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The Economic Value of Camel Milk in Aba'ala Woreda, Afar Regional State, Ethiopia: A Contingent Valuation Study

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Abstract

Even if camel's milk is known for its varied economic and health benefits, unlike the live camel, there is no market for it in Afar region in general and in Aba'ala woreda[1] in particular. In this study, the researcher has attempted to investigate how much value the households can assign (willing to pay) for camel milk and the determinants of willingness to pay (WTP) for it using a Contingent Valuation Method (CVM). The CVM was based on face to face interview and the surveyed sample households were asked double-bounded dichotomous choice questions followed by an open-ended questions to elicit their WTP for camel milk. Out of the total 250 sample households 3 of them were not willing to purchase but the remainder 247 were willing to purchase camel milk had it been camel milk market in the woreda. In this study, three econometric models; Tobit, Probit and Bivariate Probit models were employed. The result from the Tobit model revealed that households' income, age, remittance and the randomly offered bid positively and significantly affects households' maximum WTP for camel milk. On the other hand, age square affects households' maximum WTP for camel milk negatively and significantly. In the Probit model, the main determinants of the households' probability of accepting the randomly offered bid are income, remittance, age, age square, the randomly offered bid, education level of the household head and adult ratio. Income of the household, remittance, age of the household head and education level of the household head positively and significantly affects the probability of accepting the randomly offered bid. On the other hand, age square, the randomly offered bid and adult ratio negatively and significantly affects the probability of saying "yes". In this study the Bivariate Probit model was employed to verify the statistical efficiency gain of the double-bounded over the single-bounded dichotomous choice model. Therefore, it is found that the double-bounded dichotomous choice model does not increase statistical efficiency over the single-bounded dichotomous choice model. Hence, we can employ the single-bounded dichotomous choice model instead of the double-bounded dichotomous choice model. Moreover, the mean WTP for camel milk computed from the three models is almost equal.

Key Words: Aba'ala, Afar, Bid, Bivariate Probit, Camel Milk, CVM, Double Bounded, Open ended, Probit, Single-Bounded, Tobit, WTP.

1. Introduction

Pastoralism is a social and economic system based on the raising and herding of livestock and it is a livelihood system practiced in the arid and semi-arid areas of the world. Drylands cover about 43% of Africa's inhabited surface and it is thought, there are about 268 million pastoralists on the African continent (African Union, 2010). Moreover, pastoralism is one of the oldest socio-economic system in Ethiopia, in which livestock production in open grazing areas represents the major means of livelihood. Pastoralists cover about 60% of the national territory and constitute 12% of the total population of the country (Mohammed, 2004; FDRE Ministry of Federal Affairs, 2008).

Ethiopia, with its vast arid and semi-arid areas, has the largest number of domestic livestock in Africa and much of it coming from the country's pastoral and agro-pastoral areas. These areas contain an approximately 30% of the national animal population of cattle, 52% of sheep, 45% of goats and close to 100 % of camels (Catley, 2009). In most developing countries like Ethiopia, livestock has an economic and social importance both at household and national levels and it contributes a significant share of the national export earnings. Livestock contributes approximately 15-17% of GDP, 35-49% of agricultural GDP and 37-87% of the household incomes (Sintayehu *et al*., 2010). Lowland breeds of livestock play an important role in the national economy and in the 1980s, 90% of the total export of live animals was coming from arid and semi-arid areas (Kahsay *et al*., 1999). Although much can be said about the pastoralist sub-sector, the avaialble data and the knowledge we

[1] Is an administrative unit in Ethiopia, which is similar to District

have about it is very seketchy (Mohammed, 2004; Kahsay *et al*., 1999). Moreover, despite its contribution to the national economy, past development policies showed that pastoralism has been neglected for many years and what ever development policy put in place have remained inappropriate until recent years (Mohammed, 2004).

The lowland areas of North East Africa, in which Ethiopia is located, are known for their huge camel population. According to FAO (2008), the total population of camels in the world was 22 million and over 80% of them found in Africa with highest concentration in North East Africa (63% of the world camel population). According to this report, Ethiopia with its 2.3 million camels have the third largest camel herd in the world after Somalia and Sudan with 7 million and 3.7 million respectively.

Camels play an important role in the arid and semi arid areas for its milk, meat and energy production. However, the economic contribution of camel to the livelihood of the pastoralist population in particular and national economy in general has never been properly accounted because the milk and meat production is yet mainly used for subsistence consumption, or, in case of surplus considered as a gift and significant amount camel milk is wasted. Besides, only few references are available, albeit recording data are now steadier than in the past (Faye, 2004). Although camel's milk has been consumed for thousands of years in Africa and the Middle East, its economic and medical benefits were not documented until recently. Camel milk is famous for its nutritional qualities and health properties (Faye, 2004; Raziq *et al.,* 2011). Agrawal *et al.,* (2003); Musinga *et al.,* (2008); LPPS, (2005), have demonstrated anti-diabetic properties of camel milk and its positive effect in controlling high blood pressure.

Even if Ethiopia is the third largest producer of camel, it is the second largest producer of camel milk in the world with 175,000 Metric tons after Somalia with 870,000 Metric tons and followed by Sudan, Mali, Kenya with 94,000, 55,700, 32,500 Metric tons respectively (FAO statistics, 2008). In Ethiopia, under rain fed conditions, camels can be milked 13 kg per day. However, the camels are not intensively milked, some milk is left for their calves and the exact amount is difficult to know (Knoess, 1979).

Afar region[1] is one of the four major pastoral regions in Ethiopia. People in the region are dependent on livestock production, especially in camel, cattle and small ruminants for their livelihoods. The livestock population in the region is 703,424 cattle, 1,003,000 heads of sheep, 2,014,418 heads of goats and 301,733 camels (Philpott *et al*., 2005). The camels play vital role by supplying milk almost throughout the year to the people in the region (Kebebew, 1999). Hence, camel's milk contribution towards securing food for Afar pastoralists is indispensible (PFE, 2009).

However, unlike the international experiences of camel milk market in Kenya (Musinga *et al.*, 2008; Siloma, 2012), Mauritania (Gaye, n.d), and national experience of Ethiopia's (Somali regional state, Yohannes *et al*., 2007) as source of income, selling camel milk in Afar region is taboo. According to Dahl (1979) cited in Yagil (1982), the milk of the Afar camels in Ethiopia is not allowed to be processed or sold, despite its economic and health benefits (Agrawal *et al*., 2003; Musinga *et al*., 2008; LPPS, 2005).

