Factors Affecting Milk Market Participation in Bahir Dar Milk Shed area, Amhara National Regional State, Ethiopia

Mesfin Bahta1*, Lemma Zemedu 2, and Berhanu Gebremedhin 3

1 Sirinka Agricultural Research Center (SARC), Amhara Agricultural Research Institute, 2 Debrezeit Agricultural Research Center, 3 University of Dallas, Texas, U.S.A. *Corresponding Author, Email: <u>mebag2@yahoo.com</u>

Abstract

The study was conducted in Bahir Dar milk shed area of Amhara National Regional State (ANRS) in Ethiopia during 2017 to identify determinants for milk market participation and level of participation of dairy producers. Using the multistage sampling technique primary data was collected directly from 160 dairy cow producer households. Descriptive statistics and Heckman two-stage econometric model were used for analysis. In the first step of Heckman two-stage, Milk Market Participation (MMP) of dairy producers was estimated. Among the fourteen explanatory variables used, price of milk in kebele, access of the respondent to marketing information, total land holding size, membership to dairy cooperatives affected positively and significantly while sex of the respondent affected negatively and significantly the milk marketing participation decision of the dairy producers. Determinants of volume of milk marketed (VMM) was estimated in the Second-Stage of Heckman selection estimation procedure. Education level of the household head, experience in dairy farming, and livestock size excluding dairy cows affected positively and significantly while sex of the respondent, household size, total land holding size and access to credit affected negatively and significantly the VMM. Based on the findings of this study, marketing information should be available to dairy producers to increase marketing participation and commercialization in dairy marketing. Emphasis should also be given to increase cooperative membership and boost education level of the dairy producers to improve the milk market participation.

Keyword: Dairy marketing, Heckman two stage, Market participation

Introduction

Ethiopia, with a total area of about 1.1 million square kilometers (ESS, 2012), and a population of about 120 million people, is an agrarian country comprising crop and livestock production. The agriculture sector accounts for 32.4 % of national GDP (NBE, 2022). The sector also contributes about 80% of foreign export earning, and provides about 65.62% of employment opportunities (ATA, 2021).

Ethiopia is believed to be home for the largest livestock population in Africa and the tenth in the world (ESS, 2021). There are about 66.26 million cattle, 38.01 million sheep, 45.72 million goats, 10.02 million donkeys, 2.14 million horses, 0.36 million mules, 6.9 million camels, 41.35 million poultry, and 5.98 million hives in the sedentary and pastoral rural areas of the country excluding large scale dairy

farms, fattening owned by investors, cooperatives and other institutions, and urban area livestock numbers (ESS, 2022).

Despite this huge amount of livestock, the country did not benefited from these resources and its share to the overall agricultural gross production is decreasing due to many reasons in which inadequate resources, lack of suitable institutions, technological problems, inappropriate development policies, and lack of proper government concern are among the major factors for the poor performance of the sector (Aleme and Lemma, 2015, Belay *et. al.*, 2021). According to Ethiopian Economic Association (EEA, 2015), livestock sub-sector contributed only 25.3% to the agricultural GDP and 9.1% to the total GDP in 2016/17 agricultural year. The contribution of the livestock industry to the country's total exports is also low compared to its potential mainly due to underdevelopment and lack of market oriented production, lack of adequate information on livestock resources, inadequate permanent animal route and other facilities like water and holding grounds, lack of provision of transport, inadequate infrastructural and institutional set-ups, prevalence of diseases, illegal trade and inadequate market information (Belachew and Jemberu, 2003).

Ethiopia has high potential for dairy development because of its large livestock population and favorable climate for improved high yielding breeds. However, productivity of both milk and milk product is low. The average daily milk productivity, for instance, for Ethiopia is 1.35 liters for local cow. The country produced 3.3 billion liters of milk in 2011/12, which have worth of \$1.2 billion and imported an additional worth of \$10.6 million of dairy products (FAO, 2011).

