



Research article

Farmers' perceptions of major challenges to smallholder dairy farming in selected towns of Jimma Zone, Oromia Regional State, Ethiopia: possible influences, impacts, coping strategies and support required

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ABSTRACT

Peri urban and urban small-scale dairy farming is playing a vital role in improving household income, nutrition, food security and employment for low income households in Ethiopia. However, it has been unable to meet the expected demand due to various production constraints. Thus, this study aimed to assess the farmers' perception of major challenges of smallholder dairy production, possible causes, coping strategies and support needed in selected towns of Jimma Zone, Oromia Regional State, Ethiopia. Data were collected from 52 randomly selected dairy farmers using a semi-structured questionnaire. Both qualitative and quantitative methods were used to assess responses to questions in the survey. The results revealed that the main reason for dairy farming was milk production primarily for household consumption. Majority of respondents acquired their crossbred cows through purchases. The effect of demographic characteristics of respondents on herd size and milk yield showed no significant difference ($p > 0.05$). However, there was a tendency for male respondents with university education and retired to own larger herd size (9.33 ± 1.33 and 8.00 ± 4.00) and higher milk yield (8.67 ± 2.67 and 4.50 ± 3.50 L) per cow per day. Feed scarcity (weighted mean index value = 0.371), lack of land ($\bar{x} = 0.311$), diseases ($\bar{x} = 0.077$), lack of improved genotypes ($\bar{x} = 0.061$), lack of credit ($\bar{x} = 0.058$), low productivity ($\bar{x} = 0.036$), lack of or inefficient artificial insemination ($\bar{x} = 0.034$), low milk prices ($\bar{x} = 0.025$), labour shortages ($\bar{x} = 0.023$), and water scarcity ($\bar{x} = 0.004$) were perceived as the major challenges of dairy farming. Based on the findings of the study, it was concluded that proper planning and implementation of appropriate institutional, technical, and technological interventions in an integrated approach with multiple stakeholders and dairy farmers would be essential to overcome the identified constraints of dairy production and to improve food security of dairy farmers in the study area.

1. Introduction

Agriculture is the backbone of the Ethiopia's economy and contributes about 34.1% of the national gross domestic product (GDP), 79% of employment, 79% of foreign earnings, and is the major sources of raw material and capital for investment and market (MoA, 2019). Livestock is an integral sub-sector of the agriculture and contributes about 17–25.3% of the country's GDP, 39–49% of agricultural GDP, over 50% of household income (Shapiro et al., 2017). Livestock also contributes about 12–15% of the export earnings and employs about 60–70% of the population (Azage et al., 2013), and provide a certain degree of security in times of crop failure (CSA, 2020).

Ethiopia is endowed with the largest livestock population in Africa, with approximately 65.35 million head of cattle, 39.89 million head of

sheep, 50.50 million head of goats, 2.11 million head of horses, 8.98 million head of donkeys, 0.38 million head of mules, and 7.70 million head of camel population (CSA, 2020). Livestock production systems in the country include pastoral, agro-pastoral, smallholder mixed farming, and peri-urban and urban production systems. About 75% of the livestock is found in the highlands of Ethiopia. The livestock population is expected to increase driven by population growth, urbanization, income growth, and shifts in dietary pattern or preference for animal sources foods.

Despite the huge number, livestock productivity remained very low to meet the expected demand due to several challenges that limit productivity, such as feed shortage, high prevalence of diseases and parasites, low genetic potential of indigenous breeds, limited or lack of access to artificial insemination (AI) services, inadequate veterinary services, lack

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of access to credit, poor market infrastructures, water shortage, land scarcity, and poor management practices across all production systems (Dawit et al., 2013; Selamawit et al., 2017; Welay et al., 2018).

It is estimated that almost 150 million farm households, i.e. more than 750 million people, are engaged in milk production worldwide, the majority of who are in developing countries (Hemme and Otte, 2011). Eastern Africa is the leading milk producing region in Africa, representing 68% of the continent's milk output. Ethiopia, Kenya and Tanzania are among the biggest dairy producers in Africa. The dairy sector is one of the fastest growing agricultural sub-sectors in the region, generating significant economic returns and opportunities along dairy value chains (FAO, 2011).

In Ethiopia smallholder dairy production plays an important role in poverty alleviation, improving the livelihoods of rural farmers, income generation and the national economy. Dairy farming contributes about 16.5% of the Ethiopian national GDP, 35.6% of the agricultural GDP, 15% of export earnings, and 30% of employment (Behnke and Metaferia, 2010; Metaferia et al., 2011)). Smallholder dairy farming comprises the major milk production in the country and cattle are the main source of milk (CSA, 2010). About 65% of the total milking cows are found in smallholder mixed farming system and produce about 72% of the national milk production per year (FAO and NZAGRC, 2017).

Ethiopia possesses the largest cattle population in Africa estimated at about 65.35 million, of which 97.76%, 1.91% and 0.32% are local, hybrid and exotic breeds, respectively. Dairy cows are estimated to be around 7.15 million and milking cows are about 12.57 million heads (CSA, 2020). Despite the huge number of cattle it has failed to meet the demand of the Ethiopian population and self-sufficiency in milk and dairy products. The national average milk yield of indigenous cows was estimated at 1.37 kg per/cow/day, and average lactation is about six months (CSA, 2017). The country produced over 3.8 billion litres of milk per year (FAO and NZAGRC, 2017). However, the total milk production is very low and unable to meet the domestic demand, leading to import of huge amounts of dairy products to fill the demand gap. In Ethiopia, the estimated per capita annual milk consumption of about 19 L (Dessie and Mirkena, 2011), which is low compared to the average per capita consumption of 27 L/year for African and very much below the recommended consumption levels of 230 L of milk (FAO, 2014). The low milk production in the country has significant consequences on children growth, health, and malnutrition (Land O'Lakes 2010). This shows how crucial is the need to improve milk production in the country using the huge cattle population to increase the food security and income of smallholder dairy farmers.

Earlier studies reported that the low milk production and reproductive performance of dairy cattle in Ethiopia was attributed to several institutional, socio-economic, technical, and technological challenges. The most frequently stated constraints to dairy production included feed shortage, high prevalence of diseases and parasites, low genetic merit of the indigenous cattle, lack of finance and access to credit, poor institutional support, traditional husbandry practices, land scarcity, inadequate veterinary services, lack of access to market, lack or inadequate AI services, poor access to input and services, lack of or inadequate extension services, low efficiency of improved technology adoption, water shortage, labor scarcity, and traditional husbandry practices (CSA2017; Guadu and Abebaw, 2016; Gelila, 2017). Lack of land, feed shortage, diseases, lack of extension services, credit services, improved animal breeds, and access to artificial insemination were important constraints limiting urban dairy production in Jimma town, Ethiopia. High cost of construction of housing, and animal feed, and the lack of timely insemination facilities were major constraints faced by urban dairy farmers in India (Rathva et al., 2020).

The rapidly growing population and urbanization in Ethiopia drive rising demand for dairy products (Land O'Lakes, 2010). Given the predicted population growth, rising income and rapid urbanization in African countries, an understanding of livestock production challenges becomes significant and relevant when thinking about livestock

development and support (Yitaye et al., 2007). Ethiopia is the second most populated country in Africa, and this growing population and increasing urbanization drive rising demand for dairy products by the growing middle class (Land O'Lakes, 2010). There is, therefore, a need for research in urban settings that will consider how livestock owners at large and dairy farmers in particular, are affected in different ways (Yitaye et al., 2007).

