Research Article

Economic Efficiency of Urban And Peri-Urban Dairy Producers in West Arsi Zone, Oromia Region, Ethiopia

Asfaw Negesse Senbeta*

Agricultural Economics, Adami Tulu Agricultural Research Centre, Oromia Agricultural Research Institute, Ethiopia

Corresponding author: Asfaw Negesse Senbeta, Agricultural Economics, Adami Tulu Agricultural Research Centre, Oromia Agricultural Research Institute, Ethiopia

Email: bls23asfaw@gmail.com

Abstract

Improving efficiency of dairy production is contributed for food security and increase income for urban and peri-urban dairy producers. This study investigated technical, allocative and economic efficiencies in urban and peri-urban dairy producers. To conduct the study, primary data was collected from 120 randomly selected dairy producers in Negele Arsi and Shashamane Towns. Stochastic Frontier approach was used to estimated efficiency. The gamma value indicated that 92.2% % of the variation in output is due to the variation in technical inefficiency among the farmers whereas the remain 7.8% due to random shocks in production. The gamma value for cost function indicated that 80.2% of the variation in output is due to the variation in allocative inefficiency among the farmers and remaining 19.8% of output variation is due to due to variation output. The mean technical, allocative and economic efficiency were 35%, 49.7% and 30.5% respectively. Farmers can increase their dairy production on average by 65% at the existing level of inputs and current technology by operating at full technical efficient level. The mean technical, allocative and economic efficiency of urban dairy producers were about 39.97%, 55.2% and 35.1% whereas peri-urban dairy producers were 25.1%, 38.9% and 21.3% respectively. Technical and economic efficiency of dairy production in urban and peri-urban was positively and significantly influenced by number of dairy cows, extension frequency and access to market information while Distance residents from animal health center affect technical and economic efficiency of dairy production of urban and peri-urban negatively. Education level technical efficiency of dairy production in urban and peri-urban positively and significantly while breed type affect it negatively. The age of respondents affects economic efficiency of dairy producers positively and significantly. Town office of Agriculture, stockholders and concerned bodies should focus on farmers' input and output information exchange, providing technical support by animal production expert and farmers increase focus on productivity of cross breed and local cows could crucial to improve efficiency of urban and peri-urban dairy producers in the study area.

Keywords: Per-urban; Urban; Efficiency; Frontier and Truncated model

Introduction

Background of the Study

Dairy production in Ethiopia is smallholder subsistence and characterized by low production and productivity. The annual production of livestock and livestock products in the country not meet the current demands of the growing human population. Therefore, urban and peri-urban dairy production is very important. The urban dairy production system includes from smallholder to highly specialized, state or businessmen owned farms, which are mainly concentrated in major cities of the country. These dairy farmers have no access to grazing land. A number of smallholder and commercial dairy farms are emerging mainly in the urban and peri-urban areas of most regional towns and districts [1].

Peri-urban areas are those non-urban landscapes adjacent to or surrounding metropolitan settlements. A peri-urban area can be defined in relation to a nearby metropolitan area on its inner boundary, a rural area on its outer boundary, or as the land in between. According to [2] peri-urban dairy production system is mainly operational in areas where the population density is high and agricultural land is shrinking due to expanding urbanization or non-existence and labor cost is on the increase. Such producers are mainly found around big cities and small towns. They may or may not have access to cultivable or pasture land and some of them are usually seen grazing the few animals they have by road side. Their main source of animal feed is home produced hay for some, and pastured hay for other with or without additional supplemental feed.

In Ethiopia urban and peri-urban dairying constitutes an important sub-sector of the agricultural production system. Urban and peri-urban dairy production systems involve production, processing and marketing of milk and milk products that are channeled to urban centers. It plays a vital role in the lives of the urban and peri-urban poor by providing a source of subsistence through household nutrition (milk and meat), supplementary income and generating employment opportunity. Improving dairy farming system through

use of crossbred cows, improved feed, health, and management important to improve income of dairy producers. However, improving this subsector requires the knowledge of production costs and gain from the activity. Thus, there is a growing demand for more updated and day to day knowledge on economic indicators to make the sector more competitive and profitable in the era of highly volatile milk and feed prices [3].

According to economic principles, only producers who achieve low-cost production by pursuing economies of scale and management efficiency through the appropriate use of production technologies can survive over time in a competitive industry such as the dairy sector [4]. According to [5], the efficiency of a farm is its ability to produce the maximum amount possible of an output using the given inputs.

