Farmers' Willingness to Pay for 2-Wheel Tractor Hiring Services in Northwestern Ethiopia: A Contingent Valuation Study

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ABSTRACT - ***This study sought to determine farmers' willingness to pay (WTP) for 2-wheel tractor hiring services in Northwestern Ethiopia. Survey questionnaire related to CVM was designed and face-to face interview were made to collect the data. Moreover, focus group discussion used to generate qualitative information on household characteristics. Both purposive and stratified sampling techniques were used based on gender, wealth class and soil type of the sampled households. For the study, a total of 144 farm households were considered using double bounded contingent valuation methods approach with an open-ended follow-up question. The study result indicated that the mean amount of money farmers is willing to pay was 1121.026 ETB (56.05 USD) per hectare. Econometric results confirm that the education level of households, land size of households, male labor availability and soil type were the factors that affecting the farmers' level of willingness to pay positively. However, age of households and tropical livestock unit (TLU) were the factors that affected the same negatively. About 80% of the sampled farmers were willing to use 2-wheel THS. The finding of this study showed that farmers demand for improved 2-wheel THS is high. Hence, there is a need to consider the above factors to introduce 2-wheel tractor hiring service for cultivation practice in the study area.***

Keywords---- Willingness to pay, 2-wheel tractor, Tractor hiring service, Contingent valuation method

1. BACKGROUND

Agriculture is a means of livelihood for about 85% of the Ethiopian population. It contributes about 40% of the GDP and generates over 80% of export earnings (Kasahun and Colin, 2014). Ethiopian economy grows on average at a rate of 10.3% annually (World Bank, 2015). In the highlands, mixed farming (grain and livestock) is prevalent. Nearly 80% of the population lives on only 37% of the total land mass, while the remaining 20% inhabits 63% of the total land mass (Teller, 2014).

Ethiopian agriculture is mainly rain fed with two rainy seasons: June-September (*Meher* season) and February-May (*Belg* season). The country's total arable land is 74 Million hectares (Guush, 214). At present, only about 25 per cent of its arable land is cultivated, and agriculture is dominated by subsistence rain fed farming, using fewer inputs and characterized by low productivity (Melaku, 2011).

The main sources of power to carry out agricultural operations are human and animal power. Oxen play an important role in meeting the farm power requirements of tillage practice. However, the ox ploughing system is currently under stress because of shrinking cultivated areas per household, reduced fodder availability and land degradation (Aune et al., 2001). Hence, soils in Ethiopia are traditionally ploughed repeatedly with an ox-drawn *Maresha* plug before sowing (Aune et al., 2001). Its simplicity, light-weight and the low cost of the *Maresha* plough makes it popular with small scale farmers of Ethiopia (Melesse, 2000). Almost all farmers own this simple implement. However, only about one third of all highland farmers own two oxen. The majority of smallholders have to engage in some form of traditional renting and exchange agreements to access draught oxen in order to plough their land

Ethiopia's farmers are also diverse; agriculture is dominated by smallholder farming. There are approximately 14.7 million households, of which, approximately 60% of which operate on less than 1 hectare of land while only approximately 1% of farmers operate on land greater than 4 hectares. They can be categorized: 1) Marginal farmers -farm

size of less than 0.5 hectares and represent approximately 36% of the rural households. 2) Small farmers - farm size between 0.5 and 1 hectare. 3) Semi-medium farmers- farm size between 1 and 2 hectares 4) Medium farmers- farm size between 2 and 10 hectares and 5) Large farmers- farm size that is larger than 10 hectares (Melesse, 2017).

A traditional tillage method with the *marshal* plow requires repeated plowing with two consecutive tillage operation carried out perpendicular to each other. This requires longer time for seedbed preparation and consumes high animal and human energy. Literatures indicated that about 29% of Ethiopian farmers have no oxen, 34% have one, 29% have two and 8% have two or more. Hence, more than 60% of the farmers have to rent in or borrow one or two animals for cultivation (Melaku, 2011). Small farmers who rely on oxen of others for land preparation cannot plough at the right time (due to short preparation time at the onset of the rainy season) and pay between one quarter and half of their output of cereals and pulses for hiring a team of oxen. Delayed planting shortens the length of the growing period available for the crop and reduction of crop productivity (Melese, 2017). Moreover, the *maresha* ploughing system exposes the soil to erosion and can be expensive for farmers without oxen.

