identify the factors that influence their willingness to pay decisions. The use of an open-ended questionnaire

is justified by its advantage in directly eliciting the maximum willingness to pay amount by avoiding the use of starting values, which in most cases could be a major source of bias. Moreover, the data compiled on income, asset ownership, economic cost of malaria and other related variables extends for five consecutive years (1989-1993 E.C.) and the averages of these variables are used in the analysis mainly to avoid specific yearly variations that might occur due to peculiar situations.

The survey was conducted at Ilu Woreda, a systematically selected Woreda from among 158 malaria endemic Woredas in Oromiya Regional State. This Woreda was selected mainly considering the fact that it is the number one priority area in Western Shoa Zone as well as on reasons of cost effectiveness and administrative convenience to conduct the survey. The survey covered a total of 300 households selected using appropriate sampling techniques.

The study employed both descriptive and multiple linear regression methods of analysis. The descriptive statistics are used to check the reasonability of the information collected through the survey, while the multiple regression model is utilized to identify the relationships between the dependent variable (WTP) and the independent variables (the various household characteristics).

3.2. Model specification

A general multiple regression model with κ explanatory variables can be stated as:

$$y = f(x_1, x_2, x_3, ..., x_k) + U$$

where y is the independent variable, $x_1, x_2, x_3, ..., x_k$ are the explanatory variables, and U is the random or error term. This equation can be regressed using the Ordinary Least Square (OLS) method in the following form:

$$y = \beta_o + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + ... + \beta_k x_k) + U$$

where $\beta_o, \beta_1, \beta_2, \beta_3, \ldots, \beta_k$ are the unknown parameters or coefficients of the respective explanatory variables.

In this study while the maximum willingness to pay (MWTP) is the dependent variable, the household characteristics and other relevant variables that determine WTP are the explanatory variables. Such explanatory variables include: *sex, age, and educational level of the household head, income and family size of the household, number of family members infected in the last five years by malaria, size of land holdings, number of oxen owned, and total economic cost of malaria incurred by households*.

Based on this functional specification, the model regressed using ordinary least squares (OLS) method is:

$$MWTP = \beta_O + \beta_1 SXHH + \beta_2 AHH + \beta_3 EDUHH + \beta_4 FSZH + \beta_5 SZLOH + \beta_6 NOXOH + \beta_7 INCH + \beta_8 NMIMH + \beta_9 TCMH + U$$

The following table depicts the descriptions and hypothesized relationships of the explanatory variables with the independent variable, MWTP for insecticide-impregnated bed nets.

Table 3.1: Descriptions and hypothesized relationships of the explanatory variables

Variable	Description of the variable	Hypothesized relationship
SXHH	Sex of the household head. **Dummy variable** 1 if head is female 0 otherwise	Women household heads are expected to be highly cautious for the health of their family. It is also assumed that women suffer more in taking care of the diseased household member. They are expected to react actively to the prevention and treatment of malaria. Hence, their willingness to pay for bed nets is hypothesized to be greater than that of men household heads.
AHH	Age of the household head	Younger household heads are expected to have better preference for modern means of health care facilities than older ones. Hence, the willingness to pay for bed nets may get lower and lower with increasing age.
EDUHH	Education level of the household head	It can in general be hypothesized that the more the household head is educated, the more would he/she be willing to participate in any intervention that reduces the incidences of malaria infection to the family members so that the higher would be the WTP f or bed nets.

Table 3.1 continued

Variable	Description of the variable	Hypothesized relationship
FSZH	Family size of the household	Other things remaining the same, households with large family size may inevitably have higher consumption expenditures. Therefore, due to higher household expenditure on the one hand and the more number of bed nets that might be needed for the whole household members on the other, the willingness to pay for bed nets is expected to be lower with the increase in family size.
SZLOH	Size of land owned by the household	Size of land holdings could be used as one means to estimate the wealth of rural households. Hence, households with larger plot of land are expected to have a better income and enjoy relatively better standard of living. Such households are hypothesized to have a greater WTP for bed nets
NOXOH	Number of oxen owned by the household	Ownership of oxen is one of the proxies for asset ownership. Those who own oxen not only can effectively cultivate their plots of land but also can lease land from those who do not own oxen and from female household heads and other aged households who can not plough on their own. Such households therefore would relatively be in a better position to have greater willingness to pay for bed nets.
INCH	Income of the household	The higher the income the greater will be the ability to pay for health facilities. Hence, the greater will be the WTP for bed nets.
NMIMH	Number of malaria infected members of the household in the last five years.	The higher the number of family members infected by malaria the greater is the suffering of the household. Hence such households are assumed to be highly willing to take any malaria prevention action. Therefore, it is hypothesized that WTP for bed nets will be greater with the increase in the number of household members who were infected by malaria.
TCMH	Total economic cost incurred for the prevention and treatment of malaria.	Households with higher expenditure for prevention and treatment of malaria would have more WTP for any intervention that could protect malaria infection and hence reduce the burden inflicted by the infection. Therefore, it is hypothesized that such households will have greater WTP for bed nets.