Statement of the problem

The urban and peri-urban dairy production is crucial for food security, income generation, and employment, particularly in areas with high milk demand, by bridging the supply-demand gap and providing a reliable source of milk and milk products. Even though dairy farms are a source of income and job opportunities to the dwellers and dairy farms household, milk production has not increased significantly in recent years; while on the other hand, the human population has continued to grow at an unprecedented rate, increasing the milk demand. Ethiopia has spent more than 15 million USD/year on average for imported dairy products with negligible exports. The estimated average per capita milk consumption is 20 liters per year [6]. Even though Ethiopia has large dairy cattle population and favorable climatic conditions Productivity is relatively low; Quality feeds are difficult to obtain and Support services are inadequate [7]. Urban and peri-urban dairy production systems in Ethiopia are constrained by several factors such as technical, socioeconomic and institutional factors [8].

Price and lack of technical knowledge for optimum allocation of inputs which further leads to variation in efficiency of milk production among the dairy farmers. According to [9], daily milk yield of crossbreeds in the urban system of the Shashamene-Dodola-Robe milkshed (specifically West Arsi zone) ranged from 10 to 16 litres per cow per day. In peri-urban areas of the same milkshed, productivity was 9.5 litres of milk per cow per day. But, the average lactation period per cow at country level is estimated to be about seven months and average milk yield per cow per day is about 1.48 liters [7].

The better use of inputs is relevant and could contribute to improvements in dairy productivity and efficiency. Intensive dairy farming could contribute to the needed dairy productivity and efficiency gains in Africa, with important positive effects for poverty reduction and rural development [10].

There is inefficiency of dairy production as from different empirical review of literature ([11:12:13:14]. The mean technical efficiency of dairy production was 63.7% in central zone of Tigray region [15] and 65% in Oromia Region Ada'a District of East Shewa Zone [16].

Adami Tulu Agricultural Research Center undertakes composite breeding of Arsi Cows to increase the productivity and genetic improvement. The center also distributed the cross-breed bulls to farmers as intermediate results of composite breeding, but it takes time to reach target population. Therefore, it is crucial to improve the efficiency of dairy producers with existing technology and breeds by identifying the factors contributing to dairy production efficiency. Therefore, it is important to identify the determinants of technical and economic efficiency of urban and peri-urban dairy producers to further intervene and increase milk production in the study area.

Objectives of the Study

1. To identify the technical, allocative and economic efficiencies of Urban and Peri-Urban dairy producers

2. To identify determinants of technical and economic efficiency of urban and Peri-Urban dairy producers.

Research Methodology

Description of the Study Area

This study was conducted in West Arsi zone of Oromia region, Ethiopia. It encompasses different agro-ecologies namely high land, midland and lowland. In the Zone the high land agro-ecology (47.92%) took more coverage followed by midland (42.50%) and lowland (9.82%) agro-ecologies. The Zone lies within altitude of 1500-3800 meter above sea level [17].

The total population in the Zone was 2,290,280 of which 45.50% are male and 50.50% are female [17]. The Zone was received 600mm-2700mm annual rain fall and has a bimodal pattern of rain fall. It was also received 12°C-27°C annual temperature per year. The Zone has a total of 1,286,277.50 hectare of land. From the total land, 0.36% is arable land, 29.27% cultivated land, 19.50% forest land, 17.05% grazing land, 4.58% used for construction and 29.26% used for other purposes [17].

Sources of Data, Data Types, and Methods of Data Collection

Both primary and secondary sources of data was used. Quantitative and qualitive types of data were used. This study was household survey data that was collected from Shashamane and Negele Arsi Towns. Secondary data was gathered from West Arsi zone office of agriculture, Sample urban agriculture office and from published and unpublished sources.

Sampling Procedure and Sample Size

A three-stage sampling procedure was employed to select the sample urban and peri-urban dairy farms. In 1st stage, two towns selected from West Arsi zone based on dairy cattle population and milk supply. 2nd stage two kebeles from each urban and peri-urban were selected based on potential of dairy cattle.

3rd Stage: 120 sample dairy producers determined by formula by [18] was used to determine sample size (Table 1).

Method of Data Analysis

The data was analyses using the descriptive statistics, Cobb-Douglas regression analysis in the form of a profit function, and truncated regression (Table 2).

Table 1: Sampling frame and sample size.

