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Farmers' Willingness to Pay for Walking Tractor Rental Service in Northwestern Ethiopia

Workineh Yenewa[1, *], Tsegaye Molla[2]

[1]Department of Agricultural-Economics, Fogera National Rice Research and Training Center, Bahir Dar, Ethiopia

[2]Department of Agricultural Economics, College of Agriculture and Natural Resources, Debre Markos University, Debre Markos, Ethiopia

Email address:

wyenewa27@gmail.com (W. Yenewa)

[*]Corresponding author

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Abstract: This study was designed to measure farmers' willingness to pay for walking tractor rental service. Specifically, this study addresses how much they are willing to pay and what factors hinder farmers' WTP for walking tractor technology. Accordingly, CVM questionnaire was designed and face-to-face interviews were made to collect the data. One and one-half bounded contingent valuation format followed by an open-ended question was applied to elicit farmers' WTP for walking tractor rental service. For this study, a multi-stage sampling technique was applied to select representative samples. Finally, primary data were collected from 197 randomly selected sample respondents. The collected data were analyzed using descriptive statistics, and Tobit econometric model. About 80.53% of the sampled farmers were willing to pay for walking tractor rental service. The CV survey revealed that the mean WTP of smallholder farmers for walking tractor rental service was 718.50 ETB per timad. Moreover, the model result indicated that land size, suitability of the land, annual income, model farmers, and training had positive and statistically significant effect on WTP of smallholder farmers for walking tractor rental service. However, age had a significant and negative effect on WTP of smallholder farmers. The findings imply that researchers, policymakers as well as zone and woreda agriculture office and development workers should consider age, land size, suitability of the land, annual income, model farmers, and training variables to provide walking tractor service.

Keywords: One-and-One-Half Bounded Elicitation Contingent Valuation, Tobit, Walking Tractor, Willingnessto Pay

1. Introduction

The Ethiopian economy is highly dependent on the agricultural sector. Accordingly, about 84% of the nation's population is engaged in various agricultural activities and generates their income for household consumption to sustain their livelihood [1]. On average the agricultural sector accounts for 42.9% of gross domestic product and generates over 90% of the foreign exchange [6].

According to the Ministry of Finance and Economic Development [11], since the 1990s as a national strategy, Ethiopia has espoused Agricultural Development-Led Industrialization (ADLI) which predominantly advocates smallholder agriculture and its transformation into commercial agriculture by employing agricultural technologies.

The agricultural operation is characterized by subsistence farming, low input, and low output, fragmented and inadequate land holding, very traditional or buck ward farming techniques or absence of mechanization for most operations, and non-market-oriented production. Farm power sources are categorized into human, animal, mechanical, and a combination of them [24].

Such farming is the main source of employment; that is, most of the population is involved directly or indirectly, including 75% of the population in sub-Saharan Africa (SSA) countries and 80% in Ethiopia [8, 20]. However, because of the inefficient technologies employed, production and productivity are very low.

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. A traditional tillage method with the maresha plow requires repeated plowing with two consecutive tillage operations carried out perpendicular to each other. This requires a longer time for seedbed preparation and consumes high animal and human energy. Farmers who rely on oxen for land preparation cannot plow at the right time due to short preparation time. Delayed planting shortens the length of the growing period available for the crop and reduction of crop productivity [19]. Mechanization expands farmers' sources of cash income by shortening the land preparation period, which allows them to become involved in other income-generating activities.

To overcome these challenges with the traditional plowing system, looking for an appropriate plowing method is vital to improving agricultural practices. Hence, introducing appropriate mechanization technology like walking tractor technology would benefit the farm household economy.

Walking tractor also known as hand tractor [3] is a prime mover in which direction of travel and its control for field operation is performed by the operator walking behind it. Walking tractor occasionally termed as Power tiller, a two-wheel tractor or single axle tractor, mostly used for rotary cultivation in puddle soil and can be replace the animal power more effectively and help in increasing demand for human labor. The small and marginal farmers form major user for custom hiring of power tiller. Power tiller is preferred in small land holding farmer for all farm operations like puddling and preparatory tillage. The machine provides opportunities for self-employment in rural areas.

The concept of walking tractor came to the world in the year 1920. The first country to use walking tractor on large scale was Japan. The first successful model of power tiller was designed in the year 1947. During the year 1950 to 1965 the production of walking tractor increased rapidly. Walking tractor was introduced in India during 1963. The walking tractor is a multipurpose hand tractor designed primarily for rotary tilling and other operations on small farms. While in operations, an operator walks behind to maneuver it. It is also known as a garden tractor. No availability of matching equipment for different farm operations limits the versatility of the walking tractors. Implements initially offered with the power tillers included rotator attachment, trailer, and in some cases a plow and ridge. The initial introduction of the walking tractor was without a complete range of matching equipment [17].

Between the 1960s and 1980s, many of the developing countries of Africa and other developing countries of Asia, India, and China started mechanizing their farm. As a result, significant economic improvement had been recorded. But, while the number of tractors in other continents is going on increasing alarmingly, that of the African continent is stagnant and the farming systems in most Sub- Saharan Africa (SSA) countries are getting back to hand-hoe and animal-drawn implements. In the study area, crop production especially rice is the major source of income for the rural farmers; but, the production system is traditional, backward, and yields low products due to the shortage of pre-harvest and post-harvest mechanization technologies and inadequate awareness of post-harvest management and utilization.

To overcome this problem, the application of improved agricultural technology plays a great role. Fogera National Rice Research and Training Center (FNRRTC) as one of the federal research centers of the Ethiopian Institute of Agricultural Research (EIAR) based at Woreta Town has worked on such area to promote batch production and participatory evaluation of recommended farm tools and implements (pre-post harvesting technologies) for wider adaptation through field demonstration and training of farmers, development agents, and local manufacturers. The mission of the center is to provide market competitive agricultural technologies that will contribute to increased agricultural productivity, sustainable food security, and economic development to the community and the nation as well. Among improved technologies, walking tractor technology is the one that provides different functions with different attachments to the community. As a result, to bring policy changes in Ethiopia, there is a need to identify factors that determines the demand for the service, to measure the effect of mechanization on-farm production for major crops in the study area, and to assess factors that challenge the supply of walking tractor and understanding the willingness to pay for walking tractor rental service of the farmers plays a great role to realize production practices. So, the objective of this study will be to assign a monetary value for walking tractors based on households' willingness to pay for rental services.