There is wide opportunity in milk production and marketing due to the favorable environmental conditions and increased demand for milk and milk products in big cities in the country in general and Bahir Dar in particular. Despite the huge potential of milk production and importance of dairy marketing, the existing situation and problem with dairy marketing have not yet studied in the area so far. Thus, finding the gap in the dairy marketing and directing favorable marketing environment that can accommodate increased supply and demand and satisfy both the producers and other actors need emphasis. Hence, this study is aimed to identify factors affecting the milk market participation in Bahir Dar Milk Shed area in the Amhara National Regional State (ANRS).

Methodology

Description of the Study Area

The study was conducted in Bahir Dar milk Shed area which includes Bair Dar city (Bahir Dar Liyu Zone), Bahir Dar Zuria and Mecha districts in West Gojam of Amhara National Regional State (ANRS). ANRS is one of the nine Regional States



in Ethiopia and is endowed with about 42,337,722 livestock population accounting over 16.86 % of total livestock population of the country (ESS, 2021).

Figure 1. Map of the study areas

Data type, source and sampling technique

Qualitative and quantitative cross sectional primary and secondary data were used for this study. Primary data was collected directly from dairy cow producer households, milk and butter traders, milk cooperatives, processors, cafes/restaurants/ hotels, and individual consumers. Data were also collected from key informants and focus group discussions. Secondary data were collected from different sources such as Ethiopian Statistical Service (ESS); Bureau of Agriculture and Rural Development; and Livestock Agencies.

Multistage sampling technique was used for the study. In the 1^{st} stage, three districts (Bahir Dar Zuria, Bahir Dar City, and Mecha districts) within Bahir Dar Milk Shed area were selected purposively based on their milk production potential. In the 2^{nd} stage, 2 kebeles were randomly selected from the selected potential kebeles in each district hence a total of 6 kebeles were selected. In the 3^{rd} stage, households who have dairy cows were listed from each kebele and were randomly and proportionally selected for the study. Sample size for the dairy producer households was

determined using Yamane (1973) simplified formula for sample size determination, i.e.

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

Where: n = sample size,

N = total population (total dairy producer households=2573)

e = the level of precision

Totally, 160 dairy producer households were used for the study.

Name of sample districts	Name of sample kebeles	Total number of dairy producers per kebele	Number of Sampled dairy producers per kebele
Padir Dar Zuria	Huletu Yigoma	650	40
Bauli Dai Zulia	Sebat Amit	630	39
Dahia Dan Citu	Shimbit (Kebele 13)	300	19
Dahir Dai City	Ginbot Haya (Kebele 14)	153	10
Mecha	Bachima	390	24
	Enamrit	450	28
	Total	2573	160

Table 1. Sample size distribution in the sampled kebeles

Method of Data Analysis

Descriptive Analysis

The descriptive analysis includes mean, standard deviation, percentage, and frequency distribution to compare the demographic, socio economics and institutional characteristics of the dairy household.

Econometric Analysis

Heckman Two-Stage econometric estimation procedure was employed since two decisions (i.e. the participation in milk marketing and intensity of participation) are to be estimated.

The binary dependent variables in this study are whether the dairy producer sells milk or not (Market Participation behavior).

 $\Pr(\mathbf{y} = 1 | \mathbf{x}) = \int_{-\infty}^{x'\beta} \phi(t) dt = \phi(x'\beta).$ (1) Where:

Pr(y) = the probability that the dummy response variable takes 1

x = is a vector of explanatory variables

 β = is a vector of coefficient parameters

 ϕ = (.) represents the standard normal distribution function

Given the specification in equation (1), calculating the marginal effect of x on the expected probability (y) is:

Where $\phi()$ is the standard normal density function. In case of dummy explanatory variables, the marginal effect is simply the change in the expected probability, evaluated at the mean values of the remaining independent variables, when the dummy variable changes from 0 to 1(Sykuta, 2008).

