International Journal of Advanced Research in Biological Sciences
ISSN: 2348-8069
www.ijarbs.com
DOI: 10.22192/ijarbs Coden: IJARQG(USA) Volume 6, Issue 6 -2019

Research Article

DOI: http://dx.doi.org/10.22192/ijarbs.2019.06.06.005

# Production System Characterization of Large, Medium and Small Scale dairy farms in Ethiopia: Implications for Developing Breeding Objectives of Holstein Friesian and crossbreed dairy cattle.

Amare Berhe Kidane[1, 3], Kefena Effa Delesa[2], Yesihak Yusuf Mummed[3], Million Tadesse[4]
[1]Samara University, Samara, Ethiopia,
[2]International Livestock Research Institution(ILRI) Addis Ababa, Ethiopia,
[3]Haramaya University, Haramaya, Ethiopia,
[4] Ethiopian Institute of Agricultural Research (EIAR), Holeta, Ethiopia.

## Abstract

In low-input low-out put dairy production systems, characterizing the existing of dairy production systems and identifying of husbandry practices are key factors for developing viable, structured and sustainable breeding programs. Reconnaissance survey, group discussions and interview were conducted using semi-structure questionnaire. Production systems of dairy farms were categorized into three major prevailing dairy production systems. Data were collected from 236 dairy farms and categorized in to large scale (>30 dairy cows), medium scale (>5≤30 dairy cows) and small scale (≤5 dairy cows) dairy farms. Most of the respondents had a secondary level educational background with an overall average percentage of 58%. Majority (55.00%, 67.06% and 55.86% for large, medium and small scale dairy farms, respectively)of the producers were non-agricultural professionals and only with an overall average of 40.69% were an agricultural professional. The current study revealed, majority of the pure Holstein Friesian dairy producers kept dairy cattle mainly for milk production only followed by for both milk production and replacement heifers with an overall index value of 0.46 and 0.38,respectively.Whereas thecross breed dairy cattle owners were attached greater importance primarily for both milk production and replacement heifers followed by milk production only, within and overall index values of 0.43 and 0.40, respectively. Based on the respondents response, the general hygiene and milking practices were significant ($P<0.05$) among the dairy farms. Majority (85%) of the large scale dairy farms and 100% of both the medium and small scale dairy farms were used hand milking. Feed shortage, land shortage, labor and milk prices were the main constraints of dairy production with overall index values of 0.39, 0.39, 0.07 and 0.07, respectively. To improve and sustainable use, it is imperative to measure, observe the existing production environments and involve dairy farmers for manipulating the existing production systems.

**Keywords:** Dairying, Hygienic Practices, Production Systems

# 1. Introduction

Ethiopia is a large and diverse country, which has an estimated population of approximately 109.1 million **(**World Meter, 2019**).**Agriculture is the backbone of the Ethiopian economy and determines the growth of all the other sectors and, consequently, the whole national economy (Atsbaha and Tessema, 2010). Ethiopia is endowed with a staggering number of livestock resources. Recent estimates indicate that 59.5million cattle, 30.6 million sheep, 30.2 million goats,59.5 million of poultry, 2.16 million horses, 8.43 million donkeys and 1.21 million camels are found in the country (CSA, 2016/17).

The livestock subsector has an enormous contribution to Ethiopian national economy and it plays vital roles in generating income to farmers, creating job opportunities, ensuring food security, providing services, contributing to asset, social, cultural and environmental values, and sustain livelihoods of significant number of population. The subsector contributes about 16.5% of the national gross domestic product (GDP), 35.6% of the agricultural GDP (Metaferia *et al*., 2011) and also 30% of agricultural employment (Behnke, 2010). Dairy production is one of the sub-sectors of livestock production that contributes to the livelihood of the Ethiopians through important sources of food and income (Yigremet al., 2008). The dairy sector constitutes about 13.7% of the total agricultural production and 39.4% of the total livestock production (FAOSTAT, 2011).Despite its potential for dairy development, the productivity of livestock genetic resources in general is low, and the direct contribution to the national economy is limited. The average cow milk production per cow in 2009 was 1.86 liters/cow per day (CSA, 2011), and the per capita milk consumption was only about 16 kg/year, which is much lower than African and world per capita averages of 27 kg/year and 100 kg/year, respectively,(FAOSTAT, 2009). According to the(CSA, 2010/11) report the total production of milk from dairy cows in the country was about 4.06 billion liters. Furthermore, the annual rate of increase in milk yield (estimated to be 1.2%) lags behind the increment in human population (estimated to be about 2.7% per annum) (CSA, 2008) and this resulted in compatibility of supply and demand for fresh milk (MoARD, 2004). Ethiopia's human population will increase to about 149.3 million by the year 2040 (FAO, 2005) thus, the demand for animal products is expected to increase substantially. To meet the ever-increasing demand for milk, milk products and their contribution to economic growth, genetic improvement of the indigenous cattle has been proposed as one of the options. According to the road map for growth and transformation of Ethiopia the numbers of crossbreed cows should increase by 793% between 2015 and 2020 (Sharpiro et al., 2015).

Genetic improvement of the indigenous cattle, basically focusing on crossbreeding and introduction of pure Holstein Friesian, particularly in the large scale and medium scale dairy productions, it has been practiced for the last five decades. The large and diverse livestock genetic resources, existence of diverse agro-ecologies suitable for dairy production, increasing domestic demand for milk and milk products, better market opportunity, and proximity to international markets indicate the potential and opportunities for dairy development in the country (Lobago, et al., 2007). However, dairy development has been hampered by multi-faceted, production system-specific constraints related to poor infrastructure and breeding program, genotype, feed resources and feeding systems, access to services and inputs, low adoption of improved technologies, marketing problems and absence of clear policy to support the livestock sector (Negassa et al., 2011: Solomon et al., 2003). Hence, in order to alleviate challenges that limit productivity and thereby exploit the untapped potential, it is necessary to characterize and analyze the existing dairy production systems, identify major constraints along the dairy production, forward pertinent and practical strategies to lighten the problem and to improve dairy sector in the country. So the objective of the study was, to characterize the production systems of the large scale, medium scale and small scale dairy production systems in Ethiopia.

# 2. Materials and Methods

## 2.1. Description of the study area

The study was conducted in large, medium and small scale dairy production systems of Dire Dawa, Harar, Haramaya University, Bishoftu, Holeta agricultural research center and Mekele dairy farms in Ethiopia.

