Journal of Agriculture and Environmental Sciences

Research Article

Management practices and cow comfort of crossbred dairy cows in youth managed dairy farm enterprises, South Gondar Zone, Amhara Region, Ethiopia

Mequanint Biks[1], Asaminew Tassew[2,*] and Fisseha Moges[2]

[1] College of Agriculture and Environmental Sciences, Debre Tabor University, Debre Tabor, Ethiopia
[2] College of Agriculture and Environmental Sciences, Bahir Dar University, P O Box 5501, Bahir Dar, Ethiopia
***Corresponding author:** asaminew2@gmail.com

Received: May 23, 2023; Received in revised form: November 2, 2023; Accepted: November 5, 2023

Abstract: *Good dairy farming methods and cow comfort are essential variables in reproductive efficiency, milk output, milk quality, and dairy cow health. The purpose of this study was to look into the management techniques and cow comfort status of crossbred dairy cows in youth managed dairy farm enterprises in Ethiopia's Amhara region's South Gondar zone. All (20) youth-managed dairy farm enterprises were chosen and questioned using a pre-tested semi-structured questionnaire, and all (204) lactation dairy cows were chosen for cow comfort assessment. The SPSS version 22 program was used to analyze the data. According to the findings, the most common feed sources used for their dairy cattle were formulated and unformulated agro-industrial byproducts followed by non-conventional and hay. Piped (35%) and bore (30%) water were the most common water sources for dairy cattle, with the majority of farms allowing free access to water. The majority of dairy farm firms (70%) uses artificial insemination as well as bull services. The majority of dairy farm enterprises (55%) had shared sheds, followed by individual sheds (45%) built with government assistance (55%), and family (30%) with the same design and construction. The challenges confronting dairy farm enterprises were ranked feed scarcity and high feed costs first, followed by a lack of access to land, a lack of access to markets, and a lack of credit, whereas the opportunities for dairy farm enterprises were ranked first increased demand for milk and milk products first, followed by rapid urbanization, rapid population growth, and the availability of cheap labor. The vast majority of cows (92%) were severely lame, followed by moderate lameness (83%) and the vast majority of cows (52.5%) had moderately injured legs, followed by severely injured legs. The udder and leg cleanliness of most cows was mid cleanliness (52.7%), as opposed to dirty (30%) and clean (17.2%) with a low cow comfort index (0.48). The mean stall length, bed length, brisket board height, neck rail height, lung space, feeder height, and feeder width were 239±16 cm, 222.7±28.3 cm, 10.5±3.6cm, 61.5±15.3 cm, 128.15±21.5 cm, 40.6±8.7 cm, and 36.7±6.9 cm, respectively. The results also revealed that the overall floor softness scored marginal (45%) softness rather than hard (30%) and normal (25%) floor softness. The majority of dairy farm enterprises (55%) did not provide bedding material for their cows and, the bedding materials include straw, hay, and sawdust. Bedding materials are renewed once a month (37.5%), twice a week (37.5%), and once a week (25%). The frequency of manure removal was twice daily (60%), three times daily (30%), and once daily (20%). The findings revealed that the cow's comfort status is poor, so it is recommended that the barn be renovated routine management practices be improved, and assistance from the government and other relevant stakeholders is required in order to obtain credit to renovate the cow barn and improve management practices.*

Keywords: Cow comfort, Dairy enterprises, Management practices, Renovation of cow barn

Citation: Biks, M., Tassew, A. and Fisseha Moges, F. (2023). Management practices and cow comfort of crossbred dairy cows in youth managed dairy farm enterprises, South Gondar Zone, Amhara Region, Ethiopia. J. Agric. Environ. Sci. 8(2): 37-54. https://dx.doi.org/10.4314/jaes/v8i2.3

1. Introduction

After Nigeria, Ethiopia is Africa's second most populous country. The working-age population (15-60 years) accounted for 52% of those populations, and finding jobs for the rapidly rising youthful population is a big concern (Bundervoet *et al*., 2017). To address youth unemployment, the Ethiopian government has engaged youths in various productive agricultural sectors such as crop and livestock enterprises such as dairy, poultry, fattening, and apiculture. Ethiopia has a large livestock population, with approximately 70,291,776 cattle, 42,914,865 sheep, 52,463,535 goats, 2,148,492 horses, 10,791,896 donkeys, 382,784 mules, 8,145,790 camels, and 56,992,987 chickens (CSA, 2021). Among other things, the dairy industry is an important enterprise for income generation, poverty alleviation, job creation, and improving the community's health and nutritional status. The government provides loans, a built barn, and technical assistance for dairy investment.

Producers must offer the correct environment and implement good management methods for their dairy cattle in order to make the dairy farming company sustainable and profitable. Cow comfort and routine management activities are known to have their own effects on dairy farming's sustainability and profitability (Solano *et al*., 2015; Cook *et al*., 2016). The term "comfort" refers to the relationship between cow well-being, housing arrangements, and management practices. Improved cow comfort has been shown in studies to improve reproductive, productive, and economic performance, as well as herd health and longevity (Grant and Miner, 2015; Verdes *et al*., 2020). Poor cow comfort, on the other hand, raises the risk of lameness (van Gastelen *et al*., 2011), reduces lying time and raises the risk of mastitis (Mureithi and Njuguna, 2016), and causes bodily injuries (Cook *et al*., 2016; Jewell *et al*., 2019). The risk factors that contribute to poor cow comfort, on the other hand, can be mitigated through proper barn design, construction, and restoration, as well as routine management efforts.

Youth-managed dairy farm enterprises are currently in operation in Ethiopia in general and in the South Godar Zone of the Amhara Region in particular. However, there is no information available on the overall husbandry practices and cow comfort status of crossbred dairy cows managed by youth groups, as well as the challenges they have faced and strategies that encourage youth dairy enterprise engagement. Thus, research on management techniques and cow comfort aids is important in the development of interventions to increase dairy farming productivity and profitability. As a result, the purpose of this study was to look into the management techniques and cow comfort status of crossbred dairy cows in youth-managed dairy farm enterprises in the South Gondar Zone, Amhara Region, Ethiopia.

2. Materials and Methods

2.1. Description of the study area

The study was conducted in selected towns in the South Gondar Zone of Ethiopia's Amhara Region. Four district towns with youth dairy farm operations were chosen for this study among those: Debre Tabor, Woreta, Addis Zemen, and Hamusit (Table 1; Figure 1). Crop-livestock farming is the primary source of livelihood in the South Gondar zone. The predominant livestock species raised by urban farmers are dairy cattle, beef cattle, and chicken.