Heckman Two-Stage Econometric estimation procedure

If two decisions are to be estimated such as the participation in milk marketing and intensity of participation, (Heckman, 1979) two-step estimation is the appropriate method for the analysis. Heckman two-stage econometric estimation procedure has two steps. The first step is the participation equation which indicates the probability of Milk Market Participation (MMP) by capturing factors affecting the market participation decision using the Probit Model. In the second stage of the Heckman two-stage procedure, the intensity of volume of milk marketed is estimated based on conditional on their first decision. In the second stage of the Heckman procedure, an additional variable called the Inverse Mills Ratio (IMR) calculated from the Probit model is added to the model of the extent of participation to adjust the selection bias.

Model specification:

Based on the two steps, specification of the Heckman two-step procedure has the following equations:

The Milk Market Participation (MMP) Equation:

It is a Binary Probit Model equation:

Yi = xi βi + εi, i=1,...,n
Where Y_i is a dummy variable indicating the milk market participation (Yi=1 if Yi>0, otherwise Yi=0)
β_i are the variables that determine market participation X_i is unknown parameter to be estimated in the Probit Model

 \mathcal{E}_i is random error term

The Volume of Milk Marketed (VMM) or Supply Equation

 $Yi = xi \beta i + \mu \lambda i + \eta_i$ (4) Where: *Y*i is the volume of milk marketed in the second step β_i are the explanatory variables determining the quantity of supply x_i is unknown parameters to be estimated in the quantity supply μ is a parameter that shows the impact of participation on the quantity supply η_i is the error term

Hypothesis and Definition of Variables

Dependent Variables used in the Econometric Models

Milk Market Participation (MMP): This is a dependent variable in the first step of the Heckman two-stage econometric estimation procedure and indicates whether the dairy producer participates in milk selling or not. It is a dummy variable that takes a value of 1 if the dairy producer sells milk, 0 otherwise.

Volume of Milk Marketed (VMM): This is dependent variable in the second stage of the Heckman two-stage econometric estimation procedure. It indicates the volume of milk in liters per day marketed by the dairy producers.

Independent Variables used in the Econometric Models

Based on different empirical studies and economic theories, definitions of the independent variables that were hypothesized to affect potentially the decision of participation in milk marketing and volume of milk marketed of dairy producer household are described and hypothesized in Table 2 below.

			Expected sign in each model		
Variable Description	Туре	Values	Milk market participation	Volume of milk marketed	
Sex of the respondent (SER)	Dummy	0=Female, 1=Male	+ve	-ve	
Age of the household head (AGEH)	Continuous	In years	-ve	+ve	
Education level of the household head (EDUC)	Categorical	Level of education	+ve	+ve	
Household size (HSIZE)	Continuous	In adult equivalent	-ve	-ve	
Experience in dairy farming (EXPDAIRY)	Continuous	In years	+ve	+ve	
Price of milk in kebele (PMILKK)	Continuous	In Birr	+ve	+ve	
Non/off farm income (NFINC)	Dummy	0= No, 1=Yes	+ve	-ve	
Household access to marketing information (ACCINF)	Dummy	0=No, 1=Yes	+ve	+ve	
Livestock size excluding dairy cows (LSEXD)	Continuous	In TLU	+ve	+ve	
Total land holding (TLAND)	Continuous	In hectares	+ve/-ve	+/-	
Membership to milk cooperative (MRCOOP)	Dummy	0=No, 1=Yes	+ve	-	
Access to credit (MRCOOP)	Dummy	0=No, 1=Yes	+ve	-ve	
Distance to nearest milk market (DISTNMKT)	Continuous	In kilometers	-ve	-ve	
Contact with livestock extension agent (CONLEX)	Dummy	0=No, 1=Yes	+ve	+ve	

Table 2. The independent variables used in the econometric models for milk market participation and volume of milk marketed

Results and Discussion

Descriptive Analysis

Socio-economic, demographic, and Institutional Characteristics of Sample Households

Out of the total sample respondents, 86.2% were male-headed and 13.8% were female headed households. Among the male household heads, 101 (73.2%) of them have participated in milk marketing whereas out of the total female household heads, 20 (90.9%) were participated in milk selling. The chi-square test showed that there was a significant difference at 10% probability level among the two groups on their milk market participation (Table 3).