### Dire Dawa

Dire Dawa is geographically located in eastern parts of Ethiopia between 9°27'E and 49'N latitude and between 41°38' N and 19'E longitude and is located 515 km away from Addis Ababa (Melese and Dutamo, 2015).Topographically, it is a dissected mountainous region and its altitude varying from 950 meters above sea level inthe Northeast lowlands to 2,260 meters above sea level in the southeast highlands. Dire dawa has a bimodal rainfall with the mean annual rainfall varying from 550 mm in the northern lowlands to about 850 mm in the southern mountains. The mean annual maximum and minimum temperatures of the town are 31.4$^0$C and 18.41$^0$C, respectively (Mumed and Eshetu, 2015). The total human population of the town is estimated at 288,000 with a growth rate of 2.5% (CSA, 2013).

### Harar

The Harari region is one of the nine administrative regions of Ethiopia. Harari National Regional State is located at a distance of 525 km eastern of Addis Ababa(Salih, 2009). The Harari region lies between latitude 9˚24'N and 9˚42'03"E and 42˚16'E longitude. The Harari region has a wet tropical and receives an annual rainfall between 596 mm and 900 mm in a bimodal pattern. It is located at an altitude of 1850 meters above sea level and has a mean annual maximum and minimum temperature of 25 and 10°C, respectively(Abebe *et al.,* 2014). The total human population of the town is estimated at 125,000 with a growth rate of 2.6% (CSA, 2013).

### Bishoftu

Bishoftu is a town and separate district located in the East Shewa zone at a distance of 45 km South East of Addis Ababa, Ethiopia. The town is located in east Showa zone of Oromia region and it lies 9° North latitude and 40° East longitude at an altitude of 1850 meters above sea level in the central high land of Ethiopia. It has an annual rainfall of 866 mm of which 84% is in the long rainy season (June to September) and the remaining in the short rainyseasonextending from March to May. The mean annual maximum and minimum temperatures of the area are 26°C and 14°C, respectively, with mean relative humidity of 61.3% (IPMS, 2005).

### Holota

Holota is a town and separate district in the Oromia special zone surrounding Finfinnee. The town is located 40 km west of Addis Ababa at 9°30' N and 38°30' E with altitude range from 2300-3800meters above sea level. The annual mean temperature ranges from 14°c to 24°c and annual rainfall ranges from 900-1100 mm. According to the population and housing censes of 2007 the population of the town is 23,296.

### Mekele

Mekelle, the regional capital city of the Tigray region, is located in the northern Ethiopia high lands at 777 kmdrive north of Addis Ababa. Geographically it is located between 13$^0$24' to 13$^0$36' latitude and 39$^0$25' to 39$^0$38' longitude. It has an average altitude of 2200 meters above sea level with a mean minimum, mean maximum and mean average monthly temperatures of 8.7, 26.8 and 17.6° C,respectively (Kibrom, 2005). Mekelle has an estimated total population of 215,546 (CSA, 2008).

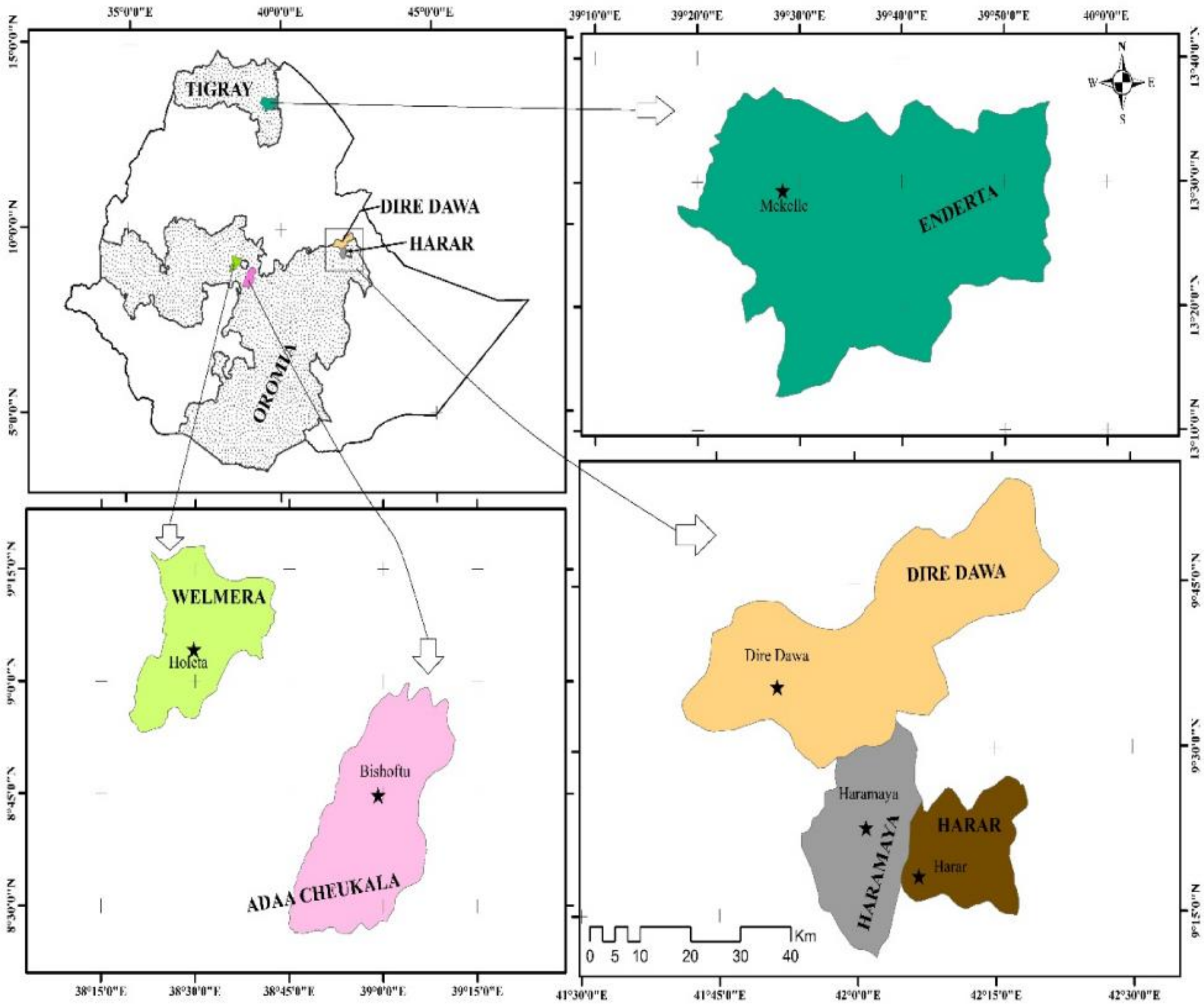


Fig 1 . Study area

## 2.2. Sampling Strategy and Data Collection

In order to characterize the dairy production systems and identify the bottlenecks of dairying in the areas, Dire- dawa, Harar, Bishoftu and Mekele dairy farms were selected purposely. Before the actual work was started, focused group discussions were held with the different experts working, at the regionaland zonal agricultural development office. Discussions were also made with dairy cattle owners and developmental agents across all the production systems to know the current dairy cattle production systems.