Therefore, the researcher has attempted to answer the following research questions:

- How much is the households' willingness to pay for camel milk in Aba'ala woreda?
- What are the main determinants of households' willingness to pay for camel milk in the study area?
- How much is the aggregate economic benefit that would be obtained using the households' willingness to pay in the study area?
- Why camel milk is not commercialized in Afar region in general and in Aba'ala woreda particular?

2. The Empirical CVM Survey

2.1. Description of the study area

Afar region covers one-third of pastoral areas of the country (Yirgalem, 2001). It has a total population of 1,390,273 consisting of 13.32% urban and 86.68% rural inhabitants (CSA, 2007). Majority of the land is dry and rocky, unsuitable for cultivation. Out of the total area cultivable land constitutes 5.24%. For this reason, the region is frequently exposed to persistent droughts and is classified as one of the drought-affected regions in Ethiopia. People in the region therefore depend mainly on livestock production for their livelihood (PFE, 2009).

[1] Throughout the paper Afar region is synonymously used as Afar National Regional State.

The study area, Aba'ala (formerly called Shiket) woreda is found in the northern part of Afar region, north - eastern part of Ethiopia. Aba'ala woreda lies approximately between 13°15' and 13°30' North latitude and 39°39' and 39°55' East longitude. It is about 50 km east of Mekelle city, Tigray regional state. It is characterized by semi-arid type of climate with sandy and salty soils (Diress *et. al.,* 1999; Yirgalem, 2001). The woreda has a population of 37,963 consisting of 10,301 (27.13%) urban and 27, 662 (72.87%) rural inhabitants (CSA, 2007). Livelihood of the people in the woreda is also dependent on livestock production. The livestock population in the woreda is estimated at 33,938 cattle, 34,144 heads of sheep, 149,450 heads of goats, 22,069 camels and 725 mules (CSA, 2004).

2.2. Data Source, Sampling and Survey Design

This study uses mainly primary data which is collected through a Contingent Valuation survey with face to face interview and focus group discussions (FGD). The study area is purposefully selected, for its huge potential of camel milk, but no market for it in the woreda. Time and money limits the researcher from expanding to include other woredas in Afar region for more investigation. Aba'ala town, the major town of the woreda, based on the 2007 Census conducted by the Central Statistical Agency of Ethiopia (CSA), has a total population of 10,301 of whom 5,191 are men and 5110 are women. Moreover, about 80.53% of the populations are Islamic religion followers and since, most of the time camel milk is consumed by Muslims, then, the respondents are purposively selected that is, they are all Muslims. Out of the total Muslim population found in the study area about 250 household were selected using simple random sampling. Out of the 250 households 247 of them were used for further analysis but the remainder 3 households were excluded from further analysis because they were protest zeros. Since, the number of invalid responses (protest zeros) are very small then this may be too small to result in sample selection bias.

There are about five major elicitation methods so far used in contingent valuation (CV) surveys. These are: the open-ended/direct question, bidding game, payment card, dichotomous choice method (single-bounded dichotomous choice) and dichotomous choice method with follow up (double-bounded dichotomous choice). Open-ended question, single-bounded dichotomous choice and double-bonded dichotomous choice approaches were applied in this study. In the single-bounded dichotomous choice approach the respondents were asked a question requiring a "*yes" or "no"* response about whether they would accept the randomly offered bid or not. In the double-bounded dichotomous choice approach, the respondents were also asked a question requiring a "*yes" or "no"* response about whether they would accept the randomly offered follow up bid or not. Moreover, if the respondents say "*yes"*, another willingness to pay (WTP) question was asked using a higher bid (the bid would be doubled). If the respondents say "*no"*, another WTP question was asked using a lower bid (the bid would be halved).

To come up with the first draft of the questionnaire, the researcher did FGD. Following the piloting and finalization of the survey questionnaires, survey was conducted using seven experienced enumerators selected based on their experience in household survey and their knowledge of Afar language. The CV survey begins with the opening statement on "Households WTP for Camel Milk" and its first part contains the DBDC question followed by an OE questions. The contingent valuation (CV) scenario tries to give as much information as possible for the respondent about the hypothetical market, about the good to be valued, the payment vehicle and method of delivery. Important points, which are suggested by Mitchell and Carson, (1989) and Arrow *et al.,* (1993) to be considered in the scenario, are incorporated as much as possible. The second part of the questionnaire contains questions related with household socio-economic and demographic characteristics.

After incorporating the findings of the pilot survey and focus group discussion the following double-bounded dichotomous question was developed. Hence, the amount of initial bid and follow-up bids and their corresponding sample size distribution is presented in the table below.

Table 2.1: Bid design and number of randomly assigned sample households

Bids			Sample size
1st round bid	2nd round bid if "YES" in 1st round	2nd round bid if " NO" in 1st round	
15	30	7.5	83
10	20	5	84
5	10	2.5	80

3. Empirical Models

3.1. The Random Utility Model (RUM)

In the single-bounded valuation question the dependent variable takes 1 if the respondent says yes and 0 otherwise. The basic model for analyzing dichotomous CV responses is the RUM. Therefore, RUM developed by Haab and McConnell, (2002) is employed. In the CV case, there are two alternatives, so that indirect utility for respondent j is written as;

$$v_{ij} = v_i\left(m_j, z_j, \varepsilon_{ij}\right) \tag{3.1}$$

Where i = 1is the final state and i = 0 is the status quo. Utility is determined by m_j (the j^{th} respondent's income), Z_j (vector of households socio-economic characteristics) and the error term ε_{ij}.

The respondent j accepts the randomly assigned bid B_j if and only if;

$$v_1\left(m_j - B_j, z_j, \varepsilon_{1j}\right) > v_0\left(m_j, z_j, \varepsilon_{0j}\right) \tag{3.2}$$

The probability of "Yes" response is;

$$\Pr(yes_j) = \Pr(v_1\left(m_j - B_j, z_j, \varepsilon_{1j}\right) > v_0\left(m_j, z_j, \varepsilon_{0j}\right)) \tag{3.3}$$

Utility function as additively separable in deterministic and stochastic preferences can be written as:

$$v_j\left(m_j, z_j, \varepsilon_{ij}\right) = U_i\left(m_j, z_j\right) + \varepsilon_{ij} \tag{3.4}$$

The probability statement for respondent j becomes

$$\begin{aligned}\Pr(yes_j) &= \Pr[U_1\left(m_j - B_j, z_j\right) + \varepsilon_{1j} > U_0\left(m_j, z_j\right) + \varepsilon_{0j}] \\ &= \Pr[U_1\left(m_j - B_j, z_j\right) - U_0\left(m_j, z_j\right) > \varepsilon_{0j} - \varepsilon_{1j}] \\ &= F_\eta[\Delta U]\end{aligned} \tag{3.5}$$

Where $\eta = \varepsilon_{0j} - \varepsilon_{1j}$, $\Delta U = v_1 - v_0$ and $F_\eta(\Delta U)$ is the cdf of η.

