

Determinants of Raw Milk Supply and Value Addition Participation in Mecha Woreda, Amhara National Regional State, Western Ethiopia

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Abstract

Dairy sector has important role in supporting the national economy and livelihood of milk producers. Milk producers are one of key actors that play great role along the dairy value chain in the study area. Milk producers' participation in milk and milk products marketing played roles in improving household welfare, and also means improved food security and reduced poverty. Though there are studies conducted on milk production, processing and utilization, there is insufficient information on determinants of milk producers' milk supply and milk value addition participation in Mecha woreda. Thus, this study was conducted in Mecha woreda with objectives of analyzing determinants of smallholder milk producers' participation decisions and intensity in cow milk supply and value addition. Formal survey techniques were employed to collect data. The data were collected from 200 milk producers using systematic random sampling techniques. Bivariate probit model was employed for participation decisions while recursive bivariate tobit model was used to analyze determinants of participation intensities. The econometric model result revealed that age of household head, number of local cows owned, distance of dairy products market, household milk consumption, family size, dairy farm experience, milk yield size per day, and membership in dairy cooperatives were influential variables that affected milk supply participation decision significantly. The household land size, milk consumption, distance of dairy market, milk yield per day, cooperative membership and milk market experience affected milk supply participation intensity significantly. Value addition participation decision was influenced by land size, distance of market and value addition experience positively and significantly. Distance of dairy product market, dairy farm experience, and membership in dairy cooperatives influenced value addition participation intensity significantly. In this study, improving market access by increasing number of dairy cooperatives, road and infrastructures, upgrading traditional milk products, introducing labor saving technologies, and empowering cooperatives and producers are recommended to increase smallholders' participation in dairy products marketing.

Keywords: Bivariate Tobit-Probit, milk supply participation, value addition participation

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1. INTRODUCTION

Dairy production is one of among agricultural sectors which have huge development opportunity in Ethiopia. The country has more than 18 million dairy animals which account 31.92 percent of the total cattle population and produces 3.1 billion liters of cow milk annually with milk yield of 1.37 liter/cow/day (CSA, 2017). Dairy production is dominantly characterized by subsistence farming systems by which about 98 percent of total milk is produced by smallholder dairy producers (TAP Consultancy Services, 2016).

Dairy sector has been recognized by Ethiopia government as it supports national economy and the livelihood of rural, peri-urban and urban milk producer households. Therefore, the dairy master plan has been prepared and eight major dairy milk shed areas have been identified in the country (Brandsma *et al.*, 2013). The sector has been strongly interlinked with mixed cultivation by providing manure and draft power for crop sector. It also provides employment opportunities to a large number of people; and is important to flow foreign currency in. This sub-sector contributed 12-16% to the national economy GDP and shares 45% of the agricultural GDP (Behnke and Fitaweke, 2011). In addition, dairy products and by-products have large contributions to smallholder dairy producers and the country at large in ensuring food security, nutrition and income generation (Habtemariam *et al.*, 2002). About 85% of the total milk produced is consumed at the household level and only 7% of raw milk is supplied to market in formal and informal markets and the remaining (8%) milk is processed to butter, ghee, yogurt and soft cheese (Land O'Lakes, 2010). Despite raw milk marketing, small-holder farmers add value to milk by processing milk using indigenous knowledge. Butter, ergo (fermented whole milk), cottage cheese (*ayib*), and butter milk are commonly marketed dairy products (Azage *et al.*, 2013; Alganesh and Yetenayet, 2017).

Contrary to low milk products supply, the demand for milk is increasing with rapidly increasing of population growth rate and urbanization. So that the domestic demand for dairy products is being met through imports. The country spent approximately US\$ 11–15 million in foreign exchange on imports of milk and milk products between 2011 and 2013 (FAO and NZAGGRC, 2017). To address these problems, Minister of Agriculture in Ethiopia aimed to improve cow productivity through extension services provision (improved

technologies, building capacity, promoting collective action, and facilitating linkages) followed by the livelihood and income of smallholder dairy producers. The issues of dairy sector are planned in GTP II plan to satisfy domestic milk demand and begin to export cow milk in 2020 by improving traditional family dairy production (Shapiro *et al.*, 2015).

Amhara National Regional State is one of the highest potential milk producer regions in Ethiopia next to Oromia Region. The Region shares about 23.1 percent of milking cows population and produces more than 597 million liters of milk per annum which contributes 19.1 percent of the national milk volume (CSA, 2017) but the amount of milk supplied to market is less than 10% (LMD, 2013). As stated at national level, small holder milk producers engage in producing and marketing traditional milk products; butter, ghee, *ayib*, and *metata-ayib*. In Amhara Region, Mecha woreda is one of the potential milk producing areas among West Gojjam Zone's wordas. The woreda's agricultural practice is characterized by mixed farming system in which both productions are interdependent each other. There are 37,347 milking cows of which 4.8 percent are cross lactating cows and the total milk production by the woreda is estimated about 22,171,523.22 liters per year (North Mecha Woreda livestock and development office, 2019).

1.1. Statement of the Problem

Ethiopia has large potential of dairy production with high cows population while the sector is not fully exploited. Poor exploitation of dairy industry is brought due to poor genetic of indigenous cattle, inadequate feed resources, short supply of improved breed, weak linkages between research, extension service providers and technology users, weak promotion of dairy products market, **lack of clear milk marketing system, lack of market information**, lack of unique and clearly defined dairy policy and institutional structures (Zelalem *et al.*, 2011; Bingi and Tondel, 2015; Tesfaye, 2017). Though the country has large number of milking cows, milk supply and per capita milk consumption is low. Ethiopian dairy products consumption per annum was 39 kg per person in 2011 while the world average consumption was approximately 90 kg (FAO, 2017). On the other hand the per capita milk consumption was 19 liters in 2016 (ATA, 2016). It is low compared to countries per capita liquid milk consumption; 110 liters in Kenya (Rademaker *et al.*, 2016), 71 liter in Sudan (RVO, 2016) and 59 liter in Rwanda (Ntirenganya, 2016) with a few livestock population compared to Ethiopia and very far below the FAO/WHO recommended per capita milk consumption which is 200 liters (Getachew *et al.*, 2009). One of the reasons for low consumption of milk is low supply of milk that is only 5% of the country milk produced is sold in commercial markets (CSA, 2011). Similarly below 10 % of milk produced is marketed to formal channel in Amhara Region (LMD, 2013).

Value addition is another alternative means of supporting livelihood income for dairy producers by processing high perishable raw milk to less perishable milk products like butter and cheese at local market. Ethiopia has untapped potential of adding value to milk. However, the demand of processed milk products could not be addressed by existing volume of milk products available in the market. Currently the quantity of exported dairy products and its destinations are insignificant that the country is net importer. Butter was mainly exported to Djibouti and South Africa, targeting to Ethiopian Diaspora. From the south Eastern region of Ethiopia, milk is solely exported to Somalia (Getnet, 2009). Producers mainly added value to milk and produced butter, ghee and *metata-ayibe* that they used them as source of income, food and medicinal value (Eyassu and Asaminew, 2014). Appreciation of milk value addition participation at farm level is needed to increase producer income and support their livelihood. Countries like India appreciate indigenous milk products and undertake regular experiments to improve and commercialize those products (Chawla *et al.*, 2008) but in Ethiopia the concern of improving of these products is very limited. Low milk quality, weak promotion of milk products, and unimproved processing technologies are among constraints of milk value addition (Frew and Getnet, 2013).