Access to oxen can be seen to be more important than land size in the Ethiopian context, because without the oxen, the land cannot be cultivated. It is also more difficult for farmers without oxen to intensify production, as a part of the surplus is reserved for the ox's owner (Aune, 2001).

The research explains that an increasing number of farmers are not able to maintain a pair of oxen. One of the main reasons is the reduced farm size, resulting in reduced fodder availability to feed the oxen (and other livestock) (Aune, 2001). A pair of oxen consumes about nine tonnes of forage per year and with the increased land use, there is less communal land for grazing and raising livestock, especially in densely populated areas. Another reason why oxen are less available than before is that farmers having oxen prefer to sell them after fattening.

Improved equipment for animal traction has been pursued by research, but with little effects and this still has the disadvantage of oxen. Implements for row seeding as well as mechanical weeding are not available. Farm mechanization has progressed little in Ethiopian smallholder agriculture.

Ethiopia has a long history of involvement with the introduction of tractors (especially four-wheel tractors). To nurture agricultural mechanization, state farms both irrigated and rain fed has played a very big role, especially during the second period of the previous socialist regime, large mechanized state farms were established (about 200,000 hectares) out of which about 47,000 hectares were irrigated (Jonathan et al., 2011). In the 70s to 90s period another mechanization approach tried in the period was government operated tractor hire schemes. These were later abandoned; partly due to heavy financial burden on the government as a result of subsidizing the service (CIMMYT, 2014). However, farm mechanization has progressed little in Ethiopian smallholder agriculture due to cost and fragmented land.

Over the last four years, particularly since, 2011, the use of various types of tractors has shown a definite increased trend (for example, the number of imported 4- Wheel tractors increased from 547 in 2005 to 2940 in 2013), and the projected demand would expect to increase from 4375 (in 2014) to 14532 (in 2017). The reason is that due to the increased attention of the government for commercial farmers, availability of financial support for investment, increased foreign direct investment). However, the demand for 2 -wheel tractor is scattered existence in Ethiopia and only few farmers are using it (Tadess et al., 2014).

In order to overcome these challenges with the traditional ploughing system, looking for an appropriate ploughing method is vital to improve e agricultural practices (soil fertility management, seedbed preparation, row seeding and planting,) and efficient use of agricultural inputs. Hence, introducing appropriate mechanization technology like 2-wheel tractor hiring services which is similar to farmers' oxen plowing would benefit the farm household economy. The study, therefore, tries to analyze the farmers' willingness to pay and identify factors that affect the price level to tractor hiring services.

2. RESEARCH METHODOLOGY

2.1. Description of the study area

The survey was conducted in selected three capacity building for scaling up of evidence based best practices in agricultural production in Ethiopia (CASCAPE) project intervention areas including Jigna, Tagel wedefit and Ahuri keltafa *Kebeles* (lowest administrative unit in Ethiopia) of Dera, Mecha and Achefer districts, respectively. These districts have high potential for crop production in the region. About one third of the national production is produced in this region. Mixed farming practice (crop production &livestock rearing) is common and supplementary irrigation practice is used during the dry season. The common dominant crops grown in the area are maize (Zea mays), rice, onions (Allium cepa), finger millet *Eleusine coracana* (L.) Gaertn*),* teff *(Eragrostis tef),* chickpea (*Cicer arietinum*), potato (*Solanum tubersum*) and other commercial crops. The soil type is Nitosoils and Vertisols. The lands are mainly have gentle slopes that are suitable for mechanized agriculture.

2.2. Sampling techniques.

Two stages sampling technique were used by selecting the districts first, followed by selection of *Kebeles*. In the first step, 3-districts Dera, Mecha and Achefer districts, were selected purposefully, because of three major reasons: The study area was potential producers of food crops in Amhara region (North West Ethiopia) and a potential area for

irrigation use due to the presence of Lake Tana, Koga irrigation scheme and several rivers. In the second stage, 3 *kebeles namly* Jigna, Tagel wedefit and Ahuri keltafa *Kebeles* (lowest administrative unit in Ethiopia), respectively, were selected based on geographical location, soil type and accessibility to introduce 2-wheel tractors hiring services. The respondents were selected based on the pre-defined criteria and the criteria were wealthclass (richer if the household owns two or more oxen and poor if households own one or no ox (Tadess et al. , 2014). Soil type (black and red soil), accessibility and crop type (maize and rice potential *Woredas*). A total of 5,154 households is found in the three *kebeles* distributed in Tagele wedefit (1,558 HH), Ahuri keltafa (2,104 HH) & *Jigna* (1,492 HH). A proportional random sampling technique was used to identify the respondents and a total of 144 households were selected for the study. To estimate the sample yemane formula were used (Yamane, 1967).