The increase in demand for dairy products has offered an opportunity for landless and resource limited urban dwellers to run small-scale family dairy farming in their residential compound to improve their income and livelihoods (Duguma et al., 2011). According to Hemme and Deeken (2005), to meet the rising demand for milk and dairy products, a sustainable and strong dairy farming base will be critical, and to achieve this, it becomes essential to address key challenges faced by dairying such as, low animal productivity, ineffective breeding, improper feed and fodder management, deficient veterinary care, poor farm management practices and low financial inclusion.

In the present study towns, smallholder dairy farming by urban poor households is increasingly becoming important as a source of income, improving nutrition and food security, and employment, taking the opportunity of the rapidly increasing demand for milk and its products in urban areas. The farmers keep both crossbred and local dairy genotypes for milk production. They practice either extensive or zero-grazing/intensive management system. However, dairying is characterized by very low productivity due to various constraints. Sustainable improvement of the smallholder dairy production requires alleviation of the major constraints in the view point of the farmers to ensure optimum productivity. The major constraints to urban small-scale dairy production has been reported in Akaki, Bishoftu and Gonder towns located in central, north and southern Ethiopia (Abebaw et al., 2016; Genzebu et al., 2016; Haile et al., 2012). However, there is limited information with regard to farmers' identified major constraints to dairy production in the current study area. It is, therefore, important to investigate the existing major challenges to dairy production from farmers' viewpoints. The information from the study will provide information for the development and implementation of appropriate interventions that will contribute to the sustainable dairy production. Moreover, it will contribute to the growing source of information on constraints of urban smallholder dairy farming owing to increasing urban dairying as important source of income, nutrition, employment and food security for urban households in Ethiopia and elsewhere. The objective of this study was to assess farmers' perception of major challenges to dairy production, their possible causes, and coping strategies in selected towns of Jimma Zone, Oromia Regional State, Ethiopia.

2. Materials and methods

2.1. Description of the study area

This study was conducted in five districts' capital towns (namely Agaro, Seka, Sheki, Serbo and Yebu) in Jimma Zone, Oromia Regional State, Ethiopia. Jimma Zone is located 352 km southwest of Addis Ababa (Finfinnee), the capital of Ethiopia and Oromia Regional State. The five study towns were selected purposively based on the high dairy cattle production and relative potential of dairy development. The towns are geographically located at: Agaro (latitude 7°40' - 8°04" N and longitude 36°17' - 36°46" E), Seka (7°17' - 7°44" N, 36°17' - 36°42" E), Sheki (7°13' - 8°39" N, 36°43' - 37°12" E), Serbo (7°35' - 8°00" N, 36°46' - 37°14" E) and Yebu (7°38' - 7°54" N, 36°38' - 36°53" E). The altitude ranges from 880 to 2660 m above sea level. Agaro, Seka, Sheki, Serbo and Yebu towns are located at 45, 18, 23, 23 and 22 km from the Jimma town, capital of Jimma Zone, respectively. The mean annual rainfall ranges from 1,400-1,900 mm. The average annual minimum and maximum temperature is 7 °C and 31 °C. Mixed crop-livestock is the predominant production system in Jimma Zone. Indigenous cattle, goats, sheep, equines and poultry are the common livestock species reared, with cattle being the

most predominant species. According to the information obtained from Agricultural and Rural Development offices of the study area, cereals such as barley (*Hordeum vulgare* L.), maize (*Zea mays* L.), sorghum (*Sorghum bicolor* L.), tef (*Eragrostis tef* (Zucc) Trotter.), wheat (*Triticum aestivum* L.), and legumes like faba bean (*Vicia faba* L.), field pea (*Pisum sativum* L.), and haricot bean (*Phaseolus vulgaris* L.) are the major food crops. Coffee (*Coffea Arabica* L.) and Khat (*Catha edulis* F.) are the major cash crops. Ensete (*Ensete ventricosum* Welw.) Cheesman, fruits trees such as avocado (*Pereia Americana* Mill.), mango (*Mangifera indica* L.), papaya (*Carica papaya* L.), and root crops such as cassava (*Manihot esculenta* (cassava), potatoes (*Solanum tuberosum* L.), sweet potatoes (*Ipomoea batatas* L.) Lam, taro (*Colocasia esculenta* L.), and yam (*Dioscorea rotundata*), and vegetables are also grown in considerable amounts for household consumption and local market.

2.2. Study design, sampling procedure and sample size

A cross-sectional study design using random sampling technique was conducted among smallholder dairy farming households in the study area. The target population of this survey consisted of all households in the five towns keeping dairy cattle (indigenous (*Bos indicus*) or crossbred (indigenous \times Holstein Friesian or both genotypes) during this study. A list of all dairy owners was provided by the Office of Livestock and Fisheries Resources Development Agency (OLFRDA) of the respective districts. Accordingly, 151 smallholder urban dairy owners from the five study towns were listed as sampling frame. Specifically, there were 52, 18, 12, 35, and 34 in Agaro, Yebu, Sheki, Serbo and Seka towns used as the sampling frame for the study, respectively. Finally, proportional sample size was used to randomly select a total of 52 dairy farming households (18 in Agaro, six in Yebu, four in Sheki, 12 in Serbo and 12 in Seka towns) for formal survey (Table 1).

2.3. Methods of data collection

A single visit-multiple-subjects formal survey method (ILCA International Livestock Center for Africa, 1990) was used through household face-to-face interviews and personal observation of herd size. A total of 52 randomly selected dairy households were individually interviewed using pre-tested semi-structured questionnaires, which consisted of both open-ended (herd size and structure, major constraints and their ranking according to perceived importance, possible influences of constraints, impacts of constraints, coping strategies, support needed by respondent to overcome the constraints) and closed-ended (sources of income, sources of information, sources of foundation crossbred cows, reasons for keeping dairy cattle) questions. The questions were mostly closed-ended, i.e. with predetermined set of options to choose from, including (if relevant) the option of 'other' where the respondent could specify an option additional to those already defined. The interviews were conducted in local language (Afaan Oromo), face-to-face with each respondent by the author who is native speaker of the local language. Before the actual survey, the questionnaire was pre-tested on 15 dairy farmers from within the five towns but who were not included within the final study and reviewed in order to evaluate its suitability for the respondents. Then, questions which were not clear to the farmers were restated and

necessary modifications were made before the formal survey. To avoid or minimize bias due to interviewer, the interviews were administered in the local language by the author who is native speaker of the language of the interviewees using the pre-tested semi-structured questionnaires. Almost all the respondents were not used to keeping any written records on their dairy farm due to no or low level of formal education, so the researchers relied on the memory of the respondent for obtaining information. The questionnaire covered information on demographic and socio-economic characteristics of the respondents' (not reported in this paper; Duguma, 2020), source of income and information on dairy production, reasons for keeping dairy cattle, means of acquisition of crossbred cow or heifer, breed of dairy cattle, cattle herd size and structure, effect of demographic characteristics of respondents' on dairy cattle herd size and milk yield, farmers' perception of major challenges/constraints to dairy production and their prevailing causes, impacts, farmers' coping strategies and supports needed by farmers from government and non-governmental organizations. Regarding the constraints to dairy production, the respondents were first asked to list all the major constraints to dairy production and then to rank them from the most important to the least important. Moreover, interview with key informants such as animal health and production staff of the respective towns was made. Furthermore, personal observation to ensure herd size and structure was used.