The existing milk and milk products amount of supply could not satisfy the increasing demand of milk in the country. In this regard, increasing producer's participation in milk market and level of participation has important roles in improving household welfare, and also means improved food security and reduced poverty (Mmbando *et al.*, 2017; Poole, 2017). However, identifying and understanding factors influencing smallholder producers to participate in milk market and value addition is needed to be prior act before intervention. Numbers of studies were conducted in different regions of the country by different scholars. For instance; Berhanu *et al.*, 2014; Benyam *et al.*, 2016; Ali, 2017 conducted studies on determinants of milk market participation of smallholder farmers. Similarly Betela *et al.*, 2017, Embaye, 2015; Benyam *et al.*, 2017; and Tadele *et al.*, 2014; identified factors that influence milk value addition participation at farm level. Yitaye *et al.*, 2009; Shewangzaw *et al.*, 2016 Eyassu and Asaminew, 2014 conducted research on production, processing, and utilization of cow milk in the Amhara region. Though number of researches conducted in different regions of the country by different scholars, empirical study has not been studied and documented in the particular study area. Therefore, this study was conducted to address the paucity of information on factors that influence small holder milk producers' participation and intensity in milk market and value addition in North Mecha woreda. This study is important for policy makers and dairy stakeholders to understand factors that influence producers' milk market

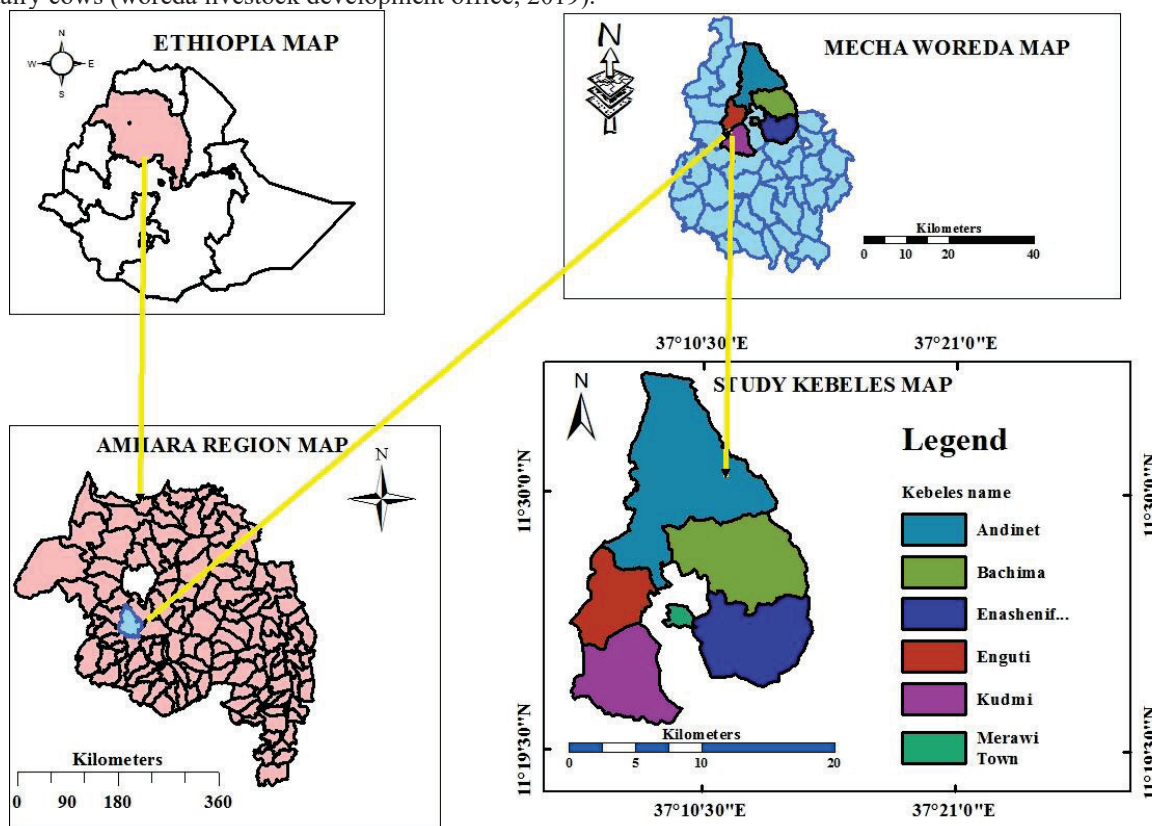
and value addition participation decision and intensity in order to develop strategies required to improve small holder milk producers' participation in milk market and value addition. Thus, this study aimed specifically to analyze the determinants of milk producers' milk supply participation decision and level of participation in milk value chain; to analyze the determinants of milk producers' value addition participation decision and level of participation.

2. METHODOLOGY

2.1. Description of the Study Area

The study was conducted in North Mecha Woreda which is located 30 kms south-west of Bahir Dar town, the capital of Amhara Region and 524 km north-west to Addis Ababa. It borders North Achefer in the north, South Achefer in the south and west, and Yilmana Densa Woreda in the east. The woreda has 35 rural kebeles and 3 urban kebeles. Based on 2012 the population projection the woreda had 317, 963 population of which 160,686 and 175,277 were male and female respectively. Merawi (the town of the woreda) had 18,682 total populations of which 9,632 and 9,050 were males and females respectively (CSA, 2011). The woreda's covers 112438 hectare of land which comprises potential cultivated land(12677.19 ha) , grazing land (12818.98 ha), bush land (2156.6 ha) , settlement land (4120.6 ha) , natural forest (6670.98 ha) ,and human made forest land(2592 ha) . From the total land 94% of the land is plain and the remaining lands are hill and valley lands. The soil type of the woreda is mainly red soil which accounts 97% whereas the remaining portion of land is black soil. The Woyina Dega agro ecology of the woreda covers 95% and the remaining 5% agro ecology is characterized by Dega. The woreda annual average temperature is 24°C and the annual average rainfall is about 2000 mm.

The woreda has 12 milkshed kebeles that are identified based on milk production potentials and market accessibility. According to the Woreda livestock development office basic data, the woreda had 80607, 117738 , 44472,37803,44272,80488,34387,17514,7859, an 1096 oxen, cows, bulls, heifers ,calves, sheep, goats, donkeys , mules and horses respectively. The woreda had 6,570 and 114,722 cross breed dairy cattle and local breed dairy cows respectively. It had 37,347 lactating cows; of which the total breed lactating cows accounts only 4.77 % . The monthly estimated milk production of the woreda is 19,507,076.82 litter from local cows and 2,664,446.4 litters of milk from cross dairy cows which indicates that about 87.98 % of milk is produced from local breed dairy cows (woreda livestock development office, 2019).



Source: Ethiopian GIS shape file
Figure 1. Map of study area

2.2. Data Types, Sources and Methods of Data Collection

Both cross-sectional quantitative and qualitative data were collected from secondary and primary data sources. Secondary data sources were livestock husbandry and management experts; livestock product experts; annual reports, journals, and websites whereas primary data sources were smallholder dairy farmers. To collect these data both informal and formal survey methods were employed. In informal survey Focus Group discussion (FGD) was conducted whereas in formal survey, pretested semi-structured questionnaire which was translated to Amharic language was prepared to collect data from sampled small holder farmers. Quantitative data producers the amount of milk produced per day, the amount of milk sold, the amount of milk allocated to add value and the amount of milk allocated for home consumption were collected. Thus, the amount of butter, cheese, and whey produced were calculated using the conversion factor of milk for each milk products produced traditionally.

2.3. Sampling Procedure and Sample Size Determination

Sampling procedures: Purposive systematic random sampling technique was employed to determine sample size. Six kebeles were selected purposively based on the dairy production potential and milk market accessibility among 12 milk shed kebel in Mecha Woreda. Then, list of the smallholder milk producers were accessed in each selected kebele. List of milk producers were arranged in order of milking cows holding and then respondents were selected using systematic random sampling technique. The skip interval (K) was determined by dividing the population of each keble (P) to sample size(S), that is, $K = \frac{P}{S}$. Thus, every K^{th} item from the list was selected and being the sampling element for this study.

Sample size determination: The total sample size for milk producers were determined by using Yamane formula (1977); $n = \frac{N}{1+N(e)^2} \rightarrow n = \frac{1254}{1+1254(0.065)^2} = 199 \sim 200$

Where n is the total sample size, N is the total population and e is the precision level. Since the targeted population for the study is the milk producers who have currently lactating cows, the respondents of the study come homogenous relative to all milk producers in the study area. Thus, Yamane formula with the precision level of 6.5 % was employed to represent the population. The sample size of the milk producers in each kebele was determined using proportionate sampling method. Thus, face to face interview was undertaken with the total of 200 milk producers. Focused group discussion was conducted with 12 small holder milk producers to dig out the traditional milk products at farm level.