The deterministic part of linear utility function is;

$$U_{ij}\left(m_j\right) = \alpha_i z_j + \beta_i(m_j) \tag{3.6}$$

$$U_{1j}\left(m_j - B_j\right) = \alpha_1 z_j + \beta_1(m_j - B_j) \tag{3.7}$$

$$U_{0j}\left(m_j\right) = \alpha_0 z_j + \beta_0(m_j) \tag{3.8}$$

With constant marginal utility of income the change in deterministic utility is;

$$U_{1j} - U_{0j} = \alpha z_j + \beta B_j \tag{3.9}$$

Thus, the probability of "Yes" for respondent j can be estimated as;

$$\Pr(\alpha z_j - \beta B_j + \varepsilon_{ij} > 0) = \Pr(\varepsilon_{ij} < \alpha z_j - \beta B_j) = \Phi\left(\frac{\alpha z_j}{\sigma} - \frac{\beta B_j}{\sigma}\right) \tag{3.10}$$

Where Φ is the cnd function, α is vector socio-economic characteristics and β is the parameter estimate of the bid.

The Likelihood function for the probit model is;

$$L(\alpha, \beta | m, z, B) = \prod_{j=1}^{T} \left[\Phi\left(\frac{\alpha z_j}{\sigma} - \frac{\beta B_j}{\sigma} \right) \right]^{I_j} \left[1 - \Phi\left(\frac{\alpha z_j}{\sigma} - \frac{\beta B_j}{\sigma} \right) \right]^{1-I_j}$$

(3.11)

The study employed the Probit model and it is used to examine factors affecting the willingness to pay (WTP) of households for camel milk. The model takes the following form (Cameron and Quiggin, 1994).

$$WTP_i^* = X_i^* \beta + \varepsilon_i$$

WTP^* is unobservable latent variable, that is unobservable households willingness to pay for camel milk. But, we can observe the dummy variable WTP_i which is defined as:

$$WTP_i = 1 \quad \text{If} \quad WTP_i^* > B^1$$

$$WTP_i = 0 \quad \text{If} \quad WTP_i^* < B^1$$

Where, WTP_i = is willingness to pay of the i[th] household (1, if the response is "Yes" and 0, if the response is "No")

X_i = is Vector of independent or explanatory variables

β = Vector of Coefficients

ε_i = is the error term where, $\varepsilon_i \sim (0, \sigma^2)$

WTP_i^* = is the latent variable

B^1 = is the bid randomly offered to the respondents

The mean is an appropriate welfare measure but not the median (Hanemann and Kanninen, 1998). Since the probit model is used to calculate the mean WTP, for the single bounded questions it can be defined as below:

$$MeanWTP = \mu = \frac{-\alpha}{\beta}$$

Where α = is the constant or intercept term

β = is the coefficient of the 'bid' posed to the respondent

The regression parameters was estimated by Maximum Likelihood Estimator using STATA econometric software.

3.2. The Bivariate Probit Model

The double-bounded version of discrete response CV comes as follow up question on the initial question, by advancing a higher or lower bid depending on the response to the first bid (Hanemann and Kanninen, 1998). If we assume the unobserved willingness to pay of the respondent i (WTP_i^0) in the first question is between the lowest value (WTP_i^L) and the highest value (WTP_i^H) and if the respondent is asked whether she/he is willing to pay B^q amount for one liter camel milk or not where, q=1 if B is the first bid amount and q=2 if B is the second bid. Therefore, there are four possible response sequences: (a) both answers are yes; (b) both answers are no; (c) a yes answer followed by a no answer; and (d) a no answer followed by a yes answer (Haab and McConnell, 2002; Hanemann and Kanninen, 1998).

a. Yes-Yes, if the respondent answers "yes" for both the first bid and the second bid, that is, $WTP_i > B^1$ and $WTP_i > B^2$.

b. Yes-No, if the respondent answers "yes" for the first bid and "No" for the second bid, that is, $WTP_i > B^1$ and $WTP_i < B^2$ or ($B^1 < WTP_i < B^2$) that is, the highest willingness to pay is between WTP_i^L and WTP_i^H.

c. No - Yes, if the respondent answers "No" for the first bid and "yes" for the second bid that is, $WTP_i < B^1$ and $WTP_i > B^2$.

d. No - No, if the respondent answers "No" for both the first bid and the second bid, that is, $WTP_i < B^1$ and $WTP_i < B^2$ that is, the highest willingness to pay is between 0 and WTP_i^L.

Hence, the probability of the responses is given by;

Pr {Yes /Yes} P^{yy} = Pr ($WTP_i^1 > B^1$, $WTP_i^2 > B^2$)

Pr {No / No} P^{nn} = Pr ($WTP_i^1 < B^1$, $WTP_i^2 < B^2$)

Pr {Yes / No} P^{yn} = Pr ($WTP_i^1 > B^1$, $WTP_i^2 < B^2$)

Pr {No / Yes} P^{ny} = Pr ($WTP_i^1 < B^1$, $WTP_i^2 > B^2$)

The most general econometric model for the double-bounded data comes from the formulation (Haab and McConnell, 2002).

$$WTP_{qi} = \mu_q + \varepsilon_{qi}$$

Where WTP_{qi} represents the i^{th} respondent's willingness to pay, and q=1, 2 represents the first and second answers. The μ_1 and μ_2 are the means for the first and second responses. This general model incorporates the idea that, for an individual, the first and second responses to the CV questions are different, perhaps by the same covariates but with different response vectors and with different random terms.

To build the likelihood function, we first derive the probability of observing each of the possible two-bid response sequences (yes-yes, yes-no, no-yes, no-no). For instance, the probability that respondent j answers yes to the first bid and no to the second is given by;

$$\Pr(yes, no) = \Pr(\mu_1 + \varepsilon_{1i} \geq B^1, \mu_2 + \varepsilon_{2i} < B^2)$$

The other three response sequences can be constructed in the same way. The i^{th} contribution to the likelihood function is;

$$L_i(\mu|B) = \Pr(\mu_1 + \varepsilon_{1i} \geq B^1, \mu_2 + \varepsilon_{2i} < B^2)^{YN} * \Pr(\mu_1 + \varepsilon_{1i} > B^1, \mu_2 + \varepsilon_{2i} \geq B^2)^{YY}$$
$$* \Pr(\mu_1 + \varepsilon_{1i} < B^1, \mu_2 + \varepsilon_{2i} < B^2)^{NN} * \Pr(\mu_1 + \varepsilon_{1i} < B^1, \mu_2 + \varepsilon_{2i} > B^2)^{NY}$$

Where YY=1 for a yes-yes answer, 0 otherwise, NY=1 for a no-yes answer, 0 otherwise, YN=1 for a yes-no answer, 0 otherwise and NN=1 for a no-no answer, 0 otherwise. This formulation is referred to as the bivariate discrete choice model. If the error terms are assumed to be normally distributed with means 0 and variances of $\sigma_1^2 and \sigma_2^2$ then WTP_{1i} and WTP_{2i} have a bivariate normal distribution with means $\mu_1 and \mu_2$, variances $\sigma_1^2 and \sigma_2^2$ and correlation coefficient ρ. The likelihood function for the bivariate probit model can be derived as below.