Multi-stage purposive and simple random sampling procedure was implementedat three stages. In the first stage, dairy farms were identified based on the milk productionpotentials and accessibility. In the second stage dairy cattle producers were identified and categorized based on the number of dairy cow. In the third stage, individual dairy cow owner households were selected randomly. The total number of households interviewed on the dairy production system was 236 (40, 85 and 111, households for large, medium and small scale dairy farms, respectively). Semi-structured questionnaire and formal interviews were used to gather information from the selected households. The questionnaire was tested before the actual survey to ensure that all questions were sufficiently clear for the interviewees. Data on the general household information, purpose of keeping, husbandry practices and major constraints of dairy cattle productions were collected by trained enumerators.

### 2.3. Data analysis

Statistical analysis software(SAS, 2008) was used to describe the general household characteristics across all the production systems. A one-way analysis of variance was applied for quantitative dependents variables using the production systems as independent variable. Preference ranking and dairy cattle production constraints were ranked by calculating index values with the principle of weighted average according to the following formula.

**Index = $(R_n \times C_1 + R_{n-1} \times C_2 ... + R_1 \times C_n) / \sum(R_n \times C_1 + R_{n-1} \times C_2 + ... + R_1 \times C_n)$**

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. Socio-economic Characteristics of Households in Study Areas

#### 3.1.1. Household Head Characteristics in the Study Areas

Household characteristics of respondents of the study areas are presented in Table 1. The average family size per household were2.40, 3.20 and 2.65 persons in large, medium and small scale dairy cattle producers, respectively, with an overall mean value of 2.81 persons per family. Family size was significance (P<0.05) between medium scale and large scale and small scale dairy producers whereas, it was non significance (P>0.05) between large scale and small scale dairy farms. The size of the family was relatively higher in medium scale dairy producers as compared to that of large scale and small scale dairying. The overall average family size observed in the present study was smaller than that reported by Gatwech (2012) who found that the overall mean household size in Gambella was 7.72 persons per household and Belay and Geert(2014) who reported of 6.02 persons in Jimma town. Some interviewees stated that large family size was very important source of labor for dairy activities. The majority of the respondents (95%, 78.82% and 81.98% for large, medium and small scale, respectively) were male, which was in agreement with results of Azage(2004) in Addis Ababa and Yitaye et al. (2009) in northwest Ethiopia. Age was not significance (P>0.05) among dairy cattle production systems. The mean age of the respondents was 43.90±6.36, 43.35±8.54 and 42.98±8.06yearsfor large scale, medium scale and for small scale farms, respectively. The results indicate that large, medium and small scale dairying farming were generally run by categories of a productive working age group. These might be due to the active involvement of physical activities required by the farming system to satisfy the scarce input like feed to yield optimum production.

Table1. Percentage of Household head Characteristics

| **Variables** | | **Production systems** | | | |
|---|---|---|---|---|---|
| | | **Large scale (n=40)** | **Medium scale (n=85)** | **Small scale (n=111)** | **Over all (n=236)** |
| Sex | Male | 95.00 | 78.82 | 81.98 | 83.05 |
| | Female | 5.00 | 21.18 | 18.02 | 16.95 |
| Family size (mean±SD) | | 2.40±0.74[b] | 3.20±1.53[a] | 2.65±1.2[b] | 2.81±1.31 |
| Age (mean ±SD) | | 43.90±6.36[a] | 43.35±8.54[a] | 42.98±8.06[a] | 43.27±7.96 |
| House hold position | HH | 62.50 | 67.06 | 62.93 | 64.41 |
| | SH | 25.00 | 17.65 | 20.69 | 20.76 |
| | SO | 12.50 | 15.29 | 16.38 | 14.83 |
| Marital status | Married | 60.00 | 76.47 | 70.27 | 70.76 |
| | Divorced | 17.50 | 9.41 | 11.71 | 11.86 |
| | Widowed | 2.50 | 8.24 | 9.91 | 8.05 |
| | Unmarried | 20.00 | 5.88 | 8.11 | 9.32 |

**HH= household head, SH= spouse head, SO= son, n= number of respondents**

### 3.1.2. Educational and Professional Background

Education is the way to improve life of urban and rural communities. The role of education is obvious in affecting household income, adopting technologies, demography, health and as whole the socio-economic status of the family and the country as well (Adebabay, 2009). Hence to increase farmer's knowledge, they shall have learned either regular or irregular way and should send their children to school. The level of education in the large, medium and small scale production systems are presented in Fig 2. Majority (45.00%, 67.06%, and 66.67% for large, medium and small scale dairy producers, respectively) of the dairy producers had a secondary school and with an overall percentage value of 58%. In the current study, only 40.00%, 8.24% and 6.31% for large, medium and small scale, respectively had a university education with an average of 18% and this was lower than the findings of Yusuf (2003) who reported that 24% of the respondents in Harar milk shed in Ethiopia had college and university education and the findings of Belay and Geert (2016) it was reported that the majority (42.6%) of the farmers had college and university education in the smallholder urban dairy producers in Jimma town, Ethiopia. Comparatively, those people involved in large scale dairy production had exposed to higher (40%) education compared to the two production systems.

The current study revealed that, relatively equal proportions of people with agricultural and non-agricultural background of dairy cattle producers were studied. Majority (55.00%, 67.06% and 55.86% for large, medium and small scale dairy farms, respectively) of the producers were non-agricultural professionals and only with an overall average of 40.69% of the respondents were an agricultural professional. Existence of more educated farmers indicates easy adoption of new technologies, using extension messages and training for improved dairy production. However, the higher proportions of non-agricultural professionals involved in the production attract attention as they might not fast enough to adopt new technologies in the field of dairy compared to the agricultural background, as they have not exposed to the basics of farming which would be a background for further progress.