2.4. Methods of Data Analysis

Descriptive statistics such as frequency, means, ratios, percentages, standard deviations were used to analyse the survey data collected from smallholder milk producers and econometric models; bivariate probit and Tobit models were used to undertake econometric analysis using STATA 14.

2.4.1. Econometric model specification

Bivariate probit model:

In many practical economic applications economic actors' choices are restricted. In this study, 54% of milk producers did not participate in raw milk marketing and whereas 38% of them did not participate in milk value addition. In each economic activity binary choices (to participate or not to participate) were overlooked. Participation decision by milk producers is the binary response variable that probability model can be developed with three approaches; linear probability, logit and probit model. Linear probability model (LPM) worked with OLS approach but it could not fulfill the underlying assumptions of OLS. Logit and probit models are alternative models that can avoid the defects of LPM (Wooldridge, 2012). Logit model is mainly employed for logistic distribution and practically applied for growth phenomenon such as population, GNP, money supply etc. whereas probit (normit) model is applied for normal distribution (Gujarati, 2003). In this study the cumulative distribution function (CDF) of the dependent variables were assumed to be normal and maximum likelihood is an efficient and appropriate estimator (Greene, 2012). Thus, probit model can be applied to estimate the binary dependent variables parameters, determinants of raw milk marketing and milk value addition participation decisions. However, separate probit model could not applied since raw milk marketing participation decision and value addition participation decision are correlated negatively and the spearman correlation coefficient (rho) showed significant interdependence between raw milk supply decision and milk value addition decision. Therefore, bivariate probit model enables to evaluate the association of dependent variables and the marginal effects of covariates (Kohler and Rodgers, 1999). If correlation coefficient between probit equations were zero, the bivariate probit model became two independent univariate probit models (Cotei and Farhat, 2011 and Green, 2012).

The general specification of bivariate probit equation model;

$$y_1^* = x_1\beta + \varepsilon_1, y_1 = 1, y_1^* > 0, 0 \text{ otherwise} \quad (1)$$

$$y_2^* = x_2\beta + \varepsilon_2, y_2 = 1, y_2^* > 0, 0 \text{ otherwise} \quad (2)$$

$$\begin{pmatrix} \varepsilon_1 \\ \varepsilon_2 \end{pmatrix} / x_1, x_2 \sim N \left[\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & \rho \\ \rho & 1 \end{pmatrix} \right]$$

Where y_1^* and y_2^* are raw milk marketing participation decision and milk value addition participation decision respectively and ε_1 and ε_2 are error terms which are assumed to be distributed normally (Greene,2012). Since the two separate probit models have specific independent variables, seemingly unrelated probit model was employed. The probit model in milk market participation decision showed the 1 failure and 0 success completely determined so that milk market experience was excluded from the model.

Bivariate Tobit model:

Two dependent variables, raw milk supply participation intensity and value addition participation intensity were expressed in percentage that their value laid between 0 and 1. After specifying linear functional relationship, OLS assumptions tests, independence and simultaneity tests; and identification issues were assessed. Variance inflation factor (VIF) was employed to detect the multicollinearity problem. VIF estimates how much the variance of a regression coefficient is inflated due to multicollinearity in the model. Variance inflation factor can be calculated by;

$$VIF = \frac{1}{1-R^2}$$

VIF above 10 indicates the multicollinearity problem. The VIF values of independent variables were below 2.26 and the mean VIF was 1.49 in milk supply participation intensity regression model. The values indicate that there was no multicollinearity problem in the model. The normality distribution of the error term was tested by Shapro-Wilk test for normal data had p-value 0.39 and the null hypothesis of normality was accepted. The tests; heteroscedasticity and omitted variable tests indicated that non-constant variance of error term and the model has omitted variables. Heteroscedasticity can be happened due to either the presence of outliers in the data or omission of variable from the model. In the case of this study, there was no an outlier and the error terms are normally distributed. On the other hand, as the omitted variables test indicated that there could be the problem of model misspecification. To assure whether there were model misspecification, link test was applied. Link test can be applied for any single equation to test misspecification of the model. About 63% percent of the model was explained by independent variables. The p-value in the linktest of this model after regression was 0.11 and the null hypothesis of good specification was accepted. From these perspectives we are sure that heteroschedasticity is not due to misspecification of the model.

With similar fashion of raw milk supply participation level equation, all tests were conducted in value addition participation level equation. The VIF values of explanatory variables were below 2.24 and the mean value of VIF was 1.5 which shows there was no multicollenearity problem in the model. The normality test of error term by qnorm plot and kdensity shows normality. The heteroschedasticity and omitted variable test indicates that there was no hetteroschedasticity problem and no omitted variable and no misspecification problem respectively. Link test of the model showed that there is good model speciation.

Before estimation of the parameters, two important issues of independence and simultaneity were examined. Dependent variables were correlated negatively and significant at 1% significant level with correlation coefficient of -0.77. Under spearman independence test, the spearman correlation coefficient (rho) was -0.74 which was statistically significant at 1% significant level. The test showed that the null hypothesis of independence of two variables was rejected, they are interdependent.

Practically as producers' value addition participation intensity at farm level increases, it shares the amount of raw milk supplied that is the raw milk supply participation intensity decreases and vice versa. Thus, these two variables may have cause and effect relation. To test simultaneity, a version of the Hausman specification error test was employed. In this t-test, the coefficient of the residual of raw milk supply was significant at 1% significant level in value addition equation whereas the residual of value addition equation was not significant in milk supply equation. This situation implied that raw milk supply causes value addition negatively but value addition did not cause milk supply participation level to increase or decrease. In general, it was assured that the two systems of equations were strongly interdependent and had recursive or unidirectional relationships.

With above procedures, we arrived at the conclusion of two equations were recursive simultaneous censored equations. In structural equations, the issue of identification must be assessed prior to estimation. If the equation is under-identified, the structure of the equation is not unique or there is not sufficient information to distinguish the equation. If the equation is just identified, there is sufficient information available to distinguish the equation. If the equation is over identified, there is more than sufficient information regarding the equation. In this study, the order condition of identification method indicated both equations are over identified. Order condition method is the necessary but not sufficient identification method while rank condition is necessary and sufficient condition of identification method. The rank condition of identification was employed and indicated both equations are just identified. Thus, since the order condition and rank condition were satisfied the equations were over identified.

Models like Tobit (Tobin, 1958), Double Hurdle or Cragg's (Cragg, 1971) and Heckman selection model (Heckman, 1979) can be applied for single limited dependent variable. However these model frameworks are not applicable to situations when there are two or more correlated limited dependent variables. Applying univariate model analysis by neglecting interdependence and simultaneity problem causes an estimator for separate analysis to be inconsistent (Chen, 1997) and biased estimates of parameters (Hsiao, 1986; Yoo, 2005). Thus; Amemiya (1974) was first considered bivariate Tobit to analyze joint determination of censored dependent variables. For this study, recursive bivariate Tobit model was proposed to be appropriate in order to account censoring, interdependence and endogeneity that can exist due to simultaneity. Previous study conducted by Zenebe (2014) and Ali (2017) looked at milk market participations and value addition participation intensity determinants with separate model and nothing was expressed about the interdependence of two equations. On the other hand, different researchers applied bivariate and multivariate Tobit for their studies. For instance; Yoo (2005) applied bivariate Tobit to identify determinant of household bottled water and water purifier expenditures; and Kubanychbekova (2013) also applied to identify factors affecting parents' time allocation for children. Zhang et al (2017) used multivariate tobit to identify the effect of off-farm employment on forestland transfers in China; Rahman and Chima (2016) used multivariate Tobit to identify determinants of food crop diversity and profitability in southeastern Nigeria. Therefore, simultaneous (recursive) bivariate Tobit was used to estimate the parameter to account for the potential interdependent, endogenous and censored issues.