$$n = \frac{N}{1 + N(e^2)},$$

Where, *n* is the sample size, *N* is the population size and *e* is the level of precision.

2.3. Type and source of data

In the study both primary and secondary data were collected using a structured questionnaire. The data included household characteristics like demographic characteristics, livestock ownership, description of weeding and ploughing practices and its organization and past experience in relation to mechanized agriculture, farmers' perception, labour and oxen challenges of ploughing, present situation and current ploughing and weeding practices and willingness to pay for 2-wheel tractor services. The questionnaire was pre-tested for the validity of the questionnaire before the actual survey was conducted. Moreover, focus group discussion (with 8-12 members) were conducted in the three districts to collect qualitative data about farmer's willingness to pay and information about the problems of ploughing, weeding, THS services and to supplement the data obtained during the main survey arguments of the results to set initial bids for the actual survey. Depending on the result of preliminary survey, initial bids were determined using open-ended contingent valuation format (Belhaj, 2003, Gebremariam, 2012, Kasaye, 2015 and Tilahun et al., 2011).

For the CV-survey, face-to-face interview technique was used and also farmers were aware/ clearly informed/ information on the technology (2-wheel tractor) before they give their response for the possible things which affects their decision about their willingness to pay As a result, initial open-ended questions were randomly assigned to 144 sampled households in the final survey. Finally, the cross-sectional data were collected through a well designed contingent valuation survey questionnaire.

2.4. Methods of data collection

2.4. 1. The contingent valuation method (CVM)

Contingent Valuation Method is among the stated preference valuation approaches (non-market goods) and is based on direct opinions of individuals (Tang et al., 2013). Since the 1960s economists have used contingent valuation to value various environmental goods (Mitchell and Carson, 1989). The theoretical foundations of CVM are in the random utility theory (Kanyoka, 2008). It is assumed that respondents know which choice maximizes their utility. The respondent households are initially asked whether or not they would be willing to pay a specific amount for the service received. When a respondent asks one dichotomous choice question, the response is usually "yes" or "no", depending on the individual's WTP the proposed bid value. To improve the precision of the WTP estimates, in recent years, researchers have introduced follow up questions to the dichotomous choice payment question which can increase efficiency (Hanemann et al., 1992, Alberini and Cooper, 2000).

The advantages of using the CVM is firstly, it is simple to understand. It also minimizes the possibility strategic biases (Cameron and Quiggin, 1994, Jantzen, 2006, kahalid, 2008). In addition, CVM is relatively information-rich in terms of the characteristics of the data of respondents and does not rely on secondary data. It is frequently used in developing countries where markets are more imperfect (Stein and Bekele, 2004). However, this method has some disadvantages. It is easy for the respondent to introduce a "strategic bias", by stating a willing to pay or willing to accept lower or higher than the true one to influence the decision making process. It also used a sophisticated statistical and estimation method to analyze qualitative responses. Moreover, only limited information can be obtained from respondents and this method also requires appropriate ranges of value (Reta, 2013). However, many scholars agreed that there is no other best method which is appropriate unlike this method to evaluate the willingness to pay for a hypothetical market estimated over the past fifteen years (Dasgupta, 2000). In order to obtain the respondents' WTP by CVM, different types of elicitation formats have been used. These include open-ended formats, the dichotomous and doubted bound choice approach (Bennett and Blamey, 2001, Mburu, 2005).

Open-ended: elicitation format is where the individual is asked to state a maximum WTP or minimum WTA for a described environmental change. In this case, descriptive statistics (such as means and medians) can be used to obtain rough indications about the respondents' value judgments. For the open ended contingent valuation survey responses, the maximum figures for the willingness to pay reported by the respondents can simply be averaged to produce an estimate of mean willingness to pay (FAO, 2007). The main drawback of this approach is that it is easy for the respondent to introduce a "strategic bias", by stating a WTP/WTA lower or higher than the true one to influence the decision making process. This problem can be avoided by designing better CVM questionnaires and surveys (Aliberini, 1995).

