

*Full Length Research Paper*

# Factors influencing urban and peri-urban dairy producers' participation in milk value addition and volume of milk value added in Welmera Woreda, West Shewa Zone of Oromia Regional State, Ethiopia

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Value addition is currently becoming an important topic in agricultural sector, especially for perishable agricultural products. The aim of this paper was to assess factors influencing urban and peri-urban dairy producers' participation in milk value addition and volume of milk value added (VMVA) in Welmera Woreda. The study employed both primary and secondary data. The primary data were collected by structured questionnaires from 120 urban and peri-urban dairy producers, while the secondary data were gathered from different governmental and non-governmental organizations, from published and unpublished sources. The data were then analyzed using both descriptive (mean and standard deviation) and econometric model. Heckman's two-step econometric model was used to identify factors affecting value addition participation (VAP) and VMVA. The result of the model shows that gender, age and education of household head, market distance, number of local milking cows and quantity of annual milk production affected the probability of participation in value addition positively in the first step. In the second step, sex of household head, income from non-dairy source, distance to market, number of local milking cows and quantity of annual milk production affected the VMVA positively, whereas number of children less than age of 6 years and number of crossbred milking cows had a negative influence on it. The finding implies that paying a special attention to female headed households will have a positive effect in participation in value addition. In addition, expanding rural education and arranging a mechanism for experience sharing among experienced and young farmers would have a positive effect. Better infrastructure and introduction of processing machines are also helpful for selling raw milk and value addition, respectively.

**Key words:** Heckman's two-step, urban, peri-urban, Welmera Woreda, Ethiopia.

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## INTRODUCTION

Value addition can be broadly stated as the process of economically adding values to products (raw commodities) that possess intrinsic value in their original

state by changing their current place, time, and form characteristics to improve their economic value and preferred by consumers in the market place (Coltrain et

al., 2000). According to these authors, the act of value addition can be achieved in two ways.

These are innovation and coordination. Value addition through innovation focuses on improving existing processes, procedures, products, and services or creating new ones, while value addition through coordination involves arranging partnership among the value chain actors that produce and market farm products.

Currently, adding value to agricultural products is becoming important task for several reasons. One of the reasons is the fact that the gap between farm gate value and retail value of farm products is rising indicating that producers are receiving less value than non-value added products. Another reason is the existence of wider gap on the rate of return on equity received by farms and food companies. For instance, as indicated in Coltrain et al. (2000), the average return on equity for food companies was 16%, while the average farm return on equity was zero (0) for the period of 1980 to 1996 in America. This can encourage producers to participate in value addition so as to capture some of the revenues, margins, and related profits that are available between the farm gate and consumers with value-added products. Griffin (2000) also revealed five essential reasons of adding value to agricultural products. These are: increased urbanization and income growth in the developing countries; growing power of supermarkets; concentration in the processing sector; existence of different levels of adding value; increased segmentation of consumption; and changes in eating habits of consumers. Value addition is very important for farmers because it can transform unprofitable agriculture into a profitable one (Fleming, 2005).

Value addition has a particular importance for dairy producers in that it enables processing milk (a perishable commodity) into some less perishable products like butter and local cheese especially where the producers have limited access to raw milk market or where the value of raw milk is economically less than the value of value-added products. The majority of dairy producers in Ethiopia have been participated in milk value addition by changing the form (traditional milk processing) for several years. Most of the milk produced in the country is processed by changing sour milk to butter and local cheese (*ayib*) through traditional methods. This traditional milk processing is practiced in all parts of the country for a long period of time though the type of milk processing equipments and methods vary from place to place (Belete et al., 2010).

Traditional milk processing can be performed using *mesbekia* (a stick having 3 to 6 finger-like projections at one end which is inserted in a clay pot containing sour

milk and rotated using palms of both hands to stir the milk in the other hand) (Belete et al., 2010). It can also be performed using clay pot only. A combination of both methods can also be used for traditional milk processing. The sour milk is stirred for some time with *mesbekia* first and agitated by shaking the sour milk in the clay pot back and forth until the butter is formed (Zelalem and Inger, 2000).

