Sci. Technol. Arts Res. J., Jan.-March 2020, 9(1), 1-15
DOI: https://doi.org/10.20372/star.v9i1.01
ISSN: 2226-7522 (Print) and 2305-3372 (Online)
Science, Technology and Arts Research Journal
Sci. Technol. Arts Res. J., Jan.-March 2020, 9(1), 1-15
Journal Homepage: https://journals.wgu.edu.et

Original Research

Milk Production and reproduction performances of local and crossbred cows, milk processing and milk marketing systems in rural and urban villages of Diga district of East Wollega zone, Oromia

Ararso Terafu[1], Ayantu Mekonnen[2] & Gemeda Duguma[2]*

[1]Office of Livestock Development, Diga, East Wallaga Zone, Oromia
[2]School of Veterinary Medicine, Wallaga University, Po Box 395, Nekemte, Ethiopia

Abstract

The study was conducted in rural and urban areas of Diga district, East Wallaga zone, Oromia, to investigate milk production and reproduction performances of local and crossbred cows, milk processing, and marketing systems. A total of 240 dairy producers were involved in the study from eight purposefully selected peasant associations (PAs) in the district. A questionnaire survey was supported by group discussions and key informant interviews to capture the data. The collected data were analysed using the Statistical Package for Social Science (SPSS version 2018) and the General Linear Model (GLM) procedures (SAS, 2008) as deemed necessary. The result of the study revealed that the average milk yields of local and crossbred cows were 1.62±0.55 and 3.34±1.24 litres per head per day, respectively. The average milk yield per head per day was significantly ($p<0.05$) higher for crossbreds. About 7.0±07 and 8.04±0.98 months of mean lactation length were reported for local and crossbred cows, respectively. The average age at first sexual maturity of local and crossbred female dairy cows in urban and rural areas was 3.68±0.09 and 3.9±0.05 years, respectively. The mean age at first calving of local cows was 4.5±0.10 years in urban areas and 4.6±0.06 years in rural areas. The corresponding ages at first calving for crossbred cows were 3.6±0.022 and 3.63±0.21 years. The mean calving intervals for local and crossbred cows in urban and rural areas were 1.8±0.06 and 1.9±0.03, 1.3±0.11 and 1.5±0.11 years, respectively. In the study areas, about 20.8% and 66.7% of milk producers used whole milk before and after processing, respectively. Guard (81.2%) and plastic materials (18.8%) were mostly milking utensils used in the study areas. Informal dairy product marketing was generally practiced, and milk marketing in rural settings was nil. Milk production, processing, and marketing are not consistent across the years. They vary due to seasonal effects, feed shortages, disease, shortages of improved breeds, and inadequate AI services. On the other hand, the presence of a conducive climate, increasing demand for milk and milk products, and the availability of perennial rivers are some of the most important opportunities for dairy production in the study areas. In addition, the diverse flora, different spices, and smoking plant materials, as well as the rich indigenous knowledge in milk production and processing, are also important positive drivers for dairy development in the study areas.

Article Information

Article History:
Received : 01-01-2020
Revised : 27-02-2020
Accepted : 28-03-2020

Keywords:
Conducive climate; Diga district; milk products; spices; smoking materials

*Corresponding Author:
Gemeda Duguma

E-mail:
gdjaallataa@yahoo.com

INTRODUCTION

Ethiopia is believed to have the largest livestock population in Africa. This livestock sector has been contributing a considerable portion to the economy of the country and is still promising to rally around the economic development of the country. It is eminent that livestock products and by-products in the form of meat, milk, honey, eggs, cheese, butter, etc. provide the needed animal protein that contributes to the improvement of people's nutritional status. According to the CSA (2016), the total cattle population of the country is estimated to be about 59.5 million. Out of this total cattle population, female cattle constitute about 55.5 percent, and the remaining 44.5 percent are male cattle.

Dairy production is an important component of livestock farming in Ethiopia. Ethiopia holds large potential for dairy development due to its large livestock population, favorable climate, emerging market opportunities, and improved policy environment for the involvement of the private sector (Mebrate et al., 2019). According to the authors, the dairy production systems of Ethiopia are classified as urban, peri-urban, and rural dairy production systems from a location perspective. From the overall Ethiopian milk production, the rural system, which comprises the pastoral, agro-pastoral, and mixed crop-livestock systems, contributes about 97.4% to the total milk production of the country (CSA, 2016). The remaining 2.6% is produced by peri-urban and urban farms and commercial dairy farms.

Regarding the milk processing method, the traditional home processing method is widely and dominantly practiced, and it involves the processing of fluid milk into fermented or sour milk, butter, and local cheese. For example, in the rural highland system, milk is fermented for three to five days before it is processed into butter and other milk products (Uddin et al., 2010). According to Azage et al. (2013), the major dairy products commonly marketed in most parts of Ethiopia are fresh milk, butter, ititu (fermented whole milk), cottage cheese (baaduu), and buttermilk.

