Tractor Service Price Determinants among Smallholder Farmers in Ethiopia

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ABSTRACT

Draught power, important agricultural input that mostly affects farm productivity is becoming important problem of Ethiopian agriculture as DAPs are decreasing and mechanization/tractorization/ is most important solution. This study examines factors influencing farmers' tractor use in Oromia. Data was collected from 160 samples HHs in two districts of Arsi Zone. Data included challenges to provide tractor rental service and farmers' WTP. Partial budgeting ensured that percentage profitability over traditional practice for hired tractor was 35.91 and 13.11 for wheat and teff respectively. Tobit model result shows that educational level, landholding, rental station distance, extension contact, cooperative membership, farm fragmentation, land suitability for tractor operation, tractor quality, hired labor, oxen number, and family labor determine WTP while, education level, landholding, cooperative membership, farm fragmentation, hired labor and land suitability for tractor operation influence the intensity. To enhance agricultural mechanization human Capital development, strengthening extension services and supply of tractor and availing credit for purchase of small tractors are recommended. Moreover, farmers should pool their farm land to economize their farm.

Key words: agricultural mechanization, tractorization, partial budgeting, Tobit model, Oromia

1. INTRODUCTION

Like other African countries, the Ethiopian economy is highly dependent on agricultural sector. Accordingly, about 84% of the nation's population are engaged in various agricultural activities and generate their income for households' consumption to sustain their livelihood (CSA, 2009; Abera D., 2009).

Inspites of its dominance in the economy of the nation, like other African countries' agriculture, Ethiopian agriculture is also characterized by subsistence farming, by low input and low output, fragmented and inadequate land holding, very traditional or back ward farming techniques or absence of mechanization for most operations, and non-market oriented production.

As many studies showed, the use of tractor on farm for tillage purpose has significant contribution on farm productivity. (Pierce, and Cavalieri, 2002). For example, the findings of study done in India revealed that, production of farm with tractor is more productive than that of the animal power farm. A study conducted in South East Oromia (part of Ethiopia) showed that the average rate of return on investment in mechanized farm with rented machinery was 63.6% whereas; with owned machinery

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was 100.4% while it was 55% for non-mechanized farm (Henock, 1972). According to Singh and Chancellor (1974); Motilal (1973) and Madras (1977), tractor - owned farms obtained increased productivity of paddy, sugarcane and groundnut from 4.1 to 28.3 per cent, from 13.1 to 34.2 per cent and from 9.8 to 54.8 per cent, with an average value of 15.8 per cent, 23.2 per cent and 31.8 per cent, respectively. Likewise, the average increase in productivity on farms hiring tractors was reported to be 11.8, 13.0 and 16.0 percent for paddy, sugarcane and groundnut, respectively.

Between 1960s and 1980s many of the developing countries of Africa and other developing countries of Asia, India and China started mechanizing their farm and a number of tractors were introduced into these countries. As a result significant economical improvement had been recorded. But, while the number of tractors in others continents is going on increasing alarmingly, that of Africa continent is stagnant and the farming systems in most SSA countries is getting back to hand-hoe and to animal drawn implements. But the getting back to these traditional farming system could not support the sustainable feeding of the population as the farm is highly facing problem of power due to different reasons like prevailing animal disease, shortage of feed, epidemic diseases like HIV. Recent research outputs shows that one of every three households in Ethiopia has no oxen while one of every three households has only one ox (Desalegn R., 2009). Moreover, the copping strategy for oxen shortage for those who had reported “No oxen” were “hand digging” for more than 2.2 million people which shows how much the problem was severe (CSA, 2009). Therefore, propositions of mechanizing could also be justified with the prevailing animal diseases, and shortage of feed, shortage of rural labor at the required quality and level at the required times.

Recently recognizing the situation, other African countries (like Mali, Ghana, Zimbabwe *etc*.) are striving to mechanize their farm by preparing Agricultural Mechanization Strategy (Mathias, 2010). Therefore to bring such policy changes in Ethiopia, there is a need to identify factors that determines the demand for the service or use of tractor, to measure effect of tractorization on farm production for major crops in the study area and to assess factors that challenges the supply of tractor rental services.