There is a limitation of empirical findings on factors affecting dairy producers' participation in milk value addition and volume of milk value added (VMVA) in Ethiopia. As to our knowledge, the only information available regarding this topic in Ethiopia is the work of Berhanu et al. (2011) which tried to analyzed determinants of participation decisions and level of participation in farm level milk value addition by the smallholder dairy producers of rural Welayta zone farmers of South Nations, Nationalities and People (SNNP) of Ethiopia. However, the scope of this finding was limited to rural smallholders rather than urban and peri-urban farmers.

Hence, the aim of this paper was to assess factors affecting urban and peri-urban dairy producers' participation in milk value addition (traditional milk processing at household level) and the VMVA in Welmera Woreda, West Shewa zone of Oromia regional State of Ethiopia.

## METHODOLOGY

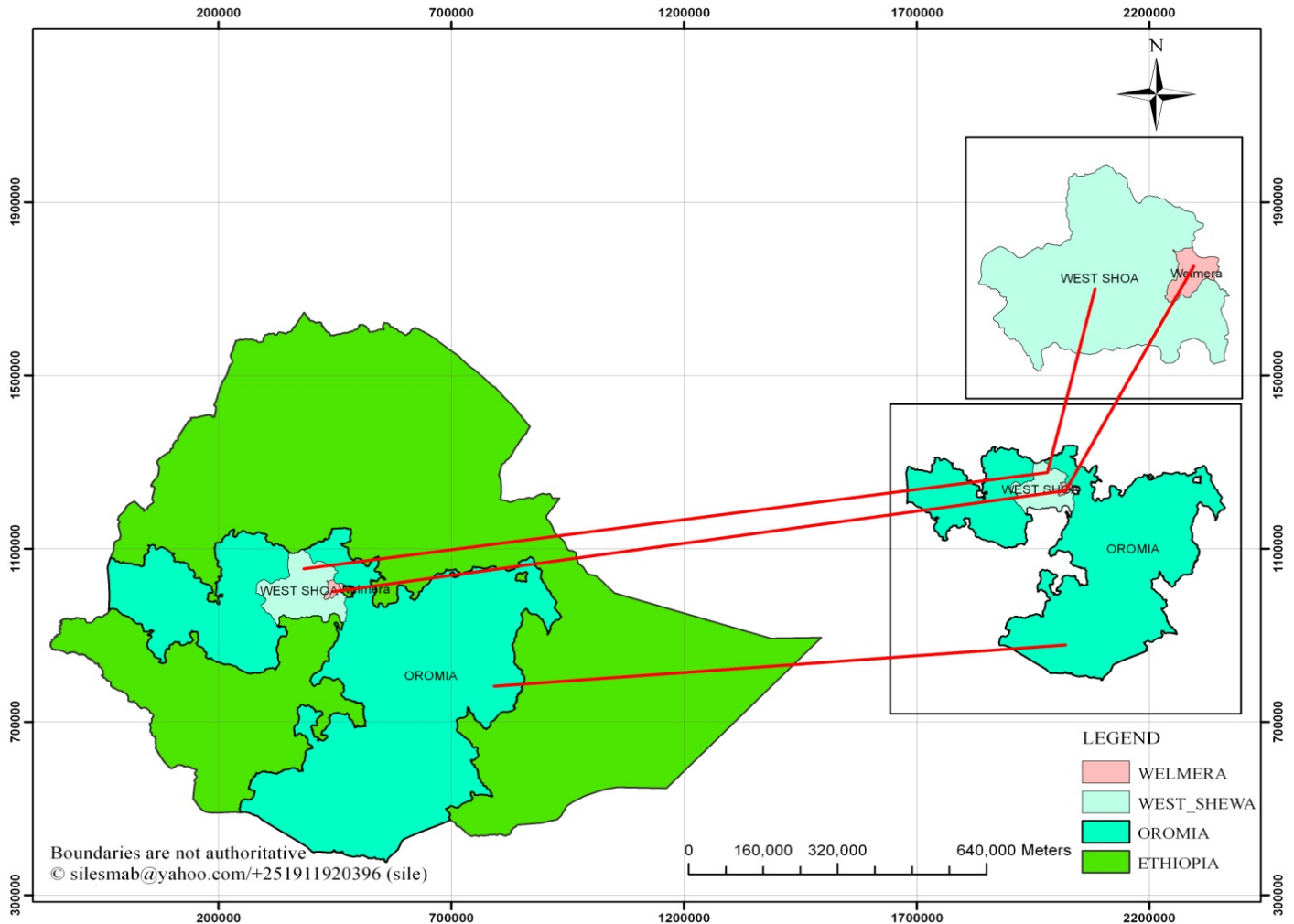
### Description of the study area

The study was conducted in Welmera Woreda (one of the eight Oromia special zones surrounding Addis Ababa but administrated by West Shewa zone). The capital town of the Woreda is Holetta which is located at 40 km West of Addis Ababa on the main road of Addis to Ambo. Geographically, the area ranges 8°50' - 9°15'N and 38°25' - 38°45'E with an area of 775 km<sup>2</sup>. According to Welmera Woreda Agriculture and Rural Development Office (WWARDO) (2010), most of the areas of the Woreda are high lands (*Dega*) and mid highlands (*Weyna Dega*) with an altitude above sea level ranges from 2060 to 3380 m. The area has bimodal rainfall pattern. One is a *belg* rainfall season (usually from December to April) and the other is a summer season (*meher*) which covers months from June to September accounting more than 80% of the annual rainfall. The average, maximum and minimum annual temperature of the area is 24, 27, and 0.1°C, respectively.

Crop-livestock mixed farming is a typical agriculture practice in the area. Livestock production consists of cattle, sheep, goats, equines and poultry. Cattle are kept for dairy and meat. Dairy farm is carried out in the area both in large-scale dairy production system for commercial purpose and in smallholder farming system.

Most of the smallholder dairy farms keep indigenous breeds although some farmers use crossbreeds of *Boran*-Friesian cows, while commercial dairy farms use exotic and crossbred dairy cows. The map of the study area is shown in Figure 1.

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**Figure 1.** Map of Wolmera Woreda.

### **Sampling techniques, types of data, data sources and methods of data collection**

#### ***Sampling techniques and sample size***

A multistage sampling technique was used to determine the sample households. First, the Welmera Woreda was purposively selected based on: its huge potential for dairy production; it is the place where urban and peri-urban dairy production system is widely exercised and, the Woreda is expected to participate in dairy processing and value addition activities as it is located at a near distance to the capital city and hence near for facilities and inputs.