More than, 45.6% of them were literates and as it is indicated from the table below, there is significant difference between the literate and the illiterate on their milk market participation. A chi-square comparison has indicated that there was a systematic association in education level and milk market participation with a chi-square value of 10.28 at 5% probability level.

Variable	Description	Non- participants		Participants		Total		χ ² -value
		N	%	Ν	%	Ν	%	
Sex	Female	2	9.1	20	90.9	22	13.75	3.23*
	Male	37	26.8	101	73.2	138	86.25	
Education	Illiterate	28	71.8	59	48.8	87	54.4	
	From grade 1-4	8	20.5	22	18.2	30	18.7	
	From grade 5-8	2	5.1	22	18.2	24	15.0	10.29**
	From grade 9-10	1	2.6	10	8.3	11	6.9	
	Above grade 10	0	0.0	8	6.6	8	5.0	

Table 3. Sex and education level of sample dairy producers by milk market participation

**, and * are significant at 5% and 10% significance level.

The mean age of the respondents was 43.13 years with a standard deviation of 11.47. An independent t-test has showed a significant difference in mean of age among the milk market participants and non-participants with 10% probability level. The sampled dairy producers have a mean household size of 4.97 adult equivalents. The experience in dairy farming of the sample dairy producers ranges from 1 up to 40 years with a mean of 17.69 years and has a significant difference at 10% probability level among milk market participants and non-participants.

The dairy producers in the sampled sites possess an average land size of 1.34 hectares ranging from 0 to 4 hectares. The average land size is greater than the regional and the national average land holding which is 1.13 ha and 0.92 ha respectively (ESS, 2022). The livestock size the household has measured in Tropical Livestock Unit (TLU that is equivalent to 250 kg) in the study area ranges from 0.75

TLU to 30.72 TLU with a mean of 6.51 TLU showing significant difference at 5% probability level between milk market participants and non-participants.

The sample respondents in the study area produce different amount of milk either for purpose of consumption at home or for sale or for both consumption and sale. An independent sample t-test comparison showed that market participants were superior in milk production than non-participants with significant difference at 1% significance level

Among the total sample dairy producer households, 69.4% of them use family labor to perform their dairy farming activities while only 1.9% of them use hired labor. The rest 28.7% of the sample dairy producers use both family labor and hired labor for dairy farming activities. The chi-square-test showed that there was significant difference in source of labor for dairy farming activities between the milk market participants and non-participants at 1% probability level.

Out of the dairy producers who have access to market information, 84 (88.42%) of them had participated in milk marketing whereas among the respondents who have no market information, only 37 (56.9%) of them were participated in milk marketing. The chi-square test comparison for the association of marketing information and milk market participation showed that there was significant difference in access to marketing information between the milk participants and non-participants at a significance level of 1%.

Econometric Analysis

Determinants of Milk Market Participation

In the analysis of Milk Market Participation, fourteen explanatory variables were used to estimate the milk market participation decision of the dairy producer households using the Probit Model (Table 4). The likelihood Ratio (LR) indicated by Chi^2 statistics was highly significant (p<0.0000) and this indicates that the model has strong explanatory power. The Pseudo R² was 0.44 confirming the model specification fits the data well. Out of the explanatory variables used, five of them significantly affected the participation of dairy producers in milk marketing.

Sex of the Respondent (SER): Being male affected the milk market participation negatively and significantly at 1% significance level. This is in contrary to the prior expectation. This might be due to the fact that male headed households may not need to sell milk instead they use other alternatives such as crop production as a main income generating activities while female headed dairy producers use milk as a means of income for other home consumption needs. Most women tend to keep dairy animals and other livestock such as poultry and shoat and their contribution in management of livestock such as feeding, cleaning of shelters, milking and others

is high. The marginal effect indicates that, being male decreases the probability of milk market participation by 10.6%.

