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Factors Affecting Milk Market Supply and Level of Supply by Smallholder Milk Producers: The Case of Dessie Zuria District, South Wollo Zone, Ethiopia

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Abstract
The study was conducted in Dessie Zuria District of South Wollo Zone, Northern Ethiopia with the specific objectives of analyzing determinants of milk market supply. A two stage sampling procedure was applied to select sample milk producer households of the study area. In the first stage, 12 potential milk producer *kebeles* were purposively selected out of 37 administrative *kebeles* of the district based on their level of milk production. Then, a total of 6 sample *kebeles* were selected randomly. In the second stage, 100 sample smallholder milk producers were selected from those 6 randomly selected *kebeles* and both qualitative and quantitative types of data were collected. Secondary data were collected from journals, reports and documents used in the study area. Primary data were collected from individual smallholder milk producers, key informants and focus group discussions using both structured and semi-structured types of questionnaires. Data analysis was performed both by descriptive and econometric analysis employing STATA version 12 software. Factors determining participation of milk market supply was analyzed using Heckman two stage estimation model and the results of first stage/probit regression model showed that both decision of participation and level of participation of households in milk market supply were affected significantly by age of the household, educational level, number of milking cows owned, distance from market/urban centres and technical training. Decision of participation of households in milk market supply was also affected significantly by access to credit whereas level of participation was affected significantly by sex of the household, family size and access to market information. Thus, it is suggested that strengthening of participation of smallholder milk producers in milk market supply via capacity improvement and enhanced access of appropriate technical support service provision.
Keywords: Heckman two stage model, Milk, Market supply

1. Introduction

The growth of economy in developing countries largely depends on the growth of agricultural sector. Agricultural growth is important for reduction of poverty as 75% of the world's extremely poor people live in rural areas and depend on it for their income source (FAO, 2011). About three-fourth of these extremely poor people are engaged in livestock keeping for their livelihood. In developing countries, about 60% of rural people depend on livestock for their livelihood and thus, contribution of livestock for escaping poverty and to improve economic growth is important (FAO, 2010).

The milk subsector provides income and employment opportunities for about 12 to 14% of the world population (FAO, 2010). Expansion of urbanization, growth of population and per capita income level favor livestock sector to boost the demand of high value livestock product food sources (such as meat, milk and milk products) and thereby creates business opportunities for livestock keepers (FAO, 2009). The availability of such high demand can promote the growth of dairy sector development and thereby existing opportunities can be exploited by dairy farmers. Hence, improving this sector to increase livestock outputs is highly linked and a strategically crucial means to escape poverty (Pica-Ciamarra, 2009).

The economy of Ethiopia is mainly an agrarian economy. The contribution of agriculture, service and industry to the economy of the country accounts for about 41%, 46% and 13 % of total GDP, respectively (CSA, 2011). Agriculture also contributes more than 80% of employment, and 88% of export earnings (IFPRI, 2010).

Livestock production is an integral part of Ethiopia's agricultural sector and plays a vital role in the national economy. Livestock sector in the country serves as source of income, draft power and means of employment with an economic contribution share of about 12-16% of the total GDP, 47% of agricultural GDP (Staal et al., 2008), 60-70% livelihoods of the population (Halderman, 2004) and 15% of the total export earnings of the country (SNV, 2008). Besides as a crucial means of income, employment, and poverty alleviation for Ethiopian smallholder milk producers, milk provides valuable nutrients such as calcium (which is used for the formation of bone and teeth) and proteins (which are source of amino acids required for our body building

and tissue repairs but are scarce in the cereal food sources) (MoARD, 2007). Given considerable potential for increasing smallholder income generation and employment opportunities from milk and milk products in Ethiopia, development of the milk subsector can remarkably contribute to poverty reduction and improvement of nutritional status in the country.

Ethiopia is the first top ranked country for its largest livestock population in Africa having about 56706389 cattle, 29332382 sheep, 29112963 goats, 2033115 horse, 400 329 mule, 7428037 donkey, 1164106 camel, 56866719 poultry and 5885263 beehives (CSA, 2015). Cattle, goats and camel are the main sources of dairy products in Ethiopia (MOARD, 2004). According to CSA (2015), Ethiopia earned about 3071977015 liters of cow milk (from 11381972 milking cows) and 233,845,521 litres of camel milk by the year 2014/2015. About 82% of total milk in Ethiopia is obtained from cow and of which 97 % is from local breeds (MOARD, 2007) with an average daily milk yield of 1.35 liter per cow for about 6 months of lactation period (CSA, 2015). This production and productivity is very low compared with other countries and world average (FAO, 2011).

On the other hand, per capita consumption of milk in Ethiopians is low (19 kg) (SNV, 2008) when contrasted with average consumption of Africa (49 kg) and world (104 kg) (world dairy submit, 2012). Such milk supply shortage in Ethiopia is due to absence of sustainable approach of the dairy development to improve milk production and marketing and because of the challenges of active engagement of smallholder milk producers in milk value chain and marketing (Eyasu *et al.,* 2014).