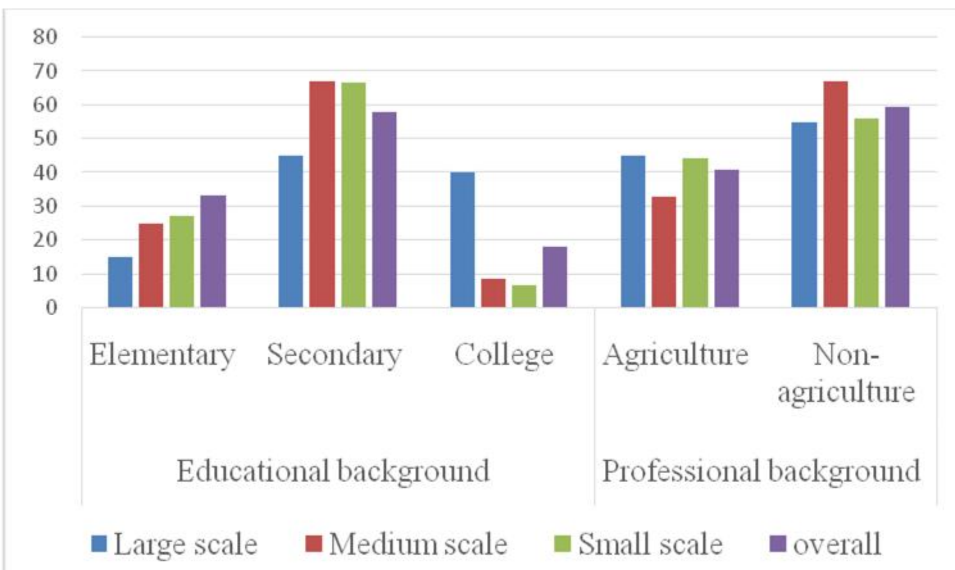


**Fig 2. Educational and Professional statues of dairy cattle producers (%)**

### 3.1.3. Land Holding Pattern

Land holding and land use pattern in the current study areas are presented (Table 2). The overall average for the three scales of dairy productions were 3.78±8.38hectares per household with an average of 6.32, 4.64and 0.39 in large, medium and small scale dairy producers, respectively. The overall land holding per household observed in the study area was higher than that reported, Ayalew (2017) in the rural, peri-urban and urbanareas of South Wollo Zone, which were 0.45ha. Relatively larger size ($P<0.05$) of land was owned by large and medium scale dairy farmers compared to small scale once.

This might be due to the large size of milking cows owned by the two systems which need more feed, the main component of production cost, and a scarce commodity as per the respondents of the interview.

Table 2. Land holding (ha) and land use pattern per dairy cattle producers

| Land uses type | Production systems | | | |
|---|---|---|---|---|
| | Large scale (n=40) | Medium scale (n=85) | Small scale (n=111) | Over all (n=236) |
| Total amount of land | 6.32±19.29[a] | 4.64±5.42[a] | 0.39±0.42[b] | 3.78±8.38 |
| Land for crop | 1.49±1.69[b] | 2.91±3.59[a] | 0.37±0.40[c] | 1.59±1.89 |
| Land for forage | 0.38±1.46[b] | 1.31±2.01[a] | 0.01±0.26[b] | 0.57±1.24 |
| Land for grazing | 2.00±12.65[a] | 0.07±0.30[b] | 0.00[b] | 0.69±4.32 |
| Land for hay conservation | 2.04±6.26[a] | 0.35±0.84[b] | 0.01±0.07[b] | 0.8±2.39 |

Note: means with same letters are not significantly different, n=number of respondents

### 3.1.4. Dairy Cattle Husbandry Practices

#### 3.1.4.1. Purpose of Keeping Dairy Cattle

Reasonable understanding of keeping animals is prerequisite for deriving operational breeding goals (Rewe et al.,2006). Dairy cattle were the most important component of the farming system in the study area since they provide milk, income and meat. Similar functions were reported by Yitaye et al. (2001) in southern Ethiopia. The average ranking for keeping of Holstein Friesian dairy producers and crossbreed dairy producers in large scale dairy farms (Table 3 and 4) indicated that, dairy producers were attached greater importance to milk production only (0.45 and 0.45) followed by milk production and replacement heifers (0.38 and 0.38), respectively. Medium scale Holstein Friesian dairy farm producers were attached greater importance for milk production only (0.52) followed by milk production and replacement heifers(0.34). Unlike, the medium scale Holstein Friesian dairy producers, medium scale crossbreed dairy producers were kept dairy cattle for the purpose of milk production and replacement heifers (0.45) followed by milk production only (0.38),respectively. The study also shows that, small scale dairy producers for both the Holstein Friesian and crossbreed dairy farms, respondents were attached greater importance to milk production and replacement of heifers(0.42 and 0.46, for Holstein Friesian and crossbreed dairy producers, respectively) followed by milk production only (0.41 and 0.37, for Holstein Friesian and crossbreed dairy producers, respectively) (Table 3 and 4). Dairy cattle producers keeping Holstein Friesian breeds were given higher priority for milk production only whereas, crossbred dairy producers were given greater priority to milk production and replacement heifers so, crossbred dairy cattle producers were slightly kept their dairy cattle for dual purpose.

Table 3. Purpose of keeping Holstein Friesian dairy cattle (%)

| Purpose of keeping | Dairy Production system | | | | | | | | | | | | Overall I (n=90) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Large scale (n=20) | | | | Medium scale (n=40) | | | | Small scale (n=30) | | | | |
| | R1 | R2 | R3 | I | R1 | R2 | R3 | I | R1 | R2 | R3 | I | |
| Milk production only | 70.00 | 30.00 | 0.00 | 0.45 | 95.00 | 5.00 | 0.00 | 0.52 | 46.67 | 53.33 | 0.00 | 0.41 | 0.46 |
| Replacement heifers only | 0.00 | 0.00 | 100.00 | 0.17 | 0.00 | 0.00 | 67.50 | 0.11 | 0.00 | 0.00 | 80.00 | 0.13 | 0.14 |
| Replacement draught oxen | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Replacement of draught oxen and milk | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 32.50 | 0.05 | 0.00 | 0.00 | 20.00 | 0.03 | 0.02 |
| Milk production and heifers replacement | 30.00 | 70.00 | 0.00 | 0.38 | 5.00 | 95.00 | 0.00 | 0.34 | 53.33 | 46.67 | 0.00 | 0.42 | 0.38 |

**R1= rank one, R2= rank two, R3= rank three, I= index**

Table 4. Purpose of keeping crossbreed dairy cattle (%)

| Purpose of keeping | Dairy Production system | | | | | | | | | | | | Overall I (n=146) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Large scale (n=20) | | | | Medium scale (n=45) | | | | Small scale (n=81) | | | | |
| | R1 | R2 | R3 | I | R1 | R2 | R3 | I | R1 | R2 | R3 | I | |
| Milk production only | 70.00 | 30.00 | 0.00 | 0.45 | 26.67 | 73.33 | 0.00 | 0.38 | 23.46 | 76.54 | 0.00 | 0.37 | 0.40 |
| Replacement heifers only | 0.00 | 0.00 | 65.00 | 0.12 | 0.00 | 0.00 | 82.22 | 0.14 | 0.00 | 0.00 | 85.19 | 0.14 | 0.13 |
| Replacement draught oxen | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Replacement of draught oxen and milk | 0.00 | 0.00 | 35.00 | 0.06 | 0.00 | 0.00 | 17.78 | 0.03 | 0.00 | 0.00 | 14.81 | 0.02 | 0.04 |
| Milk production and heifers replacement | 30.00 | 70.00 | 0.00 | 0.38 | 68.89 | 31.11 | 0.00 | 0.45 | 75.31 | 24.69 | 0.00 | 0.46 | 0.43 |

