Review Paper

Paper ID: #370

DETERMINANTS OF HOUSEHOLD'S WILLINGNESS TO PAY FOR IMPROVED MIRT STOVE IN CASES OF SEMI URBAN AREAS OF GURAGE ZONE: AN APPLICATION OF CONTINGENT VALUATION METHOD

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ABSTRACT

The households of Ethiopia mainly depend on biomass energy for their day to day activity. This dependency on biomass resource with traditional cook stove contribute to the depletion of environmental resource and health problem specially for women's and children's from indoor air pollution. From this the government has been encouraging the uses of improved cook stove technology at the household level. However, the uses of improved cook stove were very low. Hence, this study aims to estimate households WTP for improved Mirt stove and to identify factors that determine their WTP in semi urban areas of Gurage zone using Contingent valuation method and seemingly unrelated Bivariate Probit model. A sample of 251 households was randomly selected. The result of this study shows that households mean WTP is significantly influenced by bid price, monthly household income, family size, age, sex, marital status, environmental awareness, house ownership and availability of children under five year. The mean WTP for improved Mirt stove from the double bounded dichotomous choice format computed using the Krinsky Robb method was estimated to be 234.11 Birr and the total willingness to pay for improved Mirt stove is 3,561,281 birr. From the total surveyed households, 94.6% have shown their willingness to pay if there is an improvement in Mirt stove. Thus, the result can inspire the stakeholders those work in this area to invest for improving the current Mirt stove.

KEYWORDS

Contingent Valuation Method, Improved Mirt Stove, Willingness to Pay.

1 INTRODUCTION

In Ethiopia, with nearly all rural households and 80% of urban household's dependent on solid biomass for cooking with inefficient cook stove (IEA, 2014). This highly dependence and inefficient use of biomass resources partly contribute to the depletion of the country's forest resources; on the other hand the use of traditional cooking technology, one source of inefficient biomass resource usage, has been associated to indoor air pollution (Damte and Koch, 2011).

Dependence on biomass energy for cooking and heating, forces women and children to devote hours each week to collect firewood. Cook stoves that uses unsustainably harvested biomass fuel with traditional cook stoves have a negative impact on environment, and it leads to climate change. Several activities related to improved cook stoves have been implemented in Ethiopia, however, it is failed to deliver the required impacts because of technical, social, financial and institutional factors were not taken into account sufficiently (NCCSPE, 2011).

To take full advantage of the energy saving and potential health impact from ICS, the stove must first be adopted and used correctly and consistently (Shankar et al., 2014). As discussed in Barnes et al., (1994); Shanko et al., (2009), the efforts to disseminate various types of fuel-saving technologies have faced different problems at different times for instance some of the stove programs were not successful due to problems related to the stove itself (technical problems), lack of understanding of consumer tastes and due to the lack of an appropriate promotion strategy.

Majority of Mirt stove which were seen in use had been modified in some way, this shows that customer needs are not being met with the current design. A large range in construction quality like configuration of the pot support and concrete mixture reduce the durability of the stove. Customers and producers had multiple product ideas because they were unsatisfied with the current product, which was limiting mass adoption of Mirt stove. Given the massive amount of energy used to bake *injera* AETPDD (The Alternative Energy Technology Promotion & Dissemination) could develop more stove models for different market segments. Most likely, the middle and small class to afford a stove of better quality and performance even can be completely smokeless (Ministry of water and energy, 2013).

By reducing the diameter of the Mirt stove, because there is a difference between the mitad and Mirt stove, efficiency of the stove can be increased (Amare et al., 2015). And in Putez and Muller (2011), if some improvements made on Mirt stove it could increase the efficiency on fuel wood savings. As reported on Accenture Development Partnerships (2012), many customers complained in Mirt stove like the fire mouth is too small and does not allow them to use larger pieces of wood, many customers requested a Mirt stove that could be more easily transferred from house to house because the current Mirt stove have large weight about

45 kg. Therefore, consideration could be given to designing a Mirt stove that can be easily assembled and disassembled.

In SNNPR open three stone fire is used for about 95% of *injera* baking. Still Mirt stove sales volume in the region is very low because of a problem like its difficulty of portability (Shanko and Lakew, 2011 and Gurage Zone Water, Energy and Mineral Office, 2016). As reported in Ministry of Water and Energy (2013), in Ethiopia up to the end of 2012 the total sales volume of Mirt stoves were only 418,248 units, which is a very low adoption and use in a country of almost 20 million household.