2. Materials and Methods

2.1. Description of the Study Area

The study was conducted in the South Gondar Zone of the Amhara region particularly in Dera and Fogera Districts. Fogera District is located in the South Gondar Zone of the Amhara National Regional State and is one of the 106 woredas found in the region. It is bordered on the south by the Dera district, on the west by Lake Tana, on the North by Gondar Zuria district, and on the East by Farta and Ebenat districts. The capital of the District is Woreta, which is located 625 km northwest of Addis Ababa and 55 km from the regional capital, Bahir Dar..

It is situated at 11°46 to 11°59 latitude North and 37°33 to 37°52 longitude East. It has a total land area of 117,414 hectares, which consists of flat lands (76%), mountains and hills (11%), and valley bottoms (13%). The land use pattern of the District can be described as 48%cultivated land, 22% grazing land, 21% water bodies, 2% forest land, and 7% for others. The total population of the Woreda is 249,826 with an area of 1,111.43 square kilometers. The rural population is estimated to be 220,421. The proportion of the male and female population is almost similar in both rural and urban areas. The number of agricultural households is 44,168 [7].

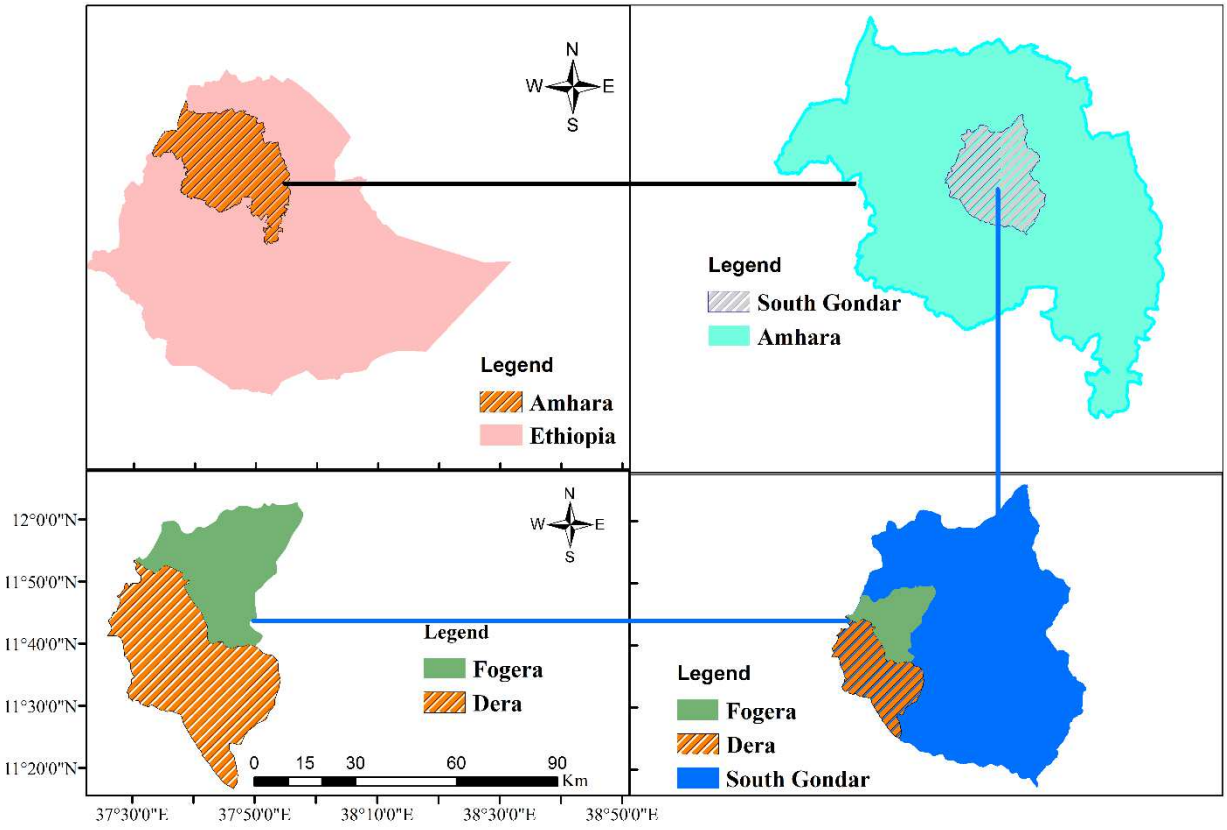

Figure 1. *Map of the study area.*

Dera is one of the woredas in the South Gondar Zone of the Amhara region. It is bordered on the south by the Abay River on the west by Lake Tana, on the north by Fogera, and on the east by West Estie. Deraworeda is found at 610 km from Addis Abeba, the capital city of Ethiopia, 42 Km from Bahir Dar, the capital city of Amhara Regional State. The woreda lays between 37°25′45′′E-37°54′10′′ E longitude and 11°23′15′′ -11°53′30′′ latitude and is characterized under WoinaDega agro-ecological zone with an average rainfall ranging from 1000-1500mm; its annual temperature is between 13 and 30°C.

2.2. Sampling Procedure

For this study, a multi-stage sampling technique was applied to select the study sample Kebele's and households. In the first stage, household heads from two woredas namely: Dera and Fogeraworeda of the South Gondar zone were selected purposively, because of the study areas nearness to the Fogera National Rice Research and Training Center and potentiality in production of Rice and other food crops and the land was suitable for applying Mechanization technologies like walking tractor. In the second stage, four kebeles (two from each) from 39 kebeles of DeraworedaJigna and Zahara and 34 kebeles of FogeraworedaWeretaZuria and Quhar Abo were selected randomly. In the third stage, sample respondents were stratified based on headship i.e. male and female-headed households, and probability proportional to sample size was employed to draw several respondents from each woreda and stratum. Finally, systematic sampling was applied to draw a total of 197 sample respondents from each stratum..