2. Literature Review

As many current literatures pointed out, Africa is the only region in the world where agricultural productivity is largely stagnant (FAO, 2008). The productivity of the agricultural sector in Ethiopia is by far lower than that of other Sub-Saharan African countries (The RATEs Center, 2003: in Jema, 2008). To feed the growing population, most experts believe that the current production system in the country has to be supported by mechanization (FAO, 2008; Soltani, 1974). The rate of agricultural growth in Ethiopia needs to grow significantly in order to mitigate our historic association with hunger and

starvation, and our dependence and burden on imported food. According to many development practitioners, this can be realized through, among other things, increasing agricultural productivity using mechanization (Asoegwu and Asoegwu, 2007). The practicability of such action has been proved in many countries such as China (Li, 2005), and Oman (Ampratwum *et al.,* 2004). For instance, research done in Philippine showed that mechanization increases output although not impressive, by increasing the cropping intensity and yield. Even though absolute contribution of tractor without other technological change may not be reflected, it enhances the employment of production factors such as fertilizer which has higher impact on yields and the total production increases indirectly due to tractorization (Yolanda, 1981). Also, a research done in Ethiopia around Chilalo area of Arsi Zone shows that there is yield difference between mechanized and that of un-mechanized farm (CADU, 1970).

3. Research Methodology

3.1. *Study Area*: - The study was conducted in Arsi Administrative zone, South-Eastern part of Oromia Regional State. Arsi zone is one of the 22 zones of the Oromia National Regional State. It is located in the southeastern part of the country. It is also situated between $6^0$45'N to $8^0$58'N latitude and 38^0 32'E to 40^0 50'E longitude (Atlas of Arsi Zone, 2002). It has a surface area of about 20737.24 km^2 and characterized by mixed farming system. It is also known for its surplus production and knows as wheat-belt of Ethiopia (Hailu, 1992).

3.2. Sample Size and Sampling procedure

Multistage and purposive sampling techniques were employed. At the first step using multistage sampling technique, based on convenience for tractorization, farming/cropping system two districts (Hetosa and Lode Hetosa) which are known for the production of teff and wheat (major crops of the area) were selected purposively. In the second stage two PAs from each district were selected and name of households (HHs) along with their farm size was listed and the HHs were stratified as small and large farm holders. Finally, 160 respondents were selected from the two strata by systematic random sampling in such a way that both groups were included in the sample.

3.3. Data Type, Source and Methods of Collection

Primary data were used in the analyses and these consisted of socio-economic data and production data. The data sources were farmers and private and governmental and non-governmental organizations engaged in hiring agricultural machineries in the study area. To collect data from farmers, pre-tested structured questionnaire was used. The data collected included socio-economic characteristics of farmers and information specific to their current tractor use and future demand. Additional data from private and governmental and non-governmental organizations were collected

using checklist. To supplement this information, Focus Group Discussion (FGD) was held with key informants.

The farmers' actual experience of expenditure for tractor service was tried to be estimated by the use of revealed preference method. This method employs econometric approach to determine the estimate price of tractor service for different purposes. To estimate farmers' future demand and willingness to pay (service price) for the tractor service, CVM approach was used. In CVM a hypothetical tractor service market was created, and the potential value of tractor service was approximated based on discussions made with service providers, as a basis for the first bid value. Then, the survey was conducted to record the respondents' willingness to pay for the service. Dichotomous approach of elicitation as a "Yes" or "No" was made. If he/she says "Yes" for the first or willing to pay the first bid value, the bid was continued by increasing value until he/she says "No" and if the answer was "No" for the first bid value the bid was continued by decreasing the value until he/she says "Yes". The biding price was used from last year's price.

3.4. Methods of Data Analysis

To measure the effect of tractor on farm profitability, partial budgeting for teff and wheat were employed. The farmers' actual experience of expenditure for tractor service was tried to be estimated by the use of revealed preference method. This method employs econometric approach to determine the estimate price of tractor service for different purposes. Ordinary least square (OLS) method of estimation by using limited ranges of observations result is both inconsistent and biased parameter estimates. But there are broad classes of models that have both discrete and continuous parts. One important model in this category is the use of censored model known as Tobit[2] model which is also called Limited Dependent Variable Models (Gujarati, 2004).