The marketing of milk and milk products varies depending on the source of milk, access to the market, the culture of the society, the season, and the fasting period. For instance, marketing fluid milk is not common in remote rural areas due to cultural reasons and inaccessibility to the market. Milk processing in the country is basically limited to the smallholder level, and the hygienic qualities of the products are generally poor. In the urban dairy production system, producers market 72% of the fluid milk produced per day (Zelalem & Faye, 2006). In order to mitigate challenges that limit productivity and thereby exploit the untapped potential, it is necessary to characterize and analyze dairy production, processing, and marketing systems, identify major constraints along the value chains, and devise pertinent and practical strategies to alleviate the problem and improve dairy production and marketing systems in the country (Sintayehu et al., 2008). Information on milk production, processing, and marketing in the East Wallaga Zone in general and in Diga District in particular is scant. Therefore,

the objective of the current study was to assess milk production, milk processing, marketing systems, reproduction performance, and major constraints to milk production in the study area.

Materials and Methods

Description of the Study Area

The current study was conducted in Diga district, East Wallaga zone, Oromia. Diga district is located about 12 kilometers west of Nekemte city, the East Wollega Zone capital, which is located about 330 kilometers from Addis Ababa. It is located between 9^0 and $9^0 10'$ North latitude and $36^0 10'$ to $36^0 30'$ East longitude. It receives an average temperature range of 18^0C to 32^0C and 1200 ml to 2100 ml of rainfall per year. The area experiences a unimodal type of rainfall that extends from April to October. The total livestock population of Diga district is about 132,748, of which cattle account for about 132,748, sheep for 25,700, goats for 23,100, chickens for 74,760, and equines for 13,220 (DLRDO, 2019).

Data Collection and Sources

Both primary and secondary data were used for the study. Primary data was collected through a pre-tested, semi-structured questionnaire, while secondary data was collected from relevant documents. Focus group discussions and key informant interviews were carried out to testify to the data collected from the questionnaire survey.

Sampling Techniques

Purposive and random sampling techniques were implemented to identify kebeles and targeted households. Eight kebeles were purposefully selected based on dairy cattle population and accessibility. Initially, study populations were defined as households have at least two or more milking dairy cows, both in urban and rural kebeles, and after that, dairy cow-owning households were randomly selected for an interview from the list. A total of 600 dairy-owning households were identified, of which 240 were selected for the current study based on the formula developed by Yamane (1967). However, with regard to milk and milk products marketing, all market actors were involved.

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

Where:

n is the sample size,

N stands for total number of targeted population

1 stands for the probability of the event occurring

e stands for maximum variability 5% (0.05)

Data Analysis

Qualitative data were analyzed by employing descriptive statistics in the Statistical Package for Social Sciences (SPSS, 2018, version 18). Whereas quantitative data were analyzed employing the General Linear Model Procedures (GLM) in Statistical System Analysis (SAS, 2008). Significance was declared at the 5% level. The ranking of milk production constraints was computed by employing an index formula following Duguma et al. (2011).

Results and Discussion

General characteristics of respondents

The general characteristics of the respondents are indicated in Table 1. The average family size in the study area was 4.3±0.13 and 3.3±0.07 in urban and rural kebeles, respectively. Significant ($p<0.05$) differences were observed between rural and urban kebeles in family size. Family size per household was larger in urban areas compared to rural areas, contradicting the general perspective that family size is higher in uneducated rural areas compared to urban dwellers. In the present study, there is no major discrepancy between male and female respondents involved in the study. The proportion of male and female respondents was about 54.2% and 45.8%, respectively. Female respondents involved in the current study were larger than the 16% reported by Dajene (2018) in the study conducted in Bona Zuria district of the Sidama zone of the SNNP region. The majority of respondents (65.8%) targeted in the current study were between the ages of 35 and 49 (Table 1). The age category of respondents reported in this study is also in agreement with the 41–50-year-old age category reported by Dessalegn (2018) for Akaki and Bishoftu areas of Ethiopia. About 97.9% of the present study respondents are married. With regard to education, about 59.6% of the respondents involved in the current study attended elementary school, about 12.9% attended secondary school, and about 27.5% did not enroll in any formal school.