**R1= rank one, R2= rank two, R3= rank three, I= index**

### 3.1.4.2. Dairy Cattle Management and Housing Systems

Assessment of dairy cattle management systems and labor force indicated that, large scale dairy farms were managed by employed managers (85.00%) followed by family managers (15.00%). Results of this study farms showed that higher dairy managers were employed than the report of Emebet (2006) who reported 66.7% of the large scale dairy farms of the urban dairy production systems in Dire-Dewa was managed by employed managers. Unlike, to large scale dairy farms, medium scale and small scale dairy farms was managed by family managers (71.76% and 100.00% for medium scale and small scale, respectively)followed by employed managers (28.24% for medium scale farms) (Table 5). Regarding to the labor force, the large scale (80.00%) and medium scale (62.35%) dairy farms were used wage employee labor force whereas, small scale farms (92.79%) were used family labor to manage their dairy farms.In dairy farms, the need to group dairy cows based on their physiological state of production or reproduction was reported as mandatory especially in specialized dairy farms.

A major problem in dairy herds regarding housing is the lack of sufficient space for eachgroup of animals according to age and production (Martin, 1973). In the large and medium scale dairy production systems, majority (95.00%, 95.29% for large and medium scale, respectively) of dairy cattle were managed in a modern barn but, had no individual cattle pen (Table 5). In contrast to the large and medium scale, higher (79.28%) proportions of small scale dairy farm were managed in traditional free stall and only 11.71 percent of the dairy farms were managed under modern barn without individual cattle pen. Similar, to this study farms, large scale (100.00%) and small scale (87.9%) dairy farms of the urban dairy production systems in Dire-Dewa was managed in modern barn without individual cattle pen and in traditional free stall, respectively (Emebet, 2006). The study observations for flour type of dairy farms shows that, large scale (97.50%)and medium scale (68.24%)dairy farms had concrete floor types whereas the small scale (70.27%) dairy farms had hardened soil flour type. Similar to this study farms, majority of cows (93%) in Bishoftu, Ethiopia were housed in concrete type floor barn (Lencho and Seblewongel, 2018). Generally, ideal building material was seldom used in dairy farms in this study (Table 5).

Table 5. Dairy cattle management and housing system (%)

| Activities | Production system | | | |
|---|---|---|---|---|
| | **Large scale (n=40)** | **Medium scale (n=85)** | **Small scale (n=111)** | **Overall (n=236)** |
| **Management and labor force** | | | | |
| Family management | 15.00 | 71.76 | 100.00 | 62.25 |
| Employed manager | 85.00 | 28.24 | 0.00 | 37.75 |
| Family labor | 0.00 | 3.53 | 92.79 | 32.11 |
| Family and wage employee | 20.00 | 34.12 | 7.21 | 20.44 |
| Wage employee | 80.00 | 62.35 | 0.00 | 47.45 |
| **Housing system** | | | | |
| Traditional free stall | 0.00 | 4.71 | 79.28 | 28.00 |
| Modern barn with individual cattle pen | 5.00 | 0.00 | 0.00 | 1.67 |
| Modern barn without individual cattle pen | 95.00 | 95.29 | 11.71 | 67.33 |
| Open barn only fences | 0.00 | 0.00 | 4.01 | 1.34 |
| Presence of calving pen | 80.00 | 21.18 | 9.11 | 36.76 |
| **Flour type** | | | | |
| Hardened soil | 2.50 | 28.24 | 70.27 | 33.67 |
| Concrete | 97.50 | 68.24 | 24.32 | 63.35 |
| Stone slab | 0.00 | 3.53 | 5.41 | 3.00 |
| **Drainage** | | | | |
| Good | 12.50 | 10.59 | 3.60 | 11.90 |
| Satisfactory | 40.00 | 62.35 | 75.68 | 59.34 |
| Poor | 47.50 | 27.06 | 20.72 | 31.76 |

The result revealed that flour type was significant (P<0.05) among production systems. The results of the study showed that drainage system was non-significant (P>0.05) among production systems. In large scale dairy farms, majority (47.50%) of the drainage systems was poor, this was due the uneven land and number of dairy cattle they had. Whereas, small scale (75.68%) and medium scale (62.35%) dairy farms relatively had satisfactory drainage system in their farms.

### 3.1.4.3. Breeding Practices and Artificial insemination Services

The study revealed that, both artificial insemination (Al) and natural mating were practiced in the study farms. Majority of the dairy farms were used artificial insemination with an overall index value of 0.46 and 0.46, for large scale and medium scale, respectively. Whereas majority of the small scale dairy farms were used bull for mating their animal. But,the bulls that used fornatural mating were paid bulls. Unlike to this study, natural mating service (100%) was the widely used breeding method (Belay and Geert,2016)under Smallholder Dairy Farmers' in JimmaTown.Majority of artificial insemination services were provided by governmental services with a mean percentage value of 67.5, 62.35 and 62.16 for large scale, medium scale and small scale dairy farms, respectively followed by both government and privateorganization (Fig 4).