Structural equation of the model was specified as;

$$r_{1i}^* = x_{1i} \beta_1 + \varepsilon_{1i}, r_{1i} = \max(r_{1i}^*, 0) \quad (3)$$

$$v_{2i}^* = x_{2i} \beta_2 + \delta r_{1i}^* + \varepsilon_{2i}, v_{2i} = \max(v_{2i}^*, 0) \quad (4)$$

The reduced form of equation can be written as;

$$r_{1i}^* = x_{1i} c_1 + \mu_{1i}, r_{1i} = \max(r_{1i}^*, 0) \quad (5)$$

$$v_{2i}^* = x_{2i} c_2 + \mu_{2i}, v_{2i} = \max(v_{2i}^*, 0) \quad (6)$$

Where the superscript asterisk represents the unobservable latent variables; x_{1i} and x_{2i} are the vectors of exogenous variables including constant term, ε_{1i} and ε_{2i} are random disturbances that follow bivariate normal distribution $BVN(0, \Omega)$, where Ω is covariance matrix with the correlation coefficient (ρ) between the error terms of two structural equations. Under reduced form equation μ_{1i} and μ_{2i} are random disturbances that follow univariate normal distribution $N(0, \sigma^2)$. The Doornik-Hansen test was used for bivariate normality test and the null hypothesis of bivariate normality is accepted. The bivariate normal distribution of probability density function can be stated by;

$$p(x_1, x_2) = \frac{1}{2\pi\sigma_1\sigma_2\sqrt{1-\rho^2}} \exp\left[-\frac{z}{2(1-\rho^2)}\right] \quad (7)$$

Where $z = \frac{(x_1 - \mu_1)^2}{\sigma_1^2} - 2\rho \frac{(x_1 - \mu_1)(x_2 - \mu_2)}{\sigma_1\sigma_2} + \frac{(x_2 - \mu_2)^2}{\sigma_2^2}$, $\rho = \text{cor}(x_1, x_2) = \frac{v_{12}}{\sigma_1\sigma_2}$ and v_{12} is the covariance of x_1 and x_2 .

Maximum likelihood is an indispensable estimator for nonlinear models. Maximum likelihood estimator is consistent and efficient estimator under identified regressors (low multicollinearity) and normal distribution of data (Green, 2012). Maximum likelihood estimators are sufficient, asymptotically efficient and unbiased if normality is satisfied. Even under non-normality distribution, maximum likelihood is more efficient than OLS as long as the distribution of the disturbances is correctly specified (Wooldridge 2002; Baltagi, 2008). Therefore, for this study maximum likelihood estimator is selected to estimate the parameters. For a random variable, y_i and given set of parameters, θ the likelihood function is usually expressed by log:

$$\ln L(\theta|y) = \sum_{i=1}^n \ln f(y_i|\theta) \quad (8)$$

$$\text{Where } (y_i|\theta) = \prod_{i=1}^n f(y_i|\theta) = L(\theta|y_i)$$

A two-stage simultaneous equation procedure (proposed by Nelson and Olson) was employed to estimate structural parameter. The first stage was to regress the reduced form of equations (for equation 2) and used the coefficient estimates of c_2 to generate the predicted values of latent dependent variables. Secondly, the predicted value of the latent variables was used as instruments on the right-hand sides of the structural form equation. Finally a Tobit approach was applied to estimate parameters of the structural equations. The likelihood ratio (LR) test was conducted on the bivariate model with the null hypothesis of $\rho=0$. The corresponding statistics rejected the null hypothesis that indicated a bivariate Tobit estimator (maximum likelihood) should be employed with the Nelson–Olson procedure to attain more efficient estimates.

2.4.2. Definition of Variables and Hypotheses

Dependent variables:

Milk supply participation decision (MPD) and intensity of participation (MPI): First, sampled households take a value of 1 if they participate in milk market and 0 otherwise. Secondly, households who participated in milk market take the percentage amount of milk sold to total milk produced and 0 otherwise.

Milk value addition participation decision (VAPD) and intensity of participation (VAPI): First, sampled households take a value of 1 if they participate in value addition and 0 otherwise. Secondly, households who participated in value addition take the percentage amount of milk sold to total milk produced and 0 otherwise.

Independent variables for milk market participation

Age of the household head (AGE): It is a continuous variable that is measured in year. Bardhan *et al.*(2012); Berhanu *et al.*(2014) and Chamboko *et al.* (2017) identified that age affected the probability of participating in milk marketing negatively and significantly. In contrast, Emukule *et al.*(2018) indicated that as age increases, there would be better milk production and marketing experience which in-turn increases the probability of milk market participation. Study by Chamboko *et al.* (2017) showed that age affected the volume of milk sold negatively whereas Emukule *et al.* (2018) inferred that age affected milk market participation intensity positively. Therefore, the effect of household head age on milk market participation decision and intensity participation was difficult to hypothesize.

Family size (FMSZ): It is a continuous variable measured in adult equivalent. As dairying and marketing are labor intensive activities, milk producers used family labor for these activities. Thus, family size is expected to have positive impact on milk market participation and intensity of participation. A study conducted by Benyam *et al.* (2016) indicated that family size affected milk market participation and level of participation positively. Emukule *et al.* (2018) identified household size was associated with the milk sell likelihood positively. In contrast, family size increases home milk consumption which affects the milk market participation. Berhanue *et al.* (2014) found that family size affected the volume of milk supply negatively. Thus, it was difficult to hypothesize the variable's effect on milk participation.

Education level (EDU): It is a discrete variable and is measured in the formal education class that a household head has attended. Education can capacitate the performance of farmers in farming, information sharing and technology implementation and then can improve the decision making quality (Fakoya *et al.*, 2007). Studies by Chamboko *et al.*(2017) and Emukule *et al.* (2018) identified that education level affected the likelihood of milk sell positively. This variable was hypothesized to affect milk market participation decision and intensity of participation positively.

Land holding size (LNS): It is a continuous variable that is measured in hectare. Land is important input for forage and pasture development which enhances dairy production. It is expected that as land size increases, the household proportion land allocation for dairy production can be increased and then milk market participation increases. A study conducted by Chamboko *et al.* (2017) indicated that land size affected the level of milk sell positively. Emukule *et al.* (2018) identified land size affected the likelihood of milk sell positively while it affected the volume of milk sold negatively. Studies conducted by Berhanu *et al.* (2014) and D. Bardhan *et al.*(2012) indicated that land holding size of the household affected the probability of milk market participation and the volume of supply negatively. Therefore, it was difficult to hypothesize the effect of land holding size on milk market participation.

Number of local breed milking cows (NULC): It is a discrete variable measured in number. As the number of local milking cow increases, the volume of milk produced increases and producers would have surplus milk to sell. Benyam *et al.* (2016) identified that number of local dairy cows had positive relationship with milk market participation decision and amount of participation. Similarly, Chamboko *et al.* (2017) showed as the number of dairy cows increase milk market participation decision and level of participation would also increase. Therefore, this variable was hypothesized to affect milk market participation decision and intensity positively.

Number of cross breed milking cows (NUCRC): It is a discrete variable measured in number. Benyam *et al.* (2016) identified that number of cross milking cows had direct relationship with milk market participation. Bayan and Pratim (2018) pointed out that producers had cross breed were more commercial oriented than producers did not have. Therefore, this variable was hypothesized to affect milk market participation decision and participation intensity positively.

Dairy farming experience (DFMEXP): It is a continuous variable which is measured in year. It is expected that the experience of farmers in milk production influence the probability and level of milk market participation positively. Studies conducted by Zenebe (2014) and Berhanu *et al.* (2014) identified that dairy farming experience caused both the probability of milk market participation and volume of supply negatively. On the hand Selman *et al.* (2015) identified dairy farming experience influenced market participation decision level and intensity positively. Thus, it was difficult to hypothesize the effect of this variable on milk participation decision and intensity.

Volume of milk yield per day (sqrtMLY): It is a continuous variable that is measured in litter. It is expected

that producers supply milk when they have large volume of milk at hand. Past studies conducted by Omiti *et al.* (2009); Bardhan *et al.* (2012); Berhanu *et al.* (2014) and Zenebe (2014) showed that the amount of milk produced per day affected the milk market participation decision and intensity positively. Therefore, this variable was hypothesized to affect milk market participation positively.