Table 1: Description of the study areas

Description	Study sites			
	Debre-Tabor town	Woreta town	Addis Zemen town	Hamusit town
Distance from Addis Ababa (km)	666	606	566	515
Distance from Bahir Dar (km)	100	57.8	83.3	34.6
Altitude (masl)	2,706	1828	1975	1945
Latitude	11^0 51`N	12^0 07`N	12^0 07`N	11^0 46`N
Longitude	$38^0$1`E	$37^0$42`E	$37^0$47`E	$37^0$33`E
Temperature (ºC)	7-21 ºC	13-26 ºC	12-26 ºC	13-24 ºC

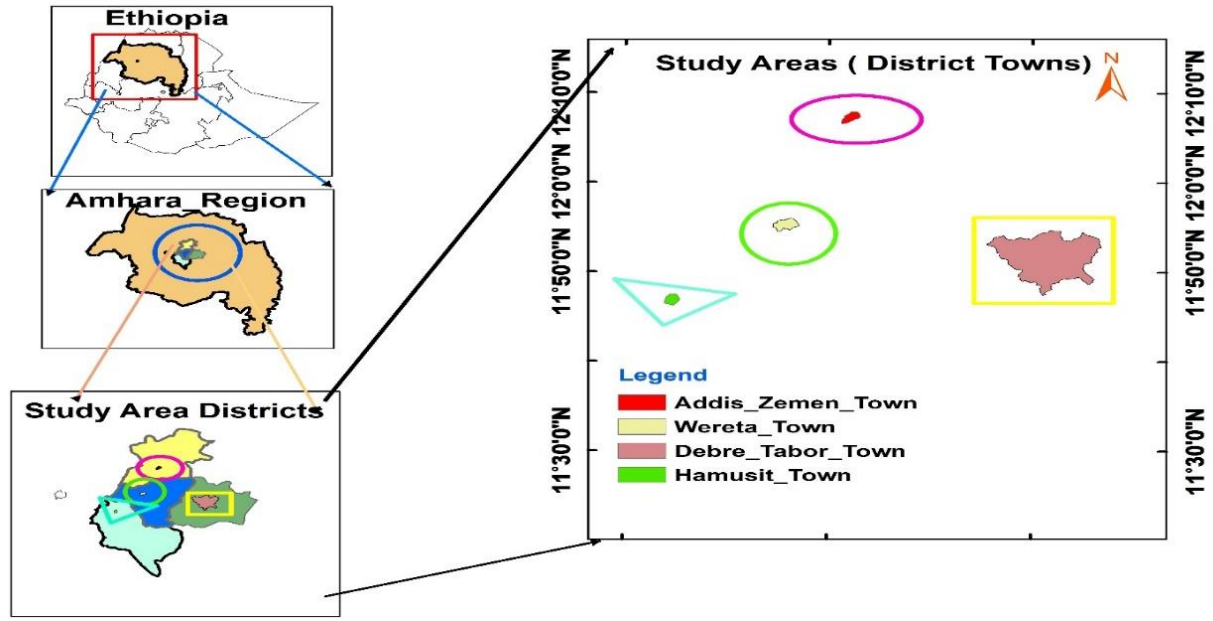

Figure 1: Maps of the study areas

Source: Prepared by Geographic Information System (GIS)

2.2. Methods of data collection

The study used both primary and secondary data sources. To acquire primary data, surveys, focus group discussions, key informant interviews, and measurements were used. Secondary data were collected from published documents, farm record data, reports from zonal and district livestock development and promotion offices, and other non-governmental organizations.

2.2.1. Survey

The study included all youths who ran dairy farm enterprises in the study locations. Lists of youths involved in dairy farm enterprises were provided by the South Gondar zone livestock development and promotion and vocational and enterprise offices. A pre-tested semi-structured questionnaire was used to interview twenty youth-managed dairy farm enterprises (five from Debre Tabor, six from Woreta, five from Addis Zemen, and four from Hamusit towns). To triangulate and validate the survey findings, key informant interviews and focus group discussions were conducted.

2.2.2. Cow comfort assessment

Cow comfort assessments were conducted on 204 lactating dairy cows. The cow comfort assessments included animal-based, environmental-based, and management-based measures and were carried out using the cow comfort assessment methods used by Solano *et al*. (2015) and Vasseur *et al*. (2015).

Animal-based measures such as lameness (normal, moderately lame, severely lame), leg injury (no injury, moderately injured, severely injured), and udder and leg cleanliness (dirty, mid, clean) were evaluated based on the scoring systems used by previous scholars (Solano *et al.*, 2015; Vasseur *et al*., 2015). The number of cows lying down in a barn, and the number of cows standing in a barn, and the number of cows not feeding in a pen were assessed one hour after morning milking to capture maximum laying behavior, and the average value was used as a single observation. Finally, the cow comfort index, stall use index, and stall standing index were calculated by dividing the number of cows lying in a barn by the number of cows who have access to the barn; the number of cows lying in a barn by the number of cows who are not fed in a pen; and the number of cows standing in a barn by the number of cows who have access to the barn.

The environmental-based measures such as stall length, stall width, neck rail height, lung spaces, and brisket board were measured in centimeters using a measuring tape. It is divided into three categories: insufficient length, adequate length, and too long for stall length; insufficient width, adequate width, and too wide for stall width; present but not well positioned, present and well positioned, and not present for the availability of positioning neck rail and brisket board; and insufficient space, adequate space, and too much space for lung and leg space. The floor softness was visually assessed and categorized as (hard or floor caused extreme discomfort on the knees, moderate or floor was somewhat uncomfortable on the knees, such as a cement floor, and normal or floor was soft and did not cause any level of discomfort on the knees), availability of bedding material (yes, no), types of bedding material (grass, straw, sawdust, other), floor condition (muddy or have a high amount of manure, fairly clean or have small amount of manure, clean or no manure). The drainage system was judged by determining whether or not water could flow from the outside surfaces of the stalls and was categorized as (poor, good, very good).

The management-based measures of cow comfort, such as the frequency with which stall manure was removed, the use of bedding material on laying surfaces, and the frequency with which the barn was cleaned, were assessed by preparing a questionnaire and interviewing farm owners.

2.3. Data analysis

The Statistical Package for Social Sciences (SPSS, version 22) software was used to analyze the data. The rank index formula was used to prioritize the constraints and opportunities of dairy farm enterprises. The formula indicated below was used to compute the rank index (Kosgey, 2004).

$$\text{Rank index} = (Rn \times C1 + Rn-1 \times C2 + \cdots + R1 \times Cn)/\sum (Rn \times C1 + Rn-1 \times C2 + \cdots + R1 \times Cn)$$

Where, R_n = the last rank. C_n = the % of respondents in the last rank, C_1 = the % of respondents ranked first.

3. Results and Discussion

3.1. Socioeconomic characteristics of the respondents

More males (69.5%) were participated in dairy enterprises compared to females (30.5%). The majority of enterprise members (45.3%) were between the ages of 21 and 25, followed by those between the ages of 15-20 (25.3%) as indicated in Table 2. This showed that the members are of extremely young or productive ages, putting in more effort for various tasks and being educated in high schools and higher institutions.

The majority of dairy enterprise members (35.8%) held diplomas in various fields of expertise, followed by high school (26.3%) and degree holders (22.1%). This demonstrated that farm owners are capable of adopting modern dairy farm management technologies. The findings are analogous to the findings of Megersa (2016), who claimed that the majority of households keeping crossbreed dairy cows in the urban and peri-urban areas of the Oromia Region were able to read and write, and educated in high school and higher education institutions and their age ranges between 25 and 62. This would imply that crossbreed cow owners have a high correlation to adopt modern dairy animal management technology, and most farmers are also at their productive age and hence they can actively manage their dairy cows.