Supporting of intensified dairying is one of the strategies of the Ethiopian government to improve the low productivity problem of local cattle and then to allow mixed crop-livestock smallholder farmers raise their incomes. To boost the productivity of livestock and milk products, government has attempted to support the livestock sector and to solve livestock development associated problems. Development agents of livestock production and management, veterinary technicians and artificial inseminator were trained and assigned at *kebeles* levels. The livestock and fishery resource development has been established autonomously at ministry level to improve the sector contribution and increase the income level of households at large and thereby ensure food security of the community.

Milk marketing in the study area involves different marketing actors along the chain which include milk collectors, semi-wholesalers, milk processors, cafes/hotels and retailers. The smallholder milk producers also supply their milk to retailers, cafes/hotels as well as direct sales to consumers for relatively better prices in the study town, Dessie. Smallholder dairy farmers who are concentrated close to urban consumption centers are relatively market-oriented due to the effects of better market access where there is an efficient market infrastructure. As market infrastructure develops well, efficiency of market increases. The limited market information available to the value chain actors particularly to the smallholder milk producers allows the broker to manage information in their favor. Enhancing household's market participation to benefit them from growing demand of dairy products is a better option that should be considered by policy makers since participation of milk producer households in market supply is an essential strategy for poverty alleviation and ensuring food security in developing countries (Heltberg and Tarp, 2002).

In Ethiopia, about 98% of milk is held and managed by smallholder dairy farmers (MoARD, 2007). However, only 5% of the milk produced in the country is sold in commercial markets while the rest of 95% is consumed and processed at home (CSA, 2012). While in the year 2011, out of the total production of milk, butter and cheese in rural Ethiopia, about 6.55%, 36.58% and 14.35% was sold in the market, respectively (CSA, 2011). This indicates that the demand for milk and milk products is higher and supply is lower in towns than in rural areas due to high pressure of population growth (Zelalem *et al.,* 2011). Dessie is one of the towns with large number of population (187900) and high demand for milk and milk products with low supply from peri-urban areas that do not meet the observed demand in the area (S/Wollo Zone department of agriculture annual report, 2015) which is an opportunity for smallholder milk producers of Dessie Zuria District to exploit the milk market access or high demand. Given such opportunity, milk producers could not get better income from their products sale mainly due to their inability to increase their market supply. So, improving milk market supply can help to satisfy the demand in the area and create market access thereby increase producers income.

Interventions were made by Government to enhance producers' income via market oriented strategies by giving technical support and introducing improved technologies to increase the capacity of smallholder milk producers and improve their livelihood. Although remarkable successes have been attained, the benefits gained from productivity and production of milk is not encouraging. In addition, some households in the study area participate in milk market supply while others are not participating. Assessment of determinants of milk market supply is important to design new development interventions strategies by responsible bodies. With regard to this, many studies were conducted on determinants of milk market supply (Woldemichael, 2008; Meryem, 2013; Berhanu, 2014; Bedilu et al., 2014). However, none of these studies has been done so far in the study area to gather such information. Conversely, the milk market information in the study area is lacking which requires an assessment to indicate the leverage point of interventions strategies of milk production and marketing by milk producers and service providers and thereby to enhance and safeguarded the involvement of producers into milk

subsector development. The intention of this study was therefore, to enrich availability of relevant information about determinants of milk market supply and level of supply by smallholder milk producers.

2. Materials And Methods

2.1. Description of the Study Area

Dessie *Zuria* District is amongst 21 districts of South Wollo Zone (Fig. below), Located 400 km to North of Addis Ababa (capital of Ethiopia). The Latitudinal and Longitudinal location coordinates at 11°10′00″N and39^0 19′59″E, respectively (http://dateandtime.info/city.php?id=8643760). The altitudinal range holds 1800 to 3700 meters above sea level and the agro ecological zones are sub-afro alpine, highlands and mid highlands. The average annual rain-fall is about 1072 mm with erratic distribution and the colour base soil classification in the district includes black, red, brown and grey soil. The major crops grown are barely (very dominant), wheat, pulse, maize and vegetables (potato, cabbage, and carrot) with a dominant crop-livestock mixed farming system. The total human population and household of the district is 175136 and 37769, respectively. The total cattle population is about 99128 (Dessie Zuria District office of Agriculture, 2016).