The dichotomous choice approach includes single-bounded and multiple bounded choices. It was developed to overcome the limitations of the elicitation formats that were used in the early stages of CVM studies (Young, R., 2005). In the single-bounded dichotomous choice approach, a randomly selected single amount of bid is offered to the respondent and the respondent provides an answer of "yes" or "no". The "yes" or "no" answers from the respondents are converted to a variable and WTP is estimated from the statistical models based on the probability of "yes" or "no", the bid amount and other socioeconomic variables (Young, R., 2005). If the Initial bid value is significant and positive, there is a bias on the starting bid value; otherwise there is no bias (Reta, 2013).

The double-bounded dichotomous approach, which is one of the multiple-bounded dichotomous approaches, is similar to the single-bounded dichotomous approach, but offers each respondent the bid twice. If the respondent answers "yes" when the initial bid is offered, a higher bid is offered and the respondent who answers "no" to the initial bid has offered a lower bid. Since, this approach gains more information from each respondent (Young, R., 2005). The double-bounded format has, however, been thought of to be the most efficient in minimizing the tendency for the respondent to say "yes" continuously (Mburu, 2005).

Although the double-bound format for the discrete choice contingent valuation method has the benefit of higher efficiency in welfare benefit estimates than the single-bound discrete choice CVM, it has been subject to criticism due to evidence that some of the responses to the second bid may be inconsistent with the responses to the first bid. As a means to reduce the potential for response bias on the follow-up bid in multiple-bound discrete choice formats, introducing the one-and-one-half-bound approach would present a real-world application (Cooper et al., 2001). Therefore, particularly for this study, double contingent valuation approach was employed about his WTP a pre-specified % or value that farmers are willing to pay (Warolin L. 1998).

2.4.2 Description of the technology (CV- scenario)

a) RUMPTSTAND two wheel tractor is a multi-purpose plowing machine and it works like farmer's ploughing practice with a hand hoe which will make it to get a success in African markets (Figure 1a) The small size of the tractor and the possibility of making many of its parts locally makes it easily accessible by private investors, small holder farmers or cooperatives in Ethiopia.

b) Oxen plowing: this is a locally available technology which is made of metal called Marasha (Figure 1b). An ox ploughing in Ethiopia is common practice and was started 3000 years ago in the highland parts of Ethiopia.

Figure 1. Rumpsad two wheel tractor (a) an oxen plough (b)

5. DATA ANALYSIS

The choice of econometric model depends on the nature of the dependent variable. The farmer's expenditure for the tractor hiring service was triying to be estimated by use of revealed price method (CVM). This method used econometric approach called tobit model. For the analysis of willingness to pay, following contingent valuation method (CVM) different approaches used by different authors' example, probit model uses for estimation of willingness to pay for national parks (Anemut, 2006). Improved forage seeds (Lemi, 2015).Willingness to pay for potato seed tubers (Reta, 2013) and Willingness to pay for agricultural services (Daniel and Teferi 2015) and other researchers also used tobit model to analyze tractor services price determinants in the Oromaya region (Tamrat, 2014). Also Mabiso, (2005), applied the double hurdle probit model in estimating consumers' willingness to pay for the analysis of fresh apples and tomatoes in U.S.A. For this research analysis, tobit model was applied to analyze farmers maximum willingness to pay for THS in the study area.

For model specification, the sampled household is either willing or not willing to pay the initial bid value offer for 2-wheel THS service, a tobit model was adopted (Gujarati, 2004 and Wooldridge, 2002).

$$Y^{*} = \beta_1 + \beta_i X_i + U_i \quad (1)$$

$$Y_i = Y^{*} \text{ if } Y^{*} > 0$$

$$Y_i = 0 \text{ if } Y^{*} \le 0$$

Where;

Y_i = the observed dependent variable in this case the amount of money farmers willingness to pay for 2wheel THS per hactare.

Y^{*} = The latent variable which is not observable.

X_i = Vector of factors influencing the amount of WTP and intesity of willingness to pay.

β_i = Vector of unknowen parameters to be estimated.