Table 2: Socio-economic characteristics of the dairy farm enterprises

Socio-economic characteristics		Locations								Overall (N=95)	
		DT (N=24)		WO (N=31)		AZ (N=22)		HM (N=18)			
		N	%	N	%	N	%	N	%	N	%
Sex	Male	18	75	20	64.5	16	72.7	12	66.7	66	69.5
	Female	6	25	11	35.5	6	27.3	6	33.3	29	30.5
Age	15-20	5	20.8	8	25.8	6	27.3	5	27.8	24	25.3
	21-25	10	41.7	14	4.52	10	45.5	9	50	43	45.3
	26-30	6	25	4	12.9	5	22.7	2	11.1	17	17.9
	>30	3	12.5	5	16.1	1	4.5	2	11.1	11	11.5
Educational status	Elementary school	3	12.5	3	9.7	8	36.4	1	5.6	15	15.8
	High school	6	25	10	32.3	4	18.2	5	27.8	25	26.3
	Diploma	8	33.3	11	35.5	7	31.8	8	44.4	34	35.8
	Degree	7	29.2	7	22.6	3	13.6	4	22.2	21	22.1
Marital status	Single	14	58.3	18	58.1	12	54.5	12	66.7	56	58.9
	Married	7	29.2	9	29	6	27.3	4	22.2	26	27.4
	Divorces	3	12.5	4	12.9	4	18.2	2	11.1.4	13	13.7

Note: N = number of observation, DT = Debre Tabor, WO = Woreta, AZ = Addis Zemen, HM = Hamusit

3.2. Cattle herd size and composition

The overall mean number of crossbred cows, heifers, male calves, and female calves was 13±4.2, 1.6±0.9, 5.8±1.1, and 4.4±1.8, respectively (Table 3). The current result is higher than the result of Derege and Yoseph (2014), who reported that the overall average herd size of crossbred dairy herds in Sebeta Awas district was 10.6±2.1 in urban and 11.3±2.0 in peri-urban areas. It is also higher than Melaku's (2016) finding, which stated that the mean number of cows per household in the west Gojjam zone was 4.57 and 3.5±5.2 in urban and peri-urban dairy production systems, respectively.

Table 3: Cattle herd size and composition of the dairy farm enterprises

Cattle herd size	Locations				Overall Mean ±SD
	DT (N=5)	WO (N=6)	AZ (N=5)	HM (N=4)	
	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD	
Cows	13.4±7.3	11.9±3	12.8±3.4	13±3.4	13±4.2
Heifers	2.2±0.8	0.8±0.7	2.2±0.8	1±0.5	1.6±0.9
Male calves	6±1	6.2±1	5.2±0.8	5.9±1.5	5.8±1.1
Female calves	4.6±2.4	4.8±1.2	4.2±1.7	3.5±2.3	4.4±1.8

Note: N = number of observation, DT = Debre Tabor, WO = Woreta, AZ = Addis Zemen, HM = Hamusit

3.3. Feeds and feeding practices

In the study area, the most common feed sources were formulated and unformulated agro-industrial byproducts, followed by non-conventional, hay, and crop residue (Table 4). The agro-industrial byproducts include cereal flour mill byproducts (wheat, maize, rice, sorghum, barely shorts or middling, rice bran, wheat bran, bean or pea bran) and oilseed cakes (nug, cotton, sesame, and peanut seed cakes). Purchased formulated diets, on the other hand, are solely utilized for milk cows. Byproducts of local breweries (such as Atella and brinti) fermented and distilled from cereal crops such as maize, sorghum, barley, wheat, and finger millet were the most common non-conventional feed supplies. According to Minale and Yilikal (2015), hay was used as a dairy cattle feed by 84.96% and 67.67% of dairy producers in the Kucha and Chencha districts of southern Ethiopia, respectively.

Furthermore, all of the enterprises used conserved feeds such as hay and crop residue. To increase feed palatability, they also used mineral (salt) and urea molasses blocks as a lick for their cows. Similar

findings revealed that hay and crop residues were the most common feed resources for dairy cattle in the Shashemene-Dilla milk shed's urban and peri-urban dairy system (Azage *et al*., 2013).

The results revealed that hay was purchased from farmers (70%), school compounds (65%), and university and college compounds (55%). The majority of dairy enterprises (70%) purchased agro-industrial by-product feeds from crop mills, while the remaining (65%) purchased them from oil processors. However, the majority of them purchased formulated feeds from animal feed distributors, followed by feed processing plants. The cost of formulated feeds has grown over the last five years. This is due to a lack of feed processing plants in the area, a lack of other feed resources to replace the formulated feeds in the area, an increase in the prices of inputs used for rationing in the feed processing plant, and an increase in formulated feed customers from year to year.

Table 4: Feeds and feeding practices of dairy farm enterprises

Variables		Locations								Overall (N=20)	
		DT (N=5)		WO (N=6)		AZ (N=5)		HM (N=4)			
		N	%	N	%	N	%	N	%	N	%
Sources of feed	Purchased	5	100	6	100	5	100	4	100	20	100
	Own produces	0	0	0	0	0	0	0	0	0	0
Major purchased feed sources	Unformulated agro-industrial by products	5	100	6	100	4	80	2	50	17	85
	Formulated agro-industrial by products	4	80	6	100	3	60	4	100	17	85
	Non-conventional feeds	3	60	5	83.3	5	100	3	75	16	80
	Hay	5	100	4	66.7	3	60	4	100	16	80
	Mineral (salt, UMB)	3	60	4	66.7	5	100	2	50	14	70
Places to purchase conserved feeds	Farmer	4	80	4	66.7	3	60	3	75	14	70
	School compound	2	40	5	83.3	3	60	3	75	13	65
	University and college compound	3	60	2		4	80	2	50	11	55
Places for purchasing unformulated agro-industrial byproducts	Oil processer	3	60	6	100	3	60	2	50	13	65
	Crop mill	2	40	4	66.7	4	80	3	75	14	70
Places for purchasing formulated feeds	Feed processing plant	5	100	4	66.7	3	60	3	75	15	75
	Distributor	5	100	4	66.7	5	100	2	50	16	80
More supplement is given	Lactating cow	4	80	4	66.7	5	100	3	75	16	80
	Pregnant cow	1	20	2	33.3	0	0	1	25	4	20

Note: N = number of observation, DT = Debre Tabor, WO = Woreta, AZ = Addis Zemen, HM = Hamusit

3.4. Water sources

The most common source of water for dairy cattle was piped water (35%), followed by bore water (30%). The majority of farms provide water to their animals three times per day. Water scarcity (45%), followed by water impurity (30%), the presence of parasites in the water (15%), and distances from the farm (10%), was the area's biggest water concern (Table 5). Similar to the current study's findings, Azage *et al*. (2013) reported that the majority of respondents (71.8%) in the urban dairy farming system (Hawassa, Shashemene, Yirgalem, Dilla) use pipe water for their dairy cattle.

Table 5: Watering practices of the dairy farm enterprises

Variables		Locations								Overall (N=20)	
		DT (N=5)		WO (N=6)		AZ (N=5)		HM (N=4)			
		N	%	N	%	N	%	N	%	N	%
Water sources	River	0	0	0	0	2	40	1	25	3	15
	Pipe water	2	40	2	33.3	2	40	1	25	7	35
	Spring water	2	40	2	33.3	0	0	0	0	4	20
	Bore water	1	20	2	33.3	1	20	2	50	6	30
Frequency of watering per day	Free access	2	40	2	33.3	2	40	3	75	9	45
	Three times	3	60	1	16.7	3	60	1	25	8	40
	Two times	0	0	3	50	0	0	0	0	3	15
Water-related problem	Scarcity	2	40	3	50	3	60	1	25	9	45
	Parasites	1	20	1	16.7	1	20	0	0	3	15
	Impurities	1	20	1	16.7	1	20	3	75	6	30
	Distances to farm	1	20	1	16.7	0		0	0	2	10

Note: N = number of observation, DT = Debre Tabor, WO = Woreta, AZ = Addis Zemen, HM = Hamusit

3.5. Breeding practices

The majority of dairy farm enterprises used both bull and artificial insemination (AI) breeding (70%), followed by those only use AI breeding (45%) (Table 6). The findings revealed that while all dairy enterprises did not have their own breeding bull, the majority of the enterprise owners (64.28%) paid the bull owners to use selected bulls from other farms or neighbors. In addition, some farm owners (21.4%) and (14.2%) used breeding bulls from government breed multiplication centers and institution farms (university or college dairy farms) for free. According to Alemselam *et al.* (2015), the most common breeding method of crossbred dairy cows in Mekele city was both AI and bull (39.5%), followed by AI only (34.5%) and bull only (26%). Similarly, in the East Wollega Zone, the majority of respondents (50.5%) used both natural mating and artificial insemination, followed by bull only (45%) and AI (4%) (Misgana *et al*., 2015). Although the use of AI services in dairy enterprises was growing, the efficiency and effectiveness were not satisfactory. The problem was exacerbated by inexperienced and unskilled technicians, followed by a lack of eustress detection and a shortage of liquid nitrogen and sperm, respectively.