4. Findings of the survey

This section presents the empirical survey results on the willingness to pay for insecticide-impregnated bed nets of rural households in two subsections. The first presents descriptive statistical results of the survey while the second reports on the multivariate regression estimation of WTP.

4.1. Descriptive analysis

a) Households characteristics

Out of the total 300 sample households contacted 230 (76.7%) are male-headed while the rest 70 (23.3%) are female-headed households. The proportion of younger household heads (18 to 30 years of age) constitutes 21.3% of the total sample households. Those between 31 to 45, 46 to 65 and greater than 65 years of age account for 37.7, 28 and 13%, respectively.

The majority of the household heads (57%) are found to be illiterate, and those who can only read and write account for nearly 16%. It is only about 23% the household heads that have education levels ranging from primary to secondary.

Table 4.1: Education level of household heads

Education level	No	%
Illiterate	168	56.8
Read and write	47	15.9
Elementary	47	15.9
Junior Secondary	21	7.1
Secondary	13	4.4
Total	**296**	**100**

The average family size in all the five sample kebeles does not show significant variation, the lowest being 6.06 and the largest 6.81. The overall average family size is therefore 6.31. However, variations are observed at individual household level. Hence, out of the total sample households contacted, 3% of them have a family size of 1 to 2, while those with 3 to 5 family members are nearly 39%. The majority of the households (58%) are found to have more than 5 family members.

Average size of land holding per household is found to be 2.83 hectare, which is by far better than the national average. It is only 5 households (nearly 2% of the sample)

that reported not to own any land of their own. The proportion of landless households is relatively low due to voluntary redistribution of land by the elderly to their own youth family members.

Table 4.2: Average size of land holdings by sample kebeles

Name of Kebele	Number	Average land holdings *(in hectare)*
Weserbi Besi	44	3.4
Alengo Tulu	81	2.68
Bili	47	2.62
Mida Jigdu	52	3.21
Wereso Kelina	71	2.51
Total	**295**	**2.83**

However, variations in land holding are observed at individual household levels. While the majority (71%) of the households contacted owns 2 or more hectares of land, nearly 24% own between 1 to 2 hectares. The proportion of those owning less than 1 hectare is very small (5%). The landless group reported to rent or lease land from those who could not plough on their own due to various reasons.

Table 4.3: Size of land holdings per household (in hectare)

Size	No	%
<1	16	5.4
1.01 – 2	70	23.7
2.01 – 3	130	44.1
>3	79	26.8
Total	**295**	**100**

Oxen are one of the important assets for agricultural households in Ethiopia, since almost all rural households earn their livelihood from farming. The survey revealed that only a very small proportion (about 2%) of the sample households does not own oxen. The vast majority (nearly 77%) have reported to own 2 to 4 oxen.

Table 4.4: Ownership of oxen by households

Number of oxen	No	%
0	6	2.2
1	47	17.2
2	143	52.4
3 – 4	66	24.2
>4	11	4.0
Total	**273**	**100**

b) The malaria situation and its burden

Asked whether any member of their family has been ill with malaria in the last five years, the majority of the households (271 or 93%) responded in the affirmative. And large proportion of these households (97%) has also reported to have taken the sick family members to the nearby health facilities for treatment, predominantly to the nearest clinic (63%). Treatment at hospital level is low (5%) as compared to the proportion that used traditional health facilities (12%).

The number of household members infected by malaria has shown variations from household to household and from year to year. For instance, in a period of five years (1989-1993 E.C.) three to five family members were infected in nearly half (52%) of the sample households. It has to be noted that the proportion of households that reported more than five malaria infection cases per family are not also small (29%).

Table 4.5: Average number of people infected by malaria per household

Average number of sick family members	No	%
1-2	55	19.6
3-5	146	52
>5	80	28.5
Total	**281**	**100**

The total number of people reported to have been infected by the disease in the five years of analysis has also shown variations: 11.3% of the infection was in 1989, 22.1% in 1990, 43.4% in 1991, 15.8% in 1992 and 7.3% in 1993 (all in E.C). Malaria infection is reported to be the lowest in 1993 E.C. primarily because of DDT spraying in the preceding year and partly due to the change in the intensity of rainfall in the area.

On the other hand, compared to the higher rate of morbidity, mortality caused by malaria is lower. Out of the total sample households 13% have reported deaths of family members as a result of malaria infection during the above five years period of analysis. All in all, a total of 43 people are reported to have died of malaria in the five years period, about 37% of which were children under 5 years of age.

c) Willingness to pay

Reduction of man-mosquito contact is one of the malaria control measures suggested by professionals in the area. In this regard, insecticide-impregnated bed net is one of the protective measures available to reduce man-mosquito contact. This study

therefore has focused on estimating the maximum amount that rural households are willing to pay for insecticide-impregnated bed nets.

The survey questionnaire was designed in such a way that the information and knowledge that households have concerning insecticide-impregnated bed nets could be investigated before the willingness to pay questions were posed. To this end, household heads were asked if they have any information on bed nets. Accordingly, it was observed that not only nearly 97% of the respondents lack any information on bed nets, but also almost all of them (97%) have not even seen it before let alone have prior experience in using it (99%).