U_i = disterbance terms that are independently and normaly distributed with mean zero and a common variance δ^2.

3. RESULT AND DISCUSSION

3.1. Descriptive analysis

Among the respondents, about 30 percent of the sample was female HH and 70 % of them were male headed. Male headed HH were more willing to use THS than female headed HH. There was an association between maleness and femaleness towards THS at the 10% level of significance.

Table 1 Descriptive statistics of categorical variables of the HH.

Descriptive characteristics		Willingness to pay			test
		No	Yes	Total	Chi2
1.Sex of household Head	Male	16	85	101	
		15.8%	84.2%	100.0%	2.80*
	Female	12	31	43	
		27.9%	72.1%	100.0%	
2.Model or none model farmer	Model	15	32	47	6.76**
		31.9%	68.1%	100.0%	
	Non model	13	83	96	
		13.9%	86.1%	100.0%	
3.Wealth status of HH	Poor (HH owing one or no ox)	13	34	47	
		27.7%	72.3%	100.0%	5.07*
	Rich (HH owing two or more oxen)	15	82	97	
		15.5%	84.5%	100.0%	

*** and * = significant at 5%, and 10% level of significance, respectively*

About 36% of the respondents were illiterate and the rest were educated (HH from grade one to grade nine). With regard to the wealth status of the respondents, 67% were rich (having two or more of oxen) and 32% were poor (having one or no ox). The chi-square test reveals that three discrete variables (sex of HH, model farmers and tropical livestock unit) showed statistically significant differences between the two groups at, 10, 1, and 10% probability levels, respectively to pay THS.

The average age of the sampled household was 42.4, with a standard deviation of 8.72.. Older groups were less likely more willing to use THS than younger ones. The average land size was one hectare of land and the maximum was 3 hectares of land. Farmers have higher land size are willing to use tractor hiring services than otherwise. There is a significant association between age and their willingness to use THS service ($p<0.4769$). On average, the average family members of the HH were 5, the maximum was 13 and the minimum was 1. Farmers having larger family size are not statistically significant on willing to use THS ($p<0.37$). A common finding that emerged from various studies was that tractorization displaced mainly bullock labor, but its impact on manpower was much less. Other studies concluded that owing to this relatively low displacement of manpower that was unavoidable, mechanization should not be viewed in isolation (Dagnine and Wolelaw, 2016). A similar study also confirmed that the two-wheel tractor saves time and energy; it ploughs twice as fast as oxen (Simiret, 2015).

Similarly, the average off farm income of the HH was about ETB 2854.50. Farm HH who have higher income are willing to use THS but there is no statistical association between income and WTP. The average tropical livestock unit (TLU) was 5.07, with the maximum of 18.42 and the minimum of zero. Hence, farmers having higher TLU were willing to use THS than otherwise. There is a strong association between TLU and willingness to use THS at ($P<0.08$).

Table 2 Descriptive Statistics of Continuous Variables

Descriptive characteristics	Willingness to pay	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]		t-value
Age of HH	No	27	43.48	1.94	10.07	39.5	47.47	0.713
	Yes	115	42.15	0.78	8.41	40.59	43.70	
Land size	No	28	0.92	0.09	0.45	0.75	1.1	-1.880*
	Yes	116	1.14	0.05	0.57	1.03	1.25	
Off-farm income	No	3	1462.67	776.78	1345.43	-1879.6	4804.9	-0.706
	Yes	9	3100	1276.93	3830.8	155.39	6044.61	
Family size	No	28	4.89	0.47	2.5	3.92	5.86	-0.897
	Yes	116	5.38	0.24	2.59	4.9	5.86	
Tropical livestock unit (TLU)	No	28	4	0.68	3.6	2.61	5.4	-1.759*
	Yes	116	5.34	0.33	3.6	4.67	6	
Proportion of heavy soil	No	28	0.02	0.02	0.09	-0.01	0.06	-3.62***
	Yes	112	0.31	0.04	0.41	0.23	0.38	
Oxen number	No	28	1.39	0.19	1.03	0.99	1.79	-1.94*
	Yes	116	1.88	0.11	1.22	1.65	2.1	
Female labour	No	28	1.32	0.25	1.33	0.8	1.84	-0.97
	Yes	116	1.53	0.09	0.95	1.36	1.71	
Male labour	No	28	1	0.2	1.05	0.59	1.41	-2.46*
	Yes	116	1.61	0.11	1.21	1.39	1.83	