2.3. Method of Data Collection

The data for this study were collected from both primary and secondary sources to address the objectives of this study. Quantitative primary data were gathered accompanied by face-to-face interviews using a structured questionnaire. The data were included household characteristics like demographic characteristics, livestock ownership, and description of plowing about mechanized agriculture, farmers' perception about mechanized agriculture, current plowing practices, and willingness to pay for walking tractor rental services. The questionnaire was pre-tested through a pilot survey for the validity of the questionnaire before the actual survey was conducted. Based on the result of the baseline survey, initial bids were determined using an open-ended contingent valuation format [10, 16].

2.4. Elicitation Procedure

Dichotomous choice format CVM studies are preceded by a pre-test survey of the small sample population. The discussion by [13] indicated that pilot studies with open-ended questions can help to provide some information on the bounds of respondents' WTP. As a result, a pilot survey was conducted before the actual survey. The objective of the survey was to determine the maximum and minimum amount

the respondents are willing to pay in terms of cash for walking tractor rental service and to set starting bid for the actual survey. To do this, 30 households were randomly selected for pre-tests before the actual survey. Depending on the result of the preliminary survey, initial bids were determined using an open-ended contingent valuation format. As a result, 225, 450, and 675 birr, 235, 470 and 705 birr, 240, 480 and 720 birr and 235, 470 and 705 birr followed by open-ended questions were used for Jigna, Zehara, Woretazuria and Quhar abo Kebeles respectively with an equal number of respondents as a starting bid for the actual survey. After the bids were designed, the respondents were asked yes/no questions to elicit their willingness to pay. If his/her answer was yes, the next higher amount was asked to state his/her answer.

Finally, the respondents were asked their maximum willingness to pay both for the bounded and unbounded value using an open-ended question to state the maximum amount they are willing to pay. Whereas, if his/her answer was no, the next minimum amount followed by an open-ended question was also employed to solicit his/ her maximum amount.

2.5. Method of Data Analysis

This study uses Contingent Valuation Method (CVM) and Tobit model to elicit and analyze farmers' WTP in cash for the walking tractor rental services. The Contingent Valuation method is a well-established technique to measure the benefit from changes in the quality of the environment. Contingent valuation is a stated preference method commonly used to evaluate goods and services that are not traded at markets and, therefore, have no apparent market value. CVM enables economic values to be estimated for a wide range of commodities, which are not marketable, measured about utility functions through the concepts of willingness to pay. As a result, the Contingent Valuation Method asks people to directly state their willingness to pay for non-use values rather than inferring them from observed behaviors in regular marketplaces [2]. Descriptive statistics such as percentage, frequency, mean, minimum, maximum, standard deviation, charts, and tables were utilized for this study.

According to [27], ordinary least square estimates become biased and inefficient depending on the number of zeros about the number of observations in the data set. As a result, estimation of this data using the ordinary least square method may lead to a biased and inconsistent result. On the other hand [4] explained that Craggit is an alternative to the Tobit model which integrates the probit model to determine the probability of the dependent variable and the truncation model for given continuous values of the dependent variable. [25] Explained that Tobit has been the predominant approach in more recent studies where some observations in the sample lacked data or had zero values for the dependent variable. This is particularly relevant for willingness to pay data set. Consequently, the Tobit model is the right model for such types of dependent variables. For model specification, the sampled household will be either willing or not willing to pay the initial bid value offer for walking tractor rental service. So, the Tobit model was applied to analyze the determinants of households' maximum willingness to pay for walking tractor rental service. The dependent variable for this model is the maximum willingness to pay respondents for walking tractor rental service. The model is specified following [28].

$$Y^* = \beta' X + Ui \quad (1)$$

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

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

Where;

Yi = the observed dependent variable, in this case, the number of money farmerswillingness to pay for walking tractor rental service per hectare.

Y^* = the latent variable which is not observable.

Xi = Vector of factors influencing the amount of WTP and intensity of willingness to pay.

βi = Vector of unknown parameters to be estimated.

Ui = disturbance terms that are independently and normally distributed with mean zeroand a common variance δ^2.

The model parameters are estimated by maximizing the Tobit likelihood function and the marginal effect of an explanatory variable on the expected value of the dependent variable is:

$$\partial E \frac{(Yt)}{\partial Xi} = F(z)\beta t$$

Where $\beta\, t\, X\, i/\delta$ is denoted by z, and F is cumulative distribution.

The changes in the probability of willingness to pay as independent variable Xi changes are:

$$\partial F \frac{(z)}{\partial Xi} = f(z)\frac{\beta\prime}{\delta}$$

The changes in the number of money respondents are WTP concerning a unit change in an explanatory variable among those who are willing to pay are:

$$\frac{\partial E\left(\frac{Yt}{Yi}>0\right)}{\partial Xt} = \beta t\left[1 - Z\frac{f(z)}{F(z)} - \left(\frac{f(z)}{F(z)}\right)^2\right]$$

Where;

F (z) = is the cumulative normal distribution of z,

f (z) = is the value of the derivative of the normal curve at a given point (unit normal density),

z = is the z score for the area under a normal curve,

β= is a vector of Tobit Maximum Likelihood estimates and

σ = is the standard error of the error term.

Individual *i's* WTP can be modeled or estimated as a linearfunction:

$$WTP_i\,(x_{i,},\ \varepsilon_i) = x_i'\beta + \varepsilon_i$$

xi is a vector of explanatory variables which were assumed to have an impact on the WTP.. β is a vector of parameters to be estimated and εi is the error term, assumed tobe normally

distributed with mean zero and constant variance σ^2. The estimates of β representthe marginal effects of the explanatory variables on the WTP.