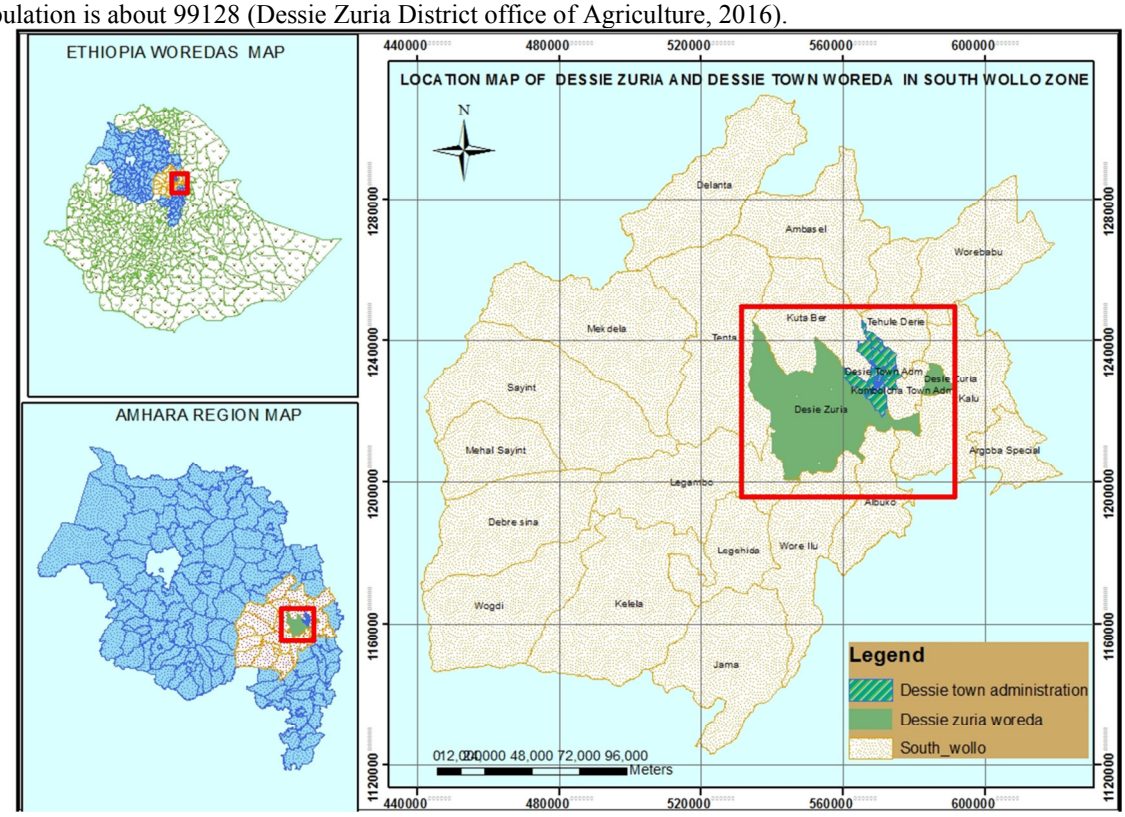

Figure: Map of the study area

2.2 Types, Sources and Methods of Data Collection

Both quantitative and qualitative data types were collected as: the secondary data from the District and Zonal Agricultural office, internet and CSA whereas the primary data was collected by surveying through conducting of interviews with randomly selected milk producer and traders using pre-tested structured and semi-structured questionnaires.

2.3. Sampling Procedure and Sample Size

A two stage sampling procedure was applied to select sample milk producer households in the study area. In the first stage, 12 potential milk producer *kebeles* were purposively selected out of 37 administrative *kebeles* of Desseie zuria District based on their level of milk production. Then, a total of 6 sample *kebeles* have been selected randomly. In the second stage, a total of 100 sample smallholder milk producers were selected randomly from those 6 randomly selected *kebeles*. The sample size of milk producers selected for this study was calculated using the formula of Yamane (1967) given as: …… (1)

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

with 10% level of precision where, n = sample size, N = population size and e = level of precision. The total population size where samples were drawn was 6207. The probability proportional to size calculation were

used to distribute the total sample size for each 6 *kebele* as indicated in Table 1 below which depicts the selected *kebeles* and sample size of milk producer household per *kebele*.

Table 1: sample summary of milk producer household for *kebeles* and study area

S.No.	Name of the *Kebele* administration	Total number of milk producer households	Proportion (%) of milk producer per *kebeles*	Sample size
1	*kelina*	405	0.07	7
2	*Abaso kotu*	1186	0.19	19
3	*Harawabello*	1055	0.17	17
4	*Kurkur*	1746	0.28	28
5	*Kelem Dereba*	640	0.1	10
6	*Boru Silassie*	1175	0.19	19
	Total	6207	1.00	100

2.4. Method of Data Analysis

The collected data were analyzed using descriptive statistics and summarized by their means, ratios, percentages, standard deviations and presented using tables accordingly. Econometric model was used to analyze factors affecting the decision of participation and level of participation of smallholder milk producer households in milk market supply using Heckman two stage model.