Following Maddala (1992), Johnston and Dinardo (1997), Green (2000) and Gujarati (2004) the Tobit model can be defined as:

$$Y^* = \beta 1 + \beta i Xi + Ui \quad \text{..... (9)}$$

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

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

Where,

Y_i= the observed dependent variable, in this case amount of money farmer is willing to pay for the service per a hectare or land size he will allocate under tractor

Y_i^*= the latent variable which is not observable

[2] Tobit Model was first studied by Tobin (1958). His Model was nick named the Tobit Model (Tobins Probit) by Goldberger (1964)

X_i= vector of factors influencing the amount of WTP and intensity of willingness

β_i = vector of unknown parameters to be estimated

U_i= residuals that are independently and normally distributed with mean zero and a common variance δ_2

The model parameters are estimated by maximizing the Tobit Likelihood Function of the following form (Maddala, 1997).

$$\prod_{Y^*>0} \frac{1}{\sigma} f(\frac{yi - \beta Xi}{\sigma}) \prod_{Y^*\leq 0} F(-\frac{\beta Xi}{\sigma}) \quad \text{.....Eq (10)}$$

Where f and F are respectively, the density function and cumulative distribution function of

Y_i^*, $\prod_{Y^*>0}$ means the product over those i for which $y_i^*>0$, and $\prod_{Y^*\leq 0}$ means the product over those i for which $Y^* \leq 0$.

***A. Dependent Variables*:** - There are two endogenous variables that are going to be estimated by the selected model (Tobit model) and are explained as follows;

1. Willingness to pay (WTP)*:* It is the amount of monetary value that respondents are willing to pay per a hectare of land and it is continuous variable measured in terms of Birr. It will be estimated by linear regression model by using MLE procedure by Tobit model.

2. Intensity of willingness: - Size of farm land in hectare that farmers are willing to allocate under tractor plowing is the other continuous dependent variable that was estimate by MLE procedure using Tobit model.

B. Other exogenous variables in the model are defined as follows:

COOPM= membership in cooperative (1= member 0= otherwise)
HHSEX = sex of household head (1=male 0= otherwise)
HHAGE = age of the household head (year)
HOUSETYPE = house type (1= corrugated iron 0= thatched roof)
HHEDUC = household head education (year of schooling)
LANDCULTVTD = cultivated land holding (hectare)
STATIONDST = distance from tractor rent station (km)
PLOTNUMB = number of plots of farm
SUITLAND = farm size suitable for tractor operation (hectare)
NONFINC = households' non farm income (Birr)
SERVQ = service quality (1= good 0 = bad)
HIRDLABOR = hired labor on farm (man equivalent)

OXNUMBER = number of oxen
FLABORME = labor contribution of family (man equivalent)

4. Result and Discussion

4.1 The Socioeconomic Characteristic of Small holder Farmers in Arsi Zone of Oromia-Ethiopia

Out of the total households, only about 33.3 % (54) are regular users of tractor rental services for land plowing while about 41.9 % (67) are using sometimes and the rest 24.9% (39) have never used the service. The age of the respondents ranges from 24 to 72. The mean age of the regular, sometimes and never users' are 43.80, 45.94 and 45.72 and the total mean age of the respondents' is about 46.19 with mean standard error of 0.93.

Economically active family labor in terms of man-equivalent becomes 3.92 for the sample while it is 4.03 and 3.59 for users and non-users respectively. The family size of the respondents range from 1 to 12 with total mean of 5.76. Mean family size of the users and non-users were 5.75 and 5.77 respectively with slight more for non-users but statistically insignificant (Table 1).

The mean hired labor in man-equivalent (ME) for users and non-users was 0.6281 and 0.2308 respectively which implies that tractorization doesn't necessarily mean displacement of labor by mechanical implements. The prior research output by different researchers also confirmed that tractorization did not displace human labor but by large animal labor (Johl, 1970; Bhogwati Committee on unemployment, 1970).
Mean values of non-farm income for users and non-users were found to be 7175.26 Birr and 731.79 Birr respectively with mean value difference significant at 1% level. The total mean non-farm income for the sample is 2579.66 Birr (Table 1).