Physical appearances were the most important selection criteria for most dairy farm enterprise owners (80%), followed by pedigree and milk yield. The most common reasons for herd culling were financial constraints (95%) and low milk yield (85%), or herds were sold to pay credit and purchase farm inputs. According to Dessalegn *et al*. (2016), the majority of dairy farm owners in Bishoftu Akaki areas sold their herds for financial reasons.

Table 6: Breeding practices of the dairy farm enterprises

Variables		Locations								Overall (N=20)	
		DT (N=5)		WO (N=6)		AZ (N=5)		HM (N=4)			
		N	%	N	%	N	%	N	%	N	%
Breeding system	Bull	-	-	-	-	-	-	-	-	-	-
	AI	1	20	3	50	1	20	1	25	6	30
	Both	4	80	3	50	4	80	3	75	14	70
Sources of bull	Other farm	1	25	2	100	3	75	3	100	9	64.28
	Multiplication center	2	50	0	0	1	25	0	0	3	21.4
	Institution	1	25	1	0	0	20	0	0	2	14.2
Is there AI problem?	Yes	5	100	6	100	5	100	4	100	20	100
	No	0	0	0	0	0	0	0	0	0	0
Reasons for AI failure	Unskilled and low experiences of technician	2	40	4	66.7	3	60	3	75	12	60
	Shortage of liquid nitrogen and semen	0	60	1	16.7	1	20	1	25	3	15
	Poor heat detection	3	60	1	16.7	1	20	0	0	5	25
Milking cow selection criteria	Color	3	60	5	83.3	4	80	3	75	15	75
	Blood level	3	60	2	33.3	4	80	2	50	11	55
	Physical appearances	5	100	4	66.7	4	80	3	75	16	80
	Pedigree	2	40	3	50	4	80	3	75	12	60
	Milk yield	2	40	3	50	4	80	3	75	12	60
Herd sources for replacement	Owen herd	1	20	2	33.3	2	40	1	25	6	30
	Another herd	3	60	2	33.3	2	40	2	50	9	45
	Purchased from market	1	20	2	33.3	1	20	1	25	5	25
Do you cull your herd?	Yes	5	100	6	100	5	100	4	100	20	100
	No	0	0	0	0	0	0	0	0	0	0
Reason for culling herds	Disease	2	40	2	33.3	1	20	3	75	8	40
	Old age	4	80	2	33.3	3	60	2	50	11	55
	Low milk yield	3	60	6	100	5	100	3	75	17	85
	Infertility of cows	2	40	5	83.3	5	100	3	75	15	75
	Financial constraint's	5	100	6	100	5	100	3	75	19	95
	Feed shortages	3	60	4	66.7	1	20	2	50	11	55

Note: N = number of observation, DT = Debre Tabor, WO = Woreta, AZ = Addis Zemen, HM = Hamusit, AI = artificial insemination

3.6. Dairy cattle health

The major health problems identified in this study area were foot and mouth disease (75%), lumpy skin disease (55%), contagious bovine pleuropneumonia (CBPP) (50%), pasteurellosis (35%), anthrax (25%), blackleg (25%), and external parasites (20%), which further reduces dairy cattle productivity due to morbidity and mortality (Table 7). According to Demissu *et al*. (2014) trypanosomiasis, anthrax, black-leg, bovine pasteurellosis, lumpy skin disease (LSD), contagious bovine pleuropneumonia (CBPP), mastitis, calf scours, skin diseases, internal and external parasites, bloating, and calf pneumonia were the major diseases responsible for low dairy cattle productivity in the West Oromia region.

Table 7: Dairy disease and parasites prevalence in the study areas

Variables		Locations								Overall (N=20)	
		DT (N=5)		WO (N=6)		AZ (N=5)		HM (N=4)			
		N	%	N	%	N	%	N	%	N	%
Diseases	Pasteurellosis	2	40	2	33.3	1	20	2	50	7	35
	Anthrax	1	20	2	33.3	1	20	1	25	5	25
	Blackleg	1	20	2	33.3	1	20	1	25	5	25
	FMD	3	60	4	66.7	4	80	3	75	15	75
	LSD	2	40	4	66.7	2	40	3	75	11	55
	CBPP	2	40	3	50	3	60	2	50	10	50
	Mastitis	1	20	0	0	0	0	1	25	2	10
	Parasite	2	40	1	16.7	0	0	1	25	4	20

Note: N=number of observation, DT= Debre Tabor, WO=Woreta, AZ=Addis Zemen, HM=Hamusit, FMD = foot and mouth disease, LSD = lump skin disease, CBPP = contagious bovine pleuropneumonia

3.7. Housing types and facilities

Due to a lack of land for grazing and exercising, the dairy herd was housed in all locations at night and during the day. The majority of dairy farm enterprises had common sheds (55%) (one shed for more than two dairy farm enterprises), followed by individual sheds (45%) built with the help of governments (55%) and family (30%) with the same design and structure (Table 8). Corrugated iron sheets were used for roof construction in all dairy farm enterprises. The majority of dairy farm enterprises (50%) used wood with mud for wall construction, followed by a concert floor (65%) and toughened soil (35 percent). Alemshet (2014) discovered that the majority of dairy farm houses in the Adigrat area had concert floors, whereas Zemenu *et al*. (2014) discovered that farm owners in Debre-Markos used separate enclosure houses with stone slab floors.

Table 8: Housing types and facilities of the dairy farm enterprises

Variables			Locations								Overall	
			DT(N=5)		WO(N=6)		AZ (N=5)		HM (N=4)			
			N	%	N	%	N	%	N	%	N	%
Types of shed		Individual shed	2	40	1	16.7	3	60	3	75	9	45
		Communal shed	3	60	5	83.3	2	40	1	25	11	55
Who constructs the shed?		Government	4	80	3	50	2	40	2	50	11	55
		Family	1	20	2	33.3	2	40	2	50	7	35
		Own	0	0	1	16.7	1	20	0	0	2	10
Construction materials	Roof	Corrugated iron sheet	5	100	6	100	5	100	4	100	20	100
	Wall	Corrugated iron sheet	0	0	6	100	0		0		6	30
		Wood with mud	4	80	0	0	3	60	3	75	10	50
		Others	1	20	0	0	2	40	1	25	4	20
	Floor	Concert	3	60	4	66.7	2	40	4	100	13	65
		Stone slab or toughened soil	2	40	2	33.3	3	60	0	0	7	35
Availability of individual pen		Yes	4	80	4	66.7	3	60	4	100	15	75
		No	1	20	2	33.3	2	40	0	0	5	25
Availability of feed and water trough		Yes	5	100	6	100	5	100	4	100	20	100
		No	0	0	0	0	0	0	0	0	0	0

Note: N = number of observation, DT = Debre Tabor, WO =Woreta, AZ = Addis Zemen, HM = Hamusit

3.8. Calf rearing and weaning practices

About 75% of dairy farm owners raised their calves through partial suckling, with the remaining 30% using the bucket feeding method (Table 9). Those partially suckled calves suckled the dam freely immediately after parturition in order to get adequate colostrum, and they were separated from their dams and kept in individual pens until weaning age. Calves were allowed to suckle their dams for a few minutes prior to milking to stimulate milk letdown. They were then tied in front of their dams while the cows were milked by hand. Calves were allowed to re-suckle their dams for a few minutes after milking. However, bucket feed calves were separated from their dam at birth and kept in a separate pen until weaning.