3.1.1. Experience of Tractor cultivation in the study area

In the study area, farmers used to plough their field using a traditional plough. However, they were asked whether they had experience in using a tractor or not and the result indicated that about 54% of them had long experience in the use of tractors. They explained that during the previous government (DERGU regime) state owned farms mainly used large scale mechanization. The survey result also indicated that the farmers would accept 2- wheel THS services if a tractor would be available in the area, about 80% of the sampled farmers are willing to use tractor use /hiring services. However, 20% of them refused due to the following reasons, the reasons are: Due to high depth ploughing results to reduce yield, farmers, smaller land holding, farmers' awareness about the benefit before and High cost of ploughing are the common one.

Table 3 Experience and willingness THS

Willingness (experience) of HH	Frequency	Percent (%)
i. Do you have experience using a tractor?		
No	67	46.5
Yes	77	53.5
Total	144	100
ii. In case a tractor would be available in your community, would you be willing to try it?		
No	28	19.4
Yes	116	80.6
Total	144	100

3.2. Farmers' willingness to pay for 2wheel Tractor hiring service (THS)

The descriptive result showed that the mean of willingness to pay for tractor service were found to be 280 ETB, respectively with a standard deviation of 265.68 ETB. The result showed that the respondents were willing to pay less than the average of WTP.

The result of the contingent valuation survey demonstrated that the willingness to pay of sample households ranges from the minimum 50 ETB to the maximum 1500 ETB per timad (one fourth of a hectare).

Many researchers explained that If a respondent indicates a willingness to pay for the first offered amount, the next higher amount is presented to him/her to elicit his/her maximum WTP, but if the respondent is unwilling to pay the first offered amount, the second bid which is less than the first amount is presented (Hanneman, 1984, Carson, 1985). For this procedure to reduce the potential for response bias on the follow-up bid in choice formats (such as the DB mode), Cooper et al., (2006) used the one-and-one-half-bound approach elicitation in order to present a real-world application. Hence, following Cameron and Quiggin (1994), sets of bids were determined for double bounded dichotomous choice format by making twice the initial bid if the first response is "Yes" and half of it if the response is "No". Thus, sets of bids for THS were (100, 200 and 300 ETB per timad).

In the first scenario (Bid 1), The data obtained from the survey depict that the minimum bid amount was set and 81 (56.2%) of sampled farmers willing to pay (the yes-yes response) for 2-wheel tractor hiring services for the first offering price (amount) and 63 (43.8%) of the respondents (yes-no) response were not willing to pay for starting bid amount for THS. In the first scenario (starting bid), the improvement of the service quality was proposed. The second maximum amount was set and the respondents were asked to pay the maximum amount, the result was indicated that 38.4% of the willing respondents would have WTP between 350 and 550 Birr per annually and 27.9% would have WTP between 500 and 750 ; and 18.6% agreed to pay between 800 and 950 ETB per year

In the second scenario (next bid), the improvement of the service quality was proposed and the respondents who accepted the first offered amount were again asked the next highest amount. The result indicated that 56.9% of them were not willing to pay the for THS (Table4).

In seconded scenario, among the respondents who replied to the first offered amount was 29 (46%) of the respondents accepted the next minimum offered amount; contrary to this, 34 (54%) of the respondents again refused to pay the amount which is less than the first offered amount. In this case, open ended question was prepared to elicit the minimum amount those respondents are willing to pay for the stated.

Table 4 Joint repose of stated bids of THS services (2wheel THS)

Farmers Response	Joint repose of willingness Frequency	Percent (%)
yes-yes	33	22.92
yes-no	48	33.33
No-yes	29	20.14
No -no	34	23.61
Total	144	100

Besides, the respondents were asked the maximum amount if their answer was yes-yes to the first bid and the minimum amount if their answer was a no-no for the first and the next minimum bids. As the result of the contingent valuation method indicated, 33 (22.92%) of the respondents were willing to pay the maximum amount beyond the stated bids; on the other hand, 34 (23.61%) of the respondents refused to pay both the first and the next minimum bid (Table 4).