To improve the efficiency of the estimation, follow-up dichotomous questions were asked after the initial dichotomous question. An individual will be expected to accept the offered bid if their WTP will higher than the proposed bid and to reject it if their WTP will be less than the proposed bid. The second bid or follow-up bid will be conditional on the responses of the initial bid. For simplicity, m^1 denotes the initial bid, m^{2l} represents the second bid if the individual answers "no" to the first question; and m^{2h} represents the second bid if the individual's response will be negative to the first question. y^1 and y^2 are the dichotomous variables, which capture the responses of the first and second questions respectively. Under the assumptions, each individual was in one of the four categories described below [18].

For an individual whose response is 'yes to the first and 'yes' to the second bid, $m^{2h} \leq$ WTP$<\infty$. The probability of this case (yes, yes) is given by:

$$pr(y_i^1 = 1,\ y_1^2 = 1|x_i) = pr(1,\ 1) = \phi\left(x_i\frac{\beta}{\sigma} - \frac{m^{2h}}{\sigma}\right)$$

For an individual with the answers 'yes to the first and 'no' to the second bid, $m^{2h} > m^1$, i.e., $m^1 < WTP \leq m^{2h}$. The probability of this case (yes, no) is given by:

$$pr(y_i^1 = 1,\ y_1^2 = 0|x_1) = pr(1,\ 0) = \phi\left(x_i'\frac{\beta}{\sigma} - \frac{m1}{\sigma}\right) - \phi\left(x_1'\frac{\beta}{\sigma} - \frac{m^{2h}}{\sigma}\right)$$

For an individual with the answers 'no' to the first and 'yes' to the second bid, $m^{2l} < m^1$, i.e. $m^{2l} \leq WTP < m^1$. The probability of this case (no, yes) is given by:

$$pr(y_i^1 = 0,\ y_1^2 = 1|x_1) = pr(0,\ 1) = \phi\left(x_i'\frac{\beta}{\sigma} - \frac{m\,21}{\sigma}\right) - \phi\left(|x_1'\frac{\beta}{\sigma} - \frac{m^1}{\sigma}\right)$$

For an individual with the answers 'no' to the first and 'no' to the second bid, $0 < WTP < m^{2l}$. The probability in this case (no, no) is given by:

$$\mathrm{pr}(\mathrm{yi}^1 = 0, \mathrm{yi}^2 = 0|xi) = pr(0,0) = 1 - \phi(xi'\tfrac{\beta}{\sigma} - \tfrac{\mathrm{m}^{21}}{\sigma})$$

2.6. Contingent Valuation Method (CVM)

Is among the stated preference valuation methods and is based on direct expression of individuals' WTP or WTA in compensation for any change in environmental quantities, qualities, or both [16]. It asks people to directly state their WTP for non-use values rather than inferring them from observed behaviors in regular marketplaces [2]. 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. The CVM technique has great flexibility, allowing the valuation of a wider variety of non-market goods and services than is possible with any of the indirect techniques.

Among the dichotomous choice formats, double bounded CV format has the benefit of higher statistical efficiency than single bounded CV format [15]. In double bounded CV, the second price is set based on the subject's response to the first price. If the subject responds "yes" to the first price, the second price is some amount higher than the first price; if the initial response is "no," the second price is some amount lower [9]. But double bounded CVM has aroused controversy because of evidence that responses to the first price may sometimes be inconsistent with the responses to the second price which leads to a lower WTP [21].

As a result, one and one-half bounded CVM was introduced to reduce the potential responses biases due to the follow-up bid in double bounded CV format [5]. The advantages of using the CVM are first, it is simple to understand. It also minimizes the possibility of strategic biases [14]. In addition, CVM is relatively information-rich in terms of the characteristics of the data of respondents and does not rely on secondary data.

Table 1. *Definition of Variables and their measurement.*

Variables	Type of variables	Definition	Measurement	Expected sign
Dependent variable				
WTP		Willingness to pay	Ethiopian Birr	
Independent variables				
SEHH	Dummy	Sex of household head	1 if the head is male, 0 Otherwise	+
AGE	Continuous	Age of household heads	Years	-
MARSTA	Dummy	Marital Status	1if married, 0 otherwise	b+
EDUC	Dummy	Educational status	1 for literate, 0 otherwise	+
FSIZE	Continuous	Family size	Number	+
LSIZE	Continuous	Land Size	Hectare	+
LSUITABILITY	Dummy	Land suitability	1 if yes, 0 otherwise	+
AINC	Continuous	The annual income of households	Birr	+
Livestock Holding	Continuous	Number of livestock	TLU	+
RACCESSIBILITY	Dummy	Road Accessibility	1 if yes, 0 otherwise	+
MODEL	Dummy	Model farmers	1 if yes, 0 otherwise	+
TRAINING	Dummy	Access to Training	1 if yes, 0 otherwise	+
SOCIALPOST	Dummy	Social position	1 if yes, 0 otherwise	+

3. Results and Discussion

3.1. Household Characteristics

From the total surveyed respondents 153 (80.53%) were willing to pay for walking tractor technology whereas, the rest 37 (19.47%) were not willing to pay for walking tractor technology. The survey result indicated that about 168 (88.42%) were male respondents while the remaining 22 (11.58%) were female respondents. Of the total male respondents, 143 (75.26%) were willing to pay for the technology; whereas, from the total female respondents about 10 (5.26%) were willing to pay for the technology. On the other hand, about 25 (13.16%) of male and 12 (6.32%) female-headed households from the total respondents were not willing to pay for walking tractor service, respectively. The result of the chi-square test shows that the sex of household head and willingness to pay for walking tractor rental service had a statistically significant association at p< 0.01.

Of the total respondents, 167 (87.9%) were married, 12 (6.32%) were divorced and 11 (5.79%) were widowed. The survey result revealed that 142 (74.74%), 6 (3.16%), and 5 (2.63%) of willing respondents were married, divorced, and widowed, respectively; whereas, 25 (13.16%), 6 (3.16%), and 6 (3.16%) of not-willing respondents were married, divorced and widowed respectively. The result of the chi-square test shows that the marital status of household head and willingness to pay for walking tractor rental service had a statistically significant association at p< 0.01.