Model Specification:

Heckman's two-stage estimation model is an econometric model which was used in this study to analyze both the decision of participation and level of participation of smallholder milk producers in milk market supply. This implies that Heckman selection model captures the milk producer's participation decision whether to participate or not in milk market supply and if they participated, also to select their level of participation. Therefore, a Heckman (1979) two -stage estimation model was employed for its advantage of selectivity bias correction using the inverse Mill's ratio which is generated in the first stage/probit regression estimate of the participation decision and used in the second stage of regression as one of the explanatory variable with other variables to estimate level of participation (volume of milk market supply). The ordinary least squares (OLS) can be used to analyze determinants of level of participation in milk market supply. But, some milk producer households may prefer not participating in milk market supply in search of other alternatives while others milk producer households may be totally expelled from participation due to asset limitations. Then, if OLS regression is employed excluding the non-participants from analysis, a sample selectivity bias will be formed in the model. So, to overcome this problem, Heckman (1979) two stage selection model was employed to analyze determinants of the likelihood of smallholder milk producers participation decision and level of participation in milk market supply. The selection equation for decision of smallholder milk producers either to participate or not to participate in milk market supply could be formulated as binary response model which could be analyzed employing the specification of the probit regression equation as Wooldridge (2002) was used:

$Y^* = MMSP_i^* = X_{1i}\beta_{1i} + \varepsilon_{1i,\ \varepsilon 1i \approx N(0,1)}$ ..... (2)

$Y = MMSP_i = 1$, If $Y^* > 0$

$Y = MMSP_i = 0$, If $Y^* < 0$

Where:

Y^* = is a latent (unobservable) variable representing household discrete decision whether to participate or not in milk market supply

X_{1i} = vector of explanatory variables assumed to determine the likelihood of milk producer households in milk market participation

β_{1i} = is a vector of unknown parameter in participation equation

Y = is a dependent (response) variable that takes the value one if a milk producer participates in milk market supply and zero otherwise.

ε_{1i} = Random disturbance term that captures all unmeasured variables

MMSP = milk market supply participation decision

The functional form of Probit model requires the error term to be homoscedastic as the probability form depends only on the difference between the error terms of one choice with the other error terms (Amemyia, 1985). This means that the computation comprise the partial derivatives that measure the change in the participation probability per unit change in the explanatory variable. The marginal effect of continuous explanatory variables can be computed multiplying the estimate of coefficient by standard probability density function holding other explanatory variables at their mean values whereas the marginal effect of dummy explanatory variables can be analyzed by relating the probability result of dummy variables taking the two values; 1 if supply milk to market and 0 otherwise holding all other explanatory variables at their mean values of the sample (Wooldridge, 2002). Then the maximized log likelihood value to obtain estimates of parameters

and subsequent marginal effects is denoted as:

$$\mathbf{Ln\ L}\left(\frac{\alpha}{Y}, \mathbf{Z}\right) = \sum_{y=1} \ln\left(\Phi(\mathbf{Z}'\boldsymbol{\alpha})\right) + \sum_{y=0} \ln\left(1 - \Phi(\mathbf{Z}'\boldsymbol{\alpha})\right) \quad \text{…….. (3)}$$

The supply equation of level of participation for smallholder milk producers' in milk market supply could be formulated and analyzed employing Heckman second stage model which could be specified as Heckman (1979):

$$\mathbf{Y_{2i} = MMSV = \beta_0 + \beta_{1i}X_{1i} + \beta_{2i}X_{2i} + \cdots + \beta_n X_n + \eta_n \lambda_n (X_i \beta) j + \varepsilon_j} \quad \text{……... (4)}$$

Where:

Y_{2i} = MMSV = milk market supply volume
Xj = exogenous variable in the second stage
β_j = vector of unkown parameter in the equation of marketed volume of milk
$\lambda_j (X_i\beta)_i$ = the inverse Mills ratio derived in the first stage/probit regression
η_n = shows the influence of participation on the volume of milk supply
ε_j = stochastic term in the second stage
MMSV = milk market supply volume

$$\text{Mills ratio } (\lambda) = \frac{F(X1\ \beta1)}{1-F(X1\ \beta1)} \quad \text{……..……..……..…… (5)}$$

Where: $\mathbf{X}\beta$ = a density function
1-F $(X_1\beta_1)$ = distribution function

2.5. Definition of Variables and their Proposed Hypothesis

Determinants of the participation decision and level of participation in milk market supply and their effects were hypothesized as follow:

The dependent variables which were assumed to be influenced by explanatory variables were:

Decision of participation in milk market supply: which is a dummy dependent variable that represented the probability of milk market participation by milk producers? The variable represented the value of one if milk producer participated in milk market supply and zero otherwise.

Level of participation (Volume of milk supplied to the market): is continuous dependent variable measured in litres indicating the actual volume of milk supplied to the market per household per day.

The explanatory variables which were hypothesized to influence decision of participation and level of participation in milk market supply were the following:

Sex of the household head: is a dummy variable and assumed to influence the households decision to participate in milk market supply. Women are expected to contribute more labour especially for milking, value addition and sale of milk and other dairy products. Therefore, in this study, being male household head was expected to affect negatively milk market supply participation decision and volume of milk supplied. But, the study of Meryem(2013) showed that being male head of a household affected the likelihood of participation in milk market positively.