Volume of milk allocated for home consumption (MLCN): It is a continuous variable which is measured in liter. Household consume during regular days or/and during socio-cultural ceremonies. A study conducted by Luoga (2007) found that the amount of milk consumed per household was a highly significant indicator producers' failure to milk market participation. According to Karna (2015) and Ali (2017) the size of milk consumption was inversely related with butter participation decision and intensity. As more milk is required to allocate for family consumption, the probability of milk participation decision and volume of milk supply decline. Therefore, this variable was hypothesized to influence milk market participation negatively.

Membership to milk cooperatives (MEMCOOP): It is a dummy variable that take the value of 1 if a household is a member of cooperative and 0 otherwise. Chagwiza *et al.* (2016) revealed that cooperatives have strong roles in facilitating technology transformation and commercialization. The study conducted by Phon and Yamaji (2016) showed that membership in agricultural cooperatives improves participation decision and intensity in vegetable markets. Similarly, Kumar (2018) indicated dairy cooperative membership has positive impact on milk yield which enhances market participation. Therefore, membership to milk cooperative was hypothesized to affect milk market participation positively.

Distance of from the nearest dairy market (DSTM): It is a continuous variable measured in kilometer. As producers far from the market, they cannot access markets facilities; market information and infrastructure and incurred high transaction costs which discourage sellers to supply milk. Previous studies conducted by Omiti *et al.* (2009), D. Bardhan *et al.* (2012); Zenebe (2014) and Benyam *et al.* (2016) indicated that distance of market had indirect relationship with the likelihood of milk market participation decision and volume of supply. Therefore, distance of milk market was hypothesized to affect market participation decision and intensity negatively.

Livestock holding (TLU): It is a continuous variable which is measured total tropical livestock unit. In Ethiopia, shortage of grazing land, in general shortage of feed is the main constraint in dairy production (Mebrate *et al.*, 2019). Extra cattle holding shares limited feed resources owned and decreases milk volume so that producers would not sell milk. Thus, this variable was hypothesized to affect milk participation decision and intensity negatively.

Milk market experience (MRKTEXP): It is a continuous variable that is measures in year. Experience in marketing helps to understand market opportunities. According to Kumar (2010) milk market experience influenced milk participation decision and intensity positively. **The study conducted by** Sigei *et al.* (2013) showed marketing experience influenced the extent of market participation positively in pineapple market. Mbitsemunda and Karangwa (2018) also showed market experience had direct influence on participation decision and extent of participation in bean market. Therefore, the variable was hypothesized to affect milk market participation decision and intensity positively.

Independent variables for value addition participation

Age of the household head (AGE): It is a continuous variable that is measured in year. Older household can have more dairy cows and volume of milk and have higher probability to add value than younger. Tadele *et al.* (2014) found age has positive association with value addition participation decision. Similarly, Karna (2015) and Benyam *et al.* (2017) identified age of the household is positively associated with the likelihood to add value to milk. Therefore, the variable is hypothesized to affect milk value addition participation and intensity of participation positively.

Family size (TOTFM): It is a continuous variable measured in adult equivalent. Embaye, (2015) identified that family size tended to decrease the likelihood of selling butter. However, a study conducted by Ali (2017) showed that as family size increases, the value addition participation and its intensity increases. Similarly, Tsega *et al.* (2017) showed family size affected probability of participation in milk value addition positively. Therefore, it was difficult to hypothesize this variable on milk value addition participation.

Land holding size (LNS): It is a continuous variable that is measured in hectare. According to Ali, (2017) study result ,land holding size had negative relationship with household likelihood of value addition and level of value addition participation. Thus, this variable was hypothesized to affect value addition participation decision and intensity of participation negatively.

Number of local breed milking cows (NULC): It is a discrete variable measured in number. Due to the higher fat content local dairy cows' milk than cross dairy cows' milk, producers prefer to processes the local dairy cow milk. High number local dairy cows encourage milk processing and add value to milk. Study by Tadele *et al.* (2014) showed that number of local milking cows had positive effect on milk value addition decision and amount. In contrast, Ali (2017) found that number of local breed milking cows had negative effect of value addition participation decision and intensity. Hence, it was difficult to hypothesize the influence on value addition

decision and intensity positively.

Number of cross breed milking cows (NUCRC): It is a discrete variable measured in number. Dairying cross milking cows enables to produce large milk volume. Producers prefer more to sell milk of cross cows than to process due to less fat content of cross cow milk. Tadele *et al.* (2014) and Tsega *et al.* (2017) indicated number cross dairy cows affected milk value addition participation negatively. Thus, this variable was hypothesized to affect milk value addition participation negatively.

Dairy farming experience (DFMEXP): It is a continuous variable which is measured in year. As producers experienced in dairying, they probably improve their production system and amount of production. Producers with large volume of milk prefer selling to processing milk. Karna (2015) found that dairy experience of farmers affected the likelihood of value addition to milk negatively and significantly. Thus, this variable was hypothesized to affect value addition negatively.

Membership to milk cooperatives (MEMCOOP): It is a dummy variable that take the value of 1 if a household is a member of cooperative and 0 otherwise. Milk producers who are not member cooperative participate more in milk value addition than cooperative members. The study conducted by Ali (2017) and Tsega *et al.* (2017) showed that as dairy producers switched from non-member to member of dairy cooperative, their value addition participation decision as well as level of participation in milk value addition would decline. Thus, cooperative membership was hypothesized to affect milk value addition participation positively.

Volume of milk yield per day (sqrtMLY): It is continuous variable measured in litter. Households have a chance to allocate certain amount of milk that goes to value addition when milk volume per day is high. Tadele *et al.* (2014); Karna, (2015); Betela *et al.* (2017) and Tsega *et al.* (2017) found that increase in milk yield per day enhanced milk value addition participation. In contrast, study conducted by Ali (2017) identified that milk yield per day had negative association with probability of value addition and volume of value addition. Therefore, this variable was difficult to hypothesize the effect on value addition participation decision and intensity.

Distance of from the nearest dairy market (DSTM): It is a continuous variable measured in kilometer. Tadele *et al.* (2014) identified distance of market had positive effect on milk value addition participation decision and intensity. In contrast, Embaye (2015) identified distance of dairy market affected butter supply decision and level of butter negatively. Karna (2015) identified distance of market is associated with value addition participation decision negatively whereas it is directly associated with level of value addition. Therefore, it was difficult to hypothesize the effect of market distance on value addition participation.

Value addition experience (VLADEXP): It is a continuous variable that is measured in year which indicates the year that household engaged in value addition. Experience in value addition enhances knowledge on milk processing and marketing activities. Ngore (2010) and Tijani (2018) indicated year of market experience had positive association with probability of participation and amount of supply in butter market. Thus, this variable was hypothesized to affect milk value addition participation decision and intensity positively.

Livestock holding (TLU): It is a continuous variable that is measured in tropical livestock unit. Holding large herd size share the feed resource of lactating cows and milk productivity probably decrease. Low milk volume discourages value addition participation decision and intensity and produces use milk for self-consumption. Study conducted by Dirriba and Lemma (2016) indicated that livestock size and butter market participation decision as well as level of participation had negative relationship. Therefore, this variable was hypothesized to affect value addition participation negatively.

3. RESULTS AND DISCUSSIONS

3.1. Descriptive Results

Demographic and socio-economic characteristics of sampled milk producers

Of the total respondents, female household heads accounted only 7.5%. More than 90% of the respondents were married. Small holder farmers practiced mixed farming practice and of the total respondents about 68.8% of them lead their livelihood with crop cultivation and about 19.6% of the respondents replied as their major livelihood is dairy farming. This implied that though dairying is less support in livelihood relative to cropping, farmers begun to realize dairy production can be as business beyond home nutrition fulfillment. The average age of the respondents was 45 years and their average educational status in class year completion was 2.8. Milk producers traveled 5 km on average to sell milk and milk products. Whereas, when a household wanted to visit their livestock to veterinary clinic, he /she traveled 2.6 km on average (Table 5).