2.4. Data analysis

The data collected were coded and analyzed using the Statistical Package for Social Sciences (SPSS) statistical software version 16 (SPSS, 2007; Inc., Chicago, Illinois, USA) for Windows. Analyses included descriptive statistics such as means and (\pm SE; standard error), frequencies and percentages values. One way ANOVA was used to test the variability of different variables among the five towns such as crossbred and indigenous breed of dairy cattle holdings. Differences among means were evaluated using Duncan Multiple Range Test at $P < 0.05$. T-test was used to compare means of herd size and structure of crossbred and indigenous breeds of dairy cattle. Cross tabulations and Chi-square (χ^2) test was used to examine differences between levels of significance of different categorical variables among towns. Student's unpaired t-test and one way ANOVA were used to assess the difference between the means of the farmer demographic characteristics and herd size and milk yield. Statistically significant differences were reported if the p value was <0.05 . Indices (weighted averages) were calculated to represent overall weighted average rankings of the constraints of dairy production according to importance with the formula: Index = sum of (7 for rank 1 + 6 for rank 2 + 5 for rank 3 + 4 for rank 4 + 3 for rank 5 + 2 for rank 6 + 1 for rank 7) given for an individual or specific reason or preference divided by the sum of (7 for rank 1 + 6 for rank 2 + 5 for rank 3 + 4 for rank 4 + 3 for rank 5 + 2 for rank 6 + 1 for rank 7) summed over all reasons.

2.5. Ethical approval

The data collection instruments (household survey questionnaire) was reviewed for ethical clearance and approved by the Jimma University, College of Agriculture and Veterinary Medicine. Moreover, informed consent was obtained from all surveyed households of this research. Participation in this study was voluntary with strict confidentiality of information and freedom to stop participating at any time.

3. Result and discussions

3.1. Major sources of household income and information

The main sources of household income and information in the study area are presented in Table 2. The percentages, given in all the results of this study indicate the percentages of the respondents interviewed, unless

Table 1. Proportionate distribution of urban farmers according to district towns.

Town	Estimated number of dairy farmers	Proportion	Number selected
Agaro	52	(52/151) \times 52	18
Yebu	18	(18/151) \times 52	6
Sheki	12	(12/151) \times 52	4
Serbo	35	(35/151) \times 52	12
Seka	34	(34/151) \times 52	12
Total	151		52 (34%)

Table 2. Sources of income and information in a cross-sectional survey of 52 smallholder dairy farmers in selected towns of Jimma zone, Ethiopia (% of respondents in each town and overall).

Sources of income or information	Study towns						P-Value
	Agaro	Yebu	Sheki	Serbo	Seka	Overall	
Major source of income							0.030
Dairy farming	66.7	16.7	0.00	0.00	16.7	27.8	
Crop production	16.7	33.3	0.00	16.7	58.3	25.0	
Small business (trade)	22.2	16.7	75	25	0.00	20.0	
Employment/salaries	5.5	0.00	0.00	25	25	11.1	
Livestock production	5.5	16.7	25	0.00	0.00	9.4	
Remittances	0.00	16.7	0.00	16.7	0.00	6.7	
Secondary source of income							0.090
Pension	72.2	33.3	50	100	75	66.1	
Small business	5.5	33.3	25	0.00	0.00	12.8	
Mini shops	5.5	33.3	0.00	0.00	2.8	8.3	
Dairying	0.00	0.00	25	0.00	8.3	6.7	
Sale of fuel wood	11.1	0.00	0.00	0.00	0.00	2.2	
Salary	0.00	0.00	0.00	0.00	8.3	1.7	
Crop and livestock farming	5.5	0.00	0.00	0.00	0.00	1.1	
Source of information for dairy farming							
Local Livestock Extension Agents (LEAs)	22.2	66.7	100	25	25	47.8	
Other dairy farmers	33.3	16.7	0.00	0.00	0.00	10.0	
Mass media, books and LEAs	5.5	0.00	0.00	8.3	25	7.8	
Radio and television programs	0.00	0.00	0.00	0.00	33.3	6.7	
Books	0.00	0.00	0.00	0.00	8.3	1.7	
Books and LEAs	0.00	0.00	0.00	8.3	0.00	1.7	
Mass media and books	0.00	0.00	0.00	8.3	0.00	1.7	
No information	38.9	16.7	0.00	50	8.3	22.8	
Received training on dairy farming?							
No	100	100	100	100	100	100	

otherwise stated. The main sources of income for the respondents, in decreasing order of importance, were from dairying or sale of milk, crops, salaries, and trading. Pension and trading were reported to be the second most important sources of income by 66.1% and 12.8% of respondents, respectively. Although sale of milk was the main sources of income, most of the respondents depended on other off-farm activities, and produced milk as a complementary source of income.

The most common sources of getting information on dairy production and management practices included from local Livestock Extension Agents (LEAs), followed by from other dairy farmers, mass media, books and LEAs, radio and television (broadcasts) programs (Table 2). However, about 22.8% of respondents indicated that they had no access to sources of information. None of the respondents received training on dairy management practices, which could be attributed to lack of access to adequate extension services. Therefore, the local Livestock and

Fishery Resources Development and Animal Health Agency office should provide training to the farmers on recommended dairy management practices (breeding, feeding, health, disease control, housing, economic and marketing), since training of farmers is one of their main mandates. The availability of adequate extensions services to small-scale dairy farmers increases their adoption of improved dairy technologies and could eventually have a significant impact on enhancing milk productivity.

3.2. Reasons for keeping dairy cattle and means of acquisition of crossbred foundation cow

The main reasons for keeping dairy cattle are presented in Table 3. The need to produce milk mainly for home consumption was the main reason for keeping dairy cattle, followed by milk for sale and both for home

Table 3. Reasons for keeping dairy cattle and sources of foundation crossbred cows in a cross-sectional survey of 52 smallholder dairy farmers in selected town of Jimma zone, Ethiopia (% of respondents in each town and overall).

Variable	Study towns						P- Value
	Agaro	Yebu	Sheki	Serbo	Seka	Overall	
Reasons for keeping dairy cattle							0.433
Home consumption	72.2	33.3	75.0	75.0	83.3	52.8	
Source of income	22.2	33.3	0.00	8.3	8.3	15.4	
Both for income and home consumption	5.5	33.3	25.0	16.7	8.3	17.8	
Means of acquisition of foundation crossbred cow							0.055
Purchased	55.6	16.7	75.0	91.7	83.3	64.5	
Upgrading local cows using improved bull	22.2	50.0	0.00	8.3	16.7	19.4	
Upgrading local cows using AI	22.2	33.3	25.0	0.00	0.00	16.1	

consumption and as a source of income. Majority of the respondents produced milk for subsistence, which was attributed to the use of mainly indigenous dairy genotypes with low milk production potential, feed scarcity in quantity and quality, poor access to AI, and lack of land for grazing and forage production. The present findings contradict with results of Haile et al. (2012), who reported that the sale of milk to generate income was the main reason for keeping dairy cattle in Hawassa town. However, our finding is in agreement with the results of Makokha et al. (2006), who also reported that milk production for household consumption and cash income was the main reasons for keeping dairy cattle in Kenya.

Farmers' sources of foundation crossbred cows are presented in Table 2. The results showed that there was a significant difference ($P < 0.05$) in the mode of acquisition of their foundation crossbred cows across the study towns. Interviewed farmers acquired their foundation crossbred dairy cows from various sources. Majority (64.5%) of respondents acquired their foundation crossbred cows or heifers through purchases, followed by upgrading their local cows through improved bulls and upgrading their local cows through artificial insemination. The fact that majority of the respondents acquired their crossbred cows through purchasing shows that the farmers were using only indigenous breed of cattle for milk production before acquiring their crossbred dairy cows. However, due to lack of record keeping, it was difficult to know the exotic blood level of their purchased crossbred cows. In agreement with the present finding, Mburu (2015) also reported that majority (75.9%) of the farmers in coastal lowlands of Kenya acquired their upgraded or grade dairy cows through purchase.