Following the Woreda selection, determining the peri-urban areas to decide on the sample frame was the next task. In this study, peri-urban areas are limited to rural kebeles situated at a periphery of the Holetta town, while urban dairy producers are those who are found in Holetta town. Four peri-urban kebeles were randomly selected. Then, households who own dairy cows were identified from the households list available at each kebele office. Finally, representative samples were selected from each peri-urban kebeles based on probability proportional to size. The specific sample households were selected using systematic random sampling. As a result, 92 peri-urban sample dairy producers were

selected. In addition, two urban dairy producer kebeles were also included. That is, 28 urban dairy producers were randomly selected and included. Based on the above procedure, 120 total sample households were selected.

#### ***Method of data collection***

The primary data collection was done through a pre-tested structured questionnaire prepared for dairy producing farmers using enumerators who are fluent in local language and have got training on the content of the questionnaire and interview techniques with day to day check up and supervision, while the secondary data were collected from different published and unpublished sources.

#### **Data analysis**

Both descriptive analysis and econometric model were used to analyze the data. Descriptive statistics like percentages, means and standard deviations were used to describe the result while t-test, Chi-square test were used to test it. Econometric model (Heckman's two steps) was used to capture factors affecting participation in

value addition and VMVA.

### Specification of Heckman's two-step model

Decision to participate in value addition and VMVA for participants is a two-step procedure. In such a case the Heckman's two-step model (developed by Heckman in 1979) which has a potential of solving a selectivity bias problem is used to analyze factors affecting the participation decision in the first step and the level of participation in the second step.

The first step of the model, 'value addition participation equation' (VAP) attempts to capture factors affecting value addition decision. The selectivity term called 'inverse Mill's ratio' or hazard ratio (which is added to the second step outcome equation that explains factors affecting VMVA) is constructed from the first equation. This ratio is a variable used for controlling bias due to sample selection (Heckman, 1979). The second step involves estimating the outcome equation (VMVA equation) using ordinary least square (OLS). If the coefficient of the Mill's ratio is significant, then the hypothesis that an unobserved selection process governs VAP equation is confirmed. Moreover, including this, extra term (Mill's ratio) makes the coefficient in the second step selectivity corrected equation unbiased (Zaman, 2001).