Age of the household: is a continuous variable measured in year and hypothesized to have a positive relationship with milk market supply. As the age of milk producers' increases, their likelihood to be wise in milk business also increases.

Educational level of the household: It is a continuous variable measured in number of years of schooling and hypothesized to have a positive relationship with market supply. Education can enhance the knowledge and skills of milk producers and enables them to perform the farming activities accurately, efficiently and accordingly. Formal education enhances the information sharing and technology implementation abilities of the farmer, thereby improving the quality of decision making (Fakoya *et al*., 2007).

Family size of the household: is a continuous variable measured in number and assumed to influence participation of household in milk market supply positively. This is assumed due to the fact that when the number of family size increases, the availability of work force per household increases and thereby participate in milk market supply since there may not be work force shortage. Finding of Woldemichael (2008) and Budilu *et al.* (2014) showed the positive relationship of family size and milk market participation.

Number of children under six years old: is a continuous variable measured in number and hypothesized to influence negatively participation decision and level of participation for milk market supply by smallholder milk producers. This is due to the assumption that milk is as a favorite food of children.

Land holding size of the household: is continuous variable measured in hectare and proposed to influence positively the decision of participation and volume of market supply by milk producers. When the land holdings of a household increases, farmers have a likelihood of getting better farm output that enables them to fulfill necessary inputs for milk business activities. Land is very important input for fodder and pasture development to

feed dairy cows. Therefore, it is assumed that as the size of landholding increases, the proportion of land allocated for fodder and pasture development increased and thereby the volume of milk produced also increased with the possibility of increased market supply. But, according to Berhanu (2012), landholding size showed an inverse relationship with the probability of milk sales decision and value addition by milk producers.

Number of milking cows: is a continuous variable and measured in number which is hypothesized to affect positively the decision of participation and level of participation. When a farmer has more cows, it can also be assumed that milk produced also increased which then producer can have a chance of milk market supply. The result of the study conducted by Meryem (2013) showed that number of milking cows and quantity of annual milk production affected the probability of participation in milk market supply positively.

Experience in milk production: is a continuous variable measured in years and assumed to influence positively the decision of participation and level of participation of milk producers in milk market. This assumption is based on the fact that when the experience of a farmer increases, the skill to perform milk business in a better way also increases.

Access to market information: is a dummy variable taking the value of one if a household had access to market information and 0 otherwise. Having mobile phone and good communication with milk traders can provide access to market information. Berhanu (2012) found that market information showed positive relationship with decision of participation and level of participation in milk market supply by milk producers. According to the study of Goetz (1992) on food marketing, better market information significantly enhances probability of market participation of households. Therefore, this variable is hypothesized to influence positively decision of participation and level of participation of milk producers in milk market.

Distance from market/urban centres: is a continuous variable measured in km and hypothesized to affect negatively decision of participation and level of participation of milk producers in milk market supply. The study of Luoga *et al*. (2008) found that distance to milk selling point was negatively and significantly related to decision of participation and level of participation of milk producers in milk market.

Access to credit: is dummy variable taking a value of one if the household got access to credit and zero otherwise. This variable was hypothesized to have a positive relationship with the participation and level of participation of milk producers in milk market supply. A study of Mereym (2013) indicated that credit access showed positive relationship with household milk market participation decision. It is assumed that access to credit improves the financial capacity of dairy households to buy more improved dairy cows and other inputs thereby increasing milk production and milk market supply participation.

Frequency of extension contact per month: is continuous variable hypothesized to have a positive relationship with milk market supply and value addition. It is expected that extension service widens the actor's knowledge and has positive impact on participation decision and market supply of milk. Holloway and Ehui (2002) identified that extension visit is directly related to capacity of household in dairy production, value addition and market supply.

Technical training: is dummy variable proposed to influence the participation decision and level of participation in milk market supply by milk producers positively. It is expected that training service widens the actor's knowledge and has positive impact on milk market supply in the possible areas. Hence, access to training service was hypothesized to affect milk producers positively in milk market supply.

Table 2: Summary of hypothesis and variables relationship

List of independent variables and types		Dependent Variables (participation and level of participation in milk market) and their Relationship with Independent variables
List	**Variable type**	Relationship
• Sex of the household	Dummy	- (Male)
• Age of the household(yr)	Continuous	+
• Educational level of the household	Continuous	+
• Family size of the hh(num.)	Continuous	+
• No. of children ≤6 yr old	Continuous	-
• Land holding size (ha)	Continuous	+
• Number of cows	Continuous	+
• Experience in milk production(yr)	Continuous	+
• Access to market information	Dummy	+
• Distance from market center (km)	Continuous	-
• Access to credit	Dummy	+
• Extension service	Dummy	+
• Technical training	Dummy	+

3. Results and Discussions

This section contains results of descriptive and econometric data analysis of the study. Descriptive analysis was used to describe demographic and socioeconomic characteristics of milk producer households with regard to their milk market supply participation. The econometric analysis was used to assess determinants of participation decision and level of participation in milk market supply. The software used for data analysis was STATA version 12.