3.3. Herd size and structure of crossbred and indigenous dairy cattle

Herd size and structure of crossbred and indigenous dairy cattle owned per household are presented in Table 4. Respondents kept both crossbred and indigenous cattle and the total number of dairy cattle kept by all respondents was 357 animals, of which total of 95 were crosses of indigenous x Holstein Friesian and the rest 262 animals were indigenous zebu breed. This indicates that the majority of the dairy cattle kept by the respondents were the indigenous cattle breed.

On average, the crossbred (indigenous x Holstein Friesian) dairy herd constituted 26.6% of the total dairy cattle kept by respondents.

Respondent farmers who kept crossbred dairy genotypes reported that the main reason for preferring them was due to their higher milk production potential, fast growth rate, and higher body weight selling price compared to the local breed.

The overall average herd size of crossbred cattle per household was 1.83 ± 0.46 , comprising of 22.95% milking cows, 18.03% dry cows, 12.57% female calves, 12.57% male calves, 19.13% growing heifers, 10.38% breeding bulls and 4.37% pregnant heifers. This finding in respect of herd size is comparable with earlier reports (Sintayehu et al., 2006; Mekonnen et al., 2006), but is lower than that of Gelila (2017). Lactating cows comprised the highest (23 %) proportion of the total herd sizes, due to their importance for increased milk production and breeding to produce future replacement heifers. The mean number of bulls varied significantly ($p < 0.05$) between towns. None of the respondent in Sheik and Yebu towns owned breeding bulls, and relied on either AI or bulls from neighbors. The low crossbred herd size observed in the current study could be attributed to their high price, lack of access to AI services, feed shortage, lack of land, and their susceptibility to local diseases when managed under free grazing system. Interviewed farmers did not know the exotic blood level of the crossbred dairy animals kept due to lack of records.

The herd size and structure of the indigenous dairy cattle per household is also presented in Table 4. For the herds surveyed, the major dairy breed kept by the farmers was the indigenous zebu and constituted 73.4% of all herds owned by the respondents. For indigenous cattle, the average herd size per household was 5.04 ± 0.46 , comprising of 22.02 % lactating cows, 23.21% dry cows, 12.10 % male calves, 14.48% female calves, 2.18% pregnant heifers, 14.88% growing heifers, and 10.71% breeding bulls. The mean number of male calves and growing heifers varied significantly ($p < 0.05$) between study towns. Dry cows (23.2%) comprised the major proportion of the total herd of indigenous cattle, followed by lactating cows indicating their importance for production and breeding purpose as well as for sustainability of the herd. The mean number of heifers and female calves suggest that there is a major shortage of replacement heifers on the small-scale farms in the current study and seems a key concern for sustainability of dairying.

Despite their low productivity, respondents valued the indigenous genotypes for their well adaptation to the local or tropical production environment including tolerance to heat and feed and water shortages,

Table 4. Mean \pm SE of herd size and structure of crossbred and indigenous breeds of dairy cattle per household in a cross-sectional survey of 52 smallholder dairy farmers in selected towns of Jimma zone, Ethiopia.

Herd size and structure*	Study Town						P-Value
	Agaro	Yebu	Sheki	Serbo	Seka	Overall	
Crossbred cattle							
Milking cows	0.28 ± 0.11	0.83 ± 0.83	1.25 ± 0.25	0.33 ± 0.25	0.25 ± 0.13	0.42 ± 0.12	0.220
Dry cows	0.39 ± 0.02	0.00	0.00	0.55 ± 0.24	0.33 ± 0.33	0.33 ± 0.13	0.807
Male calves	0.11 ± 0.08 ^a	0.00 ^b	1.0 ± 0.41 ^c	0.25 ± 0.13 ^{ab}	0.25 ± 0.18 ^{ab}	0.23 ± 0.07	0.017
Female calves	0.17 ± 0.12	0.33 ± 0.33	0.50 ± 0.29	0.17 ± 0.17	0.25 ± 0.18	0.23 ± 0.08	0.851
Pregnant heifers	0.06 ± 0.0.06	0.00	0.00	0.17 ± 0.17	0.08 ± 0.08	0.08 ± 0.05	0.843
Growing heifers	0.44 ± 0.18 ^a	0.00 ^a	1.50 ± 0.50 ^b	0.08 ± 0.08 ^a	0.25 ± 0.25 ^a	0.35 ± 0.11	0.010
Bulls	0.28 ± 0.13	0.00	0.00	0.08 ± 0.08	0.33 ± 0.26	0.19 ± 0.08	0.608
Total	1.72 ± 0.59	1.17 ± 1.17	4.25 ± 0.63	1.58 ± 1.04	1.75 ± 1.33	1.83 ± 0.46	0.661
Indigenous cattle							
Milking cows	0.77 ± 0.21	0.67 ± 0.33	1.00 ± 0.71	1.25 ± 0.35	1.75 ± 0.30	1.11 ± 0.15	0.121
Dry cows	1.14 ± 0.33	1.00 ± 0.36	1.75 ± 0.25	1.17 ± 0.27	0.67 ± 0.28	1.17 ± 0.16	0.337
Male calves	0.55 ± 0.14	0.17 ± 0.17	0.25 ± 0.25	0.58 ± 0.26	1.08 ± 0.23	0.61 ± 0.10	0.085
Female calves	0.67 ± 0.02	1.00 ± 0.45	0.75 ± 0.48	0.83 ± 0.27	0.58 ± 0.23	0.73 ± 0.12	0.888
Pregnant heifers	0.11 ± 0.0.07	0.00	0.00	0.08 ± 0.08	0.25 ± 0.18	0.11 ± 0.05	0.654
Growing heifers	0.44 ± 0.17	0.50 ± 0.34	0.50 ± 0.50	1.00 ± 0.27	1.17 ± 0.40	0.75 ± 0.14	0.285
Bulls	0.50 ± 0.18	0.67 ± 0.21	0.00	0.17 ± 0.17 ^a	1.08 ± 0.29 ^b	0.54 ± 0.11	0.032
Total	4.50 ± 0.68	4.0 ± 0.89	4.25 ± 1.44	5.08 ± 1.16	6.58 ± 1.04	5.04 ± 0.46	0.427

SE = standard error; means within a row with different superscript letters differ significantly at $P < 0.05$; * calves <12 months, bulls and cows >3 years, growing heifers 12–24 months, pregnant heifers 2–3 years.

diseases resistance, ease of management, longevity, and good qualities of milk and its products than those of the improved dairy breeds, which are susceptible to diseases, heat, and limited feed resources availability. Other reasons stated by respondents were less expensive to acquire and maintaining, high longevity and long experience of keeping them under traditional management practices. These findings are in agreement with Mekonnen et al. (2010). Despite their adaptation to local production environment, the farmers mentioned low milk production and poor reproductive performance were reported to be the bad traits of indigenous dairy breeds, and this result is consistent with reports of Kebreab et al. (2005).

3.4. Ranking of respondents on the basis of number crossbred and indigenous cattle owned

The ranking of respondents by the number of crossbred and indigenous genotypes holdings is summarized in Table 5. The number of dairy cattle owned per household was variable. Of the surveyed households, the majority (59.6%) of respondents had no crossbred dairy cattle genotypes, which could be attributed to lack of supply, their high prices when available and poor adaptation to the local production environment (disease, feed scarcity and poor management practices). About 26.9% of the respondents owned between 1 - 5 cattle each, while 13.3% had between 6 - 16 animals. Only one farmer (1.9%) out of the total surveyed respondents owned the highest number (16) of crossbred animals, and this was attributed to the large farm size owned by him.

Of all the respondents interviewed, 13.5% had no indigenous dairy cattle (Table 4). Majority (46.1%) of the respondents had between 1 and 5 indigenous dairy cattle each, while 40.4% had between 6 and 16 animals.