The education level of the sample respondents was categorized into those who can read and write as literate and those who cannot read and write as illiterate. Based on this, illiterate respondents constituted 97 (51.05%) of the total respondents and the literate groups constituted 93 (48.92%). Out of the total illiterate respondents, 72 (37.89%) were willing to pay whereas, from the total literate respondents 81 (42.63%) were willing to pay for the technology. On the other hand from the total illiterate and literate respondents, 13.16% and 6.32% were not willing to pay for the technology respectively and the chi-square test shows that education of the household head and willingness to pay for walking tractor rental service had statistically significant association at p<0.05.

The survey result indicated that 77 (40.53%) of the respondents were model farmers while the remaining 113 (59.47%) were non-model farmers. Out of the model farmers, 74 (38.95%) were willing to pay and 3 (1.58%) were not-willing to pay for the technology. While out of the non-model farmers 79 (41.58%) were willing to pay and 34 (17.89%) were not willing to pay. There was a statistically significant association between model farmers and willingness to pay for walking tractor rental service at p< 0.01.

Table 2. *Characteristics of sample household heads by Willingness to pay statusfor dummy variables.*

Variable Category	Willing to pay		Not-Willing to pay		Total		Chi-square
	No	%	No	%	No	%	
SEHH							
Male	143	75.26	25	13.16	168	88.42	19.516***
Female	10	5.26	12	6.32	22	11.58	
EDUC							
Illiterate	72	37.89	25	13.16	97	51.05	5.015**
Literate	81	42.63	12	6.32	93	48.92	
MRST							
Married	142	74.74	25	13.16	167	87.9	17.919***
Divorced	6	3.16	6	3.16	12	6.32	
Widowed	5	2.63	6	3.16	11	5.79	
MHH							
Model	74	38.95	3	1.58	77	40.53	20.035***
Non-model	79	41.58	34	17.89	113	59.47	

*** Significant at P< 0.01, ** Significant at P< 0.05; Source: own survey, 2021.

Regarding the continuous variables mean age of the respondent was found to be 42.52 with a standard deviation of 11.84. On the other hand, the mean age for willing respondents was found to be 41.58; while, the mean age for non-willing respondents was 46.41 years. The T-test result indicates that there is a statistically significant difference between willing and not-willing respondents about their age at p< 0.05.

The average farming experience of the respondent was found to be 21.62 years. The average farming experience for willing respondents was found to be 20.96 years while; average farming experience for not-willing respondents was 24.35 years. The independent T-test result confirms that there was a statistically significant difference between mean farming experience and willing and not-willing households at P<0.1.

The average family size was found to be 6 with a minimum of 1 and a maximum of 11 family members. The average family sizes of the willing respondents and not-willing respondents were 6 and 5, respectively. The independent T-test result confirms that there was a statistically significant difference between mean family size and willing and not-willing households at P<0.01.

Table 3. *Characteristics of sample household heads by Willingness to pay statusfor continuous variables.*

Variable	willingness to pay for walking tractor								T-value
	Willing				Not- willing				
	Mean	Minimum	Maximum	Std.	Mean	Minimum	Maximum	Std.	
Age	41.58	20.00	68.00	11.34	46.41	26.00	80.00	13.18	-2.25**
Farming experience	20.96	1.00	50.00	10.59	24.35	3.00	50.00	10.98	-1.735*
Family Size	5.90	1.00	11.00	1.84	4.95	1.00	8.00	1.79	2.826***
land size	0.988	0.00	3.50	0.537	0.961	0.125	2.250	0.465	0.315
TLU	5.08	0.00	13.42	2.32	3.92	0.00	11.95	2.53	2.692***

** Significant at P< 0.05, * Significant at P< 0.1; Source: own survey, 2021.

3.2. Major Crops Grown

According to the results of the survey conducted the dominant crops grown in the study area during the 2020/21 cropping season are Rice, Maize, and Onion respectively. From this 184 (96.84%) respondents grow rice, 112 (58.94%) grow maize and 105 (55.3%) grow onion. Based on the results stated below (Table 8) from the total rice growers, 149 (78.42%) farmers' were willing to pay for walking tractor rental service; while, 35 (18.42%) of the respondents were not willing to pay for the service. On the other hand, 4 (2.11%) of the farmers' were not growing the rice but were willing to pay and 2 (1.05%) respondents did not grow the rice as well as not willing to pay for the service.

Similarly, from the total maize growers 91 (47.89%) of the respondents were willing to pay for walking tractor rental service; while, 21 (11.05%) of the respondents were not willing to pay for the service. On the other hand, 62 (32.63%) of the farmers' were not growing the maize but were willing to pay and 16 (8.42%) respondents did not grow the maize as well as not willing to pay for the service.

The result is shown in (Table 8), from the total onion growers 89 (46.84%) of the respondents were willing to pay for walking tractor rental service; while, 16 (8.42%) of the respondents were not willing to pay for the service. On the other hand, 64 (33.68%) of the farmers' were not growing the onion but were willing to pay and 216 (11.05%) respondents did not grow the maize as well as did not willing to pay for walking tractor rental service.

Table 4. *Major crops Grown in the study area.*

Willingness to pay vs major crops grown						
Major crops		Willingness to pay		Not-willing		Chi-square
		No.	%	No.	%	
Rice	Yes	149	78.42	35	18.42	0.759
	No	4	2.11	2	1.05	
Maize	Yes	91	47.89	21	11.05	0.091
	No	62	32.63	16	8.42	
Onion	Ye	89	46.84	16	8.42	2.685
	No	64	33.68	21	11.05	

Source: Own survey (2021).