Recognizing the difficulty that respondents may face in answering willingness to pay questions, they were given a comprehensive explanation what an insecticide-impregnated bed net is, its importance and the results obtained in reducing malaria morbidity and mortality in many parts of the world. Posters and some items with which the rural households are familiar (for example Netela) were used to visually demonstrate bed nets. This approach has assisted a lot to ease the difficulties that respondents would have encountered in responding to the open ended willingness to pay questions.

Right after it was believed that respondents have grasped sufficient information on bed nets and the need for impregnation every six month with a cost of Birr 2.00, they were asked whether they would be willing to buy or not if it were available in the market. In this regard, about 290 (97%) household heads have positively responded to the participation question. The remaining 10 (3%) respondents, who have expressed their unwillingness to buy bed nets, were asked as to why they were not willing to buy the stated bed net. The majority (8) responded that they would not afford it.

Those who were willing to buy stated the maximum amount they would be willing to pay for a bed net as shown in Table 4.6. The table reveals that larger proportion (81%) of the respondents is willing to pay up to Birr 50 for a medium sized rectangular bed net. Household heads that are willing to pay between Birr 51 to 100 account for 15.2 percent, while those who have shown a willingness to pay above Birr 100 constitute only 3.7 percent.

Table 4.6: Willingness to pay data

WTP intervals (Birr)	Mid point (Birr)	Frequency	Relative frequency	Cumulative frequency
5 – 25	15	93	32.1	32.1
26 – 50	38	142	49.0	81.0
51 – 75	63	20	6.9	87.9
76 – 100	88	24	8.3	96.2
101 – 125	113	3	1.0	97.2
126 – 150	138	3	1.0	98.3
151 – 200	175.50	5	1.7	100
Total		**290**	**100**	

Moreover, the households were asked to state the amounts they would be willing to pay on cash and credit basis and the number of bed nets they would be willing to buy under each option. The responses obtained indicate that households would be willing to pay Birr 44.26 for a bed net sold in cash and Birr 65.05 if provided on credit basis. And the number of bed nets that each household would be willing to buy under the two scenarios is found to be one and two, respectively. It can thus be concluded that under a situation where the average family size in the survey area is close to six, the number of bed nets proposed to be purchased by respondents in either case could not be sufficient to protect the whole family against mosquito bites.

In an attempt to identify the factors that might influence the WTP decisions, the WTP responses are cross tabulated in terms of household characteristics in the tables to follow. Accordingly, no significant difference is observed in the responses of male and female respondents for WTP amounts ranging from Birr 5 to 100. However, the percentage of female household heads willing to pay above Birr 101 for a bed net is observed to be slightly greater than that of male household heads (Table 4.7).

Table 4.7: Willingness to pay amounts by type of household head

Willingness to pay interval	Male		Female	
	No	%	No	%
5 – 50	182	81.2	52	80
51 – 100	35	15.7	9	13.8
>101	7	3.1	4	6.2
Total	**224**	**100**	**65**	**100**

Viewed in terms of age, larger proportions of adult (31 – 45 years) and older (greater than 46 years) household heads are found to be willing to pay in the range of Birr 5 to

50 than the younger ones (18 – 30 years) (Table 4.8). However, the percentage of younger household heads that show willingness to pay higher amounts for bed nets is relatively greater than the other groups of respondents.

Table 4.8: Willingness to pay amounts by age

Willingness to pay Interval	18-30		31-45		46-65		>65	
	No	%	No	%	No	%	No	%
5 – 50	44	71	95	87.2	63	79	32	84.1
51 – 100	10	16.1	13	11.9	16	20.2	5	13.2
>101	8	12.9	1	0.9	1	1.3	1	2.6
Total	**62**	**100**	**109**	**100**	**80**	**100**	**38**	**100**

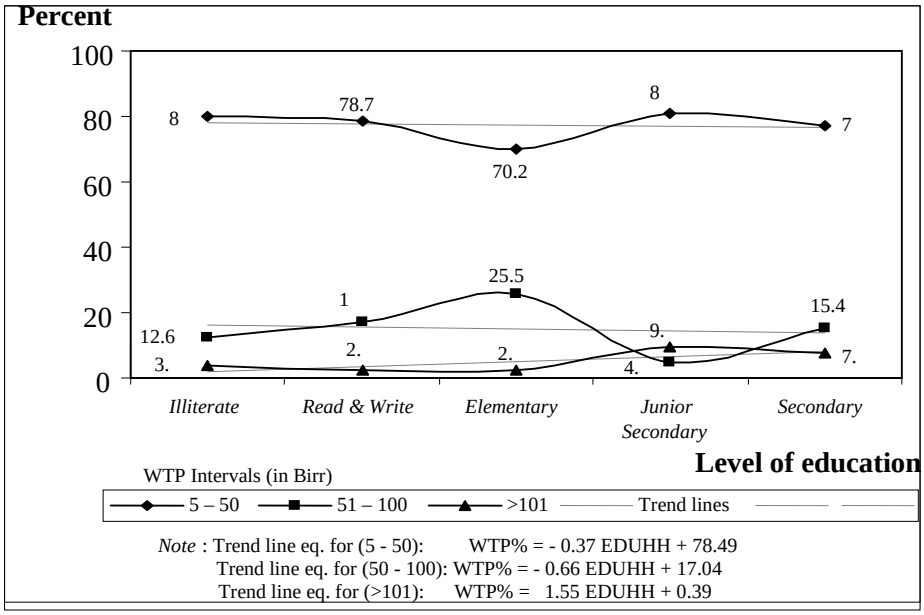
Annual income of households is also cross tabulated against WTP. The vast majority (92%) of households with mean annual income of Birr 1000 or less are willing to pay Birr 5 - 50 for an insecticide-impregnated bet net. This proportion is large compared to the respondents of higher income groups (i.e., Birr 1001 – 2000 and greater than Birr 2000). However, the proportions of households willing to pay higher amounts for bed nets (i.e., Birr 51 – 100 and greater than Birr 101) seem to increase with the level of annual income. For instance, while close to 11% of those with mean annual income of Birr 1001 – 2000 are willing to pay Birr 51 – 100, 26% of households with mean annual income exceeding Birr 2000 are willing to pay greater than Birr 101 per a bed net (Table 4.9).