Table 5. Ranking of the respondents based on the number crossbred and indigenous dairy cattle owned in a cross-sectional survey of 52 smallholder dairy farmers in selected towns of Jimma zone, Ethiopia.

Herd size	% of respondents	Number of respondents in each town					Overall
		Agaro	Yebu	Sheki	Serbo	Seka	
Crossbred breed							
0	59.6	9	4	0	9	9	31
1	1.9	1	0	0	0	0	1
2	11.5	4	0	0	1	1	6
3	5.8	1	0	1	0	1	3
4	5.8	1	0	2	0	0	3
5	1.9	0	0	0	1	0	1
6	3.8	1	0	1	0	0	2
7	3.8	0	2	0	0	0	2
9	1.9	1	0	0	0	0	1
12	1.9	0	0	0	1	0	1
16	1.9	0	0	0	0	1	1
Total	100	18	6	4	12	12	52
Indigenous breed							
0	13.5	4	1	0	2	0	7
1	1.9	0	0	1	0	0	1
2	1.9	0	0	0	1	0	1
3	11.5	2	1	0	1	2	6
4	9.6	0	0	2	1	2	5
5	21.2	5	3	0	2	1	11
6	13.5	2	1	0	2	2	7
7	11.5	3	0	0	1	2	6
8	5.8	1	0	1	1	0	3
9	5.8	1	0	0	0	2	3
15	1.9	0	0	0	1	0	1
16	1.9	0	0	0	0	1	1
Total	100	18	6	4	12	12	52

3.5. Comparison of herd size and structure of crossbred and dairy indigenous cattle

As indicated in Table 6, there was a significant difference ($P < 0.01$) in herd size and structure of crossbred and local dairy cattle kept by the respondents across the five towns. On average, local zebu was the most widely kept breed for milk production than crossbreds (Friesian x Zebu) animals.

3.6. Effect of demographic characteristics of the respondents on herd size and milk yield

As indicated in Table 7, the effect of demographic profile of the respondents on herd size and milk yield per cow showed no significant difference ($P > 0.05$). Despite the lack of statistical difference, average herd size tends to be larger in male than female managed farms (7.27 ± 0.63 vs. 4.62 ± 0.50), with university than senior secondary education (9.33 ± 1.33 vs. 5.40 ± 0.58), retired than daily laborer (8.00 ± 4.00 vs. 5.00 ± 2.00), and higher average daily milk yield/cow/day was observed in male than female-headed farmers (6.41 ± 1.14 vs. 2.94 ± 0.50), with university education than illiterate (8.67 ± 2.67 vs. 3.45 ± 1.60) and retired farmers than housewives (4.50 ± 3.50 vs. 1.83 ± 1.12). The lack of significant variation with regard to the effect of demographic profile of the respondents on herd size and milk yield could be due to the practice of keeping relatively similar breed of dairy animals and lack of remarkable difference in dairy management practices. The result obtained in the present study is not in agreement with that of earlier studies (Stanly et al., 2012; Duguma et al., 2012), who reported that the effects of demographic characteristics of respondents on herd size and milk yield showed significant differences in Jimma and northern Malawi.

3.7. Farmers' perception of major constraints to dairy production

Table 8 shows the major challenges/constraints to small-scale family dairy production as identified and ranked by the respondents in the study area. Constraints refer to the challenges which are faced by farmers in successful operation and management of dairy activity. Respondents were asked to list and rank (1st to 10th) ten major constraints to dairy production based on their perceived importance in successful dairy farming business. Based on the respondents' perceived importance, feed shortage, lack of land, diseases and parasites, lack of improved genotypes, lack of access to credit, low productivity of dairy animals, lack of and/or inadequate AI/bull services, low milk prices, scarcity and high cost of labour, and shortage of water were ranked as the major constraints to dairy production in decreasing order of importance. These findings obtained in the present study are in conformity with those of previous research studies (Duguma et al., 2011;

Table 6. Comparison of herd size and structure of crossbred and local breed of dairy cattle per household in a cross-sectional survey of 52 smallholder dairy farmers in selected towns of Jimma zone, Ethiopia.

Class of cattle	Crossbred (Mean \pm SE)	Indigenous (Mean \pm SE)	P-Value
Milking cows	0.42 \pm 0.12 ^a	1.11 \pm 0.15 ^b	0.002
Dry cows	0.33 \pm 0.13 ^a	1.17 \pm 0.16 ^b	0.001
Male calves	0.23 \pm 0.07 ^a	0.61 \pm 0.10 ^b	0.005
Female calves	0.23 \pm 0.08 ^a	0.73 \pm 0.12 ^b	0.002
Pregnant heifers	0.08 \pm 0.05 ^a	0.11 \pm 0.05 ^b	0.000
Growing heifers	0.35 \pm 0.11 ^a	0.75 \pm 0.14 ^b	0.017
Breeding bulls	0.19 \pm 0.08 ^a	0.54 \pm 0.11 ^b	0.002
Total	1.83 \pm 0.46^a	5.04 \pm 0.46^b	0.002

SE = standard error, means within a row with different superscript letters differ significantly at $p < 0.05$.

Table 7. The effect of respondents' characteristics on herd size and milk yield in a cross-sectional survey of 52 smallholder dairy farmers in selected towns of Jimma zone, Ethiopia.

Farmers' characteristics	Number of farmers	Herd size (Mean \pm SE)	P- Value	Milk yield/cow/day (litres)	P-Value
Gender			0.133		0.197
Female	8	4.62 \pm 0.50		2.94 \pm 0.50	
Male	44	7.27 \pm 0.63		6.41 \pm 1.14	
Education			0.633		0.359
Illiterate	10	7.90 \pm 2.80		3.45 \pm 1.60	
Primary School	19	6.42 \pm 0.75		3.84 \pm 0.66	
Junior secondary school	10	6.40 \pm 0.78		4.84 \pm 1.11	
Senior secondary school	10	5.40 \pm 0.58		8.35 \pm 4.20	
University	3	9.33 \pm 1.33		8.67 \pm 2.67	
Main occupation			0.958		0.821
Trader	16	7.87 \pm 1.83		3.31 \pm 0.62	
Civil servant	6	7.00 \pm 1.26		4.17 \pm 1.13	
Retired	2	8.00 \pm 4.00		4.50 \pm 3.50	
Dairy farming	7	5.71 \pm 1.04		3.07 \pm 0.64	
Mixed farming	15	6.47 \pm 0.60		3.50 \pm 0.58	
House wife	3	6.57 \pm 1.45		1.83 \pm 1.12	
Daily labourer	2	5.00 \pm 2.00		2.75 \pm 0.25	

Tegengn et al., 2013; Bereda et al., 2014; Gebremichael et al., 2014) who also reported these as the major constraints to dairy farming, but with different importance.

According to respondents, feed shortage both in quality and quantity, especially during the dry season was rank as the most important critical challenge affecting smallholder dairy production and ensure optimum output. This results is supported by earlier studies (Gelila, 2017; Duguma et al., 2012; Makokha et al., 2006), who also reported feed shortage as the most important constraint to urban dairy farming. The feeding strategy in the present study area was mainly relied upon unimproved communal natural pasture grazing for feeding dairy cattle all year round. However, the availability of natural pasture was influenced by season, whereby it was most available both in quantity and quality during the main rainy season, however it declines in both availability and quality as dry season advanced, resulting in severe scarcity of feed. According to the respondents milk yield of their cows was higher during the rainy season which was attributed to the adequate availability of natural pastures. During dry season, animals fed on poor quality crop residues and

non-conventional feed resources due to scarcity of green natural pastures. It was observed that crop residues were poorly utilized due to lack of proper storage facilities, transportation, and technologies for improving their quality among the farmers. This finding is in agreement with that of (Duguma et al., 2007).