3.3. Institutional Characteristics

Households' financial and institutional characteristics have important effects on the household's preferred status concerning willingness to pay for walking tractors. The important institutional factors included in the study are access to extension, access to training, and social position. The survey result showed that from the total respondents 93 (48.95%) had received extension service on walking tractors; while, the remaining 97 (51.04%) do not receive any extension service on walking tractors. From 93 (48.95%) respondents who had contact with extension agents for walking tractor technology, 89 (46.84%) and 4 (2.11%) of the respondents were willing and not willing to pay respectively; while, from 97 (51.04%) respondents who did not take extension service regarding walking tractor technology, 64 (33.68%) and 33 (17.36) respondents were willing and not willing to pay for walking tractor technology respectively. The chi-square test of association indicated that there was a highly statistically significant association between extension contact and willingness to pay for walking tractor rental service at p< 0.01.

Training is indispensable to fill knowledge and information gaps. Now a day, both governmental and non-governmental organizations have provided training for policymakers, development agents, and farmers about improving productivity and new technology adoption through field visits, workshops, and demonstration of past experiences. So, this analysis aimed to assess the involvement of the respondents in different training that have key importance for improving crop productivity and new technology adoption. Finally, the survey result indicated that 104 (54.74%) of the respondents took training on walking tractor technology; whereas, 86 (45.26%) did not take the training. Of 104 (54.74%) respondents, who took training 99 (52.11%) and 5 (2.63%) were found to be willing and not willing to pay for walking tractor technology respectively.

On the other hand, from 86 (45.26%) respondents who did not take the training, 54 (28.42%) and 32 (16.84%) were willing and not willing to pay for walking tractor technology respectively. The chi-square test of association indicated that there is a highly statistically significant association between training access and willingness to pay for walking tractor rental service at $p< 0.01$.

The position of the respondents in their society has a vital role to access information about agricultural mechanization technology through different mechanisms; like conferences, workshops, and meetings to share best practices from other kebeles, woredas, zones, or regions. This implies that the more the number of positioned individuals in the society, he/she will have better knowledge and information about agricultural mechanization technology and motivate and order the society to take part in technological advancement. So, the result of this study demonstrated that 79 (41.58%) of the respondents have a social position and 111 (58.42%) of them do not have any social position in their kebeles. From 79 respondents who have social position, 77 (40.53%) and 2 (1.05%) of them were willing and not willing to pay, respectively. Whereas, 76 (40.00%) and 35 (18.42%) of the respondents from 111 respondents who do not have any social position were also willing and not willing to pay, respectively. To measure the association between social position and willingness to pay, a chi-square test was employed. Finally, the result revealed that there is a statistically significant relationship between social position and willingness to pay at $p< 0.1$.

Table 5. *Institutional characteristics of sample households by willing and not-willing groups for dummy variable.*

Willingness to pay vs major Institutional characteristics					
Variable	**Willingness to pay**		**Not-willing to pay**		**Chi-square**
	No	**%**	**No**	**%**	
Extension					
Yes	89	46.84	4	2.11	26.74***
No	64	33.68	33	17.36	
Training					
Yes	99	52.11	5	2.63	31.52***
No	54	28.42	32	16.84	
Social position					
Yes	77	40.53	2	1.05	24.75*
No	76	40.00	35	18.42	

Source: own survey (2021).

Regarding the wealth status, the survey result indicated that from the total respondents about 9 (4.73%) were the richest in the village, 37 (19.47%) were richer than most households, 34 (17.89%) were a little poorer than most households, 8 (4.21%) were the poorest in the village and 102 (53.68%) were average. To measure the association between wealth status and willingness to pay, a chi-square test was employed. The chi-square test of association indicated that there is a highly statistically significant association between wealth status and willingness to pay for walking tractor rental service at $p< 0.01$.

Table 6. *Wealth status of the respondents.*

Willingness to pay vs wealth status					
Variables	**Willingness to pay**		**Not-willing to pay**		**Chi-square**
	No.	**%**	**No.**	**%**	
The richest in the village	7	3.68	2	1.05	
Richer than most households	31	16.31	6	3.16	
A little poorer than most households	22	11.58	12	6.31	26.361***
The poorest in the village	2	1.05	6	3.16	
Average	91	47.89	11	5.79	

Source: own survey (2021).

3.4. Farmers' Willingness to Pay for Walking Tractor Rental Service

TThis study employed cash as a payment mechanism to measure the willingness to pay farmers for walking tractor technology. The respondents were interviewed to elicit how much they are willing to pay for walking tractor technology service in terms of cash. As a result, yes or no questions were designed to assess the willingness to pay status of the respondents in terms of cash. One and one-half bounded contingent valuation method followed by the open-ended question was used for this study. The result of the survey demonstrated that the willingness to pay of sample households ranges from 200 to 3000 ETB towards walking tractor rental services. 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 willingness to pay, but if the respondent is unwilling to pay the first offered amount, the second bid which is less than the first amount is presented [12].

In the first scenario (bid 1), the data obtained from the

survey depict that the initial bid amount was set and 127 (66.85%) of sampled farmers were willing to pay the initial bid for walking tractor rental services for the first offering price and 26 (13.68%) of the respondents were not willing to pay for initial bid amount for walking tractor rental services (refused to pay the initial bid).

In the second scenario, among 127 respondents who replied to the first offered amount (willing), they were asked the next scenario (higher bid) and from willing respondents of the first bid 91 (47.90%) of the respondents accepted the next maximum offered amount; contrary to this, 36 (18.95%) of the respondents refused to pay the maximum amount. From 26 respondents who were not-willing (refused to pay the initial bid), they were asked the next scenario (lowest bid) which is less than the first offered amount and 24 (12.63%) of the respondents accepted the next minimum offered amount, on the other hand, 2 (1.05%) respondents in addition to the initial bid, refused to pay the lowest bid. In this case, an open-ended question was prepared to elicit the minimum amount those respondents are willing to pay for the stated.

Table 7. *Joint responses to stated bids.*

Joint response of willingness to pay		
Farmers Response	**Frequency**	**Percent (%)**
Yes-yes	91	47.90
Yes-no	36	18.95
No-yes	24	12.63
No-no	2	1.05
Total	153	80.53

Source: Own survey (2021).