In Ethiopia, most of the study was conducted on factors that affect the adaption of mirt stove (Beyene and Koch, (2011),Alamir, (2014), Legesse et al., (2015) and Abate, 2016).To the fact of researcher's knowledge there is no study about household willingness to pay for improved Mirt stove by applying contingent valuation method. Thus this study will fill this gap with including problems associated with the small door size, the weight of the stove and by considering the gap between the stove and the locally produced mitad in designing hypothetical market scenario stove in semi urban areas of Gurage Zone. Therefore, the objective of this study is to elicit the households' mean willingness to pay and it's determinate for improved Mirt stove in semi urban areas of Gurage Zone using contingent valuation method.

2 METHODOLOGY

2.1 Description of the Study Area

The study was conducted in semi urban areas of Gurage Zone. Gurage Zone is located in the central and south-eastern mountainous area of Ethiopia in Southern Nation Nationality Peoples Regional State and 158 km South-west of Addis Ababa. The zone is one of the most densely populated zone in the region and the total population of the zone in 2016 was estimated about 1.7 million (Gurage Zone Finance and Economy Office, 2016). In the zone there are 13 woredas and 2 city administrations, within those woreda there are 15,212 households live in semi urban kebeles (Gurage Zone Urban Development Office, 2016).

2.2 Data Source and sample size

This study used both primary and secondary sources of data. The primary data were collected from randomly selected 251 households by using structured questionnaires. The study used a face to face interview survey method to collect the data. Double bounded dichotomies choice format with follow up questions was applied in this study to estimate household willingness to pay for improved Mirt stove. To determine the initial bid price and pretest the questionnaire a pilot survey and focus group discussion was made by randomly selecting 24 households. Based on the responses, we selected 4 initial bid prices (100, 150,200 and 250) following their frequencies. As Cameron and Quiggin (1994) stated, When respondents answer is yes for the initial bid the second bid is doubled and when the answer is no the second bid is half of its initial value. The four initial bids were randomly distributed on equal basis; those respondents who have been interviewed in the pilot survey were not included in the final work.

The samples were selected by Multistage Sampling technique. First, 3 woredas were randomly selected and from those woredas totally 6 semi urban kebele were selected by simple random sampling. Finally, 251 households were selected from the selected kebeles.

2.3 Method of Data Analysis

Econometric Model Specification

The study was employed contingent valuation method with double bounded dichotomies choice format with follow up questions. In the double-bounded model Respondents are presented with initial bid prices. Following their initial responses, they are given new prices, lower if their initial responses were no, higher if the responses were yes.

The study used the model developed by Haab and McConnell, 2002. Following Haab and McConnell, 2002, the econometric modelling for the formulation of double bounded data is given as follows,

Let b_1 be the first bid price and b_2 be the second bid price. From this there are four possible outcomes bounds on WTP. These are

$b_1 \leq WTP < b_2$ for the yes-no responses;

$b_1 > WTP \geq b_2$ for the no-yes responses;

$WTP \geq b_2$for the yes-yes responses;

$WTP < b_2$ for the no-no responses

Where

b_1= the offered values in the initial bid assigned randomly to the ithrespondent

b_2= the offered values in the second bid assigned randomly to the ithrespondent

WTP= willingness to pay

The most general econometric model for the double-bounded data comes from the formulation

$$WTP_{ij} = \mu_i + \varepsilon_{ij} \qquad (2.1)$$

Where

WTP_{ij} = represents the j^{th} respondent's willingness to pay,

i = 1, 2 represents the initial and second answers.

$\mu_1$and μ_2= are the means for the first and second responses.

ε_{ij} = unobservable random component distributed N (0,σ^2)

Setting $\mu_i = X_{ij}\beta_i$ allows the means to be dependent upon the characteristics of the respondents.