Price of Milk in Kebele (PMILKK): As the prior expectation, it affected milk market participation positively and significantly at 1% significance level. As the price of milk increases, the producers are encouraged to sell milk because of the high price incentive. The results of the marginal effect confirms that as the average milk price in kebele increases by one Birr, the probability of dairy producer to participate in milk marketing increases by 14.8%. This is in line with the finding of Kurgat et. al., (2021).

Total Land Holding Size (TLAND): This variable affected the probability of market participation positively and significantly at 1% significance level. As the dairy producer owns more land, he allocates land to forage production to increase his/her milk production and this increase in milk production leads to the decision to sell milk. The marginal effect result indicated that as the land holding size increased by one hectare, the probability to participate in milk selling increased by 10.5%. But this is contrary with the findings of (Berhanu *et.al.*, 2014) in their study on factors affecting milk market participation in which they found that total land affected negatively the milk market participation of dairy producers. It is also contrary with the findings of smallholder farmers' participation in Zambian dairy sector's interlocked contractual arrangements.

Household Access to Marketing Information (ACCINF): As expected, this dummy variable affected the milk market participation positively and significantly at 1% significance level. The marginal effect results show that, keeping other factors constant, having access to market information increases the probability of market participation by 15.7%. This is in line with the findings of Kiwanuka & Machethe (2016), Chamboko et al., (2017), Girmay *et. al.*, (2020), and Kena *et al.*, (2022). Similarly, Jari & Fraser (2014) have also found that households are most likely to increase participation in both formal and informal markets with the availability of market information.

Membership to Milk Cooperative (MRCOOP): As of its prior expectation, being a member to milk cooperative has increased the probability of market participation positively and significantly at 1% significance level. As the dairy producer become a member to milk cooperative, keeping other factors constant, the probability of milk market participation increases by 25.8%. This is in line with the findings of (Kena *et al.*, 2022).

Table 4. Factors affecting milk market participation

		Robust		Marginal	
variables	Coef.	Std. Err	P> z	Effect	
Constant	-7.940	2.435	0.001		
Sex of the Respondent	-1.251***	0.459	0.006	-0.106	
Age of the household head	-0.023	0.016	0.151	-0.003	
Education level of the household head	0.226	0.158	0.153	0.035	
Household size	-0.003	0.127	0.981	0.000	
Experience in dairy farming	0.000	0.018	0.995	0.000	
Non/off farm income	-0.144	0.315	0.646	-0.023	
Livestock size excluding dairy cows	0.148	0.087	0.089	0.023	
Price of milk in kebele	0.964***	0.260	0.000	0.148	
Total land holding size	0.684***	0.213	0.001	0.105	
Access to marketing information	0.895***	0.325	0.006	0.157	
Membership to milk cooperative	1.808***	0.476	0.000	0.258	
Access to credit	-0.525	0.547	0.337	-0.059	
Distance to nearest milk market	0.030	0.054	0.578	0.005	
Contact with livestock extension agent	-0.379	0.333	0.256	-0.050	
Number of obs =160; LR chi ² (14) = 45.35; Pro > chi ² = 0.0000; Log pseudo likelihood = -49.451516 ; Pseudo R ² =					

0.4435; *** = Statistically significant at 1% significance level

Determinants of Volume of Milk Marketed

The determinant variables for volume of milk marketed are indicated in the Second-Stage Heckman Selection Estimation procedure. The reported model output chi² test (Wald test) is 42.90 and is significant at 1% significance level. Results of the second-stage Heckman selection estimation indicated that among the thirteen explanatory variables used in the model, seven variables affected significantly the volume of milk marketed (Table 5).

Sex of the dairy producer (SER): As it was expected, this dummy variable affects the volume of milk marketed negatively and significantly at 5% significance level. As the econometric result shows, being male decreases the volume of milk marketed by 3.63 liters. This may be due to the fact that male headed households prefer to consume milk but are likely to sell other commodities like grains while female headed households may need to sell more milk and milk products to cover their financial needs.