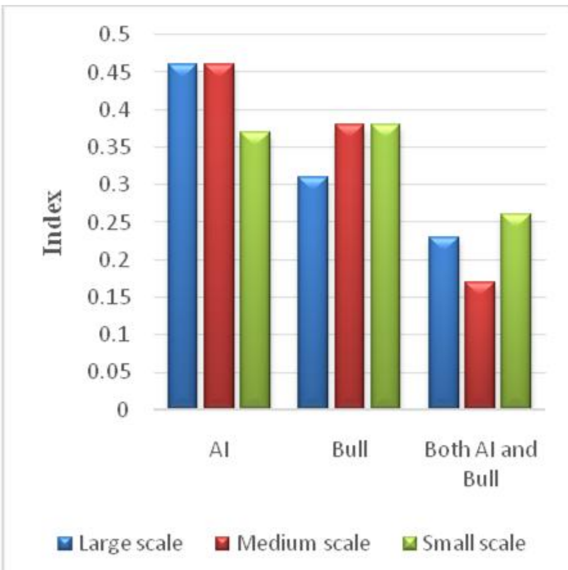


Fig 3. Dairy cattle breeding practices

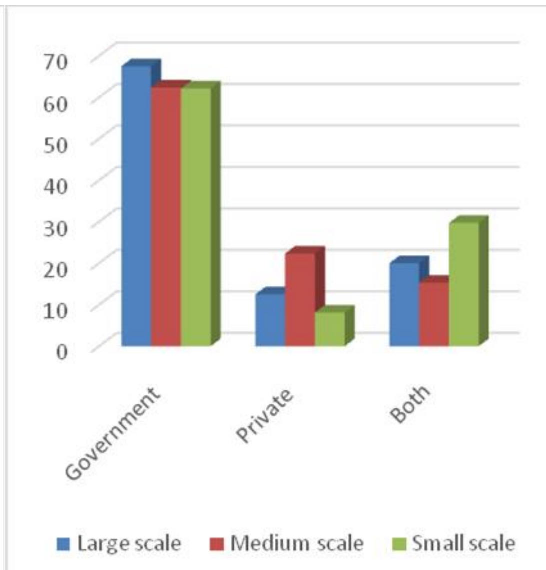


Fig4. Percentage of AI delivery services

### 3.1.5. Management Type and Faming Activity of Dairy Cattle

Management types and faming activities of dairy cattle are presented in Fig 5. The results of the study indicates that majority of the dairy producers were manage their animals in the intensive management systems with a mean percentage value of 90.00, 92.94, and 59.46, for large, medium and small scale dairy productions, respectively (Fig 5). In the large and medium scale dairy production systems, producers does not practice extensive management where as in the small scale production respondents were practice extensive (17.12%) production systems. The mean percentage value of intensive management system practice in the study farms was higher than Shekiet al. (2016) who reported of 25% in the rural areas of Sinana District of Bale Zone, Oromia Region, Ethiopia and Dehinenet et al.(2014) who reported of 20.8% the rural areas of Amhara and Oromia zones of Ethiopia are engaged in an intensive dairy management systems. Unlike, to this study farms, higher proportion extensive dairycattle production system was applied in the peri- urban (93.7%), urban (86.7%) and rural (53.3% areas of Sinana District of Bale Zone, Oromia Region, Ethiopia (Sheki et al., 2016). Producers in Dire dawa, Harar, Bishoftu, Holeta and Mekele dairy farms Ethiopia had better understanding of dairy husbandry and management practices. In the study farms, major farming activity were livestock production (85.00%, 75.27%, and 64.86%, for large, medium and small scale, respectively) followed by mixed production systems (15.00%, 24.71% and 35.14%, for large, medium and small scale, respectively) (Fig 5).

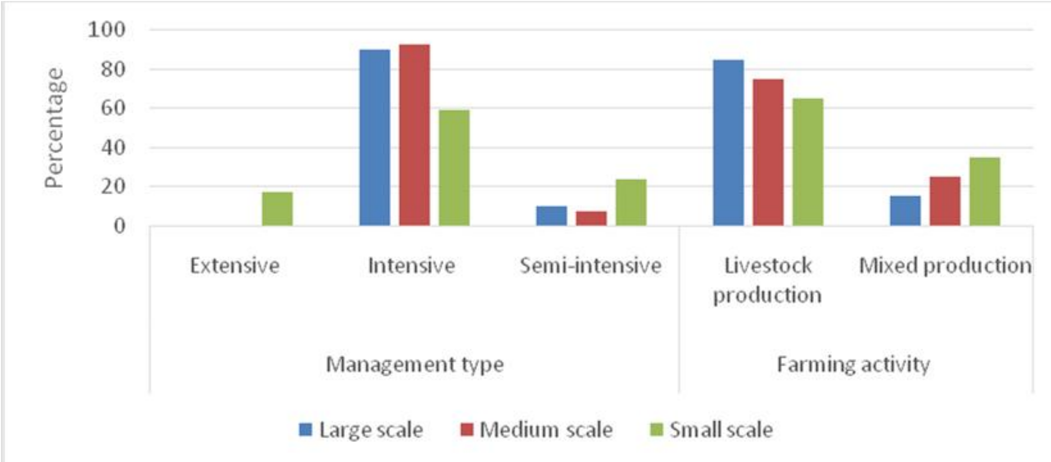


Fig 5. Percentage of respondent on dairy cattle management types and faming activity

### 3.1.6. Dairy Cattle Facilities and General Health Activity

Dairy cattle facilities and health activities are summarized in Table 6 and 7. In the study areas majority of the dairy producers had the paucity of knowledge about dairy cattle facilities. Since it was clear that about 22.5%, 20.00% and 22.83% of the large, medium and small scale dairy farms wereused untreated water supplies from bore holes and others sources by carts and donkeys (Table 6), respectively. Similar, to this study Ahmed and El Zubeir (2013) reported about 25.00% of the dairy farm in Khartoum was used untreated water supplies from bore holes and others sources by donkeys. The present study farms showed that majority (85.00%, 100.00% and 100.00%, for large, medium and small scale, respectively) of the dairy farms had no clinic in their farms and only 5.00% of the large scale dairy farms had clinic in their farms.

Record keeping is the milestone to get healthy milk from the cows for dairy farmers. Record keeping was non-significant (P>0.05) among dairy productions. Comparing to the medium scale dairy farm, greater number of large scale dairy farms had poor recording practices. The study farms showed that, small scale farms had smaller experiences in record keeping for theirdairy farms.The present data also showed that, storage room for forage were absent in most (58.56%) of the small scale dairy farms in Ethiopia (Table 6). Unlike to small scale dairy farms, medium and large scale farms had no store houses with mean percentage value of 25.88% and 5.00% in their dairy farms. The current study showed that, majority (57.50%, 63. 96 %,) of the largeand small scale dairy farms were used aluminum and plastic bowl milk containers, respectively. Unlike to the large scale dairy farms, majority (48.24%)of medium and small scale dairy farms were used stainless steelmilk containers.

Good dairy management practices will ensure that milking routines do not harm the animals or introduce contaminants into milk, that milking is carried out under hygienic conditions and that the milk is handled properly after milking (FAO and IDF, 2011). The current study indicated that, modern technologies for milking cows were not used in most of the dairy farms in Ethiopia. Majority (85.00%) of the large scale dairy farms was practicedhand milking and only 15.00% the dairy farms had used machine milking to milk their dairy cows. Comparing to the large scale dairy farms, none of the medium scale and small scale dairy farms had used machine milking rather they were practiced hand milking (Table 7). Most of the farmers (76% and 87.50%, for large and medium scale, respectively) reported that, they had washed the udder of the cow before milking. Unlike to the large and medium scale dairy farms, majority (54.05%) of the small scale dairy farms was not washed the udder of the dairy cows before milking. Regarding to the monitoring health practices of dairy farms, majority (50.00%) of the large scale farms visit by veterinarians once a week and the remaining (47.50%) the dairy farms was visited daily by veterinarians. In contrast to the large scale dairy farms, majority (92. 79% and 61.18%) of the small and medium scale dairy farms was nottotally visited by veterinarians unless their animals are exposed to risky symptom.

