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

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## 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




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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 | +/- |

## 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 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).

**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.

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).

**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.

| | | | Variables |
|---|---|---|---|
| Dairy producers | Statistics | 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.

| | | | | Which dairy cow do you have? | |
|---|---|---|---|---|---|
| Dairy producers | Percent | 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 | | | Cost frontier | |
|---|---|---|---|---|---|
| | ML estimate | | | ML estimate | |
| | Coefficient | Std.Err | Variables | 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 |
| | ∑β= 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 |
|---|---|---|---|---|---|
| | | Urban (n=80) | 0.3997 | 0.212 | |
| Dairy Production | Technical Efficiency | Peri-urban(n=40) | 0.251 | 0.188 | 3.7424*** |
| | | Total(n=120) | 0.35 | 0.215 | |
| | | Urban (n=80) | 0.552 | 0.203 | |
| | Allocative Efficiency | Peri-urban(n=40) | 0.389 | 0.222 | 4.0199*** |
| | | Total(n=120) | 0.497 | 0.223 | |
| | | Urban (n=80) | 0.351 | 0.194 | |
| | Economic Efficiency | 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.

| | Technical efficiency | | | Economic Efficiency | | |
|---|---|---|---|---|---|---|
| Variables | 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 $chi^2$ (12) | 668.45 | | | 563.08 | | |
| Prob> $chi^2$= | 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.

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