The educational level of households was one of the influencing factors for technology adoption in a given society. In this research the mean values for users and non-users were calculated and became significant at 1% of probability level. The mean values were found to be 4.95 and 6.55 years for non-users and users respectively. This shows that educational level of the households head positively affects the tractor service rental use (Table 1).

Out of 160 sampled households only 11 (6.9%) were female headed while the rest 149 (93.1%) were male. Out of 121 total users, females account for 4.13% (5) and the rest six were non-users which are 6.88% of total non-users. The difference in use of tractor service between male and female may be due to less education background, extension contacts and other information accesses which may help females to be motivated for technology adoption and in particular this may be the result of sex

discrimination (table 1). About 93.8% (150), 1.9% (3) and 4.4% (7) were married, single and widowed respectively. Out of the users about 93.39%, 2.48% and 4.13% were married, single and widowed respectively. The chi-square test for marital status was 1.04 and found to be weak (Table 2).

4.2 Resource ownership of the sample households

The average landholding for the study area is 2.00hectare (AZBOFED, 2010). The mean actual cultivated land holding for 2010/2011 production year was 3.89ha with standard deviation of 2.70. The mean actual holding of users and non-users was 3.88ha and 1.88ha respectively with significant mean difference. The mean of land rented-in land was 1.80 and 0.742ha for users and non-users respectively.

Farm animals have crucial roles in the rural economy. In general, they are sources of draught power, food such as milk and meat, cash, and means of transport both for human beings and agricultural produces. In addition to these, animal dung is used as fuel and organic fertilizer. Moreover, in the study area, farm animals are used as a measure of wealth.

Accordingly, the mean value livestock size held by the respondents was 6.39 tropical livestock unit (TLU) with standard deviation of 3.22. The mean livestock holding for tractor rental service users and non-users was found to be 6.76 TLU and 5.24 TLU. The average size of cattle held by the sampled households was 4.80 TLU with standard deviation of 2.45. Average cattle in TLU for users and non-users were 5.07 and 3.98 respectively. Similarly the average number of oxen held by the sample was 2.91 with standard deviation of 0.107 while the mean number of oxen for users and non-users were calculated as 3.08 and 2.38 oxen respectively with significant mean difference.

4.3 Households' non-farm activities

Out of the total respondents, about 45% of households involved in one or more types of non-farm activities. Out of the households involved in non-farm activities 81.94% and 18.06% were users of tractor rental service regularly or sometimes and non-users or those who never used so far respectively with chi-square (χ^2) value 2.836 (Table 4). This shows that the involvement of households on non-farm activities especially on grain trading, positively affects the use of tractor rental service. This is may be due to the fact that these households spent much of their time on other non-farm activities and understood the profitability of the technology (tractor use).

4.4 Households' income sources

The mean income from livestock for tractor rental service users and non-users are 537.77Birr and 388.21Birr with insignificant mean difference (t-value=0.886). The largest proportion of income comes from crop both for tractor users and non-users which has mean values of around 42,529.2 Birr and 13,836.9 Birr respectively (Table 5). Income from sale of wheat crop takes the lion share of the income sources in the study area.

4.5 Institutional characteristics

4.5.1 Distribution of respondents by access to different services

The important institutional services that are required to increase agricultural productivity through adoption of new technology, among all others, are extension service (participation on different field days, farm trainings, demonstrations of proved technologies advises etc), availability of improved technology, such as fertilizer, improved seeds, and access to credit service. It was understood from previous studies that increase in productivity can be achieved with appropriate utilization of technological innovations. The survey result shows that about 91.88% (147) of the respondents had access to extension services and contact DAs, get agricultural inputs like fertilizer, seed and agricultural extension advices. Among those who had access to extension services, about 74.15% (109) of them uses tractor rental services while only around 25.85% (38) are non-users of the technology. Significant number of HHs 125 (78.12%) also contacts cooperative leaders to get farm inputs like chemicals (pesticides, insecticides, and herbicides etc), out of which about 78.4% (98) were users of tractor and the rest were non-users with Chi-square 2.387 (Table 7). In addition to these, a few tractor users have (10) also strong relation with agricultural inputs traders (Table 6).