About 80% of the farmers are willing to accept 2- wheel THS. The demand curve for willingness to pay indicated that the number of respondents decrease if the bid gets higher and higher (Figure 2).

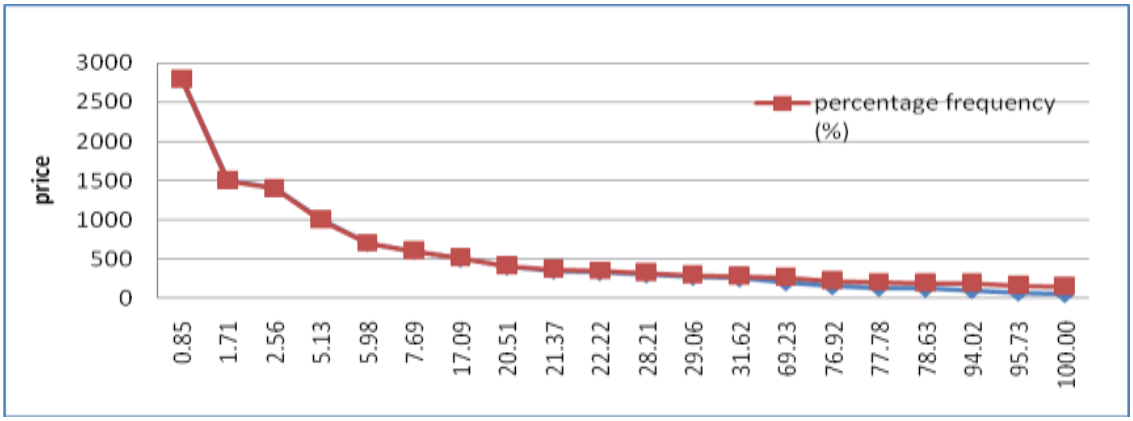

Figure 2. Demand curve of sample respondents for 2wheel THS

3.2. Econometric result of Tobit model.

The tobit regression was estimated for the number of variables which expected to affect how much the farmers are willing to pay for the 2-wheel THS services. These variables include: Sex of the household head (SEX), age of household head (AGE), education level of the household head (EDUCLEVEL), model farmer (MODELFARMER) farmland size (LANDSIZE), male labour (MALELABOUR), Female labour (FEMALABOUR). Ploughing frequency (PLOWFREQ), Herbicide use (HERBCIDUSE), Experience of tractor use (EXPTRACTOR), Number of oxen owned (OXENOWNED), the proportion of heavy soil (SOILTYPE), family size (FAMLYSIZE) and Livestock owned (TOTAL_TLU). Four of the variables were found to be statistically significant at different levels of significance, however, four of them were insignificant. The results are presented in Table 7.

The result of the study showed that age of the respondent has a negative association with willingness to pay for hiring services ($P<0.05$). It suggests that as the farmer's age increased their willingness to pay for a 2-wheel tractor service was less likely. This might be aged household heads may confront cash constraint when his/her age gets older and older. As household age increases by one year, the probability of willing to pay for 2-wheel THS decreased by 32%. In terms of financial terms, the amount of payment will reduce by 141 ETB as the age of the household's head increases by one year. This research output is consistent with a study by (Mabiso, 2005), which explains that age of consumer has a negative effect on the willingness to pay for fresh apple and tomato.

Education level of households is one significant variable which encourages tractor hiring services for households if available in the area. The result of the study indicated that, farmers who have more level of education were willing to pay for 2-wheel THS ($p<0.05$). The marginal effect shows that the probability of willing to pay for a tractor hiring service will increase by 12% if farmer's level education is increased by one unit. The result was also in line with the study by Tamrat, (2014). The educational level of HH was one of the influencing factors for technology adoption in a given society in this study education and. The result showed that the educational status of the households affected the tractor service rental use.

Land size was expected to have a positive effect on willingness to pay. As land size of households increases, the probability of willing to pay for 2-wheel THS ($p<0.05$). In other words, the probability of willing to pay for THS will increase by 15.8% if the land size increased by one hectare. The marginal effect shows that a one unit increase in a hectare of land will cause a 13% increase in the probability of willing to pay for THS. Study by Rasouli, et al., (2009) indicated that "small farming and scattered agricultural holdings" is a major inhibiting factor which affecting mechanization in Iran. This is also similar in the study by Blachandran (2003), on the adoption of Agro-mechanical Technology in Rice Cultivation in Kerala. In similar studies, research work done on tractor use of rice farms in Philippines indicated that small parcels and the prevalence of small farms also make tractor use uneconomical for both two- and four-wheel tractors are indivisible capital-intensive (Celerina, and Maranan, 1980).