Table1

General characteristics of household dairy producers

	Least Square Mean (LSM±SE)						P-value
Variables	Urban (N=60)		Rural (N=180)		Over all		
Family size	4.3±0.13		3.3±0.07		3.55±1.04		0.0001
	N	%	N	%	N	%	
Age category (yr)							
35-49	40	66.7	118	65.6	158	65.8	
50-65	5	8.3	33	18.3	38	15.8	
Gender/Sex							
Male	40	66.7	90	50	130	54.2	
Female	20	33.3	90	50	110	45.8	
Marital status:							
Married	57	95	178	98.9	235	97.9	
Single	1	1.7	0	0	1	0.4	
Divorced	2	3.3	2	1.1	5	2.1	
Educational level							
Illiterate	13	21.7	53	29.4	66	27.5	
Primary school	35	58.3	108	60	143	59.6	
Secondary school	12	20	19	10.6	31	12.9	

Livestock species and dairy cow holding per household

The livestock species and livestock holdings per household observed in the study are presented in Table 2. The average number of livestock holdings

per household in the study area was 4.22±2.03, 4.26 ± 2.14, 1.4±0.87, and 0.80±0.88 for cattle, chickens, sheep, and goats, respectively. The number of animals owned per household was significantly ($p<0.05$) larger in rural Kenya compared to urban Kenya. Excluding chickens, cattle were the largest in number both in rural and urban areas, followed by sheep. This finding was slightly larger than the 1.04±1.06 and 1.23±0.95 reported by Ayalew (2017) for rural and peri-urban areas in South Wollo Zone, Amhara Regional State, Ethiopia

Table2

Livestock species and livestock holding per household

Livestock species	Least Square Mean (LSM±SE)			
	Urban (N=60)	Rural (N=180)	Over all (N=240)	p-value
Cattle	2.80±0.26	4.70±0.15	4.22±2.03	0.0001
Sheep	1.28±0.11	1.40±0.06	1.40±0.87	0.44
Goat	0.35±0.11	0.95±0.66	0.80±0.88	0.0001
Chicken	2.23±0.27	4.94±0.15	4.26±2.14	0.0001
Horse	0.1±0.05	0.19±0.03	0.17±0.42	0.0001
Donkey	0.08±0.06	0.7±0.04	0.52±0.54	0.0001
Local dairy cows	2.7±0.12	2.3±0.07	2.4±1.0	0.0036
Crossbreds	0.4±0.06	0.07±0.03	0.14±0.45	0.0002
Milking cows	1.6±1.06	1.83±0.09	1.8±1.24	0.209

Dairy production system in the study area

During the current study, two major types of cattle production systems were identified in the study areas. These are the mixed crop-livestock system and the peri-urban cattle production system.

Mixed crop-livestock Production System

This type of production system is the typical and predominant cattle production system in the study areas. In this type of production, crop cultivation and livestock production are complementary, in that livestock provides power for land preparation and crop transportation after harvest and manure as fertilizer, while crop by-products (residues and aftermath) serve as a source of animal feed. The mixed crop-livestock system mainly uses indigenous breeds that sustain themselves on natural pasture grazing, crop aftermath, and crop residues with no or very limited, if any, supplementary feeds. Accordingly, their milk production is low. In line with the current study findings, Afras (2019) indicated that most of the livestock production systems in Ethiopia are traditional and based on indigenous breeds of cattle.

In the mixed crop-livestock production system, milk produced is retained for home consumption and seldom goes for sale. Crop farming in the study area is mainly practiced using oxen draught power. Because a large part of the land in the study area is covered by natural forest, it is common to see highly diversified cropping practices with fruits and vegetables that are commonly grown. Some of the major crops grown in the study areas include teff, maize, and sorghum, indicating that the area is classified under midland and lowland agro-ecologies. Dairy production in Western Oromia is predominantly produced under crop-livestock mixed farming and peri-urban cattle production systems (Ulfina et al., 2018).

Peri-Urban Dairy Production System

The peri-urban dairy production system in the study area is covered in and around small towns

where there is relatively better demand for fluid milk and milk products. Most dairy producers in peri-urban households depend on different activities for their livelihoods, such as trade, and some of them grow food crops, especially maize, in nearby rural areas either by renting farmlands or on a contractual basis. Though the peri-urban dairy production system is a bit better than that of the crop-livestock mixed system (rural dairy), dairy production in the system is still less market-oriented. A similar finding was reported: a peri-urban dairy production system has developed in and around small cities where there is higher demand for milk and milk products in Ghimbi District, West Wollega Zone, Oromia, Ethiopia (Ulfina et al., 2018).

Milk Handling and Hygienic Practice in the Study Area

Cleaning of hands, teats, udders, and milk utensils before and between milking and the use of towels contribute to hygienic milk production. The hygienic practices during milking and other activities that were done by the farmers in the study areas are presented in Table 3. The majority of the respondents (76.3%) from both rural and urban areas (75% and 80%, respectively) reported that women wash their hands before milking. Similar results were also reported in urban and peri-urban areas of Dangila Town, Western Amhara Region, Ethiopia (Bekele et al., 2015). Over all, about 69.2% of dairy producers (88.3% from urban areas and 62.7% from rural areas) practiced udder and teat washing before milking cows. However, according to the majority of farmers (95%), dairy owners (91.7% from urban areas and 96.1% from rural areas) did not wash their hands in between milking. In contrast with the current findings, Tadesse et al. (2020) reported that about 43% of women did not wash their udders before milking.