Attending demonstrations and field-days on mechanization and farm training on different issues like mechanization, improved variety use, natural resource utilization and conservation etc have strongly and positively influenced the households towards tractor rental service usage. For example, out of 39 farmers who attended demonstration on farm mechanization like tractors, 33(around 84.42%) are tractor users (Table 7).

4.5.2 Access to market center

A number of farmers from sampled respondents sell their agricultural products immediately after harvest to cover farm input loans, social obligations and urgent family expenditures. The survey result also indicated that the mean value of the distance that the farmers travel to get market is 2.59km with a 0.188 standard deviation. The result of survey has also revealed that there was significant mean difference between users of tractor rental service and non-users with less mean value for tractor users (Table 8).

4.5.3 Access to tractor rental service providers

There are three types of agricultural mechanization service providers in the study area. The first type is state farms which are primarily established for revenue generation for governments. But these state farms provide rental services only in combine harvesters occasionally when there are climatic problems like non-seasonal rainfall during harvest seasons. The second type service providers are private limited companies and the third ones are those who were not registered as investor or other special farmers but they are known as ordinary farmers in the PAs. The second types of companies are primarily established for such service provision for tractor rental service (table 8).

4.6 Challenges for the Provision of Tractor Rental Service: operational and maintenance problems

By institutional factors it is to mean the laws and bylaws that govern the service providers and the way in which the service providers are organized in such a way that they can provide their service continuously and sustainably. This factor includes absence of skilled man-power on operation, maintenance in case of breakage and servicing, and lack of spare-parts. Similar to other parts of the country, institutional problem is the main problem that hinders the provision of the service. Absence of tractor operator in the area was the main problem. For instance out of ten respondents in the study area two of them have operators who have taken formal training how to operate and the rest 8(80%) have operators trained informally.

This absence of formally trained operator is the main cause for most tractor breakage and it in tern leads to another problem which could not be solved locally which is maintenance problem. Because of the absence of skilled mechanics in the locality, the owners are forced to transport whole or parts of their tractors to Adama (Nazareth) or Addis Ababa which will incur them another additional transport and other related costs. Absence of spare parts in the local market was also another problem. Out of 10 respondents all 10 (100%) of them responded that there is serious spare part problem in terms of both price increments trough time and shortage of the parts in the market.

4.7 Sources of Potential Constraints Facing Traditional Animal-powered Farm in the Study Area

The farmers of the study area were asked to put the major constraining factors that they thought crucial in their area. According to the survey result, expensiveness of oxen, shortage of grazing land and animal feed, and drudgeries work are the main factors that are found and that will make the farming in the study area difficult to continue by animal power as it is now being done. Accordingly,

about 89.4%, 93.1% and 68.1% of the respondents selected the expensiveness of the oxen (draught power animal), grazing land and feed constraints, and work drudgery as the main constraints respectively, while 30% and 11.3% selected shortage of agricultural labor and prevailing animal diseases as constraints respectively (Table 10).

4.8 Determinants of willingness to pay for the use of the tractor rental service

Determinant factors for price of tractor were discussed in table 11. The result has shown that type of house that the household possessed (HOUSETYPE) was important variable and positively related to dependent variable. From the focus group discussion (FGD) and the survey report it was concluded that type of house that a household possessed was the indicator of wealth in the society. Similarly shift of household's house from thatched to corrugated iron roof house type increases the amount of WTP by amount 58.49 Birr.

As expected, educational level of the households (HHEDUC) was the factor that was highly significant and positively influenced the probability of being willing to use and the WTP for tractor rental service by the farmers (households). The result also supports the finding of earlier researchers on adoption of agricultural mechanization technologies (Hassena M. *et al*, 2000).