Name of sampled Urban	Dairy producers	Total Dairy producers' households (number)	Proportion sampled Households (%)	Number of samples household heads (number)
Negele Arsi	Urban	1683	26.67	32
	Peri-urban	1631	25.84	31
Shashamane	Urban	2525	40	48
	Peri-urban	473	7.49	9
Total		**6312**	**100**	**120**

Source: Own computation, 2023.

Table 2: Description of independent variables.

Independent variables		Unit	Expected Sign
Sex of HH	Sex of household head (1= male, 0=female)	Dummy	+/-
Age of HH	Age of household head	Years	+
FSZ	Number of persons per household	Number	+
EDUCLEVEL	Number of years of formal education	Years	+
DAIRY	Total number of dairy cow owned	Number	+
DAIRYEXPER	Experience of farmer dairy production	Years	+
FREQEXTE	Frequency of extension one year during survey	Number	+
MARKETDIST	Distance of farmer house from nearby market	Kilometer	-
DISTANIMAHEALH	Distance to animal health center	Kilometer	-
ACESSMARKETINF	Access to market information	Dummy	+
NON/OFFFARM	Participation of non/and off-farm activities	Dummy	+
BREEDTYPE	Type of breed under production	Categorical	+/-

Table 3: Sex of sample respondents.

Variable		Urban (n=80)		Peri-Urban (n=40)		Total sample size(n=120)		χ2-value
		Freq	%	Freq	%	Freq	%	
Sex Respondents	Male	43	53.75	28	70	71	59.17	2.9146*
	Female	37	46.25	12	30	49	40.83	

Source: Survey result, 2023.

tropical livestock unit (TLU) were 5.33. The average distance resident from animal health center was 2.50 kilometers and average frequency of extension contact was 2.64 per year. An independent sample t-test result shows significant mean difference between urban and peri-urban farmers in terms of distance to animal health center implied that distance to residence from animal health center peri-urban far distance than urban areas (Table 4).

About 61.25% and 52.5% urban and peri-urban access to market information respectively. The participation of non-farm activities and participation of dairy cooperatives was very low in urban and peri-urban areas. The results showed that only 25% and 30% participated in nonfarm activities of urban and peri-urban dairy producers respectively. About 1.25 % and 2.5% of urban and peri-urban dairy producers participated in dairy cooperatives. An independent sample χ2-test result shows insignificant difference between urban and peri-urban farmers in terms of Access to market information, nonfarm activities and participation in dairy cooperatives. (Table 5).

Results and Discussion

Descriptive Results

Sex of sample respondents: Majority of respondents 59.17% were male respondents in urban and female 40.83% in peri-urban dairy producers were interviewed. There is significance difference between urban and peri-urban dairy farmers in terms of sex of respondents. The percentage of female in urban areas more than in peri-urban areas implied that in urban areas females more engaged in dairy productions (Table 3).

The average age of the sample respondents was 39.71 years which indicated that the sample respondents were work age group and well experienced dairy production. The family size is on average the sample respondents was 6.52 persons per household and the dependency ratio was 0.84. The farming experience of dairy production was about 7.55 years on average. On the average livestock holdings in terms of

Table 4: Inferential results of continuous variables.

Variables	Urban		Peri-urban		Over all		t-value
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev.	
Age of household head in years	39.76	9.36	39.62	10.67	39.71	9.77	0.0723
Family size in numbers	6.59	2.39	6.4	2.34	6.52	2.36	0.4085
Dependency ratio	0.86	0.71	0.81	0.64	0.84	0.66	0.377
Dairy production experience	7.73	5.42	7.2	4.56	7.55	4.74	0.6041
Livestock holding (TLU)	5.014	2.92	5.97	3.32	5.33	3.08	-1. 6185
Distance to Animal health center	2.09	1.48	3.31	2.04	2.5	1.78	-3.7531*
Frequency of extension contact	2.75	1.19	2.47	1.19	2.64	1.18	0.7245

Source: Survey result, 2023

Table 5: Summary of categorical variables.

Dairy producers	Percent	Access to market information			Non/and off-farm activities			Participation in Dairy cooperatives		
		Yes	No	Total	Yes	No	Total	Yes	No	Total
Urban	Freq	49	31	80	20	60	80	1	79	80
	%	61.25	38.75	100	25	75	100	1.25	98.75	100
Peri-urban	Freq	21	19	40	12	28	40	1	39	40
	%	52.5	47.5	100	30	70	100	2.5	97.5	100
Total sample size	Freq	70	50	120	32	88	120	2	118	120
	%	58.33	41.67	100	26.67	73.33	100	1.67	98.33	100
χ2-value	0.84				0.3409			0.2542		
Pr	0.359				0.559			0.614		

Source: Survey result, 2023

Table 6: Dairy cow, number of cattle, milking cow and lactation period.