Table 1. Socio-demographic Characteristics of sampled producers

Variables		Number	Percent
Sex	Female	15	7.5
	Male	185	92.5
Marital status	single	11	5.56
	married	181	91.41
	widow	3	1.52
	Divorce	3	1.52
Religion	Orthodox	181	90.95
	Protestant	18	9.05
Major livelihood	crop cultivation	137	68.84
	dairy	39	19.60
	government employment	8	4.02
	crop and dairy	11	5.53
	dairy and merchant	4	2.01
Variables	Mean : N=200	SD.	Min(Max)
Family size (ADE)	5.482	1.976	0.75 (9.450)
Age (year)	44.970	10.970	20.0 (68.0)
Education (year)	2.799	3.060	0.00 (10.0)
Distance of veterinary clinic(km)	2.6	1.9	0.10 (9)
Distance of dairy product market(Km)	5.029	1.874	1.015 (8.6)

On average, dairy farmer produced and consumed 9.5 and 1.3 liters of milk per day respectively. The average total land holding size of the household was 1.44 hectare. A respondent held about 5 total livestock on average. He/she held nearly one 0.6 and 2 1.8 cross lactating dairy cows on average. Hence the raw milk market was under-development; respondents had lower experience in milk participation than value addition.

Household dairy products market participation: The mean proportion mean in the summary indicates that from sampled respondents 46 % and 62% of them were participating in raw milk marketing and value addition respectively. The mean raw milk market and value addition participation intensity of sample household was 32.1% and 39.3% respectively. Raw milk market participation is newly immersed economic activity in the study area. The average milk market experience of a household was 1.5 years while the value addition experience was 8.9 years (Table 6).

Table 2. Summary statistics for dairy market participation and asset holding

Variables	Mean :N=200	SD.	Min	Max
Milk market participation decision (0/1)	0.460	0.500	0.000	1.00
Value addition participation decision (0/1)	0.620	0.487	0.000	1.000
Cooperative membership (0/1)	0.310	0.464	0.000	1.000
Raw milk market participation intensity (0/1)	0.321	0.372	0.000	0.932
Value addition participation intensity (0/1)	0.393	0.324	0.000	0.875
value addition experience (year)	8.938	4.637	1.015	20.585
Milk market experience (year)	1.504	1.882	0.000	7.500
Total land size (hectare)	1.460	1.014	0.000	3.950
Land allocated for crop	0.818	0.767	0.000	3.250
Land allocated for forest	0.224	0.435	0.000	5.000
Land allocated for grazing	0.418	0.413	0.000	1.750
Number of local cow (number)	0.570	0.754	0.000	3.000
number of cross cow (number)	1.780	0.809	1.000	4.000
Dairy farming experience (year)	8.230	2.783	2.000	15.000
Milk yield (litter) per day/HH	9.55	5.33	0.8	23.00
Milk consumption (litter)	1.348	0.673	0.276	3.064
livestock holding (TLU)	5.376	2.410	1.700	10.180

Land holding and allocation: Farmers undertook mixed agricultural practices, both crop and livestock. The major crops grown in the area are maize, millet, wheat, teff, and vegetables. Eucalyptus is the major cash crop that supports the livelihood of farmers. As a result farmers allocated their land for eucalyptus next to crop production. According to this survey calculation about 56.1 and 28.6 percent of land was allocated for crop and forest production respectively. Land allocation for forest production usually indicates the eucalyptus production in the area. The remaining portion land (15.3% of land) was allocated for livestock production (grazing). A farmer held 1.46 hectare of land on average which is higher than the national average land holding size per households ,1.04 hectare (CSA , 2018).

Livestock holding: The average size lactating cows holding size was about 2 per household whereas a household had a total of 5 livestock size (TLU) on average. Milk producers kept local cows mainly for milk consumption and butter production whereas cross dairy cows were targeted to sell raw milk but they also added value to milk (process and sell) when raw milk demand became low. Milk producers, who had only local lactating cows, did not participate in raw milk marketing. Besides raw milk marketing, milk producers used calves for selling live and made it as source of home income. Farmers kept female calves for rearing unless they incurred feed shortage but male calves were used for live marketing.

3.2. Inferential Statistics Results

The mean comparison T-test in table 8 below shows that the mean proportions of milk market participation decision between participants and non-participants are statistically different and significant at 1% significant level. Similarly, mean proportions of value addition participation decision are significantly different at 1% significant level. The means of participation intensity between participants and non-participants are significantly different at 1% significant level both in milk market and value addition participation.

In raw milk market participation, of the total 14 independent variables the means of 13 variables between participants and non-participants are different and statistically significant. The means of milk yield per day, age of the household head, and land holding size between participants and non-participants are different significantly at 5% significant level. The means of household education level and total livestock holding between participants and non-participants are statically and significantly different at 10% significant level. The means of the remaining 8 independent variables; dairy farm experience, milk market experience, value addition experience, number of local cows ,number of cross cows, distance of dairy products market , household milk consumption and membership in dairy cooperative between participants and non-participants are significantly different at 1% significant level.

In milk value addition participation, the means of 8 independent variables are significantly different. The means of household head age, family size, dairy farm experience, and distance of dairy product market are significantly different at 5% significant level. The means of land holding, value addition experience, number of local cows, and membership in dairy cooperative are significantly different at 1% significant level.

Table 3. Descriptive and inferential statistics of variables used in regression

Variables	Milk market participation		t-value	Value addition participation		t-value
	No	Yes		No	Yes	
	n=108	n= 92		n=124	n=76	
	mean (SD)	mean (SD)		mean (SD)	mean (SD)	
MPD				0.724 (0.45)	0.298 (0.459)	6.4***
VAPD	0.805 (0.397)	0.402 (0.493)	6.4***	NA	NA	
MPI	0.00	69.8 (19.1)	- 37.97***	59.8 (37.97)	15.1 (24.33)	10.15***
VAPI	59.4 (27.07)	15.6 (12.86)	14.97***	5.7 (18.7)	59.8 (19.04)	-19.6***
MLY	6.69 (3.44)	12.91 (5.21)	-10.10**	9.85 (5.57)	9.35 (5.19)	0.64
AG	47.11 (9.94)	42.46 (11.62)	3.05**	41.96 (11.78)	46.89 (9.99)	-3.1710**
EDU	2.42 (2.80)	3.24 (3.30)	-1.89*	3.03 (3.35)	2.65 (2.86)	0.87
FMLSZ	5.67 (1.81)	5.26 (2.14)	1.47	4.98 (1.96)	5.8 (1.92)	-2.96**
TLU	5.71 (2.43)	4.98 (2.33)	2.1573*	4.77 (2.22)	5.76 (2.46)	-2.88**
LNS	1.64 (0.95)	1.21 (1.04)	3.07**	1.069 (0.99)	1.68 (0.96)	-4.3***
DFMEXP	5.20 (3.30)	6.97 (3.35)	-3.74***	6.49 (3.49)	5.71 (3.38)	2.00**
MRKTEXP	1.00 (1.78)	2.78 (1.99)	-6.65***	1.90 (1.89)	1.77 (2.19)	0.45
VLADEXP	9.7 (4.83)	8 (4.23)	2.6***	7.79 (4.65)	9.67 (4.49)	-2.9***
NULC	0.81 (0.79)	0.26 (0.57)	5.61***	0.32 (0.61)	0.71 (0.78)	-3.74***

Variables	Milk market participation		t-value	Value addition participation		t-value
	No n=108	Yes n= 92		No n=124	Yes n=76	
	mean (SD)	mean (SD)		mean (SD)	mean (SD)	
NUCRC	1.49 (0.66)	2.14 (0.86)	-6.04***	1.94 (0.88)	1.69 (0.77)	2.02
DSTM	5.71 (1.82)	4.23 (1.61)	6.05***	4.49 (1.67)	5.37 (1.91)	-3.31**
MLCN	1.60 (0.68)	1.10 (0.54)	5.82***	1.37 (0.77)	1.33 (0.60)	0.47
MEMCOOP	0.11 (0.31)	0.54 (0.50)	-7.4***	0.43 (0.49)	0.23 (0.42)	3.02***

The value ***, ** and *represents statistical probability level at 1%, 5% and 10%., respectively
 Source: survey result, 2019

3.3. Econometric Model Results

3.3.1. Bivariate probit model results

Dependent variables; raw milk supply decision and value addition decisions were suspected as they were interdependent. The Spearman independence test ($\rho = -0.414$) showed that there is interdependency between raw milk supply and value addition decision. The Wald test of the correlation coefficient of rho (-0.82) was significant at 1% significant level. Thus, bivariate probit model is appropriate to estimate parameters.