With regard to types and quality of milking utensils, dairy owners both from urban and rural areas (88.3%) reported that they clean their milk utensils. About 85% and 89.4% of respondents from urban and rural areas, respectively, reported that they clean their milking utensils (Table 3). Though the number of respondents varied, Tadasse et al. (2020) also reported that households clean milk utensils in Abune Gindeberet District, West Shewa Zone of Oromia Region, Ethiopia.

Table 3

Milk Handling/Hygienic Practice in the Study Area

Variables		Production area					
		Urban(N=60)		Rural(N=180)		Overall(N=240	
		N	%	N	%	N	%
Hand washing before milking	Yes	48	80	135	75	183	76.3
	No	12	20	45	25	57	23.7
Udder and teat washing before milking	Yes	53	88.3	113	62.8	166	69.2
	No	7	11.7	67	37.2	74	30.8
Hand washing between milking	Yes	5	8.3	7	3.9	12	5
	No	55	91.7	173	96.1	228	95
Washing utensils pre- and post-milking	Yes	51	85	161	89.4	212	88.3
	No	9	15	19	10.6	28	11.7

Milk yield and lactation length

The average milk yield obtained from local and crossbred cows per day was 1.62±0.55 lit and 3.55±1.25 lit, respectively (Table 4). Milk yield from crossbred cows in urban areas was significantly (P<0.05) higher compared to that obtained from crossbred cows. The difference might be due to differences in management practices. The average lactation lengths of local and crossbred cows in the study area were 7.0±0.86 and 8.04±0.98 months, respectively (Table 4). The lactation length reported in the current study was shorter than the 8.9 and 10 months, respectively, reported for local and crossbred cows by Kassu (2016) in Bona Zuria district of Sidama Zone, southern Ethiopia. The likely reasons for the difference in lactation length may be breed, management, and agro-ecology differences.

Table 4

Milk Production Performance and lactation length in the Study areas

	Least Squares Mean (LSM±SE)			
Variables	Urban(N=60)	Rural(N=180)	Overall(N=240)	P-value
Milk yield per cow/day (liter)				
Local cows	2.28±0.07	1.4±0.04	1.62±0.55	0.0001
Crossbred cows	3.9±0.37	2.83±0.35	3.35±1.25	0.051
Lactation length (month)				
Local cows	7.0±0.11	7.0±0.06	7.±0.86	0.21
Crossbred cows	8.2±0.29	7.9±0.28	8.04±0.98	0.52

Reproductive performance of dairy cows

The reproductive performance of dairy cows in the study areas is presented in Table 5. According to respondents in the current study, the estimated average age for first service (AFS) for the local breed was 3.9±0.76 years, and for the crossbred, it was 2.8±0.84 years. The corresponding ages at first calving (AFC) were 4.6±0.83 and 3.6±0.73 years. The calving interval (CI) reported for local cows was 1.9±0.49 years and 1.5±0.38 years for crossbred cows. Age at first service for the local breed was significantly different (p<0.05) between urban and rural areas. AFS was shorter in the urban area than it was in the rural area (Table 5). The likely difference may be housing and feeding management. In the rural areas of the current study, mostly barns with simple fences are used for housing cattle, whereas cattle in urban areas are housed in shelters that protect animals from cold weather and rain. No significant difference (p > 0.05) was observed between local and crossbred dairy cows managed in rural and urban areas with regard to AFC and CI, but AFS. These were in disagreement with the findings reported by Kassu (2016) for local and crossbred dairy cows managed in rural and urban areas in the Bona Zuria district of the Sidama Zone of southern Ethiopia. However, the author reported a CI of 16.04 months (1.37 years) for crossbred cows, which is in agreement with the 1.5 years reported in the current study. The 44 months (3.67 years)

and 26.98 months (2.25 years) of AFS reported for local and crossbred dairy cows by Kassu (2016) were lower than the current study findings.

Table 5

Reproductive performance of Dairy cows in the study areas

Variables	Least Squares Mean (LSM±SE)			
	Urban(N=60)	Rural(180)	Overall(N=240)	P-value
AFS (Local breed)	3.68±0.09	3.9±0.05	3.9±0.76	0.013
AFS (Crossbreds)	2.7±0.25	2.9±0.24	2.8±0.84	0.598
AFC (Local breed)	4.5±0.10	4.6±0.06	4.6±0.83	0.505
AFC (Crossbreds)	3.60±0.22	3.63±0.21	3.6±0.73	0.961
CI (Local breed)	1.9±0.06	1.9±0.03	1.9±0.49	0.863
CI (Crossbreds)	1.32±0.11	1.6±0.11	1.5±0.38	0.110

Milk processing, handling and milk equipment in the Study Area

Milk processing

As reported by respondents, cow's milk was processed into different products such as yogurt or sour milk, butter, ghee (melted and filtered butter), and buttermilk. The processing of milk depends on the quantity of milk that a household can produce. In the study areas, only traditional milking equipment is used for all processing activities of milk and milk products.