Table 6. Comparisons of water supply, record keeping and milk containers in the farms (%)

| Production systems | Water supply | | | Clinic in the farm | | Record keeping | | store | | Milk containers | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Water pipes** | **Cart** | **Donkey** | **Yes** | **No** | **Yes** | **No** | **Yes** | **No** | **Plastic bowl** | **Aluminum** | **Stainless steel** |
| Large scale | 82.50 (31) | 22.50 (9) | 0.00 | 15.00 (34) | 85.00 (6) | 77.50 (31) | 22.50 (9) | 95.00 (38) | 5.00 (5) | 12.50 (5) | 57.50 (23) | 30.00 (12) |
| Medium scale | 80.00 (68) | 20.00 (17) | 0.00 | 0.00 | 100.00 (85) | 80.00 (68) | 20.00 (17) | 74.12 (63) | 25.88 (22) | 18.82 (16) | 32.94 (28) | 48.24 (41) |
| Small scale | 77.48 (86) | 16.22 (18) | 6.31 (7) | 0.00 | 100.00 (111) | 65.77 (73) | 34.23 (38) | 41.44 (46) | 58.56 (65) | 63.96 (71) | 11.71 (13) | 24.32 (27) |
| Total | 79.99 | 19.57 | 2.10 | 5.00 | 95.00 | 74.42 | 25.58 | 70.19 | 29.81 | 31.76 | 34.05 | 34.19 |
| Level of significance | 0.31$^{ns}$ | | | 0.001$^{***}$ | | 0.06$^{ns}$ | | 0.001$^{***}$ | | 0.001$^{***}$ | | |

***= highly significant (P<0.001) ns= non-significant,

Table 7. General hygiene and milking process in different dairy farms (%)

| Production system | Types of milking | | Cleaning the Udder | | Cleaning milk utensils | | Veterinary visits | | |
|---|---|---|---|---|---|---|---|---|---|
| | **MM** | **HM** | **Yes** | **No** | **Yes** | **No** | **Yes daily** | **Yes weekly** | **No visit** |
| Large scale | 15.00 (6) | 85.00 (34) | 87.50 (35) | 12.50 (5) | 90.00 (36) | 10.00 (4) | 47.50 (19) | 50.00 (20) | 2.50 (1) |
| Medium scale | 0.00 | 100.00 (85) | 65.88 (56) | 34.12 (29) | 65.88 (56) | 34.12 (29) | 5.88 (5) | 32.94 (28) | 61.18 (52) |
| Small scale | 0.00 | 100.00 (11) | 45.95 (51) | 54.05 (60) | 75.68 (84) | 24.32 (27) | 0.00 | 7.21 (8) | 92.79 (103) |
| Total | 5.00 | 95.00 | 66.44 | 33.56 | 77.19 | 22.81 | 17.79 | 30.05 | 52.16 |
| Level of significance | 0.001*** | | 0.001*** | | 0.014* | | 0.001** | | |

MM= machine milking, HM= hand milking, ***= highly significant (P<0.001), *= significant ((P<0.05), **= significant (P<0.01)

### 3.1.7. Feed Resources, Seasonal Fluctuations and Coping Mechanisms

Availability of feed resources, feed fluctuations and coping mechanisms are summarized in Fig 6 and 7. The main feed resources in the study areas were concentrates, natural pasture, crop residues, improved forage and hay (Fig 6). In the large scale dairy farms, majority of the feed used were concentrate followed by improved forage and hay with an index value of 0.43 and 0.35 for concentrate and improved forage and hay, respectively. According to the respondents, improved forage and hay and concentrates followed by crop residue were the main used feed resources in the medium scale dairy farms, (Fig 6). In contrast to the large scale and medium scale dairy farms,improved forage and hay, crop residues andconcentrates were the main feed resourcesin small scale dairy farms. Seasonal fluctuations in availability of feed resources was not significant (P>0.05) among production systems. Most of the respondents (84.31%) in the study area reported that there was seasonal fluctuations in feed resources availability (Fig 7). The dairy cattle owners use different coping mechanisms to overcome feed shortages and this was vary significantly (P<0.05) among production systems. In the large scale and small scale dairy farms, 75% and 75.68% of the respondents, respectively stated that they were purchased feed while the rest 25% and 24.32% for large scale and small scale, respectively were forced to sale their animals during sever feed shortages. Unlike to the large scale and small scale dairy farms, more than half of (51.76%) the respondents were sold their animal as a coping mechanism when availability of feed resources are limited.