The probability of a no-no response, is

$$\Pr(\mu_1 + \varepsilon_{1i} < B^1, \mu_2 + \varepsilon_{2i} < B^2) = \Phi_{\varepsilon_1\varepsilon_2}\left(\frac{B^1 - \mu_1}{\sigma_1}, \frac{B^2 - \mu_2}{\sigma_2}, \rho\right)$$

Where, $\Phi_{\varepsilon_1\varepsilon_2}$ is bivariate normal cumulative distribution function with zero means, unit variance and correlation coefficient of ρ (Haab and McConnell, 2002).

Defining $y_{1i} = 1$ if yes to the first question, 0 otherwise, $y_{2i} = 1$ if yes to the second question, 0 otherwise, $d_{1i} = 2y_{1i} - 1$, and $d_{2i} = 2y_{2i} - 1$, the i^{th} contribution to the bivariate probit likelihood function is;

$$L_i(\mu / B) = \Phi_{\varepsilon_1\varepsilon_2}(d_{1i}\left(\frac{B^1 - \mu_1}{\sigma_1}\right), d_{2i}\left(\frac{B^2 - \mu_2}{\sigma_2}\right), d_{1i}d_{2i}\rho$$

The bivariate probit model is a parametric model of two-response surveys. In this study, the double -bounded dichotomous question data was analyzed via Stata econometric software.

Finally, the mean willingness to pay (MWTP) from bivariate probit model is calculated using the formula specified by (Haab and McConnell, 2002).

$$MeanWTP = \mu = \frac{-\alpha}{\beta}$$

Where α = is the constant or intercept term

β = is the coefficient of the 'bid' posed to the respondent

4. Results and Discussions

4.1. Descriptive Analysis

Socio-Economic and Demographic Characteristics of Households

The data used for this study was collected from a randomly selected 250 sample households. Of the total sample surveyed households, 47 were female headed and the remainder 203 were male headed households. The mean household size and family size (adjusted for adult equivalent) of the total sample households was 6.26 and 6.24 respectively. The sample households are with a minimum of 1 and a maximum of 12 household members. The data showed that the average dependency ratio is 1.007 with a minimum of 0 dependants and maximum of 6 dependants to 1 independent. The average dependency ratio 1.007 implies that the number of dependents and independents in the total sample households is almost equal. On the other hand, the data also showed that the average number of adults in a given household is about 3.56 with a minimum of 1 adult household member and maximum of 9 adult household members. The average age of the sample households is 40.22 years.

Of the 250 household heads about 150 of them are illiterate and the balances are literate. The average years of schooling is 4.62 ranged from illiterate or zero years of schooling to a maximum of more than 16 years of schooling, that is, Masters Degree. Out of the total literate household heads 17 of them did attend their primary education (from grade1-8) which excludes those household heads who were attending informal education but can read and write, 45 did attend their secondary education (from grade 9-12) and the remaining 38 did attend their tertiary education (Bachelor and Masters' Degree).

The sample surveyed households earn an average annual income of Birr 31,604 which ranges from a minimum of Birr 0 to maximum of Birr 181,200 per annum and Birr 152,799 is the mean monetary value of assets owned by the sample households. Moreover, the sample households spent an average of Birr 51,243 per annum with a minimum of Birr 8,322 and a maximum of Birr 328,068 for different purposes such as household food and non food expenditure. The average remittance (from domestic and international sources) obtained by the sample households during the year 2012/13 is about Birr 2,714 which ranges from Birr 0 to Birr 52,000. Out of the 250 sample households 148 of them own land withholding rights and the remaining 102 of them do not own land.

Households willingness to purchase of camel milk

In the structured questionnaire, households were asked whether they are willing to buy camel milk had it been camel milk market in the woreda. Hence, of the total sample households, 247 were willing to purchase and 3 of them were not willing to purchase. These 3 respondents who were not willing to purchase camel milk, they were asked to state their reasons and the first respondent reasoned out existence of better substitutes of camel milk such cow and goat milk and the two household heads reason was purely tradition and as a result, they do not want to purchase camel milk.

Households maximum WTP for camel milk

Households were also asked an open-ended question in order to state their maximum WTP for one liter of camel milk from the hypothetical camel milk market. Hence, the data showed that households WTP for one liter of camel milk is positive with a minimum of Birr 8 and maximum of Birr 100. As a result, the mean WTP for one liter of camel milk is

$$MeanWTP = \mu = \frac{\sum MWTP_i}{n}$$

Where n = is the number of households in the sample excluding household heads with invalid response (protest zeros) and each $MWTP_i$ is a reported WTP amount by surveyed household heads.

$n = 247, \quad \sum MWTP_i = 4395$

Hence, $MeanWTP = \mu = \frac{4395}{247} = 17.79$ Birr

Thus, the mean willingness to pay for one liter of camel milk is Birr 17.79 and the total willingness to pay is Birr 4395.

Why camel milk market is missing in the woreda?

In many parts of the world camel milk market is missing and also in Afar region. But, why there is no camel milk market in the region and in the woreda? In this study, both structured questionnaire and FGD were used in order to identify the main reasons for the absence of camel milk market in the woreda. The results from the FGD showed that, religion does not prohibit the sale of camel milk rather it is the tradition of the people. That is, even the unwillingness to sale of the camel milk owners is not the main or internal reason but it is the traditional (tradition) restrictions and their perception. The Afar pastoralists perceive (believe) that if they sell their camel milk, their camels will all die. As a result, the camel milk owners are not willing to sale their milk.

The data from the structured questionnaire also showed that, of the 250 respondents only 2 of them responded that the reason for the absence of camel milk market is that consumers do not want to purchase it. On the other hand, 78 of the respondents answered that the main reason for the absence of camel milk market is the tradition of the Afar people and 53 of the respondents answered that camel milk owners are not willing to sell and only 5 of the respondents said it is because consumer are not willing to purchase and producers are not willing to sell. However, the majority, (112 of the respondents) said that, the reason for the absence of camel milk market is the tradition of the people and camel milk owners are not willing to sell their milk. However, no one mentioned religion as one of the reasons for the absence of camel milk market in the woreda.