Households' cultivated land holding (LANDHOLD) and land size that is suitable for tractor operation (SUITLAND) were found to be variables that are significant in influencing the WTP for technology use of the households positively while Number of oxen possessed and labor contribution in man equivalence of the family has negative relations with willingness to pay amount as expected.

Access to the technology or the distance of households from tractor rental service provision station (STATIONDST) was also important explanatory variable which affect the amount of WTP for the service negatively.

Extension contact rate (EXTCONTCT) of the households were also another variable that become significantly influential to determine the probability of the farmers' WTP value positively and it was significant at 1% probability level.

Number of farm plots (PLOTNUMB) that a farmer possessed was another variable that determines the WTP amount of the farmers for tractor rental service. Number of farm plot is a measure of farm fragmentation and those farmers who have less number of farm plots (more consolidated farm) have more interest to use tractor and more willing to pay for the service they are provided.

Quality of the service being provided around the study area as perceived by households has also negative influence on the WTP of the households. The increase in quality of service from bad to good will increase the amount that a household is willing to pay by birr 7.10 Birr and the increase by one unit in hired labor has probability of increasing the value of WTP by 40.99.

4.9 Determinants of intensity of willingness for tractor rental service

Household head's education level, total cultivated land holding (LANDCULTVATD) of a farmer and land suitability for tractor operation that a farmer possessed were variables that significantly and strongly influenced the size of farm land to be allotted under tractor operation. The increase in education level of household's head and total cultivated land holding (LANDCULTVATD) and land size suitable for tractor operation of a farmer by a unit will have the probability to increase the size of the farm under tractor operation by 0.2, 0.52 and 0.32 hectare respectively (table 12).

The intensity of tractorization decreases with the number of farm plots that a farmer (PLOTNUMB) possessed (significant at 5% probability level). The increase in the number of farm plot by one unit will decrease the intensity by 0.15 hectare. As it was discussed in descriptive analysis part of this material, as fragmentation of farm land increases the amount of money that farmers are required per hectare of land for tractor operation also increases.

5. Conclusion Recommendations

The result of the study revealed that households' demographic and socio-economic characteristics such as farm income, wealth category, and educational background are the major factors that influence the willingness of the farmers to use tractor rental services, WTP for the services and the intensity of tractor use (farm to be under tractor rental services). In addition to this, the result of descriptive statistics analysis shows that trained man-power on tractor operation and mechanics for maintenance of tractor are the main problem in agricultural farm tractor supply side. Therefore, this result justifies the importance of the development of human capital for households (users) by exposing different short and medium term courses. In addition to this, in order to reduce maintenance cost and lengthen the life span of the tractor, trained and skilled operators and skilled mechanics must be produced.

Extension workers should also consider the issue of agricultural mechanization, and some guidelines (National Agricultural Mechanization Strategy) should also be prepared at national level to lead DAs and regional BOARD to transform the Ethiopian agriculture systematically.

Strengthening the Supply of tractor is the other solution as poor quality of the service reported by farmers was the result of too oldness of the tractors and poor maintenance service provision for the machineries. The poor maintenance service provision also led to less number of functional tractors and this led to high service provision price. Absence of competition in the market may be seen as one of the reasons for high price of tractor rental service. Above all, high tractor rental price was the result of different factors such as, increase in the price of imported spare parts, fuel and lubricants price increase through time, unavailability of maintenance shops and garages locally, unskilled operators of the machineries which fueled the damage of machineries and uneconomical farm size which consume more fuel by turning here and there because of land fragmentation.

Availing credit for purchase of small tractors: It is proved that there is no credit facility for tractor service use or to buy tractor. Therefore, as tractorization promotes agricultural modernization which calls for market-led agriculture, credit facilities for purchase of small tractors and rental purposes should be given due attention. In addition to this, activities that can promote the culture of saving of the farmers should get due attention as the farmers who have good annual farm income were found to be more willing and use tractor services and are willing to pay more and allot more size of farm under tractor plow.