X_{ij} = represents a vector of different explanatory variables

β_i = the regression parameter of the model

To construct the likelihood function, first derive the probability of observing each of the possible two-bid response sequences (yes-no, yes-yes, no-yes, no-no). These are;

The probability that respondent j answers yes to the first bid and no to the second is given by

Pr (yes, no) $p_r(WTP_{lj} \geq b_1,\ WTP_{2j} < b_2)$

$$p_r(\mu_i + \varepsilon_{ij} \geq b_1,\ \mu_i + \varepsilon_{ij} < b_2)$$

The probability that respondent j answers yes to the first and the second is given by

Pr (yes, yes) $p_r(WTP_{lj} \geq b_1,\ WTP_{2j} \geq b_2)$

$$p_r(\mu_i + \varepsilon_{ij} \geq b_1,\ \mu_i + \varepsilon_{ij} \geq b_2)$$

The probability that respondent j answers no to the first bid and yes to the second is given by

Pr (no, yes) $p_r(WTP_{lj} < b_1,\ WTP_{2j} \geq b_2)$

$$p_r(\mu_i + \varepsilon_{ij} < b_1,\ \mu_i + \varepsilon_{ij} \geq b_2)$$

The probability that respondent j answers no to the first and the second is given by

Pr (no, no) $p_r(WTP_{lj} \leq b_1,\ WTP_{2j} \leq b_2)$

$$p_r(\mu_i + \varepsilon_{ij} \leq b_1,\ \mu_i + \varepsilon_{ij} \leq b_2) \qquad (2.2)$$

Based on the above equation each individual (j^{th}) contribution to the likelihood function becomes

$$L_j(\mu/b) = \left[p_r\left(\mu_i + \varepsilon_{ij} \geq b_1, \mu_i + \varepsilon_{ij} < b_2\right)\right]^{YN} \times \left[\ p_r\left(\mu_i + \varepsilon_{ij} \geq b_1, \mu_i + \varepsilon_{ij} \geq b_2\right)\right]^{YY} \times$$
$$\left[p_r\left(\mu_i + \varepsilon_{ij} < b_1, \mu_i + \varepsilon_{ij} \geq b_2\right)\right]^{NY} \times \left[p_r(\mu_i + \varepsilon_{ij} \leq b_1, \mu_i + \varepsilon_{ij} \leq b_2)\right]^{NN} (2.3)$$

Where YN=1 for a yes-no answer, 0 otherwise.

YY = 1 for a yes-yes answer, 0 otherwise,

NY=1 for a no-yes 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 errors are assumed to be normally distributed with means 0 and respective variances of σ_1^2 and σ_2^2 then WTP_{lj} and WTP_{2j} have a bivariate normal distribution with means μ_1 and μ_2, variances σ_1^2 and σ_2^2 and correlation coefficient ρ. By definition, $\rho = \sigma_{12}/\sqrt{\sigma_1^2 + \sigma_2^2}$, and σ_{12} is the covariance between the errors for the two WTP functions.

Given the dichotomous choice responses to each question, the normally distributed model is referred to as the bivariate probit model. From this the study models the functional form of Seemingly Unrelated Bivariate Probit (SUBVP) model as follow.

$$ANSIBID = \alpha_0 + \beta_1 IBID + \beta_2 INC + \beta_3 EDU + \beta_4 AGE + \beta_5 FAMSIZE + \beta_6 MAS + \beta_7 AWS + \beta_8 SEX + \beta_9 UND5 + \beta_{10} HUOWS + \beta_{11} CREAVB + \varepsilon_i$$

$$ANSSBID = \alpha_0 + \beta_1 SBID + \beta_2 INC + \beta_3 EDU + \beta_4 AGE + \beta_5 FAMSIZE + \beta_6 MAS + \beta_7 AWS + \beta_8 SEX + \beta_9 UND5 + \beta_{10} HUOWS + \beta_{11} CREAVB + \varepsilon_i$$

Where

$ANSIBID$ = WTP answer for the initial bid price as dummy variable (1= yes for the initial bid price, 0= otherwise)

$ANSSBID$ = WTP answer for the second bid price as dummy variable (1= yes for the second bid price, 0= otherwise)

α_0= constant term

IBID = the amount of initial bid offered in ETB

SBID = the amount of second bid offered in ETB

INC= monthly income of the households in ETB

EDU= education level of household head in years of education

AGE= age of respondents in years

FAMSIZE= household family sizes in numbers

MAS= marital status of respondents as dummy variables (1= married, 0 otherwise)

AWS= awareness of the household on the advantages of improved Mirt stove in environmental, economic and health problem as dummy variable (1= yes, 0 = no)

SEX= sex of respondents as dummy variables (1= female, 0= male)

UND5=availability of children under five years as a dummy variable

HUOWS= household house ownership as a dummy variable (1=house ownership, 0 otherwise)

CREAVB= credit availability as dummy variable (1= credit access, 0 otherwise)

$\beta_0, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7, \beta_8, \beta_9, \beta_{10}$ *and* $\beta_{11}$are the parameters and ε_i= error term which has a normal distribution with mean zero and variance σ^2

The mean willingness to pay (MWTP) from the seemingly unrelated bivariate probit model can be calculated using the Krinsky and Robb (1986) method.