Education Level of the Household Head (EDUC): As it was expected, this variable affects the volume of milk marketed positively and significantly at 5% significance level. As the household head moves to next education level, the volume of milk marketed increases by 1.07 liters. This might be due to the reason that increasing education status creates awareness of the benefits of selling livestock products and increases the way to commercialization of smallholder farmers. This finding is in line with the findings of Kiwanuka & Machethe (2016) and Kena *et. al.*, (2022) in their study on the determinants of smallholder farmers' participation in Zambian dairy sector's interlocked contractual arrangements.

Household Size (HSIZE): This variable represents the number of people living in the same house within the household and share living and is measured in adult equivalent. As the prior expectation, it affects the volume of milk marketed negatively and significantly at 5% significance level. As the household size increases by one adult equivalent, the volume of milk sold to the market decreases by 1.03 liters. This may be due to the fact that increased number of household members need additional food especially during the childhood age is highly associated with high milk consumption. This depicts that the larger household size, the more volume of milk required for domestic consumption especially for children and reduces the amount of milk to be marketed. This finding is in line with the findings of Berhanu *et.al*, (2014), Berhanu and Moti (2010), and Girmay *et. al.*, (2020).

Experience in Dairy Farming (EXPDAIRY): As it was expected, this variable affects the volume of milk marketed positively and significantly at 5% significance level. As the dairy producer gets more experience in dairy farming, She/ he creates awareness on the allocation of the product and look for other alternatives such as selling of milk, hence this in turn increases the volume of milk produced to sell to the market. The model result revealed that as the experience in dairy farming increases by one year, the volume of milk marketed increases by 0.2 liter. This finding is consistent with the findings of Berhanu *et.al.*, 2014).

Livestock size excluding Dairy Cows (LSEXD): As the prior expectation, this variable affects the volume of milk marketed positively and significantly at 10% significance level. As the number of livestock excluding dairy cows increase by 1 TLU, the volume of milk to be marketed increases by 0.42 liters. This may because that as the number of other livestock increases, the income generated from these livestock increases and this increased income may be used to purchase additional dairy cows. Hence, this in turn enhances to sell additional volume of milk to the market.

Total land holding Size (TLAND): It affects the volume of milk marketed negatively and significantly at 5% significance level. As the total land holding size of the household increases by one hectare, the volume of milk marketed decreases by 1.4 liters. This could be because households with more land holding tend to produce more crops and enjoy high income from these agricultural products and decrease their focus on dairy farming. This in turn decreases the sale of milk to markets. This finding is contrary with the finding of Chamboko *et al.*, (2017) and Kena *et al.*, (2022) which stated that increasing land size increases the sale of milk.

Access to Credit (ACREDIT): As its prior expectation, the household access to credit decreased the volume of milk marketed negatively and significantly at 5% significance level. As the dairy producer gets access to credit, the volume of milk

marketed decreases by 4.2 liters. This could be because the dairy producer may use this credit to cover some financial needs and then he may reduce the volume of milk to be sold. This is in line with the finding of Kurgat *et. al.*, (2021).

Inverse Mill's Ratio (lambda): As it is observed from the Heckman two-stage estimation, the Inverse Mill's Ration (lambda) is significant at 5% significance level. This indicates the existence of sample selection bias, that is, the existence of some unobservable variables affecting the likelihood to participate in milk market and thereby affecting volume of milk supply to market. The estimation result rejects the null hypothesis of H₀: $\rho = 0$. The Rho (ρ) = -0.82is significant and this indicates the correlation among the two equations (the outcome equation and the selection equation). The unobserved variables affect the milk market participation and then affect the volume of milk marketed.