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Annexes

Table 1 Demographic characteristic of households

No	Description	Mean	t-value

		Users	Non-users	Total	
1.	Age	44.16	52.49	46.19	4.72***
2.	Farming Experience	24.88	34.15	27.14	5.112***
3.	Labor (ME)	4.031	3.59	3.92	1.444
4.	Hired labor (ME)	0.6281	0.2308	0.5312	4.074***
5.	Family size	5.75	5.77	5.76	0.039
6.	Education	6.55	4.95	6.16	2.681***

*** Statistically significant at 1% probability level

Table 2 Distribution of the Sample Households by Sex and Marital Status

No.	Description	Users		Non-users		Total		(χ^2)
		N	%	N	%	N	%	
1.	Sex							
	Female	5	4.13	6	15.34	11	6.88	5.83**
	Male	116	95.87	33	84.61	149	93.12	
2.	Marital status							
	Married	113	93.39	37	94.87	150	93.8	
	Single	3	2.48	0	0	3	1.9	
	Widowed	5	4.13	2	5.13	7	4.38	1.04*

** and * Statistically significant at 5 and 10% and probability levels.

Table3: Resource ownership of households (continuous variable)

No	Description	Mean			Std Error	t-value
		Users	Non-user	Total		
1.	Actual land hold	3.89	1.88	3.89	0.21	6.65
2.	Rent in land	1.80	0.74	1.47	0.20	4.79***
3.	Rented out land	0.02	0.15	0.05	0.02	-2.38*
4.	Grazing land	0.11	0.14	0.12	0.02	0.76
5.	Wheat farm	2.80	1.15	2.40	0.19	6.42***
6.	Teff farm	0.77	0.15	0.62	0.47	0.99
7.	TLU	6.76	5.24	6.39	0.25	3.39***
8.	Oxen	3.08	2.38	2.91	0.11	3.37***
9.	Cattle (TLU)	5.07	3.98	4.80	0.19	3.07***

***, ** and * shows level of significance at 1%, 5% and 10%

Table 4: Households' Non-farm activity participation by tractor use category

		Participation on Non-farm activities				
		Yes		No		(χ^2)
		N	%	N	%	
Tractor	Users	59	81.94	62	70.45	2.836*
	Non-users	13	18.06	26	29.55	

* Chi-square is significant at 10% level

Table 5: Household's Income sources

No	income source	Mean			t-value
		Users	Non-users	Total	

1. Sheep, goat, chickens &honey-bees	537.77	388.21	501.31	0.886
2. Sale of crops	42,529.2	13,836.9	35535.5	5.984***
3. Non-farm	3175.26	731.79	2573.66	4.313***
4. Wheat sale	31,549.8	8,596.7	30110.7	5.418***
5. Teff sales	624.0	687.4	639.50	0.214

*** Significant at 1% level

Table 6: Household's contact with different bodies

Contact		Users	Non-users	χ^2
DAs	Yes	109(74.15) **	38(25.85)**	2.136*
	No	12(92.31)	1(7.69) **	
Cooperative leaders	Yes	98(78.4)**	27(21.6)**	2.387*
	No	23(65.71)**	12(34.29)**	
Agricultural inputs	Yes	10(90.9)**	1(9.1)**	1.497*
Traders	No	111(74.5)**	38(25.5)**	

** Numbers in brackets indicate the percentage
* Significant at 10% probability level

Table 7: Household's Attendance on demonstration, field-days and farm training

No. Attendance of HHs	Users		Non-users	χ^2
1. Demonstration of	Yes	33(84.42)*	6(15.38)	2.261**
Mechanization technology	No	88(72.73)	33(27.27)	
2. Field-days	Yes	47(87.04)	7(12.96)	6.258***
	No	73(69.52)	32(30.48)	
3. Farm training	Yes	115(77.18)	34(22.82)	2.847**
	No	6(54.55)	5(45.45)	

* Numbers in brackets are percent of users from out of total who attended or not
, * significant at 5 and 1% probability level

Table 8: Access to different service providers

No.	Description	Mean-value			
		Users	Non-users	Total	t-value
1.	Distance to market	2.35	3.31	2.59(0.188)	2.51*
2.	Development unit distance	1.79	1.84	1.81(0.127)	0.167
3.	Distance to tractor rental Service station	3.225	4.78	3.61(0.31)	2.546*