Table 8. *Reasons for not-willing respondents.*

Reasons	Frequency	Percent
I am not able to pay the stated amount because of a shortage ofincome	13	6.84
I have no interest in walking tractor technology	9	4.74
I am satisfied with oxen plowing	9	4.74
I have not enough land to plow with a walking tractor orNature of land terrain	6	3.15
Total	37	19.47

Source: Own survey (2021).

Even though, oxen plow is dominant in the study area; they were asked whether they had experience in using a walking tractor or not and the result indicated that about 16 (8.42%) of them had experienced the use of walking tractors; whereas, 6 (3.2%) of the respondents were used walking tractor technology for plowing 2012/13 cropping season.

Table 9. *Trends and importance of walking tractor in the study area.*

Walking tractor using the experience of HH	Frequency		Percent (%)	
	Male	Female	Male	Female
Do you think that walking a tractor is Important?				
Yes	155	20	81.58	10.53
No	13	2	6.84	1.05
Do you have experience using a walking tractor?				
Yes	15	1	7.89	0.53
No	153	21	80.53	11.05
Do you use walking tractor technology in 2012/13?				
Yes	5	1	2.63	0.53
No	163	21	85.79	11.05

Source: Own survey (2021).

3.5. Estimation of Total Willingness to Pay for Walking Tractor Rental Service

The total willingness to pay farmers' for walking tractor rental service was estimated based on the proportion (willing farmers' vs not-willing farmers') of the survey result. As the result indicated that, about 80.53% of sample respondents were willing to pay for walking tractor rental service. The total households of sample kebeles were estimated based on this ratio. The data obtained from the agriculture office of Fogera and Deraworeda indicated that a total of 6,068 households live in the selected kebele. Based on this, 4,887 households were willing to pay for walking tractor rental service.

Table 10. *Estimated total willingness to pay in terms of cash (ETB).*

Class limit (WTP)	Classmark (A)	Sample HHs		Total HHS		Sample HHS WTP		Total HHs
		Fi	%	Fi	WTP	Fi	%	WTP
200-512	356	50	26.31	1596	568,176	153	80.53	54468
513-825	669	60	31.58	1916	1281804	103	54.21	68907
826-1138	982	35	18.42	1118	1097876	43	22.63	42226
1139-1451	1295	3	1.58	96	124320	8	4.21	10360
1452-1764	1608	3	1.58	96	154368	5	2.63	8040

Class limit (WTP)	Classmark (A)	Sample HHs		Total HHS		Sample HHS WTP		Total HHs
		Fi	%	Fi	WTP	Fi	%	WTP
1765-2077	1921	1	0.53	32	61472	2	1.05	3842
2078-2390	2234	0	0	0	0	1	0.53	2234
2391-2703	2547	0	0	0	0	1	0.53	2547
2704-3016	2860	1	0.53	32	91520	1	0.53	2860
Total		153	80.53	4887	3379536			

Source: Own computation.

The first column shows the maximum willingness to pay interval, and the second is the classmark for willingness to pay (the mid willingness to pay amount) of the first column. The third and the fourth columns show the number and the percentage of sample households whose willingness to pay amount fall within the given interval.

The total number of households in two woredas' of the study area has been multiplied by the proportion of sample households falling in each category to obtain the total number of households whose willingness to pay amount lies in each boundary (column fifth). And total willingness to pay (column sixth) has been obtained by multiplying the mid willingness to pay the amount by the total number of households willing to pay that amount. The total willing households of 4887 in two woredas' of the study area were expected to pay 3,379,536birr for the service.

Therefore, the result of the survey indicates that the average willingness to pay of sample households was birr 718.50. Column seven and eight indicates the number and the percentage of sample household willingness to pay at least the amount in each interval. Similarly, column nine shows a total number of households willing to pay at least the amount in each interval and it falls as the mid willingness to pay amount rises (column nine). It can be obtained by multiplying the mid willingness to pay the amount (column two) by the corresponding sample households' willingness to pay at least that amount, (column seven).

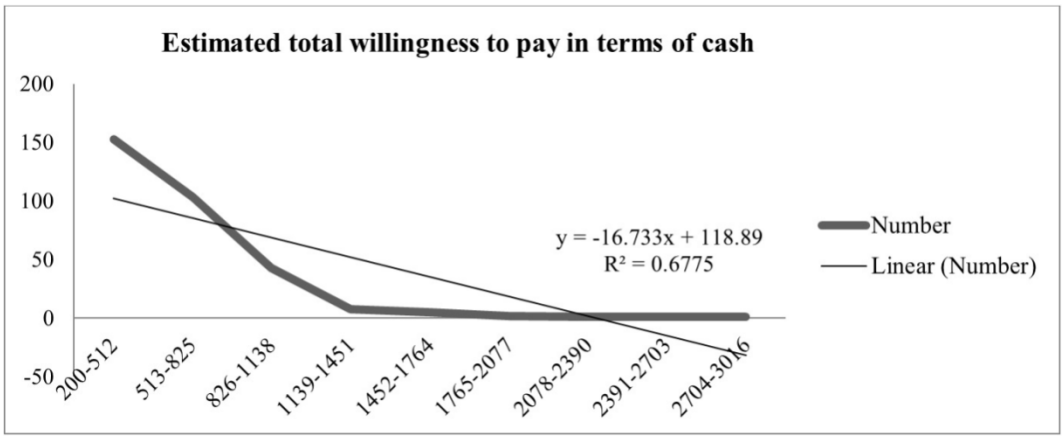

Figure 2. *Estimated total willingness to pay (birr).*

3.6. Econometric Result of Tobit Model

Tobit model was applied to analyze determinants of Maximum willingness to pay of sample farmers for walking tractor rental service in terms of cash. It was estimated for the number of variables which expected to affect how much the farmers are willing to pay for walking tractor rental services. Thirteen explanatory variables were included in the model to predict the maximum willingness to pay of the respondents in cash. Out of the thirteen variables hypothesized to influence the maximum willingness to pay of the respondents in terms of cash, five were found to be statistically significant at less than 1% probability level. These variables are age, land size, annual income, being a model farmer, and Training on walking tractor technology. On the other hand, Land suitability was significant at less than 5% significant level.