The majority of dairy farm owners (75%) weaned calves, and the main reason for calf weaning in most dairy farm enterprises was to prepare cows for mating (45%), followed by getting more milk (20%) and giving rest time for the cows in the next calving (10%). The findings revealed that the weaning age of the majority of crossbred calves was greater than four months. Previous research showed that urban and peri-urban dairy producers weaned their calves at three months of age (59.9%), with the remaining 25.9% and 14.1 % weaning at four months and more than four months of age, respectively (Dereje and Yosef, 2014). The higher weaning age could be due to dairy farm owners using calves to stimulate milk let down.

Table 9: Calf rearing and weaning practices of the dairy farm enterprises

Variables		Locations									
		DT (N=5)		WO (N=6)		AZ (N=5)		HM (N=4)		Overall N=20)	
		N	%	N	%	N	%	N	%	N	%
Milk provision for calf	Bucket feeding	1	20	2	33.3	1	20	2	25	6	30
	Partial suckling	4	80	4	66.7	4	80	2	75	14	70
Do you wean calf?	Yes	3	60	4	66.7	5	100	3	75	15	75
	No	2	40	2	33.3	0	0	1	25	5	25
Reasons for weaning calf	To get more milk	0	0	1	25	2	40	1	33.3	4	20
	To prepare for mating	2	66.7	3	75	2	40	2	66.7	9	45
	To give rest time for next calving	1	33.3	0	0	1	20	0	0	2	10
Weaning age of the calf	Three months	0	0	1	25	0	0	0	0	1	5
	Four months	2	66.7	3	75	1	20	0	0	6	30
	>four months	1	33.3	0	0	4	80	3	100	8	40

Note: N = number of observation, DT = Debre Tabor, WO = Woreta, AZ = Addis Zemen, HM = Hamusit

3.9. Constraints of dairy farm enterprises

Various constraints reduce the productivity and profitability of existing dairy farm businesses. Feed scarcity and high feed costs were ranked first, followed by a lack of land access, a lack of market access, and a lack of credit (Table 10). According to Misgana *et al*. (2015), the main challenges of market-oriented dairy cattle production in the East Wollega zone were feed shortages, a lack of knowledge about local breed selection, unimproved husbandry practices, input scarcity, poor infrastructure, crossbreeding issues, and informal milk marketing. The current findings are also comparable to those of Haile *et al*. (2012), who stated that a lack of animal feeds and limited space were the most significant constraints in urban and peri-urban dairy farms in southern Ethiopia. It is also comparable to the finding of Asrat *et al*. (2013), who reported that the major constraints of dairy production in Boditti town, South Ethiopia, were land scarcity, feed availability and costs, a scarcity of genetically improved dairy animals, discouraging seasonal marketing systems, poor animal health services, waste disposal problems (for urban producers), poor extension services, and a knowledge gap regarding improved dairying.

Similarly, the major constraints for dairy development in Mekelle city were a lack of feed, high feed costs, insufficient land for dairy expansion and feed preparation, seasonality of milk demand due

to fasting season, a lack of improved breed animals at an affordable price, less access to credit, an AI problem, a lack of water, and a knowledge gap in identifying quality crossbred cattle (Solomon, 2014).

The findings also revealed that some of the constraints are imposed by enterprise members, such as youth disinterest in dairy farming, disagreement between enterprise owners due to labor division, and negative attitudes or perceptions of youth groups toward dairy farming. The current study's findings are comparable to the findings of Afande *et al*. (2015), who reported that one factor for youth engagement in agriculture in Kenya was a negative perception of the sector among youth. According to Njeru *et al*. (2014), poor perception of agriculture by youth can also be attributed to the fact that agriculture is perceived as a less worthy subject or as a last resort for underachieving students. Agriculture is also regarded by urban youth as a "dirty job" that they are unwilling to pursue. Due to weaker financial institutions, the small size of start-up capital and lack of credit access were the major throat cuts of small and micro enterprises in developing countries, particularly Ethiopia (Ermias *et al*., 2017).

Table 10: Major constraints of the dairy farm enterprises

Constraints	Index	Rank
Lack of land access	0.19	2
Lack of information	0.13	6
Feed scarcity and high feed costs	0.21	1
Lack of credit	0.16	4
Lack of market access	0.17	3
Negative attitude of youths	0.14	5

3.10. Opportunities for dairy farm enterprises

Despite the presence of various constraints that hamper the development of dairy farm enterprises in the study area, there were also encouraging conditions to improve dairy farm enterprise production and productivity. Milk and milk product demand increased the most, followed by rapid urbanization, rapid population growth, and the availability of cheap labor opportunities (Table 11). Other opportunities for dairy farm enterprises in the study areas included the availability of infrastructure (road and electricity) and favorable environmental conditions.

According to Eyassu and Reiner (2014), the main opportunities for smallholder urban dairy farms in Dire Dawa, Ethiopia, were high milk demand, the presence of high traditional milk consumption habits, the presence of people from various cultural and religious backgrounds, the availability of cheap labor for dairy farms, and milk selling activities. Tsegay *et al.* (2015) discovered comparable findings to the current study in Sidama, Ethiopia, where the primary prospects for the dairy business were market availability (56.3%), infrastructure (22.2%), and veterinarian and artificial insemination services (21.5%).

Table 11: Opportunities for dairy farm enterprises

Opportunities	Index	Rank
Infrastructure availability	0.12	5
Increase demand for milk and milk products	0.23	1
Rapid urbanization	0.21	2
Availability of cheap labor	0.16	4
Rapid population growth	0.18	3
Conducive environmental condition	0.10	6

3.11. Cow comfort assessment of dairy farm enterprises

3.11.1. Animal-based measures

The vast majority of cows (92%) was severely lamed, followed by moderate lameness (83%) and had moderately wounded legs (52.5%) and severely injured legs (Figure 2). This could be due to the type of flooring, the slipperiness of the flooring, the cleanliness of the stall, a lack of bedding material, and a lack of walking or movement area in most dairy farm enterprises (cows were staying in the barn for long hours). A similar finding revealed that the majority of lactating dairy cows in Kenyan smallholder dairy farms were clinically lame, and lameness is a significant economic problem that reduces milk yield (Kathambi, 2018). According to Geenough (2007), lameness is a clinical sign of pain that can be caused by a variety of hoof and leg diseases and disorders. It has also been shown to cause fertility issues by decreasing ovarian activity and decreasing heat expression, and one of the most serious concerns about lameness is the pain associated with it (Rushen *et al*., 2011).