Lack of land for forage production, lack of supplemental feeds, unavailability and high cost of concentrate feeds, seasonal fluctuations in feed availability and quality, population growth and the competition for land use for housing and public infrastructures, and increasingly encroaching on communal grazing areas at the outskirts of the study towns were the main causes of feed shortage reported by respondents. Based on the findings of this study, there is a need to adopt feed conservation, efficient utilization of locally available conventional and non-conventional feed resources, proper conservation and utilization of crop residues, natural pasture improvement, supplementary feeding based on milk yield and physiological status, balancing the number of animals (stocking rate) to pasture productivity and quality, improved feeding strategies (semi-intensive), supporting farmers via improved feed supply through value chain development, provision of training to farmers on adoption of improved technology such as urea-molasses-mineral blocks, feed formulation using locally available feed resources, and treatment of crop residues to improve its nutritive value as important interventions to cope with feed shortage.

A lack of land was ranked as the second most important constraint to dairy farming in the present study area. This finding concurs with results of earlier studies (Gelila, 2017; Swai et al., 2014). Kavana and Msangi (2005) also reported that most dairy farmers fail to establish pastures due to land scarcity, which compromise the sustainability of urban and peri urban dairy production. The lack of land was attributed to lack of private land and shrinking of communal grazing land, which in turn was attributed to increasing urbanization and population growth, leading to encroachment of communal natural pastures by housing and other public infrastructures, resulting in feed scarcity and low productivity of dairy animals. Interviewees who practiced zero-grazing system kept their animals within their residential compounds due to lack of access to land. Lack of access to land together with rapidly diminishing communal pasture lands could hamper the sustainability of dairy production in the present studied towns and requires the attention of towns' municipalities to maintain the existing communal grazing lands for livestock grazing, and make future efforts in designing and implementing land use plan that consider urban livestock production in general and dairying in particular. Respondents who practiced free grazing system keep their animals within

Table 8. Major constraints to dairy production as ranked in order of importance by respondents in a cross-sectional survey of 52 households in selected towns of Jimma zone, Ethiopia (values are the percentage of respondents who rated that constraints as the 1st, 2nd, 3rd or 4th most important).

Constraints	% of responses				(Index) Rank*
	1 st	2 nd	3 rd	4 th	
Feed shortage	71.2	26.9	1.9	0.00	(0.371) 1
Lack of land	23.1	71.2	1.9	1.9	(0.311) 2
Animal diseases and parasites	0.00	0.00	30.8	15.4	(0.077) 3
Lack of improved dairy genotypes	0.00	0.00	17.3	26.9	(0.061) 4
Lack of credit & shortage of capital	1.9	0.00	21.2	7.7	(0.058) 5
Low productive performance	1.9	1.9	5.8	11.5	(0.036) 6
Lack of and/or inefficient AI services	1.9	0.00	9.6	7.7	(0.034) 7
Low milk prices	0.00	0.00	5.8	13.5	(0.025) 8
Shortage of labor	0.00	0.00	3.8	15.4	(0.023) 9
Shortage of water in the dry season	0.00	0.00	1.9	0.00	(0.004) 10
Total	100	100	100	100	1.00

Index = (4 for 1st rank +3 for 2nd rank +2 for 3rd rank 1 for 4th rank) for particular constraint \div by sum of (4 for 1st rank +3 for 2nd rank +2 for 3rd rank +1 for 4th rank) for all constraints, * the lower the rank of the constraint, the greater is its importance (1 = most important and 10 = least important).

their residential compound at night due to lack of land for separate housing. This has created a problem for manure disposal leading to pollution from animal waste and can also increase risk of zoonotic infectious diseases. Interviewed farmers reported that they dispose manure wherever open land is available, which could cause air and water pollution from nutrients leaching out from manure. This study suggests government and town's municipality support through policies that integrates dairy farming into town land-use planning and assigning specific land areas for dairying to mitigate the problem of grazing land the respondents are currently experiencing.

In this study, high prevalence of diseases and parasites was ranked as the third most important challenge of dairy production. This finding is in agreement with reports of earlier studies (Gelila, 2017; Duguma et al., 2012; Makokha et al., 2006). - The major diseases and parasites identified in the current study area was reported in the earlier part of this study (Duguma, 2020). Diseases have negative effect on production and reproductive performance of dairy cows, and impede introduction of improved breeds of dairy cows due to their higher susceptibility to diseases and parasites, especially tick-borne diseases compared to the local breeds. Feed scarcity, poor disease prevention skill, lack of adequate veterinary services and lack of routine vaccination practices could account for the high prevalence of diseases in the present study area. Farmers stated that disease occurrence was higher when they experience feed scarcity, particularly during the dry season. According to Payne and Wilson (1999), disease prevention has to be adjusted to the management system, the disease pattern in the herd, and by providing good hygienic conditions. Vaccination, vector control, and securing colostral immunity for young animals are ways of controlling diseases (Debrah and Birhan, 1991). Based on the results of this study, provision of effective health care services, regular vaccination and training of farmers on disease prevention and good health practices would be imperative to reduce economic losses due to diseases and parasites.

The present study found that, lack of improved dairy genotypes was reported as the fourth important challenge of dairy production. The low production and reproductive performance of local dairy cows was mainly due to their low genetic potential. Lack of access to artificial insemination services, high prices of improved cows and heifers, and lack of capital were mentioned as the main limiting factors for the lack of improved dairy cows. Therefore, breeding programs which enable dairy farmers to crossbreed their indigenous cows with improved dairy breeds either through natural or AI services should be provided by the government and non-governmental organization. Alternatively, the government or NGO should supply farmers with crossbred genotypes with affordable prices to increase productivity together with improved feeding technologies.

Lack of access to credit services was ranked as the 5th most serious problem to dairy production. It was reported that, lack of credit to allow farmers for investing in technological changes is a major constraint to intensification among smallholder dairy farmers (Romney et al., 2000). Use of formal credit was a major constraint due to lack of securities as most of the dairy farmers are resource poor. Generally, investment in improved inputs was found to be very low, except farmers who kept crossbred dairy animals. The locally available financial institutions such as state owned commercial banks, micro-finance institutes, and private banks provide credits to commercial businesses, and smallholder farmers lack access to credit services from these financial institutions due to lack of collateral security. Moreover, the farmers feared the high interest rate and short repayment period to borrow from bank. This discouraged farmers to borrow money from banks. Therefore, there is a need from the government to encourage financial institutions to provide access to affordable credit services and long-term repayment to help farmers invest in improved dairying inputs to improve productivity of their dairy animals and household nutrition and food security.

Another major constraint identified by respondents was low productivity of dairy cows. This was associated with lack of improved dairy breeds, which was again attributed to their high prices, lack of or inefficient AI services and shortage of quality feeds, among others.

Non-remunerative prices of milk and lack of preservative facilities especially during the long Orthodox Christians fasting periods and higher milk yields in the rainy season were reported as the main constraints for low milk prices. This result supports that of Debrah and Birhan (1991), who reported the low milk prices and demand of milk was attributed to the long fasting season, whereby the Ethiopian Orthodox followers abstain from consuming milk for more than 150 days/year. Respondents reported that they are unhappy with the prices they were getting for milk during long fasting periods. Therefore, to overcome the low demand and fluctuations of milk prices, especially during the long fasting periods, value addition to milk in form of butter and cheese could make a better market for milk after fasting periods or for home consumption. Moreover, the farmers should be encouraged to establish dairy cooperative or milk collection center in order to have access to formal marketing and strong bargaining power in setting fair prices for their products, as well as to obtain improved inputs such as supplementary feeds, AI, credit, veterinary services and drugs at affordable prices through their cooperative.