As opposed to the theoretical expectation, cross tabulation of WTP with level of education failed to show any clear trend. Viewed generally, the data does not show a clear association between WTP amounts and the level of education of household heads (categorized into groups extending from those who have no formal education to those who completed secondary school) (Figure 4.1).

Table 4.9: Willingness to pay amounts by mean annual income

Willingness to pay interval	Average Total Income					
	≤1000		1001-2000		>2001	
	No	%	No	%	No	%
5 – 50	65	91.6	106	89.1	64	64
51 – 100	5	7	13	10.9	26	26
>101	1	1.4	0	0	10	10
Total	**71**	**100**	**119**	**100**	**100**	**100**

Figure 4.1: WTP responses vs level of schooling



However, closely examining the data using the trend lines generated for the different WTP responses, one may draw the following observations: (a) 70 to 81 percent of the respondents in all categories are willing to pay Birr 5 – 50 for a mosquito bed net; (b) the negative slopes of the trend lines for lower and medium payment levels indicate that the proportion of household heads willing to pay the specified amounts decreases with the education level of the respondents; and (c) for those willing to pay more than Birr 101 for a single bed net, the percentage of WTP responses and level of education are positively related, implying that the more educated the household head, the higher is the amount s/he would be willing to pay for the prevention scheme. The last observation may prompt one to conclude that 'education to have a positive influence on the WTP decisions the amount of payment involved needs to be higher'.

Ownership of land and oxen are believed to be important agricultural assets in the rural Ethiopia. It is common to observe those owning only one of these physical assets to enter into a certain form of arrangement with those having the other asset. For instance, farmers who do not have any plot of land can lease, rent or enter into share cropping practices if they own oxen. Hence, ownerships of land and oxen are hypothesized to positively influence the WTP decisions through their impacts on the income of agricultural households.

Since individual farmers are observed to differ in the size of land holdings and number of oxen they own, WTP responses are cross tabulated against these latter variables. However, the results obtained failed to clearly confirm to the proposed hypotheses. According to the study, there is no clear indication that the amount households are willing to pay for an insecticide-impregnated bed net increases with the increase in land size and number of oxen they own. Rather close examinations of the results obtained seem to reveal that WTP responses are showing generally a decreasing trend at the lower WTP interval and an increasing trend at medium and higher WTP amount when land size and number of oxen are increasing (Figures 4.2 and 4.3).

Generally, two major conclusions can be drawn from the above analysis. First, the majority of the respondents (55 – 83%) are willing to pay in the range of Birr 5 to 50 for a bed net. Secondly, large land holdings and owning many oxen have a positive influence on WTP decisions if only the amount of payment involved is higher.