Variables	Coef.	Std. Err	P> z		
Constant	17.230	7.100	0.015		
Sex of the respondent	-3.629**	1.677	0.030		
Age of the household head	0.094	0.063	0.135		
Education level of the household head	1.072**	0.494	0.030		
Household size	-1.034**	0.472	0.029		
Experience in dairy farming	0.165**	0.077	0.032		
Non/off farm income	-1.712	1.219	0.160		
Livestock size excluding dairy cows	0.417*	0.222	0.061		
Price of milk in kebele	-0.394	0.609	0.517		
Total land holding	-1.401**	0.705	0.047		
Household access to marketing information	1.740	1.529	0.255		
Access to credit	-4.225**	2.021	0.037		
Distance to nearest milk market	-0.222	0.198	0.263		
Contact with livestock extension agent	-0.245	1.441	0.865		
Inverse Mills Ratio (Lambda)	-5.044**	2.049	0.014		
Rho = -0.822; Sigma = 6.139; Number of obs =121; Wald chi ² (13) = 42.90; Prob > chi ² = 0.0000; ** and *:					
Statistically significant at 5% and 10% significance level respectively.					

Table 5. Second-stage Heckman selection estimation for factors affecting volume of milk marketed

Conclusion and Recommendations

Conclusion

The main purpose of the study was to estimate milk market participation and level of participation of dairy producers in Bahir Dar milk shed area. The descriptive part of the study revealed that sample selected milk market participants as compared with non-participants were characterized by their education level, resource ownership, volume of milk produced and livestock size. Access to different institutions including access to market information, and distance to nearest milk market were also found to be associated with sampled milk market participants.

Econometric analysis revealed that price of milk in kebele, access of the respondent to marketing information, total land holding size of the dairy producer, and membership to dairy cooperatives positively and significantly affected the milk market participation of the dairy producers whereas sex of the respondent negatively and significantly affected the Milk Market Participation decision. Education level of the household head, experience in dairy farming, and livestock size excluding dairy cows were found to affect the volume of milk marketed positively and significantly whereas sex of the respondent, household size, total land holding size and access to credit affected negatively and significantly the Volume of Milk Marketed.

Recommendations

The model result showed that access to market information positively and significantly affected the probability to participate in milk marketing. This implies information flows focusing milk market demand and price should be available to dairy producers to increase marketing participation and commercialization in dairy marketing.

Membership to milk cooperative was also associated with market participation and this implies that emphasis should be given to either establish dairy cooperatives or strengthen and capacitate the existing cooperatives so as to increase milk market participation.

The model result revealed that education level of the dairy producer positively and significantly affected the volume of milk marketed. This implies that increasing education level or giving short-term training creates awareness of benefits from selling and this leads to creating commercialized communities. Hence, focus should be given towards expanding education institutions and/or training dairy producers.

Being male has decreased the volume of milk marketed implying that, in addition to the female dairy producers, emphasis should be given to male dairy producers focusing the advantage of selling milk to increase volume of milk to be marketed.

Total land holding size negatively and significantly affected the volume of milk marketed. This implies that as the total land of the dairy producer increases, the dairy producer may shift the land to other agricultural activities such as crop production by giving less focus to milk production and marketing. Therefore, in addition to give more focus on the dairy producer households who have small land to increase their dairy business by increasing milk productivity per given area of land like intensive production systems, emphasis should be given to encourage the dairy producer households who have large land size to allocate land to dairy production so as to increase volume of milk to be marketed.

Acknowledgments

The authors greatly acknowledge the Livestock and irrigation value chains for Ethiopian Smallholders (LIVES) project for funding this research work.