Shortage of water in the dry season was another constraint identified by farmers in the study area. Support from government and non-governmental organization for water development such as well water and improving municipality water supply are suggested to mitigate shortage of cattle drinking water in the dry season.

3.8. Possible influencing factors, impacts and coping strategies with constraints to dairying, and supports required by the farmers to improve productivity

Table 9 show farmers' perceived constraints to dairy production, influencing factors, impacts on dairy animals and producers, coping strategies adopted to mitigate the constraints, and the supports required to improving productivity. According to the respondents, the major causes of feed shortage were lack of land, shrinkage of communal grazing lands, severe scarcity of feed in the dry season, expansion of towns encroaching nearby grazing lands, high prices and unavailability of commercial feeds, lack of forage production, inadequate knowledge on how best use locally available feed resources, and lack of access to credit and capital problems. Hence, there is a need for introduction of alternative feeding system, such as efficient use of locally available feed resources, feed conservation, treatment of crop residues, adoption of Urea-Molasses-Mineral-Blocks, concentrate supplementation to lactating cows when affordable, and on farm feed formulation from local feeds as substitute to costly commercial concentrates are suggested to alleviate the causes feed scarcity and ensure all year round feed availability, especially for lactating cows.

As indicated in Table 9, farmers' revealed that high prevalence of endemic infectious and parasitic diseases, lack of routine vaccination, inadequate veterinary services, lack of proper disease prevention skills, transmission of diseases during communal grazing and high cost of treatment as factors associated with animal health problems. Therefore, training farmers' and provision of adequate health care extension services on diseases control and best health practices, adequate veterinary services and drug supply, routine vaccination for the most common infectious diseases are suggested.

The results presented in Table 9 revealed that lack and/or inefficient AI services, low conception to AI, high cost and unavailability of crossbred cows, more vulnerability of improved breeds to diseases, high management and feed scarcity were reported to be the critical factors for non-adoption of crossbred/improved cows. The study suggests improved access to AI, access to long term and low interest rate credit services for purchasing improved animals, and improving the efficiency of AI technicians to reduce the problem of low conception rate are areas that need to be highlighted for alleviation of the problem.

The results of the current study indicated that lack of specific financial systems and policy support in relation to credit services, unavailability of rules for dairy animals to be used as collateral security for borrowing from financial institutes, and fear of the short-term repayment and high

Table 9. Summary of possible influences of constraints to dairy farming, their impacts on animals and producers, coping strategies and desired supports as suggested by farmers in a cross-sectional survey of 52 households in selected towns of Jimma zone, Ethiopia.

Constraints	Possible influences	Effects on animals	Impacts on producers	Coping strategies employed by farmers	Support required to overcome the constraints as suggested by farmers
Feed shortage	<ul style="list-style-type: none"> • Lack of land • Shrinkage of communal grazing lands • Grazing land degradation • Seasonality of natural pasture and crop residue availability • High prices and unavailability of commercial concentrate feeds • Lack of capital for purchasing concentrate feeds • Lack of forage production and feed conservation • Population growth and urbanization encroaching grazing land • Lack skill on efficient utilization of locally available feed resources • Limited access to crop residues • Dry season or lack of rain • Poor feed quality 	<ul style="list-style-type: none"> • Low milk production • Reduced growth of calves • Low reproductive performance (late age at puberty and first calving, long calving interval, low conception rate) • Reduced fertility • High chance of susceptibility to diseases • Increased morbidity and mortality • Lose weight or poor condition 	<ul style="list-style-type: none"> • Decreased income • Less food security (buy less human food) • Loss of animals due to mortality • Less sustainable dairying • Milk yield reduction • Reduced household milk consumption 	<ul style="list-style-type: none"> • Conserve hay and crop residues • Purchase roughage • Reduce herd size • Increase use of non-conventional feed resources • Supplement concentrate feed when affordable and available • Supplement household leftovers • Increase use of <i>bulule</i> (grain mill house leftovers) • Supplement <i>atella</i> (local alcohol and liquor by-product) 	<ul style="list-style-type: none"> • Government or town municipality should allocate land for grazing • Government should supply concentrate feeds at reasonable prices • Access to credit services with low interest rate • Government should encourage private investors to establish feed processing mills close to farmers' reach with affordable prices
Lack of land	<ul style="list-style-type: none"> • Lack of own land • Shrinking communal lands 	<ul style="list-style-type: none"> • Feed scarcity and low productivity of dairy animals • Problem of manure disposal • Pollution • Conflict with nondairy neighbors due to foul smell of manure 	<ul style="list-style-type: none"> • Problem of space to increase number of animals • Reduced milk yield • Reduced income and food insecurity 	<ul style="list-style-type: none"> • Use communal land 	<ul style="list-style-type: none"> • Government or town municipality should allocate land for grazing • Government should provide earmarked specific land for grazing at outskirts of the
Animal diseases and parasites	<ul style="list-style-type: none"> • High prevalence of diseases and parasites • Inadequate veterinary services • Lack of vaccination, except during disease outbreak • High cost of treatment • Lack of knowledge on disease prevention • Inadequate veterinary services 	<ul style="list-style-type: none"> • Increased morbidity and mortality • Blocked teats • Reduced milk production • Low feed intake • Poor body condition • Reduced growth • Reduced fertility • Poor condition 	<ul style="list-style-type: none"> • Reduced income and food insecurity • Loss of animals • High risk for sustainable dairying • Reduced milk yield • Reduced milk consumption • Money spent to treat animals 	<ul style="list-style-type: none"> • Use veterinary medicine • Use of traditional medicines • Keep crossbred animals indoor 	<ul style="list-style-type: none"> • Improved access to public veterinary services • Adequate provision of low price medicines • Free vaccination • Access to drugs for tick control
Lack of improved genotypes or poor genetic potential of local breed	<ul style="list-style-type: none"> • High prices of improved genotypes • Lack of and/or inadequate AI services • Lack of quality feed • Vulnerability of improved breeds to diseases • High management practices of improved animals • Low conception rate of AI • Lack of capital to purchase inputs 	<ul style="list-style-type: none"> • Low milk production 	<ul style="list-style-type: none"> • Low milk yield for consumption and sale • Low income • Food insecurity 	<ul style="list-style-type: none"> • Crossbreeding local cows through AI 	<ul style="list-style-type: none"> • Increase access to AI or services • Government should supply crossbred animals at affordable prices • Government should supply pregnant crossbred cows with long term and low interest credit • NGOs should provide crossbred cows for free
Lack of access to credit	<ul style="list-style-type: none"> • Lack of bank loan • Fear of short-term repayment period and high interest rate • Lack of use of dairy animals as collateral security • No financial support 	<ul style="list-style-type: none"> • Shortage of capital • Feed scarcity of animals 	<ul style="list-style-type: none"> • Unable to increase milk yield • Low income • Food insecurity • High risk for sustainable dairying 	<ul style="list-style-type: none"> • Borrow from relatives and friends during critical capital needs 	<ul style="list-style-type: none"> • Government should support access to credit at low interest rate and long term repayment period from government owned financial institutes • Government should support to use dairy animals as collateral needed for bank and microfinance loans

(continued on next page)

Table 9 (continued)