Figure 4.2: WTP responses vs land size

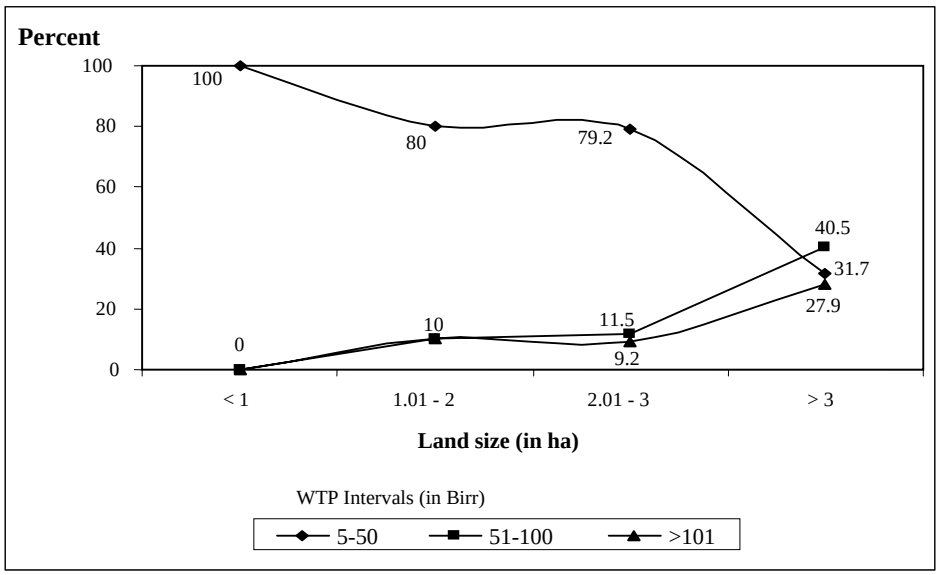
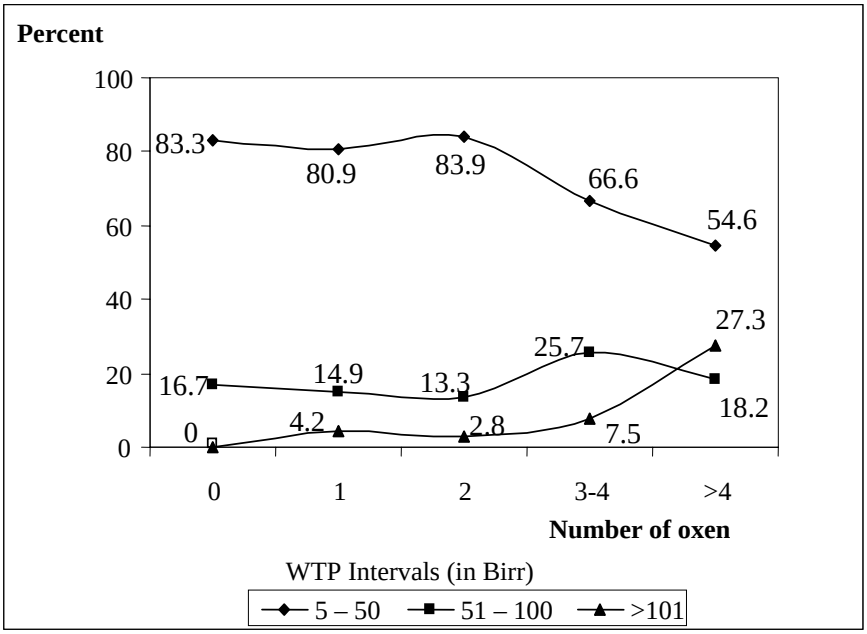


Figure 4.3: WTP responses vs number of oxen owned



Cross tabulation of WTP responses with family size has also produced mixed results: a negative relationship at the lower level of payment and a positive association at medium and higher payment levels. While the former is in perfect agreement with the proposed hypothesis, the latter is not. That is, except at the lower level of payment (Birr 5 – 50), the larger the family size the higher is the households' willingness to pay higher amounts for a bed net (Table 4.10). This result could probably show the larger marginal contribution of family size on income of the household compared to its effect in increasing the total expenditure of the household. In this regard, one could argue that large family size provides more agricultural labour force, which of course is the basis for intensive and extensive farming practices, that would likely result in higher household income.

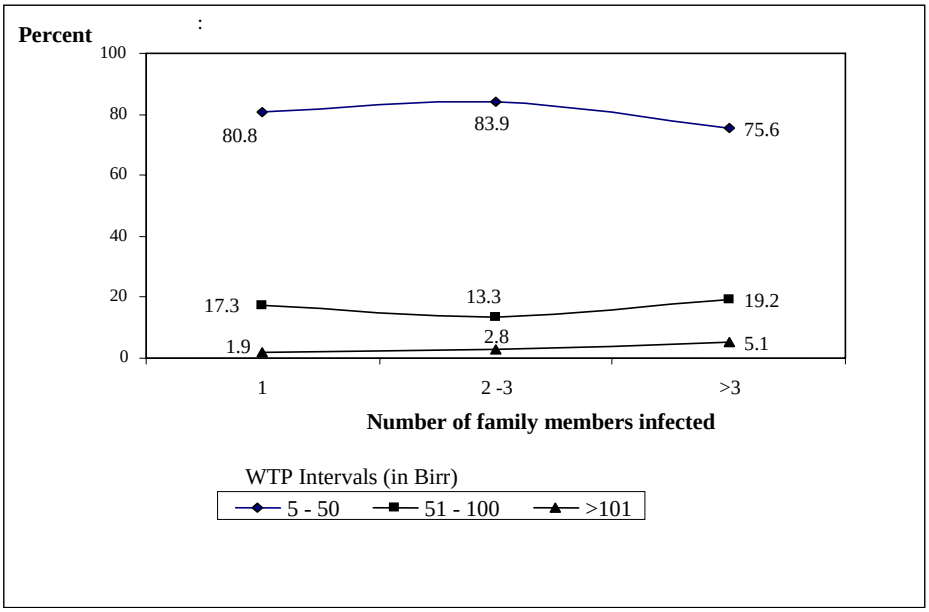
However, it may be reasonable to accept the negative association as it is the one depicted by the majority of the cases. Because for the vast majority (81 – 87%) of the respondents under each category who prefer to pay only Birr 5 – 50 for a single bed net, the proportion of WTP responses decreases with the increase in the family size.