Traditional Yoghurt, Cheese, and Butter Making

According to respondents, sour milk is produced from whole milk and sometimes after removing the whey (the fluid part). The preparation of yogurt starts with the cleaning and smoking of the container. Respondents indicated that smoking of utensils used for milking or storage is crucial and is a very common practice in the area. The containers are smoked by either turning them upside down on the smoking material or by smoking the container or shaking it until the smoke dies. Thereafter, fresh milk is added to the container and allowed to curdle through natural fermentation without using any starter culture. After the formation of the curd, the whey is removed. Similar traditional yoghurt-making was also reported by Kebede et al. (2019) for Borana pastoralists in southern Ethiopia. The majority of respondents (72.1%) reported that the shelf life of yoghurt is 3–4 days, which is in agreement with the findings of Amanuel et al. (2018) in the Gimbi area of the West Wallaga Zone, West Oromia. In the study areas, butter is processed from the churning of curdled milk.

Milk producers in the study areas make cottage cheese from buttermilk. It is made either by storing buttermilk for about 1–3 days, by boiling buttermilk for certain minutes, or by using both methods based on the availability of food. In the present study, dairy producers in rural areas mainly use the storing method. However, both boiling and storing for cheese making and vice versa were true for urban dairy producers. Based on respondents, the buttermilk, or Ammaraasee, is placed on fire in a clay or metal pot and heated gently on fire for about 5–30 minutes, based on the climatic conditions. Thereafter, it is cooled for some time, and then the whey is drained off. The

boiling time reported in the current study was in close agreement with the findings reported by Bekele et al. (2015) from urban and peri-urban areas of Dangila Town, Western Amhara Regional State, Ethiopia.

Churning frequency is dependent on the volume of milk milked per household. It was reported by respondents that the churning time ranges from 20 to 60 minutes. In the current study areas, common churning equipment is locally known as Abuubbii raasaa or Rooo, which is made of the genera Lagenaria and Siceraria. Churning is solely done by women, and sometimes girls and boys. Based on respondents, about 66.7% of respondents from urban areas indicated that about 4–6 liters of milk are required per churning. However, the majority of respondents (60%) from the rural area reported that 2–3 liters of milk are required per churning. Roo (Lagenaria siceraria) churning is done on the lap (leg) until butter granules are formed. According to respondents, women frequently pause or break churning to check that butter granules are formed by opening the churner and looking for drops of milk. This will continue until the butter is fully recovered from the milk. Respondents did not know the exact amount of butter obtained per liter of milk. In the study area, butter is mainly produced for home consumption and income generation. This is in agreement with Habtamu & Adugnaw (2018), who reported for Enemay District, East Gojjam, Amhara, Ethiopia.

Different spices in ghee-making

According to respondents, ghee is made by melting butter in a clay or metal pot over an open fire. In addition, different spices are added to the boiling butter to impart a good aroma and taste. It is also believed that species are used for preservation purposes. Heating and stirring with a metal or wooden spoon continue until foam, which floats on the upper layer of the boiling butter, is dispensed and a clear liquid is obtained. Finally, the clay or metal pot is removed from the fire and allowed to cool, and the liquid fat is filtered into a clean material. The processed butter and ghee can be stored for about 2 months or even longer. Spices used for ghee-making are indicated in Table 6. The types and amounts of spices required depend on an individual woman and the volume of butter to be processed into ghee.

Table 6

Different Spices in Ghee Making in the Study Areas

Spices scientific name	Common name	Varnacular name (Afaan Oromo)	Urban (N=60)		Rural (N=180)		Overall (N=240	
			N	%	N	%	N	%
Allium sativum	Garlic	Qullubbii adii	22	36.6	62	34.4	84	35.
Zingiber officinale	Ginger	Jijinbila	13	21.7	44	24.4	57	23.8
Curcuma domestica	Turmeric	Irdii	8	13.3	24	13.3	32	13.3
Aframomum korerima	Korerima	Oogiyoo	6	10	13	7.2	19	7.9
Nigella sativa	Black cumin	Qimamii gurraattii	3	5	15	8.3	18	7.5
Trigonellaa goeniculum	Fenugreek	Sunqoo	4	6.7	15	8.3	19	7.9

Milk equipment

The types of milk equipment or materials used in the handling of milk in the study area are indicated in Table 7. Commonly used milk storage equipment and utensils reported in the current study are gourds (Qabee) and plastic materials. Urban dairy producers tend to use more plastic and other modern storage materials than rural communities, probably due to access. The utensils used for milk storage in the current study are in contrast with Tadesse et al. (2020), who reported that about 51.6% of households use clay pots in Abuna Gindeberet district, west Shewa zone of Oromia region, Ethiopia. About 78.3% of respondents among urban dairy producers and about 95.6% of respondents among rural dairy producers reported that they do not use towels. Some dairy producers use a common towel for all milking cows. Mitiku et al. (2019) also reported that about 96.8% of households did not use towels in Haramaya District, Ethiopia.