Constraints	Possible influences	Effects on animals	Impacts on producers	Coping strategies employed by farmers	Support required to overcome the constraints as suggested by farmers
Low productivity of local dairy animals	<ul style="list-style-type: none"> • Poor genetic merit of local zebu cows • Lack of crossbred cows • Feed scarcity • Disease (mastitis) and parasites • Poor housing • Low management practices 	<ul style="list-style-type: none"> • Low milk production • Retarded growth of calves 	<ul style="list-style-type: none"> • Low milk yield • Low income • Food insecurity • Less milk for home consumption 	<ul style="list-style-type: none"> • Supplement with whatever locally available feeds 	<ul style="list-style-type: none"> • Improved access to AI and supply of crossbred animals at an affordable price • Access to affordable credit to purchase concentrate feeds and crossbred cows
Lack of and/or inefficient AI services	<ul style="list-style-type: none"> • Lack of access to AI services • Inadequate AI services • Sometimes no semen or liquid N₂ • Unavailability of AI technicians at the time of need & week ends 	<ul style="list-style-type: none"> • Poor productive and reproductive performance • Poor conception rate and repeat breeding • Long calving interval 	<ul style="list-style-type: none"> • Low or no crossbred cows • Low income • Food insecurity • High risk for sustainable dairying • Low replacement heifers 	<ul style="list-style-type: none"> • Use local bull • Repeat AI service if the cow did not conceive with previous insemination 	<ul style="list-style-type: none"> • Improved access to AI with high conception rate • AI technicians should be readily available when needed and on week ends
Low milk prices	<ul style="list-style-type: none"> • Seasonal demand fluctuations due to fasting • Lack of milk collection centre • Lack of appropriate milk processing technologies 	<ul style="list-style-type: none"> • Low concentrate supplementation • Low production 	<ul style="list-style-type: none"> • Low income • Food insecurity (purchasing less food items for family) 	<ul style="list-style-type: none"> • Do nothing but sell with low price 	<ul style="list-style-type: none"> • Milk collection co-operative • Appropriate technology for processing milk during long fasting periods
Labor shortage	<ul style="list-style-type: none"> • High cost of labour • Scarcity of labour 	<ul style="list-style-type: none"> • Inefficient animal management • Low milk yield 	<ul style="list-style-type: none"> • Inefficient management of animals • Reduced milk yield • Less income • Food insecurity 	<ul style="list-style-type: none"> • Use family labour • Hire casual labour only during critical needs 	-
~~~~~	<ul style="list-style-type: none"> <li>• Dry season (lack of rain)</li> <li>• Inadequate municipality water supply in the dry season</li> <li>• Labour scarcity (zero-grazed crossbred owners)</li> </ul>	<ul style="list-style-type: none"> <li>• Low milk production</li> <li>• Poor body condition</li> <li>• Low feed intake</li> <li>• Stress to animals during dry season trekking to distant rivers</li> </ul>	<ul style="list-style-type: none"> <li>• Less income</li> <li>• Long distances and time to watering points</li> </ul>	<ul style="list-style-type: none"> <li>• Use permanent rivers located at distant location</li> <li>• Use well water</li> </ul>	<ul style="list-style-type: none"> <li>• Town municipality should improve water supply, especially in the dry season</li> </ul>

interest rate that discourage farmers from borrowing are the main influencing factors for access to credit services. For majority of the respondents it was impossible to buy crossbred cows due to critical limitation of capital. Thus, the government should encourage the local government controlled micro-finance institutes to provide long term and low interest rate credit services that fits the dairy farmers to acquire improved inputs and technologies that improve milk production and their income. Low milk price was also considered another challenge to dairy production. The possible influences reported by farmers were poor genetic merit of local cows, lack of crossbred animals, feed scarcity and lack of supplementation, diseases (mastitis), and poor management practices. Therefore appropriate measure need to be taken to improve access to efficient AI services for crossbreeding the local breed along with improved husbandry practices in order to increase milk production and farmers income.

As indicated in Table 9, the low prices of milk was reported to be associated with seasonal fluctuations in demand especially during the long fasting periods of Orthodox Christians, lack of milk collection center and dairy cooperative, and unavailability of appropriate milk processing technologies to add values to milk to increase its shelf-life during fasting periods, and lack of milk price policy based on the cost of production. In Ethiopia, Orthodox Christians fast for more than 150 days per year. The long fasting periods are 55 days before Easter and 30 days before Christmas. Farmers sell their milk at farm gate to individual consumers or retailers (cafes, hotels and restaurants) with low and price fluctuations, due to lack of milk collection center and dairy cooperative, which have major influence on dairy farmer profitability. Therefore, dairy farmers should be encouraged to form dairy cooperative to develop formal milk value chain which function ethically and improve their bargaining power in terms of deciding fair prices and reduce price fluctuations and income loss to them and off course for the benefits of milk users. At Agaro town, the existing dairy cooperative was not active and need to be strengthened by providing necessary technical and institutional support.

The results of the current study further revealed that the labour shortage as constraint was reported to be associated with high cost of labour and its unavailability. Dairying is a very labour intensive enterprise but the cost paid by the farmers was not attractive for farm workers. Due to this most respondents relied on family labour for dairy management activities.

The result showed that dry season (lack of rain), shortage of municipality water supply during the dry season and labour shortage (high wages) for feed and water collection for zero-grazed (stall feeding) crossbred animals were reported to be the main associated factors for water shortage during the dry season.

In this study, surveyed farmers practiced different coping strategies in response to the challenges they faced aimed at reducing the effects of these constraints to optimize productivity and sustainability of dairy production (Table 9). Generally, farmers' perceived effect of the identified challenges on dairy animals was poor productive and reproductive performance, whereas the impacts on farmers were reduced income, food insecurity, and increasing the vulnerability in their livelihoods (Table 9). Respondents' suggested supports needed from dairy development stakeholders and government to overcome the identified constraints for sustainability of their dairy farming is presented in Table 9. Generally, the supports needed by the respondents to alleviate the identified constraints to dairy production included breeding, economic, feed and nutrition, genetics, health, and marketing interventions.

### 3.9. Limitations of the study

The author acknowledges the limitation in the data used for this study – in terms of small sample sizes gathered across the five study towns, the use of household questionnaire alone, lack of documented data and the reliance on farmer recall, which may be not accurate but not uncommon limitations of similar survey studies. However, this study offers some interesting viewpoints into the major constraints of urban small-scale

dairy production faced by farmers in the study area and provides essential baseline information for conducting related case studies in other settings.

## 4. Conclusions

It is concluded from the study that family dairy production was found to be the main source of household income for majority of the surveyed farmers. The present study highlighted that the local extension officers were the main sources in the dissemination of dairy production related information to farmers. Milk production for home consumption was considered as the main reason for keeping dairy cattle. The local cattle breeds play an important role in milk production due to their better adaptation to the local production environment and easy management. Majority of the respondent acquired their foundation crossbred cow or heifer through purchase. The demographic profile of the respondents showed no significant effect on herd size and milk yield per cow. However, there was a tendency for male respondents with university education and on retirement to own a larger herd size and more milk production per cow per day than other respondents. Feed shortage was ranked as the first most important constraint in dairy production followed by lack of land, diseases and parasites, lack of improved dairy genotypes, lack of access to credit, low productivity of indigenous genotypes, lack of and/or inadequate AI services, low milk prices, labour shortage, and water scarcity in the dry season. Based on the results of this study, it is suggested that there is a need for technical, institutional, technological and financial (credit) interventions and strengthening the extension services to improve dairy farmers' technical skills to adopt improved dairy management practices as a means to overcome the identified constraints that currently limit dairy production and to make dairying more profitable for small-scale dairy farmers in the study area. Moreover, future dairy development plan and intervention strategies in the current study area should take into consideration the farmers' identified constraints in this study.

## Declarations

### Author contribution statement

Belay Duguma: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

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### Data availability statement

Data will be made available on request.

### Declaration of interests statement

The authors declare no conflict of interest.

### Additional information

No additional information is available for this paper.

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