Table 4.10: Willingness to pay by family size

Willingness to pay interval	1-2		3-5		>5	
	No	%	No	%	No	%
5 – 50	7	87. 5	91	81.3	137	80.6
51 – 100	1	12.5	17	15.2	26	15.3
>101	0	0	4	3.5	7	4.1
Total	**8**	**100**	**112**	**100**	**170**	**100**

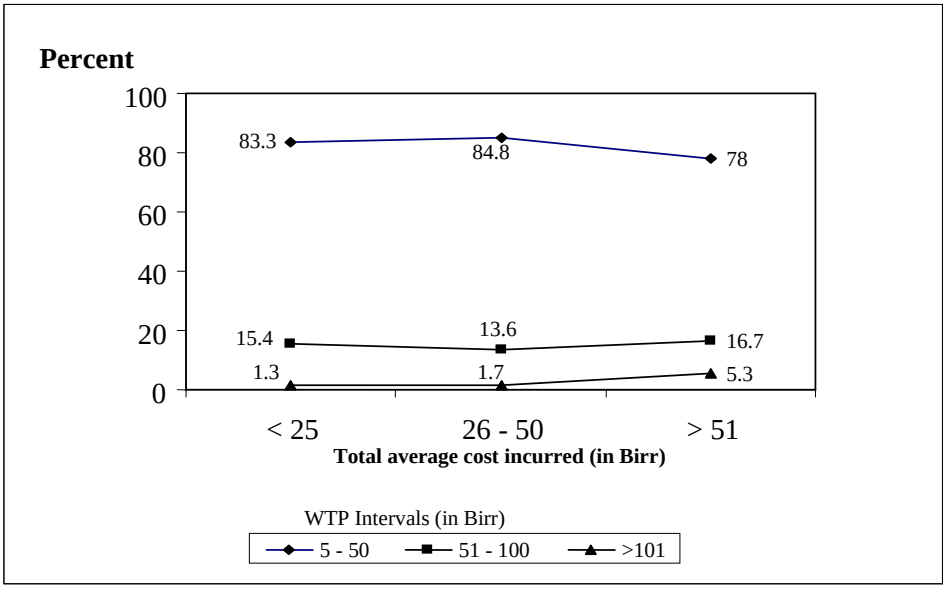
Finally, cross tabulation seems to depict positive associations, though not consistently, between WTP amounts and two related variables: the number of family members infected by malaria, and the associated expenditure on malaria prevention, treatment and other expenses. Except at the lower level of payment (Birr 5 – 50), which more than 75% of the respondents are willing to pay, WTP decisions are observed to vary directly with both the number of malaria infected family members and the total average cost incurred due to malaria infection (Figures 4.4 and 4.5). For instance, the larger the number of family members infected with malaria the higher is the proportion of households willing to pay more than Birr 101 for a bed net. The same relationship is also observed between WTP responses and the average amount of money expended on malaria prevention, treatment and other associated costs.

Figure 4.4: WTP responses vs number of malaria infected family members



All the above relationships depicted by cross tabulation would be further examined and elaborate discussions would be made how significantly the explanatory variables affect the WTP decisions using regression analysis.

Figure 4.5: WTP responses vs total average cost incurred due to malaria infection



4.2. Regression results

As stated in the introduction, identifying the determinants of households' willingness to pay for insecticide-impregnated bed nets is one of the objectives of this study. For such an exercise the multivariate analysis is usually employed for the quality of information it provides. In a contingent valuation method (CVM) that attempts to elicit how much individuals or households are willing to pay, the ordinary least square (OLS) method could be used when the number of non affirmative responses to the participation question is few. For the study since only 12 households, out of the 300 sample households covered by the survey, responded "no" to the WTP question, the OLS method could therefore qualify and hence is used for the estimation. Moreover the correlation between all explanatory variables was checked against a bivarate correlation matrix of the SPSS econometric package. Thus there is a positive correlation between number of infected family members and total economic cost of

malaria as depicted by Pearson correlation coefficient test, which is found to be o.407. This confirms that the higher the number of family members infected by malaria the higher is the cost incurred.

After checking that there is no heteroscdasticity[5] problem in the data set the linear model

$$MWTP = \beta_O + \beta_1 SXHH + \beta_2 AHH + \beta_3 EDUHH + \beta_4 FSZH + \beta_5 SZLOH + \beta_6 NOXOH + \beta_7 INCH + \beta_8 NMIMH + \beta_9 TCMH + U$$

is regressed using OLS and the estimation results indicated in Table 4.11 are generated.

The result revealed that income of the household is the most dominant factor in positively influencing the willingness to pay decisions. This is in perfect conformity with economic theory that postulates income to be one of the positive determinants of demand for goods and services. In addition, the cross tabulation of these variables had also generated the same result.