The most common types of churners in the present study were The most common types of churners in the present study were Ro'oo (gourd) and plastic materials (Table 7), where Ro'oo is most commonly used by rural dairy producers and plastic materials by urban dairy producers. As opposed to Ro'oo and plastic materials, Mekdes (2008) reported that clay pots of different sizes are commonly used for churning purposes. In agreement with the current study findings, Eyassu and Asaminew (2014) reported that gourd is the most commonly used material for milking, fermented milk storage, churning, and treated butter storage in the East Wallaga Zone and North Western Ethiopia. The use of gourds or qabee as a common milking container was also reported from the East Hararghe zone of Oromia, Ethiopia, by Mitiku et al. (2019) and Alganesh (2012) from the East Wallaga zone.

Table 7

Different milk equipment used in the study areas

Milk equipment	Urban (N=60)		Rural (N=180)		Overall (N=240)	
	N	%	N	%	N	%
Do you use towel?						
Yes	13	21.7	8	4.4	21	8.7
No	47	78.3	172	95.6	219	91.3
If yes, how?						
Separate towel for Individual cow?	6	10	0	0	6	2.5
Common towel?	7	11.7	8	4.4	15	6.2
Storage utensils use for milk						
Gourd/Abuubbii	25	41.7	122	67.8	147	61.3
Clay pot	1	1.7	15	8.3	16	6.7
Plastic material	34	56.6	43	23.9	77	32.0
Milking utensils						
Qabee/ gourd	30	50	165	91.7	195	81.3
Plastic material	30	50	15	8.3	45	18.7
Type of churner						
Ro'oo/ Gourd	18	30	131	72.8	149	62.0
Plastic materials	42	70	49	27.2	91	38

Milk and milk products' equipment cleaning materials

Different methods of milk and milk products' equipment cleaning are indicated in Table 8. Milk producers in the study area practice washing and smoking milk and milk products' equipment by using varieties of plant species. The major purposes of washing are to give the product a pleasant aroma and to improve its shelf life. Plants used for cleaning and smoking milk and milk products' equipment differ from household to household based upon preferences and the availability of the herbs. Different plant species, like *Lantana trifolia*, Kefoo, *Stephaia abyssinica*, *Ruta chalepensis*, etc., are used for cleaning milk and milk products' equipment. Amanuel et al. (2018) also reported that similar plant species are used in Gimbi district, west Wallaga zone.

Table 8

Milk and milk products' equipment cleaning materials in the study areas

Milk and milk products' cleaning materials		Town(N=60)		Rural(N=180)		Overall(N=240)	
Scientific name	Local name	F	%	F	%	F	%
Lantana trifolia	Kusaayee	24	40	64	35.6	88	36.7
Na	Kefoo	15	25	50	27.8	65	27.0
Stephaia abyssinica	Kalaalaa	7	11.7	27	15	34	14.2
Ruta chalepensis	Cilaatama	7	11.7	29	16.0	36	15
Na	Marga citaa	7	11.6	10	5.6	17	7.1

Na = Scientific name not found

Smoking Material for milk equipment

Some of the common smoking materials identified in the current study are indicated in Table 9. Producers use different types of smoking materials based on the availability of plant species. Dairy producers may use one or more smoking materials at different times (i.e., they use only one material at a time). Most of the smoking materials identified in the current study are in line with Teshager et al. (2013), who reported on dairy producers in the Ilu Aba Bora Zone of the Oromia region.