The results also showed that the overall udder and leg cleanliness of most cows (52.7%) (Table 12) was rated as mid cleanliness, as opposed to dirty (30%) and clean (17.2%) (Figure 3). It is lower than the finding of (Nguhiu-Mwangi *et al*., 2013), who stated that in zero-grazing smallholder dairy farms in Kenya, 97% and 90% of cow flanks and udders were grossly dirty with a one-time manure removal frequency per day, respectively. These variations could be attributed to the floor type, drainage condition, cleaning frequency, and high manure removal frequency.

In the current study, dairy cows had a low comfort index (0.48), which is lower than the finding of Ito (2009), who reported that cows spent more time laying down or had more frequent laying events on a well-bedded stall or laying surfaces and in wider stalls than on a strong concrete floor or laying surfaces and in narrow stalls. According to the current study, the number of laying time or cow comfort indexes of cows was less than Kathambi's (2018) report. Lower lying behavior could be caused by barn design, floor type, flooring condition, leg injuries, or barn cleanliness.

Table 12: An animal-based measure of cow comfort in dairy farm enterprises

Parameters		Locations				Overall (N=204)
		DT (N=50)	WO (N=66)	AZ (N=38)	HM (N=50)	
		N (%)	N (%)	N (%)	N (%)	N (%)
Leg injuries	No injured	6(12)	9(13.6)	4(10.5)	5(10)	24 (11.8)
	Moderately injured	24(48)	29(43.9)	23(60.5)	31(62)	107(52.5)
	Severely injure	20(40)	28(42.4)	11(28.9)	14(28)	73(35.8)
Lameness	Normal	5(10)	15(22.7)	6(15.8)	3(6)	29(14.2)
	Moderately lame	16(32)	28(42.4)	15(39.5)	24(48)	83(40.7)
	Severely lame	29(58)	23(34.8)	17(44.7)	23(46)	92(45)
Udder and leg cleanliness	Dirty	17(34)	18(27.3)	18(48.6)	8(16)	61(30)
	Mid	18(36)	37(56.1)	16(43.2)	36(72)	107(52.7)
	Clean	15(30)	11(16.7)	3(8.1)	6(12)	35(17.2)
Total No of animals in a stall		50	66	38	50	204
No of laying animal during the observation		30	36	17	23	106
No of standing animals during observation		20	30	21	27	98
Stall standing index		0.6	0.54	0.44	0.46	0.52
Cow comfort index		0.4	0.45	0.55	0.54	0.48

Note: N = number of observation, DT = Debre Tabor, WO = Woreta, AZ = Addis Zemen, HM = Hamusit

Figure 2: Laying behavior (left) and neck injury (right arrow) of cow

Figure 3: Udder and leg cleanliness of cows

Note: Clean udder and flank (left), dirty udder and flank (middle), medium clean udder and flank (right)

3.11.2. Environmental or barn structure-based measures

The average stall length (SL), bed length (BL), brisket board height (BBH), neck rail height (NRH), lung space (LuS), feeder height (FH), and feeder width (FW) were 239±16 cm, 222.7±28.3 cm, 10.5±3.6cm, 61.5±15.3 cm, 128.15±21.5 cm, 40.6±8.7 cm, and 36.7±6.9 cm, respectively (Table 13). Richards et al. (2017) found that the stall length, neck rail height, feeder height, and feeder width of smallholder dairy farms in Kenya were 235 cm, 65 cm, 50 cm, and 50 cm, respectively. Inadequate stall and bed length limits laying time and may cause lameness or injury due to the long standing of the cow for an extended period of time.

Lower neck rail height may result in neck injury due to high fatigue of the neck rail with the neck, shorter brisket board height, and narrower lung space may result in leg injury because cows place their leg on the brisket locater during lying time, and these were indicators of poor cow comfort and may result in reduced milk yield.

Table 13: Stall dimension of the dairy farm enterprises

Variables	N	SL (cm)	BL (cm)	BBH(cm)	NRH (cm)	LuS (cm)	FH (cm)	FW (cm)
Overall	20	239±16	222.7±28.3	10.5±3.6	61.5±15.3	128.15±21.5	40.6±8.7	36.7±6.9
Debre Tabor	5	236.6±6.8^{a}	225.2±5.4^{a}	9.4±3.0^{a}	50.6±27.7^{b}	151.2±22.7^{a}	43.6±6.3^{ab}	33.8±4.8^{b}
Woreta	6	252.2±25.^{4a}	222.8±46.5^{a}	11±4.0^{a}	68.8±6.9^{a}	156.2±19.1^{a}	46±11.7^{a}	44.9±3.3^{a}
Addis Zemen	5	231.2±6.3^{a}	222.46±6.8^{a}	11.4±4.2^{a}	62.4±1.5^{a}	122.2±7.6^{b}	46±4.9^{b}	32.8±5.3^{b}
Hamusit	4	231.8±6.4^{a}	220.8±5.9^{a}	10.5±0.6^{a}	62.7±8.2^{a}	122.5±15.5^{b}	36±3^{ab}	32..5±5.4^{b}

Note: N = number of observation, SL = stall length, BL = bed length, BBH = brisket board height, NRH = neck rail height, Lus = lung space, FH = feeder height, and FW = feeder width

According to the current findings, the overall floor softness of most dairy farm companies was rated as marginal (45%), rather than hard (30%) or normal (25%) (Table 14). Most dairy farm companies had pretty clean floor conditions (60%) rather than muddy (30%) and clean (10%) and moderate (40%) barn dryness rather than dry and damp. This indicates that most cows had uncomfortable conditions in-floor softness or the floor of most cemented dairy farm enterprises floors do not have any level of comfort on their knees as a result most cows were lying down on such floors.

The drainage systems of most of the farms (45%) were rated as acceptable, followed by poor (35%) and very poor (20%) drainage systems and the roofs of most of the farms had no holes. A poor drainage system may be due to a lack of land or space for manure storage or drainage, as well as poor housing design during construction. It indicated that cows were in uncomfortable conditions due to poor drainage systems, as a bad smell that attracts flies was created, and the owners attempted to smoke inside the house to prevent bad odor and to remove flies on the farm. The presence of bad odors and flies on the farm may reduce milk yield and quality. Most barns in the area had flat floors, and moderate sloppy (35%) followed sloppy (30%), which was uncomfortable for dairy farms due to poor drainage and cow movement in the barn. This unpleasant condition may have reduced dairy cow milk yield. Richards (2017) discovered that more than half of cow barns on Kenyan smallholder dairy farms had bare concreted floors with little or no bedding.

3.11.3. Management based measures of cow comfort

The majority of dairy farm enterprises (55%) did not provide bedding material for their cows, while the remaining (45%) did, using bedding materials such as straw, hay, and sawdust. Bedding materials are renewed once a month (37.5%), twice a week (37.5%), and once a week (25%). Inconsistencies in using bedding materials can be attributed to both a lack of understanding about the importance of bedding materials and a scarcity of bedding materials. Clean, dry, and comfortable resting places are associated with more resting time, better health, and increased productivity. Cows sleeping on sand bedding produce more milk than cows sleeping on straw or sawdust bedding, and cows sleeping on softer surfaces produce more milk than cows sleeping on hard floors (Grant and Miner, 2015).

The frequency of manure removal was twice daily (60%), three times daily (30%), and once daily (20%) (Table 15). It is similar to Richards' (2017) finding that the majority of zero-grazing smallholder dairy farms in Kenya removed manure daily (52.1%), followed by more than once daily (10.6%), twice a week (10.03%), less than weekly (9.9%), every other day (8.3%), and once a week (8.1%). Most farms (55.7%) used bean/pea haulm as bedding material, followed by sawdust. This indicated that dairy business owners had a better understanding of cow management practices.