Farmers that used male labour were more willing to pay than farmers who use female labour ($P<0.05$) This shows that male labour availability in the households is an important variable in explaining willingness to pay for for 2-wheel THS. Farmers using male labour have a 7% more chance of being willing to pay for the THS compared to those who use female labour. A Similar study revealed that studies from the Oromia Region in Ethiopia showed that factors like, labor availability (hired and family labour) determine willingness to pay for tractor services Tamrat, 2014).

Soil type associated positively with willingness to pay for 2wheel THS. Farmers having heavy black Vertisols are more likely to use THS for cultivation as compared to red Nitisols (P<0.01). The marginal effect shows that there will be a 15% chance more likely to pay for THS services if farmers own black soil as compare to red soil. A contingent study by (Takeshima, 2016) revealed that agro-ecological conditions are one of the main factors that affect the willingness to pay less and more amount of hiring services.

The study indicated that the total number of animals possessed by the household measured in tropical livestock unit (TLU) is associated negatively with the willingness to pay to THS (p<0.1). This could be due to the fact that, farmers may prefer oxen plough /traction/ as compared to 2-wheel tractor hiring service. Moreover, oxen are culturally liked with farmer's livelihood. The marginal effect shows that an increase in TLU by one unit leads to a decrease of the willingness to pay for THS by 3%. Contrary to this result, a similar study on the willingness to pay revealed that farm households with a larger livestock herds have a higher chance of willing to pay for the improvement for irrigation (Njoko ,2014).(Table 5)

Table 5. Tobit regression result (factors influencing the amount of money willing to pay for households

HOWMUCH	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]		Probability Uncensored
SEX	44.80	40.12	1.12	0.266	-34.65	124.25	0.084
AGE	-171.13**	80.93	-2.11	0.037	-331.41	-10.84	-0.320
EDUCLEVEL	63.42**	30.72	2.06	0.041	2.57	124.26	0.119
MODELFARMER	48.85	32.78	1.49	0.139	-16.07	113.76	0.091
LANDZIZE	75.95**	32.22	2.36	0.020	12.15	139.75	0.142
MALELABOUR	35.68**	11.50	3.1	0.002	12.91	58.46	0.067
FEMALABOUR	-12.47	12.97	-0.96	0.338	-38.15	13.20	-0.023
PLOWFREQ	1.35	12.00	0.11	0.911	-22.42	25.11	0.003
HERBCIDUSE	29.12	26.64	1.09	0.277	-23.65	81.89	0.055
EXPTRACTOR	24.00	28.01	0.86	0.393	-31.47	79.47	0.045
OXENOWNED	29.95	24.14	1.24	0.217	-17.87	77.76	0.056
SOILTYPE	78.22*	41.12	1.9	0.060	-3.22	159.66	0.146
FAMLYSIZE	1.29	5.32	0.24	0.809	-9.25	11.83	0.002
TOTAL_TLU	-15.56**	7.82	-1.99	0.049	-31.04	-0.08	-0.029
_CONS	564.62	297.53	1.9	0.06	-24.62	1153.86	
_SE	138.02	9.78		(Ancillary parameter)			
Number of obs = 131, Prob > chi2 = 0.0001 , Pseudo R2 = 0.0293		LR chi2(16) =42.728, Log likelihood = -707.25					

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

4. CONCLUSIONS AND RECOMMENDATIONS

The study result indicated that the mean WTP price was found to be 1121.026 ETB (56.05 USD) per hectare with minimum of 200 ETB (8 USD) and a maximum of 2000 ETB (80 USD). The results of this study suggest that majority people would be willing to pay for 2-wheel tractor hiring services, the paper recommended that government, investors or private companies may introduce tractors and increase the number of hiring points. Moreover, the age of the household, education level, land size of household, availability of male adult labor, soil type used and the total live stock unit (TLU) were the main factors that affect farmers willing to pay for 2-wheel THS. Hence, investors and the private company's need to consider these variables for introduction 2-wheel THS.

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