Table 9

Common smoking materials for milk equipment in the study areas

Smoking materails		Urban (N=60)		Rural (N=180)		Overall (N=240)	
Scientific name	Local name	N	%	N	%	N	%
Deinboll kilimandshorica	Dabaqa	23	38.3	87	48.3	110	45.8
Syzygium guineense	Gaarrii	17	28.4	43	23.9	60	25
Carissa edulis	Agamsa	5	8.3	30	16.7	35	14.6
Olea africana	Ejersa	11	18.3	6	3.3	17	7.1
Na	Baddeessaa	4	6.7	14	7.8	18	7.5

Major constraints of milk production, processing and marketing system

According to respondents, milk production, processing, and marketing have not been consistent across the years. They vary due to seasonal effects, holidays and festivals, fasting, and no fasting conditions in the study areas. Apart from the inconsistencies, constraints in urban and rural settings of the study areas are associated with each other and raised due to feed shortages, disease, and shortages of improved breeds, inadequate AI services, inadequate infrastructure, land scarcity, and limitations of market information, which were ranked 1st, 2nd, 3rd, 4th, and 5th, respectively. Due to these problems, milk producers are not sufficiently benefiting from their milk products. The current study result agreed with the findings of Teshome and Tesfaye (2017) and Belay and Janssen (2014), who indicated that feed shortages were the major constraints in Bench Maji Zone, Southwest Ethiopia.

The constraints on milk processing reported by households in the current study areas are unimproved milk processing materials and low milk production. Amanuel et al. (2018) also reported similar challenges from Gimbi district, West Wallaga zone, and Oromia. With regard to the market, cultural taboo, low milk quantity, inadequate milk supply, and lack of improved dairy breeds, these are some of the major constraints reported by respondents. The present study result is in line with Belay and Janssen (2014), who indicated that low milk production is one of the milk marketing constraints in Jimma town, Oromia Regional State, Ethiopia.

Potential opportunities for milk production, processing, and marketing in the study areas

Potential opportunities available for expansion of dairy production in the study areas are a conducive climate, increasing demand for milk and milk products, and the availability of perennial rivers both in urban and rural dairy producers. The increasing human population and urbanization are also another opportunity for dairying in the study areas. The presence of diverse flora species, different spices, and smoking plant materials, as well as rich indigenous knowledge in milk production and processing, are also important positive drivers of dairying in the study areas.

Conclusion and recommendation

The major reasons for keeping dairy cows in the study areas were income generation, household consumption, and the rearing of calves. Natural pastures, crop residues, and crop aftermaths are the most important feed sources in the study areas. The river was the main source of water for dairy cows. The most important shelter for dairy cows was a barn in the rural area and a compound of households in the urban area. A separate house constructed for dairy cattle was rare or limited.

Local dairy cows are widely used in both urban and rural areas. Hand and udder/teat washing are practiced in both urban and rural areas. Milk is either consumed as fresh whole milk or stored for further processing. Processed milk or milk products are more consumed than milk in the study areas. Butter, cottage cheese, whey, itittuu (naturally fermented milk), and ammaraasee (buttermilk) are some of the milk products commonly processed in the current

study. Milk marketing was only done in urban areas.

The types of utensils used for milking, transportation, collection, and storage of milk were "Qabe" and plastic buckets. The most common milk production constraints in the study areas are shortages of feed, diseases, a lack of improved breeds, inadequate AI services, and a lack of awareness. Trypanosomiasis is the most economically important disease in the area. Public veterinary service is limited to urban areas. Most of the dairy producers in the rural area reportedly use different herbs to treat their sick animals. In the case of breeding, natural mating was the dominant breeding activity practiced in rural areas, but AI is practiced more in urban areas. Conducive climate, increasing demand for milk and milk products, and the availability of perennial rivers both for urban and rural dairy producers are some of the most important opportunities for diary production in the study areas. The presence of diverse flora species, different spices, and smoking plant materials, as well as rich indigenous knowledge in milk production and processing, are also important positive drivers of dairying in the study areas.

Acknowledgements

Dairy producers involved in the current study are cordially acknowledged for their time and willingness.

The authors are grateful to Diga District Livestock and Fishery Development Agency staff for their cooperation in identifying Kebeles and households involved in the current study.

REFERENCES

Afras Abera (2019). Review of breeding objectives and practices of dairy cattle production in Ethiopia. *Journal of Cell and Animal Biology, 13*(1): 1-7.

Alganesh Tola & Fekadu Beyene (2012). Traditional milk and milk products handling practices and raw milk quality in Eastern Wollega, Ethiopia. In: Laura Dean (ed.) LAP LAMBERT Academic Publishing. *Heinrich-Böcking-Str. 6 8*, 66121 Saarbrücken, Germany. Available at: www.lap publishing. com 85. ISBN 978-3-8484-3573-9.

Amanuel Bekuma,Wahid M. Ahmed, Lemma Fita & Ulfina Galmessa (2018). Dairy Production System and its Constraints in Gimbi District, West Wollega Zone, Oromia, Ethiopia Mettu University, Bedele, Ethiopia.IDOSI Publications. *GlobalVeterinaria, 20* (5), 215-224.ISSN 1992-6197

Ayalew Mokonnen (2017). *Milk production, handling, processing and marketing in three dairy production systems of south wollo zone, Amhara Regional State*, Ethiopia.