According to the results of the study age of the respondent has a negative association with willingness to pay for walking tractor rental services at less than 1% significant level ($P<0.002$). It shows that as the farmer's age increased their willingness to pay for walking tractor service was decreased. This might be aged household heads may face cash constraints when his/her age gets older and older. As household age increases by one year, the probability of willingness to pay for walking tractor rental services decreases by 0.35%. In other words, as the age of farmers increases, the probability of accepting rental services decreases. Therefore, those youth groups are more willing for walking the tractor rental service. This result is in line with the study of [26].

The land size was expected to have a positive effect on willingness to pay. As the land size of the household increases, the probability of willingness to pay for walking tractor rental service increases ($p<0.005$). As the land size of households increased by one hectare, the probability of willingness to pay for walking tractor rental service increased

by 44.87%. This means that the higher the land size owned by the respondent, the higher amount they are willing to pay for walking tractor rental service. The marginal effect also shows that a one-unit increase in a hectare of land will cause a 44.87% increase in the probability of being willing to pay for a walking tractor rental service. This result is consistent with the finding of [23] indicated that "small and scattered landholding" is a major influencing factor that affects agricultural mechanization practice in Iran.

Land suitability is the fitness of a given type of land for a defined use. It is essential for plot design planning to know what farm types and sizes will be installed. It was found to have a statistically significant positive effect on households' willingness to pay for walking tractor rental services. Farmers having suitable land are more likely to use walking tractor rental services for cultivation (P<0.048). The marginal effect shows that if farmers' own suitable land willingness to pay for walking tractor rental service increased by 23.25%. According to the studies conducted by [22], land suitability is used to increase plowing capacity through decreasing power requirement, lowering fuel consumption and highest field efficiency, and lowest delay time.

As expected, annual income was found to have a statistically significant positive effect on households' willingness to pay for walking tractor rental service at less than 1% significant level (p< 0.000). The result of the model indicates that the higher the income of the respondents, the maximum amount they are willing to pay for walking tractor rental service. In other words, for each 100 birr increase in income, the probability of using walking tractor rental service will increase by 4%.

Model farmer of the respondent was hypothesized to have a positive effect on households' willingness to pay for walking tractor rental service at less than 1% significant level (p<0.001). As expected, the variable has a statistically significant positive effect on the willingness to pay of respondents. This is because the model respondents in their society have a vital role in different activities. After all, he/she is a role model to other farmers in the area to motivate and order the society to engage in different activities. The marginal effect of being a model farmer indicated that as compared to non-model farmers, model farmers have an 8.19% probability of being willing to use walking tractor services.

The other important variable is training. As expected, the variable was found to have a statistically significant positive effect on farmers' willingness to pay at less than a 1% significant level (p<0.007). The result of the model indicated that the probability of the farmers' willingness to pay will be increased by 5.35% if the household head had taken the training. The marginal effect shows that the probability of willingness to pay for a tractor hiring service will increase by 31.05% if a farmer's training level is increased by one unit. This implies that the more the farmers' take training, the more the respondents are willing to pay for walking tractor rental service. This is because it fills knowledge and information gaps for policymakers, development agents, and farmers about improving productivity and natural resource conservation through field visits, workshops, and demonstration of past experiences.

Table 11. *Marginal effects of different variables on walking tractor rental service after Tobit regression.*

Variables	dy/dx	Std.Err.	z	P>|z|	[95% Conf.Interval]		X
Sex (Male=1)*	0.1074	0.1510	0.71	0.477	-0.1885	0.4034	0.8842
Age	-0.0035	0.0011	-3.06	0.002	-0.0057	-0.0012	42.5158
Marital status (Married= 1)*	0.0695	0.1488	0.47	0.641	-0.2222	0.3611	0.8789
Education level (Illiterate=1)	-0.0248	0.0229	-1.08	0.279	-0.0697	0.0201	1.4895
Famsize	0.0077	0.0066	1.16	0.247	-0.0053	0.0206	5.7105
Land size	0.4487	0.1614	2.78	0.005	0.1324	0.7650	0.7274
Land suitability*	0.2325	0.1174	1.98	0.048	0.0023	0.4627	0.9105
Annual income	0.0004	0.0001	3.77	0.000	0.0002	0.0006	216.2450
TLU	0.0007	0.0004	1.63	0.102	-0.0001	0.0015	29.2842
Road access*	0.0592	0.0433	1.37	0.172	-0.0257	0.1440	0.8053
Model farmer*	0.0819	0.0251	3.26	0.001	0.0327	0.1311	0.4053
Training*	0.0535	0.0198	2.71	0.007	0.0148	0.0923	0.3105
Social position*	0.0264	0.0250	1.06	0.290	-0.0225	0.0753	0.1421
Number of obs. = 190; LR $chi^2(13)$=128.42							
Un-censored observations =153; Prob> chi^2=0.0000							
Left censored observations=37							

(*) dy/dx is for discrete change of dummy variable from 0 to 1
Source: own survey (2021).

4. Conclusion and Policy Suggestion

This study was conducted to elicit farmers' WTP for walking tractor rental service using one and one half bounded CV followed by an open-ended question. The result indicated that 80.53% of sample respondents were willing to pay for walking tractor rental services with the mean WTP of 718.50 ETBper timad/2874 ETB per hectarewith a minimum of 200 ETB and a maximum of 3000 ETB. The estimated total households' willingness to pay is 3379536ETB. Among willing households, 47.90% were accepted the initially offered amount and the next maximum amount for walking tractor rental service; contrary to this, 1.05% of the

respondents rejected the initial and the next minimum bid.

Findings from the Tobit model show that land size, plot suitability, annual income, model farmers, and training had a statistically significant positive effect on farmers' willingness to pay to use walking tractor rental service. This implies that the above variables increase the willingness to pay of respondents, unlike negatively related variables which are age.

Competing Interests

The author has declared that no competing interests.

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