3.1. The Results of Descriptive Analysis

3.1.1. Gender Perspective Characteristics of the Sample Households

The total number of sampled smallholder milk producer households used for the survey was 100. Out of these, 75% and 25% were male and female household respondents, respectively. Based on the survey results, about 41% sample households were found to be milk market supply participants. According to the survey findings, of the 41% participants, about 70.73% and 29.27% were male and female household milk market supply participants, respectively. However, there is no significant difference between female and male participants and non-participants of milk market supply (Table 3).

Table 3: Demographic characteristic of the sample households by categorical variables

variables	Total (N=100)		Participation in milk market supply				χ^2
			Participants (N=41)		Non-participants (N=59)		
	number	%	number	%	Number	%	
Sex							
Female	25	25	12	29.27	13	22.03	0.675
Male	75	75	29	70.73	46	77.97	
Total	100	100	41	100	59	100	

Source: own computation from survey data (2016)

3.1.2. Access to Different Support Services

According to the survey results, about 34.2% and 13.6% of milk market participants and non-participants had access to market information, respectively. The chi-square test indicated that there was statistically significant difference between the two groups of milk market supply participants and non participants at 5% probability level.

Table 4: Access to Different support services

Variables	Total access level (%) (N=100)		Participation in milk market supply				χ^2 test
			Participants (%) (N=41)		Non-participants (%) N=59)		
	Yes	No	es	No	Yes	No	
Market information (Yes or No)	22	78	34.2	65.8	13.6	86.4	5.96**
Access to credit (Yes or No)	19	81	14.6	85.4	22.0	78.0	0.861
Access to training (Yes or No)	20	80	34.2	65.8	10.2	89.8	8.7***

The value *** and ** represents statistical probability level at 1%, 5% and 10%, respectively

Source: own computation from survey data (2016)

The findings indicated that 14.6% of milk market supply participants and 22% of non-participants had access to credit with no significant difference between participants and non participants group of milk market supply. The analysis also showed that 34.2% of milk market supply participants and 10.2% of non-participants had access to training and there is statistical difference at 1% probability level between the two groups of milk market supply participants and non-participants (Table 4).

3.1.3. Demographic and socioeconomic description of the sample households

The average age of sample households was 47.98 years whereas the mean value of age of milk market participants and non participants was 49.61 and 46.85 years, respectively. However, there was no statistical significant difference between participants and non-participants of milk market supply. The mean family size per sample household was 5.68 and the average value of 5.95 and 5.49 for participants and non participants with no significant difference between the two groups of participants and non-participants. The mean educational level of sample household was 4.01 years of formal schooling and the average value of participants and non participants were 5.32 and 3.10 years with significant difference at 5% probability level between participants and non-participants group of milk market supply. The mean value of number of children less than six years old per household was 0.445; whereas the average number of children per milk market participants and non participants

were 0.341 and 0.52, respectively; however, there is no significant difference between participants and non-participants of milk market supply. The average distance from the home of sample milk market participant and non participant households to milk market center was 4.29 and 10.79 km, respectively and had statistical difference at less than 1% probability level. The average value of dairying experience of sample households was about 12.54 years with no statistically significant difference between participants and non-participants of milk market supply. The frequency of extension visit per month provided for sample households was 3.68 times. However, the statistical difference between the participants and non participants group of milk market supply was insignificant. The average landholding size per sample household was 0.93 hectare. On the other hand, the mean value of landholding size of milk market participants and non participants were 1.024 and 0.86 hectare, respectively. However there was no significant difference between milk market participants and non participants groups of sample households. The average holding of milking cow per household was 1.48 while the average holding per milk market participants and non participants were 1.98 and 1.14, respectively with statistically significant difference at 1% probability level between the two groups of participant and non participant sample households (Table 4).

Table 4: Demographic and socioeconomic description of the sample households by continuous variables

Variables	Total (N=100)		Participation in milk market supply				t-value
			Participants (N=41)		Non-participants (N=59)		
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	
Age	47.98	12.35	49.61	12.08	46.85	12.52	1.101
Family size	5.68	1.69	5.95	1.67	5.49	1.69	1.34
Education Level (years)	4.01	4.37	5.32	4.52	3.10	4.05	2.56**
Children < 6 years old	0.445	0.65	0.341	0.66	0.52	0.65	1.32
Distance to market centre	8.13	4.53	4.29	2.75	10.79	3.49	9.97***
Experience in dairying	12.54	9.92	10.63	10.86	13.86	9.07	1.62
Frequency of extension contact/month	3.67	3.54	3.71	3.23	3.64	3.77	-0.087
Landholding size/household	0.93	0.53	1.024	0.58	0.86	0.496	-1.52
Milking cows/household	1.48	1.16	1.98	1.64	1.14	0.39	-3.79***