3 RESULTS AND DISCUSSION

3.1 Descriptive statics for Households Willingness to Pay for Improved Mirt Stove

For this study a total of 251 households were interviewed in the survey to estimate households' willingness to pay for improved Mirt stove in semi urban areas of Gurage Zone. From the total of 251 interviewed households 245 questionnaires were used for analytical purpose due to 6 incomplete responses. Since, the non-response rate is 2.4%, we did not expect the response bias. The description of demographic and socioeconomic characteristics of the households and variables used in this study was summarized as follows.

Among the sampled respondents about 94.69 % are willing to pay and the remaining 5.31% percent of them are not willing to pay for the improved Mirt stove in the given scenario. Those who refused to pay anything were asked to state their reasons on the questionnaire and they responded "We did not have enough money to pay". From this those who refused to pay anything are treated as having zero WTP.

To determine the households' willingness to pay for improved Mirt stove, they were asked their willingness to pay by giving them randomly assigned four initial bid values (100, 150, 200 and 250) and the corresponding follow up bids. From the total respondents who are willing to pay, 174 (71.02%) of them said "yes" or they were willing to accept the initial bids and the remaining 71 (28.98%) said "no" or they were not willing to accept the initial bids.

After asking the initial bid based on their answer the follow up bids were doubled for those households who were willing to pay the given initial bids and halved for those households that were not willing to accept the initial bids. From this the response to the second bid shows that 136 (55.51%) of the respondents saying "Yes" whereas 109 (44.49%) saying "No" to the second lower and higher second bides.

From the data for the first and second bid prices respondents were willing to pay 174 (71.02%) and 136 (55.51%) respectively. The percentage that said "yes" to the initial question was the sum of "Yes-Yes"+ "Yes-No" while the percentage of "yes" to the second question was the sum of: "Yes-Yes"+ "No-Yes". Hence, the total "yes" responses for both initial and second bid were the sum of "Yes-Yes"+ "Yes-No"+ "No-Yes" which is equal to 232 (94.69%).

As shown below in table 3.1, 32.24% of the respondents is agree to pay a "Yes-Yes" that is for the designed both bid prices, 38.78% agreed to pay for the first offered amount but not for second offered that is a "Yes-No" response, 23.67% answered no to the initial bid and yes to the follow-up that is "No-Yes" response, and finally 5.3% answered no to for both bids that is "No-No" response.

Table 3.1: Distributions of willingness to pay

Initial bid	lower Second bid	higher second bid	YY	YN	NY	NN	Total
100	50	200	44	18	0	0	62
150	75	300	21	25	16	0	62
200	100	400	14	25	20	2	61
250	125	500	0	25	22	11	60
Total			79 (32.24%)	95 (38.77%)	58 (23.67%)	13 (5.3%)	245 (100%)

Source: Own survey, 2017

3.2 Econometrics Analysis

In this section the data obtained from the household survey were analyzed and discussed to identify the determinants of household's willingness to pay and to calculate the mean WTP for improved Mirt stove.

To select the appropriate model, first the study checked the significance level of rho (ρ), which shows the correlation between the two WTP answers. The LR test shown that the estimate correlation coefficient is statistically significant different from zero at 5% level of significance. The estimated correlations coefficient rho (ρ) is -0.61, this shows that there is negative linear relationship between the random components of the responses to the initial bid and the second bid. The fact that Rho (ρ) is less than unity indicates that the correlation between the random components of the responses to the initial bid and the second bid is not perfect. This implies that there is a negative correlation between the two responses. From this the null hypothesis which says no correlation is rejected. Therefore, the first and second bid answers are jointly determined.

The seemingly unrelated bivariate probit model estimates the answer for the initial and the second bid equations at the same time. This model allows the estimation on the likelihood of both equations simultaneously and allows for the error terms of the two equations to be correlated via some unobservable individual behaviors, correlation coefficient. As a result, the seemingly unrelated bivariate probit model is a better methodology than the independent probit model because it captures precisely the unobservable exogeneity. So the two equations was analyzed by seemingly unrelated bivariate probit model because of regression of the two equations separately will result in inconsistent results (Hab and McConnell, 2002).