Distribution of "Yes" and "No" answers to first and second bids

The distribution of "Yes" and "No" answers to the corresponding initial and follow up bids are given in table 4.1. There are three randomly assigned initial bids for a liter of camel milk and if the respondent accepts the first bid, the initial bid would be doubled; on the other hand, if the respondent does not accept the initial bid, the initial bid would be halved. Therefore, when the initial bid was Birr 5 per liter, all respondents who are randomly been offered this bid opted to accept it. However, when the initial bid is doubled 71 out of 80 respondents accepted it; the remaining 9 respondents did not accept the bid and none of the respondents answer "NY" (no to first bid and yes to the follow up bids) and "NN" (no to first and no to the follow up bids). As far as the second initial bid is concerned, the second initial bid which was randomly offered to 84 household heads is Birr 10 per liter. In this case only 32 respondents answer "YY" (yes to first and yes to the follow up bids) and none of them answer "NN". On the other hand, 48 of the respondents answer "YN" (yes to first bid and no to the follow up bid) and only 4 respondents answer "NY". With regard to the third initial bid, which is Birr 15, majority (42 out of 83) respondents answer "YN" and no one answers "NN". However, only 13 respondents answer "YY" and 28 of them answer "NY".

4.2 The Econometric Analysis

In this section of the research, econometric method of data analysis is used to estimate the coefficients of the socio-economic and demographic variables that affect households WTP for camel milk. In order to estimate the coefficients for the socio-economic and demographic variables Tobit, Probit and Bivariate Probit models with maximum likelihood estimation methods were employed. Tobit model was used in order to estimate the coefficients of independent variables for the open-ended CV questions. Moreover, Probit and Bivariate Probit models were also employed in order to estimate coefficients of independent variables for the SBDC and DBDC models respectively.

When we use cross-sectional data we may encounter problem of heteroscedasticity (Greene, 2008). In order to correct the heteroscedasticity problem we can estimate the robust standard errors instead of the usual standard errors (Wooldridge, 2002). Thus, the econometric models used in this study are corrected for heteroscedasticity problem using robust standard errors. According to Gujarati (2004), rule of thumb, multicollinearity is a serious problem, when a pair wise correlation coefficient between two independent variables is greater than or equal to 0.8. Therefore, from correlation matrix generated using the survey data there was no series multicollinearity problem in this study. Moreover, omitted variable bias and model specification problems were not found in this study.

4.2.1. Tobit Models Results and Discussions

In table 4.2 the result for Tobit estimates of maximum WTP for camel milk is presented. As it is shown in the table, the null hypothesis which states that the coefficients of all independent variables including the constant term are equal to zero is rejected even at 1% level of significance since the P Value ($Prob > F$) is equal to 0.000 and this implies that the model is overall significant.

Interpretation of the Tobit coefficients depends on whether one is concerned with the marginal effect of the independent variables on the latent variable, observed dependent variable and the uncensored observed dependent variable. In this study the researcher is interested to understand the determinants of actual maximum willingness to pay of the respondents. Therefore, out of the four marginal effects (marginal effect on the latent variable, actual variable, conditional on being uncensored and on the probability, that an observation is uncensored) the marginal effect on the actual variable is used in this study.

As reported in table 4.2, log-transformed household income positively and significantly affects households maximum WTP for camel milk. The result is consistent with the general demand theory which says, there is a positive relationship between income and quantity demanded (in the case of normal goods). Other things remain constant, as income of the household increases by 1% the predicted value of households maximum willingness to pay for camel milk increases by 0.85 Birr. The parameter estimate for remittance is significant and has the expected sign. It affects households maximum WTP for camel milk positively and significantly. The positive relationship between remittance and households maximum WTP for camel milk may be through the impact of remittance on the households ability to pay for camel milk. As reported in table 4.2, as remittance obtained by the household increases by 1% the predicted value of households maximum willingness to pay for camel milk increases by 0.36 Birr, holding other independent variables constant. Age of the household head has a positive and significant effect on the maximum WTP for camel milk. Hence, ceteris paribus, one year increase in the age of the household head increases the predicted value of households maximum willingness to pay by 0.29 Birr. Age square is also another main determinant variable of households maximum WTP for camel milk. The Age square variable is included to verify whether the life-cycle hypothesis is valid or not in this study. According to the life-cycle hypothesis individuals have an income which is relatively low at the beginning and end of their life and earn high income during the middle years of their life, when their productivity is high (Branson, 2006). Therefore, as it is reported in table 4.2, in line with the expectation, age square affects households maximum WTP negatively and significantly. Thus, as age square of the household head increases by one year the predicted value of households maximum WTP decreases by 0.003 Birr, keeping other things constant. The initial bid (Bid1) is included in order to test the existence of starting point bias. It is found that, the initial bid has a positive effect on the households' maximum WTP for camel milk and it is statistically significant even at 1% level of significance. This implies that households' WTP amount is upwardly biased and justifying the use of different starting bids on the contingent valuation.

Sex of the household head, education status of the household head, family size and land ownership of the household are statistically insignificant even at 10% level of significance. Adult ratio is the ratio of adult male to adult female and the coefficient of this variable is also statistically insignificant.

According to Haab and McConnell, (2002), for the open-ended contingent valuation survey responses the mean measure is an appropriate method for welfare measures.[1]

4.2.2. Probit Models Results and Discussions

The binary Probit model was employed to analyze the factors that affect households WTP for camel milk given a randomly assigned bid for the SBDC questions. The result for the Probit estimates of households probability of accepting the randomly offered bid is shown in table 4.3. At the bottom of table 4.3 we see 221 observations in the data set were used in the analysis.