Dairy producers	Statistics	Variables			
		Dairy Cow (Number)	Cattle (number)	Number of milking cow	Lactation period of dairy cow (Months)
Urban	Mean	2.28	5.04	1.73	8.35
(n=80)	St.dev.	1.25	2.95	0.94	1.03
Peri-urban	Mean	2	5.56	1.35	8.6
(n=40)	St.dev.	1.12	3.17	0.98	1.08
Total (n=120)	Mean	2.18	5.22	1.6	8.433
	St.dev.	1.24	3.02	0.96	1.05
t-Value		1.1436	-0.918	2.0331**	-1.2309

Source: Survey result, 2023

Table 7: Milk production and Income milk production.

Dairy producers		Variables		
	Statistics	Milk (littre per day)	Income from milk in ETB per week	Income from milk during lactation period in ETB
Urban	Mean	22.39	7581.87	267682.5
(n=80)	Std.dev.	14.52	5151.19	180417
Peri-urban	Mean	14.48	4530.4	160143.8
(n=40)	Std.dev.	15.11	4546.32	144799.6
Total (n=120)	Mean	19.75	6564.72	231836.3
	Std.dev.	15.13	5145.48	176272.6
t-Value		2.7761***	3.1773***	3.2767***

Source: Survey result, 2023

The Urban and Peri-Urban Dairy Production of Sample Respondents

The average dairy cow was 2.28 and 2 in urban and peri-urban sample dairy producers respectively. This result implies small scale of dairy farming practiced in the study area. The average number of cattle was 5.04 and 5.56 urban and peri-urban sample dairy producers respectively. The average number of milking cow was 1.73 and 1.35 the urban and peri-urban sample dairy producers respectively. There are significant difference in between the urban and peri-urban dairy producers at 5% significance level in terms of number of milking cow. The average number of milking cows in urban was more than peri-urban dairy producers. The average lactation period was 8.35 and 8.6 months in urban and peri-urban sample dairy producers respectively. An independent t- test indicted that there is insignificant difference between urban and peri-urban dairy producers in terms of number of dairy cows, number of cattle and lactating period of dairy cow (Table 6).

Milk Production and Income from Milk Production

The average milk yield littre per cow per day was 22.39 and 14.48 in urban and peri-urban respectively. This may be the milking cows in urban more cross cows while that of peri-urban local breed cows high relative to urban. The average income urban and peri-urban dairy producers from milk and milk products during lactation period of cow were 7,581.87 ETB and 4,530.4 ETB respectively. The average income from milk and milk products during lactation period of cow were 267,682.5 ETB and 160,143.8 ETB for urban and peri-urban respectively. The urban dairy producers get more income than peri-urban dairy producers. This result may be due to price of milk difference and urban dairy producers produce more milk yield than peri-urban dairy producers. An independent t-test showed that there is significance between urban and peri-urban in terms of milk yield per day, income from milk per week and income from milk during lactation period at 1% significance level (Table 7).

The average milk yield from local breed cow was 5.48 and 5.31 litre per cow per day in urban and peri-urban respectively while for cross breed cow was 13.39 and 12.96 litre per day in urban and peri-urban dairy producers respectively. There is insignificant difference in terms of milk from local breed and cross breed cow between urban and peri-urban dairy producers (Table 8).

The majority about 78.75% and 40% produce cross breed dairy cows in urban and peri-urban respectively. This result implied that cross breed dairy cow more in urban areas than peri-urban. An

Table 8: Milk from local and cross breed cow per day.

Dairy producers	Statistics	Variables	
		Milk from local breed cow litre per day	Milk from cross breed cow litre per day
Urban	Mean	5.48	13.39
(n=80)	St.dev.	1.24	5.16
Peri-urban	Mean	5.31	12.16
(n=40)	St.dev.	1.88	11.01
Total (n=120)	Mean	5.39	12.96
	St.dev.	1.61	4.94
t-Value		0.4378	1.5596

Source: Survey result, 2023

Table 9: Type of dairy cow by sample respondents.