Table 3.2: Results for seemingly unrelated bivariate probit model (Robust standard error)

Variable	Equation I		Equation II		Marginal effect
	Coefficient	P-value	Coefficient	P-value	
IBID	-.016*** (.002)	0.000			-.003 (.000)
SBID			-.007*** (.001)	0.000	-.002 (.000)
AWS	.458** (.243)	0.06	.540** (.256)	0.035	.281 (.092)
CREAVBA	.439(.481)	0.361	.344 (.421)	0.414	.209 (.130)
SEX	-.227 (.248)	0.360	-.413** (.210)	0.050	-.193 (.074)
AGE	.037** (.019)	0.053	-.006 (.017)	0.696	.005 (.005)
MAS	-.507 (.328)	0.122	633* (.378)	0.094	.150 (.142)
FAMSIZE	-.173** (.070)	0.014	-.018 (.074)	0.805	-.042 (.025)
UND5	.505** (.222)	0.023	.085 (.150)	0.571	.135 (.060)
EDU	.023(.030)	0.439	.007 (.026)	0.782	.007(.010)
INC	.000*** (.000)	0.010	.000*** (.000)	0.005	.0003 (.000)
HUOWS	.547* (.319)	0.086	-.255 (.282)	0.367	.043 (.106)
_cons	1.468* (.877)	0.094	.863 (.690)	0.211	N/A
Athrho	-.712 (.294)	0.015			
Rho	-.612(.183)				
Wald test of rho=0: chi2(1) = 5.86144 Prob> chi2 = 0.0155 Log pseudo likelihood = -188.88623Restricted pseudo likelihood= -300.957531Pseudo R^2=0.38 No of obs. = 245 Wald chi2(22) = 117.04Prob > chi2 = 0.0000 ***, **, * indicates significance level at 1%, 5% and 10% respectively Numbers in parenthesis are standard errors N/A: not available					

Source: Own survey, 2017

3.3 Determinants of Willingness to Pay

As shown in the above table the result of robust SUBM shows that there is a negative relationship between WTP and both the initial bid value and the second bid value. The seemingly unrelated bivariate probit model result shows that both the initial and second bid level affect WTP significantly at 1% level of significance, with the negative sign implying that an increase in the initial and second bid reduces the likelihood that respondents are accepting the proposed bid price level, which is logical acceptable and consistent with the economic theory. Holding other things constant, a one birr increase in the initial and second bid will decreases the probability of the respondent's willingness to pay for improved Mirt stove by 0.34% and 0.25% respectively.

A dummy variable Environmental awareness have a positive sign in both equations as we expected and significant in the first equation at 10% level of significant and for equation two significant at 5 % level of significance. When a respondents have awareness about the impacts of Mirt stove on the environment, the probability of accepted offered amount increased by 28.13%.

A dummy variable sex of respondent have a negative sign in both equation as we expected and significant in the second equation at 5% level of significant. Male respondent has 19.37% less probability of positive response as compared to female respondents.

The variable age of respondents was significant for first equation at 10% level of significance with positive sign for equation one. Holding other things remain constant, for every one year rise in the age of the households, the probability of willing to pay for the improved Mirt stove increases by 0.53%. The role of age in explaining technology adoption is somewhat debatable. It is usually considered in technological adoption studies with the assumption that older people have more experience that helps them to adopt new technologies. On the other side, because of risk averting nature of older age people are more conservative than the youngest one to adopt new technology.

The dummy variables marital status has significant in the second equations at 10% level of significance. As expected in the second equation the coefficient registered a positive sign. Married respondent has 15.05% higher probability of positive response for willingness to pay for the stove as compared to single or divorced household respondents.

As we expected the coefficient for the family size of the respondents would have a negative sign in both equations and significant in the first equation at 5% level of significant. Holding other things remain constant, when the family size of the household increased by one family members, the probability of willing to pay for the improved Mirt stove decreased by 4.12%. It indicate that the larger family sizes the lesser willing to pay for the reason that of high family outlay and also may be households with more children or females are likely to

assign a lower value to a new stove because they have more people who can take care of the cooking and fuel collection.

As expected availability of children under age of five in the household has a positive sign which is also significant at 5% level of significance in equation one. Thus, keeping other things constant, for those households that have children less than five years, the probability of accepting the offered bid to pay for the improved Mirt stove increase by 13.5%.

Households average monthly income has positive sign and statistically significant at 1% level of significance for both the first and the second equation. Holding other things remain constant as monthly income of the household increases by one birr the probability of households' willingness to pay for improved Mirt stove increases by 0.03%.