The Heckman two-step procedures specification can be written in terms of the probability of VAP and VMVA as follows: The VAP equation/the binary probit equation

$$Y_{1i} = X_{1i}\beta_1 + U_{1i} \quad U_{1i} \sim N(0, 1) \quad (1)$$

$$/AP = 1 \text{ if } Y_{1i} > 0 \quad (2)$$

$$/AP = 0 \text{ if } Y_{1i} \leq 0 \quad (3)$$

Where  $Y_{1i}$  is the latent dependent variable (unobserved),  $X_{1i}$  is vectors that are assumed to affect the probability of VAP,  $\beta_1$  is vectors of unknown parameter in VAP equation,  $U_{1i}$  are residuals that are independently and normally distributed with zero mean and constant variance.

The observation equation/the VMVA equation for those participated:

$$VMVA = Y_{2i} = X_{2i}\beta_2 + U_{2i} \quad U_{2i} \sim N(0, \sigma^2) \quad (2)$$

$Y_{2i}$  is observed if and only if VAP = 1. The variance of  $U_{1i}$  is normalized to one because only VAP, not  $Y_{1i}$  is observed. The error terms  $U_{1i}$  and  $U_{2i}$  are assumed to be bivariate, normally distributed with correlation coefficient  $\rho$ , and  $\beta_1$  and  $\beta_2$  are the parameter vectors to be estimated.

$Y_{2i}$  is regressed on explanatory variables,  $X_{2i}$ , and the vector of inverse Mills ratio ( $\lambda_i$ ) is estimated from the selection equation by OLS.  $Y_{2i}$  is the observed dependent variable,  $X_{2i}$  is factors assumed to affect VMVA equation,  $\beta_2$  is vector of unknown parameter in the VMVA equation and  $U_{2i}$  is residuals in the VMVA equation that are independently and normally distributed with mean zero and  $\sigma^2$  variance.

$$\lambda_i = \frac{f(X\beta)}{1 - F(X\beta)} \text{ is the Mill's ratio equation} \quad (3)$$

Where  $f(X\beta)$  is density function and  $1 - F(X\beta)$  is distribution function.

Stata software (Version 9.0) was used for the estimation purpose.

### Hypothesis and variables definition

Both continuous and discrete variables are included and discussed as follows in order to explain dairy producers' probability of participation in value addition and VMVA:

#### Dependent variables

**Value addition participation decision (VAP):** This is a dummy variable that represents the probability of participation of the household in value addition that is regressed in the first stage taking the value of 1 for participants and 0 for non-participants.

**Volume of milk value added (VMVA):** This is continuous dependent variable in the second step of the Heckman model. It is measured in litters and represents the actual volume of milk used in value addition process.

#### Independent variable

**Sex of household head:** This is dummy variable that takes a value of 1 if male and 0 if female. Women contribute more labour input in area of cleaning of barns, milking, value addition and sale of milk and other dairy products. Therefore, in this study, being male household head is expected to affect VAP decision and VMVA negatively.

**Age of household head:** Aged farmers acquire experiences and hence age positively influences the VAP and VMVA. On the other hand, the young are fast to analyze advantages of value addition and hence the inverse relationship. Therefore, it is difficult to decide its sign a priori.

**Education level of household head:** It is hypothesised that educated dairy producers have some knowledge on the importance of value addition and it helps them to increase the amount of value added milk. Therefore, formal education is hypothesized to influence VAP and VMVA positively.

**Family with members aged less than 6 years old:** This is a continuous variable and measured in number of children less than 6 years in a family that are expected to consume milk. Hence, it is hypothesized to have inverse impact on VAP and VMVA.

**Financial income from the non dairy sources (in ETB):** This is continuous variable that represents income generated by any member of a family from different sources other than dairy. This income makes the household to expand production. On the other hand, if the households have a secured non-dairy income sources, they may focus on it and hence decreases their participation in value addition. Thus, it is difficult to priori hypothesize the impact of income from non dairy source.