Dairy producers	Percent	Which dairy cow do you have?			
		Local breed	Cross Breed	Both local and cross breed	Total
Urban	No.	11	63	6	80
	%	13.75	78.75	7.5	100
Peri-urban	No.	21	16	3	40
	%	52.5	40	2.5	100
Total sample size	No.	27	84	9	120
	%	22.5	70	7.5	100
χ2-value		10.7917**			

Source: Survey result, 2023

Table 10: Estimated Dairy stochastic production frontier and cost frontier function.

Variables	Production frontier		Variables	Cost frontier	
	ML estimate			ML estimate	
	Coefficient	Std.Err		Coefficient	Std.Err
Intercept	2.83 ***	0.5416577	Intercept	3.19**	1.517288
LnHerd size	0.43***	0.138918	LnConcetratecost	0.54***	0.1336533
LnConcentrate	0.34***	0.0849114	LnRhoughagecost	-0.09	0.1314357
LnRhoughage	0.17	0.0900641	Lnlabourcost	0.29*	0.1657953
LnLabor	0.24	0.1524106	LnVeterinary &other operational costs	0.05	0.0824847
	$\sum\beta$= 1.18				
$\sigma^2=\sigma^2u + \sigma^2v$	1.304			1.06	
$\lambda= \sigma_u / \sigma_v$	3.447	0.2031964		2.01	0.2877628
γ (gamma)	0.922***			0.802	
Log likelihood	-127.02825			-128.80707	
LR test	9.86			3.46	

***, **,* Significant at 1% , 5% and 10% respectively. Source: Own computation, 2023

independent χ2 test indicated that these is significance difference between urban and peri-urban in terms of type of cow breed raring practices. This implies that cross breed cows more milk yield than local breeds that why majority produced cross breed cows (Table 9).

Model Testing and Efficiency Estimation

The stochastic frontier model over the convectional production function can be tested using the statistical significance of the Stochastic Production Frontier Ordinary Least Square parameter gamma, Ý. The estimated value of gamma indicated that 92.2% % of the variation in output is due to the variation in technical inefficiency among the farmers where as 7.8% due to random shocks in production The results indicated that there is wider room to increase productivity of farmers in the study area through identification of principal factors affecting technical efficiency. Hence, the production function estimation using SPF analysis is more appropriate than convectional production function.

All the coefficients of the physical variables (herd size, concentrate and labor) implies that as each of these variables is increased, ceteris paribus, milk output increased. The coefficients of the variables; herd size and concentrate are significant. The estimated value of gamma indicated that 80.2% of the variation in output is due to the variation in allocative inefficiency among the farmers and remaining 19.8% of output variation is due to due to variation output (Table 10).

Technical, Allocative and Economic Efficiencies Estimation

The study indicated that 35%, 49.7% and 30.5% were the mean levels of technical, allocative and economic efficiency of respectively. This in turn implies that farmers can increase their dairy production on average by 65% at the existing level of inputs and current technology by operating at full technical efficient level. The mean technical, allocative and economic efficiency of urban dairy producers were about 39.97%, 55.2% and 35.1% whereas peri-urban dairy producers were 25.1%, 38.9% and 21.3% respectively. An independent sample t-test result indicated that significant

mean difference between urban and peri-urban farmers in terms of technical, allocative and economic efficiencies at 1% significance level. This result implies that urban dairy producers more efficient than peri-urban dairy producers. This result is in line with the finding of [16] (Table 11).

Returns to Scale Dairy Production

The maximum likelihood estimates (MLE) of the Cobb-Douglas based stochastic production function parameter of 1.18 obtained from the summation of the coefficients of the estimated inputs (elasticity) of dairy. It indicates that dairy production in study area was in the stage I of the production stage which is increasing positions of return to scale where resources and production were believed to be efficient. This means an increase in all inputs at the sample mean by one percent will increase Dairy by 1.18% in the study area (Table 12).

Table 11: Technical, allocative and economic efficiencies.

Types of commodities	Efficiency	Dairy producers	Mean	Std. dev.	t-value
Dairy Production	Technical Efficiency	Urban (n=80)	0.3997	0.212	
		Peri-urban(n=40)	0.251	0.188	3.7424***
		Total(n=120)	0.35	0.215	
	Allocative Efficiency	Urban (n=80)	0.552	0.203	
		Peri-urban(n=40)	0.389	0.222	4.0199***
		Total(n=120)	0.497	0.223	
	Economic Efficiency	Urban (n=80)	0.351	0.194	
		Peri-urban(n=40)	0.213	0.18	3.7676***
		Total(n=120)	0.305	0.2	

Source: Survey data, 2023.