As reported in table 4.3, the coefficient for the log-transformed income is significant and has the expected positive sign. The results intuitively suggest that households with higher income are more willing to accept the bid than households with lower income. The marginal effect estimates shows that keeping other factors constant, a 1 percent increase in the income of the household, increases households probability of accepting the randomly offered bid by 1.38 percent. The parameter estimate for the log- transformed remittance is also significant and has the expected positive sign. Households who obtained remittance are willing to pay higher price than those who did not obtain remittance. As shown in table 4.3, the marginal effect showed that, other things remain constant, a 1 percent increase in the remittance obtained by the household, increases households probability of accepting the randomly offered bid by 0.53 percent. Age of the household head affects households decision whether to accept the randomly offered bid or not positively and it is statistically significant even at 1 percent level of significance. The variable age square is also another determinant variable with negative sign. Education level of the household head is statistically significant with the expected positive sign. The positive sign of the

[1] The mean measure which is an appropriate method for welfare measures for the open-ended contingent valuation survey responses is already computed and given in the descriptive analysis part of this chapter, in page 7 and it is about 17.79 Birr.

coefficient of this variable indicates that, more educated household heads may have more knowledge and awareness about the economic and health benefits of camel milk and thus, literate household heads are more willing to (accept the bid) pay for camel milk than illiterate household heads. In line with the economic theory of demand (the higher is the bid; the less likely households would be willing to pay) and as it is expected, it has a negative effect on the households probability of accepting the randomly assigned bid. When the initial bid (Bid1) increases by one Birr, the probability accepting the initial bid decreases by 1.43 percent, holding other things constant. Adult ratio is the ratio of adult male to adult female. As shown in table 4.3, households with high adult ratio have lower probability of accepting the randomly offered bid than those households with low adult ratio. The coefficient of this variable is statistically significant (at 5 percent level of significance). This may be due to the fact that in pastoral areas females are more responsible for most of the works and they may be the main source of income for the household. Therefore, households with low adult ratio implies that there are more adult female members relative to adult male members in the household and this may induce the households to be more willing to accept the randomly offered bid. The marginal effect showed that, when adult ratio of the household increases by one unit the probability of accepting the randomly offered bid decreases by 1.49 percent.

The land ownership variable has a positive but statistically insignificant effect on the households probability of accepting the randomly offered bid. The sign of family size is positive, which is not the same as the expected sign and the variable sex of the household head has a negative sign as it is expected. However, both of those variables are also statistically insignificant even at 10 percent level of significance.

4.2.3. Bivariate Probit Model Results and Discussions

In this study, sample households were asked a DBDC question. According to Haab and McConnell (2002), the DBDC models increase efficiency when it is compared to SBDC models. In the DBDC model households were asked first the initial bid and based on their initial responses, they were given new prices, lower (halved) if their initial responses were no, higher (doubled) if their responses were yes.

As in table 4.4, 'rho' (ρ), the correlation coefficient of the two error terms is -0.997 and this correlation is statistically significant at 1% level of significance. Moreover, the ρ is close to one and it implies that the error term of WTP for the first question is almost perfectly correlated with the error term of WTP for the follow-up question. In table 4.4, the randomly offered initial bid (Bid1) affects the households WTP negatively and significantly. This implies, as the randomly offered initial bid increases by one Birr, the probability of accepting that bid decreases by 20.6%, ceteris paribus. The randomly offered follow-up bid (Bid2) has also a negative and statistically significant effect on the households probability accepting the bid. Hence, other things remain constant, as the follow-up bid increases by one birr, the probability of accepting that bid decreases by 10.34 %.

4.2.4. Single-Bounded Versus Double-Bounded Dichotomous Choice Models Estimates

Theoretically and empirically, DBDC models are found to be more efficient than the SBDC models. The DBDC models ha statistical efficiency gain over SBDC models (Carson *et al.,* 2001; Haab and McConnell, 2002; Hanemann and Kanninen, 1998; Hanemann *et al.,* 1991; Ahmed and Gotoh, 2006; Whitehead, 2000; Weldesilassie *et al.,* 2009). On the other hand, it is also found that the DBDC model does not increase statistical efficiency when it is compared with the SBDC model (Yibeltal, 2011). In this study, the SBDC model was estimated using Probit model and the DBDC model was also estimated using the bivariate Probit model. Thus, the estimated result for the two models is given in table 4.5.

In a finite sample, we can verify whether DBDC model has an efficiency gain over the SBDC model using*:*

(a) The precision of the estimates of the coefficients of the constant term and the randomly offered bid,

(b) The goodness of fit of the estimated WTP model and

(c) The precision of the estimates of welfare measures derived from the underlying coefficient estimates (Hanemann *et al.,* 1991).

In table 4.5 it is clearly put, following the (Hanemann *et al.,* 1991) verifying methods of the gains in statistical efficiency, there are no efficiency gains of using DBDC model over the SBDC model. That is, the coefficient of the bid and the constant term of both models are statistically significant at 1% level of significance and the standard errors of the bid and the constant term of both models are also approximately the same. Therefore, the bivariate Probit model estimates (DBDC model) instead of the Probit model estimates (SBDC

model) was used to calculate the mean WTP of households for camel milk. To calculate the Mean WTP from bivariate Probit model the formula which was developed by Haab and McConnell (2002), is adopted.

$$MeanWTP = \mu = \frac{-\alpha}{\beta}$$

Where α = is the constant or intercept term

β = is the coefficient of the 'bid' posed to the respondent

Thus, the mean WTP using the coefficient of the initial bid and the first constant term is given as follows; obit model is 15.35 Birr per liter.

$$MeanWTP_1 = \mu_1 = 18.87 \quad \text{Birr per liter} \quad \text{and} \quad MeanWTP_2 = \mu_2 = 13.11 \quad \text{Birr per liter}$$

Following (Gebrelibanos and Edriss, 2012), the mean WTP for camel milk using the coefficients of the bivariate probit model is given as the mean (average) WTP from the coefficients of the first bid and constant term and the follow-up bid and constant term.

$$MeanWTP = \mu = 15.99 \quad \text{Birr per liter}$$

4.2.5. Estimating Aggregate Willingness to Pay and Aggregate Benefits

Now, the turn is to estimate the aggregate WTP, aggregate revenue and deriving the demand curve. In order to estimate the aggregate WTP, the WTP interval and mid points of WTP are determined in column (1 and 2) of table 4.6. As indicated in the methodology part, according to (CSA, 2007), Aba'ala woreda has a population of 37,963 (6,878 households) consisting of 10,301 (2,396 households) urban and 27,662 (4482 households) rural inhabitants.

The study area which is the major town of Aba'ala woreda has a total population of 10,301 (2,396 households) and about 80% (2,396*0.80 which is equals to 1917 households) of the populations in the area are Muslims. In the study, out of the total 250 sampled households there were only 3 (1.2%) protest zeros and there were 247 (98.80%) valid responses. Based on this information, the total expected number of protest zeros is computed by multiplying the total number of households in the study area and the percentage share of protest zeros in the sample, that is, 1.2%*1917 which is equal to 23 households and those households are excluded from further analysis. On the other hand, the total number of valid responses is calculated by multiplying the percentage share of valid responses in the sample, that is, 98.80%*1917 which is equal to 1894 households and those households are included in the study for further analysis. The grand total WTP in column (5) is equals to 30,618.19 Birr. As it is shown in table 4.6, as mid points of WTP in column (2) increases, the total number of households who are willing to pay at these corresponding mid points in column (9) decreases.