Table 4.11: OLS estimation results

Variables	Coefficients	Standard Error	t-ratio	Significance Level
Constant	32.302	5.410	5.970	.000
SXHH	-1.214	2.947	-.412	.681
AHH	-.222	.081	-2.751	.006
EDUHH	-7.457	2.674	-2.788	.006
FSZH	-1.506	.574	-2.624	.009
SZLOH	1.256	1.281	.980	.328
NOXOH	4.281	1.418	3.020	.003
INCH	9.716	.000	5.123	.000
SZMIMH	1.669	.530	3.148	.002
TCMH	4.404	.002	2.227	.027
Adjusted R^2 = .240		Standard error of the estimate = 18.5983		
F-value = 10.562		Number of observation = 274		

[5] A standard econometric test for the equality of variances; i.e., a method of testing whether or not the variances between the actual sample values and the sample mean are remaining constant between observations.

The other important factor found to determine willingness to pay is ownership of oxen. Oxen are one of the important assets to the rural households in determining their well being. Households with more oxen could cultivate more plots of land by renting, leasing or sharecropping in addition to their own plots. Farmers owning more oxen could also generate more income by renting them to other households. Hence, the positive coefficient indicates that the higher the number of oxen owned the greater is the willingness to pay for bed nets. As opposed to the ambiguous cross tabulation results obtained earlier, the regression analysis indicates a statistically significant association between the maximum willingness to pay amounts and ownership of oxen.

The regression result further revealed that those households whose family members are suffering from malaria infection are highly willing to purchase insecticide-impregnated bed nets. The higher the number of malaria ill family members the larger is the households' willingness to pay for a measure that help reduce the malaria infection incidence.

The household expenditure on malaria prevention, treatment and other associated costs, referred to as total cost of malaria to rural households, is another important explanatory variable included in the model. Theoretically households with higher expenditure for the prevention and treatment of any disease are expected to have a greater willingness to pay for any intervention that could reduce or totally abandon the burden inflicted by the disease. The result of the regression confirmed the above expectation. Total cost incurred by households due to malaria is found to be a statistically significant factor positively influencing the WTP decisions.

It has to be recalled that mixed results were obtained earlier by cross tabulating the above two variables (the number of malaria infected family members and the associated economic cost) against WTP amounts. The regression analysis has now provided a statistical justification that it is the positive relationships that are governing the associations between the variables under consideration.

On the other hand, the model estimation revealed that WTP amounts have negative and significant associations with three explanatory variables: age and education level of the household head and family size of the household. Note also that similar results were also obtained by cross tabulation of these variables with WTP amounts.

The negative coefficient for age depicts that younger household heads have more preference for modern means of health care goods and services than older

household heads. Hence, the amount the household is willing to pay for a bed net may fall with the increase in the age of the family head.

Better education is generally assumed to create more awareness for health and hence a positive relationship was expected to exist between educational level of the household head and the willingness to pay for bed nets. But contrary to the expected relationship, the coefficient of education is found to be negative and significant, indicating a decline in the WTP amounts with education level. No valid theoretical explanation could be suggested for such an outcome other than suspecting strategic bias on the parts of respondents. It may not be wrong to assume that the power to link the present with the future increases with an increase in the level of education. If this is the case, relatively more educated household heads might have suspected their willingness to pay responses to influence the future price of bed nets and therefore deliberately quoted lower willingness to pay amounts.

The other variable with a negative coefficient is the family size of the household. The statistically significant and negative coefficient of this variable shows the decline in the maximum willingness to pay amounts as the number of family members increases. Actually this result confirms with the hypothesized relationship. Other things remaining constant, consumption expenditure is expected to be inevitably higher in households with large family size. Therefore, due to higher household expenditure on the one hand and the increased amount of bed nets that might be needed for the whole household members on the other, the amount such households would be willing to pay for a bed net is likely to be lower.

Finally, contrary to the proposed hypotheses, sex of the household head and size of land holdings are turned out to be statistically insignificant determinants of the WTP decisions.

Women household heads were expected to be highly cautious for the health of their family. It was also assumed that women would be the one who devote much of their time and energy in taking care of the family members that have fallen ill. From these the assumption that ‘women react more actively to any intervention directed towards the prevention and treatment of malaria’ followed. Accordingly, their willingness to pay for bed nets was hypothesized to be greater than that of men household heads. Nevertheless, the coefficient for the sex of the household head is found to be negative and insignificant, implying that gender has no significant role in influencing the amount of money households would be spending on the purchase of bed nets. It

has to be noted that the slight difference observed between the responses of male and female household heads as depicted by the cross tabulation (Table 4.7) is proved to be insignificant.

As a proxy measure of the wealth of rural households, though the size of land holdings is expected to produce a positive impact on the WTP decisions, the regression analysis failed to support the assertion. Other things remaining the same, the size of land a household owns is observed to have no effect at all on the amount it is willing to pay for mosquito bed nets. The regression analysis result has, therefore, invalidated the dominantly opposite relationship generated by cross tabulating WTP amounts with the size of land holdings. This means that the association observed between the two variables (Figure 4.2) is statistically insignificant.

Summing up, all the explanatory variables, except sex of the household head and size of land holdings, are found to be statistically significant factors having sound relationships with the maximum willingness to pay amounts.