Table 12: Elasticity and returns to scale of the parameters of stochastic frontier.

Dairy production	Input Variables				Returns to scale
	LnHerd size	LnConcentrate	LnRhoughage	LnLabour	
Elasticities	0.43	0.34	0.17	0.24	**1.88**

Source: Survey data, 2023.

Table 13: Determinants of technical and economic efficiency of dairy producer.

Variables	Technical efficiency			Economic Efficiency		
	Coefficient	Robust Std.err	p>|z|	Coefficient	Robust Std.err	p>|z|
Sex of respondents	0.0097	0.041	0.813	-0. 013	0.036	0.722
Age of respondents	0.0054	0.002	0	0.0039**	0.002	0.02
Breed type	-0.053**	0.026	0.04	-0.048	0.031	0.118
Education level	0.007 *	0.004	0.086	0.005	0.004	0.165
Total family size	0.0092	0.008	0.237	0.003	0.008	0.725
Experience of dairy production	-0.0037	0.004	0.392	0.0013	0.004	0.771
Number of dairy cows	0.052***	0.014	0	0.050***	0.015	0.001
Distance to animal health canter	-0.053***	0.012	0	-0.049***	0.013	0
Extension frequency	0.053***	0.016	0.001	0.044***	0.015	0.002
Market information Accessibility	0.131***	0.04	0.001	0.126***	0.041	0.002
Non/and off-farm activities	-0. 024	0.039	0.535	-0.033	0.041	0.424
Distance residence to market center	-0. 002	0.008	0.787	0.0094	0.009	0.296
Sigma	0.169***	0.017	0	0.157***	0.013	0
Log pseudo likelihood	72.937272			82.563421		
Wald chi² (12)	668.45			563.08		
Prob> chi²=	0			0		

***, **, *: indicated at 1%, 5% and 10% level respectively. n=120 Limit: lower = 0, upper = 1, Source; model result, 2023.

Determinants of Technical and Economic Efficiency

The result of truncated model estimation indicated that the technical and economic efficiency of dairy production in urban and peri-urban was significantly influenced by number of dairy cows, distance to animal health center, extension frequency and access to market information while breed type and education level only affect technical efficiency and age of respondents affect economic efficiency of dairy producers (Table 13).

Age of respondents: The coefficient of age a statistically significant with economic efficiency at 5% significant level. The result implies that an additional year would increase farmers' economic efficiency by 0.39% than others, keeping all other factors constant. The age allows farmers to have experiences and access information, ideas, knowledge and skill to cost of production which makes them more efficient ways. This result in line with the findings of [19].

Breed Type: The coefficient for the breed types a statistically significant and negative relationship with technical and economic efficiency at 5% significant level as prior expectation. The result implies that having local breed cow would decrease farmers' technical efficiency by 5.3% than who had cross breed cow, keeping all other factors constant. This implies that having cross breed cow increase the technical efficiency of dairy producers as cross breed give more milk than local breed cows. This result in line with the findings of [20].

Education level household head: The coefficient for the education level had a statistically significant and positive relationship with technical at 10% significant level as prior expectations. The result implies that an additional unit of education would increase farmers' technical efficiency by 0.7% than others, keeping all other factors constant. Positive coefficient of education means the higher the years of schooling, the higher the rate of efficiency. This result in line with the findings of [21:22].

Number of dairy cows: Number of dairy cows had positive relationship with technical and economic efficiency as prior expectation significantly at 1% significance level. This implies that farmers who have more dairy cow size more efficient than those who few dairy cows size as economies of scale for buying inputs for production. Additional increase Dairy cow increase the dairy technical and economic efficiency increase by 5.2% and 5% respectively than others keeping all other factors constant. This result is in conformity with the finding of [23].

Distance to animal health center: Distance to farmers from animal health Center of dairy producers had negative relationship with technical and economic efficiency as prior expectation significantly at 1% significance level. This implies the farmers nearby animal health center have more information on know how to use new technologies and better health management to improve their technical efficiency. Farm distance to animal health center increase by one kilometer the dairy technical and economic efficiency would decrease by 5.3% and 4.9% than others keeping all other factors constant. This result is in conformity with the finding of [24].