Using the mean WTP obtained from the open ended questions the aggregate benefit is estimated. The aggregate benefit is equals to 33,694.26 Birr.

A downward sloping and convex demand curve for camel milk is derived from table 4.6. It is derived with mid-bid point WTP on the vertical axis and number of households with valid response on the horizontal axis. This implies an increase in the price of camel milk decreases the quantity demand for camel milk, ceteris paribus.

5. Conclusions and Policy Recommendations

5.1. Conclusions

To estimate Households WTP for Camel Milk in Aba'ala woreda using CVM both descriptive and econometric method of data analysis were used.

Three econometric models were employed. The result from the Tobit model revealed that income, age, remittance, and the initial bid positively and significantly affects households maximum WTP for camel milk. On the other hand, age square negatively and significantly affects households maximum WTP for it. In the binary probit model income, age, land ownership and education level of the household head affects the probability of accepting the randomly offered bid positively and significantly. However, age square, the initial bid and adult ratio affects the probability of saying "yes" negatively and significantly. Finally, results from the Bivariate Probit

model revealed that initial bid has a negative and significant effect on households' WTP. The follow-up bid has also a negative and statistically significant effect on the households' probability of saying "yes".

The results from DBDC and SBDC model were also compared to check the gain in statistical efficiency. However, the DBDC does not increase statistical efficiency over the SBDC model. In this study, the mean WTP for camel milk from the open-ended and dichotomous choice questions were computed. Consequently, the mean WTP from the open-ended and dichotomous questions was 17.79 and 15.35 Birr per liter respectively. The main aim of the study was to estimate the aggregate economic benefit using households WTP. The aggregate benefit from the dichotomous choice and open-ended questions is 30,618.19 and 33,694.26 Birr per liter respectively.

5.2. Policy Recommendations

Ethiopia has the third largest camel population and is the second camel milk producer in the world (FAO, 2008). However, the country did not obtain benefits commensurate with its camel population. From the CV survey responses almost all of the respondents (98.80%) were willing to purchase camel milk. This implies there is high demand for camel milk in the study area. About 88.80% of the respondents prefer camel milk than cow and goat milk. Thus, had it been the camel milk market, both consumers and producers would be beneficiary. Therefore, any concerned body should enhance the awareness of the camel milk producers on the economic benefit camel milk. The reason for the absence of camel milk market is the traditional or cultural restrictions. Hence, the government or any concerned body should also provide an evidence on the benefits of camel milk market from other regions of the country and other countries like Kenya and much effort should be exerted on the awareness creation (in collaboration with religious and tribal leaders) and breaking the cultural restrictions. In the pastoral and agro-pastoral areas of countries like Kenya and Mauritania camel milk is an important source of income. In these countries women are the main actors involving in the sale of camel milk through small and micro enterprises. Thus, the government and any concerned body should pave the way for such type of enterprises to benefit the pastoral households and women in particular.

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Table 4.1 Distribution of "Yes" and "No" answers to first and follow up bids

Responses		YY	YN	%YY	%YN
		NY	NN	%NY	% NN
Thresholds	n				
$1^{st}(2^{nd})$					
5(10/2.5)	80	71	9	88.75 %	11.25 %
		0	0	0.00%	0.00%
10(20/5)	84	32	48	38.09%	57.14%
		4	0	4.76%	0.00%
15(30/7.5)	83	13	42	15.66%	50.60%
		28	0	33.73%	0.00%

Source: Own survey, 2014

Table 4.2: Tobit Estimates of Maximum Willingness to Pay for camel milk

			Unconditional Expected Value	
Variable	Coef	P>|z|	dF/dx	P>|z|
lnincomehh	.8485956*	0.066	.8448549	0.065
	(.4598385)		(.4577)	
lnremittance	.364167***	0.007	.3625617	0.006
	(.1334302)		(.13282)	
famsize	-.1167314	0.624	-.1162169	0.623
	(.2374825)		(.23648)	
sexhh	-1.445593	0.182	-1.43766	0.181
	(1.080513)		(1.07379)	
agehh	.295313**	0.034	.2940113	0.033
	(.1387591)		(.13814)	
age2	-.0029195**	0.013	-.0029066	0.012
	(.0011608)		(.00116)	
educhh	-.0293881	0.980	-.0292584	0.980
	(1.159338)		(1.15422)	
Bid1	.4411978***	0.000	.439253	0.000
	(.1123441)		(.11177)	
ownland	1.555184	0.107	1.548624	0.106
	(.9610046)		(.95692)	
adul_ratio	-.2110696	0.606	-.2101392	0.605
	(.4086518)		(.40682)	
_cons	-1.223401	0.806		
	(4.967903)			

Number of obs = 221
F(10, 211) = 4.76
Prob > F = 0.0000
Pseudo R^2 = 0.0288

Source: own survey, 2014 ***, ** &* Statistically Significant at **1%**, **5%** and**10%** respectively
Figures in parenthesis are ***Standard Errors***

Table 4.3: Probit Estimates of Willingness to Pay for camel milk

			Marginal effect	
Variable	Coef	P>|z|	dF/dx	P>|z|
lnincomehh	.2775299*	0.057	.0138153	0.057
	(.1459164)		(.0092926)	
lnremittance	.1069086*	0.064	.0053219	0.064
	(.0578183)		(.0038721)	
famsize	.0352217	0.672	.0017533	0.672
	(.0832732)		(.0040042)	
sexhh	-.4039628	0.283	-.0262242	0.283
	(.3763361)		(.0351099)	
agehh	.1326656***	0.002	.006604	0.002
	(.0432669)		(.0036863)	
age2	-.0011767***	0.001	-.0000586	0.001
	(.0003674)		(.000032)	
educhh	.6291706*	0.059	.0294758	0.059
	(.3328379)		(.0200142)	
Bid1	-.2876709***	0.000	-.0143201	0.000
	(.0538829)		(.0054574)	
ownland	.4693767	0.157	.0221079	0.157
	(.3319035)		(.0159592)	
adul_ratio	-.2989663**	0.017	-.0148824	0.017
	(.1252236)		(.008888)	
_cons	-.9555023	0.535		
	(1.541429)			

Number of obs = 221 *McFadden's R2: 0.396*

Wald chi2(9) = 48.86 *Maximum Likelihood R^2: 0.265*

Prob > chi2 = 0.0000 *AIC: 0.569*

Pseudo R^2 = 0.3956 *BIC: -1029.782*

McKelvey and Zavoina's R^2: 0.691 *BIC': -13.993*

Source: own survey, 2014 ***, ** &* Statistically Significant at **1%**, **5%** and**10%** respectively