** significant at 10% probability level*

Table 9: Types of training taken by tractor operators

		Organizations/owners	
No.	Description	N	%
1.	Formal training on how to drive and maintain	0	0
2.	How to drive and simple maintenance	0	0
3.	Formal training only how to drive	2	20
4.	Informal training how to drive	8	80

Table 10: Problems facing animal powered farm in the study area

No.	Description	Responses

	Yes			No	
	N	%		N	%
1. Expensiveness of the farm power animal	143	89.4		17	10.6
2. Grazing land shortage and feed expensiveness	149	93.1		11	6.90
3. Work drudgery	109	68.1		51	31.9
4. Shortage of agricultural labor 48	30.0		112	70.0	
4. Animal diseases	18	11.3		142	88.8

Table 11: Maximum Likelihood Estimates of Tobit Model for determinants of WTP

EXPLANATORY VARIABLE	ESTIMATED COEFFICIENT	STANDARD ERROR	t-RATIO	MARGINAL EFFECT $\frac{\partial F(Y_i)}{\partial X_i} = f(z)\beta_i$
HHSEX	-61.86	34.47	-1.29	-61.86
HHAGE	1.35	0 .90	1.50	1.35
HOUSETYPE	58.49	26.87	2.18**	58.49
HHEDUC	13.84	2.86	4.84***	13.84
LANDCULTVTD	12.45	3.46	3.60***	12.45
STATIONDST	-3.03	2.46	- 2.03**	-3.03
COOPM	59.91	1.86	2.33***	38.12
EXTCONTCT	51.69	7.41	6.98	51.69
PLOTNUMB	-16.38	4.50	- 3.64***	16.38
SUITLAND	16.99	5.00	3.40***	16.99
NONFINC	0.001	0.002	0.56	0.001
SERVQ	-7.10	18.42	-2.19**	11.19
HIRDLABOR	40.99	14.05	2.92**	40.99
OXNUMBER	-44.96	6.34	-7.09***	-44.96
FLABORME	-7.37	6.26	-1.78*	-7.37
CONSTANT	605.46	68.86	8.79***	

Model fit: Log likelihood = -911.97; Number of observations 152; LR chi^2 (14) = 177.49
Prob > chi2 = 0.0000, Pseudo R-Square=0.0887, Fitted Y (Prediction) = 696.79

Dependent variable: Household willingness to pay for tractor rental service
***, ** and* represents level of significance at 1%, 5% and 10% respectively.

Table 12: WTP of tractor rental service and Intensity of willingness

EXPLANATORY VARIABLE	ESTIMATED COEFFICIENT	STANDARD ERROR	t-RATIO	CHANGE IN PROBABILITY $\frac{\partial F(x)}{\partial \chi_i} = f(z)\frac{\beta i}{\delta}$
HHSEX	-0.29	0.50	-0.57	-0.29
HHAGE	0.02	0.01	1.54	0.02
HOUSETYPE	-0.10	0.40	-0.24	-0.10
HHEDUC	0.20	0.04	2.15**	0.20
LANDCULTVTD	0.52	0.05	11.48***	0.52
STATIONDST	-0.02	0 .04	-0.56	-0.02
PLOTNUMB	-0.15	0.07	-2.28**	-0.15

COOPM	3.65	0.08	1.37***	0.85
SUITLAND	0.32	0.07	2.26**	0.32
NONFINC	21.23	0.00	0.03	21.23
SERVQ	0.35	0.27	1.32	0.35
HIRDLABOR	0.51	0.20	2.47	0.51
OXNUMBER	-0.05	0.09	-0.55	-0.05
FLABORME	-0.02	0.09	0.26	-7.37
constant	0.02	0.09	0.26	-

Model fit: Log likelihood = -258.538; Number of observations 152; LR chi^2 (14) = 131.50
Prob > chi2 = 0.0000, Pseudo R-Square=0.2027, Fitted Y (Prediction) = 2.0738

Dependent variables: Households' farm allocation intensity under tractor rental service
***, ** and* represents level of significance at 1%, 5% and 10% respectively.
Source: own survey result, 2011