Table 14: Environmental or barn characteristics based measure of cow comfort

Parameters		Locations				Overall (N=20)
		DT (N=5)	WO (N=6)	AZ (N=5)	HM (N=4)	
		N (%)	N (%)	N (%)	N (%)	N (%)
Floor softness	Hard	1(20)	2(33.3)	2(40)	1(25)	6(30)
	Moderate/ Marginal	2(40)	3(50)	2(40)	2(50)	9(45)
	Normal	2(40)	1(16.7)	1(20)	1(25)	5(25)
Floor condition	Muddy	0 (0)	2(33.3)	3(60)	1(25)	6(30)
	Fairly Clean	4(80)	3(50)	2(40)	3(75)	12(60)
	Clean	1(20)	1(16.7)	0(0)	0(0)	2(10)
Barn dryness	Dry	3(75)	3(50)	1(20)	1(25)	8(40)
	Moderate	1(25)	1(16.7)	4(80)	2(50)	8(40)
	Wet	1(25)	2(33.3)	0	1(25)	4(20)
Drainage system	Poor	0 (0)	3(50)	3(60)	1(25)	7(35)
	Good	4(80)	2(33.3)	1(20)	2(50)	9(45)
	Very good	1(20)	1(16.7)	1(20)	1(25)	4(20)
Presences of ventilation	Yes	2(40)	5(83.3)	4(80)	4(100)	15(75)
	No	3(60)	1(16.7)	1(20)	0(0)	5(25)
Roof condition	Presences of hole	1(20)	2(33.3)	2(40)	1(25)	6(30)
	Absences of hole	4(80)	4(66.7)	3(60)	3(75)	14(70)
Floor flatness	Sloppy	1(20)	2(33.3)	1(20)	2(50)	6(30)
	Moderate	3(60)	2(33.3)	1(20)	1(25)	7(35)
	Flat	1(20)	2(33.3)	3(60)	1(25)	7(35)

Table 15: Management based measure of cow comfort

Parameters		Locations				Overall (N=20)
		DT (N=5)	WO (N=6)	AZ (N=5)	HM (N=4)	
		N (%)	N (%)	N (%)	N (%)	N (%)
Availability of bedding material	Yes	3(60)	2(33.3)	2(40)	2(50)	9(45)
	No	2(40)	4(67.7)	3(60)	2(50)	11(55)
Types of bedding material	Hay	1(33.3)	0(0)	1(20)	1(20)	3(15)
	Straw	2(66.7)	2(40)	0(0)	1(20)	5(25)
	Sawdust	0(0)	0(0)	1(20)	0(0)	1(5)
Frequency of new bedding added	Once a week	0(0)	1(50)	1(50)	0(0)	2(25)
	Twice a week	1(50)	0(0)	0(0)	2(100)	3(37.5)
	Once a month	1(50)	1(50)	1(50)	0(0)	3(37.5)
Frequency of scraping or removing manure	Once a day	1(20)	1(16.7)	1(20)	1(25)	4(20)
	Twice a day	3(60)	3(50)	2(40)	2(50)	10(50)
	Three ways a day	1(20)	2(33.3)	2(40)	1(25)	6(30)
Availability of consistent feed schedule	Yes	2(40)	2(33.3)	3(60)	2(50)	9(45)
	No	3(60)	4(66.7)	2(4)	2(50)	11(55)
Cleanliness of feed and water trough	Dirt	1(20)	2(33.3)	2(40)	1(25)	7(35)
	Moderate	2(40)	3(50)	3(60)	2(50)	9(45)
	Clean	2(40)	1(16.7)	0(0)	1(25)	4(20)

4. Conclusion and Recommendation

The main dairy cow feed sources were formulated and unformulated agro-industrial by-products that were purchased with the highest prices, while the main water sources were piped and bore water with the majority of farms providing water with free access. The majority of dairy farm enterprises use artificial insemination as well as bull services, for which they pay bull owners and travel long distances to obtain breeding bulls. The vast majority of dairy farm enterprises had shared sheds. The major constraints were feed scarcity and high feed costs, lack of land access, lack of market access, and lack of credit. Increased demand for milk and milk products, urbanization, population growth, and the availability of cheap labor were the major opportunities. Most dairy farm enterprises experienced cow lameness and body injuries. Most cows' leg and udder cleanliness was moderate, with a low cow comfort index, and some of them had dirt leg and udder. The barn structure is also not up to the standard. The use of bedding materials is not enough. The cleanliness of the floor, feed and water troughs is also subpar. The findings revealed that the cow's comfort status is poor, so it is recommended that the barn be renovated and routine management practices be improved, and assistance from the government and other relevant stakeholders is required in order to obtain credit to renovate the cow barn and improve management practices.

Acknowledgements

The authors would like to thank the Ethiopian Ministry of Education for financial support. The authors also thank the dairy farm owners for their willingness and cooperation in participating in this study and providing valuable information.

Funding

This study was funded by Ethiopia's Ministry of Education.

Data availability

All data used to support the findings of this study are available upon request from the corresponding author.

Declaration of interest's statement

The authors declare no competing interests.

References

Afande, F.O., Maina, W.N., and Maina, M.P. (2015). Youth engagement in agriculture in Kenya: challenges and prospects. *Journal of Culture, Society and Development*. Volume: 7. DOI: 10.4236/wet.2019.103004.

Alemselam, B., Christopher, R., Goitom, G., Desalew, T., Gidena, D., Tadesse, G., and Simon, C. (2015). Assessment of reproductive performances and problems in crossbred (Holstein Friesian X Zebu) dairy cattle in and around Mekelle, Tigray, Ethiopia. *Animal and Veterinary Sciences*. 3(3): 94-101. DOI:10.11648/j.avs.20150303.14.

Alemshet, B. (2014). *Evaluation of the reproductive performances of crossbred dairy cows (HF x Zebu) and artificial insemination services efficiency in and around Adigrat, Northern Ethiopia. MSc thesis, Haramaya University, Ethiopia 31 p.*

Asrat, A., Zelalem, Y., and Ajebu, N. (2013) Characterization of milk production systems in and around Boditti, South Ethiopia. *Livestock Research for Rural Development*. Volume 25, Article #183. http://www.lrrd.org/lrrd25/10/ayza25183.htm.

Azage, T., Gebremedhin, B.. Hoekstra, D., Berhanu, B., and Mekasha, Y. (2013). Smallholder dairy production and marketing systems in Ethiopia: IPMS experiences and opportunities for market-oriented development. *IPMS (Improving Productivity and Market Success) of Ethiopian Farmers Project Working Paper 31. Nairobi: ILRI*. https://hdl.handle.net/10568/27914.

Bundervoet, T., Fuje, H.N., Ranzani, M., Lange, S., Iimi, A., and Tsehaye, E. (2017). Ethiopia - employment and jobs study. Washington, D.C.: World Bank Group. http://documents.worldbank.org/curated/en/443391562238337443/Ethiopia-Employment-and-Jobs-Study.

Cook, N.B., Hess, J.P., Foy, M.R., Bennett, T.B., and Brotzman, R.L. (2016). Management characteristics, lameness, and body injuries of dairy cattle housed in high-performance dairy herds in Wisconsin. *J. Dairy Sci*. 99, pp. 5879-5891, 2016. https://doi.org/10.3168/jds.2016-10956.

CSA. (2021). Agricultural Sample Survey 2020/21. Volume II report on livestock and livestock characteristics (private peasant holdings)," Central Statistical Agency (CSA): Addis Ababa, Ethiopia.