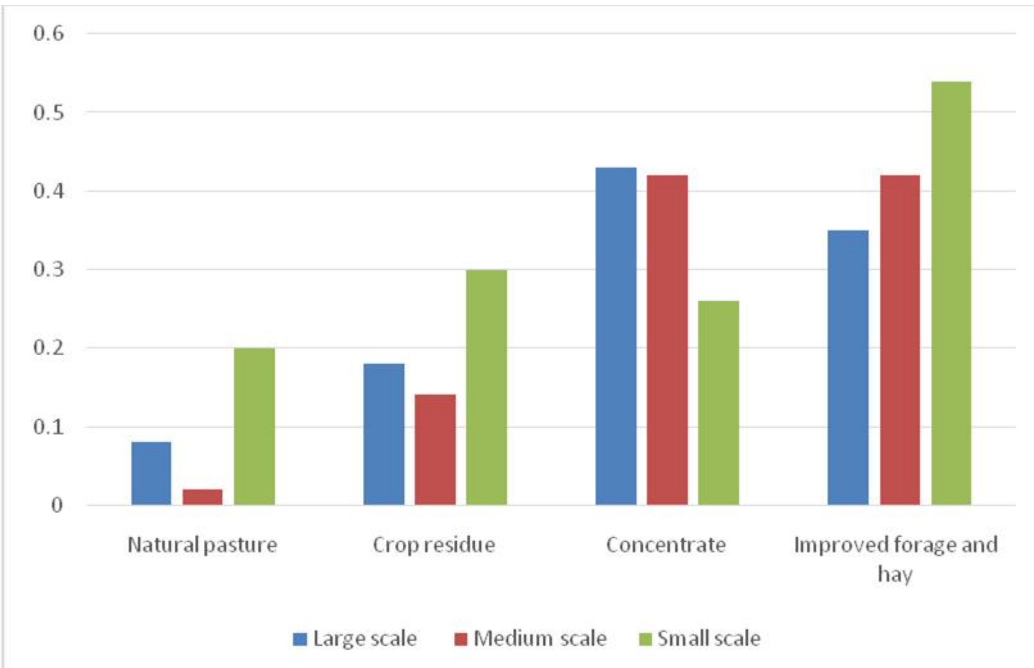


Fig 6.Respondents ranking of feed resources

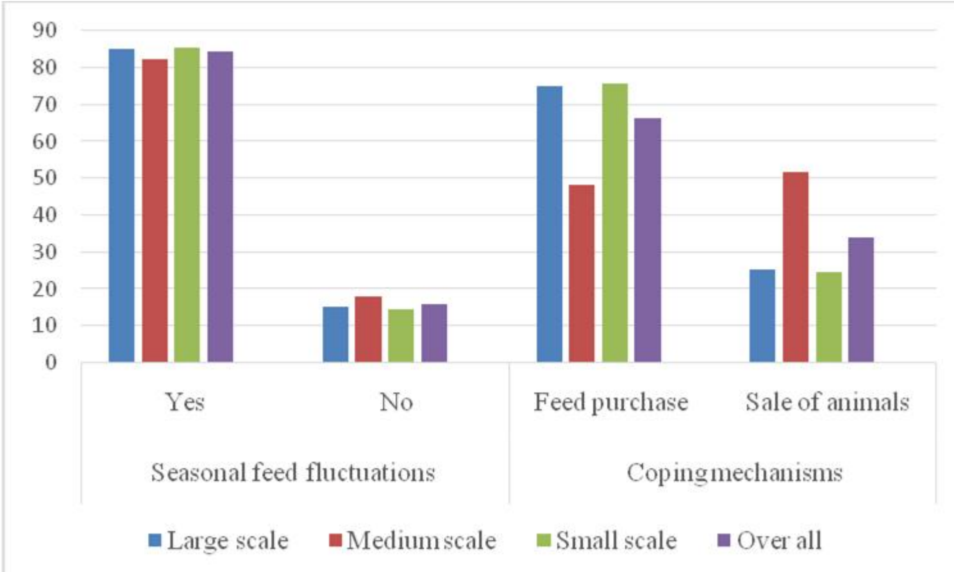


Fig 7 . Seasonal fluctuations and coping mechanisms of feed resources

### 3.1.8. Major Dairy Development Constraints

Major constraints of dairy production as ranked by the respondents in the study area are presented in Table 8.Land shortage, feed shortage, and milk price, labor and artificial services were considered as the most important constraints limiting dairy production in the study area. There was a variation in index intensity in priority constraints among the production systems. Land shortage, feed shortage, and labor were the first three constraints in large scale dairy production with an index value of 0.43, 0.35 and 0.19 respectively (Table 8). Unlike to this report, feed shortage (38.2%) was the major dairy constraints in the high wealth classes of Southern Ethiopia smallholder dairy production (Terete et al., 2014). Similar to the large scale dairy production, Land shortage (0.39), feed shortage (0.39) and milk prices (0.09) were the major constraints in medium scale dairy production, respectively. Similar to this report, land shortage were the central limiting factors of dairy production in Gondar town( Maledee*et al.*, 2015) and Jimma town, Ethiopia (Belay et al., 2012)Inthe small scale dairy farms, feedshortage, land, and milk prices were the three most limiting factors of dairy production with an index value of 0.44, 0.34 and 0.09, respectively. Artificial insemination services (0.06, 0.08 for medium scale and small scale dairy production, respectively) and diseases (0.04, 0.05 for medium scale and small scale dairy production, respectively) were also the most important limiting factors ranked by the respondent (Table8).

Table 8. Dairy production constraints ranked by the respondents and priority indices in different dairy farms

| Dairy cattle Constraints | Dairy production | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Large scale | | | | Medium scale | | | | Small scale | | | | Over all |
| | R1 | R2 | R3 | I | R1 | R2 | R3 | I | R1 | R2 | R3 | I | |
| Feed | 30.0 (12) | 52.5 (21) | 17.5 (7) | 0.35 | 47.06 (40) | 37.65 (32) | 15.29 (13) | 0.39 | 71.17 (79) | 19.82 (22) | 9.01 (10) | 0.44 | 0.39 |
| Land | 62.5 (25) | 32.5 (13) | 5.0 (2) | 0.43 | 48.24 (41) | 37.65 (32) | 14.12 (12) | 0.39 | 26.63 (29) | 52.25 (58) | 21.62 (24) | 0.34 | 0.39 |
| AI services | 0.0 | 0.0 | 0.0 | 0 | 0.0 | 12.94 (11) | 8.24 (7) | 0.06 | 0.00 | 10.81 (12) | 25.23 (28) | 0.08 | 0.05 |
| Milk prices | 0.0 | 0.0 | 17.5 (7) | 0.03 | 4.71 (4) | 8.24 (7) | 23.53 (20) | 0.09 | 2.70 (3) | 9.01 (10) | 28.83 (32) | 0.09 | 0.07 |
| Water | 0.0 | 0.0 | 0.0 | 0.00 | 0.0 | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Labor | 7.5 (3) | 15.0 (6) | 60.0 (24) | 0.19 | 0.0 | 3.53 (3) | 12.94 (11) | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Disease | 0.0 | 0.0 | 0.0 | 0.00 | 0.0 | 0.0 | 25.88 (22) | 0.04 | 0.00 | 8.11 (9) | 15.32 (17) | 0.05 | 0.03 |

## 4. Conclusion and Recommendation

Dairy farming is an indispensable investment option for all levels of dairy farmers. It plays a very important role in nourishing the rural and urban communities of Ethiopia. The present study indicates productivity of dairy cattle is limited by several constraints that include of shortage of land, poor drainage system, limited feed availability, labor problems, disease, poor milk prices, and week management systems and recording practices. To address these constraints the existing knowledge of dairy producers and manipulative proper breeding practices with complete participation of farmers is the best option in improving dairy cattle productivity in Ethiopia. Government and non-government organizations should participate genuinely for the sustainable use of the dairy cattle and dairy producers should also be train on various aspects of improving dairy cattle productivity (nutritional, recording, health, and breeding management) and develop in their entrepreneurial skills.

## 5. Acknowledgments

The authors would like to thank Ethiopian Institute of Agricultural Research (EIAR), for funding this research work and Haramaya University and Holleta agricultural research institution backing this research work. We would like to express our heartfelt gratitude to those all dairy farm owners, all experts and development agents in the study area for their genuine cooperation during data collection.

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How to cite this article:
Amare Berhe Kidane, Kefena Effa Delesa, Yesihak Yusuf Mummed, Million Tadesse. (2019). Production System Characterization of Large, Medium and Small Scale dairy farms in Ethiopia: Implications for Developing Breeding Objectives of Holstein Friesian and crossbreed dairy cattle. Int. J. Adv. Res. Biol. Sci. 6(6): 37-54.
DOI: http://dx.doi.org/10.22192/ijarbs.2019.06.06.005