Figures in parenthesis are ***Standard Errors***

Table 4.4: Bivariate Estimates of the Double Bounded Dichotomous Choice Format

Variable	Coef		P>|z|
WTP1			
Bid1	-0.206***	(0.036)	0.000
_cons	3.689***	(0.505)	0.000
WTP2			
Bid2	-0.1034***	(0.0197)	0.000
_cons	1.356***	(0.230)	0.000
athrho	-3.353***	(0.493)	0.000
rho(ρ)	-0.997	(0.002)	
Wald test of rho=0:	*chi2 (1) = 46.1381*		*Prob > chi2 = 0.0000*

Number of obs = 247
Wald chi2(2) = 82.45
Prob > chi2 = 0.0000

Source: own survey, 2014 ***, Statistically Significant at **1%**, **5%** and**10%** respectively
Figures in parenthesis are ***Robust Standard Errors***

Table 4.5 Comparison of Probit and Bivariate Probit estimates of households' WTP for camel milk

WTP1	**Probit Model**			**Bivariate Probit Model**		
	Coef.	Robust Std. Err.	P>|z|	Coef.	Robust Std. Err.	P>|z|
Bid1	-.2590397***	.0459288	0.000	-.2047082***	.0360218	0.000
_cons	4.298207***	.6310378	0.000	3.665008***	.4974224	0.000
	Number of obs = 247 Wald chi2(1) = 31.81 Prob > chi2 = 0.0000			Number of obs = 247 Wald chi2(2) = 81.36 Prob > chi2 = 0.0000		

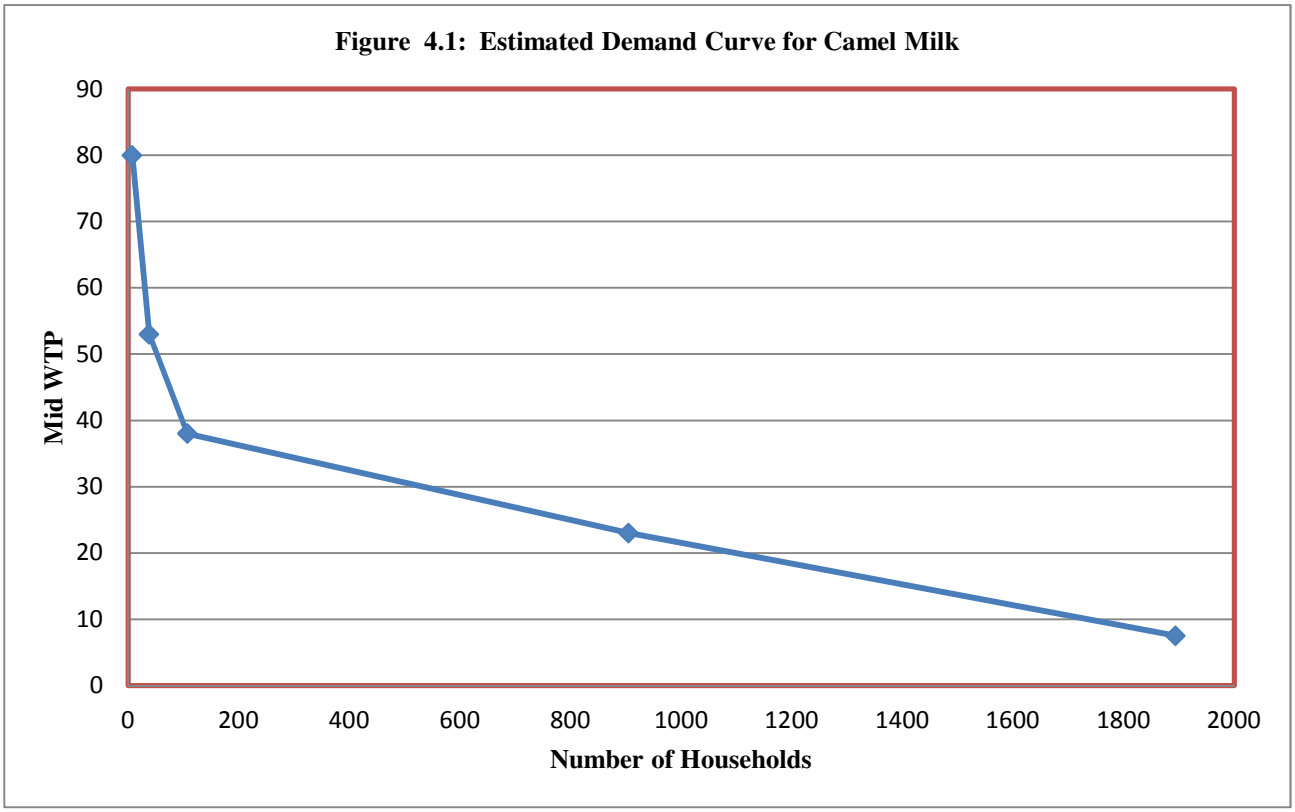
Source: Own survey, 2014 ***, Statistically Significant at **1%** level of significance

Table 4.6 Aggregate Willingness to Pay and Aggregate Benefits of camel milk

WTP Interval (Birr per liter **(1)**	Mid points of WTP [1] **(2)**	Sample Households Freq.	Percent**(3)**	Total number of households[2] **(4)**	Total WTP (in Birr) [3] **(5)**	Sample households WTP at least that amount Freq.	Percent**(6)**	Total households WTP at least that amount [4] **(7)**	Total revenue (in Birr)[5] **(8)**
0-15	7.5	129	52.23	989.24	7,419.30	247	100	1894.00	14,205.00
16-30	23	104	42.1	797.37	18,339.51	118	47.77	904.76	20,809.48
31-45	38	9	3.65	69.13	2,626.94	14	5.67	107.39	4,080.82
46-60	53	4	1.62	30.68	1,626.04	5	2.02	38.26	2,027.78
60-100	80	1	0.40	7.58	606.40	1	0.40	7.58	606.40
Total		**247**	**100**	**1894.00**	**30,618.19**				

Source: Own survey, 2014

Figure 4.1: Estimated Demand Curve for Camel Milk



[1] Is computed from (1) by summing the first and the second values and divide by two, for instance, $\frac{0+15}{2} = 7.5$

[2] Is also computed by multiplying (3) and (1894) , for instance, $0.5223*1894 = 989.24$

[3] Is computed $(5) = (2)*(4)$

[4] Total households WTP at least that amount is calculated as $(7) = (6)*1894$

[5] Aggregate revenue is computed as $(8) = (2)*(7)$

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