**Distance to market place:** This is a continuous variable (in km). The closer the dairy market, the lesser would be the transportation charges and loss due to spoilage. In addition, near to market access encourages producers to sell raw milk than processing it and hence discourages value addition. Hence, distance to the alternative market is hypothesized to have inverse effect on value

addition.

**Number of milking cows (crossbred and local breed):** This is a continuous variable measured in number of milking cows owned. The fat content of milk produced from local cows is higher than that of crossbred and exotic cows in Ethiopia. As a result, dairy producers prefer to process this milk into butter and local cheese rather than selling raw milk, while they prefer selling raw milk that produced from crossbred and exotic cows. Hence, it is hypothesised that number of local milking cows has a positive effect on value addition while that of crossbred and exotic cows has a negative effect.

**Size of milk output (measured in liters):** This is a continuous variable that positively influences the participation in value addition and VMVA.

**Access to credit services:** This is a dummy variable that takes value of 1 if there is an access to credit services and 0 otherwise. It is hypothesized to influence VAP positively.

**Access to extension service:** This is as a dummy variable taking a value of 1 if the dairy producers have access to appropriate extension service and 0 otherwise. It is expected that extension service widens the actor's knowledge and has positive impact on VAP and VMVA decision. Holloway and Ehui (2002) identified that extension visit is directly related to dairy household production, value addition and marketing. Hence, access to extension service is hypothesized to positively value addition.

**Access to market information:** Value addition decisions are usually based on market price of value added products information. Therefore, it is hypothesized to affect participation in value addition and VMVA positively.

**Milk collection centres:** This is a dummy variable that takes the value of 1 if traders' and/or cooperatives milk collection centres available in the locality and 0 if none. The availability of milk collection centres create the opportunity to sell the raw milk and hence hypothesized to affect participation in value addition and VMVA negatively. The above variables are summarized in the Table 1.

## RESULTS AND DISCUSSION

### Demographic, socioeconomic and institutional description of sample dairy producers

As shown in Table 2, value addition participants are significantly older; less educated and have fewer children of less than 6 years of age, compared to non-participants. The result shows that the mean age, education level and number of children of participants are 53.5 years, 4.58 years of schooling and 0.49, while that of non-participants are 46.7 years, 6.3 years of schooling and 0.98, respectively. Compared to non-participants, participants are situated at significantly farther distance from market, owned less crossbred cows and more local cows (Table 2). The average distance to the market, number of crossbred cows and local cows of participants are 5.2 km, 0.69 cows and 1.82 cows, whereas that of non-participants are 2.97 km, 1.32 cows and 0.68 cows,

respectively. The result also shows that significantly higher proportion of value addition participants are headed by males ( $\chi^2 = 3.519$ ) and had significantly more access to extension services in 2010 (Table 2).

### Econometric results

The Heckman's two-step model coefficient estimates (for the selection and outcome equations) and marginal effects (for the selection equations) of participation in dairy producers value addition is presented in Table 3. The likelihood function of the model is significant (Wald  $\chi^2 = 1264.34$ ,  $p < 0.0000$ ) indicating strong explanatory powers of the explanatory variables. The coefficient of the Mill's lamda is also significant ( $P = 0.034$ ) showing the presence of self-selection problem and hence justifying the appropriateness of using Heckman's two-step model.

The result indicates that sex, age and education of household head, market distance, number of local milking cows and quantity of annual milk production affected the likelihood of participation in value addition positively. Similarly, sex of household head, income from non dairy source, distance to market, number of local milking cows and quantity of annual milk production affected the VMVA positively, while number of children less than 6 years age and number of crossbred milking cows affected it negatively (Table 3).

Contrary to our expectation, being male head of a household was found to affect both the likelihood of participation in value addition and VMVA positively at 1 and 5% level of significances, respectively. The marginal effect (0.206) shows that keeping other things constant, the probability of participation in value addition of male headed households is higher by 20.6% compared to the female headed households. This might be because males are more mobile and have a chance to collect information on different value added dairy products than selling the raw milk.

As expected, both age (proxy for experience) and education of the household head influenced the likelihood of participation in value addition positively and significantly at 1% significant level each. The marginal effect values show that ceteris paribus, acquiring one additional year of age and a unit increase in year of schooling of a dairy farmer would increase his/her level of participation in value addition by 0.3 and 1.2%, respectively. The results therefore, suggest that expanding rural education and arranging social services to share experience among dairy farmers will have a positive effect in increasing number of farmers who participate in value added products.