References

- Aleme Asresie. Lemma. Zemedu. (2015). Contribution of Livestock Sector in Ethiopian Economy : A Review. Advances in Life Sciences and Technology, 29, 79–91.
- ATA. (2014). Transforming Agriculture in Ethiopia, 2013/14 Annual report.
- Belachew Hurrissa and Jemberu Eshetu. (2003). Challenges and Opportunities of Livestock Marketing in Ethiopia. In Y. Jobre & and G. Gebru (Eds.), *Proceedings of the 10th annual conference of the Ethiopian Society of Animal Production (ESAP) held in Addis Ababa*, *Ethiopia, August 21-23, 2003* (pp. 1–405). ESAP.
- Berhanu, K., Derek, B., Kindie, G., & Belay, K. (2014). Factors Affecting Milk Market Participation and volume of supply in Etiopia. Asian Journal of Rural Development, 4(1), 1–15. https://hdl.handle.net/20.500.11766/5266
- Berhanu Gebremedhin and Moti Jaleta. (2010). Commercialization of smallholders: Does market orientation translate into market participation? Improving Productivity and Market Success (IPMS) of Ethiopian farmers project Working Paper 22. In *ILRI (International Livestock Research Institute)* (22; 22, Issue 22).
- Chamboko, T., Mwakiwa, E., & Mugabe, P. H. (2017). Determinants of Milk Market Participation and Volume of Sales to Milk Collection Centres of the Smallholder Dairy Value Chain in Zimbabwe. *Journal of Agricultural Science*, 9(10), 12. https://doi.org/10.5539/jas.v9n10p156
- EEA (Ethiopian Economic Association). (2015). Report on the Ethiopian Economy.
- ESS (Ethiopian Statistical Service). (2012). Ethiopia Demographic and Health Survey 2011.
- ESS. (2021). ESS (Ethiopian Statistical Service). 2021. Agricultural Sample Survey. 2020/2021. Volume II, Report on Livestock and Livestock Characteristics (Private Peasant Holdings), Addis Ababa, Ethiopia (Vol. 589, Issue 2).
- ESS. (2022). Agricultural Sample Survey 2021/22 (2014 E.C.) (September December, 2021) Volume IV Report on Land Utilization (Private peasant holding, Meher season). In *Statistical Bulletin: Vol. IV*.
- FAO (Food and Agricultural Organization). (2011). Food and Agriculture Organization of the United Nations. http://faostat.fao.org/
- Hailay Girmay, Belaineh Legesse, A. E. & S. T. (2020). Dairy Producers Market Participation Decision and Volume of Milk Supply in Mekelle City, Ethiopia. Sustainable Agriculture Research, 9(3), 9. https://doi.org/10.5539/sar.v9n3p21
- Heckman, J. J. (1979). Sample Selection Bias as a Specification Error. *Econometrica*, 47(1), 153– 161. https://doi.org/10.2307/1912352
- Jari, B., & Fraser, G. C. G. (2014). An analysis of institutional and technical factors influencing agricultural marketing amongst smallholder farmers in the Kat river valley, Eastern Cape Province, South Africa. *International Journal of Agricultural Marketing*, 1(1), 001–009.
- Kena, D., Golicha, D., Jemal, E., Kanu, B., & Gayo, G. (2022). Smallholder dairy producers' participation in dairy marketing in Southern Omo Zone, Ethiopia. *Pastoralism*, 12(1), 13. https://doi.org/10.1186/s13570-022-00262-4
- Kibet R. Kurgat, Job K. Lagat, and E. W. G. (2021). Factors influencing choice of milk market outlets among smallholder dairy farmers in Kuresoi north sub-county, Kenya. *African Journal* of Agricultural Research, 19(2), 189–195. https://doi.org/10.5897/ajar2020.15069
- Kiwanuka, R. N. L., & Machethe, C. (2016). Determinants of Smallholder Farmers' Participation in

Zambian Dairy Sector's Interlocked Contractual Arrangements. Journal of Sustainable Development, 9(2), 230–245. https://doi.org/10.5539/jsd.v9n2p230

NBE. (2022). National Bank of Ethiopia, Annual Report 2021-22. In Annual Report.

Sykuta, M. E. (2008). New Institutional Econometrics: The Case of Research on Contracting and Organization. In Eric Brousseau and Jean-Michel Glachant (Ed.), *New Institutional Economics* A Guidebook (First, p. 618). CAMBRIDGE UNIVERSITY PRESS.

Yamane, T. (1973). Statistics An Introductory Analysis, third Edition (Third). HARPER & ROW.