Demissu, H., Fekadu, B., and Gemeda, D. (2014). Dairy productive potential, challenges and production opportunities of Horro and their F1 jersey crossbred cows: a case of Guduru livestock production and research center and its surroundings, west Oromia Ethiopia. *Sciences Technology and Arts Research Journal*. 3(4):79-84.

Dereje, S., and Yoseph, M. (2014). Evaluation of crossbred heifer calves rearing practices and growth performance in urban and peri-urban dairy systems of Sebeta Awas Wereda, Oromia, Ethiopia. *International Journal of Animal Production*. 16(2):121-132. https://media.neliti.com/media/publications/65556-EN-evaluation-of-crossbred-heifer-calves-re.pdf

Dessalegn, G., Berhan, T., and Gebreyohanes, B. (2016). Dairy cattle husbandry practices and constraints associated with milk production in Bishoftu and Akaki Towns of Oromia region, Ethiopia. *World Journal of Dairy and Food Sciences***.** 11(2): 141-149. DOI:10.5829/idosi.wjdfs.2016.11.2.10430.

Ermias, E., Mekdim, D., Ibrahim, W., Feiruz, Y., and Saba, Y. (2017). The major bottlenecks of micro and small scale enterprises' growth in Ethiopia: An econometric analysis. *Partnership for economic policy working paper*-19, 34 p.

Eyassu, S, and Reiner, D. (2014). Analysis of the dairy value chain: Challenges and opportunities for dairy development in Dire Dawa, Eastern Ethiopia. *International Journal of Agricultural Policy and Research.* 2(6):224-233. http://www.journalissues.org/journals-home.php?id=1.

Grant, R., and Miner, W.H. (2015). Economic benefits of improved cow comfort. *St. Charles (MO): Novus International*. www.novusint.com

Greenough, P. (2007). Bovine Laminitis and Lameness: *A Hands-On Approach. W. B. Saunders Company, Edinburgh, UK*.

Haile, W., Zelalem, Y., and Yosef, T. (2012). Challenges and opportunities of milk production under different urban dairy farm sizes in Hawassa City, Southern Ethiopia. *African Journal of Agricultural Research*.7(26):3860-3866. http://www.academicjournals.org/AJAR

Ito, K. (2009). *Assessing cow comfort using lying behavior and lameness. MSc thesis submitted to the University of British Columbia*. https://central.bac-lac.gc.ca/.item?id=TC-BVAU-17426&op=pdf&app=Library&oclc_number=1033017138

Jewell, M.T., Cameron, M., Spears, J. *et al*. (2019). Prevalence of hock, knee, and neck skin lesions and associated risk factors in dairy herds in the Maritime Provinces of Canada. *J Dairy Sci*. 102(4): 3376–3391. pmid:30738676, 2019. DOI: 10.3168/jds.2018-15080.

Kathambi, E. (2018). *Calf comfort pilot study and compliance and effects of cow comfort recommendations in smallholder dairy farms in Kenya. MSc thesis; University of Prince Edward Island.* file:///C:/Users/user/Downloads/ir-22560-PDF-1.pdf.

Kosgey, I.S. (2004). *Breeding objectives and breeding strategies for small ruminants in the tropics. Wageningen University and Research.*

Megersa, A. (2016). *Reproductive and productive performances of crossbred and indigenous dairy cattle under rural, peri-urban and urban dairy farming systems in West Shoa zone, Oromia, Ethiopia. Jimma University College of agriculture and veterinary medicine MSc Thesis.*

Minale, G., and Yilkal, T. (2015). Dairy production, processing and marketing in Chencha and kutcha districts, southern Ethiopia. *Journal of Marketing and Consumer Research*. 9(9): 6-16. https://www.iiste.org/Journals/index.php/JMCR/article/view/20833/20991.

Misgana., D., Gebeyehu, G., and Gebreyohannes, B. (2015). Characterization of smallholder dairy cattle production systems in selected districts of East WollegaZone, Ethiopia. *World Journal of Dairy and Food Sciences.* 10(2): 95-109. https://idosi.org/wjdfs/wjdfs10(2)15/2.pdf.

Mureithi, D.K., and Njuguna, M.N. (2016). Prevalence of subclinical mastitis and associated risk factors in dairy farms in urban and peri-urban areas of Thika Sub County, Kenya. *Livestock Research for Rural Development*.

Volume 28, Article #13, *http://www.lrrd.org/lrrd28/2/mure28013.html*.

Nguhiu-Mwangi, J., Aleri, J.W., Mogoa, E.G.M., and Mbithi, P.M.F. (2013). Indicators of poor welfare in dairy cows within smallholder zero-grazing units in the peri-urban areas of Nairobi, Kenya. *In: Insights from Veterinary Medicine. InTech*. https://www.intechopen.com/chapters/43171.

Njeru, L., Gichimu, B., Lopokoiyit, M., and Mwangi, J. (2014). Influence of Kenyan youth's perception towards agriculture and necessary interventions: a review. *Asian Journal of Agricultural Extension, Economics & Sociology*.5(1):40-45. DOI:10.9734/AJAEES/2015/15178.

Rushen, J., Butterworth, A., and Swanson, J. (2011). Animal behavior and well-being symposium: farm animal welfare assurance: science and application. *Journal of Animal Science*. 89(4): 1219-1228. https://doi.org/10.2527/jas.2010-3589.

SGZAO. (2019). South Gondar Zone, Agriculture office annual report.

Solano, L., Barkema, H., Pajor, E. *et al*. (2015). Prevalence of lameness and associated risk factors in Canadian Holstein Friesian cows housed in free-stall barns. *J. Dairy Sci*. 98: 6978-6991, 2015. DOI: 10.3168/jds.2015-9652 .

Solomon, M. (2014). *Exploration of challenges and prospects of dairy production: A survey study of Mekelle City, Ethiopia. MA Thesis, Mekelle University, Ethiopia*.

Tsegay, L., Agegnew, A., and Ashenafi, S. (2015). Challenges and opportunities of dairy cattle production in selected districts of Sidama zone, southern Ethiopia. *Journal of Food Science and Quality Management*. 44: 5-12. https://www.semanticscholar.org/paper/Challenges-and-Opportunities-of-Dairy-Cattle-in-of-Asefa-Sharo/6cbcc7b0f569896bd8fdaf5cd0587336b4683a20

van Gastelen, V.S., Westerlaan, B., Houwers, D.J., and van Eerdenburg, F.J. (2011). A study on cow comfort and risk for lameness and mastitis in relation to different types of bedding materials. J. Dairy Sci. 94, 4878–4888. DOI: 10.3168/jds.2010-4019.

Vasseur, E., Gibbons, J., Rushen, J. *et al*. (2015). An assessment tool to help producers improve cow comfort on their farms. *J. Dairy Sci*. 98:698-70, 2015. DOI: 10.3168/jds.2014-8224 .

Verdes, S., Trillo, Y., Peria, A.I., Herradon, P.G., Becerra, J.J., and Quintela, L.A. (2020). Relationship between quality of facilities, animal-based welfare indicators and measures of reproductive and productive performances on dairy farms in the northwest of Spain. Italian Journal of Animal Science. Volume 19, 2020. https://doi.org/10.1080/1828051X.2020.1743784

Zemenu, Y., Mekonen, H., Kelay, B., and Bimrew, A. (2014). Characterization of dairy cattle production systems in Debre-Markos district, Amhara Regional State, *Ethiopia*. *Pacesetter Journal of Agricultural Research*. 2(4): 42-51.