Frequency of extension contact: Frequency of extension contact was found to have a positive and significant influenced on technical and economic efficiency of sample dairy producers at 1% level of significance. The result implies that an additional unit of extension contact would increase farmers' technical and economic efficiency by 5.3% and 4.4% respectively than others, keeping all other factors constant. They farmers who got the chance to more frequently visit by extension professionals are more efficient than their counter parts. This implies that it improves the technical knowhow and skill of the farmers thereby exchange of experience that improve the efficiency. This is in line with the findings of [16].

Access to market information: Access to market information found to have a positive and significant influenced on technical and economic efficiency of sample dairy producers at 1% level of significance. Farmer who had participate in social organization were 13.1% and 12.6% respectively more of technical and economic efficiency than others respectively, keeping all other factors constant.

This implies that farmer participate in social organizationaccess information provision related to price, profitability, availabilities of new technology and the provision of credit services to its members. A farmer who is member of farmer cooperative is more likely to adopt improved agricultural technologies and hence efficient in dairy production than others. This is in line with the findings of [20].

Conclusions and Recommendations

Conclusions

Inferential analysis used to identify the significant difference between urban and peri-urban dairy producers in terms of explanatory variables. An independent sample t-test result indicated that insignificant mean difference between urban and peri-urban farmers in terms of age of respondents, family size, dependency ratio, farming experience of dairy production, livestock holdings and frequency of extension contact while significant difference in terms of distance resident from animal health center for continues variables.

The average milk yield from local breed cow was 5.48 and 5.31 litre per cow per day in urban and peri-urban respectively while for cross breed cow was 13.39 and 12.96 litre per day in urban and peri-urban dairy producers respectively. The value of gamma indicated that 92.2% % of the variation in output is due to the variation in technical inefficiency among the farmers where as 7.8% due to random shocks in dairy production. The value of gamma in cost function indicated that 80.2% of the variation in output is due to the variation in allocative inefficiency among the farmers and remaining 19.8% of output variation is due to due to variation output.

The mean technical, allocative and economic efficiency were 35%, 49.7% and 30.5% respectively. This in turn implies that farmers can increase their dairy production on average by 65% at the existing level of inputs and current technology by operating at full technical efficient level. The mean technical, allocative and economic efficiency of urban dairy producers were about 39.97%, 55.2% and 35.1% whereas peri-urban dairy producers were 25.1%, 38.9% and 21.3% respectively.

The truncated model results indicated that determinants of technical and economic efficiency of dairy production was positively and significantly influenced by number of dairy cows, extension frequency and access to market information while Distance residents from animal health center affect technical and economic efficiency of dairy production in urban and peri-urban negatively. Education level technical efficiency of dairy production in urban and peri-urban positively and significantly while breed type affect it negatively. The age of respondents affects economic efficiency of dairy producers positively and significantly.

Recommendations

Based on the findings of this study, the following recommendations are made.

The average milk yield from cross breed cows much greater than local breed cows. Therefore, urban and peri-urban dairy producers should focus on cross breeds and better management practices to improve dairy production efficiency.

The frequency of extension contact positively influenced households' technical and economic efficiency of urban and peri-urban dairy producers. Agricultural experts should be continuous follow up the dairy producers by providing technical support and extension advisors to improve technical efficiency of dairy producers.

Access to market information positively affect technical efficiency urban and peri-urban dairy producers. Therefore, Trade and market offices should be provided information both dairy production inputs and outputs by link dairy producers with input suppliers.

Number of dairy cows was positively affected technical and economic efficiency of urban and peri-urban dairy producers. Therefore, farmers should increase number and productivity of cross breed and local cows in order to increase both technical and economic efficiency.

Finally, distance to farmers from animal health center was negative relationship with technical and economic efficiency. Therefore, animal health experts should provide training and technical support at farm level other than farmers get services at animal health center.

References

1. Felleke G, Geda G. The Ethiopian dairy development policy: a draft policy document. Ministry of Agriculture (MoA), Addis Ababa, Ethiopia. J. Agric. Stud. 2001; 2: 132-146.

2. Zegeye Y. Challenges and opportunities of livestock marketing in Ethiopia. In: Proceeding of the 10th Annual Conference of Ethiopian Society of Animal Production (ESAP). 2003; 22-24: 47-54.20, 325-332.