As we expected ownership of a house has a positive sign which is also significant at 10% level of significance in equation one. Thus, keeping other things the constant, for those living in their own house, the probability of accepting the offered bid to pay for the improved Mirt stove higher by 4.3% compared with those who do not live in their own house.

3.4 Estimation of the Mean WTP

The mean willingness to pay from the seemingly unrelated bivariate probit model was calculated using the Krinsky and Robb (1986) method. The Krinsky and Robb method uses random draws from assumed multivariate normal distribution to generate new parameter vectors. WTP is then calculated for each of these parameter estimates and they are used to construct the WTP distribution for the complete set of replications.

Table 3.3: Results of the mean WTP for the two models by applying Krinsky and Robb estimation result of (95 %) Confidence Interval for WTP measures (No of reps: 5000 and Equation: ANSIBD)

Equation	MEASURE	WTP	LB	UB	ASL*	CI/MEAN
Equation I	Mean/median	234.11	218.18	253.26	0.0000	0.15
Equation II	Mean/median	285.91	260.79	325.74	0.0000	0.23

*: Achieved Significance Level for testing H0: WTP<=0 vs. H1: WTP>0
LB: Lower bound; UB: Upper bound 234.11×
Source: Own survey, 2017

As shown in table 3.3, the mean WTP is 234.11 ETB for equation one and 285.91 ETB for the second equation. For the first equation its mean WTP is bounded between 218.18 ETB and 253.26 ETB. This value is significant at 1% significance level with p value 0.000. The variation between the lower and upper bound is 35.08. For the second equation its mean WTP is bounded between 260.79 ETB and 325.74 ETB. This value is

significant at 1% significance level with p value 0.000. The variation between the lower and upper bound is 64.95.

As Ayalneh and Birhanu (2012) and Tadesse (2017) reported comparable reasons and mentioned the fact that the second equation parameters are likely to contain more noise in terms of anchoring bias as the respondent is assumed to take the evidence from the first bid while forming his/her WTP for the second question, estimates from the first equation are generally used in computing mean WTP. Therefore, the mean willingness to pay is 234.11 ETB and when multiplying the means with the number of households in the study area we can arrive at total willingness to pay. Hence, the total willingness to pay for improved Mirt stove is 234.11×15212 which gives 3,561,281 ETB. Therefore, the total willingness to pay for improved Mirt stove is 3,561,281 ETB.

4 CONCLUSION AND RECOMMENDATION

This study used double bounded dichotomous choice followed by an open ended format to elicit households' willingness to pay for improved Mirt stove in semi urban areas of Gurage zone by applying contingent valuation method. The study used survey data collected from 251 randomly selected sample households and the survey was administered through face to face interviews by trained enumerators. A seemingly unrelated bivariate probit model was used to estimate the mean willingness to pay for improved Mirt stove.

The result of this study shows that a large percentage of households are willing to pay a considerable amount for improved Mirt stoves. The mean willingness to pay is significantly influenced by monthly household income, sex, age, family size, marital status, environmental awareness, house ownership and availability of children under five year. However credit availability and the level of education of the respondents were found to be insignificant. Monthly household income, marital status, availability of children under five, and awareness have positive impact while family size and sex has negative impact on the likelihood of willingness to pay for improved Mirt stove.

The mean WTP for the improved Mirt stove obtained from the seemingly unrelated bivariate probit model is 234.11 ETB and the aggregate willingness to pay for improved Mirt stove in the study area is 3,561,281 ETB. From this, the result can inspire the stakeholders those work in this area like governmental organization, non-governmental organization and private cook stove designer and producer.

The overall conclusion of this study is that households were WTP for the improved Mirt stove. Hence; it could have significant benefits for reducing environmental, economic and health problem which arises from using traditional stoves by improving the current Mirt stove. Based on the conclusion drown on the above the visible recommendations are forwarded here under.

Factors related to demographic and socioeconomic characteristics of households were found to have a significant effect on households' WTP for improved Mirt stove. Thus, government and organizations that are trying to distribute these stoves should consider the significant variables which have an impact in determining households' WTP for improved Mirt stove.

The government and other stakeholders should give attention to create awareness about the adverse impact of traditional stoves and they should innovate and produce improved Mirt stove technologies that meet consumer needs and preferences with the cost close to the mean WTP that households were willing to pay.

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