5. Summary and policy implications

5.1. Summary

Health is both a capital and consumption good. As capital good it contributes to economic development since labour is one of the most important factors of production. As consumption good it provides satisfaction by reducing suffering from ill health.

Malaria is a communicable disease that threatens the health and lives of millions around the world. In Ethiopia about two third of the country's population and 75 percent of the area of the country are at risk of malaria. It is the second largest killer disease that affects about 4 to 5 million people annually. The rural households are more vulnerable to malaria because they are the ones who severely suffer from lack of access to health services, low income and socio-cultural factors.

The fact that malaria is a health problem posed on the nation as a whole necessitates a concerted action from the government and the public alike in designing and implementing appropriate prevention and control schemes. Accordingly, this study

has attempted not only to estimate the willingness to pay for insecticide-impregnated bed-net but also to identify the factors that determine the amount rural households are willingness to pay for it.

Thus, the survey has estimated the mean willingness to pay for an insecticide-impregnated bed net to be Birr 44.26 if paid in cash and Birr 65.05 if provided on credit basis. Viewed in terms of the willingness to pay intervals, it was observed that 81 percent of the respondents were willing to pay up to Birr 50 for a medium sized rectangular bed net. Households willing to pay between Birr 51 to 100 constituted 15.2 percent and those who would be willing to pay more than Birr 101 accounted for only 3.7 percent. All in all about 97% of the respondents have shown willingness to pay for insecticide-impregnated bed nets. As to the number of bed nets households would be willing to buy, the respondents indicated that they would buy one if sold in cash and two if supplied on credit.

An attempt has been made to identify the factors that might influence the willingness to pay decisions through cross tabulation and multivariate statistical technique, specifically using ordinary least squares method.

Hence, number of oxen owned, mean annual income, number of malaria infected family members and total cost incurred for the prevention and treatment of malaria are found to have a positive influence on the maximum willingness to pay amounts. On the other hand, age and educational level of the household head and family size of the household have opposite influence on the willingness to pay decisions. Except the level of education of the household head, the results obtained for the other two variables conform to the theoretical expectations. Furthermore, contrary to the hypothesized relationships, sex of the household head and size of land holdings are found to have no impact at all on the maximum willing to pay amounts.

5.2. Policy implications

The last objective of the study is to indicate some policy implications that could assist in decision making. To this end, the following policy implications can be extracted from the results of study.

a) In addition to the environmental sanitation endeavour, the use of insecticide-impregnated bed nets is one of the best and easiest methods of malaria prevention and control measures. Despite this fact, the great majority of the

households surveyed (97%) reported that they had no prior information about an insecticide-impregnated bed net and its role in preventing mosquito bites. This, therefore, is an indication of the massive work that should be done in community mobilization (through awareness creation and health education at the grass root level, for instance) on the one hand, and the emphasis to be placed on the preventive measures in order to control the rapid spread of the disease, on the other.

These require, among others, not only mobilizing the existing human, material and financial resources deployed in the area, but also allocating more financial resources and recruiting and training additional manpower. In this regard, the Ministry of Health is expected to design appropriate national strategies that help mobilize the required finance and coordinate and direct the activities of all those involved in the sector.

b) Among the various explanatory variables income is found to be the most important determinant of the willingness to pay for insecticide-impregnated bed nets. This was confirmed both by the descriptive and multivariate statistical analyses. Moreover, various statistical sources indicate that the mean annual income of the Ethiopian population as a whole is one of the lowest in the world.

The implication of this, therefore, is that the willingness to pay for bed nets is highly constrained mainly by the low income of the society. Hence, the majority of the rural households in Ethiopia can not afford to purchase insecticide-impregnated bed nets at the current market price, which is between Birr 100 to 130 for medium sized rectangular bed net. It should be noted that on the average the maximum amount the surveyed households were willing to pay for a bed net is only Birr 44.26.

c) The wide gap between the market price of insecticide-impregnated bed net and the maximum willingness to pay amount could be significantly narrowed down if the 62% combined tax rate (World Bank et al, 1992) levied on mosquito nets is completely lifted. If the government introduces a special cost sharing arrangement or provides a special tax incentive that promotes domestic production of insecticide-impregnated bed nets, the market price is likely to fall to the amount the society affords to pay. This in turn is expected to produce a positive impact on the extensive use of mosquito bed nets, which could be a

major achievement in the endeavour being made to halt the rapid expansion of malaria infection in the country.

d) The need for impregnation every six months, which is part of the effective utilization of mosquito nets, implies the necessity of providing special orientation to the rural households regarding the need for treating the nets with insecticide and the precaution to be taken. It should also be noted that this could be an additional factor that further constrains the purchase of bed nets under the current price level.

Finally, as this is a case study the results obtained could not be used to make generalization about the whole country regarding the issues raised relating to the WTP decisions. The study, therefore, recommends an extensive research to be conducted on sample areas that would represent the whole country. Such a study not only estimates the willingness to pay for insecticide-impregnated bed nets but also may generate substantial information that could be used as an input in the decisions to be taken regarding the prevention and control of the deadly disease, malaria.

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