3. Samuel Diro, Wudineh Getahun, Abiy Alemu, Mesay Yami, Tadele Mamo and Takele Mebratu. Cost and Benefit Analysis of Dairy Farms in the Central Highlands of Ethiopia. Ethiop. J. Agric. Sci. 2019; 29: 29-47.

4. FAO (Food Agricultural Organization). Status of and Prospects for Smallholder Milk Production – A Global Perspective. Edited by T. Hemme and J. Otte. Rome. 2010.

5. Farrell MJ. Measurement of Productive Efficiency. Journal of Royal Statistics Society, Series A. 1957; 120: 253-290.

6. FAO (Food and Agriculture Organization). Strategic analysis and intervention plan for cow milk and dairy products in the Agro-Commodities. Addis Ababa, Ethiopia. 2019.

7. CSA (Central Statistical Agency). Report on Area and Production of Major Crops. Agricultural Sample Survey, Volume I, Addis Ababa, Ethiopia. 2020.

8. Sintayehu Yigrem, Fekadu Beyene, Azage Tegegne and Berhanu Gebremedhin. Dairy production, processing and marketing systems of Shashemene–Dilla area, South Ethiopia. IPMS (Improving Productivity and Market Success) of Ethiopian Farmers Project Working Paper 9, ILRI (International Livestock Research Institute), Nairobi, Kenya. 2008; 62.

9. ILRI (International Livestock Research Institute). Improving the productivity and market success of Ethiopian farmers. Final report of the IPMS project, 2004– 2012. International Livestock Research Institute (ILRI). 2013.

10. The World Bank. Agriculture for Development: World Development Report. Agriculture. 54. Tropics and Subtropics (JARTS). 2008; 107: 1-10.

11. Binici T, Demircan V & Zulauf CR. Assessing production efficiency of dairy farms in Burdur Province, Turkey. Journal of Agriculture and Rural Development in th e Economics Research International. 2014: 10.

12. Maina F, Mburu J, Gitau G, Van Leeuwen J and Negusse Y. Economic efficiency of milk production among smallscale dairy farmers in Mukurweini, Nyeri County, kenya. Journal of Development and Agricultural Economics. 2018; 152-158.

13. Masuku BB, Masuku MB, Belete A. Economic efficiency of smallholder dairy farmers in Swaziland: An application of the profit function. J. Agric. Stud. 2014; 2: 132-146.

14. Gelan, Ayele and Muriithi, Beatrice. Measuring and Explaining Technical Efficiency of Dairy Farms: A Case Study of Smallholder Farms in East Africa. Conference paper, The 3rd Conference of African Association of Agricultural Economists Africa and the Global Food and Financial Crises 19 - 23 September 2010, Cape Town, South Africa at the Westin Grand Cape Town Arabella Quays. 2010.

15. Haile Girma. Estimation of technical efficiency of dairy farms in central zone of Tigray National Regional State. Heliyon. 2019; 5.

16. Fita L, Trivedi MM, Patel AM, Tassew B and Joshi CG. Determinants of Technical Efficiency of the Dairy Farmers in Ada'a District of Oromia State, Ethiopia. Iranian Journal of Applied Animal Science. 2013; 1: 59-65.

17. ZOA (Zone Office of Agriculture). Reports of zone office of agriculture, 2023. West Arsi Zone, Ethiopia.

18. Kothari CR. Research Methodology: Methods and Techniques. 2nd Edition, New Age International Publishers, New Delhi. 2004.

19. Dessalegn Shamebo, Meshesha Zewdie and Manoj Kumar Mishra. Technical efficiency of smallholder dairy farmers in urban Ethiopia: the case of Sululta Town. Amity Journal of management. 2021; IX.

20. Mulugeta Kebede. Echnical efficiency of dairy farms in Ehiopia: the case of Sebeta Town and selected sub- cities of Addis Ababa. A thesis submitted to school of graduate studies of St. Mary's University in partial fulfillment of the requirements for the degree of Master of Science in Agricultural Economics. Addis Ababa, Ethiopia. 2018.

21. Hasan Yilmaz, Fekadu Gelaw and Stijn Speelman. Analysis of technical efficiency in milk production: a cross-sectional study on Turkish dairy farming. Brazilian Journal of Animal Science. 2020; 49: e20180308.

22. Tremetsberge L, Christoph Winkler and Jochen Kantelhardt. Animal health and welfare state and technical efficiency of dairy farms: possible synergies. Animal Welfare. 2019; 28: 235-252.