The effect of age on value addition contradicts with previous findings (Berhanu et al., 2011; Berem et al., 2010; Kumar, 2010), while the effect of education has been supported by Kumar (2010) but contradicts with



**Table 1.** Variables included in Heckman's two-step model.

Variable	Descriptions	Variable type	Exp. sign
<b>Dependent variables</b>			
VAP	Participation in value addition	Dummy (1 = Yes; 0 = No)	-
VMVA	Volume of milk value added	Continuous (milk in litre)	-
<b>Independent variables</b>			
Sex	Sex of household head	Dummy 1 = male; 0 = female	-
Age	Age of household head	Continuous variable in years	+/-
Education	Education level of household head	Continuous (in school years)	+
Children	Number of children less than 6 years	Continuous (in number)	-
Other income	income from non-dairy sources	Continuous (in ETB)	+/-
Market dist	Distance to market place	Continuous (in km)	+
Local cow	Number of local milking cows	Continuous (in number)	+
Crossbred cow	Number of crossbred milking cows	Continuous (in number)	-
Milk yield	Quantity of annual milk produced	Continuous (in litre)	+
Credit service	Access to credit service	Dummy (1 = Yes; 0 = No)	+
Extension service	Access to extension service	Dummy (1 = Yes; 0 = No)	+
Market info	Access to market information	Dummy (1 = Yes; 0 = No)	+
Coop. Milk CC*	Availability of coop. milk CC	Dummy (1 = Yes; 0 = No)	-
Trader milk CC**	Availability of trader milk CC	Dummy (1 = Yes; 0 = No)	-

\*Cooperative milk collection centres and \*\* Traders' milk collection centres.

**Table 2.** Characteristics of sample households (continuous and discrete variables).

Alternative market outlets	Participants (67)		Non participants (53)		t-values
	Mean	St. Dev.	Mean	St. Dev.	
Age of HH head (mean year)	53.51	14.764	46.7	15.622	-2.45**
Education of HH head ( school year)	4.58	4.415	6.30	4.331	2.14**
Number of children less than 6years	0.49	0.704	0.98	0.866	3.409***
Non dairy farm income (ETB)	22067	88740	20337	39149	-0.132
Distance to market (mean in Km)	5.2119	2.336	2.971	2.125	-5.429***
Milking cross breed cows (number)	0.69	1.520	1.32	1.156	2.515**
Milking Local cows(number)	1.82	1.086	0.68	0.956	-6.024***
Total annual milk production (L)	2137	4222	2324	1984	0.297

	Participants (67)	Non-participants (53)	Total (120)	$\chi^2$
Sex of HH Head (male)	62 (92.5)	43 (81.1)	105 (87.5)	3.519*
Sex of HH Head (female)	5 (7.5)	10 (18.9)	15 (12.5)	
Access to formal credit (Yes)	6 (9.0)	6 (11.3)	12 (10.0)	0.184
Access to formal credit (No)	61 (81.0)	47 (88.7)	108 (90.0)	
Access to extension service (Yes)	38 (56.7)	16 (30.2)	54 (45.0)	8.41***
Access to extension service (No)	29 (43.3)	37 (69.8)	66 (55.0)	
Access to market information (Yes)	52 (77.6)	44 (83.0)	96 (80.0)	0.541
Access to market information (No)	15 (22.4)	9 (17.0)	24 (20.0)	

Source: Own survey data (2011); \*, \*\*and\*\*\*indicate significant difference at 10, 5 and 1% probability levels, respectively. Numbers in the bracket are percent of the sample households.

Berhanu et al. (2011).

As expected, the number of children less than six years age affected the VMVA negatively at 1% level of

significance. This is due to the fact that children below this age consume milk and hence reduce the VMVA Berhanu et al. (2011) finding contradicts with this result

**Table 3.** Estimation result of the Heckman's two-steps on the likelihoods of value addition participation and intensity of milk value added (litre/year).