Azage, T., Berhanu, G., Hoekstra, D., Berhanu, B. & Yoseph, M. (2013). Smallholder dairy productionand marketing systems in Ethiopia: IPMS experiences and opportunities for market-oriented development. *IPMS (improving productivity and market success) of Ethiopian farmer's project working paper 31*, Nairobi,Kenya, pp 65.

Bekele Ayshashim, Fekadu Beyene & Mitiku Eshetu (2015). Handling, processing and marketing of cow milk in urban and peri-urban area of Dandila Town Western Amhara Region, Ehioipa. *Global Journal of Food Science and Technology, 3*(3), 159-174

Belay Duguma & G. P. J. Janssen (2014). Smallholder milk processing and marketing characteristics at urban siry farms in Jimma town of Oromia Regional State, Ethiopia. *Global veterinaria, 13*(3), 285-292. ISSN:1992-6197. DOI:10.5829/ idosi. gv.2014.13.0.3.85.11

CSA (Central Statistical Agency). (2016). *Agricultural Sample Survey Volume II Report on Livestock and Livestock Characteristics* (Private Peasant Holdings)

Duguma G, Mirkena T., Haile A., Okeyo, A. M., Tibbo M., Rischkowsky, B., Soelkner , J. & Wurizinger, M. (2011). Identification of Smallholder farmers and pastoralists preference for sheep breeding traits: choice modle approach. *Animal, 5*(12),322-422.

Eyassu, S. & Asaminew, T. (2014). Small-scale milk processing, utilization and marketing of traditional dairy products in Bahir Dar Zuria and Mecha districts, Northwestern Ethiopia. *Journal of Food Technology Research, 1*(3),122-132.

FAO (2011). *A Review of the Ethiopian Dairy Sector. FAO Sub Regional Office for Eastern Africa (FAO/SFE*), Ethiopia

Habtamu Ayalew & Adugnaw Abatenhe (2018). *Dairy cattle production, processing and handling of milk and milk products in Enemay District, East Gojjam, Amhara, Ethiopia Online Journal of animal and feed research, 8*(6), 180-184. ISSN: 239-888X

Kassu Tsageye (2016). Assessment of milk production and marketing systems, and evaluation of the productive performances of crossbred dairy cows in Bona Zuria district of Sidama Zone, Southern Ethiopia (MSc. Thesis), Hawassa University: Hawassa.

Mebrate Getabalew, Tewodros Alemneh & Dawit Akeberegn (2019). Dairy Production in Ethiopia - Existing Scenario and Constraints. *Biomed J Sci and Tech Res, 16*(5),12304 -12309. BJSTR. MS.ID.002903.

Mitiku Eshetu, Mulu Mamo, Mekdes, A. & Yesihak Yusuf (2019). Milk Production, Marketing and Quality in Meta District of Eastern Hararghe Zone, School of Animal and Range Sciences, Haramaya University, Ethiopia. *Journal of Agricultural Science, 11*, (5), ISSN 1916-9752 E- ISSN 1916-9760.

SAS (Statistical Analysis System) (2008). *SAS for windows, Release 9.2.* SAS Institute, Cary, NC, USA.

SPSS (Statistical Procedures for Social Sciences) (2018). *SPSS Version 24*. SPSS, IBM.

Tadesse, A., Galmessa, U., & Bekuma, A. (2020). Milk Handling, Processing

Practices and Quality Evaluation. *Global Journal of Animal Scientific Research, 8*(1), 56-74.

Teshager Ayalew, Belay Duguma & Taye Tolemariam (2013). Cattle milk production, utilizetion and marketing pattern in different agro-ecological districts of Ilu Aba Bora Zone, south western Ethiopia. *Journal of Scientific Research 8*(1), 24-30. ISSN1818-6785. DOI:10.5829/idosi:aejsr.2013.8.1. 6671

Teshome Gemechu & Tesfaye Amene (2017). Dairy cattle milk production, handling, processing, utilization and marketing system in Bench Maji Zone, Southwest Ethiopia *Jornal of livestock production,8*(9),158-167. DOI:10.5897/IJLP2017.0381.

Uddin M .M, Van Huylenbroeck G., Hagedorn K., Sultana M. N. & Peters K. J. (2010). Institutional and organisational issues in livestock service delivery in Bangladesh. *Journal of International Agriculture, 49*(2),111-125.

Ulfina Galmessa, Jiregna Dessalegn, Alganesh Tola, Shiv Prasad & Mulugeta Kebede (2018). Dairy Production Potential and Challenges in Western Oromia Milk Value Chain, Oromia, Ethiopia. *Journal of Agriculture & Sustainability, 2* (1), 1-21.

Zelalem Yilma & Faye Beyene (2006). Handling and microbial load of cow's milk and Irgo fermented milk collected from different shops and producers in central highlands of Ethiopia. *Ethiopian Journal of Animal Production, 6*(2), 7–82.