The value ***, and ** represents statistical probability level at 1% and 5%, respectively.
Source: own computation from survey data (2016)

3.2. Results of Econometric Analysis

In the study area, smallholder milk producers use milk for three major purposes namely: for home consumption, market supply and value addition and the milk and milk products are important sources of income that underpin the economic status of smallholder milk producers. Based on the survey by this study, the result showed that about 41% of sample respondents were engaged in milk market supply. Thus, this section contains the results of econometric analysis of determinants of participation decision and level of participation of smallholder milk producers in milk market supply. Heckman two stage regression model was used to identify factors affecting participation decision and level of participation in milk market supply. Diagnostic test was made for multicollinearity test before analysis and results of VIF were less than 10 which indicate no problem of multicollinearity. Then, overall fitness and significance of the model was tested with the result of Wald chi^2 (13) = 146.29, Prob > chi^2 = 0.0000 which indicates that the model is statistically significant at less than 1% significance level.

The Heckman two stage regression model results indicated that about five variables namely: age of the household (age), educational level of the household (edulevel), number of milking cows (tcow), distance from market/urban centres (distancehome) and (techtraining) were affected both participation decision and the level of participation of smallholder milk producers in milk market supply while access to credit (creditaccess) affected decision of participation. On the other hand, sex of the household head (sex), family size of the household (thousehsz) and access to market information (marketinfo) were affected level of participation of smallholder milk producers in milk market supply.

Sex of the household head (sex): contrary to the hypothesis, sex of the household head affected negatively the level of participation decision of smallholder milk producers in milk market supply at less than 5% probability level. The coefficient of Heckman second stage selection model regression indicated that ceteris paribus, an additional milk market participant of a male household results in 47.53 unit increase when compared to female participation level. The study conducted by Tshiunza et al. (2001) and Meryem (2013) is in line with result.

Age of the household (age): as expected before, the age of the household affected positively and significantly the participation decision of smallholder milk producers in milk market supply at less than 10% significant level. The marginal effect for the participation decision of milk producers in milk market supply showed that as the age

of the household increases by one year, the probability of participation decision in milk market supply increases by 0.0059 (0.59%). Woldemichael (2008) and Berhanu (2012) also reported the same result. On the other hand, contrary to prior expectation, the age of the household affected negatively and significantly the level of participation of smallholder milk producers at less than 10% probability level. As the age of the household increases by a year, the volume of milk supplied to market decreases by 1.86 units. However, the study conducted by Woldemichael (2008) indicated that age of the household affected positively milk market participation of milk producers' households. **Educational level of the household (edulevel):** as prior hypothesis, the education level of the household affected positively and significantly the decision of participation of milk producers in milk market supply at less than 10% probability level. The marginal effect indicated that as the education level of milk producers household increases by one year formal schooling, the participation decision in milk market supply increases by 0.0223 (2.23%).

The finding of this result is in line with the study conducted by Gizachew (2005). While opposed to prior hypothesis, educational level of the household affected negatively the level of participation of stallholder milk producers in milk market supply at less than 10% probability level. This implies that as the education level of household increases by one year formal schooling, the level of participation of milk producers in milk market supply decreases by 4.48 units. The reason behind might be due to the fact that milk producer households who are educated more years of formal schooling seeks for other additional non dairy jobs and income sources that reduce time share of milk market participation. But, the result of Woldemichael (2008) study disagreed with this finding.

Family size of the household (thousehsz): on contrary to hypothesis, the result of this study found that family size of a household affected negatively and significantly the level of participation of a household in milk market supply at 10% probability level. This finding indicated that as household size increases by one family member in a household, the level of household participation in milk market supply increases by 8.889 units. This result was opposite with the result of study conducted by Woldemichael (2008) but, in line with the result of Berhanu (2012). **Number of milking cows (tcow):** as to the previous hypothesis, the number of milking cows owned affected positively participation decision of households in milk market supply at less than 10% probability level. The result of marginal effect indicated that probability of smallholder milk producer household who participate in milk market supply increases by 10% as number of milking cows' increases by one. The number of milking cows owned by smallholder milk producers also affected positively and statistically the level of participation of smallholder milk producers in milk market supply at less than 1% probability level. The regression coefficient indicated that as the number of milking cows increases by one, the probability of volume of milk to be supplied to market increases by 48.07 litres. The reason behind might be due to the fact that as the number of milking cows increases, volume of milk produced also increases and the producer tend to supply more milk to the market. The study performed by Holloway and Ehui (2002), Woldemichael (2008), Berhanu (2012) and Meryem (2013) reported positive relationship of number of milking cows owned with milk market participation of households.

Access to market information (marketinfo): as expected, access to market information affected positively the smallholder milk producer households in their level of milk market participation at less than 1% probability level. As indicated in table 8 below holding other variables constant, an addition of a milk market participant household who had access to market information for milk market results in 49.66 unit increase in level of participation. The study conducted by Embaye (2010) and Meryem (2013) indicated the same result.