All explanatory variables found in raw milk market supply decision equation did not found in value addition participation decision equation. Thus, seemingly unrelated bivariate probit model was used. Among types marginal effects average marginal effect was preferred with its advantages in taking into considerations of any covariates in the model (spring, 2013; Leeper, 2017). The probability of the household to supply raw milk was significantly affected by 8 variables in the model.

Table 4. Determinants raw milk market and value addition participation decision, bivariate probit result

MPD	VALPD							
	Coef.	dy/dx	std.e	z	coefceec	dy/dx	std.er.	z
AG	-0.027	-0.003	0.002	-1.67*	0.015	0.005	0.003	1.37
FMLSZ	0.136	0.018	0.011	1.65*	0.020	0.006	0.017	0.36
EDU	-0.034	-0.004	0.005	-0.89				
LNS	-0.252	-0.032	0.023	-1.39	0.333	0.105	0.034	3.1***
NULC	-0.442	-0.057	0.031	-1.86*	0.150	0.047	0.057	0.83
NUCRC	0.085	0.011	0.031	0.35	-0.109	-0.034	0.053	-0.65
DFMEXP	0.106	0.014	0.006	2.41**	-0.065	-0.020	0.011	-1.91**
sqrtMLY	1.684	0.216	0.027	7.97***	0.182	0.057	0.042	1.380
MLCN	-1.713	-0.220	0.030	-7.23***				
MEMCOOP	0.977	0.126	0.033	3.79***	-0.376	-0.118	0.070	-1.69*
DSTM	-0.154	-0.020	0.009	-2.12**	0.067	0.021	0.019	1.12
TLU	0.038	0.005	0.050	0.10	0.121	0.038	0.085	0.45
VLADEXP	0.040					0.013	0.006	1.99**
constant	-1.923**				-1.687**			
/athrho	-1.259		0.269	-4.680				
rho	-0.85		0.074					
Number of observations				200				
Log pseudo- likelihood				-137.09				
Wald $X^2(23), Pr > X^2$				122.76***				
Wald test of rho=0, Pr > X				21.93***				

The value ***, ** and * represents statistical probability level at 1%, 5% and 10%., respectively Source: survey result, 2019

3.3.2. Recursive bivariate Tobit model results

Econometric model result shows that, of total 14 variables, raw milk supply participation level was affected by 8 variables significantly whereas 5 variables affected value addition participation intensity of the household in farm level significantly.

Table 5. Determinants raw milk market and value addition participation intensity Bivariate Tobit result

MPI				VAPI		
	Coef.	Std. Err.	z-value	coef.	Std.Err	z-value
MPI				-0.024	0.205	-0.120
AG	-0.003	0.002	-1.26	0.002	0.003	0.720
FMLSZ	0.018	0.013	1.37	0.004	0.014	0.290
EDU	0.005	0.005	1.15			
LNS	-0.075	0.026	-2.9***	0.086	0.031	2.790***
NULC	-0.067	0.043	-1.57	0.070	0.046	1.520
NUCRC	0.048	0.041	1.17	-0.061	0.049	-1.250
DFMEXP	0.005	0.008	0.6	-0.020	0.009	-2.360**
sqrtMLY	0.209	0.031	6.63***	0.042	0.048	0.870
MLCN	-0.237	0.033	-7.16***			
MEMCOOP	0.195	0.053	3.7***	-0.178	0.069	-2.600***
DSTM	-0.035	0.014	-2.52**	0.028	0.016	1.710*
MRKTEXP	0.035	0.009	3.9***			
VLADEXP				0.005	0.003	1.380
TLU	0.004	0.066	0.05	0.045	0.073	0.620
cons	0.009	0.148	0.06	-0.032	0.167	-0.190
lnsigma1	-1.212	0.062	-19.510***			
lnsigma2	-1.064	0.059	-18.120***			
atrho12	-1.638	0.103	-15.950***			
sigma1	0.297	0.018	16.090***			
sigma2	0.345	0.020	17.040***			
rho12	-0.927	0.014	-64.380***			
Likelihood ratio test of rho12 = 0:			$\chi^2(1)$, pr >			χ^2 200.89***
Log likelihood			-86.470173			
Number of observation			200			
Wald $\chi^2(25)$, pr >			χ^2 499.41***			

The asterisks *, ** and *** represent significance level at 10%, 5% and 1% respectively.

Source: survey result, 2019

Determinants of raw milk market participation;

Age of household head (AG): The coefficient of household age was found to have indirect relationship with milk supply participation decision and significant at 10% probability level. The finding was agreed with the results of Bardhan *et al.*, (2012); Berhanu *et al.*, (2014) and Chamboko *et al.* (2017). As age increases by one year, probability of household decision to participate in raw milk marketing decreases by 0.3%. The reason behind might be older farmers had more accumulated capital and assets such as land than younger farmers to support their livelihood.

Family size (FMLSZ): Milk market participation decision was affected by the family size of the household positively and significantly at 10% significant level. This result is consistent with the result of Benyam *et al.* (2016) and Emukule *et al.* (2018). As the family size of increases by one unit of adult equivalent, the participation decision of the household increases by 1.8%. It is known that small scale dairying is labor intensive activity and family is the main source labor for producers. Thus, family sizes translate to labor availability which is expected to increases milk selling decision.

Number of local lactating cows (NULC): Unlike prior expectation number of local lactating cows was negatively and significantly related with milk participation decision at 10 % probability level. The average marginal effect result indicated that increasing lactating cow holding by one local lactating cow, decreases the probability of a household participation decision in raw milk market by 5.7%. This result is contradicted with that of Chamboko *et al.* (2017) and Benyam *et al.* (2016). Producers preferred local cows' milk to cross cows' milk for processing and selling butter. Extra local cow holding encourages producers to process and add value instead of selling raw milk.

Dairy farm experience (DFMEXP): Dairy farming experience affected milk market participation decision positively and statistically significant at 5% significant level. The probability of household participation decision in milk market increases by 1.4 % when dairy farm experience increases by one year. The studies conducted by Zenebe (2014) and Berhanu *et al.* (2014) contradict this result while the study conducted by Selman *et al.* (2015) in Nageria found that farm experience and milk maker participation have direct relationship. Experience in dairy farming may develop farmers' production skill and knowledge which in-turn increase productivity. Large volumes of milk push producers to sell milk.

Volume of milk size (sqrtMLY): As hypothesized prior, the total milk yield size produced per day affected the raw milk market participation decision and intensity positively and significantly at 1% significant level. One liter increase in volume raw milk size increases the raw milk market participation decision and intensity by 4.7 % and 4.4% respectively. Producers did not want to pay cost for small size milk delivering. They preferred to consume rather than selling.

Land size (LNS): Land holding size was associated negatively with milk market participation. Milk market participation level of the household was affected by the land size holding negatively and significantly at 1% significant level. When household land holding size increases by one hectare, the participation level in raw milk supply decreases by 7.5%. The finding coincides with the findings of Berhanu *et al.* (2014) and Bardhan *et al.* (2012) Emukule *et al.* (2018). Land size might attract farmers for crop production.

Milk consumption of the household (MLCN): As prior expectation, household milk consumption affected raw milk market participation negatively and significantly at 1% significant level. The average marginal effect result shows that one liter increase in milk consumption decreases the probability of milk participation by 22% while the level of participation decrease by 23.7%. Studies conducted by Karna (2015) and Ali (2017) found negative relationship with milk market participation.

Membership cooperative (MEMCOOP): As expected in hypothesis, dairy cooperatives are working for members; empower them by decreasing transaction costs of members which encouraging them to supply raw milk. Thus, membership in dairy cooperative influenced raw milk participation decision and intensity positively and statistically significant at 1% significant level. The probit result of average marginal effect indicated that being membership increases the probability of household participation in milk market by 12.6%. Similarly being membership in dairy cooperative increases the level of raw milk supply participation by 19.5%. The result is consistent with Phon and Yamaji (2016) and Kumar (2018).