Variable	Probability of participation in VAP			Intensity of milk value added	
	Coefficient	p-level	Marg. Eff.	Coefficient	p-level
<b>Constant</b>					
Sex of head	0.307***	0.000	0.206	-3.524***	0.005
Age of head	0.005***	0.000	0.003	1.002**	0.049
Education of head	0.017***	0.005	0.012	0.021	0.112
Children	-0.007	0.854	0.057	0.060	0.222
Other income	0.001	0.148	0.001	-0.719***	0.002
Market distance	0.037***	0.003	0.011	0.001**	0.041
Crossbred cows	-0.052	0.353	0.034	0.297***	0.007
Local cows	0.064**	0.013	0.004	-0.958**	0.022
Milk yield	0.001**	0.046	0.001	0.671***	0.003
Credit service	-0.012	0.895	0.049	0.001***	0.003
Extension service	-0.001	0.979	-0.023	-0.621	0.431
Market info.	-0.056	0.352	-0.032	0.245	0.533
Coop.milk CC	-0.126	0.318	-0.125	-0.285	0.529
Trader milk CC	-0.114	0.351	-0.052	-0.008	0.991
Total observation	120			-0.664	0.291
Censored	52				
Uncensored	68				
Mills lamda	Z = 2.14**	P < 0.034			
Wald $\chi^2 = 1264.34$	Prob > $\chi^2 =$	0.0000			

Source: Own estimation result. \*\*\*and\*\* means significant at 1 and 5% probability levels, respectively.

and with their prior expectation.

Non-dairy income sources influenced the intensity of milk value added positively and significantly at 5% level of significance. The result implies that having a sound non dairy income source enhances the level of value addition because it helps the producers to purchase inputs and increases milk production and hence the VMVA.

In line with our expectation, market distance from a household home affected both the probability of participation in value addition and the VMVA positively and significantly at 1% level of significance each. The nearer the dairy farmer to the milk market, the less he/she participate in value addition and VMVA. The result is in line with Berhanu et al. (2011). This implies that less access to raw milk market enforces the dairy producers to add values and sell butter and cheese whether or not it is profitable. This suggests that investing in infrastructures like rural road enables farmers to realize several market and product marketing alternatives. It is also important that availing improved milk processing equipments for farmers who are far from raw milk market.

Another important factor affected value addition is the breed type. Keeping more local breeds had a significant positive impact both on the likelihood of VAP and the VMVA, while owning more crossbreds influenced the VMVA negatively and significantly. This might be because

local breeds are better in producing milk with high fat content than crossbreds and hence high production of butter and cheese per liter of milk.

The quantity of milk produced annually, as expected, influenced both the chance of participation in value addition and the VMVA positively and significantly at 5 and 1% level of significances, respectively. The marginal effect shows that increasing annual milk production by a litre would raise the chance of dairy producer participation in value addition by 0.1%. The result of Wanyama et al. (2013) supports this finding, while Berhanu et al. (2011) found the opposite result.

## CONCLUSION AND RECOMMENDATION

The result indicate that male headed households are in a better position in adding values in milk as compared to the female headed implying that paying attention to female headed households to enable them in realizing the importance of value addition. This can be improved by participating them in different training on value addition. Age and education of the household head influenced the likelihood of participation in value addition positively. Therefore, expanding rural education and arranging social events to share experience among dairy farmers should be encouraged to enhance value addition. Non-dairy income

sources influenced the intensity of milk value added positively implying that having a sound non-dairy income source enhances the level of value addition. Therefore, diversifying income sources should be focused on by dairy producers.

The result also indicates that market distance from the dairy producers influenced both the participation in and level of milk value added implying that less access to raw milk market enforces the dairy producers to add values and sell butter and cheese whether or not it is profitable. This suggests that investing in infrastructures like rural roads enables farmers to realize several market and product marketing alternatives. It also implies that availing improved milk processing equipments for farmers who are far from raw milk market is very important.

Keeping more local breeds and quantity of milk produced annually had a positive impact on both the likelihood of VAP and the VMVA, while owning more crossbreds influenced the VMVA negatively. Therefore, processing milk produced from local cows into butter and cheese should be exercised by dairy producers. However, for milk produced from crossbreed cows, there should be a mechanism to sell the raw milk because farmers are reluctant to add value to it.

### Conflict of interest

The author(s) have not declared any conflict of interests.

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