Distance from market/urban centres (distancehome): as hypothesized, distance from market/urban centres affected negatively and significantly both participation decision and level of participation of smallholder milk producers in milk market supply at less than 1% and 10% probability level, respectively. The result of marginal effect showed that as the distance from market/urban centres increases by one kilometer, the participation decision of milk producers in milk market supply decreases by 6.35% while the level of participation also decreases by 6.38 litres. Similar findings were reported by Holloway and Ehui (2002), Gizachew (2005) and Woldemichael (2008). A shorter distance between milk producers and consumers has been proposed by many scholars to support milk market access (ILCA, 1993).

Access to credit (creditaccess): contrary to the expectation, access to credit affected negatively the smallholder milk produces decision of participation in milk market supply at less than 10% probability level. The result of marginal effect indicated that as milk producer households gets access to credit, the decision of participation in milk market supply decreases by 16.38%. This might be due to the reason that the smallholder milk producer households use the credit they got for fulfilling other agricultural inputs other than dairy sector.

Technical training (techtraining): as expected, the provision of technical training service affected positively both decision of participation and level of participation of milk producer households' in milk market supply at less than 5% and 10% probability level, respectively. The result of marginal effect indicated that the probability of decision of

Table 1: Results of Heckman two stage regression model for determinants of milk market supply

variables	Participation decision (first stage)				Level of participation (second stage)		
	Coef.	Std. Err.	P>z	Marginal effect	Coef.	Std. Err.	P>z
sex	-0.7199454	0.9810043	0.463	-0.0499806	47.52589	19.87926	0.017**
age	0.0843433	0.0492465	0.087*	0.0058553	-1.859473	1.006705	0.065*
edulevel	0.3213844	0.1755229	0.067*	0.0223114	-4.476446	2.535135	0.077*
thousehsz	-0.0043179	0.2305998	0.985	-0.0002998	-8.889372	5.158073	0.085*
nchilsix	-1.142131	0.7712139	0.139	-0.0792899	-18.97656	13.15488	0.149
landhs	-0.1906285	0.7072864	0.788	-0.013234	-3.649823	14.65323	0.803
tcow	1.439504	0.8174368	0.078*	0.0999344	48.06715	5.229355	0.000***
dairyexpe	-0.0590868	0.0417707	0.157	-0.004102	-0.1799092	0.7655798	0.814
marketinfo	0.1572472	1.200115	0.896	0.0109165	49.66209	18.27353	0.007***
distancehome	-0.9141501	0.2955957	0.002***	-0.0634628	-6.376533	3.772929	0.091*
creditaccess	-2.35852	1.227069	0.055*	-0.163735	36.99584	25.62638	0.149
extenservice	0.2520767	1.008391	0.803	0.0174999	10.70656	18.4303	0.561
techtraining	3.678397	1.664879	0.027**	0.2553645	30.1815	16.44311	0.066*
_cons	0.4919494	2.233422	0.826		82.74441	57.54941	0.150
lambda	41.64602	22.94455	0.070*				
rho	1.00000						
sigma	41.646016						

Number of obs. = 100, Censored obs. = 59, Uncensored obs. = 41, Wald chi2 (13) = 146.29, Prob > chi2 = 0.0000

The symbol ***, ** and * represents level of statistical significance at 1%, 5% and 10%, respectively.

Source: own computation from survey data (2016)

participation in milk market supply increases by 25.54% as the households participated in technical training of milk production. As indicated in table 8 above, ceteris paribus, an addition of a milk market participant household who had access to technical training for milk market results in 30.18 unit increase in level of milk market participation.

Lambda: based on the first stage of Heckman regression model, the inverse mills ratio was produced and included in the second stage of Heckman selection model as one of the explanatory variable to correct selectivity bias. The inverse mills ratio was positively related with the volume of milk market supply and significant at 10% probability level indicating that there was selection bias and there were unobserved factors that affect the likelihood of both participation decision and level of participation in milk market supply by milk producer households (Table 8).

4. Conclusions and Recommendations

The results of second stage Heckman selection model showed that the sex of the household, age, education level, family size, number of cows per household, access to market information, distance to nearest market, access to credit and technical training affected the participation of smallholder milk producers in milk market supply. According to the findings, government and other concerned sectors do play a role to empower women and minimize the work load via promoting better innovation and thereby increase their participation in milk market supply. Sustaining family planning program both in optimizing family size and active participation in dairy development activities is important for the active involvement of milk producers in milk market. Access to market information, level of education and provision of technical training should be promoted to increase technical capability and market oriented skill of milk producers and thereby improve market participation. Emphasis should also be given to improve transport accessibility of milk producers especially for those who inhabiting in the distant area to increase their involvement in milk market participation. Encouraging the promotion of the level of milk farm via increasing number of milking cows is also important to upgrade the milk market participation.

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