Milk market experience (MRKTEXP): As prior hypothesis experience of milk market affected milk participation decision and intensity positively and statistically significant at 1% significant level. When milk producer's market experience increases by one year, level of raw milk supply participation increases by 3.5%. Studies conducted by Kumar (2010); Sigei *et al.* (2013); and Mbitsemunda and Karangwa (2018) showed that market experience had positive relationship with milk market participation.

Distance of market (DSTM): The distance of market affected then milk supply participation decision and intensity negatively and statistically significant at 5 % significant level. One km increases in market distance decreases likelihood of household participation in milk market by 2% whereas intensity of value of milk market participation decreases by 3.5 %. This result is consistent with Omiti *et al.* (2009), D. Bardhan *et al.* (2012); Zenebe (2014) and Benyam *et al.* (2016).

Determinant of value addition participation;

Land size (LNS): It contrary to prior expectation, this variable had positive and significant influence on value addition participation at 1% significant level. The finding contradicts with the finding of Ali (2017). The reason might be farmers intended to crop production when they have large land size which in-turn leads to small volume of milk. Low volume of per day made farmers to collect milk, process, produce and sell butter. The average marginal effect of bivariate probit implies that keeping other explanatory variables constant, an increase in household land size by one hectare results 10.5% increase in value addition participation decision. The bivariate Tobit result indicates *ceteris paribus*, an increase in land size by one hectare increases the value addition participation intensity by 8.6%.

Dairy farm experience (DFMEXP): As prior expectation, dairy farm experience has negative and significant influence on both value addition participation decision and intensity at 5% probability level. This finding coincides with Karna (2015). The probit result indicates that keeping other explanatory variables constant, one year increase farmer's dairy experience decreases the farmer's likelihood to add value to milk by 1.9%. Similarly, the tobit model results shows that keeping other explanatory variables constant, an increase in dairying experience by one year, results 2% decrease in value addition participation intensity. Rational behind is that dairying experience increases milk volume which in-turn initiates farmers to sell fluid milk rather than selling processed products.

Membership in dairy cooperative (MEMBCOOP): As prior expectation, membership in dairy cooperative affected likelihood of household value addition participation negatively and significantly at 10% significant level. Similarly, this variable affected value addition participation intensity positively and significantly at 1% significant level. This depicts that being a membership of dairy cooperative increase the likelihood and intensity of supplying milk to milk collection center; which decreases the volume of milk to be processed at farm level. The finding coincides with the findings of Ali (2017) and Tsega *et al.* (2017). This implies that *ceteris paribus*, being membership in dairy cooperative decreases the likelihood of the household to add value to milk by 11.8%. Similarly, keeping other independent variables constant, being membership in dairy cooperative decreases the household's value addition participation intensity by 17.8 %.

Value addition experience (VLADEXP): As prior expectation, value addition experience of the household

affected value addition participation decision positively and significant at 5% significant level. This variable has positive relationship with value addition participation intensity but not statistically significant. The positive relationship indicates that the more value addition experience, the more skill of processing milk products and more knowledge about customer preference. Those milk producers who are skilled in value addition and have market knowledge could have higher likelihood of value addition participation decision. The finding coincides to the finding of Tijani (2018). This indicates that one year increase of value addition experience results 1.3% increases of likelihood of households to participate in milk value addition.

Distance of dairy product market (DSTM): Distance of dairy product market has positive and significant influence on value addition participation intensity at 10% probability level whereas it is associated positively and non-significantly with value addition participation decision. The positive and significant association between two variables revealed that as a household distant from the nearest dairy market, the more milk could be processed at farm level and the products could be delivered to market. This finding coincides with the finding of Tadele *et al.* (2014) but contradict with finding of Embaye (2015). The model result indicates that one km far from dairy product market increases the household's value addition participation intensity by 2.8%. Rational behind is that farmers are more benefited by adding value to milk, instead selling fluid milk daily to distant market.

4. SUMMARY, CONCLUSION AND RECOMMENDATIONS

4.1. Summary and Conclusions

The study was conducted with the objective of analyzing determinants of dairy market participation in North Mecha woreda. The specific objectives were; to analyze the determinants of milk producers' milk supply participation decision and level of participation ; to analyze the determinants of milk producers' value addition participation decision and level of participation. Both formal and informal surveys and market visits were carried out during June 2019 up to end of July 2019.

Primary data were collected from 200 sampled producer households that were randomly selected from purposively selected kebles. Beside formal survey, rapid market appraisal (RMA), focus group discussion, and key informants interview were carried out to dig out qualitative data and triangulate formal survey result. The survey data were analyzed using descriptive statistics, inferential statistics and, econometric tool which was bivariate probit- bivariate tobit model with help of STATA 14 software. The main findings of the study are summarized as follows.

Out of the total sampled households 46 % and 62% of them were participating in raw milk marketing and value addition respectively while the mean raw milk market and value addition participation intensity of sample household was 32.1% and 39.3% respectively. Of the total marketed milk 37% of milk was delivered to national markets. Small scale milk producers who account more than 75% managed their dairy cows in inseparable house. The main source of feed for dairy cows were hay, concentrate and crop residue and the feeding practices was stall feeding system. AI and bull services were the main breeding systems undertaken by producers to improve their cow productivity. Under small holder milk producers' management local and cross cow productivity per day was 2.2 ± 1.1 and 5.8 ± 2.44 liters. Butter, ghee and *metata-ayib* are major milk products processed and sold by smallholder farmers.

The bivariate probit model indicated that age of the household, number of local lactating cows, distance of milk market and household daily milk consumption were found to have negative and significant influence on raw milk supply participation decision of the households. On the contrary, family size, dairy farm experience, daily milk size, and membership of cooperative were found to have positive and significance effect on raw milk supply participation decision of households. Land size and value addition experience were found to have positive and significant influence on value addition participation decision of the households. On the other hand dairy farm experience and membership in dairy cooperatives were found to have negative and significant influence on value addition participation decision of the households.

The bivariate Tobit model indicated land size, household daily milk consumption, and distance of market were found to have negative and significant impact on raw milk supply participation intensity of the household. Milk volume per day, membership of dairy cooperatives and market experience were found to have positive and significant influence on milk supply participation intensity of the household. Land size and distance of market were found to have positive and significance influence on value addition participation intensity of the household. On the contrary, dairy farm experience and cooperative membership were found to have negative and significant influence on value addition participation intensity of the household.

Recommendations

Based on the findings, the study recommends the following interventions and policy implications that are assumed to mitigate the existing market participation problems. Supportive services, credit and saving services, veterinary services system should to be considered to increases dairy production development. Old aged household heads should be educated thorough extension services so as to increase the household dairy farming experience and then the probability of milk supply participation decision. Family size is the source of labor for

dairy marketing implies that stakeholders should intervene or promote labor saving technologies and infrastructure to increase the probability of household head milk supply participation. The policy implication for negative relationship of number of local lactating cows holding and milk market participation is efforts such as improving dairy cow breed and upgrading milk production potential of local cows need to be done to increase the volume of milk yield per day per household. Membership in dairy cooperatives, distance of milk market, and land size of the household and milk market experience are important variables for milk market participation decision and intensity. It is recommended that the government need to increase market access by increasing number of dairy cooperatives, and improving road and infrastructures in the area.

The econometric model results showed that land size, value addition experience, and distance to dairy market had positive relationship with value addition participation. The implication is household head has low access to raw milk market. This suggests that that investing on roads and market infrastructure enable farmers to realize several milk products market alternatives. In addition, offering processing equipment who are far from raw milk marketing are important. On the other hand, cross dairy farm experience and membership in dairy cooperatives are negatively related to value addition participation. This is due to the household head had more cross dairy cows which are preferable by producers to sell raw milk instead of adding value to milk. This study suggests there should be dairy cow breed based mechanisms and interventions in urban and per-urban areas. Livestock extension services and researches need to be intervened on value addition techniques, equipment, and upgrading, in particular relatively small scale milk producers.

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